



BURUNDI

Beyond Connections

Energy Access Diagnostic Report
Based on the Multi-Tier Framework



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Nicolina Angelou, Aditi Sadia Rahman, and Bryan Bonsuk Koo

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CONTENTS

ACKNOWLEDGMENTS	vii
ABBREVIATIONS	viii
EXECUTIVE SUMMARY	1
Access to electricity	2
Access to modern energy cooking services	5
Gender analysis	8
Access to electricity in education and health facilities	10
1. MEASURING ENERGY ACCESS IN BURUNDI	12
Country context	13
Global survey on energy access using the Multi-Tier Framework	16
Access to electricity	17
Access to modern energy cooking services	20
Using the Multi-Tier Framework to drive policy and investment	22
MTF survey implementation methodology	23
MTF survey implementation in Burundi	23
2. ACCESS TO ELECTRICITY	26
KEY MESSAGES	27
Measuring access to electricity	29
Electricity access by technology	29
Electricity access by tier	32
Attributes of electricity supply	33
Improving access to electricity	40
Providing electricity access to households without a source of electricity	40
Improving electricity access among grid-connected households	45
Improving electricity access among households using off-grid solutions as their main electricity source	55
Policy recommendations	64
3. ACCESS TO MODERN ENERGY COOKING SOLUTIONS	66
KEY MESSAGES	67
Assessing access to modern energy cooking services	69

Access by technology.....	69
Access by tier.....	73
Attributes of access to modern energy cooking services.....	74
Cooking Exposure.....	74
Convenience.....	76
Affordability.....	78
Fuel Availability.....	78
Safety.....	79
Improving access to modern energy cooking services.....	79
Expanding access to improved cookstoves.....	79
Improving access to clean fuel stoves.....	81
Policy recommendations.....	82
4. GENDER ANALYSIS.....	84
KEY MESSAGES.....	85
Access to electricity, by gender.....	87
Access to modern energy cooking services, by gender.....	89
Policy recommendations.....	90
5. ELECTRICITY ACCESS LEVELS AMONG EDUCATION AND HEALTH FACILITIES.....	92
KEY MESSAGES.....	93
Education facilities' electricity access.....	93
Health facilities' electricity access.....	95
REFERENCES.....	CS
ANNEX 1 • MULTI-TIER FRAMEWORK FOR MEASURING ACCESS TO ELECTRICITY.....	98
ANNEX 2 • SOLAR OFF-GRID SOLUTIONS IN BURUNDI.....	103
ANNEX 3 • MULTI-TIER FRAMEWORK FOR ACCESS TO MODERN ENERGY COOKING SERVICES.....	105
ANNEX 4 • COOKING SOLUTIONS IN BURUNDI.....	110
ANNEX 5 • SAMPLING STRATEGY FOR THE MTF SURVEY IN BURUNDI.....	112

FIGURES

Figure ES.1 • Key data: household access to electricity.....	2
Figure ES.2 • Key data: household access to modern energy cooking services.....	5
Figure ES.3 • Key data: gender analysis of household access to electricity and modern energy cooking services.....	8
Figure ES.4 • Electricity access in education and health facilities: key data.....	10
Figure 1.1 • Expenditure quintiles, urban/rural.....	14
Figure B1.1.1 • Trends of the RISE electricity access pillar for Burundi, 2016, 2021, and 2023.....	15
Figure B1.1.2 • Trends in RISE—Clean Cooking pillar for Burundi, 2016, 2021, and 2023.....	16
Figure 2.1 • Nationwide electricity access, by technology.....	29
Figure 2.2 • Electricity access, by technology and urban/rural location.....	30
Figure 2.3 • Electricity access, by technology and province.....	31
Figure 2.4 • Electricity access, by technology and expenditure quintile (nationwide).....	32
Figure 2.5 • MTF electricity tier distribution (nationwide, urban, rural).....	32
Figure 2.6 • MTF electricity tier distribution, by technology (nationwide).....	33
Figure 2.7 • Household distribution of Capacity attribute.....	33
Figure 2.8 • Household distribution of daily Availability (over 24 hours).....	34
Figure 2.9 • Household distribution of evening Availability (6–10pm).....	34
Figure 2.10 • Household distribution of Reliability.....	35
Figure 2.11 • Household distribution of Quality.....	35
Figure 2.12 • Household distribution of Affordability.....	36
Figure 2.13 • Household distribution of Formality.....	36
Figure 2.14 • Household distribution of Health and Safety.....	37
Figure 2.15 • Appliance ownership in electrified households, by load level.....	37
Figure 2.16 • Appliance ownership in electrified households, by type (nationwide).....	38
Figure 2.17 • Appliance ownership in electrified households, by type (urban, rural).....	39
Figure 2.18 • Electricity access, by technology, in electrified and nonelectrified communities (nationwide, urban, rural).....	40
Figure 2.19 • Households without electricity access, by expenditure quintile (nationwide, under the grid, nonelectrified communities).....	41
Figure 2.20 • Alternative energy sources used for lighting by households without electricity access (nationwide, under the grid, nonelectrified communities).....	42
Figure 2.21 • Monthly spending on alternative energy sources for lighting by households without electricity access (nationwide, under the grid, nonelectrified communities).....	42
Figure 2.22 • Reasons for not being connected to the grid, as reported by households without electricity access (nationwide, under the grid, nonelectrified communities).....	43
Figure 2.23 • Willingness to pay for a grid connection fee: Households without a grid connection.....	44
Figure 2.24 • Willingness to pay for a solar device: Households without electricity access.....	45
Figure 2.25 • Share of households by numbers of years using the grid (nationwide).....	45

Figure 2.26 · MTF tier distribution of grid-connected households (nationwide, urban, rural)	46
Figure 2.27 · Main issues with grid electricity supply (nationwide, urban, rural)	47
Figure 2.28 · Service satisfaction levels of grid-connected households (nationwide)	47
Figure 2.29 · Distribution of grid-connected households: Daily Availability	48
Figure 2.30 · Distribution of grid-connected households: Evening Availability	48
Figure 2.31 · Distribution of grid-connected households: Reliability	48
Figure 2.32 · Distribution of grid-connected households: Quality	48
Figure 2.33 · Distribution of grid-connected households: Formality	49
Figure 2.34 · Distribution of grid-connected households: Health and Safety	49
Figure 2.35 · Distribution of grid-connected households: Affordability	49
Figure 2.36 · Distribution of grid-connected households, by share of electricity expenditure in total household expenditure (nationwide, by quintile)	50
Figure 2.37 · Ownership of appliances in grid-connected households, by load level	50
Figure 2.38 · Appliance ownership in grid-connected households, by type (urban, rural)	51
Figure 2.39 · Monthly electricity consumption and expenditure of grid-connected households	52
Figure 2.40 · Distribution of grid-connected households: Monthly electricity consumption (nationwide, urban, rural, by quintile)	52
Figure 2.41 · Desired appliances in grid-connected households, by type	53
Figure 2.42 · Main backup energy source for lighting used by grid-connected households (nationwide, urban, rural)	53
Figure 2.43 · Main backup energy source for appliances used by grid-connected households (nationwide, urban, rural)	54
Figure 2.44 · Grid-connected households' monthly spending on backup solutions for lighting (nationwide, urban, rural)	54
Figure 2.45 · Share of households using a solar device, by years of ownership	55
Figure 2.46 · Access to off-grid solar solutions, by technology, in electrified and nonelectrified communities (nationwide)	56
Figure 2.47 · Access to off-grid solar solutions, by brand	56
Figure 2.48 · MTF tier distribution, by solar off-grid solution (nationwide, urban, rural)	57
Figure 2.49 · Distribution of households using off-grid solar device: Capacity (nationwide, urban, rural)	58
Figure 2.50 · Distribution of households using off-grid solar device: Daily Availability (over 24 hours)	58
Figure 2.51 · Distribution of households using off-grid solar device: Evening Availability (6–10pm) (nationwide, urban, rural)	59
Figure 2.52 · Most serious issue with main solar device (nationwide)	59
Figure 2.53 · Share of off-grid solar households by satisfaction level (nationwide, urban, rural)	60
Figure 2.54 · Distribution of off-grid solar households, by household member who made the purchase decision (nationwide, urban, rural)	60
Figure 2.55 · Distribution of off-grid solar households by acquisition method (nationwide, urban, rural)	61
Figure 2.56 · Appliances used by off-grid solar households, by share and type	62
Figure 2.57 · Appliances desired by off-grid solar households	63

Figure 2.58 • Willingness to pay for a grid connection fee among off-grid solar households.....	63
Figure 2.59 • Main backup energy source for lighting used by grid-connected households.....	64
Figure 3.1 • Access to cooking solutions, by technology (nationwide).....	69
Figure 3.2 • Access to cooking solutions, by technology (urban, rural).....	70
Figure B3.1.1 • Distribution of traditional stoves by brand (nationwide, urban, rural).....	71
Figure B3.1.2 • Distribution of improved cookstoves by brand (nationwide, urban, rural).....	71
Figure 3.3 • Access to main cookstove, by expenditure quintile (nationwide).....	72
Figure 3.4 • Access to main cooking fuel, by expenditure quintile (nationwide).....	72
Figure 3.5 • Number of cookstoves commonly used by households (nationwide).....	73
Figure 3.6 • Tier distribution of access to modern energy cooking services (nationwide, urban, rural).....	73
Figure 3.7 • Tier distribution by cookstove.....	74
Figure 3.8 • Household distribution of cooking exposure.....	74
Figure B3.2.1 • Household distribution: Cookstove emissions (nationwide).....	75
Figure B3.2.2 • Household distribution: Quality of ventilation of the cooking area, by stove type.....	75
Figure 3.9 • Household distribution of Convenience.....	76
Figure B3.3.1 • Household distribution: Fuel acquisition and preparation time (hours/week).....	77
Figure B3.3.2 • Household distribution: Stove preparation time (minutes/meal), by stove type.....	77
Figure 3.10 • Household distribution of Affordability.....	78
Figure 3.11 • Household distribution of Fuel Availability.....	78
Figure 3.12 • Household distribution of main cookstove's Safety.....	79
Figure 3.13 • Willingness of mainly charcoal users (nationwide) to pay for a Kamaro (or a metallic Biikigiti).....	80
Figure 3.14 • Stove purchase price (in FBu) paid by households.....	81
Figure 4.1 • Household distribution, by sex of the household head (nationwide, urban, rural).....	86
Figure 4.2 • Distribution of male- and female-headed households by expenditure quintile.....	86
Figure 4.3 • Household access to electricity, by technology and sex of the household head.....	87
Figure 4.4 • Tier distribution, by sex of the household head (nationwide, urban, rural).....	88
Figure 4.5 • Barriers to gaining access to the electricity grid, by sex of the household head (nationwide).....	88
Figure 4.6 • Appliance ownership among electrified households, by load level and sex of the household head (nationwide, grid, off-grid solar).....	89
Figure 4.7 • Access to cooking services, by type of primary cookstove and sex of the household head.....	89
Figure 4.8 • MTF cooking tier distribution, by sex of the household head (nationwide, urban, rural).....	90
Figure 5.1 • Access to electricity in education facilities, by technology (nationwide).....	93
Figure 5.2 • Education facilities' access to electricity, by technology (urban, rural).....	94
Figure 5.3 • Education facilities' access to electricity, by type of facility.....	94
Figure 5.4 • Health facilities' access to electricity, by technology (nationwide).....	95
Figure 5.5 • Health facilities' access to electricity, by technology (urban, rural).....	95
Figure 5.6 • Health facilities' access to electricity, by facility type.....	96
Figure A5.1 • Primary sampling unit (PSU) classification process on Google Earth.....	117

BOXES

Box ES.1 • Electricity access rates: Estimates from the “Tracking SDG 7” report versus MTF survey.....	3
Box 1.1 • Summary of the Regulatory Indicators for Sustainable Energy (RISE) (electricity access and clean cooking pillars) for Burundi.....	15
Box 1.2 • Minimum electricity requirements, by tier of electricity access.....	17
Box 1.3 • Assessing the Capacity tier of solar solutions.....	19
Box 1.4 • Types of cookstoves common in Burundi.....	20
Box 3.1 • Popular brands of traditional and improved cookstoves.....	71
Box 3.2 • Cooking emissions and ventilation.....	75
Box 3.3 • Fuel acquisition and preparation time, and stove preparation time.....	77
Box A1.1 • Calculating the capacity tier for solar lanterns (SLs) and solar lighting systems (SLSs).....	100

MAPS

Map 1.1 • Sample distribution.....	25
Map A5.1 • Map showing Burundi primary sampling units based on gridded population density (GPWv4), 2015.....	112
Map A5.2 • Urban-rural stratification of primary sampling units using the GRUMP v1 data set.....	114

TABLES

Table B1.2.1 • Appliances by load level and associated Capacity tier.....	18
Table 1.2 • Minimum requirements, by tier of access to modern energy cooking services.....	21
Table 1.3 • Distribution of enumeration areas and sampled households.....	24
Table A1.1 • The Multi-Tier Framework for measuring access to electricity.....	98
Table A1.2 • Examples of calculating the SL/SLS score.....	100
Table A2.1 • Examples of solar off-grid solutions.....	103
Table A3.1 • The Multi-Tier Framework for measuring modern energy cooking services (MECS).....	105
Table A3.2 • Cookstove emissions tiers.....	106
Table A3.3 • Ventilation tiers.....	107
Table A3.4 • Cooking exposure tiers.....	107
Table A4.1 • Photographs of stove types common in Burundi.....	110
Table A5.1 • Formula and assumptions in calculating the sample size.....	112
Table A5.2 • Distribution of households in selected primary sampling units (PSUs).....	113
Table A5.3 • Population in Burundi, by source.....	115
Table A5.4 • Listing results (electricity access).....	119
Table A5.5 • Listing results (after sample weights applied).....	124

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ESMAP is a partnership between the [World Bank](#) and [over 20 partners](#) to help low- and middle-income countries reduce poverty and boost growth through sustainable energy solutions. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector. Through the World Bank (WB), ESMAP works to accelerate the energy transition required to achieve [Sustainable Development Goal 7](#) (SDG 7) to ensure access to affordable, reliable, sustainable, and modern energy for all. It helps to shape WB strategies and programs to achieve the [WB Climate Change Action Plan](#) targets.

This Energy Access Diagnostic Report details the results of the MTF survey in Burundi and provides the status of access to electricity and access to modern energy cooking services in that country. The initiative has relied on the critical support of multiple entities and individuals that the MTF team would like to acknowledge.

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¹ Autorité de Régulation des secteurs de l'Eau potable et de l'Energie (AREEN).

ABBREVIATIONS

ABER	Burundian Agency for Rural Electrification (Agence Burundaise de l'Électrification Rurale)
AfDB	African Development Bank
CIESIN	Center for International Earth Science Information Network
EA	enumeration area
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agriculture Organization
FBu	Burundian Franc
FHH	female-headed household
GIS	geographic information system
GPS	Global Positioning System
GPWv4	gridded population density
GRUMP	Global Rural-Urban Mapping Project
HH	household
IEA	International Energy Agency
ILF	International Lifeline Fund
ISO	International Organization for Standardization
ISTEEBU	l'Institut National de la Statistique du Burundi
km ²	square kilometers
kW	kilowatt
kWh	kilowatt-hour
LED	light-emitting diodes
LPG	liquefied petroleum gas
MECS	modern energy cooking services
MHH	male-headed household
MTF	Multi-Tier Framework
PSU	primary sampling unit
RBF	results-based financing
RISE	Regulatory Indicators for Sustainable Energy
SDG	Sustainable Development Goal
SEforALL	Sustainable Energy for All
SHS	solar home system
SL	solar lantern
SLS	solar lighting system
UNAM	National Autonomous University of Mexico
UNDP	United Nations Development Programme
US\$	United States Dollar
USA	United States of America
W	watt
WFP	World Food Programme
WTP	willingness to pay

* Average exchange rate on October 29, 2021 (AfDB 2021): US\$ 1 = FBu 2,820.89.

EXECUTIVE SUMMARY

Burundi, a landlocked country in eastern central Africa, has 12.6 million people (2021)² living on 27,834 square kilometers (km²). It is the world's most densely populated country (442 people/km²), and features exceptionally dense rural regions due to a 14 percent urbanization rate. The country's rapidly expanding population is expected to double by 2040. Despite gains in health and education, Burundi ranked 187 out of 191 on the 2021 Human Development Index (UNDP 2022), and has the world's lowest per capita gross national income (US\$220 in 2021).

Burundi's National Development Plan prioritizes economic transformation and improved social welfare, recognizing the energy deficit as a critical obstacle. Despite significant hydroelectric potential, chronic underinvestment has resulted in severely limited electricity access. Per capita electricity consumption is among the lowest in Sub-Saharan Africa; wood biomass accounts for 95 percent of primary energy consumption. This dependence drives deforestation and contributes to respiratory illnesses and physical strain. In this context, the Government of Burundi implemented reforms and innovative mechanisms to address its energy challenges. These include the revision of the electricity law in March 2024 and the introduction of a results-based financing scheme aimed at bolstering private sector development. Further demonstrating its commitment to expanding electricity access, the government launched a national electrification strategy in October 2024 and pledged its support to the Mission 300 initiative in 2025.³

In 2016, the World Bank, with the support of the Energy Sector Management Assistance Program (ESMAP), launched the Global Survey on Energy Access, using the Multi-Tier Framework (MTF). The MTF survey aims to provide detailed data on access to electricity and modern energy cooking services. The MTF moves beyond binary access measures—namely, having access or not to electricity and having access or not to clean cooking fuels and technologies—to capture the multidimensional nature of energy access at the end-user level, the range of technologies, and diverse user experiences.

The MTF survey in Burundi was conducted in November–December 2021 covering all five provinces. A total of 4,104 households were surveyed in 342 enumeration areas, along with 397 education facilities and 190 health facilities. Of all households interviewed, 2,052 were located in urban areas, and 2,052 in rural areas; 2,095 were electrified and 2,009 were nonelectrified.

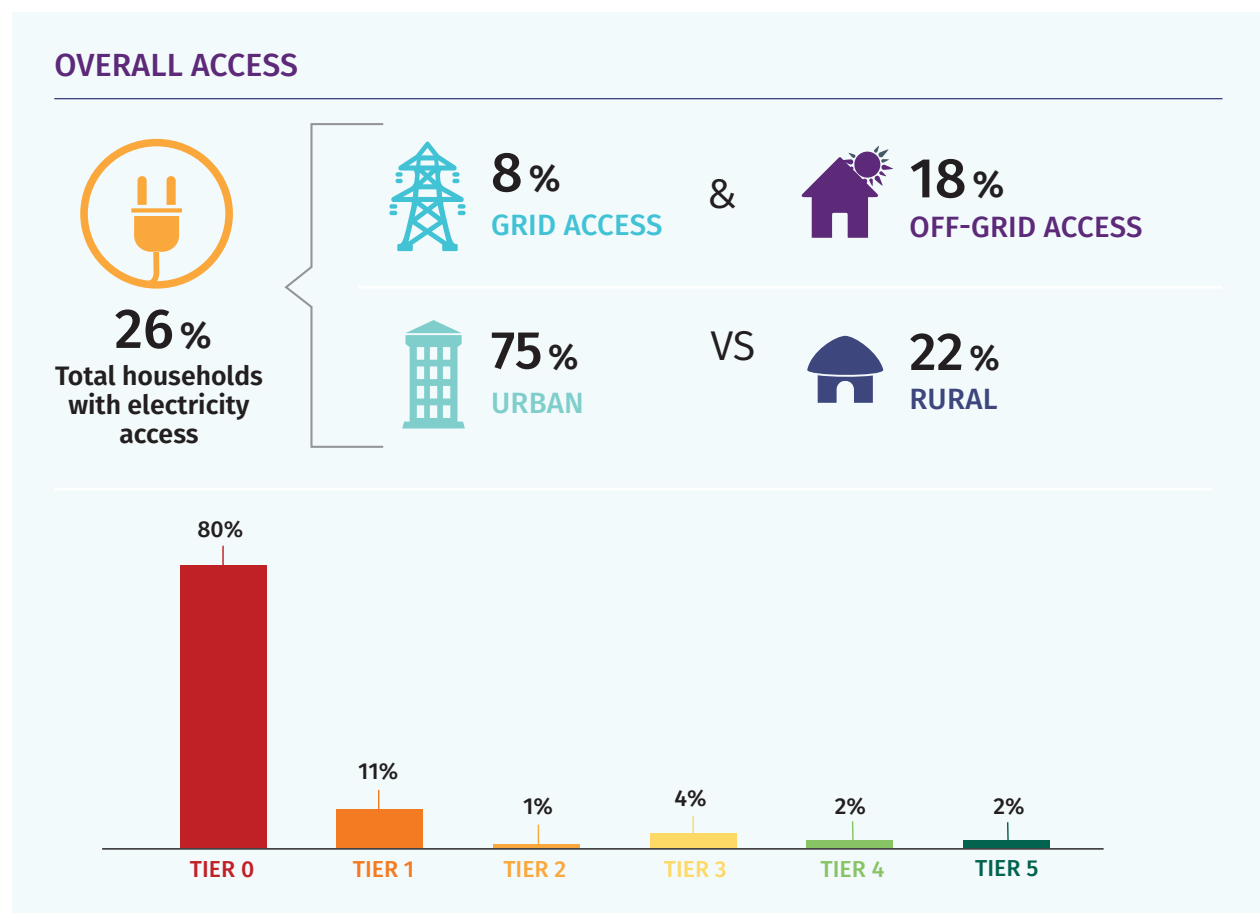
In the context of Mission 300, the MTF survey results serve as a baseline to track the implementation of Burundi's new Energy Compact. Launched by his Excellency the President of the Republic of Burundi, the compact outlines a roadmap to achieve 70 percent electricity access and 40 percent clean cooking access by 2030.

² The population of Burundi was estimated at 14.05 million in 2024.

³ Mission 300 is a collaborative initiative spearheaded by the World Bank Group and the African Development Bank that brings together African governments, the private sector, and development partners to provide affordable power, expand electricity access, enhance utility efficiency, attract private investment, and improve regional energy integration, ultimately reaching 300 million people by 2030.

ACCESS TO ELECTRICITY

FIGURE ES.1 • Key data: household access to electricity



In Burundi, an estimated 26 percent of households have access to electricity. It is important to note that, in this context, “access” often entails a very limited level of service, a point to be explored in greater detail in the analysis that follows. Of households with electricity access, 8 percent are connected to the grid and 18 percent rely on off-grid solutions as their primary electricity source. The most common off-grid solutions are solar devices (17 percent), primarily solar lanterns (10 percent); other off-grid options are rarely used as the main sources of electricity.

Electricity access patterns in Burundi differ widely between urban and rural areas. Approximately 75 percent of urban households have access to electricity, compared with 22 percent in rural areas. Most urban households (68 percent) are connected to the grid, while only 7 percent rely on off-grid solutions. Conversely, in rural areas, off-grid solutions are the primary source of electricity for 19 percent of households, and only 3 percent have grid access.

The 26 percent household electrification rate cited in the 2021 MTF survey contrasts sharply with the 10 percent reported for 2021 by the latest Tracking SDG 7 report (IEA et al. 2023). This discrepancy stems from the Sustainable Development Goal (SDG) 7 figure being a 2017 model-based estimate (box ES.1), potentially underestimating recent reforms and off-grid solutions. The MTF survey highlights rapid off-grid expansion: 56 percent of solar devices were acquired within two years, and 75 percent within three. Similarly, over 50 percent of grid connections occurred in the preceding three years, indicating a recent surge in both grid and off-grid electrification.

BOX ES.1 • ELECTRICITY ACCESS RATES: ESTIMATES FROM THE “TRACKING SDG 7” REPORT VERSUS THE MTF SURVEY

The findings noted in *Tracking SDG 7: The Energy Progress Report* (IEA et al. 2023) are based on the World Bank’s Global Electrification Database, which uses nationally representative household survey data and census data from sources like the Living Standards Measurement Study and Demographic and Health Surveys. Countries typically update their data every two to three years. Because surveys can be irregular, a multilevel, nonparametric modeling approach is used to fill in missing data points from 1990 on. This model, which was adapted from a method used by the World Health Organization, predicts electricity access by accounting for the hierarchical structure of the data (country and regional levels) based on United Nations classifications. The model is applied to all countries with at least one data point. Actual survey data are used whenever available, and the model is used only to fill gaps for missing years or to perform global and regional analyses.

The World Bank’s Global Electrification Database estimates that Burundi reached a 10 percent electrification rate in 2021. This figure is a model-based estimate, calculated using survey data from the 2017 Demographic and Health Survey and a 2014 national survey (both of which were originally sampled from the 2008 census). Because this number is an estimate, it may not fully reflect the impact of recent sector reforms.

The MTF surveys ask specific questions about each type of electricity source—including the grid, mini-grids, generators, batteries, and solar devices^a—while the World Bank’s Global Electrification Database relies on surveys with only one or two general questions, such as “Is the household connected to an electricity supply?” or “What is your primary source of lighting?” This difference in approach likely leads to different results, as households may not consider off-grid sources like solar panels as “electricity.”

^a The MTF survey includes the following questions: Is the household connected to the national grid?; Is the household connected to a mini-grid?; In the last 12 months, did the household use a generator to supply electricity?; In the last 12 months, did the household use any rechargeable batteries, such as car batteries, for electricity?; In the last 12 months, did the household use any solar-based devices?

The MTF defines access to electricity as a spectrum ranging from Tier 0 (no access) to Tier 5 (full access) across seven attributes: Capacity, Availability, Reliability, Quality, Affordability, Formality, and Health and Safety.⁴ Nationwide, 20 percent of households achieve Tier 1 access or higher—6 percentage points below the overall 26 percent household electricity access rate based on technology. Notably, only 8 percent of households attain Tier 3 or higher, which corresponds to the grid penetration rate. A mere 2 percent of households reach Tier 5, suggesting that the majority of grid-connected households operate at lower tiers.

Providing electricity access to the 74 percent of households that have no access to any source of electricity is a critical priority. For the 11 percent of households without access who live “under the grid,” grid densification could provide them electricity access, especially if connection costs could be spread over time, leveraging available financing options. Approximately 33 percent of households without grid connections express a willingness to pay (WTP) the current connection fee of FBu 492,000 (US\$174.41) up front, while an additional 22 percent would opt for flexible payment plans spanning 3, 6, or 12 months. A significant increase in WTP is observed with a reduced connection fee of FBu 68,880 (US\$24.42); at that rate, 64 percent of households indicate they would pay up front and an additional 14 percent would opt for payment plans.

⁴ See annex 1 for more information.

For the 63 percent of households without electricity in nonelectrified communities, off-grid solar solutions offer a more feasible path to electricity access. Solar lanterns are appealing, between 42 percent and 57 percent of these households are willing to pay up front for a solar lantern⁵ priced between FBu 10,000 (US\$3.54) and FBu 30,000 (US\$10.63). An additional 10–20 percent, depending on the price, would opt for flexible payment plans over 3, 6, or 12 months. The WTP for solar lighting systems is substantially lower. The adoption of these solutions should be supported by quality control systems, microfinancing, and consumer awareness programs to ensure high penetration of Tier 1+ solutions and minimize the distribution of poor-quality products. While mini-grids are not currently widespread in the country, they may represent a cost-effective solution for higher-density rural areas.

There is potential for improvement in grid electricity service for 74 percent of grid-connected households that do not achieve Tier 5. Nationwide, 54 percent of households report unpredictable interruptions, and 21 percent experience voltage issues. Rural households are significantly more likely to report unscheduled interruptions.

Furthermore, only 47 percent of grid-connected households use high- or very high-load appliances. Conversely, 34 percent use only very low-load appliances, with this share reaching 56 percent in rural areas. Consequently, these households are not fully leveraging the capacity of the grid, resulting in underutilization. Only 45 percent of grid-connected households consume over 100 kilowatt-hours (kWh) per month, while 39 percent consume up to 60 kWh per month.

Electrification has significant potential to unlock productive uses of electricity, particularly as many grid-connected households currently underutilize the grid. To enable households to reach higher tiers of energy access, it is crucial to make energy-efficient appliances like refrigerators, fans, and electric mills more available and affordable. By combining an enhanced availability of these higher-load appliances with consumer financing options, households can improve their quality of life, enable small business growth, and boost overall economic activity, moving beyond basic lighting to truly transformative energy use.

Improving availability of electricity supply, especially in the evening, addressing voltage issues, and reducing unpredictable interruptions would shift most grid-connected households to higher tiers (Tier 4 and 5). To promote the adoption of higher-load appliances, it is recommended that popular energy-efficient appliances, such as refrigerators, fans, electric kitchen mills, and televisions, be made more widely available, alongside consumer financing options.

In Burundi, 18 percent of households use off-grid solutions; of these, 34 percent fall in Tier 0, due to poor Capacity or Availability. Off-grid solar devices are relatively new in Burundi. Among households that use a solar device as their main electricity source, over 75 percent obtained it within the previous three years, and 34 percent in the last 12 months. Nationwide, approximately 30 percent of households primarily rely on unbranded solar devices, while another 29 percent use Sun King devices.

Most off-grid solar households in Burundi (62 percent) fall in Tier 1, and 34 percent fall in Tier 0. Inability to power large appliances is the most common issue with solar devices. Fifty-four percent of off-grid solar households are satisfied with their main solar device. All off-grid solar households would like to power additional appliances (that they do not own) with their solar device. The most commonly desired appliances are televisions and radios (both 67 percent), followed by smartphones (29 percent), refrigerators (24 percent), and electric kitchen mills (23 percent). Promoting the distribution of high-quality solar devices and enhancing the availability and affordability of higher-tier solar products can enable off-grid solar households to progress to higher access tiers, facilitating the use of desired appliances such as televisions and radios.

⁵ The solar lantern presented in the WTP module is the d.Light A2, a compact and lightweight device with an integrated 0.3-watt solar panel (see annex 2). It provides four hours of illumination at 30 lumens, which is three times brighter than a kerosene lamp, meeting Tier 1 capacity standards.

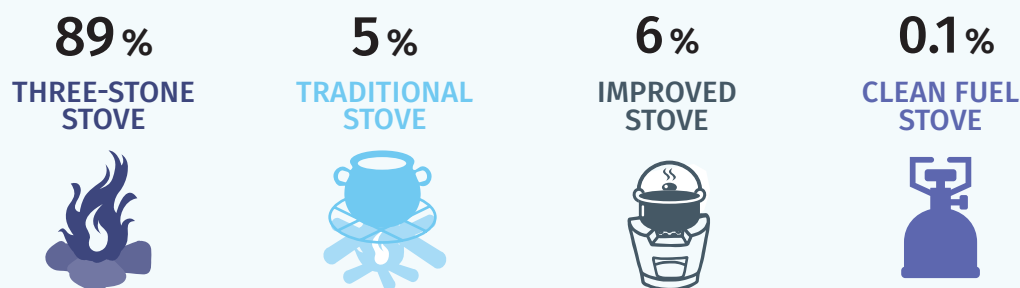
Prioritizing financial tools is key to accelerating the adoption of stand-alone solar home systems and mini-grids. Results-based financing, for instance, incentivizes private developers by linking payments to verified results like new connections. Additionally, developing well-designed, targeted subsidies is crucial to reduce up-front costs for both providers and low-income users, bridging the affordability gap without distorting the market. Combining these tools creates a robust financial ecosystem that drives rapid and equitable off-grid electrification.

ACCESS TO MODERN ENERGY COOKING SERVICES

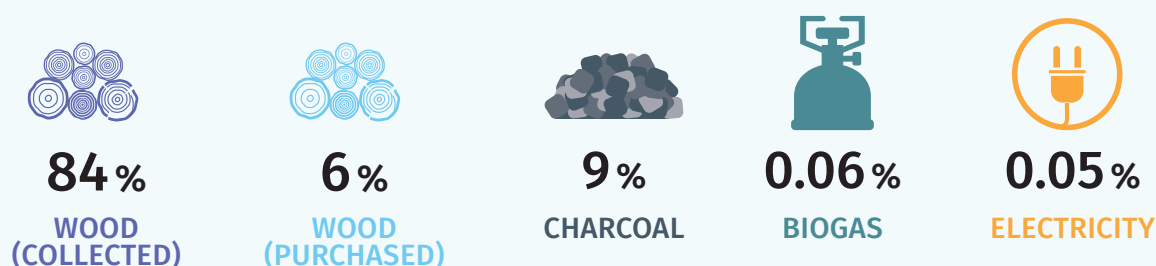
FIGURE ES.2 • Key data: household access to modern energy cooking services

OVERALL ACCESS

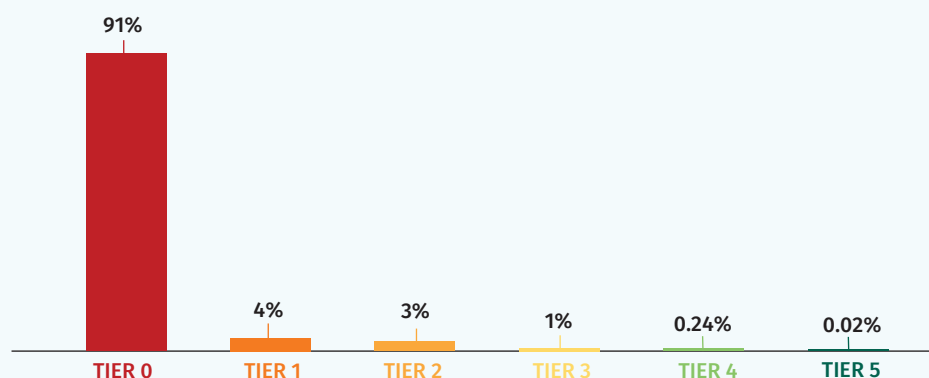
Households primarily cook with:



Total households using biomass as primary cooking fuel: 99 percent



MTF tiers



In Burundi, over 99 percent of households use biomass as their primary cooking fuel, with wood being the predominant source, most of it collected rather than purchased. Approximately 89 percent of households use a three-stone stove as their main cookstove, 5 percent use a traditional stove, and 6 percent use an improved cookstove. The share of households using clean fuel stoves is exceptionally low at 0.1 percent and includes users of biogas stoves and electric stoves. Stove stacking is not a common practice in Burundi. Over 98 percent of households use a single stove for meal preparation.

The MTF measures access to modern energy cooking services along a spectrum ranging from Tier 0 (no access) to Tier 5 (full access) across six attributes: Cooking Exposure, Cookstove Efficiency, Convenience, Safety of the primary cookstove, Affordability, and Fuel Availability.⁶ Approximately 91 percent of households are in Tier 0, while only 1 percent reach Tier 3 or above. Tier 0 households are those that cook primarily with three-stone stoves, traditional cookstoves, or improved cookstoves (without embedded exhaust systems) and have bad ventilation.

Limited access to modern energy cooking services is strongly linked to significant health and gender-related impacts. When families rely on polluting fuels, women and children are exposed to dangerous levels of indoor air pollution, causing serious respiratory and cardiovascular illnesses. The lack of efficient cooking solutions also places a disproportionate burden on women and girls, whose time-consuming duties of gathering fuel and managing stoves contribute to time poverty, limiting their opportunities for education and employment. Therefore, improving access to modern energy cooking services is crucial for advancing public health and gender equality.

Urban and rural households have different cooking patterns. In urban areas, 82 percent of households primarily cook with charcoal, using either traditional stoves (47 percent) or improved cookstoves (35 percent). Only 16 percent of urban households use a three-stone stove, and less than 2 percent use clean fuel stoves. In rural areas, 95 percent of households primarily cook with a three-stone stove, predominantly using collected wood (89 percent). Only 7 percent of rural households purchase wood. Approximately 2 percent of rural households cook with charcoal using improved cookstoves, and 1 percent use traditional charcoal stoves. No rural households were found to be using clean fuel stoves.

Approximately 6 percent of households primarily use an improved cookstove for cooking, with two-thirds of those relying on charcoal. A concerning 83 percent of these still fall in Tier 0 for Cooking Exposure due to poor ventilation (indoor cooking without an exhaust system). The remaining 17 percent cooks outdoors or on a veranda, avoiding this issue. Households cooking with traditional stoves could also improve their access to modern energy cooking services by transitioning to improved cookstoves with exhaust systems, without needing to switch fuel. This opportunity applies to 46 percent of urban households. To improve access, households with traditional or improved cookstoves used indoors must address ventilation through external or embedded exhaust systems. Campaigns raising awareness of indoor air pollution's health impacts, coupled with incentives to obtain affordable stoves and exhaust systems, are crucial for driving change.

Of households using charcoal as their main cookstove (9 percent overall, 82 percent of urban households), 41 percent are willing to pay FBu 15,000 (US\$5.32) up front for improved cookstoves like the Kamaro or Biikigiti, with another 24 percent opting for payment over 6–24 months. Reducing the price to FBu 4,950 (US\$1.75) increases up-front WTP to 62 percent, with 12 percent choosing to pay in installments. Offering fast-ignition improved cookstoves and addressing affordability through reduced up-front costs and flexible payment plans can drive widespread adoption.

⁶ See annex 3 for more information.

Of the 91 percent of households relying on wood for cooking, 56 percent are willing to pay FBu 7,333 (US\$2.60) up front for a low-end, wood-based improved cookstove (66 percent of the full price), with 23 percent opting to pay in installments over 6–24 months. Conversely, only 9 percent of the households using wood are willing to pay the full price (FBu 100,000 or US\$35.45) of a high-quality improved cookstove up front (and an additional 24 percent over time). Dropping the price to FBu 33,333 (US\$11.82) significantly boosts WTP to 24 percent up front and 36 percent over time.

A mere 0.1 percent of households (N=32)⁷ use clean fuel stoves as their primary cooking method, restricting detailed analysis. These users are exclusively urban (1.5 percent of urban households) and in the wealthiest quintile. Of the clean fuel stoves used, 59 percent were biogas and 41 percent were electric. No liquefied petroleum gas (LPG) stoves were reported. Despite high urban electricity access (75 percent), only 0.6 percent of urban households use electric stoves as their primary cooking stove, likely due to the higher up-front purchase costs. Interestingly, no clean fuel stove user reported using a secondary stove. Consumer finance or subsidies can address the high up-front costs of electric stoves, though ongoing electricity costs remain a barrier. In rural areas, both biogas potential and LPG adoption should be assessed, placing priority on fuel availability and affordability. A comprehensive plan, including supply and demand considerations and awareness campaigns, is essential.

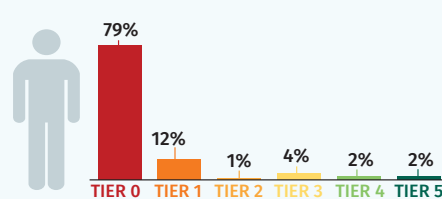
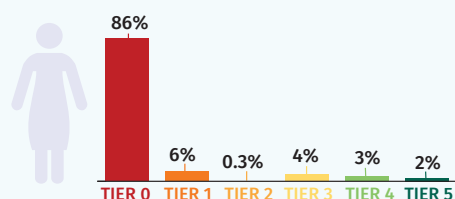
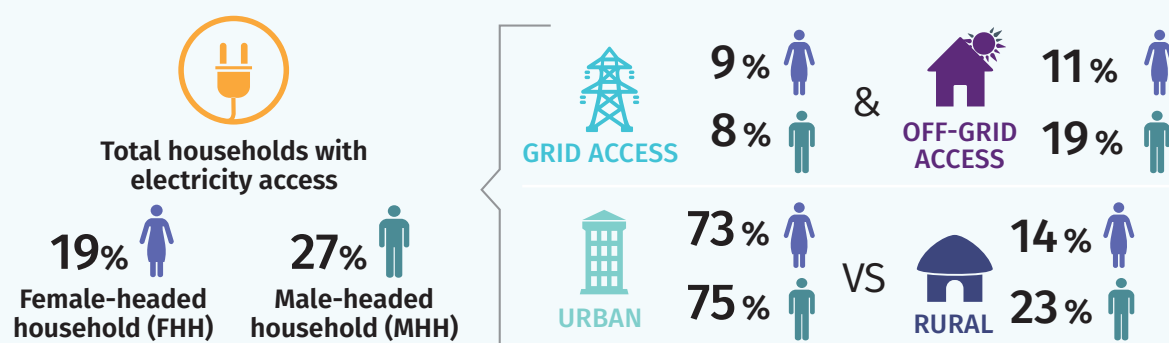
Integrated planning is essential for a successful rollout of modern energy cooking services. By treating electric cooking as a core electrical load from the start, utilities can ensure the power grid is properly sized and reinforced, avoiding overloads. This unified approach also enables special tariffs that make electric cooking more affordable. Coordinating grid expansion with modern energy cooking initiatives creates economies of scale, reduces costs, and accelerates the transition from traditional fuels. This strategy boosts electricity sales and revenue, strengthening the business case for electrification while also advancing climate and public health goals.

⁷ Only 32 households in the unweighted sample reported using clean fuel stoves.

GENDER ANALYSIS

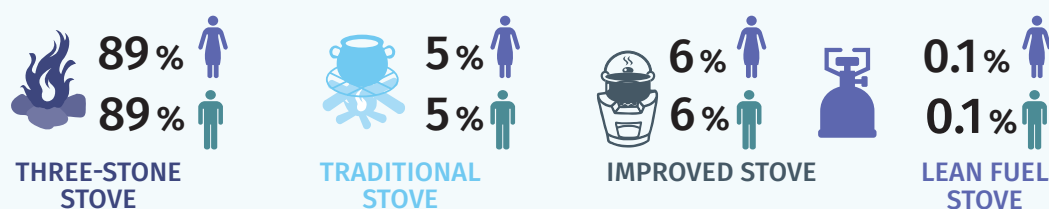
FIGURE ES.3 • Key data: gender analysis of household access to electricity and modern energy cooking services

ACCESS TO ELECTRICITY

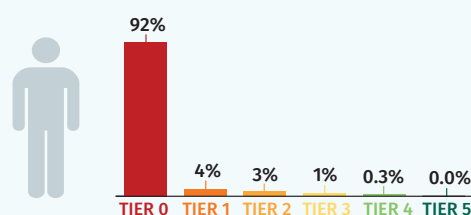
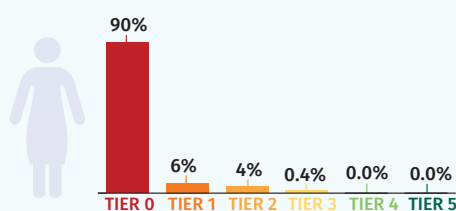
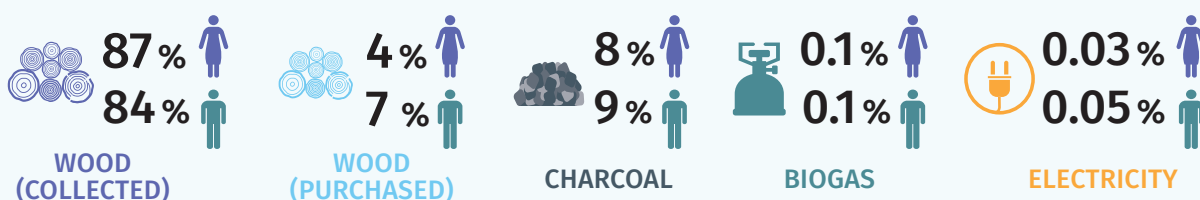


ACCESS TO MODERN ENERGY COOKING SERVICES

Total households primarily cooking with:



Total households using biomass as primary cooking fuel: 99 percent



Women head approximately 13 percent of Burundian households. Contrary to trends in other Sub-Saharan African countries, the share of female-headed households is similar in urban and rural areas. A stark marital status disparity exists: 90 percent of female heads are widowed or divorced, compared to 2 percent of male heads. Female-headed households in Burundi are generally poorer and more financially and socially vulnerable than male-headed households.

Female-headed households are less likely to have access to electricity than male-headed households (19 percent versus 27 percent, respectively). In urban areas, the gender gap is less than 2 percentage points in favor of male-headed households (75 percent versus 73 percent). Notably, female-headed households in urban areas are more likely to access the grid than male-headed households but less likely to access off-grid solutions (particularly solar home systems and mini-grids).

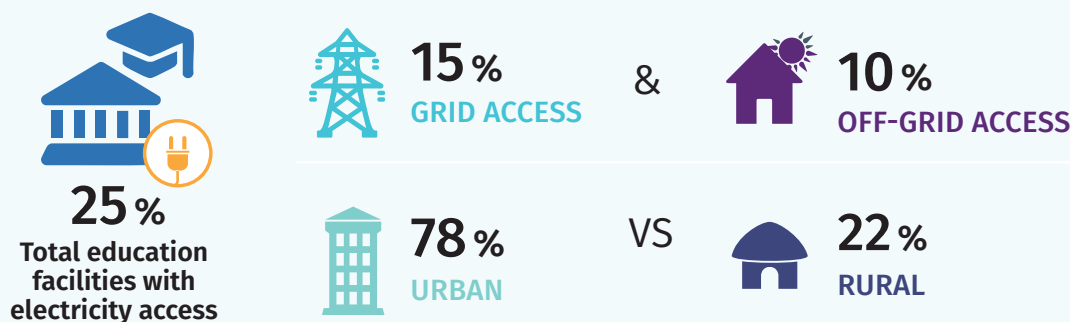
Nationwide, both male- and female-headed households cite similar reasons for lacking grid connection. However, in urban areas, female-headed households more frequently report high connection costs as the primary barrier (54 percent versus 38 percent). Further research is needed to identify access barriers for both female- and male-headed households. Targeted pro-poor interventions, such as interest-free credit, flexible connection fee payments, subsidized connections, and lifeline tariffs, should include poor and female-headed households.

Nationwide, access to modern energy for cooking services is comparable among female- and male-headed households. This parity extends to both urban and rural areas. Culturally sensitive service design is crucial to drive access. Research should explore culinary traditions, fuel preferences, acquisition methods, and barriers to clean cooking. Targeted financing mechanisms are needed to address affordability for vulnerable and female-headed households. Education campaigns for both genders are essential to promote clean and efficient cooking.

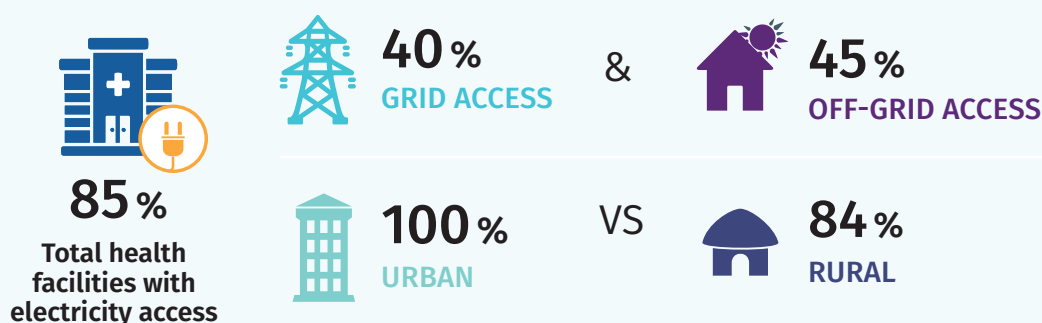
ACCESS TO ELECTRICITY IN EDUCATION AND HEALTH FACILITIES

FIGURE ES.4 • Key data: Electricity access in education and health facilities

ELECTRICITY ACCESS IN EDUCATION FACILITIES



ELECTRICITY ACCESS IN HEALTH FACILITIES



The MTF survey in Burundi covered 396 education facilities, 94 percent of which are rural. Elementary/middle schools comprised 77 percent of the sample, followed by general (17 percent) and technical (4 percent) secondary schools. Only 9 percent of these facilities provide on-campus meals. Only 25 percent education facilities have access to electricity. Approximately 15 percent are connected to the grid and 10 percent use off-grid solutions, mainly rechargeable batteries (6 percent), and solar lighting systems (4 percent). Electrification of education facilities varies by location: 78 percent of urban facilities have access to electricity, mainly through the grid, compared to only 22 percent of rural facilities, split evenly between grid and off-grid solutions. Most (86 percent) of the facilities without access to electricity lack any lighting source, while 12 percent use flashlights or torches.

The MTF survey in Burundi covered 189 health facilities, 91 percent of which are rural. Health centers constituted 80 percent of the sample, followed by clinics and municipal hospitals (both 5 percent). Notably, 85 percent of health facilities have access to electricity, with a near-even split between grid (40 percent) and off-grid (45 percent), predominantly solar. Health facility electrification varies by location: 100 percent of urban facilities are electrified, primarily through the grid, compared to 84 percent electrification for rural facilities (35 percent grid and 50 percent off-grid, mainly solar). Hospitals report high levels of electrification, while only 25 percent of health centers are electrified using off-grid solutions (mainly solar).



1. MEASURING ENERGY ACCESS IN BURUNDI



Access to energy is central to addressing critical development challenges. Energy deeply influences human development, serving as a catalyst for economic growth and social development. The United Nations acknowledges the paramount importance and far-reaching impact of energy access, enshrining it in Sustainable Development Goal (SDG) target 7.1, which aims for universal access to affordable, reliable, and modern energy services. SDG 7.1 is instrumental in achieving numerous other SDG targets, spanning poverty eradication through advancements in health, education, water supply, and industrialization to mitigating climate change.

Burundi is making great strides toward universal energy access. The government has shown a steadfast commitment to achieving SDG target 7.1, including by partnering with the World Bank to conduct a Multi-Tier Framework (MTF) survey. This survey provides crucial insights that will inform strategic targets, policies, and investment strategies to expand energy access for the Burundian people.

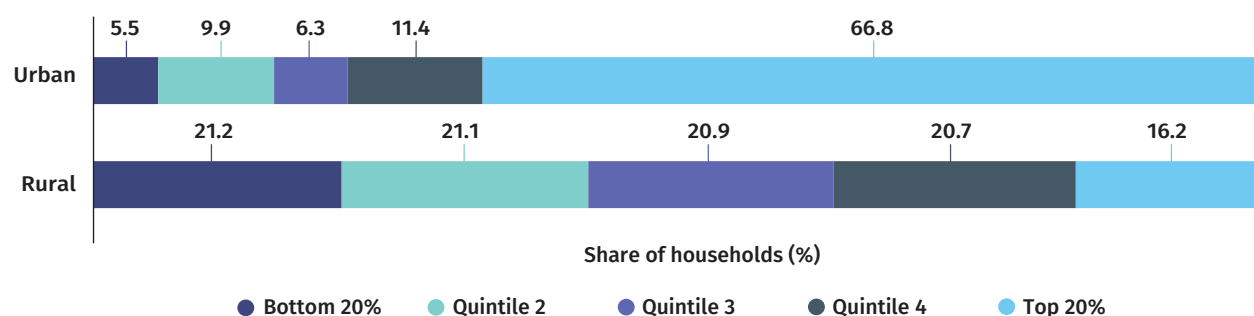
COUNTRY CONTEXT

Burundi faces immense development challenges. Burundi is located in eastern central Africa, with a population of 12.6 million (2021)⁸ on a land area of 27,830 km². It is among the most densely populated, predominantly rural countries in Sub-Saharan Africa, at 488.8 people/km² (while its urbanization rate stands only at 14.1 percent).⁹ Its rapidly rising population is expected to double by 2040. Despite progress in health and education indicators, Burundi ranks 187 out of 191 countries on the 2021 Human Development Index (UNDP 2022). It has the lowest per capita gross national income in the world (US\$220 in 2021). Agriculture is the backbone of Burundi's economy, employing 80 percent of the population. However, a significant portion of the Burundian population faces hunger, with chronic malnutrition affecting one in every two children under the age of five (Ishimwe 2021; Wagué 2025). Repeated climate disasters and political shocks have severely constrained economic growth and poverty alleviation.

Poverty remains a pervasive challenge in Burundi. The MTF survey estimates the total monthly household expenditure at FBu 397,688 (US\$141). Inequalities are stark between urban and rural areas. In urban areas, two in three households belong to the richest 20 percent, while in rural areas 42 percent of households are in the bottom 40 percent (figure 1.1). Total monthly household expenditure in urban areas is FBu 1,048,132 (US\$372), whereas in rural areas it drops to FBu 344,951 (US\$122).

⁸ The population of Burundi was estimated at 14.05 million in 2024.

⁹ World Development Indicators.

FIGURE 1.1 • Expenditure quintiles, urban/rural

Source: Original compilation.

Energy access is crucial for advancing progress toward Burundi's development goals. The revised Burundi's National Development Plan 2018–2027 aims to structurally transform the economy for robust, sustainable, resilient, inclusive growth, creating decent jobs for all and leading to improved social welfare. The plan also refers to the energy deficit as one of the main constraints to economic growth. Poor access to electricity (and water) deteriorates living standards and increases the cost of doing business, inhibiting investments. Despite abundant hydroelectric potential, Burundi faces low generation and transmission capacity due to chronic underinvestment, deterioration, and damage.

Burundi's power sector is highly centralized, and vertically integrated with a single state-owned utility, REGIDESO. The sector operates under a single-buyer model with independent power producers. Isolated networks providing electricity service in rural areas are managed by the Burundian Agency for Rural Electrification (ABER), which owns and operates the infrastructure. The government's recent reforms include a broad public-private partnership framework and various electricity production regimes, competition in generation, and light-handed regulation for small power projects (box 1.1).

Burundi is actively reforming its energy sector. The Government of Burundi has recently implemented new policies and mechanisms to address its energy challenges, including a revised electricity law in March 2024 and a new results-based financing scheme to strengthen the private sector. The government also launched a national electrification strategy in October 2024 and pledged its support to the Mission 300 initiative in 2025, demonstrating its commitment to expanding electricity access.

Burundi's new Energy Compact provides a clear roadmap to achieve the country's ambitious energy goals. This compact, officially launched at the UN General Assembly in September 2025, aims to achieve ambitious targets: 70 percent electricity access and 40 percent clean cooking access by 2030. To address barriers to electrification, the compact outlines measures that will (1) create a new regulatory environment that encourages private sector participation; (2) ensure the financial viability of the energy sector and promote sustainable investments with cost-reflective tariffs, while keeping energy services affordable for consumers; and (3) encourage regional integration.

Access to electricity remains severely limited in the country. While the 2023 Tracking SDG 7 report (IEA et al. 2023) estimated 2021 access levels at just 10.2 percent,¹⁰ the 2021 MTF survey indicates a higher rate of 26 percent. In both cases, coverage falls significantly below the Sub-Saharan Africa average of 50.1 percent. Furthermore, Burundi's average per capita electricity consumption of 23 kWh per year is among the lowest in the region, representing a mere fraction of the regional average of 480 kWh per year (World Bank 2020).

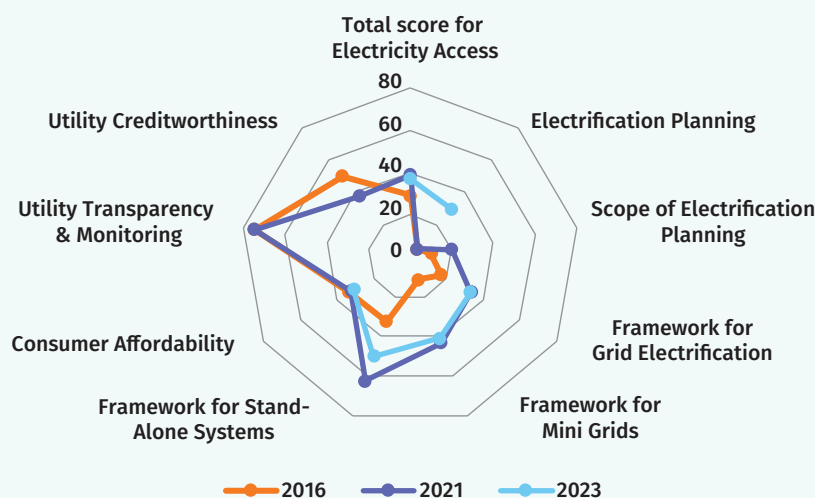
¹⁰ Electrification rates were also estimated at 62.8 percent in urban areas and 1.6 percent in rural areas (IEA et al. 2023).

Burundi overwhelmingly depends on wood fuel for cooking. The dependence on wood biomass is driving deforestation and adversely impacting the environment. Biomass represents 95 percent of primary energy consumption, while oil accounts for 2.5 percent and electricity only 1.3 percent (World Bank 2020). According to Burundi's 2016–17 household survey, 85 percent of the population uses wood¹¹ as the main source of energy for cooking (Ministère à la Présidence chargé de la Bonne Gouvernance et al. 2017). Beyond deforestation, reliance on wood as fuel causes respiratory illness related to indoor air pollution and physical strain related to wood collection.

BOX 1.1 • SUMMARY OF THE REGULATORY INDICATORS FOR SUSTAINABLE ENERGY (RISE) (ELECTRICITY ACCESS AND CLEAN COOKING PILLARS) FOR BURUNDI

In 2021, Burundi's RISE score for Electricity Access was 39, up from 29 in 2016. In that same time frame, the electricity access rate increased from 8.5 percent to 10.2 percent, and 360,000 more people obtained access to electricity (while the population grew by 1.65 million). Four electricity access indicators improved between 2016 and 2021: scope of electrification planning, framework for grid electrification, framework for mini-grids, and framework for stand-alone systems. Two remained unchanged—electrification planning and utility transparency and monitoring—and two declined, consumer affordability and utility creditworthiness (figure B1.1.1). In 2023, Burundi's RISE score decreased to 37.

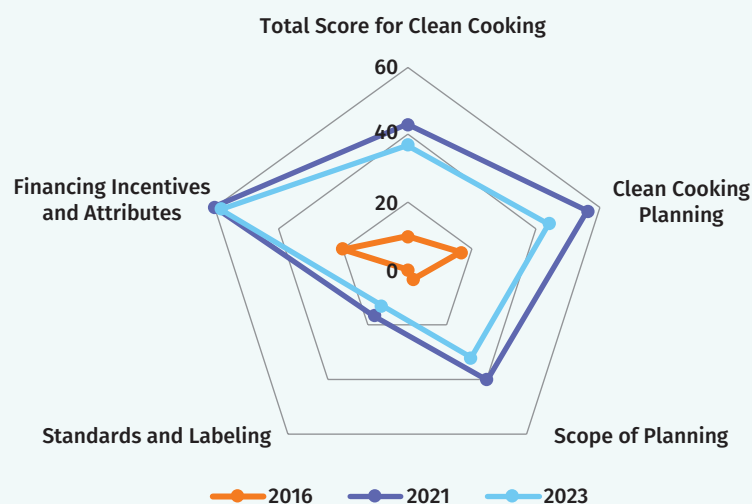
FIGURE B1.1.1 • Trends in the RISE Electricity Access pillar for Burundi, 2016, 2021, and 2023



¹¹ Another 5 percent use charcoal and 9 percent use other biomass, totaling 99 percent.

BOX 1.1 • SUMMARY OF THE REGULATORY INDICATORS FOR SUSTAINABLE ENERGY (RISE) (ELECTRICITY ACCESS AND CLEAN COOKING PILLARS) FOR BURUNDI (cont.)

FIGURE B1.1.2 • Trends in the RISE Clean Cooking pillar for Burundi, 2016, 2021, and 2023



Source: <https://rise.esmap.org>.

GLOBAL SURVEY ON ENERGY ACCESS USING THE MULTI-TIER FRAMEWORK

In 2016, the World Bank and the Energy Sector Management Assistance Program launched the Global Survey on Energy Access, pioneering a more granular understanding of energy availability. This survey employs the MTF to achieve its objective: providing nuanced data on energy access, including access to electricity and modern energy cooking services.

The MTF revolutionizes how we measure energy access. The MTF goes beyond the traditional binary measurement of energy access—namely, having access or not to electricity and having access or not to clean cooking fuels and technologies. It captures the multidimensional nature of energy access at the end-user level, and the vast range of technologies that can provide energy access, while accounting for the wide differences in user experience.

The MTF provides a comprehensive definition and measurement of energy access. It defines energy access as the ability to obtain energy that is adequate, available when needed, reliable, of good quality, affordable, formal, convenient, healthy, and safe for all required energy applications across households, enterprises, and community institutions. Based on this definition, the MTF measures energy access provided by any technology or fuel, based on a set of attributes that capture key characteristics of the energy supply that affect the user experience. Based on those attributes, it defines six tiers of access, ranging from Tier 0 (no access) to Tier 5 (full access), along a continuum of improvement. Each attribute is assessed separately, and the overall tier of access to electricity or modern energy cooking services for each user (household, enterprise, education facility, or health facility) is the lowest tier attained across the attributes (Bhatia and Angelou 2015).

ACCESS TO ELECTRICITY

Electricity access is measured by seven key attributes, defining a six-tier system. These attributes of the primary electricity source are: Capacity, Availability, Reliability, Quality, Affordability, Formality, and Health and Safety (annex 1). They define six tiers of access, from Tier 0 (no access) to Tier 5 (full access), representing a continuum of improvement (box 1.2; annex 1).

BOX 1.2 • MINIMUM ELECTRICITY REQUIREMENTS, BY TIER OF ELECTRICITY ACCESS



Tier 0	Tier 1	Tier 2
Electricity is not available or is available less than four hours a day (or less than one hour per evening), or has a capacity of <3 watts (or <12 watt-hours). Households cope by using candles, kerosene lamps, or battery-powered devices, such as flashlights and radios.	Electricity is available at least four hours a day, including at least one hour per evening, and the capacity is sufficient to power task lighting and phone charging or a radio. All electricity sources may meet these requirements—from solar lanterns to the national grid.	Electricity is available at least four hours a day, including at least two hours per evening, and capacity is sufficient to power low-load appliances as needed during that time, such as multiple lights, a television, or a fan (see Table B1.2.1). Sources that may meet these requirements include a rechargeable battery, solar home system, generator, mini-grid, and the national grid.
Tier 3	Tier 4	Tier 5
Electricity is available at least 8 hours a day, including at least 3 hours per evening, and capacity is sufficient to power medium-load appliances as needed during that time, such as a refrigerator, freezer, food processor, water pump, rice cooker, or air cooler (see Table B1.2.1). In addition, the household can afford a basic consumption package of 30 kWh per month. Sources that may meet these requirements include a solar home system, generator, mini-grid, and the national grid.	Electricity is available at least 16 hours a day, including at least 4 hours per evening, and capacity is sufficient to power high-load appliances as needed during that time, such as a washing machine, iron, hair dryer, toaster, and microwave (see Table B1.2.1). There are not long or frequent unscheduled interruptions, there are no voltage issues, and the electricity source is formal and safe. Sources that may meet these requirements include a generator, mini-grid, and the national grid.	Electricity is available at least 23 hours a day, including 4 hours per evening, and capacity is sufficient to power very high-load appliances as needed during that time, such as air conditioners, space heaters, vacuum cleaners, and electric stoves (see Table B1.2.1). The most likely source for meeting these requirements is the national grid, although a generator or mini-grid might suffice as well.

BOX 1.2 • MINIMUM ELECTRICITY REQUIREMENTS, BY TIER OF ELECTRICITY ACCESS (cont.)**TABLE B1.2.1 • Appliances by load level and associated Capacity tier**

Load level	Indicative electric appliances	Capacity tier typically needed to power the load
Very low load (3–49 W)	 Incandescent light bulb, fluorescent tube, compact fluorescent lamp, light-emitting diodes (LEDs), torch/flashlight/lantern, radio/CD players/sound system, smartphone (Internet phone) charger, regular mobile phone charger	TIER 1
Low load (50–199 W)	 Black-and-white television, computer, fan, flat-screen color television, regular color television, VCD/DVD	TIER 2
Medium load (200–799 W)	 Indoor air cooler, refrigerator, electric water pump, electric food processor/blender, rice cooker, freezer, electric sewing machine, electric hot water pot or kettle	TIER 3
High load (800–1,999 W)	 Washing machine, electric iron, microwave oven, electric toaster, dishwasher, electric hairdryer	TIER 4
Very high load (2,000 W or more)	 Space heater, electric water heater, solar-based water heater, electric stove	TIER 5

Source: Bhatia and Angelou, 2015

Tier 0 signifies minimal or no access, meaning households receive electricity for less than four hours daily (or less than one hour in the evening), or their primary source has a capacity under three watts (or less than 12 watt-hours). Tier 1 represents limited access, with small quantities of electricity from any technology, such as a basic solar lighting system, providing a few hours a day for lighting and phone charging.

Higher tiers are characterized by increased capacity and longer availability, enabling the use of medium- and high-load appliances like refrigerators, washing machines, or air conditioners. These tiers also require adequate Affordability, Reliability, Quality, Formality, and Health and Safety. While a grid is the most common source for higher tiers, a diesel generator or a large mini-grid can also achieve them. Advances in photovoltaic solar home systems and energy-efficient direct current appliances are also making higher levels of access possible.

Beyond grid connections, six off-grid solutions are reported: mini-grids, generators (e.g., diesel-powered), solar devices—including solar lanterns (SLs), solar lighting systems (SLSs), and solar home systems (SHSs)—and rechargeable batteries (e.g., car batteries). For more information on solar solutions, see box 1.3.

BOX 1.3 • ASSESSING THE CAPACITY TIER OF SOLAR SOLUTIONS

Solar devices are classified into three types based on the number of light bulbs and the type of appliances or electricity services they can provide. This categorization is used to assess their Capacity tier.

- **Solar lanterns (SLs)** power only one light bulb, and may or may not include a power outlet (to charge a phone or power a radio). The Capacity tier of a solar lantern may be Tier 0 or Tier 1, depending on their score. The score will depend on (1) the possibility of charging a mobile phone or powering a radio and (2) the level of the lighting service calculated based on the ratio of the number of people served with adequate lighting to the household size (annex 1).
- **Solar lighting systems (SLSs)** power two or more light bulbs, and may or not include a power outlet (to charge a phone or power a radio). The Capacity tier of a SLS may be Tier 0 or Tier 1, depending on the score. The score will depend on (1) the possibility of charging a mobile phone or powering a radio and (2) the level of the lighting service calculated based on the ratio of the number of people served with adequate lighting to the household size (annex 1).
- **Solar home systems (SHSs)** power two or more light bulbs and can power at least low-load appliances (such as a television, fan, computer, or VCD/DVD player). The Capacity tier of a SHS is Tier 2 by default, unless the household owns appliances that reach an Appliance tier above Tier 2, in which case the Capacity tier will correspond to the highest Appliance Tier reached by the appliances (in working condition) owned by the household (see Table B1.2.1 for appliances by load level and associated Capacity tier).

See annex 2 for the list of off-grid solar solutions available in Burundi.

ACCESS TO MODERN ENERGY COOKING SERVICES

The MTF also measures access to modern energy cooking services using six key attributes. The services may be provided by any cookstove and fuel (box 1.4), and the six attributes capture key characteristics that affect the user experience: Cooking Exposure, Cookstove Efficiency, Convenience, Affordability, Safety of primary cookstove, and Fuel Availability (annex 3). Based on the combination of these attributes, the MTF defines six tiers of access with minimum requirements, ranging from Tier 0 (no access) to Tier 5 (full access) along a continuum of improvement (table 1.2; annex 3).

BOX 1.4 • TYPES OF COOKSTOVES COMMON IN BURUNDI

- **Three-stone stove:** A pot balanced on three stones or a tripod over an open fire. In general, this stove uses firewood, has a low combustion temperature, and its fire is exposed, leaving a significant percentage of heat to be lost to the ambient air.
- **Traditional stove:** In Burundi, traditional stoves include: Thai-bucket, foyer ya Tsinga, double-tête stove, foyer Congo, foyer Ya jante, and simple metallic stoves. The pot sits for the most part on the fuel, has a low combustion temperature due to poor insulation, and a lot of cold excess primary air because of too many openings.
- **Improved cookstove:** In Burundi, improved cookstoves include: foyer Biikigiti ceramique, foyer Biikigiti metallique, foyer fixe, foyer Canarumwe ceramique (ILF)^a, Nyayo (improved Thai-bucket), Kamaro, foyer Inyarwanda, and foyer Onatour. An improved cookstove has a higher combustion temperature due to an enclosed combustion chamber and some insulation. The pot sits above the fire, allowing more time for combustion.
- **Clean fuel stove:** A stove that uses a clean burning fuel, such as biogas, liquefied petroleum gas, natural gas, electricity, or solar. In Burundi, only biogas and electricity have been reported as clean cooking fuels.

^a International Lifeline Fund.

TABLE 1.2 • Minimum requirements, by tier of access to modern energy cooking services

Tier 0	Tier 1	Tier 2
The main cookstove is a stove with Tier 0 emissions (such as a three-stone stove) used in a cooking area with bad or medium ventilation, OR a stove with Tier 1 emissions (such as a traditional stove or an improved cookstove without an exhaust system) used in a cooking area with bad ventilation.	The main cookstove is a stove with Tier 0 emissions (such as a three-stone stove) used in a cooking area with good ventilation, OR a stove with Tier 1 emissions (such as a traditional stove or an improved cookstove without an exhaust system) used in a cooking area with medium ventilation, OR a stove with Tier 2 emissions (such as an improved cookstove with an exhaust system) used in a cooking area with bad ventilation.	The main cookstove is a stove with Tier 1 emissions used in a cooking area with good ventilation, OR a stove with Tier 2 emissions used in a cooking area with medium ventilation, OR a stove with Tier 3 emissions used in a cooking area with bad ventilation.
Tier 3	Tier 4	Tier 5
The main cookstove is a stove with Tier 2 emissions used in a cooking area with good ventilation, OR a stove with Tier 3 emissions used in a cooking area with medium ventilation. The main cooking fuel is available more than 80 percent of the time. The main cooking solution has caused only minor accidents if any. In addition, the time acquiring and preparing the main fuel is less than three hours per week and the time preparing the main stove is less than 10 minutes per meal.	The main cookstove is a stove with Tier 3 emissions used in a cooking area with good ventilation, OR a stove with Tier 4 emissions used in a cooking area with bad or medium ventilation. The main cooking fuel is mostly available (more than 90 percent of the time), and the cost of cooking fuels is less than 5 percent of total household expenditure. The main cooking solution has not caused any accidents. In addition, the time acquiring and preparing the main fuel is less than 90 minutes per week and the time preparing the main stove is less than 5 minutes per meal.	The main cookstove is a stove with Tier 4 emissions used in a cooking area with good ventilation, OR a stove with Tier 5 emissions (such as a clean fuel stove). The main cooking fuel is always available, and the cost of cooking fuels is less than 5 percent of the total household expenditure. The main cooking solution has not caused any accidents. In addition, the time acquiring and preparing the main fuel is less than 30 minutes per week and the time preparing the main stove is less than 2 minutes per meal.

USING THE MULTI-TIER FRAMEWORK TO DRIVE POLICY AND INVESTMENT

The MTF provides crucial data and insights to accelerate global energy access. It offers robust insights that inform evidence-based policy reforms and targeted project interventions, in addition to delivering valuable market intelligence to the private sector. Across many countries, MTF survey results are driving deeper sector dialogue and guiding strategic investments toward ambitious access goals. Among others, they are supporting the optimization of policy frameworks, development of effective investment strategies, improvement of project design and utility performance, and impact assessments that enable successful development efforts. The MTF serves as a vital instrument for establishing baselines and monitoring progress toward SDG target 7.1.

The MTF survey delivers detailed data on household energy consumption. Stakeholders, including governments, development partners, the private sector, nongovernmental organizations, investors, and service providers, use these data for planning and delivery. On the supply side, the survey captures all energy sources that households use, and measures each MTF attribute. On the demand side, it captures energy expenditure, energy usage patterns, user preferences, willingness to pay (WTP) for grid connections, off-grid solutions, and cooking services, and consumers' satisfaction with their primary energy source.

MTF data empower governments to establish country-specific energy access targets. Governments can use these data to set universal access goals tailored to unique domestic conditions, available resources, and achievement timelines. These data can also help governments upgrade access for existing users—by elevating electrified households to higher tiers—and add new connections, while also determining the minimum target tier for new connections.

MTF data inform the design and prioritization of interventions for expanding access. This ensures interventions achieve maximum impact within a given budget. The data can be disaggregated by attribute and technology, revealing why households remain at lower tiers and pinpointing key barriers (e.g., insufficient generation capacity, high energy costs, or a weak transmission and distribution network). This enables targeted interventions that maximize benefits to households. MTF data also guide the selection of the most suitable technologies for nonelectrified households, indicating whether grid or off-grid solutions are more appropriate. Moreover, demand-side data, including energy spending, WTP, energy use, and appliance ownership, can inform the design and targeting of government programs, projects, and investments for energy access.

The MTF surveys offer disaggregated data that enable a more equitable approach to energy access. The data are disaggregated by location (urban or rural), expenditure quintile, and the gender of the household head. These surveys also collect socioeconomic indicators, disaggregating primary energy source, access tier, energy expenditure, WTP, and user preferences, among other indicators, by male- and female-headed households. This granular analysis enables impactful energy access planning, implementation, and financing. The surveys also capture the gender dimension. For example, they provide insights into gender roles in determining energy-related spending and gender-differentiated impacts on health and time use.

MTF SURVEY METHODOLOGY

The surveys' methodology ensures statistically accurate national and urban/rural energy access estimates. The sample size is determined on a country-specific basis, as detailed in annex 5. The sampling strategy employs a two-stage stratification process. An initial 50:50 stratification ensures balanced representation between urban and rural households. Subsequently, a second 50:50 stratification ensures equal representation of electrified and nonelectrified households within each urban and rural stratum. Finally, sample weights are applied to correct for any oversampling that may occur during stratification, ensuring the representativeness of the final estimates.

MTF SURVEY IMPLEMENTATION IN BURUNDI

Burundi's MTF survey used an innovative spatial algorithm to overcome outdated census data. Standard MTF surveys typically rely on recent census data for sampling frames. However, with Burundi's most recent census dating back to 2008, using those data for the 2021 MTF survey would have introduced significant bias. This bias would result because substantial demographic changes between 2008 and 2021, including population growth, migration, and evolving household structures, would not be accounted for.

An alternative sampling frame was developed to ensure accuracy of data. To mitigate the risk of bias, an alternative sampling frame was constructed using a spatial algorithm developed by EED Advisory, in collaboration with the National Autonomous University of Mexico and the Stockholm Environment Institute, as detailed in annex 5. The algorithm leverages the World Gridded Population Density Version 4.11 (CIESIN 2018) from the Socioeconomic Data and Applications Center and 2015 data from the Global Rural-Urban Mapping Project (GRUMP) of the Center for International Earth Science Information Network.

The Global Rural-Urban Mapping Project defined urban areas¹² for a national sampling frame. The population was divided into primary sampling units (PSUs), each with an average size of approximately 241 households, though PSU sizes varied considerably (see annex 5). Notably, unlike typical MTF surveys, the first-stage sampling weights in Burundi were calculated based on the number of households within each PSU, rather than the number of PSUs, to account for the significant variation in PSU size.

Data collection for the MTF survey was conducted in two phases: a household listing exercise, followed by primary data collection. The household listing exercise was performed in August 2021 across 65 enumeration areas—40 urban and 25 rural—to determine electrification status (see annex 5). This listing, encompassing approximately 23,000 households, informed the subsequent sampling strategy, ensuring a statistically representative sample of electrified households.

Subsequently, primary data were collected using comprehensive household and institutional surveys. This second phase took place from October 25 to December 4, 2021. The household survey employed a two-stage stratified sampling approach to achieve national representativeness. It covered all 18 provinces and maintained an approximate 50:50 ratio of electrified to nonelectrified households, as well as urban to rural areas (see annex 5).

¹² GRUMP identifies urban areas through a comprehensive analysis of population density, population counts, urban settlement points, urban extents, land area grids, national boundaries, and coastlines.

The survey successfully gathered data from over 4,000 households and numerous institutions. A total of 4,104 households, 397 educational facilities, and 190 health facilities were surveyed. The household sample was evenly distributed, with 2,052 households in urban areas and 2,052 in rural areas; similarly, 2,095 households were electrified and 2,009 were nonelectrified (table 1.3; map 1.1). The findings of the MTF survey data collection and analysis were presented to the Government of Burundi in September 2024.

TABLE 1.3 • Distribution of enumeration areas and sampled households

Province	Rural				Urban				Total		Education facilities	Health facilities
	Electrified		Non-electrified		Electrified		Non-electrified					
	EA	HH	EA	HH	EA	HH	EA	HH	EA	HH		
Bubanza	2	26	5	54	-	-	1	12	8	92	12	5
Bujumbura Mairie	-	-	-	-	130	1,501	-	-	130	1,501	153	14
Bujumbura Rural	3	34	8	95	2	32	6	72	19	233	23	78
Bururi	7	70	6	73	1	16	-	-	14	159	14	4
Cankuzo	-	-	8	98	1	16	-	-	9	114	13	7
Cibitoke	3	42	10	120	1	16	3	36	17	214	20	15
Gitega	1	16	12	144	2	32	-	-	15	192	19	7
Karuzi	-	-	12	144	-	-	1	12	13	156	21	5
Kayanza	1	16	9	108	-	-	-	-	10	124	6	4
Kirundo	1	11	10	120	2	27	1	12	14	170	14	8
Makamba	-	-	4	48	-	-	1	12	5	60	12	7
Muramvya	-	-	4	47	-	-	5	60	9	107	9	3
Muyinga	-	-	8	96	4	58	2	24	14	178	24	11
Mwaro	-	-	8	96	-	-	-	-	8	96	8	1
Ngozi	2	26	13	155	2	26	-	-	17	207	10	5
Rumonge	4	50	10	120	-	-	-	-	14	170	27	10
Rutana	1	16	10	120	2	32	2	24	15	192	1	2
Ruyigi	-	-	9	107	2	32	-	-	11	139	11	4
Nationwide	25	307	146	1,745	149	1,788	22	264	342	4,104	397	190

Source: Original compilation.

Notes: EA = enumeration area; HH = household.

BURUNDI
DIAGNOSTIC REPORT

- HOUSEHOLDS SURVEYED
- SELECTED CITIES AND TOWNS
- PROVINCE CAPITALS
- NATIONAL CAPITAL
- HIGHWAYS
- MAJOR ROADS
- PROVINCE BOUNDARIES
- INTERNATIONAL BOUNDARIES

BURUNDI

0 15 30 Miles
0 15 30 Kilometers

IBRD 47122 | MARCH 2023

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25



2. ACCESS TO ELECTRICITY

KEY MESSAGES

- **Overall electricity access remains low but is rapidly expanding.** In Burundi, 26 percent of households have access to electricity, including 8 percent connected to the grid and 18 percent relying on off-grid solutions. This figure is significantly higher than the 10 percent national electrification rate reported for 2021 in the latest Tracking SDG 7 report (IEA et al. 2023). This discrepancy is attributed to the 10 percent rate being a model-based estimate, which may underreport off-grid solutions and not fully reflect recent governmental reforms. Notably, more than half of grid connections and off-grid solar devices were acquired within the past three years.
- **There is a marked divergence in electricity access between urban and rural areas.** Approximately 75 percent of urban households have electricity access, with the majority (68 percent) connected to the grid. In contrast, only 22 percent of rural households have access, most of them (19 percent) through off-grid solutions.
- **Only 20 percent of households nationwide achieve Tier 1 or higher in the MTF, reflecting the poor performance of energy access.** A mere 8 percent reach Tier 3 or higher, about the same percentage of households connected to the grid, and just 2 percent attain Tier 5. While most Tier 1 households rely on off-grid solutions, Tiers 3–5 are almost exclusively grid connected.
- **Burundi faces significant challenges in the Quality and Reliability of its electricity supply.** A staggering 79 percent of households are at Tier 0 for Capacity, indicating they either lack electricity access or have access to less than 3 watts. Even for electrified households, Availability remains a critical issue, with 37 percent receiving less than 8 hours daily; only 10 percent of rural households receive electricity over 23 hours, compared with 54 percent in urban areas. Reliability is a major concern, as more than half of the grid-connected households experience frequent or long unscheduled outages, particularly in rural regions. Furthermore, Quality issues persist, with 13 percent of grid/mini-grid users reporting voltage fluctuations, which damage appliances.
- **High costs and limited infrastructure pose major barriers to grid expansion in Burundi.** Nearly 70 percent of households cite a lack of grid availability as the primary reason they remain unconnected. For those with physical access to the network, the connection fee of FBu 492,000 (US\$174.41) is a significant obstacle for about 30 percent of households. While one-third of unconnected households are willing to pay the current fee up front, this figure nearly doubles to 64 percent if the fee is reduced to FBu 68,880 (US\$24.42).
- **Most electrified households in Burundi own only a few appliances, indicating underutilized grid capacity.** Eight out of ten electrified homes use only very low- or low-load appliances. Even for grid-connected households, 34 percent still rely on very low-load appliances, a figure that jumps to 56 percent in rural areas.

Households without electricity access

- **Most households without electricity access (63 percent) live in communities where the grid is not available.** Meanwhile, 11 percent of these unconnected homes are actually “under the grid,” meaning they are in communities that already have grid infrastructure.
- **Households lacking electricity are often the most economically disadvantaged, especially those “under the grid.”** Nearly half (45 percent) of all unelectrified households are in the lowest 40 percent income bracket, with an average monthly expenditure of FBu 335,370 (US\$119). Among those “under the grid” but still without electricity, 48 percent are in the lowest 40 percent income bracket, averaging FBu 390,942 (US\$139) monthly. In contrast, only 26 percent of unelectrified households in nonelectrified communities are among the lowest 40 percent income bracket, with an average monthly expenditure of FBu 324,353 (US\$115). Households with grid access have a significantly higher average monthly expenditure of FBu 1,003,896 (US\$356).
- **High costs hinder grid connections and the willingness to pay for solar solutions.** Only about a third of unconnected households would pay the current FBu 492,000 (US\$174.41) grid connection fee up front, though this figure jumps to 64 percent if the fee is reduced to FBu 68,880 (US\$24.42). For solar lanterns, 42–57 percent would pay up front. However, the willingness to pay for more expensive solar lighting systems is much lower (17–32 percent).

Grid-connected households

- **Grid-connected households face significant challenges with electricity supply performance.** Many contend with limited daily availability: 44 percent receive electricity less than 23 hours per day, often totalling between 16 and 23 hours per day. Reliability is also a major concern, with over 50 percent of grid users experiencing frequent or long unscheduled outages. Furthermore, voltage issues affect about 12–13 percent of grid-connected households.
- **Electricity consumption remains low, varying by location and wealth.** Nationwide, 39 percent of grid-connected households consume up to 60 kWh per month. Urban households consume considerably more electricity than rural ones, and consumption also increases with wealth. For instance, only 27 percent of grid-connected households in the poorest quintile consume over 100 kWh monthly, a figure that nearly doubles to 50 percent in the wealthiest quintile.

Off-grid solar households

- **Off-grid solar solutions are growing rapidly in Burundi, particularly in rural areas, yet significant challenges remain in providing robust, high-tier electricity access.** Off-grid solar devices, primarily solar lanterns, now serve 17 percent of households in Burundi. Most of these devices were acquired within the preceding three years. However, most off-grid solar users are only at Tier 1, and a significant share remain at Tier 0, frequently encountering issues such as inability to supply sufficient electricity to power large appliances, limited service duration, and battery issues.

MEASURING ACCESS TO ELECTRICITY

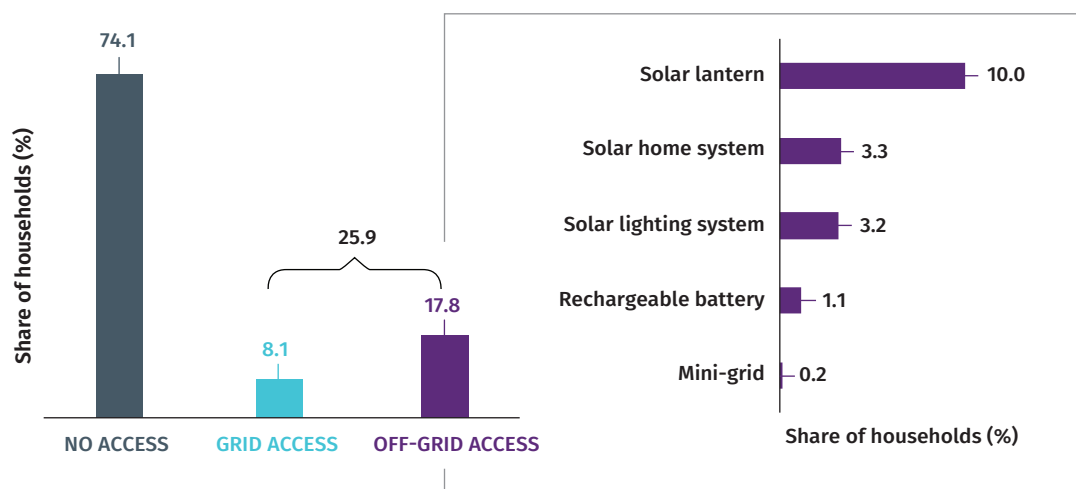
This section provides a comprehensive overview of electricity access in Burundi, based on the 2021 Multi-Tier Framework (MTF) survey. It details national and urban/rural access levels. Electricity access is disaggregated by technology, access tier, and expenditure quintile. The attributes of electricity supply are analyzed nationally and at the urban/rural level. Appliance ownership is presented by load level and type, distinguishing between urban and rural areas, as well as grid-connected and off-grid households. Finally, grid electricity consumption levels are reported.

ELECTRICITY ACCESS BY TECHNOLOGY

In Burundi, 26 percent of households have access to electricity. Of these, 8 percent are connected to the grid and 18 percent rely on off-grid solutions as their primary electricity source (figure 2.1). The most common off-grid solutions are solar devices (17 percent), primarily solar lanterns (10 percent), while other off-grid options are rarely used as the main sources of electricity.

The 26 percent household electricity access rate derived from the 2021 MTF survey significantly exceeds the 10 percent national electrification rate reported for 2021 in the latest Tracking SDG 7 report (IEA et al. 2023). This discrepancy can be attributed to several factors. First, the 10 percent figure is a model-based estimate, utilizing 2017 Demographic and Health Survey data and 2014 national survey data, which may not fully reflect the impact of recent governmental sector reforms (see box 1.1). Second, the SDG 7.1.1 estimate likely focuses on grid connections, potentially underreporting the prevalence of off-grid solutions. Notably, the MTF survey reveals a rapid expansion of off-grid access, with 56 percent of off-grid households acquiring their solar devices within the preceding two years and 75 percent within the preceding three years (figure 2.45). Similarly, over 50 percent of grid-connected households obtained their connections during the previous three years (figure 2.25), indicating a recent surge in both grid and off-grid electrification.

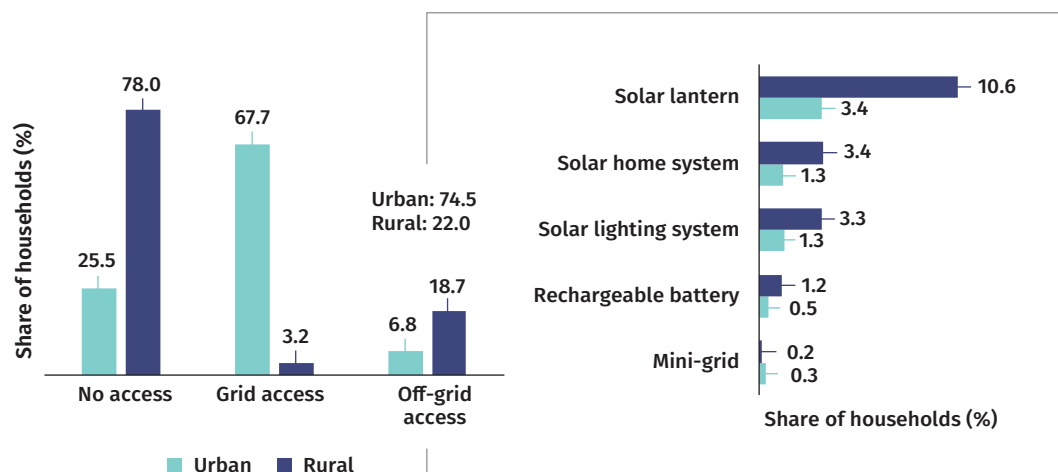
FIGURE 2.1 • Nationwide electricity access, by technology



Source: Original compilation based on 2021 MTF survey results.

Electricity access patterns in Burundi exhibit a marked divergence between urban and rural areas (figure 2.2). Approximately 75 percent of urban households have access to electricity, compared to 22 percent in rural areas. Most urban households (68 percent) are connected to the grid, while only 7 percent rely on off-grid solutions. Conversely, in rural areas, off-grid solutions are the primary source of electricity for 19 percent of households, whereas grid access is limited to 3 percent.

FIGURE 2.2 • Electricity access, by technology and urban/rural location

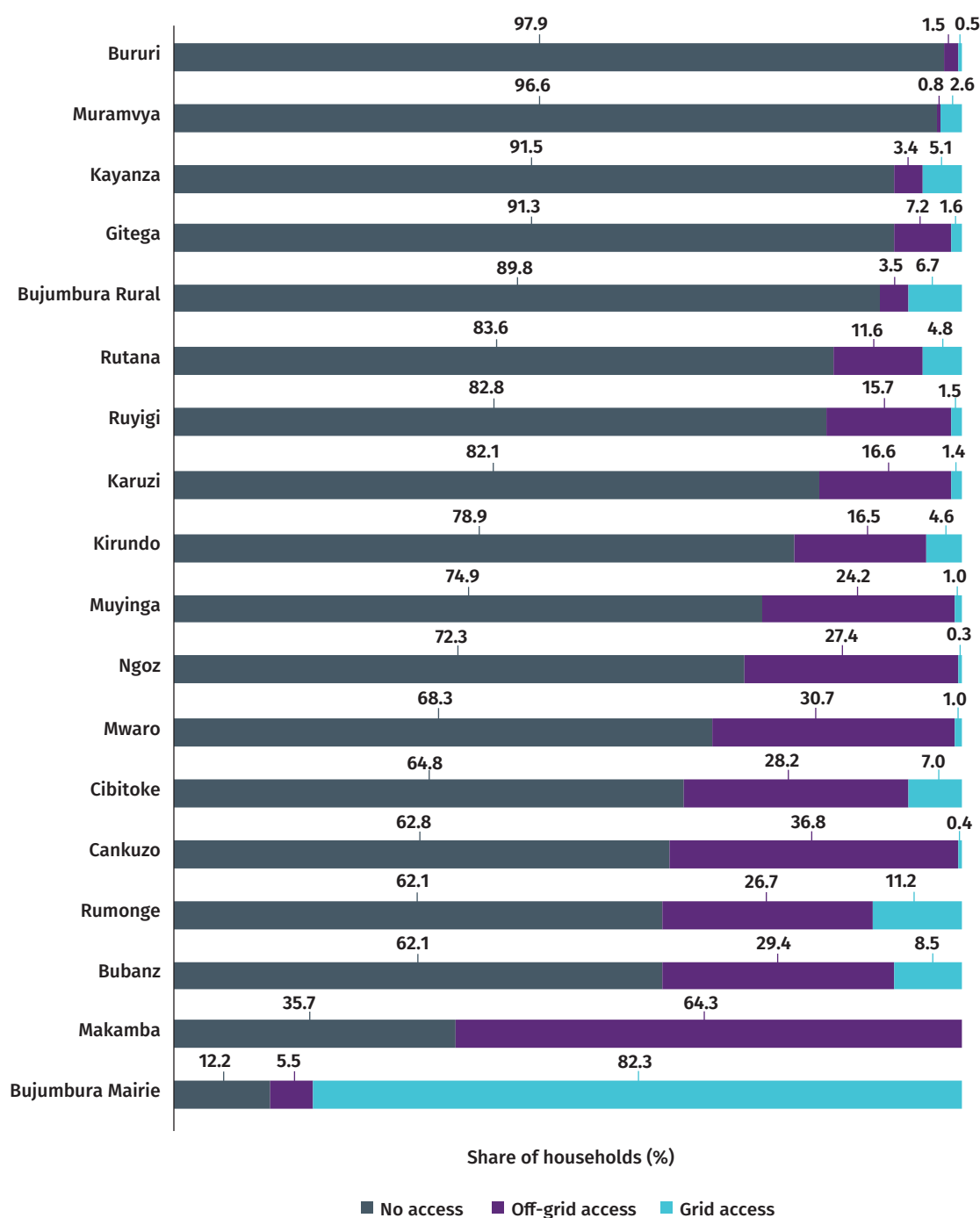


Source: Original compilation based on 2021 MTF survey results.

Access to electricity varies by province (figure 2.3). Of 18 provinces, 8 have electricity access rates above the national average of 26 percent.¹³ Bujumbura Mairie is the only province with significant grid penetration at 82 percent, while all other provinces have grid access rates ranging from 0.3 percent to 11 percent. Makamba has the second-highest electricity access rate at 64 percent, driven by off-grid solutions. The remaining provinces have off-grid access rates between 1 percent and 37 percent.

¹³ Those provinces are Ngozi, Mwaro, Cibitoke, Cankuzo, Rumonge, Bubanza, Makamba, and Bujumbura Mairie.

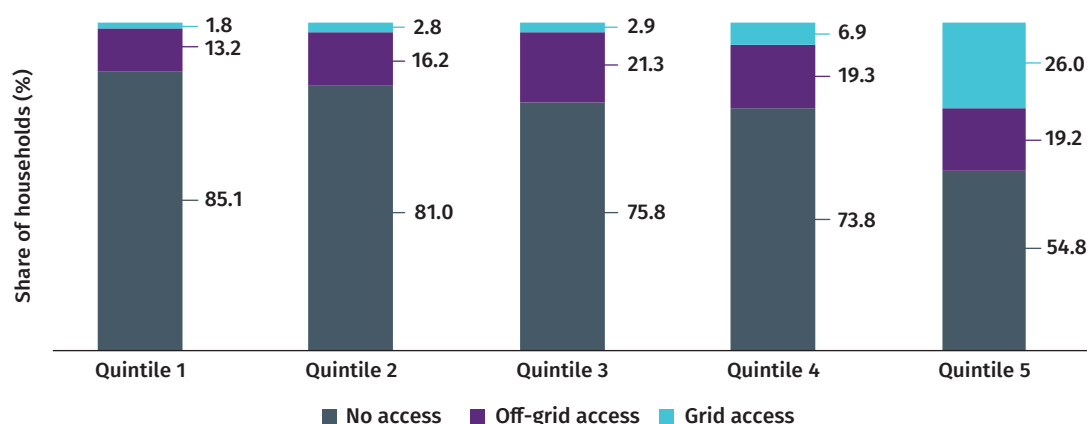
FIGURE 2.3 • Electricity access, by technology and province



Source: Original compilation based on 2021 MTF survey results.

Electricity access in Burundi demonstrates a clear correlation with household wealth. The lowest 20 percent income bracket exhibit a 30 percentage point deficit in electricity access compared to the highest 20 percent (55 percent access versus 85 percent access, respectively) (figure 2.4). Grid penetration increases proportionally with expenditure, with only 2 percent of the poorest quintile having grid access, compared with 26 percent of the wealthiest quintile. Conversely, off-grid solutions show a more equitable distribution across the majority of expenditure quintiles.

FIGURE 2.4 • Electricity access, by technology and expenditure quintile (nationwide)

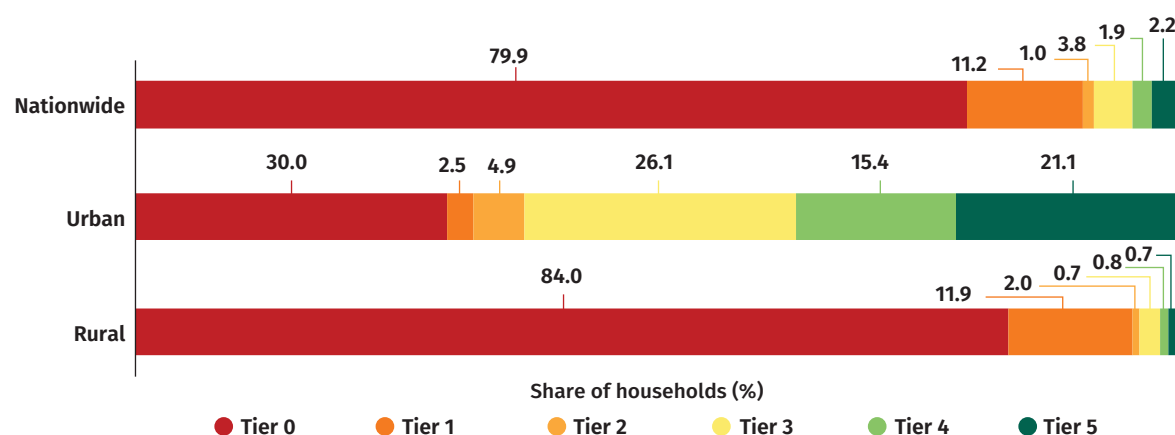


Source: Original compilation based on 2021 MTF survey results.

ELECTRICITY ACCESS BY TIER

Nationwide, 20 percent of households in Burundi achieve Tier 1 access or higher in the MTF (figure 2.5). This is below the overall 26 percent household electricity access rate based on technology. Notably, only 8 percent of households attain Tier 3 or higher, which corresponds with the grid penetration rate (figure 2.1). Furthermore, a mere 2 percent of households reach Tier 5, suggesting that the majority of grid-connected households operate within lower tiers. Consequently, the national MTF index score is 8.6 out of 100. Subnational analysis reveals a significant disparity, with urban areas scoring 51.5 and rural areas scoring 5.1.¹⁴

FIGURE 2.5 • MTF electricity tier distribution (nationwide, urban, rural)

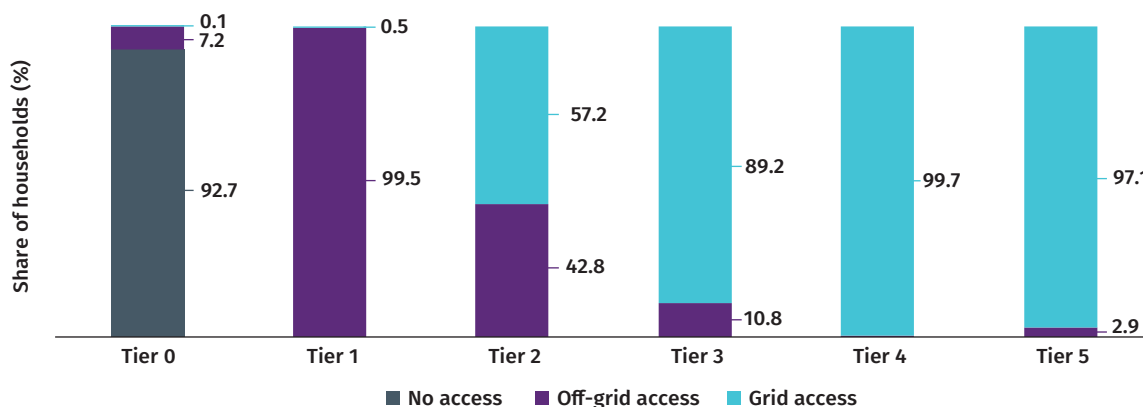


¹⁴ The MTF index is calculated by assigning weights to the tiers and then determining a weighted average. This process is as follows: $\sum (20 \cdot P_k \cdot k)$, where k is the tier number (0 to 5) and P_k the proportion of households at the k^{th} tier.

Source: Original compilation based on 2021 MTF survey results.

The large majority of Tier 0 households have no access to electricity, while a small portion have access to off-grid solutions (solar lanterns) that do not reach Tier 1 requirements (figure 2.6; see box 1.2). Virtually all households in Tier 1 use off-grid solutions. The 1 percent of the households at Tier 2 are split between those connected to the grid and those relying on off-grid solutions. Nearly all households at Tiers 3 to 5 are grid connected (or connected to a mini-grid).

FIGURE 2.6 • MTF electricity tier distribution, by technology (nationwide)



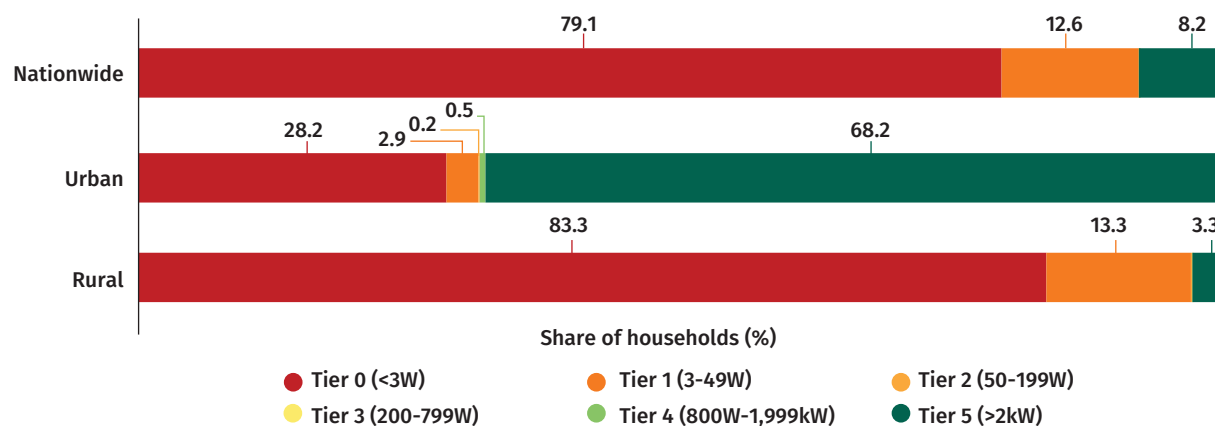
Source: Original compilation based on 2021 MTF survey results.

ATTRIBUTES OF ELECTRICITY SUPPLY

Capacity

The Capacity of the electricity supply refers to the system's ability to provide a sufficient amount of power to operate appliances, ranging from low-wattage devices (like light-emitting diode lights (LEDs) and mobile phone chargers) to high-wattage appliances such as space heaters or air conditioners (see Table B1.2.1). In Burundi, 79 percent of households are classified as Tier 0 in terms of Capacity (figure 2.7). This indicates that these households either lack electricity access entirely or rely on off-grid solutions that provide less than 3 watts (or 12 watt-hours per day). Conversely, 8 percent of households achieve Tier 5, corresponding to those with grid or mini-grid connections. Households in intermediate tiers, primarily Tier 1, utilize off-grid solutions.

FIGURE 2.7 • Household distribution of Capacity



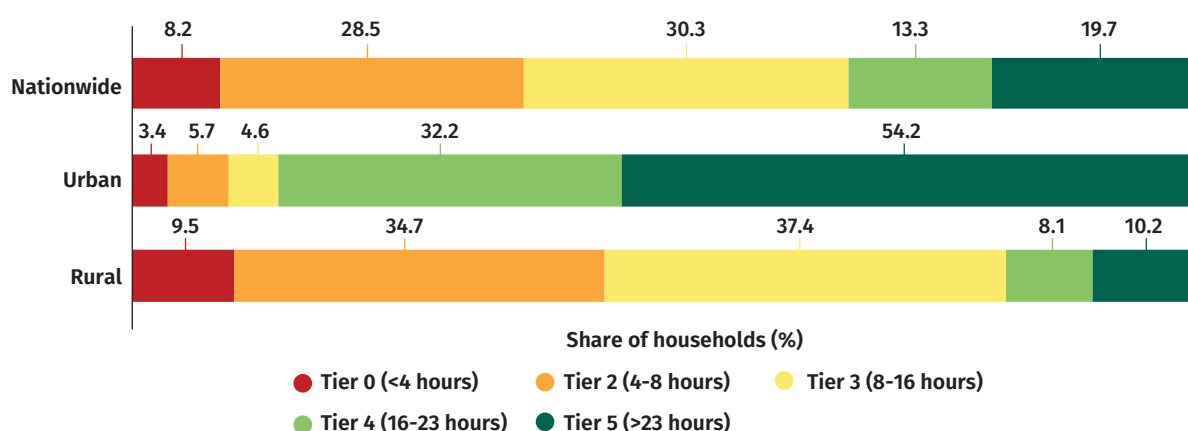
Source: Original compilation based on 2021 MTF survey results.

Note: kW = kilowatt; W = watt.

Availability

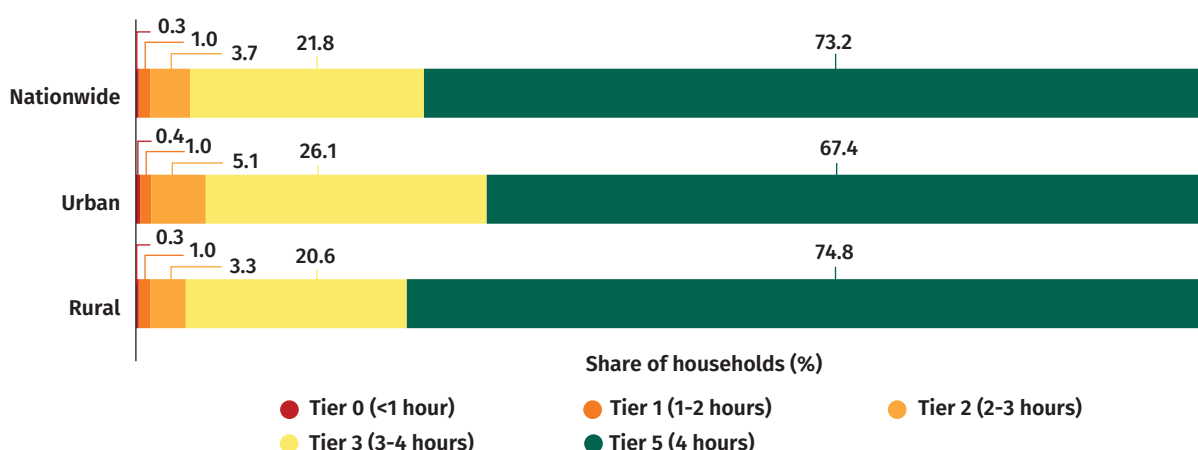
Availability of electricity supply, measured as the duration of electricity provision within a 24-hour period and during evening hours (6–10 pm), is assessed for households with electricity access. The Availability attribute applies only to households with access to electricity. Nationwide, 20 percent of households with access to electricity receive over 23 hours of supply per day, while 37 percent receive less than 8 hours (figure 2.8). A significant disparity exists between urban and rural areas. In rural areas, only 10 percent of households receive over 23 hours of hours per day, whereas 44 percent receive less than 8 hours. Conversely, in urban areas, 54 percent of households receive over 23 hours of supply per day, while 9 percent receive less than 8 hours. Regarding evening Availability, nearly three in four households have four hours of electricity in the evening (figure 2.9).

FIGURE 2.8 • Household distribution of daily Availability (over 24 hours)



Source: Original compilation based on 2021 MTF survey results.

FIGURE 2.9 • Household distribution of evening Availability (6–10pm)

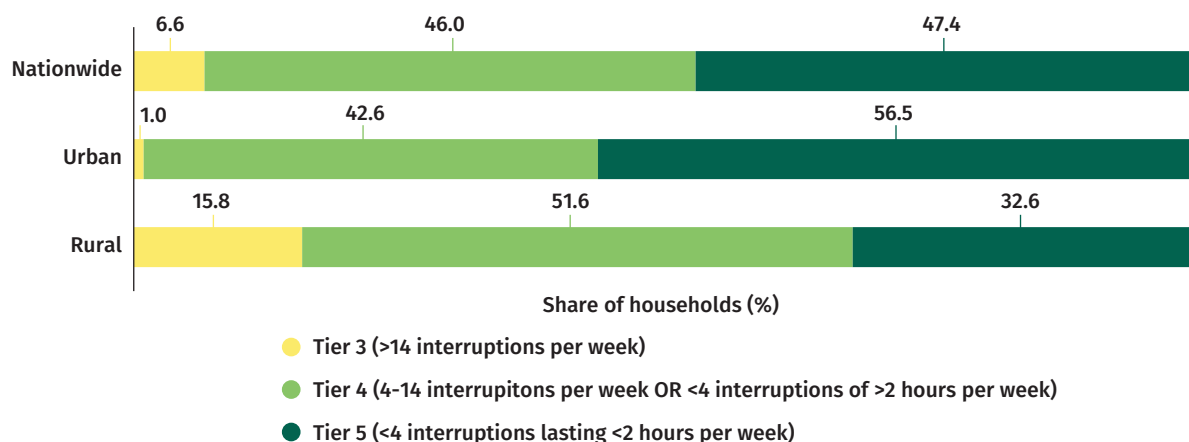


Source: Original compilation based on 2021 MTF survey results.

Reliability

Electricity supply Reliability, assessed based on the frequency and duration of unscheduled outages, is relevant only for households connected to grid or mini-grid systems. In Burundi, more than 50 percent of connected households experience either at least four unscheduled outages per week or outages lasting over two hours per week (figure 2.10). The issue of unreliable electricity supply is particularly pronounced in rural areas.

FIGURE 2.10 • Household distribution of Reliability

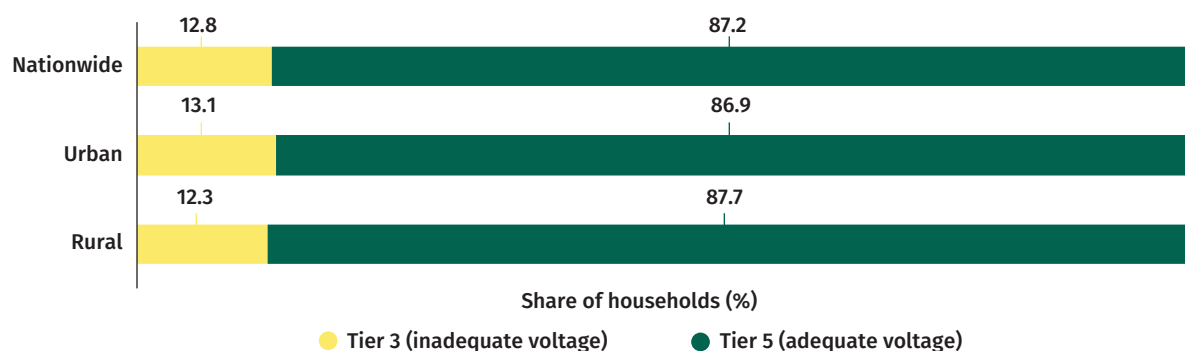


Source: Original compilation based on 2021 MTF survey results.

Quality

The Quality of the electricity supply is assessed based on the prevalence of voltage fluctuations that can lead to appliance damage, and is measured exclusively for households with grid or mini-grid connections. Nationwide, 13 percent of these households report experiencing voltage issues that result in appliance damage (figure 2.11).

FIGURE 2.11 • Household distribution of Quality

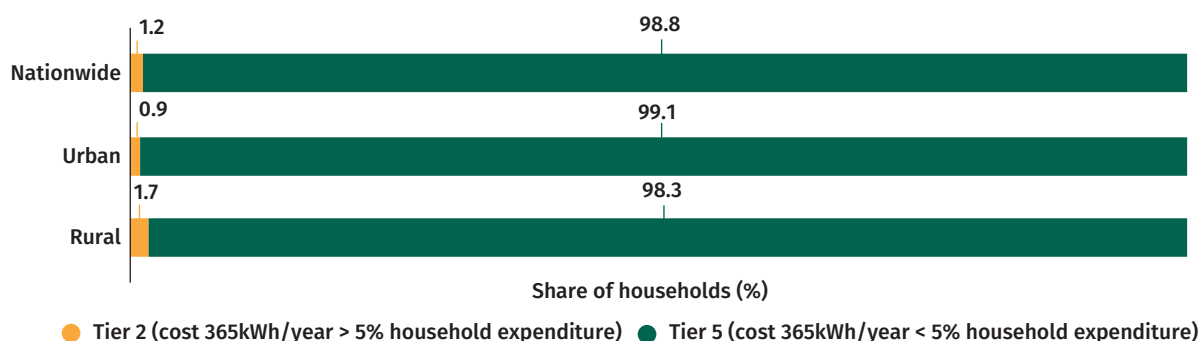


Source: Original compilation based on 2021 MTF survey results.

Affordability

The Affordability of the electricity supply is evaluated by assessing whether the cost of a standard consumption package of 30 kWh per month (or approximately 1 kWh/day) exceeds 5 percent of a household's total expenditure. This attribute is measured only for households connected to the grid or a mini-grid. For nearly all connected households, the annual cost of basic electricity services (corresponding to FBu 29,520 (US\$10.46)¹⁵ for 30 kWh per month)¹⁶ represents less than 5 percent of their total household expenditure (figure 2.12).

FIGURE 2.12 • Household distribution of Affordability



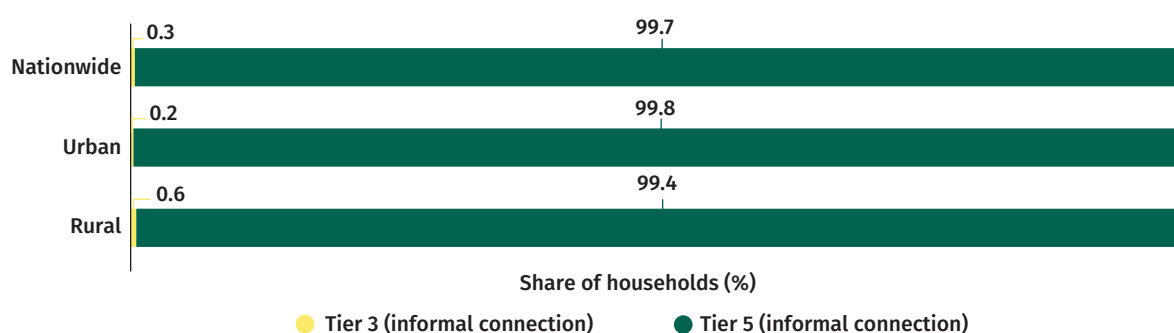
Source: Original compilation based on 2021 MTF survey results.

Note: kWh = kilowatt-hour.

Formality

The Formality of connection refers to whether a household's grid or mini-grid connection was authorized by a governing authority.¹⁷ This attribute applies only to households connected to the grid or a mini-grid. Nationwide, instances of informal connections are minimal. It is estimated that only 0.3 percent of grid- or mini-grid-connected households have an informal connection (figure 2.13).

FIGURE 2.13 • Household distribution of Formality



Source: Original compilation based on 2021 MTF survey results.

¹⁵ Average exchange rate on October 29, 2021: US\$1 = FBu 2,820.89.

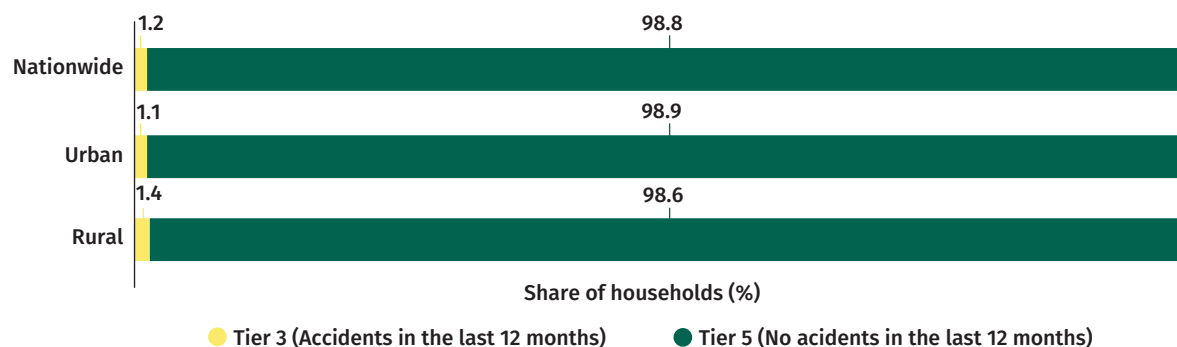
¹⁶ The cost is calculated based on an electricity tariff of FBu 82/kWh.

¹⁷ Accurately assessing the Formality of connection presents a methodological challenge. Respondents may be reluctant to disclose information regarding the legitimacy of their grid connection in a structured survey setting. Consequently, the MTF survey employs indirect questioning techniques to infer Formality. These techniques rely on questions respondents are more likely to answer (such as to whom a household member pays the electricity bill). A connection is classified as informal if no one receives payment for electricity services.

Health and Safety

The Health and Safety attribute is defined as the incidence of electricity-related accidents (including faulty wiring and appliance misuse) resulting in permanent injury or death within the past 12 months. In Burundi, electricity supply from the grid or a mini-grid is considered relatively safe, with 1.2 percent of households reporting such accidents (figure 2.14). Nevertheless, adherence to basic safety practices and compliance with national wiring standards are crucial to minimize risks.

FIGURE 2.14 • Household distribution of Health and Safety

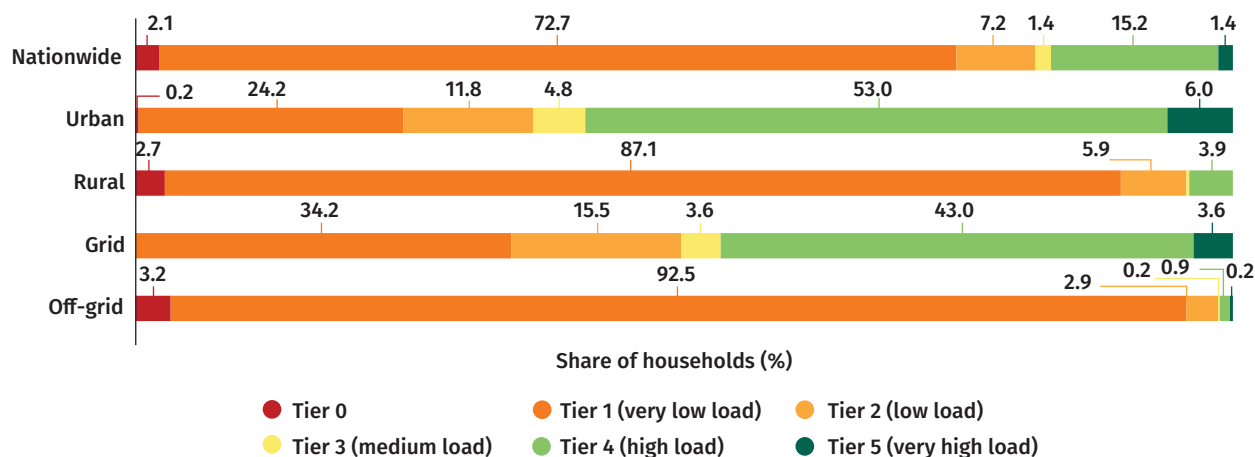


Source: Original compilation based on 2021 MTF survey results.

Appliance ownership

Nationwide, 8 in 10 electrified households use only very low- or low-load appliances (figure 2.15). The share drops to 36 percent in urban areas, while it reaches 96 percent in rural areas. Over half of the electrified households in urban areas uses high-load appliances (mainly electric irons), while in rural areas very high-power appliances (mainly water heaters) are used by a small share of households, even among grid-connected households.

FIGURE 2.15 • Appliance ownership in electrified households, by load level (nationwide, urban/ rural, grid/off-grid)



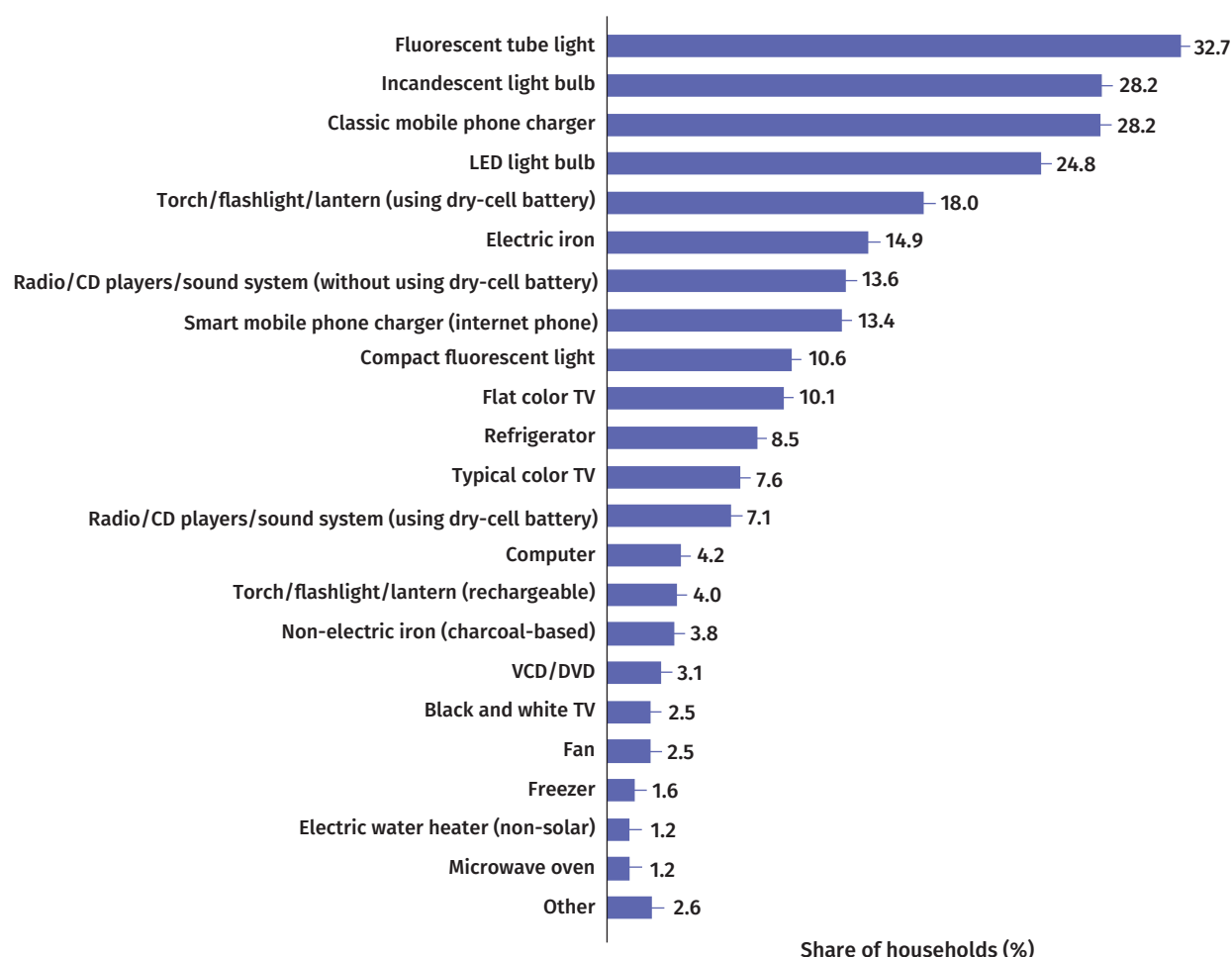
Source: Original compilation based on 2021 MTF survey results.

Notes: Tier 0 = appliances powered with dry-cell batteries; Tier 1 (very low load) = 3–49 W (such as lights, radio, and phone charger); Tier 2 (low load) = 50–199 W (such as fan, television, and computer); Tier 3 (medium load) = 200–799 W (such as refrigerator, freezer, water pump, food processor, sewing machine, kettle, and air cooler); Tier 4 (high load) = 800–1,999 W (such as washing machine, iron, microwave oven, and hair dryer); Tier 5 (very high load) = 2,000+ W (such as air conditioner, space heater, and water heater).

Nationwide, mobile phone charging is the most prevalent use of energy beyond lighting, with 41 percent of electrified households utilizing phone chargers (28 percent using classic mobile phone chargers and 13 percent using smartphone chargers) (figure 2.16). In terms of lighting technology, 33 percent of electrified households use fluorescent tube lights, followed by 28 percent using incandescent light bulbs, 25 percent using like light-emitting diode light bulbs, and 11 percent using compact fluorescent bulbs.

Approximately 18 percent of electrified households use a television (10 percent use a flat-screen television), 15 percent use an electric iron, and 9 percent use a refrigerator. The rest of the powered appliances are owned by less than 5 percent of the households.

FIGURE 2.16 • Appliance ownership in electrified households, by type (nationwide)

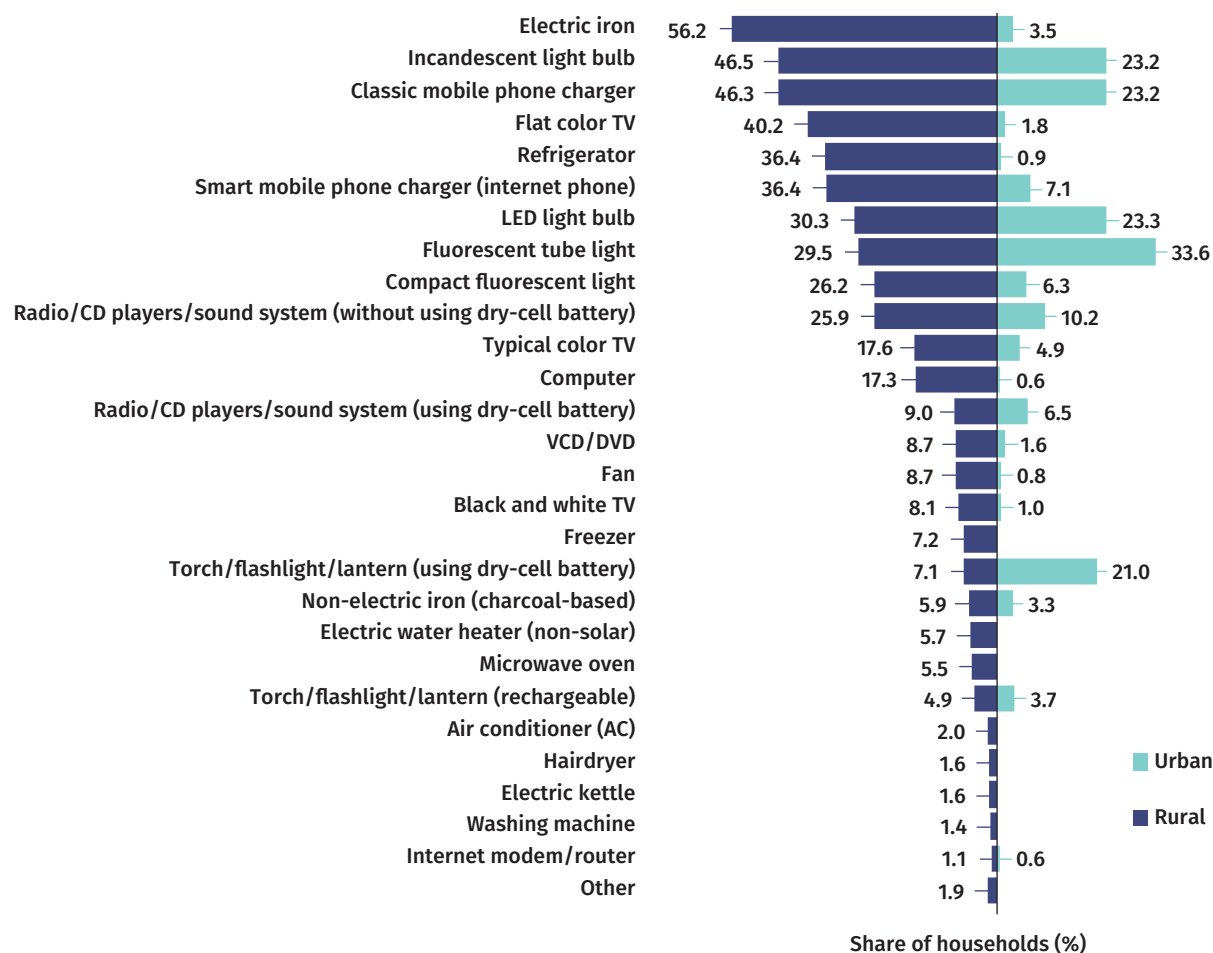


Source: Original compilation based on 2021 MTF survey results.

Notes: Households can own more than one type of light bulb. "Other" includes all appliances owned by less than 1 percent of households nationwide. DVD = digital video disc; LED = light-emitting diode; TV= television; VCD = video compact disc.

Appliance ownership rates demonstrate a significant disparity between urban and rural areas. In urban areas, beyond lighting, the most prevalent appliance among electrified households are phone chargers (83 percent), followed by televisions (66 percent) and electric irons (56 percent) (figure 2.17). Approximately 36 percent of urban households use a refrigerator. In contrast, lighting penetration in electrified rural households is considerably lower than in urban areas. Phone chargers are used by approximately 30 percent of electrified rural households. Television ownership is limited to 8 percent of these households, and ownership rates for other appliances remain low.

FIGURE 2.17 • Appliance ownership in electrified households, by type (urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Notes: Households can own more than one type of light bulb. "Other" includes all appliances owned by less than 1 percent of urban households. DVD = digital video disc; LED = light-emitting diode; TV= television; VCD = video compact disc.

IMPROVING ACCESS TO ELECTRICITY

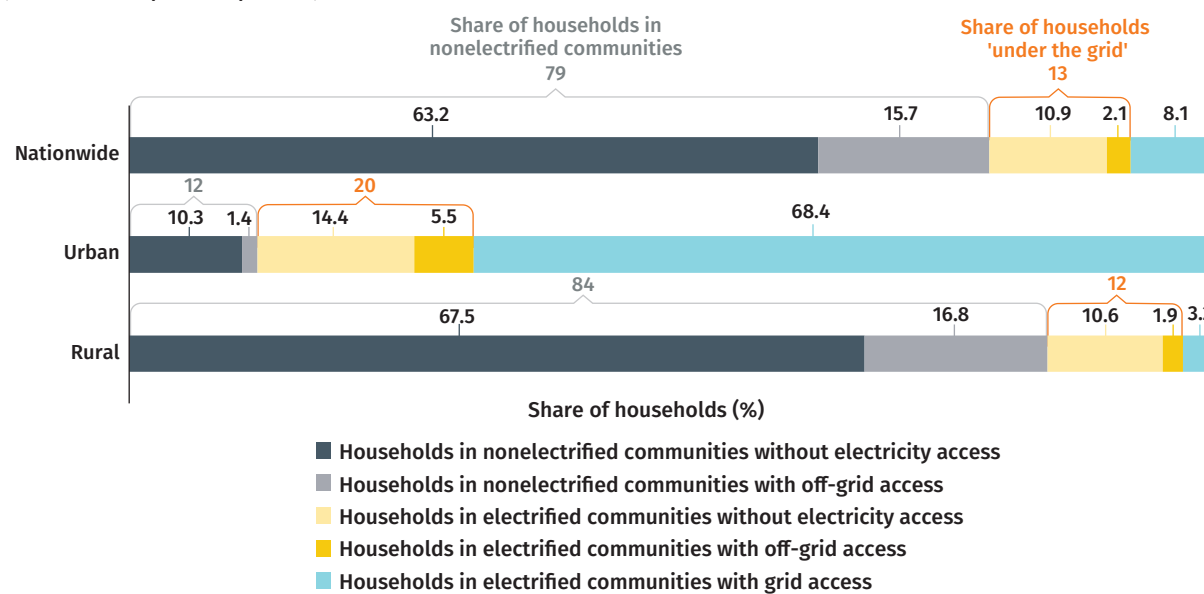
This section analyzes strategies for enhancing household electricity access, categorized by current technology status. For households lacking any electricity source, we examine geographic distribution, expenditure quintile, and reliance on alternative energy sources. We further explore key barriers to grid connection and assess households' willingness to pay (WTP) for grid access. For grid-connected households, we evaluate electricity supply attributes, identify prevalent issues, and measure household satisfaction. Access is analyzed by expenditure quintile, appliance ownership by load level and type, and grid electricity consumption. Off-grid solar households are also examined, focusing on geographic distribution, manufacturer, access tiers by device type, major challenges, satisfaction levels, acquisition methods, and appliance ownership. This comprehensive analysis aims to inform the development of targeted interventions to expand electricity access, improve service quality, and promote sustainable energy solutions.

PROVIDING ELECTRICITY ACCESS TO HOUSEHOLDS WITHOUT A SOURCE OF ELECTRICITY

In Burundi, 74 percent of households lack access to any source of electricity (see figure 2.1). Rural areas experience a disproportionately high deficit, with 78 percent of households lacking electricity compared to 25 percent in urban areas (see figure 2.2). Ten of the eighteen regions exhibit electricity access rates below the national average of 26 percent, and only two regions have a majority of households (>50 percent) with electricity access (see figure 2.3).

Households without access to electricity can be categorized in two groups: those residing “under the grid”—meaning they are located in communities where the grid is available¹⁸—and those residing in communities without grid infrastructure. The share of households without access to electricity that are located “under the grid” is 11 percent (figure 2.18). Conversely, 63 percent of households lacking electricity access live in communities where the grid is unavailable.

FIGURE 2.18 • Electricity access, by technology, in electrified and nonelectrified communities (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

¹⁸ Electrified communities are defined as those located in enumeration areas where at least one household uses grid electricity as its main source of electricity.

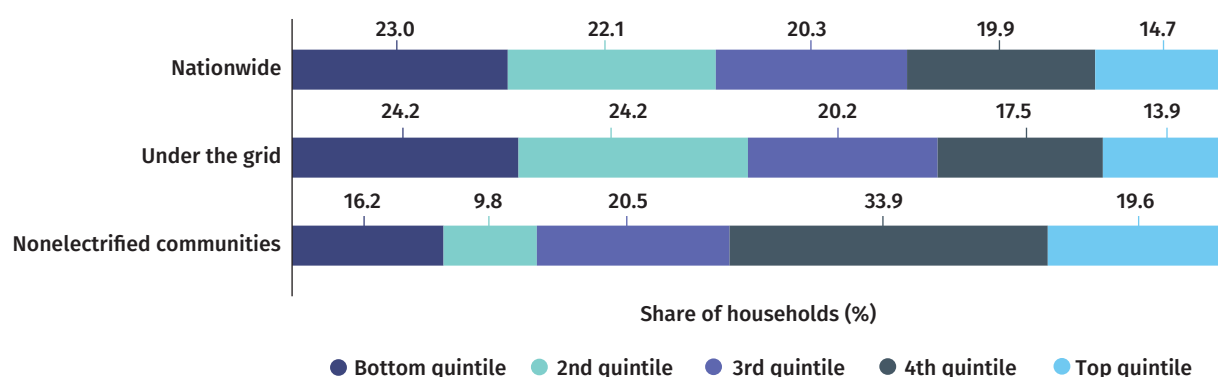
Expenditure quintiles

Households lacking electricity access are disproportionately concentrated in the first and second expenditure quintiles, representing 23 percent and 22 percent, respectively, and underrepresented in the fifth quintile, accounting for 15 percent (figure 2.19). Forty-five percent of the households without electricity access belong to the lowest 40 percent income bracket. Households without access to electricity have an average monthly expenditure of FBu 335,370 (US\$119).

Households without electricity access residing “under the grid” are also disproportionately concentrated within the lowest 40 percent income bracket, representing 48 percent, and underrepresented in the fourth and fifth quintiles, accounting for 18 percent and 14 percent, respectively.

Conversely, households without access in nonelectrified communities are more heavily concentrated in the wealthiest 40 percent of the population, comprising 54 percent. The average monthly household expenditure for households without access in electrified areas is FBu 390,942 (US\$139), while for those in unelectrified areas, it is FBu 324,353 (US\$115). In contrast, households with grid access exhibit a significantly higher average monthly expenditure of FBu 1,003,896 (US\$356).

FIGURE 2.19 • Households without electricity access, by expenditure quintile (nationwide, under the grid, nonelectrified communities)

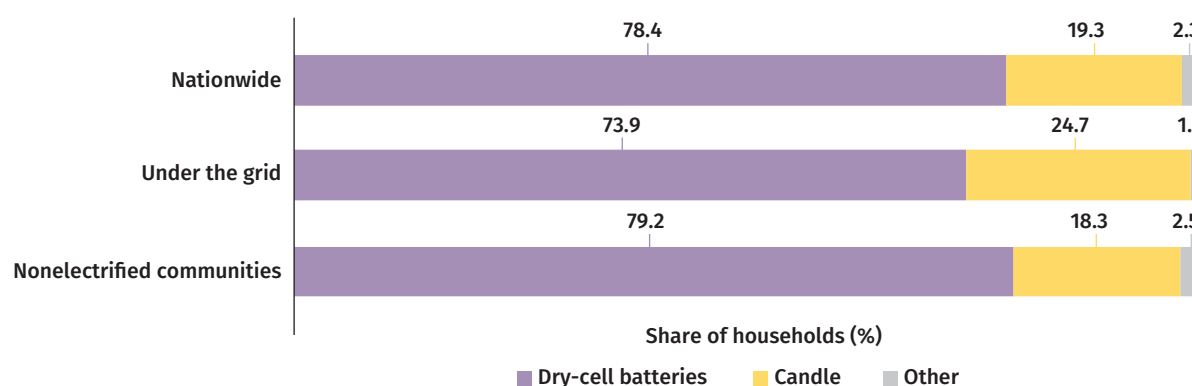


Source: Original compilation based on 2021 MTF survey results.

Alternative energy sources

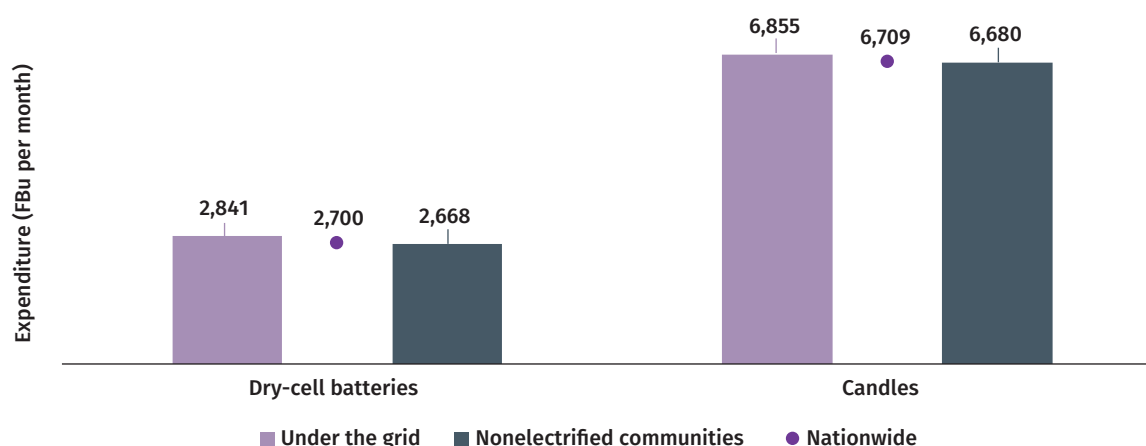
Households lacking electricity access rely on coping mechanisms for lighting, with 78 percent using dry-cell batteries, and 19 percent using candles (figure 2.20). These households spend an average of FBu 3,711 (US\$1.2) per month on alternative lighting sources—FBu 2,700 (US\$0.96) on dry-cell batteries and FBu 6,709 (US\$2.38) on candles (figure 2.21).¹⁹ The average monthly expenditure on alternative lighting is FBu 3,936 (US\$1.40) for “under the grid” households without electricity and FBu 3,662 (US\$1.30) for those in nonelectrified communities. If this spending was on grid electricity, it would provide approximately 45 kWh per month (based on the current tariff of FBu 82 (US\$ 0.03)).

FIGURE 2.20 • Alternative energy sources used for lighting by households without electricity access (nationwide, under the grid, nonelectrified communities)



Source: Original compilation based on 2021 MTF survey results.

FIGURE 2.21 • Monthly spending on alternative energy sources for lighting by households without electricity access (nationwide, under the grid, nonelectrified communities)



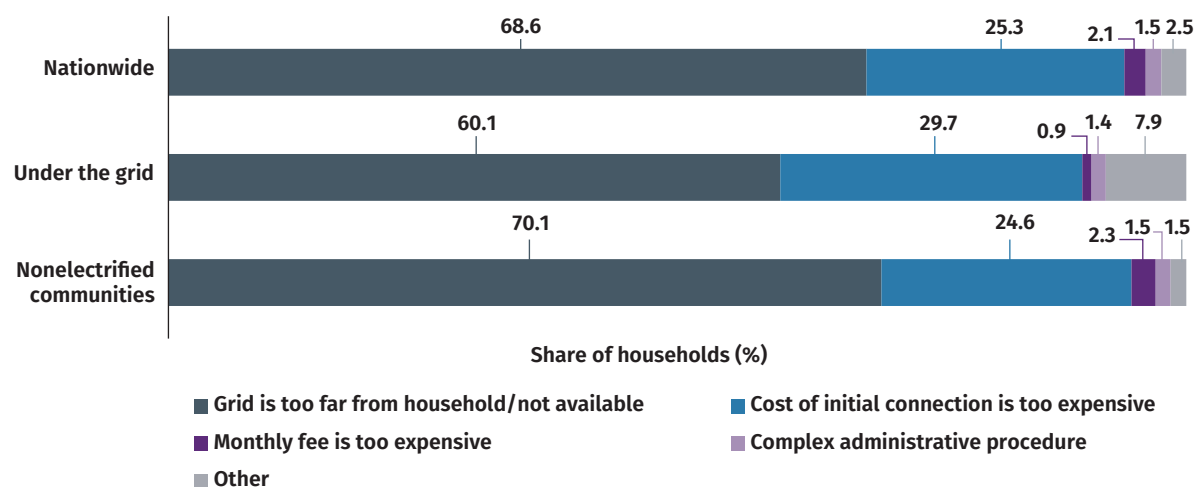
Source: Original compilation based on 2021 MTF survey results.

¹⁹ Median values for all cost values are lower than the mean values (from 1.5 to 2.5 times).

Main barriers to accessing the grid

Nationwide, 69 percent of households cite the lack of grid availability as the main reason for not being connected (figure 2.22). This share remains at 60 percent within electrified communities. Approximately 30 percent of households without electricity access who reside “under the grid” report that the connection fee is prohibitively expensive, preventing them from connecting. This reason is cited by 25 percent of households in nonelectrified communities. The utility charges FBu 492,000 (US\$174.41) for a grid connection (REGIDESO data for 2021).²⁰

FIGURE 2.22 • Reasons for not being connected to the grid, as reported by households without electricity access (nationwide, under the grid, nonelectrified communities)



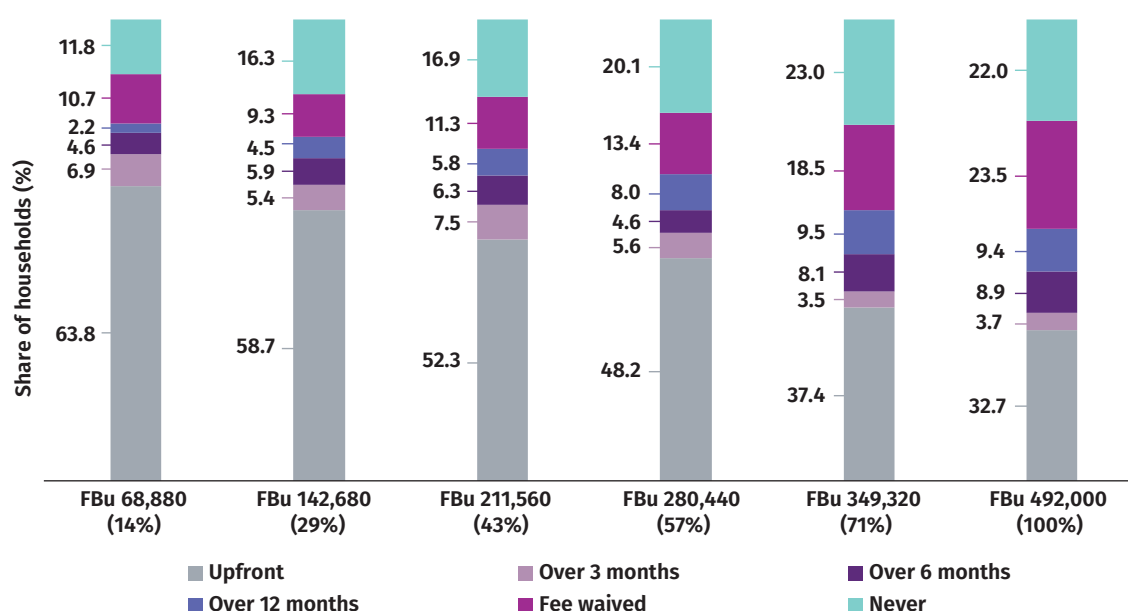
Source: Original compilation based on 2021 MTF survey results.

²⁰ The cost refers to a monophasic connection and includes a single-phase counter, materials (cables and other accessories), and labor.

Willingness to pay

Approximately 33 percent of households without grid connections express a WTP the current connection fee of FBu 492,000 (US\$174.41) up front, while an additional 22 percent would opt for flexible payment plans spanning 3, 6, or 12 months (figure 2.23). A significant increase in WTP is observed with a reduced connection fee of FBu 68,880 (US\$24.42), with 64 percent of households indicating they would pay up front and an additional 14 percent opting for payment plans. The primary reasons cited for unwillingness to pay under any scenario are the cost of internal wiring and the perceived unaffordability of the monthly electricity tariff.

FIGURE 2.23 • Willingness to pay for a grid connection fee: Households without a grid connection



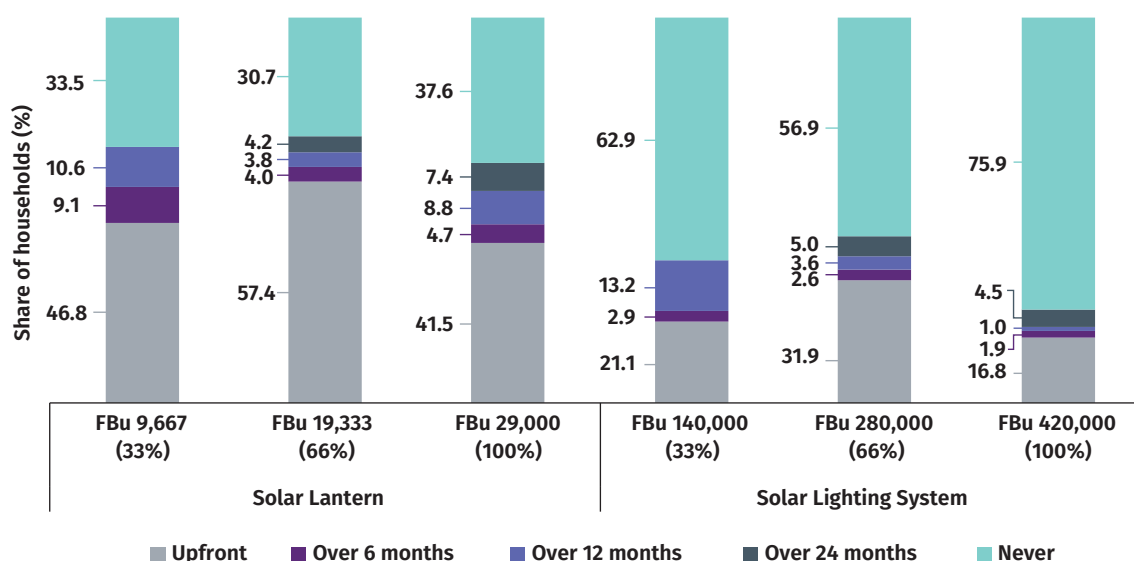
Source: Original compilation based on 2021 MTF survey results.

Notes: Households without a grid connection include households with no electricity access and households with off-grid access. FBu = Burundian Franc.

Households without electricity access exhibit a lower WTP for solar devices compared to grid connections, particularly for solar lighting systems.²¹ Specifically 42–57 percent of these households are willing to pay up front for a solar lantern²² priced between FBu 10,000 (US\$3.54) and FBu 30,000 (US\$10.63) (figure 2.24). An additional 10–20 percent, depending on the price, would opt for flexible payment plans over 3, 6, or 12 months. The WTP for solar lighting systems is substantially lower. Up-front payment is acceptable for 17 percent to 32 percent of households, depending on the price point, and up to 16 percent would consider payment over time.

²¹ The solar lighting system presented in the WTP module is a 6-watt Biolite 620+, achieving Tier 1 capacity. This system includes three hanging lights, a USB charge-out port, and an integrated MP3/FM radio (see annex 2).

²² The solar lantern presented in the WTP module is the d.Light A2, a compact and lightweight device with an integrated 0.3-watt solar panel (see annex 2). It provides four hours of illumination at 30 lumens, which is three times brighter than a kerosene lamp, meeting Tier 1 capacity standards.

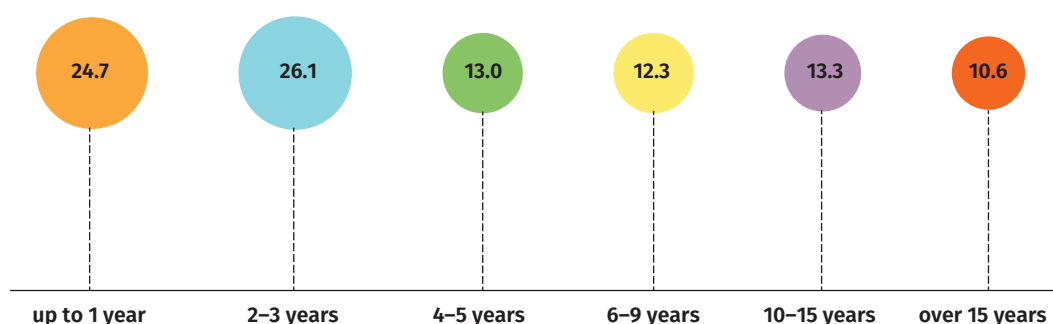
FIGURE 2.24 • Willingness to pay for a solar device: Households without electricity access

Source: Original compilation based on 2021 MTF survey results.

Note: FBu = Burundian Franc.

IMPROVING ELECTRICITY ACCESS AMONG GRID-CONNECTED HOUSEHOLDS

Grid electrification in Burundi is a relatively recent phenomenon. Nationwide, over 50 percent of grid-connected households had obtained their connection within the three years preceding the survey,²³ while less than 25 percent had been connected for 10 or more years (figure 2.25). Rural electrification is even more recent; nearly 70 percent of households had connected within the preceding three years.

FIGURE 2.25 • Share of households by numbers of years using the grid (nationwide)

Source: Original compilation based on 2021 MTF survey results.

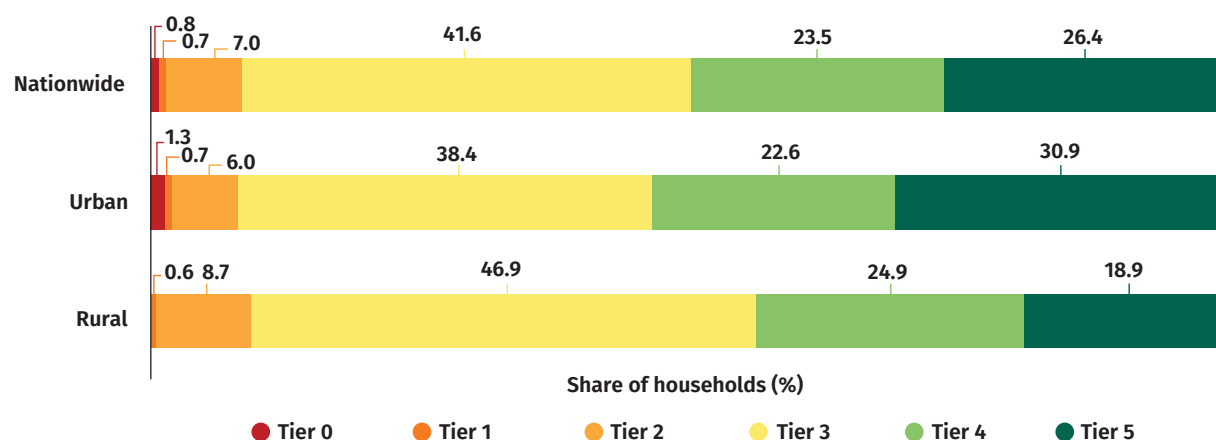
Approximately 21 percent of households are connected via ready boards, 74 percent utilize internal wiring, and the remaining 5 percent employ a combination of both. Electricity meters are present in 89 percent of grid-connected households, with 85 percent of these being prepaid meters. Furthermore, 39 percent of households share their electricity meter with other households, with this practice being more prevalent in urban areas (43 percent) than in rural areas (29 percent).

²³ The MTF survey was conducted in November–December 2021.

Tiers of electricity access

There is potential for improvement in grid electricity service for 74 percent of households that do not achieve Tier 5 (figure 2.26). Over 50 percent of grid-connected households are classified as Tier 3 or below, with 9 percent falling into Tier 2 or below. Based on this tier distribution, the nationwide MTF index score for grid-connected households is 73.1 out of 100, with urban areas scoring 74.6 and rural areas scoring 70.6.²⁴

FIGURE 2.26 • MTF tier distribution of grid-connected households (nationwide, urban, rural)



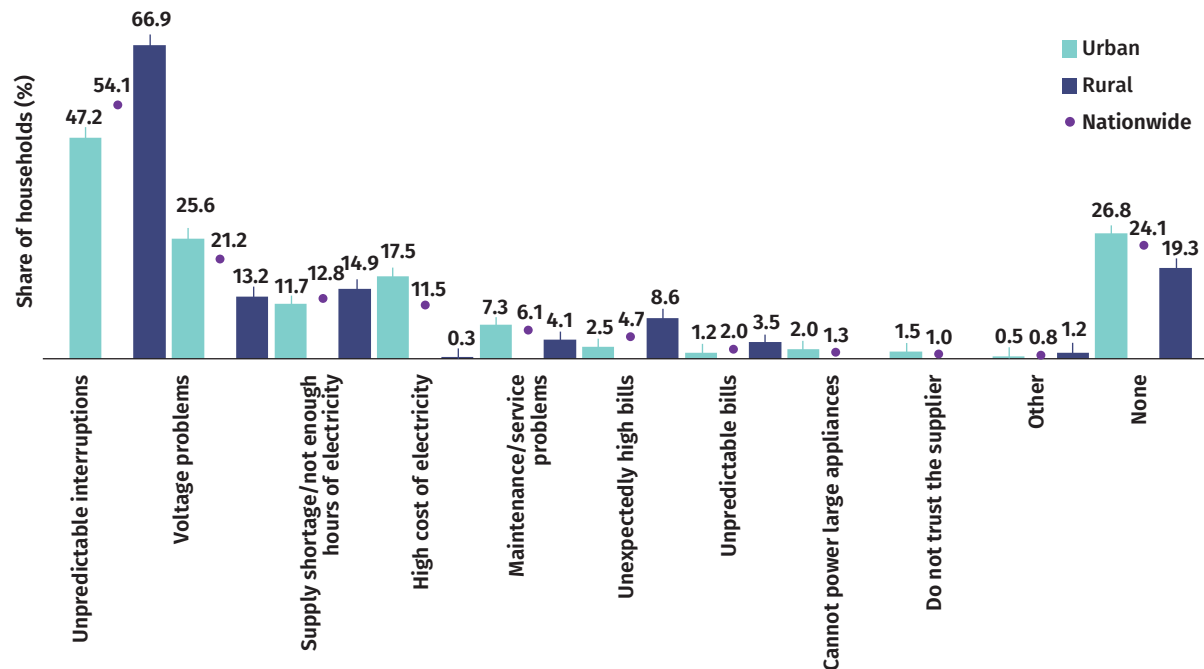
Source: Original compilation based on 2021 MTF survey results.

Main issues with grid electricity supply

Only 24 percent of grid-connected households report no issues with their electricity supply; this figure decreases to 19 percent for rural households (figure 2.27). Nationwide, 54 percent of households report unpredictable interruptions, and 21 percent experience voltage issues. Rural households are significantly more likely to report unscheduled interruptions. Despite these challenges, approximately 78 percent of grid-connected households express satisfaction with their grid electricity supply (figure 2.28), with rural areas reporting an 81 percent satisfaction rate.

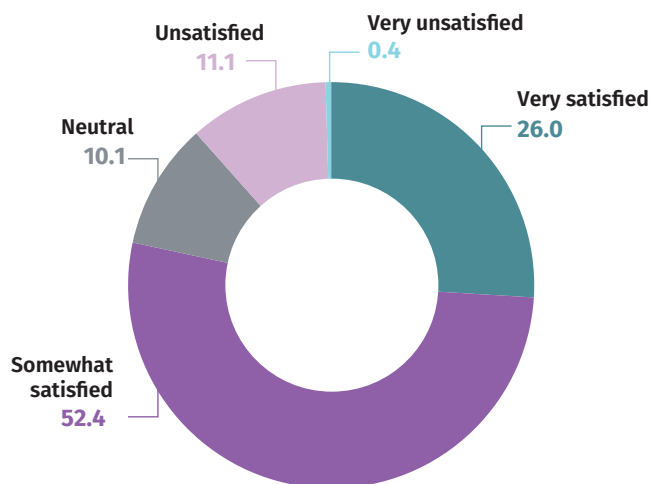
²⁴ The MTF index is calculated by assigning weights to the tiers and then determining a weighted average. This process is as follows: $\sum (20 \cdot P_k \cdot k)$, where k is tier number (0 to 5) and P_k the proportion of households at the K_m tier.

FIGURE 2.27 • Main issues with grid electricity supply (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

FIGURE 2.28 • Service satisfaction levels of grid-connected households (nationwide)



Source: Original compilation based on 2021 MTF survey results.

Attributes of electricity supply

Availability of electricity supply could be improved for 44 percent of grid-connected households that receive less than 23 hours of electricity per day (figure 2.29). Most of those households receive between 16 and 23 hours of electricity per day. Increasing evening supply to at least four hours per day for 31 percent of urban households and 36 percent of rural households would represent a significant improvement (figure 2.30).

FIGURE 2.29 • Distribution of grid-connected households: Daily Availability

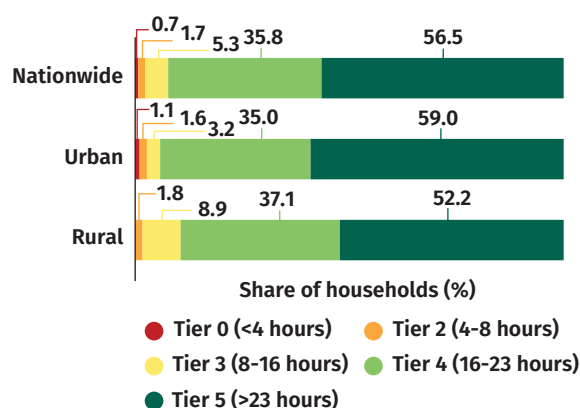
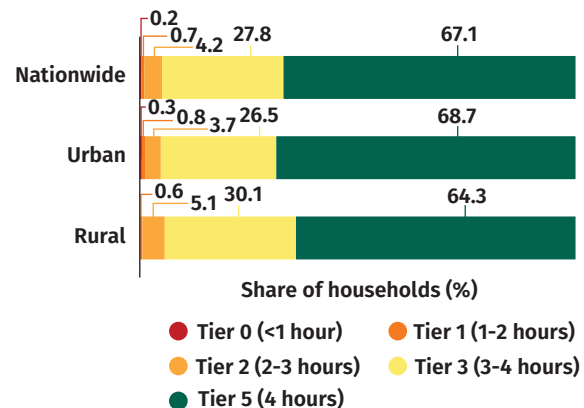


FIGURE 2.30 • Distribution of grid-connected households: Evening Availability



Source: Original compilation based on 2021 MTF survey results.

Reliability of supply could be improved for 53 percent of grid-connected households (figure 2.31). In rural areas, the share rises to 69 percent of households, with 16 percent experiencing more than 14 interruptions per week and 53 percent experiencing between 4 and 14 interruptions per week. Voltage issues affect approximately 12 percent of households (figure 2.32).

FIGURE 2.31 • Distribution of grid-connected households: Reliability

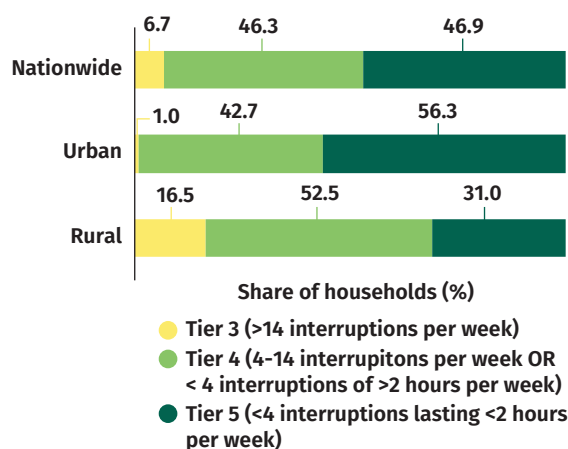
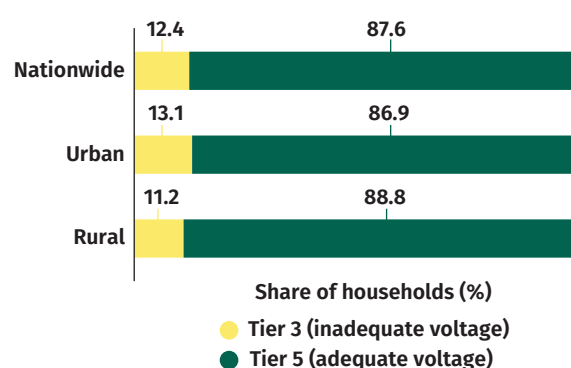


FIGURE 2.32 • Distribution of grid-connected households: Quality



Source: Original compilation based on 2021 MTF survey results.

Formality of connection is not a significant concern for nearly all grid-connected households (figure 2.33). Health and Safety issues, specifically permanent injury or death due to the electricity system, are reported by less than 2 percent of grid-connected households (figure 2.34). However, approximately 16 percent of households nationwide report exposed or uninsulated wiring, with this figure rising to 34 percent in rural areas.

FIGURE 2.33 • Distribution of grid-connected households: Formality

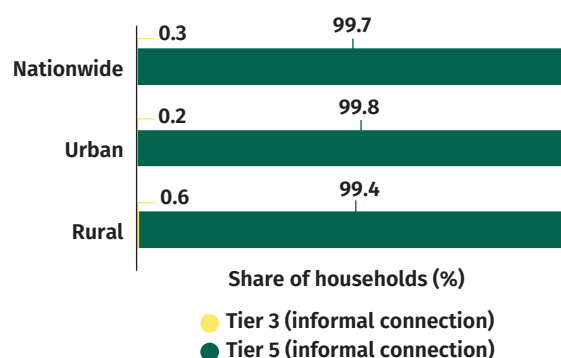
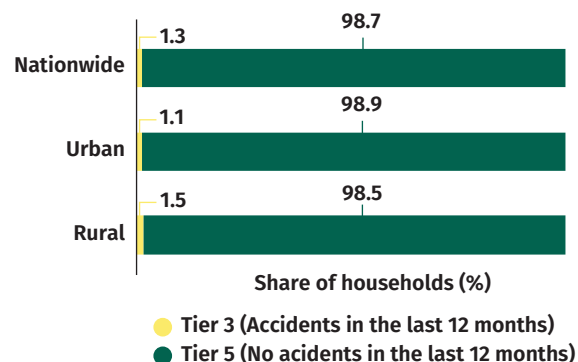


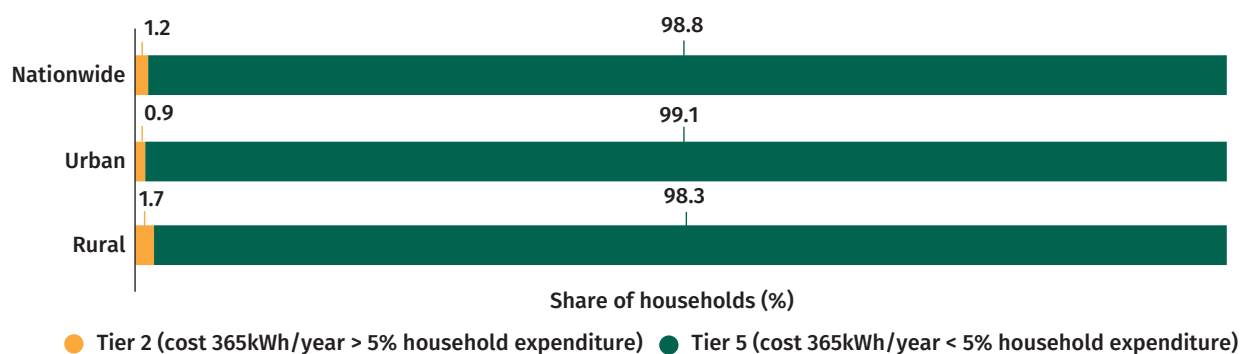
FIGURE 2.34 • Distribution of grid-connected households: Health and Safety



Source: Original compilation based on 2021 MTF survey results.

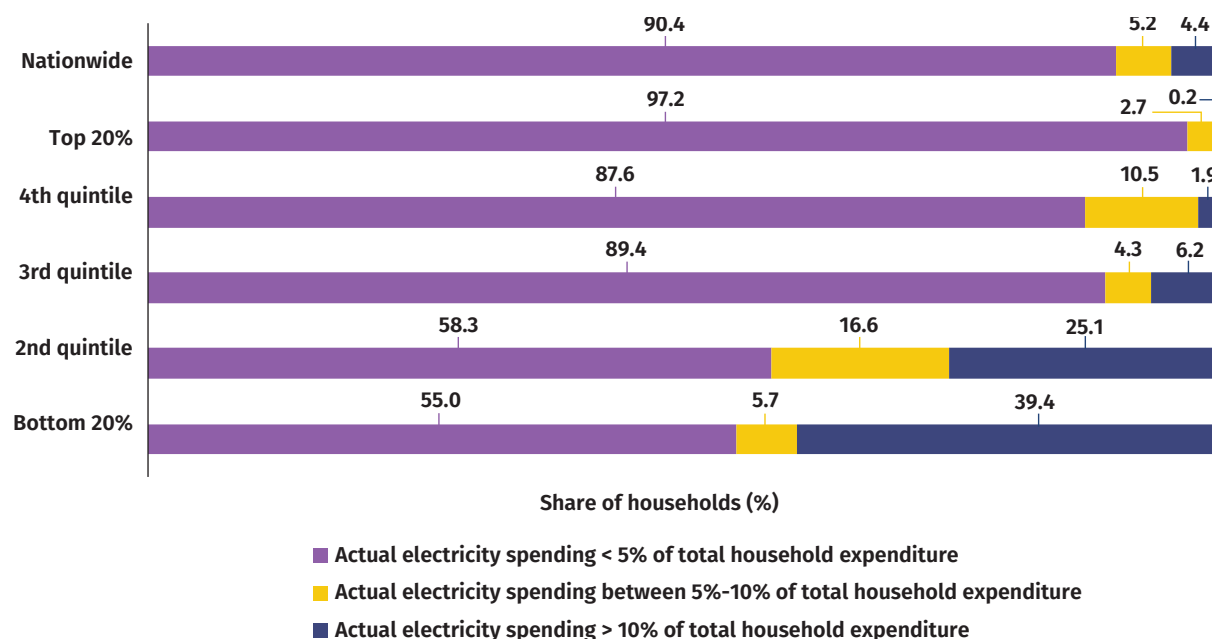
Affordability, as defined by the MTF (see annex 1), is a concern for only 1 percent of grid-connected households (figure 2.35). However, when considering actual electricity expenditure as a share of total household expenditure, approximately 10 percent of grid-connected households spend 5 percent or more of their total household expenditure (figure 2.36). This expenditure burden is disproportionately higher for lower expenditure quintiles. Specifically, 45 percent of households in the bottom quintile spend 5 percent or more of their household expenditure on electricity, compared with only 3 percent in the top quintile.

FIGURE 2.35 • Distribution of grid-connected households: Affordability



Source: Original compilation based on 2021 MTF survey results.

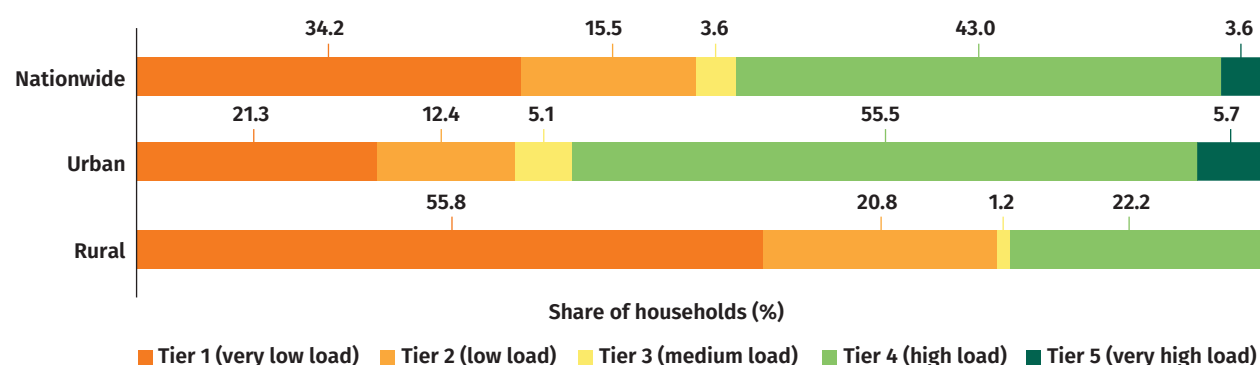
Note: kWh = kilowatt-hour.

FIGURE 2.36 • Distribution of grid-connected households, by share of electricity expenditure in total household expenditure (nationwide, by quintile)

Source: Original compilation based on 2021 MTF survey results.

Ownership of appliances

Nationwide, 47 percent of grid-connected households use high- or very high-load appliances (figure 2.37). Conversely, 34 percent use only very low-load appliances, with this share reaching 56 percent in rural areas. Consequently, these households are not fully leveraging the capacity of the grid, resulting in underutilization.

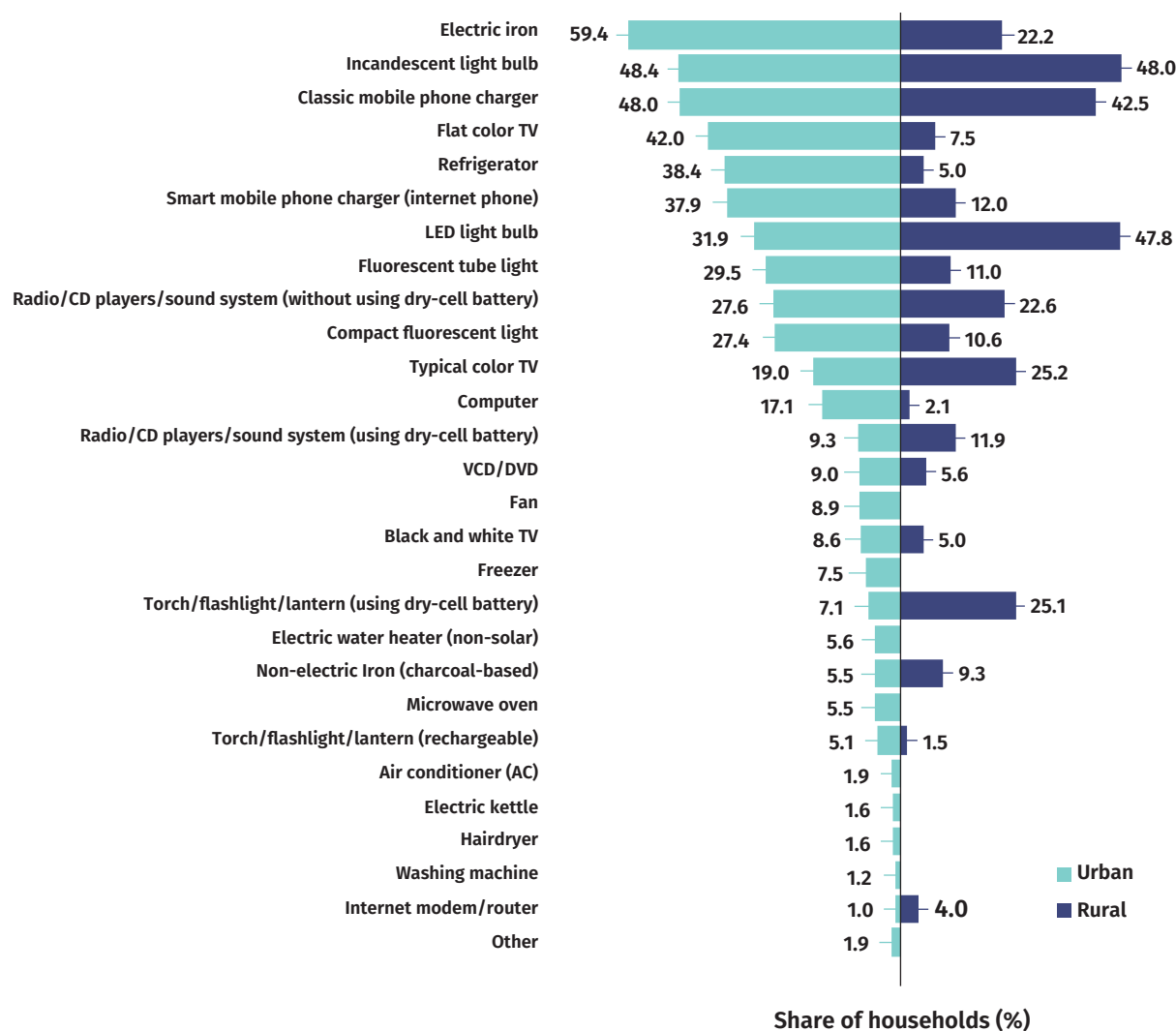
FIGURE 2.37 • Ownership of appliances in grid-connected households, by load level (nationwide, urban, rural)

Source: Original compilation based on 2021 MTF survey results.

Notes: Tier 1 (very low load) = 3–49 W (such as lights, radio, and phone charger); Tier 2 (low load) = 50–199 W (such as fan, television, and computer); Tier 3 (medium load) = 200–799 W (such as refrigerator, freezer, water pump, food processor, sewing machine, kettle, and air cooler); Tier 4 (high load) = 800–1,999 W (such as washing machine, iron, microwave oven, and hair dryer); Tier 5 (very high load) = 2,000+ W (such as air-conditioner, space heater, and water heater).

Nationwide, the top three appliances (beyond lighting) owned by grid-connected households are mobile phone chargers (86 percent in urban areas and 55 percent in rural areas), televisions (70 percent in urban areas and 38 percent in rural areas), and electric irons (59 percent in urban areas and 22 percent in rural areas) (figure 2.38). Urban and rural households show different ownership rates. The biggest gaps appear for electric irons, refrigerators, and televisions.

FIGURE 2.38 • Appliance ownership in grid-connected households, by type (urban, rural)



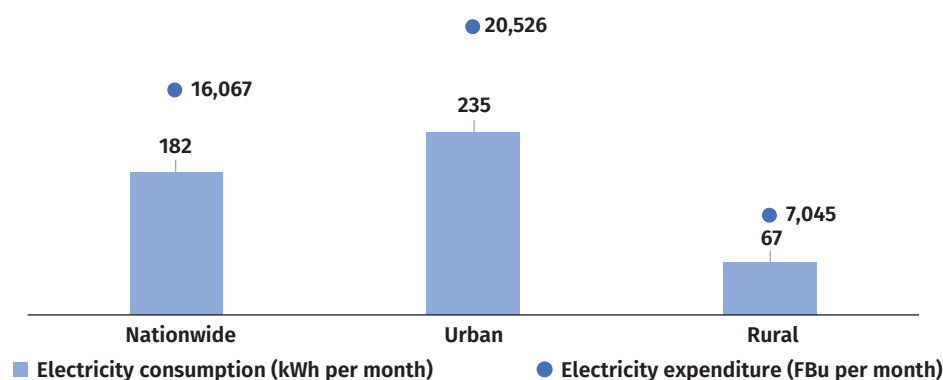
Source: Original compilation based on 2021 MTF survey results.

Notes: Households can own more than one type of light bulb. "Other" includes all appliances owned by less than 1 percent of grid-connected households. DVD = digital video disc; LED = light-emitting diode; TV= television; VCD = video compact disc.

Consumption of grid electricity

In Burundi, grid-connected households consume an average of 182 kWh of electricity per month (figure 2.39). Urban households exhibit significantly higher consumption, using 3.5 times more electricity than their rural counterparts. The average monthly electricity bill for grid-connected households is FBu 16,067 (US\$5.70).

FIGURE 2.39 • Monthly electricity consumption and expenditure of grid-connected households (nationwide, urban, rural)

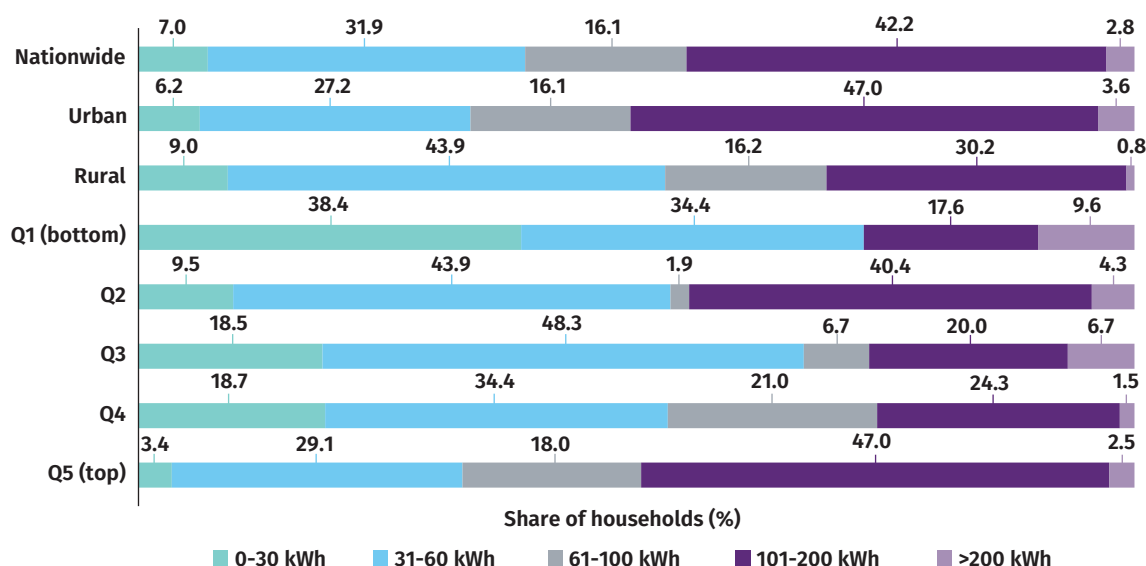


Source: Original compilation based on 2021 MTF survey results.

Notes: kWh = kilowatt-hour; FBu = Burundian Franc.

Nationwide, 39 percent of grid-connected households consume up to 60 kWh per month (figure 2.40). Urban households are likely to have higher consumption levels than rural households. Furthermore, electricity consumption correlates positively with household wealth. In the lowest expenditure quintile, 27 percent of grid-connected households consume over 100 kWh per month, while in the highest quintile the share reaches nearly 50 percent.

FIGURE 2.40 • Distribution of grid-connected households: Monthly electricity consumption (nationwide, urban, rural, by quintile)

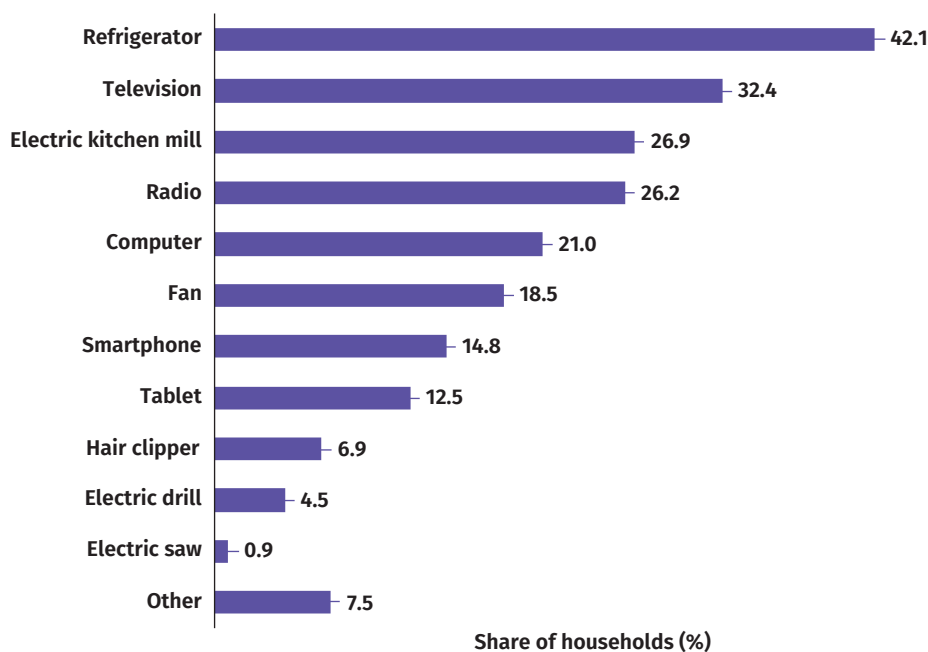


Source: Original compilation based on 2021 MTF survey results.

Note: kWh = kilowatt-hour.

Among grid-connected households, the most desired appliance is a refrigerator (42 percent), followed by a television (32 percent), and an electric kitchen mill (27 percent), closely followed by a radio (figure 2.41).

FIGURE 2.41 • Desired appliances in grid-connected households, by type



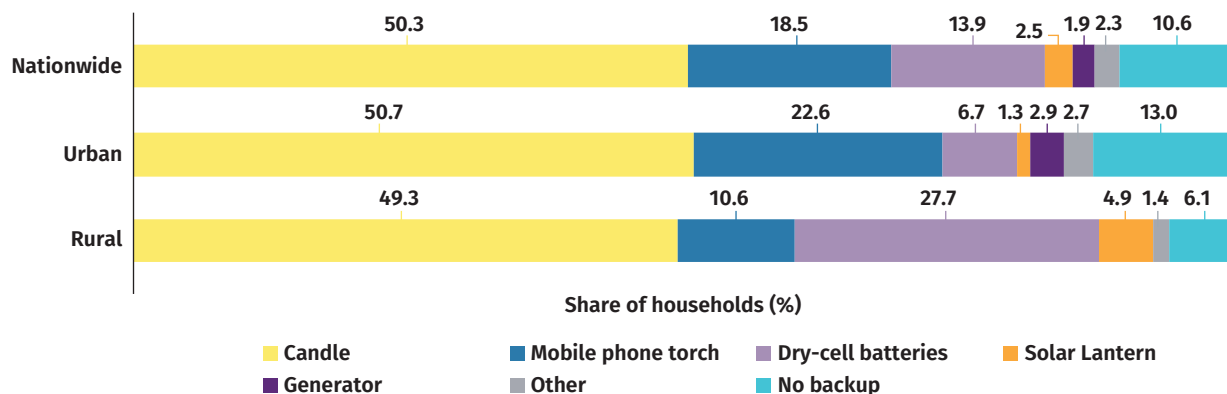
Source: Original compilation based on 2021 MTF survey results.

Note: Up to three answers by household possible.

Backup energy sources

The vast majority (89 percent) of grid-connected households use backup sources of energy for lighting (figure 2.42). The most common backup source is candles (50 percent) followed by mobile phone torches (18 percent) and dry-cell batteries (14 percent).

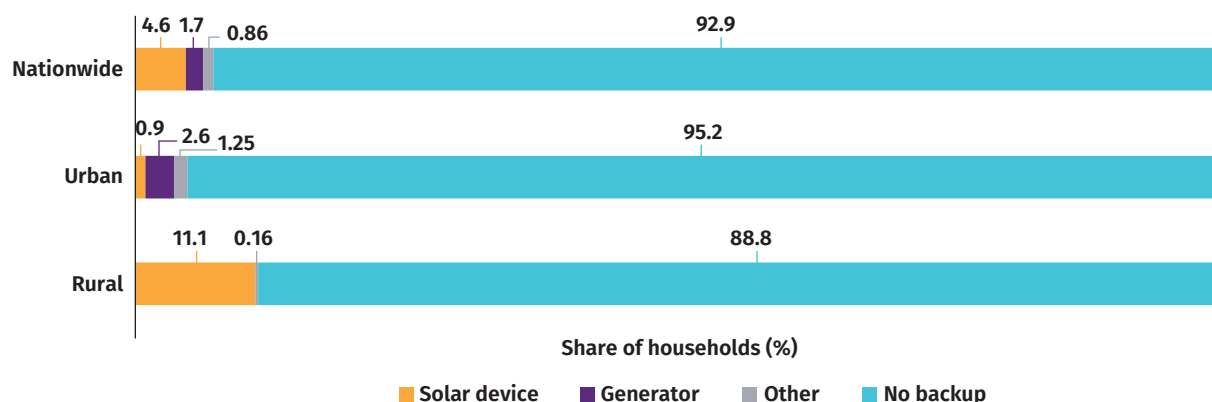
FIGURE 2.42 • Main backup energy source for lighting used by grid-connected households (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Only 7 percent of grid-connected households use backup sources of electricity for appliance operation (figure 2.43), with nearly 5 percent using solar devices.

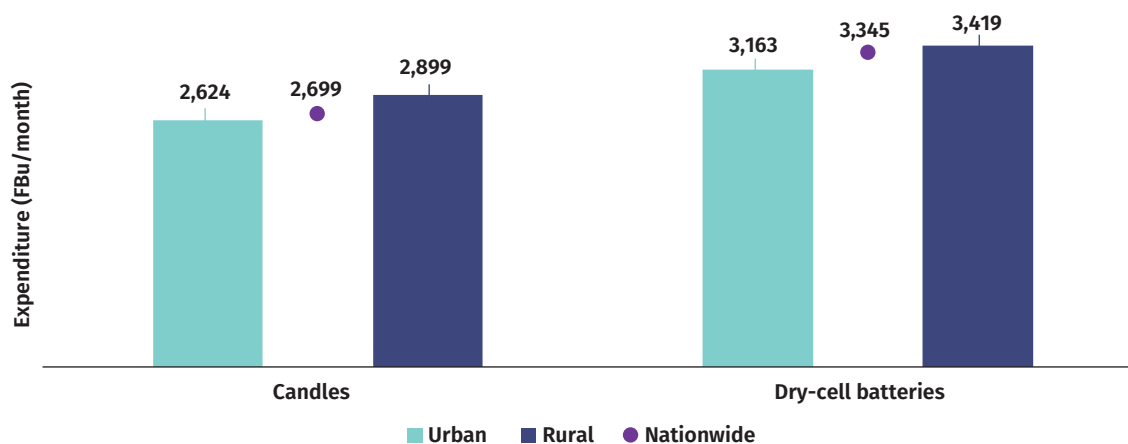
FIGURE 2.43 • Main backup energy source for appliances used by grid-connected households (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Grid-connected households spend an average of FBu 3,341 (US\$1.18)²⁵ per month on backup solutions for lighting, mainly candles and dry-cell batteries (figure 2.44). On average, urban households spend FBu 3,253 (US\$1.15) per month while rural households spend FBu 3,483 (US\$1.23). If spent on grid electricity, this amount would deliver on average 41 kWh per month to each household (40 kWh to urban households and 42 kWh to rural households).²⁶

FIGURE 2.44 • Grid-connected households' monthly spending on backup solutions for lighting (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Note: FBu = Burundian Franc.

²⁵ However, the median amount is FBu 1,500 (US\$0.53).

²⁶ Based on the current electricity tariff of FBu 82 (US\$0.03).

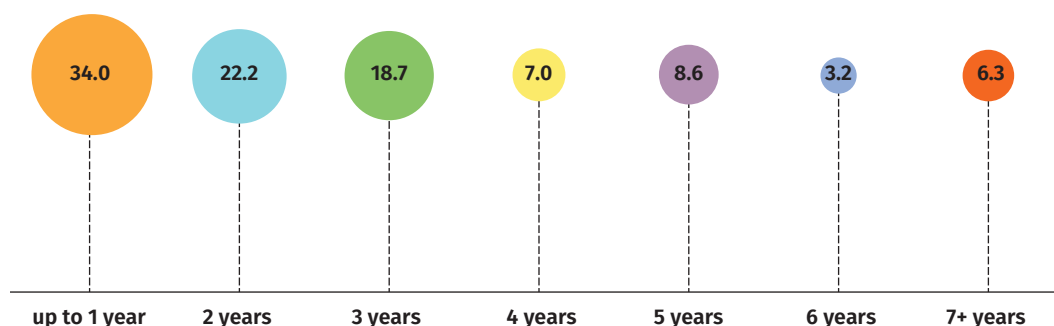
IMPROVING ELECTRICITY ACCESS AMONG HOUSEHOLDS USING OFF-GRID SOLUTIONS AS THEIR MAIN ELECTRICITY SOURCE

In Burundi, 18 percent of households use off-grid solutions as their main source of electricity (see figure 2.1). Of these households, 93 percent use solar devices. The remaining households rely on rechargeable batteries or mini-grids. Consequently, this subsection focuses on households using off-grid solar solutions as their main electricity source.²⁷

The adoption of off-grid solar devices in Burundi is a recent trend. Among households relying on solar devices as their primary electricity source, over 75 percent acquired their devices within the preceding three years, with 34 percent acquiring them within the preceding 12 months (figure 2.45). Only 9 percent of these households purchased their solar devices six or more years before the survey.

Off-grid solutions are integral to the government's electricity access targets, serving as both interim measures preceding grid expansion and as long-term solutions. According to projections outlined in Burundi's 2024 strategy for achieving universal electricity access by 2030, mini-grids will cover approximately 30 percent of demand, the national grid two-thirds, and stand-alone solar systems the rest.

FIGURE 2.45 • Share of households using a solar device, by years of ownership

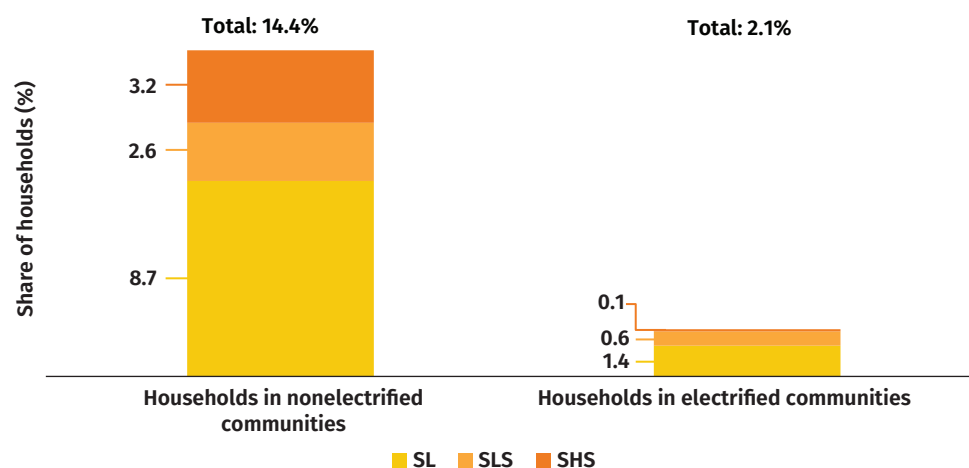


Source: Original compilation based on 2021 MTF survey results.

Solar lanterns are the most prevalent off-grid solar devices, serving as the primary electricity source for 10 percent of households. This is followed by solar lighting systems (SLSs) and solar home systems (SHSs), each used by 3 percent of households. In rural areas, 19 percent of households rely on off-grid solar solutions as their main electricity source, compared to 7 percent in urban areas (figure 2.2). Solar lanterns are the most widely used off-grid solar device in both urban and rural settings.

Approximately 86 percent of solar off-grid households reside in nonelectrified communities, with the remaining households residing in communities with grid electricity (figure 2.46). Solar lanterns are the most popular device in both types of communities. SLSs demonstrate higher penetration rates in electrified areas, while SHSs are more commonly found in nonelectrified areas.

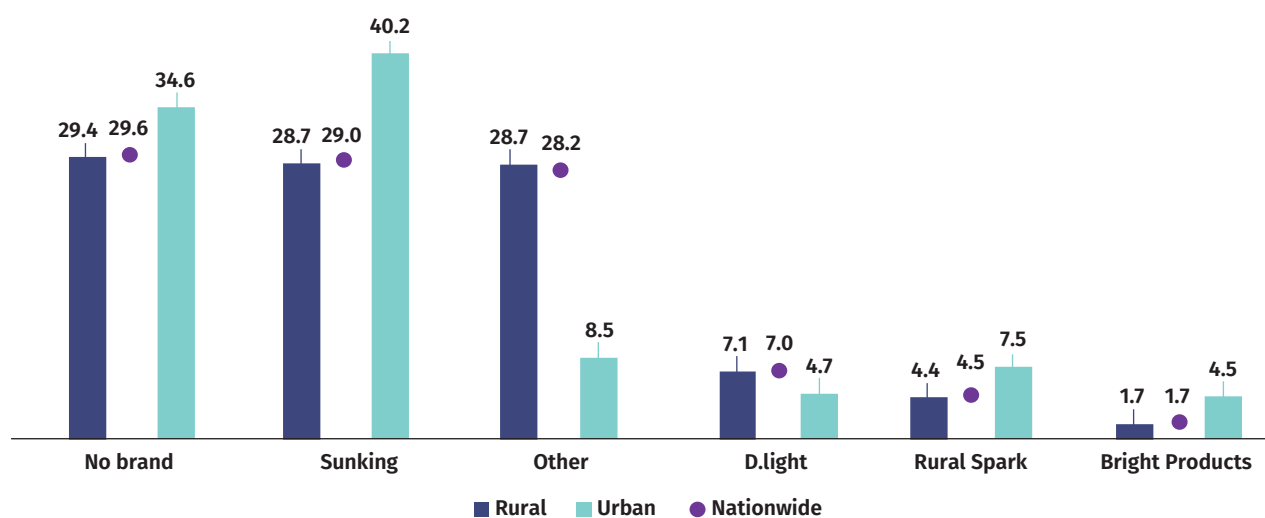
²⁷ The term "off-grid solar households" is used for households that use a solar device as their main source of electricity.

FIGURE 2.46 • Access to off-grid solar solutions, by technology, in electrified and nonelectrified communities (nationwide)

Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SL = solar lantern; SLS = solar lighting system.

Nationwide, approximately 30 percent of households primarily rely on unbranded solar devices, while another 29 percent use Sun King devices (figure 2.47). Brands like d.light and Rural Spark have lower market penetration.

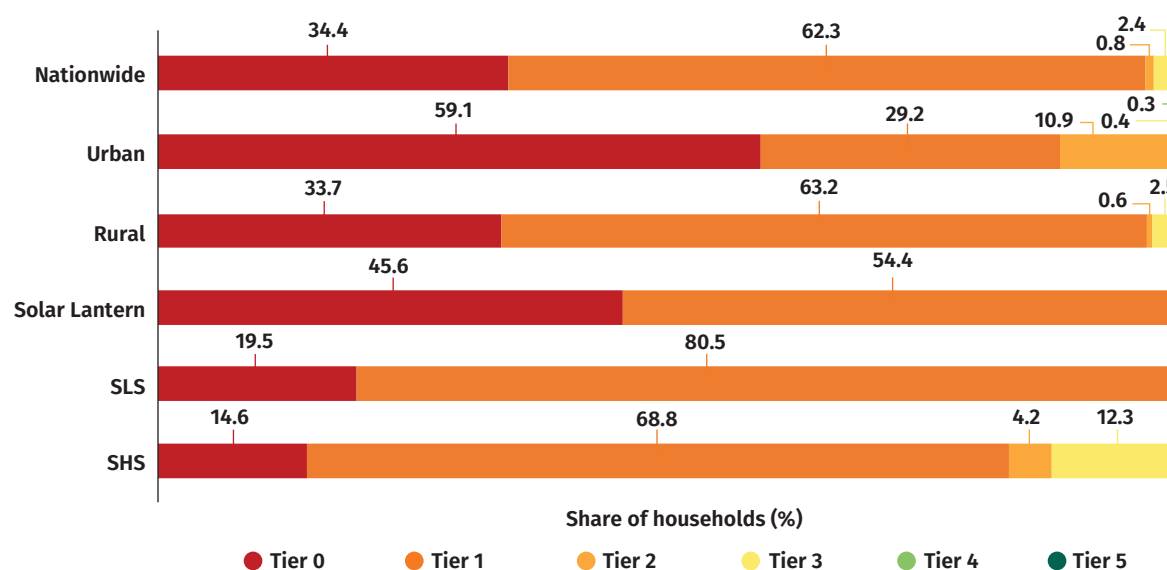
FIGURE 2.47 • Access to off-grid solar solutions, by brand

Source: Original compilation based on 2021 MTF survey results.

Tiers of electricity access

Nationwide, most off-grid solar households are classified as Tier 1 (62 percent), while approximately 34 percent are classified as Tier 0 (figure 2.48). In urban areas, the share of Tier 0 devices rises to over 59 percent. Based on this tier distribution, the nationwide MTF index for off-grid solar households is 14.3 out of 100.²⁸

FIGURE 2.48 • MTF tier distribution, by solar off-grid solution (nationwide, urban, rural)



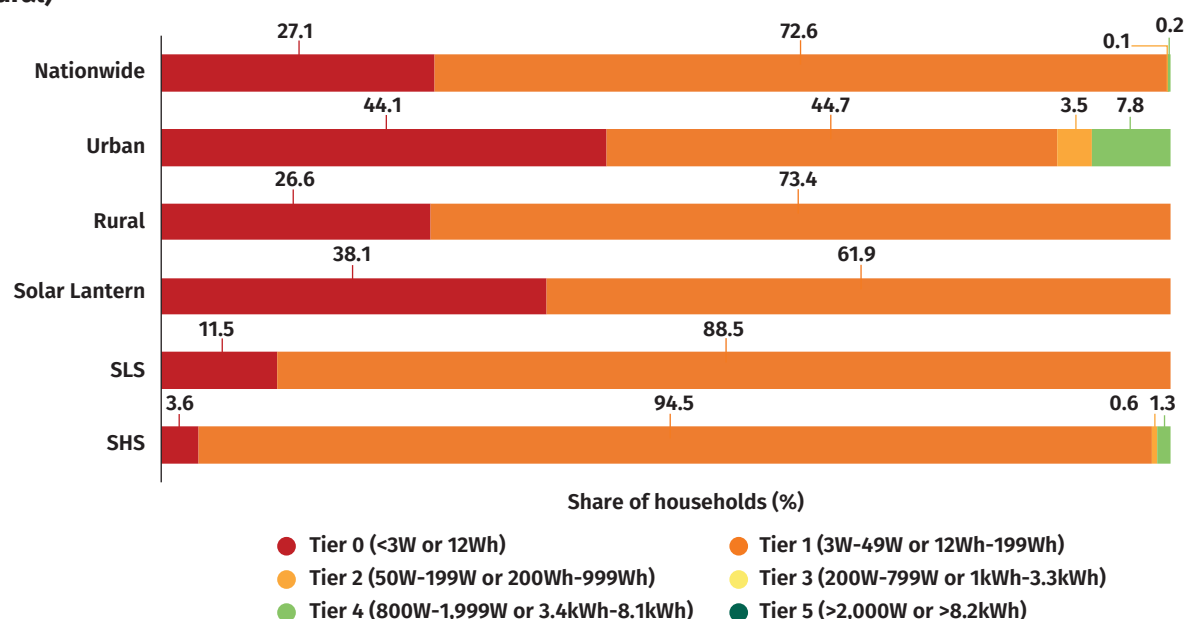
Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SLS = solar lighting system.

Attributes of electricity supply

Nationwide, 27 percent of off-grid solar devices have a Capacity below 3 watts (or 12 watt-hours), with the rest falling primarily in Tier 1 (between 12 kWh and 199Wh) (figure 2.49). In urban areas, the Capacity of 44 percent of off-grid solar devices is classified as Tier 0. Only a small share (2 percent) of SHSs achieve a Capacity level above Tier 2 (over 200 W or 1,000 kWh), and these are exclusively found in urban areas.

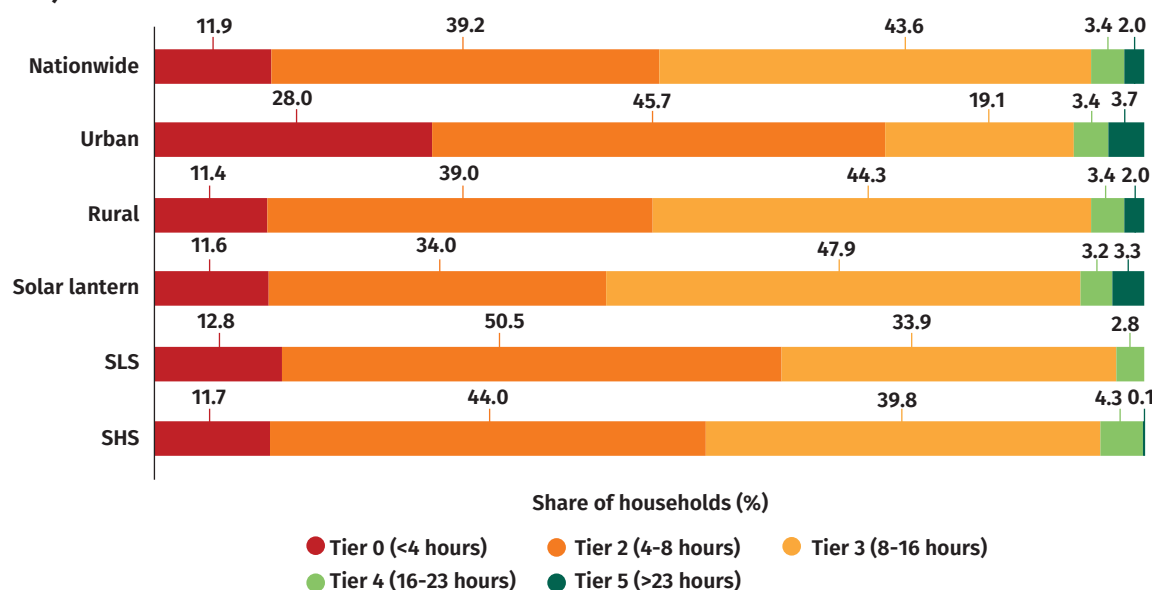
²⁸ The MTF index is calculated by weighting the tiers and arriving at a weighted average, as follows: $\sum (20 \cdot P_k \cdot k)$, where k is the tier number (0 to 5) and P_k the proportion of households at the k tier.

FIGURE 2.49 • Distribution of households using off-grid solar device: Capacity (nationwide, urban, rural)

Source: Original compilation based on 2021 MTF survey results.

Notes: kWh = kilowatt-hour; SHS = solar home system; SLS = solar lighting system; W = watt; Wh = watt-hour.

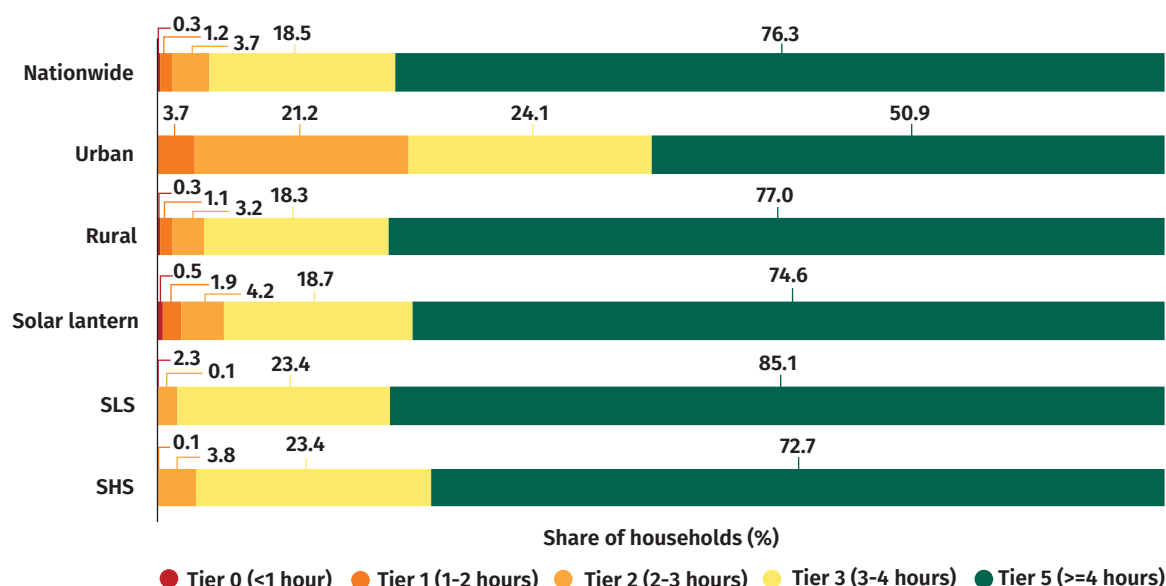
Approximately 51 percent of off-grid solar households receive up to 8 hours of electricity supply per day, and the majority of the remainder receive between 8 and 16 hours (figure 2.50). Solar lanterns demonstrate comparatively better performance than SLSs and SHSs. Over 75 percent of off-grid solar households receive at least four hours of electricity in the evening; however, this figure decreases to 51 percent in urban areas (figure 2.51).

FIGURE 2.50 • Distribution of households using off-grid solar device: Daily Availability (over 24 hours)

Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SLS = solar lighting system.

FIGURE 2.51 • Distribution of households using off-grid solar device: Evening Availability (6–10pm) (nationwide, urban, rural)



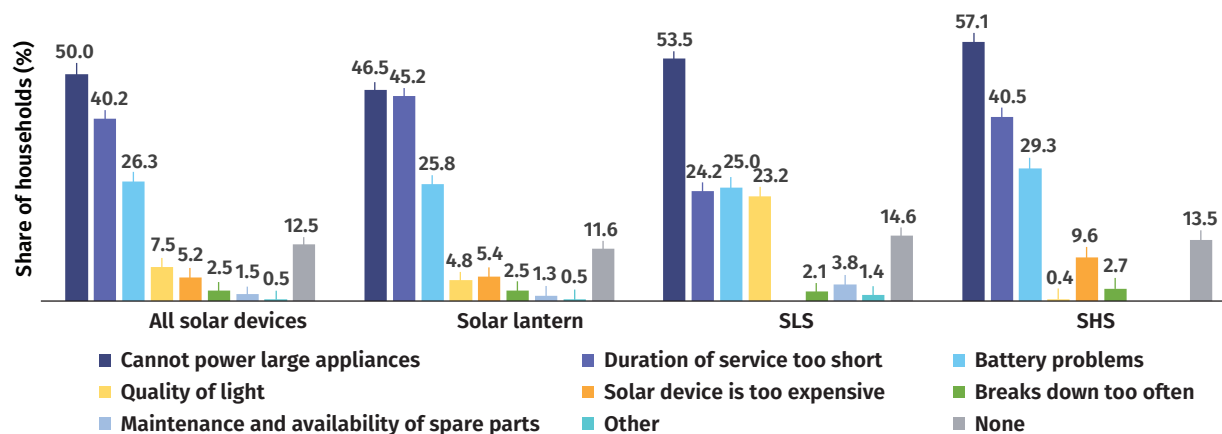
Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SLS = solar lighting system.

Main issues with off-grid solar solutions

The most frequently reported issue with solar devices, across all device types, is the inability to power large appliances (figure 2.52). Service duration is the second-most-common concern, followed by battery-related problems.

FIGURE 2.52 • Most serious issue with main solar device (nationwide)

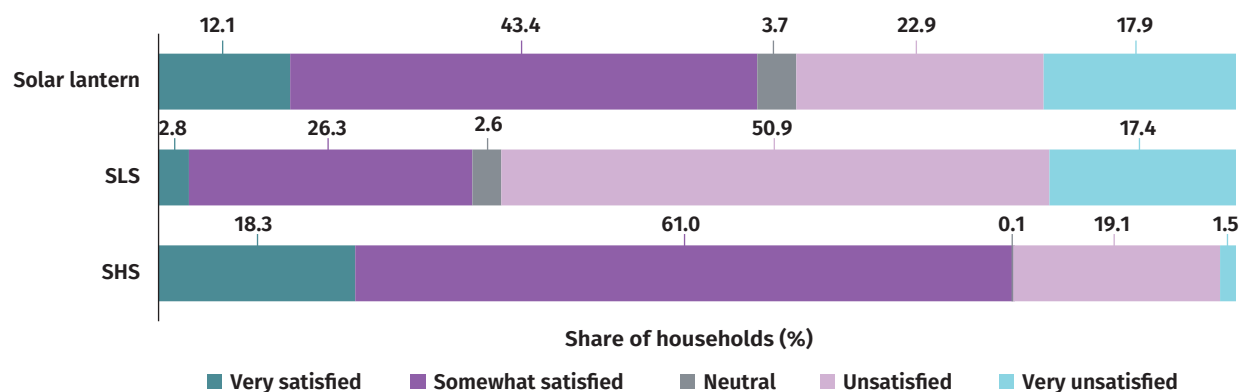


Source: Original compilation based on 2021 MTF survey results.

Note: Up to two answers per household.

Approximately 54 percent of off-grid solar households express satisfaction with their primary solar device. Satisfaction levels vary significantly by device type. Households using solar lanterns and SLSs report lower satisfaction rates, at 56 percent and 29 percent, respectively, compared to users of SHSs, who report a satisfaction rate of 79 percent (figure 2.53).

FIGURE 2.53 • Share of off-grid solar households by satisfaction level (nationwide, urban, rural)

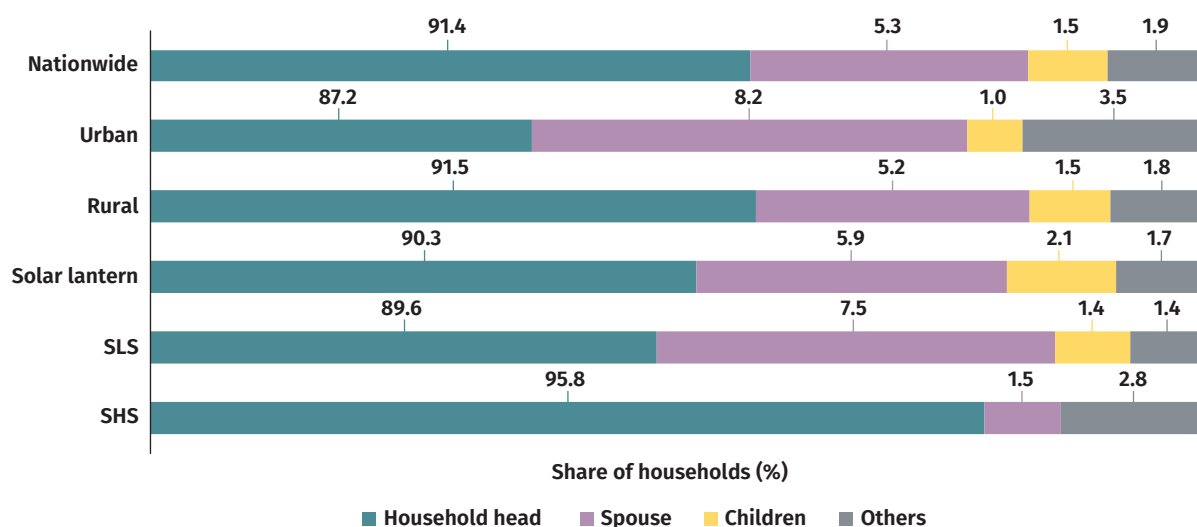


Source: Original compilation based on 2021 MTF survey results.

Acquisition method

In 91 percent of households, the solar device was purchased by the head of the household (figure 2.54). This figure decreases slightly to 87 percent in urban areas. SHSs are more frequently purchased by the head of the household (96 percent) compared to SLSs and solar lanterns (both 90 percent).

FIGURE 2.54 • Distribution of off-grid solar households, by household member who made the purchase decision (nationwide, urban, rural)

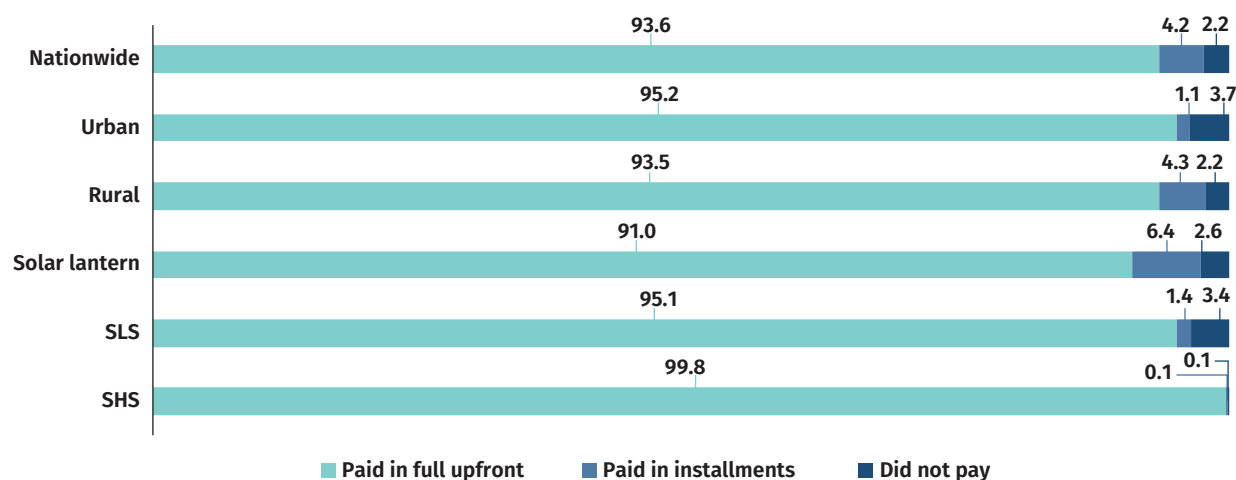


Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SLS = solar lighting system.

Approximately 97 percent of off-grid solar households purchased their main device, while 3 percent received it for free, primarily (87 percent) from a relative or friend. Of those who purchased their devices, 95 percent paid in full up front, and 4 percent paid in installments, primarily through a fixed fee arrangement (figure 2.55). Only 14 percent of households obtained a device with a warranty, allowing exchange or repair in case of malfunction.

FIGURE 2.55 • Distribution of off-grid solar households by acquisition method (nationwide, urban, rural)



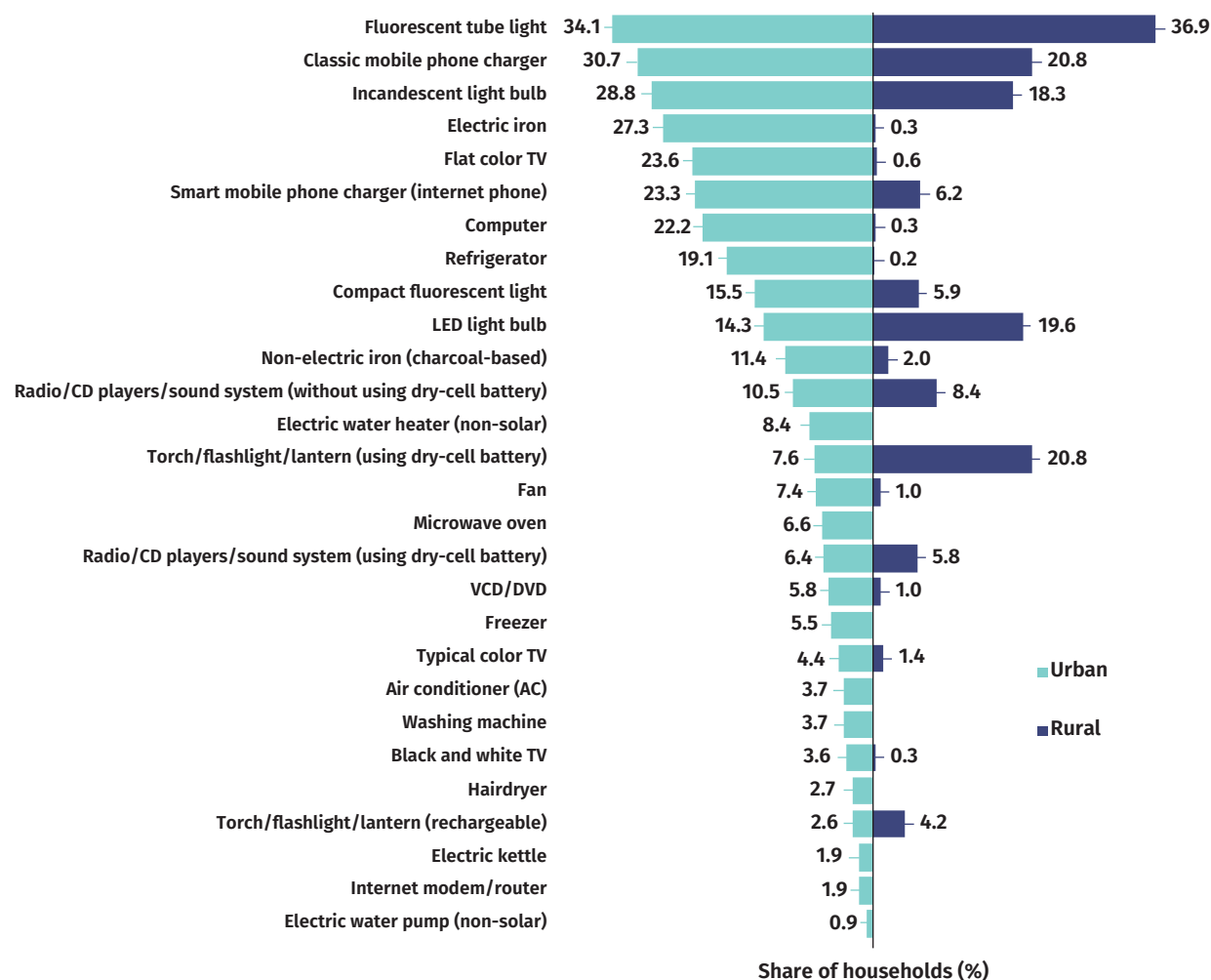
Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SLS = solar lighting system.

Ownership of appliances

The most frequently used appliance, beyond lighting, among off-grid solar households is a mobile phone charger, used by 28 percent of households (54 percent of urban households and 27 percent of rural households) (figure 2.56). The second-most-popular appliance is a radio (without dry-cell batteries), used by 8 percent of households. While urban households represent only 12 percent of all off-grid solar households, they exhibit higher usage rates for several additional appliances: televisions (32 percent), electric irons (27 percent), computers (22 percent), and refrigerators (19 percent).

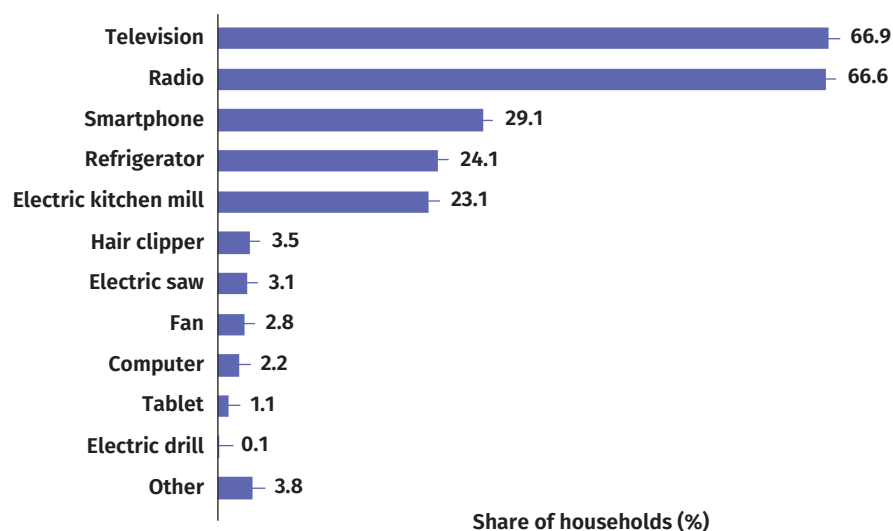
FIGURE 2.56 • Appliances used by off-grid solar households, by share and type (urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Notes: DVD = digital video disc; LED = light-emitting diode; TV= television; VCD = video compact disc.

All off-grid solar households expressed a desire to power additional appliances (currently not owned) with their solar devices. The most commonly desired appliances are televisions (67 percent) and radios (67 percent), followed by smartphones (29 percent), refrigerators (24 percent), and electric kitchen mills (23 percent) (figure 2.57).

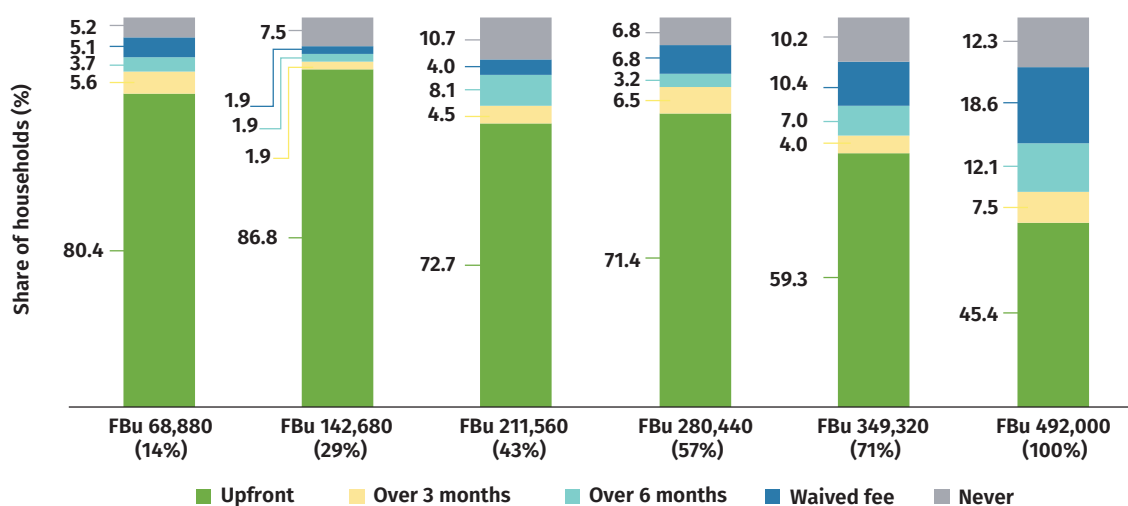
FIGURE 2.57 • Appliances desired by off-grid solar households

Source: Original compilation based on 2021 MTF survey results.

Note: Up to three responses possible.

Willingness to pay

Approximately 45 percent of off-grid solar households express a willingness to pay the current grid connection fee of FBu 492,000 (US\$174.41) up front, with an additional 24 percent opting for flexible payment plans over 3, 6, or 12 months (figure 2.58). These WTP rates surpass those observed among households without any electricity access (see figure 2.23). A reduction in the connection fee to FBu 68,880 (US\$24.42) results in a significant increase in up-front willingness to pay, with approximately 80 percent indicating they would pay up front and an additional 9 percent opting for payment over time.

FIGURE 2.58 • Willingness to pay for a grid connection fee among off-grid solar households

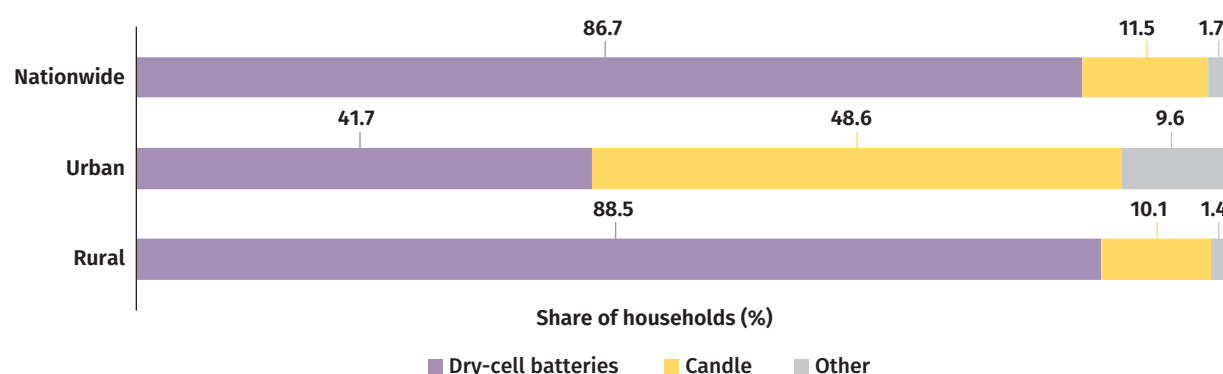
Source: Original compilation based on 2021 MTF survey results.

Note: FBu = Burundian Franc.

Backup energy sources

The vast majority (87 percent) of off-grid solar households use dry-cell batteries as a backup energy source (figure 2.59). Candles are the second-most-common backup source, used by 12 percent of households. Notably, urban off-grid solar households are significantly more likely to use candles as a backup (49 percent) compared with rural households (10 percent). Conversely, dry-cell battery use is significantly more common among rural off-grid solar households (89 percent) than urban households (42 percent).

FIGURE 2.59 • Main backup energy source for lighting used by grid-connected households (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

POLICY RECOMMENDATIONS

In Burundi, 74 percent of households lack electricity access. These households can be categorized into two groups: those residing “under the grid,” meaning they live in communities with existing grid infrastructure, and those living in communities not yet reached by the grid. For the 11 percent of households without access who live “under the grid,” grid densification could provide electricity access, especially if connection costs could be spread over time or through available financing options. For the 63 percent of households without electricity in nonelectrified communities, off-grid solar solutions offer a more feasible path to electricity access. The adoption of these solutions should be supported by quality control systems, microfinancing, and consumer awareness programs to ensure high penetration of Tier 1+ solutions and minimize the distribution of poor-quality products. While mini-grids were not widespread in the country at the time of the MTF survey, they may represent a cost-effective solution for higher-density rural areas.

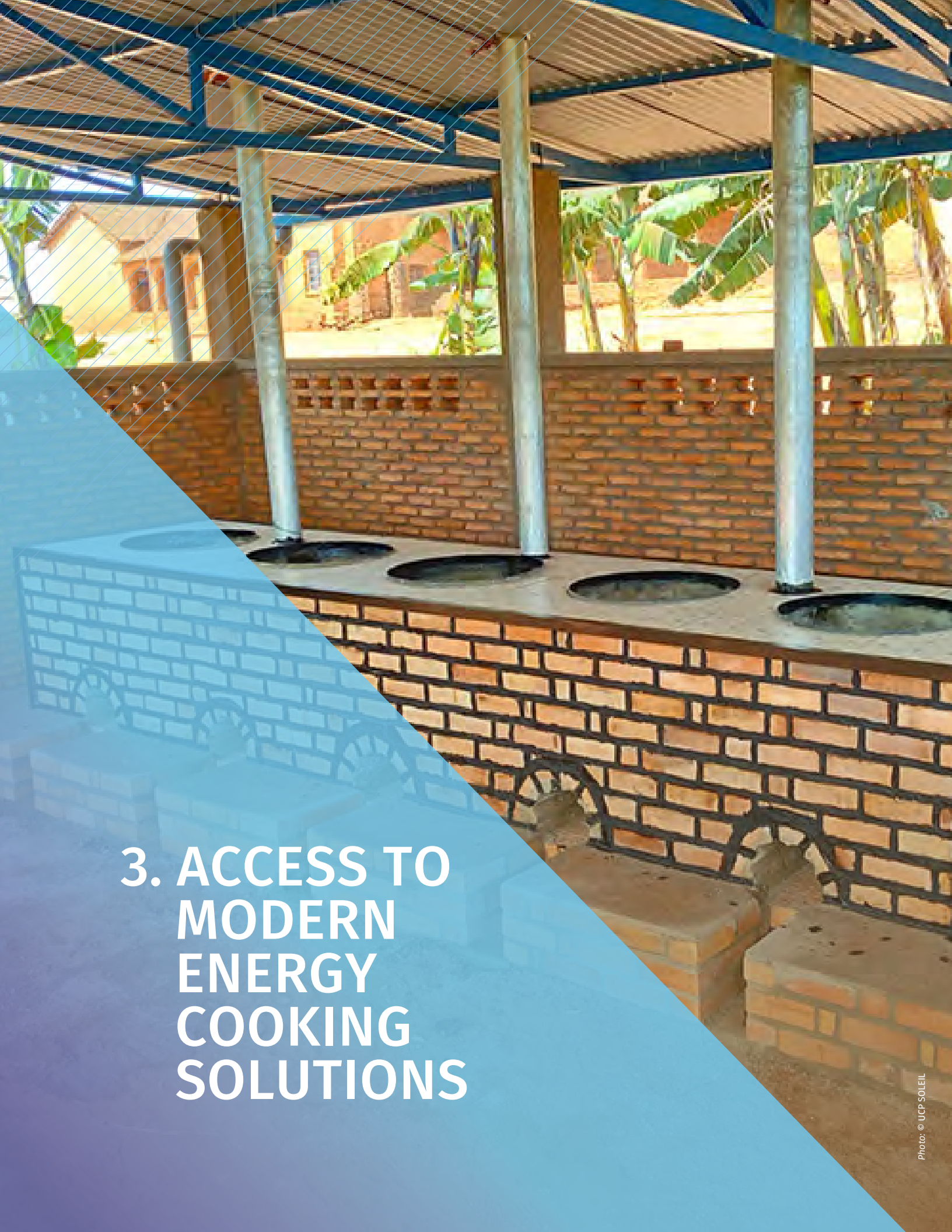
In Burundi, only 8 percent of households are connected to the grid. Of these, 74 percent do not achieve Tier 5, with 50 percent reaching up to Tier 3. Enhancing supply availability and mitigating unpredictable interruptions would enable a significant portion of grid-connected households to advance to higher tiers, specifically Tiers 4 and 5.

Approximately 50 percent of grid-connected households utilize only very low- or low-power appliances, resulting in underutilization of the grid’s full capacity. To promote the adoption of higher-load appliances, it is recommended that popular energy-efficient appliances—such as refrigerators, fans, electric kitchen mills, and televisions—be made more widely available, alongside consumer financing options.

Electrification initiatives hold significant potential to unlock a range of productive uses of electricity, driving economic growth and improving livelihoods, especially given that half of all grid-connected households in the country are currently underutilizing the grid's capacity with only very low- or low-power appliances. To advance households to higher tiers of energy access (Tier 4 and 5), a strategic focus on expanding the availability and affordability of energy-efficient appliances is crucial. By enhancing the supply of popular items like refrigerators, fans, electric kitchen mills, and televisions, and coupling this with accessible consumer financing options, households will be empowered to adopt higher-load appliances. This not only directly improves their quality of life but also enables small businesses to grow, supports the cold chain for food and medicine, and boosts overall economic activity, moving beyond basic lighting to truly transformative energy use.

Approximately 18 percent of households use off-grid solutions, primarily solar lanterns. However, 34 percent of households relying on off-grid solar solutions are classified as Tier 0, due to insufficient capacity. Promoting the distribution of high-quality solar devices and enhancing the availability and affordability of higher-tier solar products can enable off-grid solar households to progress to higher access tiers, facilitating the use of desired appliances such as televisions and radios.

To strengthen the roadmap for implementing stand-alone SHSs and mini-grids, it is critical to improve the enabling environment for decentralized energy. Burundi's energy compact features a number of priority actions, such as the enforcement of duty exemptions for solar products and the strengthening of capacity at the Burundi Tax Office (OBR). The adoption and enforcement of quality standards are also key to ensure reliable service. Financing tools that accelerate expansion and ensure equitable access should be prioritized. For example, results-based financing (RBF) incentivizes private sector developers by tying payments to verified outcomes. It is also important to develop well-designed subsidy frameworks that reduce up-front costs for both providers and low-income end users. These subsidies should be transparent and targeted to bridge the affordability gap without distorting the market. Combining these tools—for instance, using an RBF mechanism to reward scale while a targeted subsidy supports vulnerable consumers—will create a robust financial ecosystem that drives rapid, sustainable, and equitable off-grid electrification.



3. ACCESS TO MODERN ENERGY COOKING SOLUTIONS

KEY MESSAGES

- **Cooking with biomass is widespread and results in low access tiers.** In Burundi, over 99 percent of households use biomass for cooking, with wood—primarily collected—being the main fuel. Approximately 91 percent of households are in Tier 0 for access to modern energy cooking services, and only 1 percent reach Tier 3 or above. The most common cookstove is the three-stone stove, used by approximately 89 percent of households, almost all of which fall in Tier 0.
- **There is a stark urban-rural divide in cooking patterns.** In urban areas, 82 percent of households cook primarily with charcoal, using either traditional (47 percent) or improved (35 percent) cookstoves. About 40 percent of urban households reach Tiers 1 or 2. In contrast, 95 percent of rural households use a three-stone stove, with collected wood as the primary fuel.
- **Poor ventilation and exposure to harmful emissions are major concerns.** Approximately 94 percent of households nationwide are in Tier 0 for Cooking Exposure. This is largely due to the widespread use of three-stone stoves and poor ventilation.
- **Simply improving ventilation could elevate users of traditional stoves and improved stoves to Tier 2 for Cooking Exposure.** To achieve this, households cooking indoors need external or integrated exhaust systems. Campaigns raising awareness of indoor air pollution's health impacts, coupled with affordable stoves and exhaust systems, are crucial for driving change.
- **Cooking fuels are widely considered Affordable and Available, but Convenience and Safety vary.** For 96 percent of households, the cost of fuel is less than 5 percent of their total expenditure, and the primary cooking fuel is deemed “mostly” or “always” available by a large majority of households (90 percent). In terms of Safety, 87 percent of households reported no injuries, and 12 percent sustained minor injuries from cooking. In terms of Convenience, the majority (62 percent) of households are in Tier 2, spending under seven hours per week on acquiring and preparing the fuel but over 10 minutes preparing the stove per meal.
- **Improved cookstoves alone are insufficient for ensuring clean cooking.** While approximately 6 percent of households nationally use improved cookstoves, 83 percent of these users still fall into Tier 0 for Cooking Exposure. This is because they cook indoors without proper ventilation and must therefore install adequate exhaust systems. This ventilation gap presents a significant opportunity: 46 percent of urban households currently using traditional stoves could switch to improved cookstoves and incorporate proper ventilation without needing to change their fuel (e.g., charcoal).
- **A notable number of charcoal users are willing to pay for improved cookstoves, with a significant increase in interest at a lower price point.** Among households using charcoal as their primary cooking fuel (9 percent of all households, but 82 percent of urban households), 41 percent are willing to pay FBu 15,000 (US\$5.32) up front for improved cookstoves like the Kamaro or Biikigiti, with another 24 percent willing to pay over time. Reducing the price to FBu 4,950 (US\$1.75) increases the willingness to pay up front to 62 percent, with another 12 percent choosing to pay in installments.

- **Most households using wood for cooking are willing to pay for improved cookstoves, especially at a lower price point.** Among the 91 percent of households that rely on wood, 56 percent are willing to pay FBu 7,333 (US\$2.60) up front for a low-end wood-based improved cookstove. Switching to improved wood-based cookstoves is the most viable solution, especially in rural areas, but wider adoption of higher-end models will require consumer financing or subsidies.
- **Clean fuel use is virtually nonexistent, exclusively found among the wealthiest urban households.** Only 0.1 percent of households use clean fuels as their primary cooking fuel. These households are all in urban areas and fall within the wealthiest socioeconomic quintile. Biogas stoves and electric stoves are the only clean fuels reported, with no liquefied petroleum gas (LPG) stoves found. Despite high urban electricity access, the adoption of electric stoves is extremely low, likely due to high up-front costs. A national clean cooking strategy is urgently needed to address the affordability and availability of clean fuels and to raise awareness about the health benefits of clean cooking.
- **A successful rollout of modern energy cooking services requires integrating planning and electrification.** By treating cooking as a core electrical load during the planning phase, utilities can properly size and reinforce the grid, avoiding overloads. This unified approach also allows for the creation of special tariffs, making electric cooking more affordable for households.

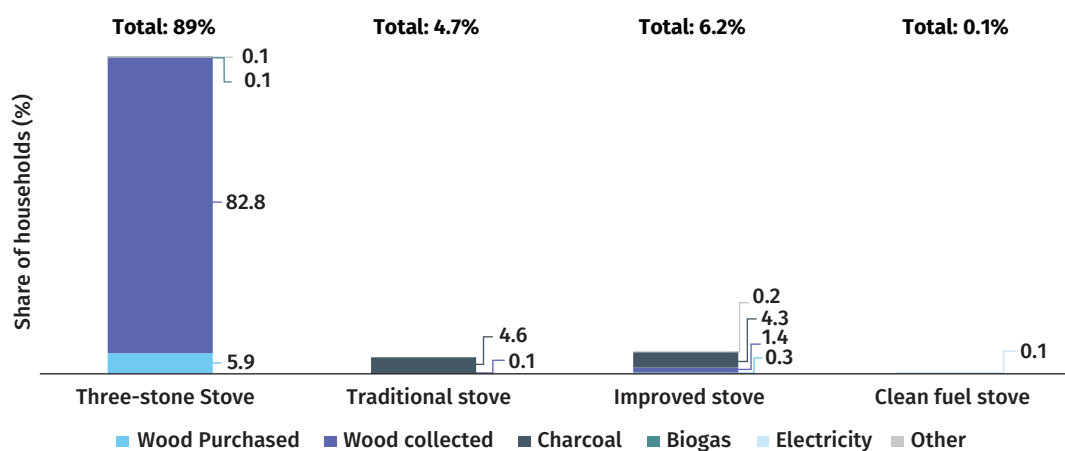
MEASURING ACCESS TO MODERN ENERGY COOKING SERVICES

This section presents an analysis of the current state of access to modern energy cooking services in Burundi, both nationally and subnationally, specifically in urban and rural areas. Access is examined by technology, access tier, and expenditure quintile, among other dimensions, and its key attributes (Cooking Exposure, Cookstove Efficiency, Convenience, Safety of the primary cookstove, Affordability, and Fuel Availability) are examined nationwide and in urban and rural areas.

ACCESS BY TECHNOLOGY

Over 99 percent of households in Burundi use biomass as their primary cooking fuel, with wood as the main source, which is primarily collected rather than purchased (figure 3.1). Approximately 89 percent of households use a three-stone stove as their main cookstove, 5 percent use a traditional stove, and 6 percent use an improved cookstove. The share of households using clean fuel stoves is exceptionally low, at 0.1 percent, and includes users of biogas stoves and electric stoves.

FIGURE 3.1 • Access to cooking solutions, by technology (nationwide)

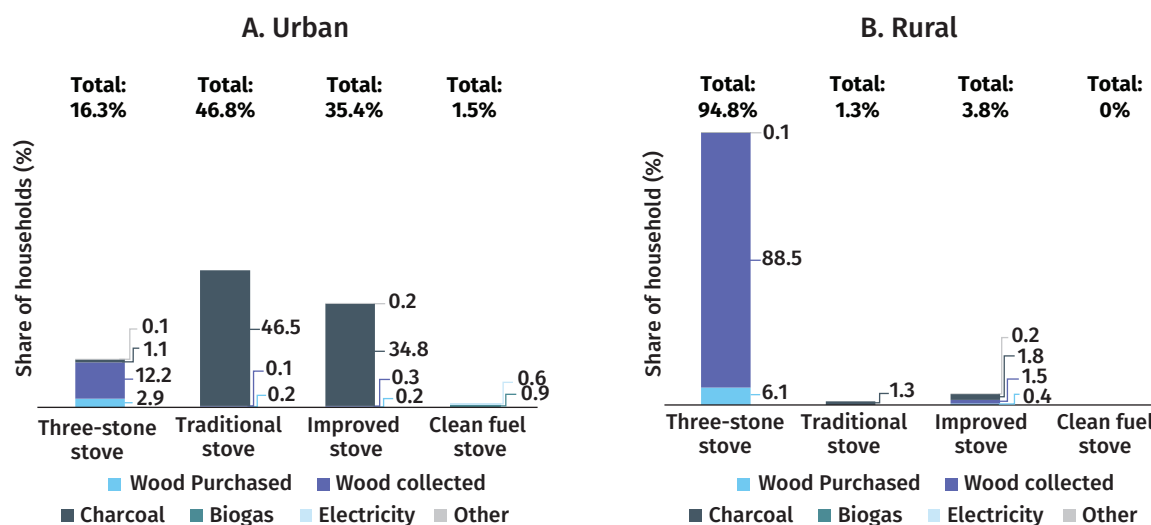


Source: Original compilation based on 2021 MTF survey results.

Access to modern energy cooking services is strongly linked to significant health benefits, especially for women and children. Households at the lowest tiers of access rely on polluting solid fuels, exposing women and children, who typically manage household cooking, to dangerous levels of indoor air pollution. Indoor air pollution is a leading cause of respiratory illnesses, cardiovascular disease, and other serious health issues. The lack of convenient and efficient cooking solutions places a disproportionate burden on women and girls, who face limited opportunities for education, employment, and community participation because they have to spend time gathering fuel and tending to inefficient stoves. Therefore, advancing households to higher tiers of access to modern energy for cooking is not just an energy issue but a critical public health and gender equality imperative.

Urban and rural households have different cooking patterns (figure 3.2). In urban areas, 82 percent of households primarily cook with charcoal, using either traditional stoves (47 percent) or improved cookstoves (35 percent). Only 16 percent of urban households use a three-stone stove, and less than 2 percent use clean fuel stoves. In rural areas, 95 percent of households primarily cook with a three-stone stove, predominantly using collected wood (89 percent). Only 7 percent of rural households purchase wood. Approximately 2 percent of rural households cook with charcoal using improved cookstoves, and 1 percent use traditional charcoal stoves. No rural households were found to be using clean fuel stoves.

FIGURE 3.2 • Access to cooking solutions, by technology (urban, rural)

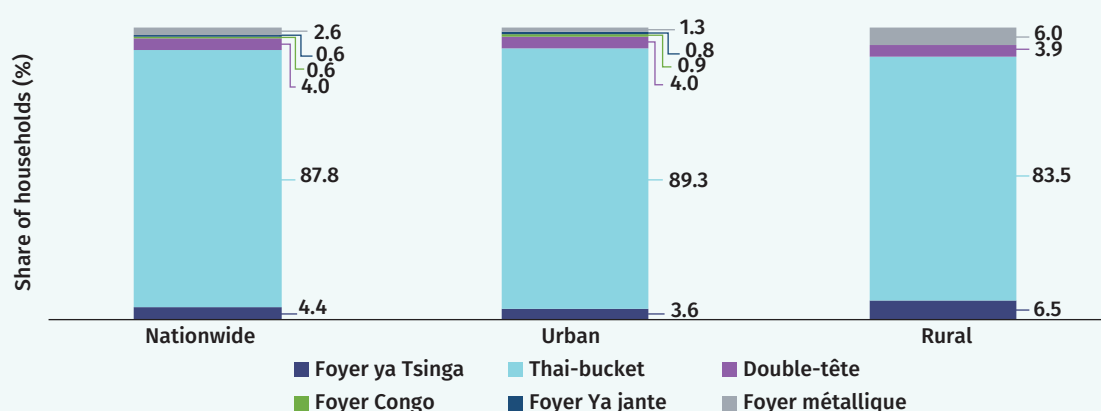


Source: Original compilation based on 2021 MTF survey results.

BOX 3.1 • POPULAR BRANDS OF TRADITIONAL AND IMPROVED COOKSTOVES

The Thai-bucket is the most common traditional cookstove type in Burundi. It is used by a large majority (88 percent) of the 4.7 percent of Burundian households using traditional cookstoves (figure B3.1.1). While rural and urban households differ starkly in the prevalence of traditional stove use (47 percent vs 1 percent, respectively), the Thai-bucket's dominance remains relatively consistent across both, used by 89 percent of urban households compared to 84 percent of rural households. The foyer ya Tsinga and the Double-tête each hold a significantly smaller market share, at 4 percent (see annex 4 for photos).

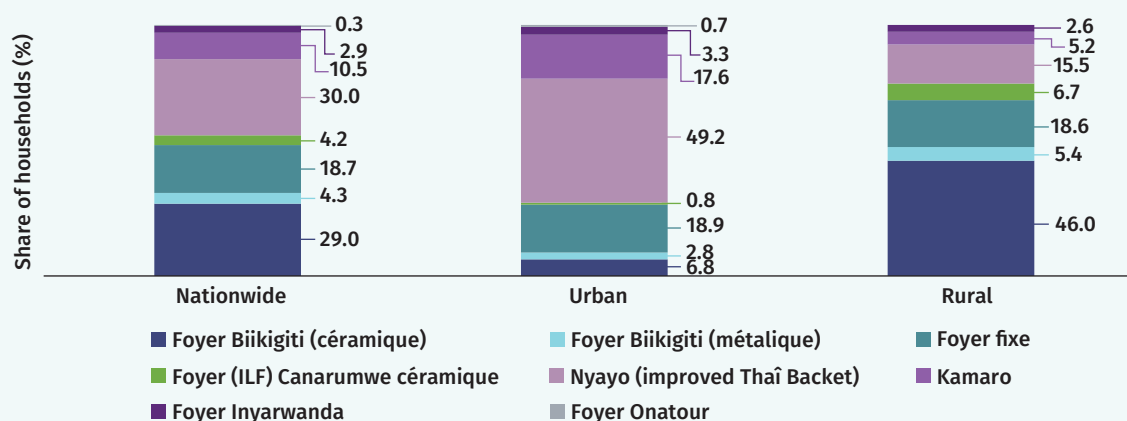
FIGURE B3.1.1 • Distribution of traditional stoves by brand (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Regarding improved cookstoves, the Nyayo (an improved Thai-bucket stove) (30 percent), the Biikigiti (ceramic) (29 percent), and the foyer fixe (19 percent) are the most prevalent in Burundi. Kamaro stoves have a 10 percent penetration rate (figure B3.1.2). Urban households prefer the Nyayo stove (49 percent), followed by the foyer fixe (19 percent) and the Kamaro stove (18 percent), while rural households favor the Biikigiti (ceramic) stove (46 percent), followed by the foyer fixe (19 percent) and the Nyayo stove (16 percent) (see annex 4 for photos).

FIGURE B3.1.2 • Distribution of improved cookstoves by brand (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Access to modern energy cooking services correlates with household wealth. The poorest 20 percent of households are 25 percentage points more likely to use a three-stone stove as their primary cookstove compared with the wealthiest 20 percent (figure 3.3) and 30 percentage points more likely to rely on wood as their primary cooking fuel (figure 3.4). Substantial improvements in access are primarily observed within the highest expenditure quintile (quintile 5).

FIGURE 3.3 • Access to main cookstove, by expenditure quintile (nationwide)

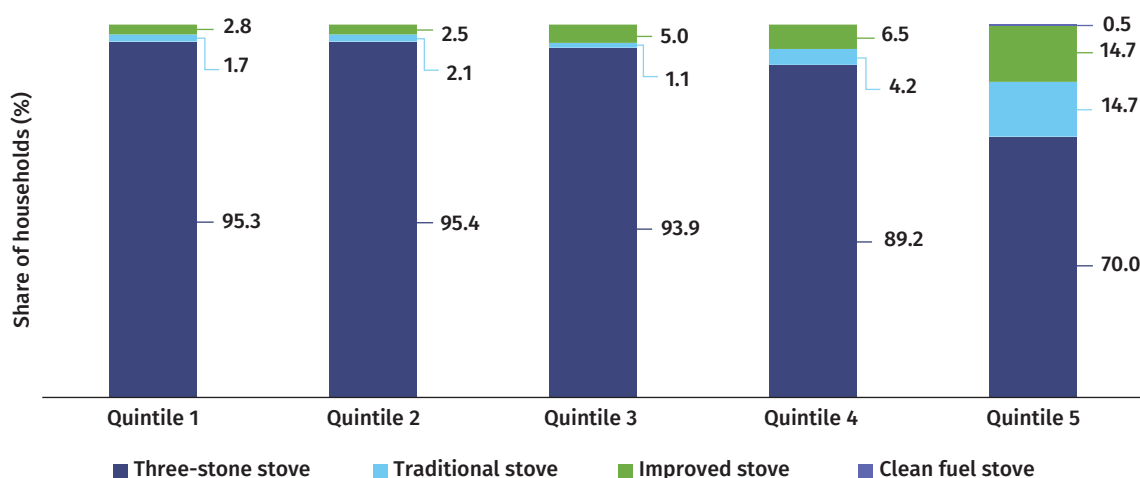
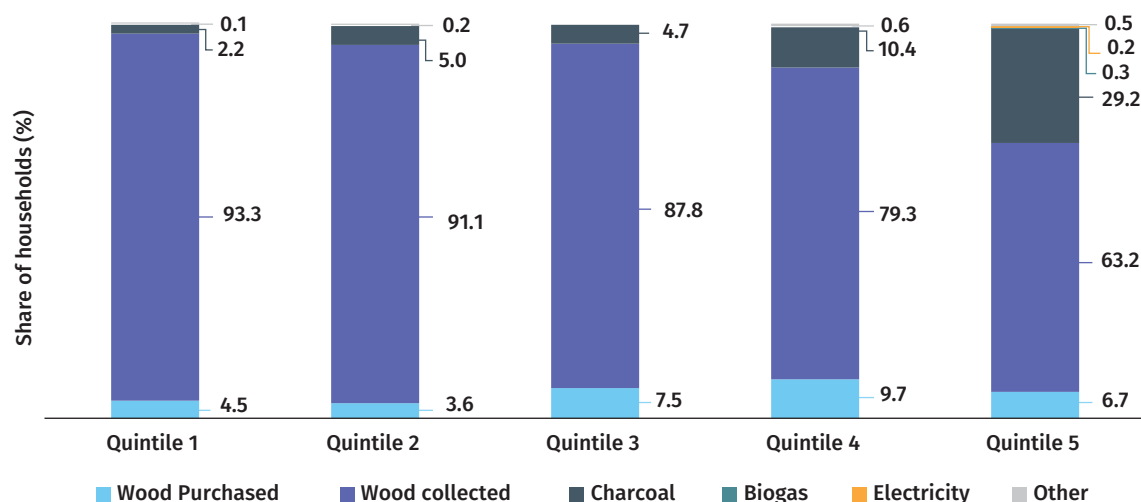
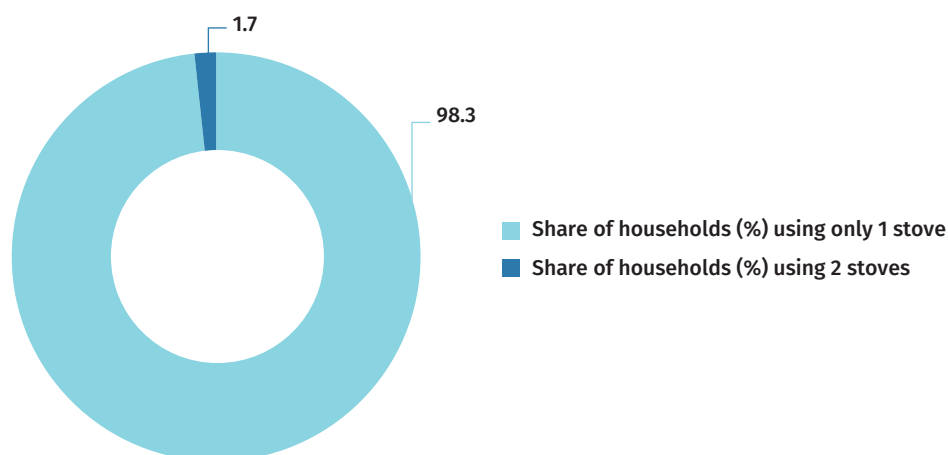


FIGURE 3.4 • Access to main cooking fuel, by expenditure quintile (nationwide)



Stove stacking is not a common practice in Burundi. Over 98 percent of households use a single stove for preparing meals (figure 3.5). All households using two stoves rely on biomass as the primary as well as secondary cooking fuel.

FIGURE 3.5 • Number of cookstoves commonly used by households (nationwide)

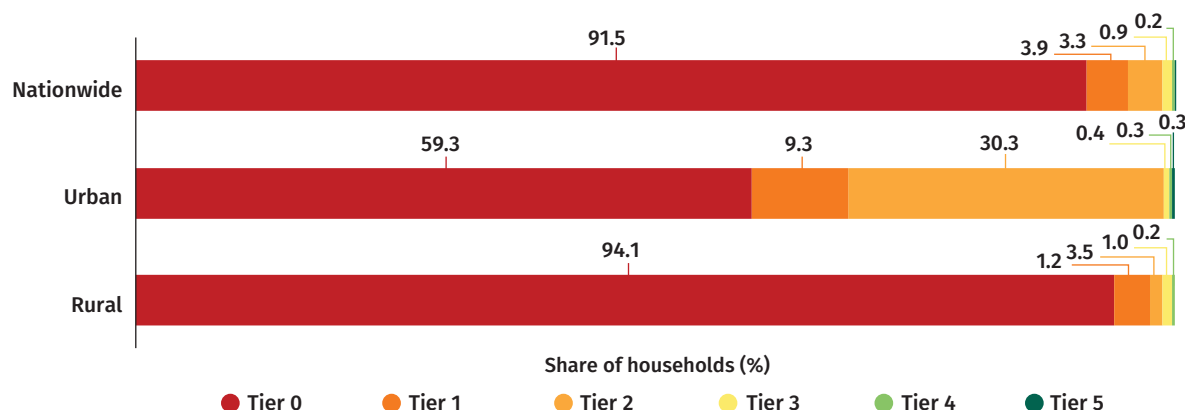


Source: Original compilation based on 2021 MTF survey results.

ACCESS BY TIER

Nationwide, approximately 91 percent of households are in Tier 0 in terms of access to modern energy cooking services, while only 1 percent reach Tier 3 or above (figure 3.6). There is a stark urban-rural disparity. In urban areas, 40 percent of households reach Tiers 1 or 2, largely due to traditional and improved cookstove use.

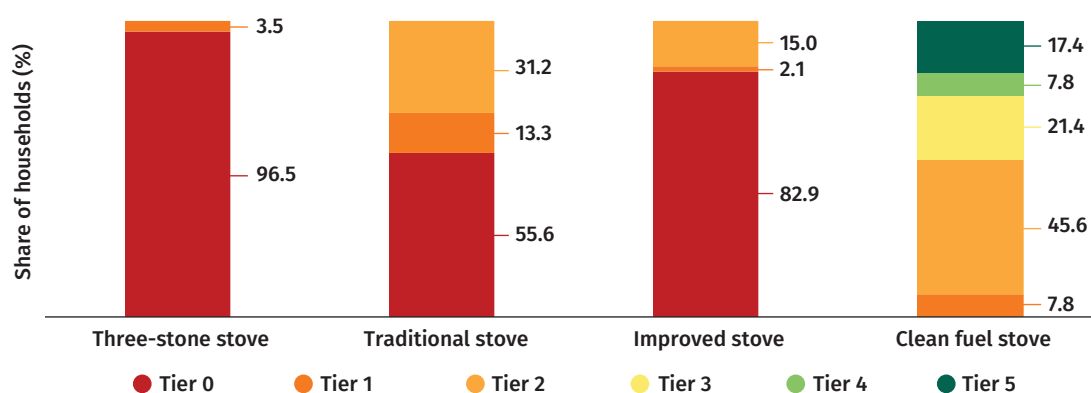
FIGURE 3.6 • Tier distribution of access to modern energy cooking services (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

In terms of cookstoves, three-stone stoves overwhelmingly (97 percent) fall into Tier 0 (figure 3.7). Only 0.1 percent of households use clean fuel stoves (figure 3.1), and less than half of the clean fuel stoves reach Tier 3 or above. Approximately 44 percent of traditional stoves reach Tier 1 or above. Surprisingly, improved cookstoves perform worse, with only 15 percent reaching above Tier 1 (box 3.2). While improved cookstoves are similar to traditional stoves in terms of emissions, users of improved cookstoves have worse ventilation.

FIGURE 3.7 • Tier distribution by cookstove



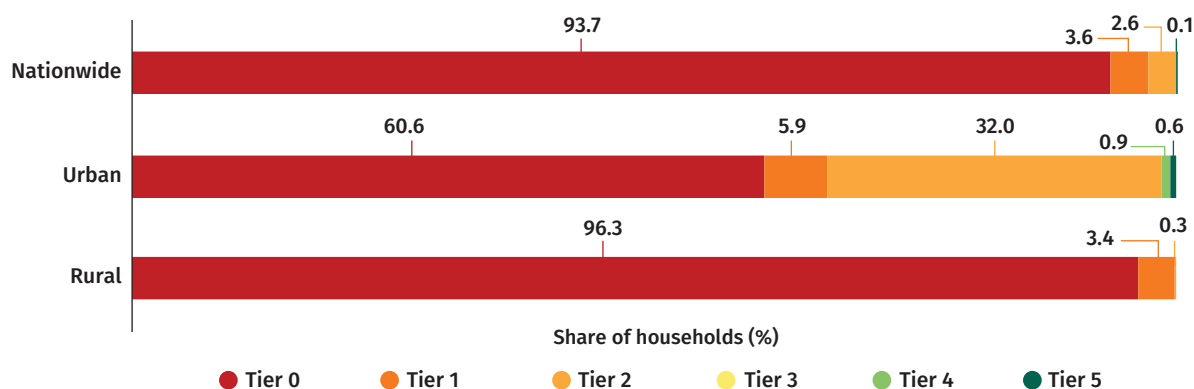
Source: Original compilation based on 2021 MTF survey results.

ATTRIBUTES OF ACCESS TO MODERN ENERGY COOKING SERVICES

Cooking Exposure

The Cooking Exposure attribute measures a person's exposure to pollutants generated during cooking activities. It is used as a proxy measure to estimate the health impact of these activities on the primary cook within the household. Cooking Exposure is assessed based on the emissions of the main cookstove and ventilation of the main cooking area (box 3.2). Nationwide, approximately 94 percent of households are in Tier 0 for Cooking Exposure (figure 3.8), primarily due to widespread use of three-stone stoves and inadequate ventilation.

FIGURE 3.8 • Household distribution of cooking exposure

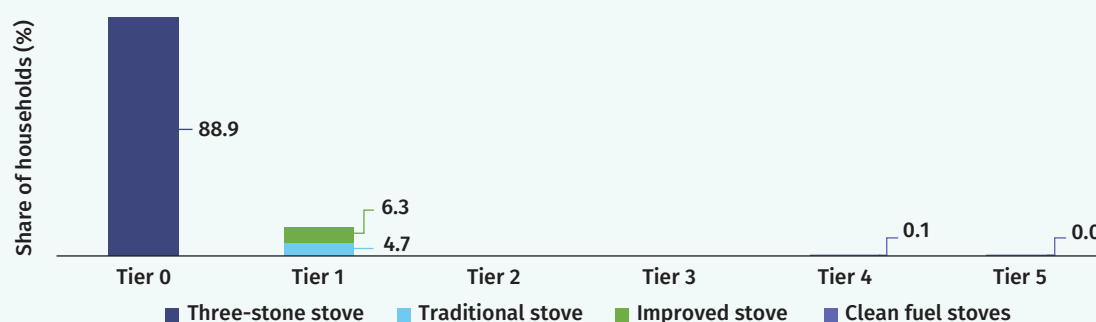


Source: Original compilation based on 2021 MTF survey results.

BOX 3.2 • COOKING EMISSIONS AND VENTILATION

Regarding emissions from cooking, three-stone stoves are in Tier 0, traditional and improved cookstoves in Tier 1, and clean fuel stoves in Tiers 4 or 5^a (figure B3.2.1).^b In terms of ventilation, over 86 percent of households are classified as having “poor” ventilation (figure B3.2.2), indicating indoor cooking without an exhaust system. Only 6 percent of households have “good” ventilation, because they cook outdoors or on a veranda.^c Poor ventilation is more likely among households using biogas stoves and three-stone stoves, followed by households using electric cookstoves and improved cookstoves. It is less likely among households using traditional stoves.

FIGURE B3.2.1 • Household distribution: Cookstove emissions (nationwide)



Source: Original compilation based on 2021 MTF survey results.

FIGURE B3.2.2 • Household distribution: Quality of ventilation of the cooking area, by stove type (nationwide)



Source: Original compilation based on 2021 MTF survey results.

a Biogas cookstoves are in Tier 4 and electric cookstoves are in Tier 5.

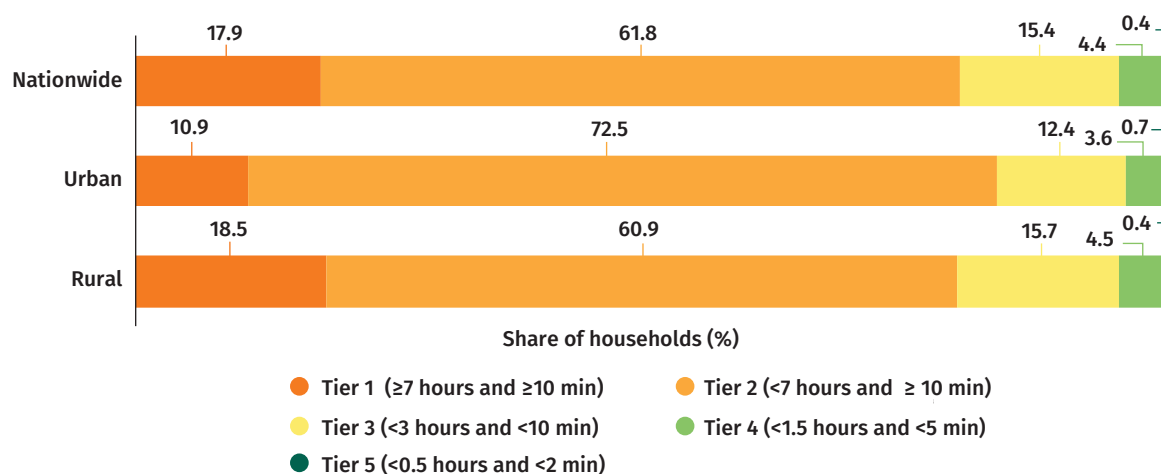
b Cookstove Emissions tiers are defined based on the ISO methodology. When data are unavailable, approximate tiers are established (see annex 3 for details).

c Refer to annex 3 for additional information.

Convenience

The Convenience attribute refers to the time household members spend collecting or purchasing fuel and preparing it and the stove for cooking. Convenience is evaluated based on the time to acquire and prepare fuel (hours/week) and the time to prepare the stove per meal (minutes/meal) (box 3.3). Approximately 62 percent of households fall in Tier 2 for Convenience, indicating that they spend under seven hours per week acquiring and preparing the fuel and over 10 minutes preparing the stove per meal (figure 3.9).

FIGURE 3.9 • Household distribution of Convenience

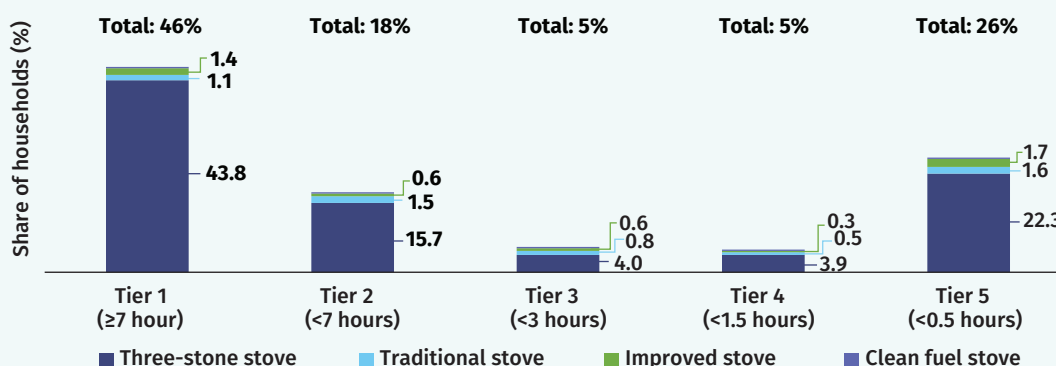


Source: Original compilation based on 2021 MTF survey results.

BOX 3.3 • FUEL ACQUISITION AND PREPARATION TIME, AND STOVE PREPARATION TIME

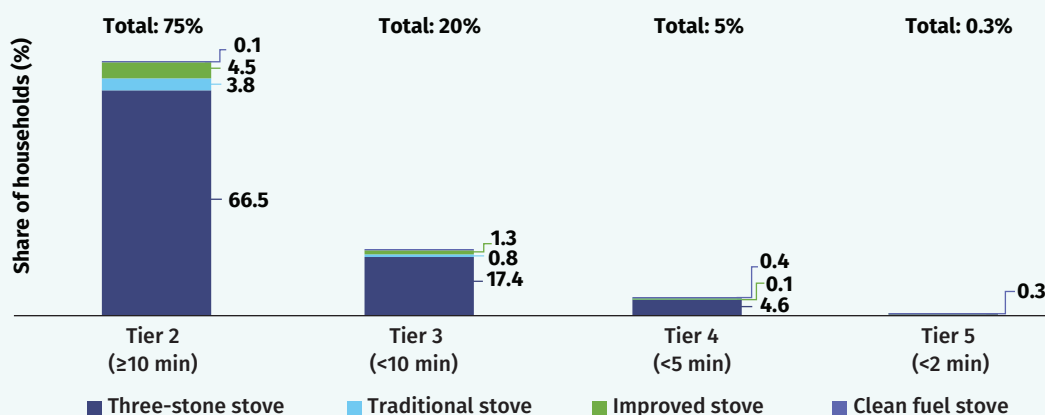
Nationwide, approximately 46 percent of households spend at least seven hours per week acquiring and preparing fuel, whereas 26 percent spend less than 30 minutes per week (figure B3.3.1). Meanwhile, 75 percent of households spend at least 10 minutes preparing the stove per meal (figure B3.3.2).

FIGURE B3.3.1 • Household distribution: Fuel acquisition and preparation time (hours/week)



Source: Original compilation based on 2021 MTF survey results.

FIGURE B3.3.2 • Household distribution: Stove preparation time (minutes/meal), by stove type



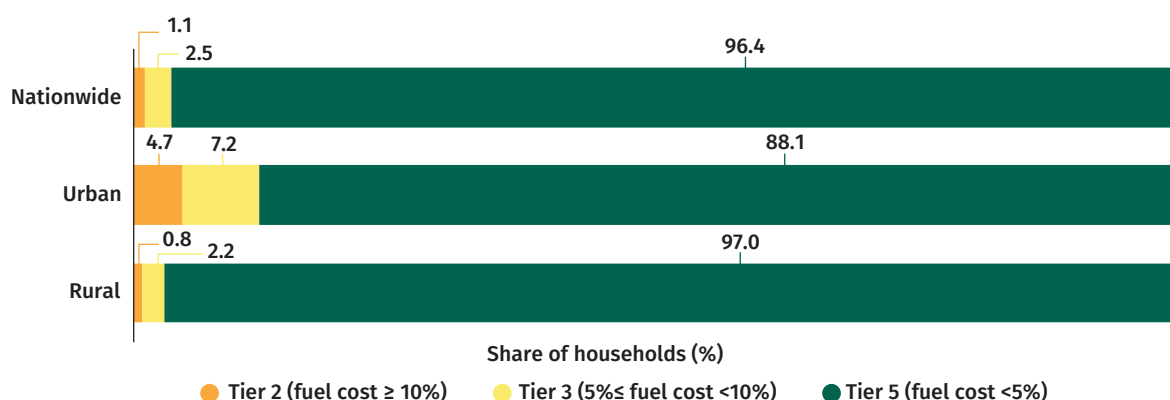
Source: Original compilation based on 2021 MTF survey results.

Note: The time noted is the time required to acquire and prepare the fuel often used for that particular stove.

Affordability

The Affordability attribute refers to the household's ability to pay for cooking fuels. It is measured by calculating the annual cost incurred for the cooking fuel as a percentage of annual household expenditure. In Burundi, cooking fuels are generally deemed affordable for a substantial majority (96 percent) of households, since fuel costs represent less than 5 percent of their total expenditure (figure 3.10). The share is lower in urban areas (88 percent) than rural areas (97 percent). This discrepancy can be attributed to the fact that households using three-stone stoves are more likely to allocate less than 5 percent of their household expenditure to fuels (99 percent), compared with households relying on traditional stoves or improved cookstoves, both of which have an 80 percent share.

FIGURE 3.10 • Household distribution of Affordability

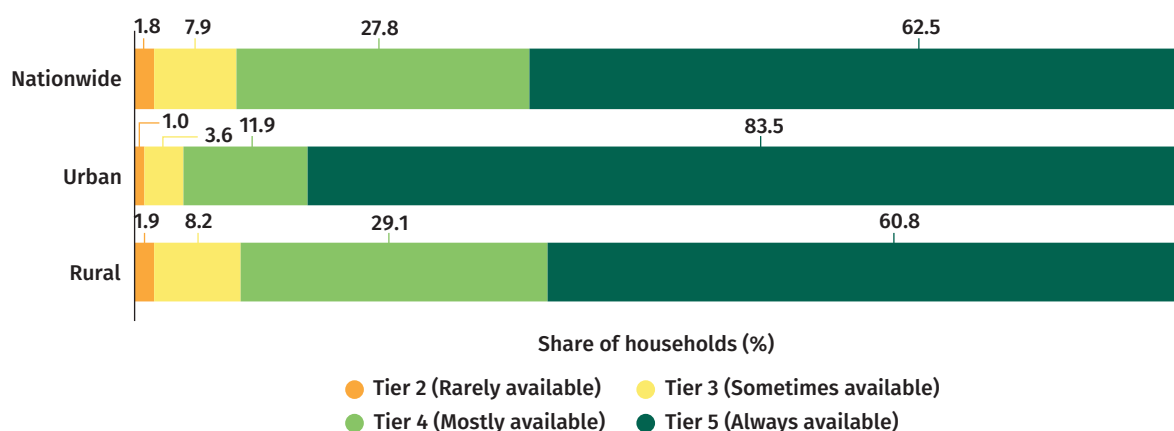


Source: Original compilation based on 2021 MTF survey results.

Fuel Availability

The Fuel Availability attribute refers to the availability of the fuel most often used for the main cookstove. Nationwide, over 90 percent of households indicated that their main cooking fuel is either “mostly available” or “always available” (figure 3.11). The share is lower in rural areas (90 percent) than urban areas (95 percent). This discrepancy can be attributed, at least in part, to the fact that households using three-stone stoves are more likely to fall into Tier 3 or below for Fuel Availability.

FIGURE 3.11 • Household distribution of Fuel Availability

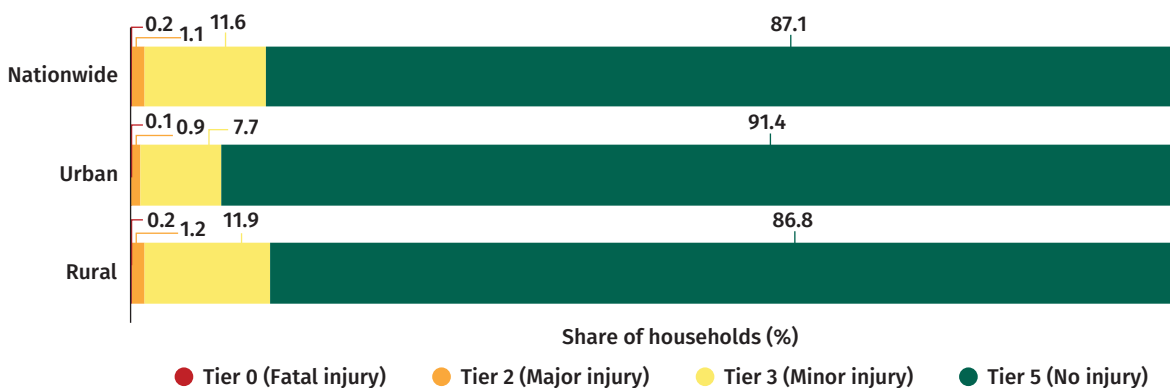


Source: Original compilation based on 2021 MTF survey results.

Safety

The Safety attribute is determined based on the reported severity of accidents occurring in the previous 12 months, specifically from using the main cookstove. Approximately 87 percent of households reported experiencing no injuries from using the main cookstove, while 12 percent reported sustaining minor injuries (figure 3.12). Three-stone stoves are associated with the vast majority of cooking-related injuries: 95 percent of minor injuries, 84 percent of major injuries, and 73 percent of fatal injuries. The remaining fatal injuries are linked to traditional stoves.

FIGURE 3.12 • Household distribution of main cookstove's Safety



Source: Original compilation based on 2021 MTF survey results.

IMPROVING ACCESS TO MODERN ENERGY COOKING SERVICES

Several key household characteristics affect the adoption of modern energy cooking services. Factors such as current cooking solutions, geographic location, household expenditure, and willingness to pay (WTP) are analyzed in this subsection, with an aim to identify opportunities to improve access to modern energy cooking services and tailor interventions accordingly. This data-driven approach will inform strategies to promote the uptake of cleaner, more efficient cooking solutions, ultimately contributing to improved health, environmental sustainability, and economic development.

EXPANDING ACCESS TO IMPROVED COOKSTOVES

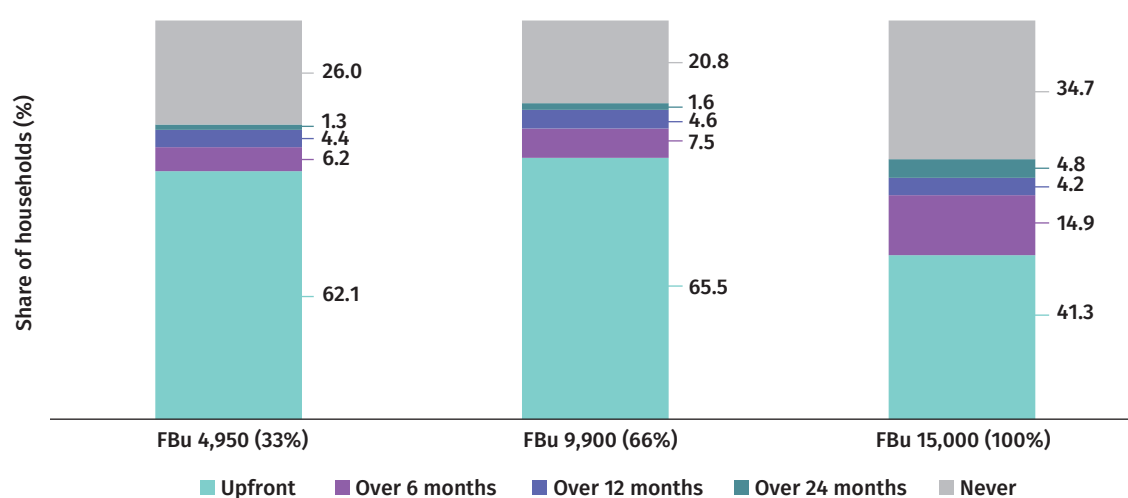
In Burundi, approximately 6 percent of households primarily use an improved cookstove—two-thirds of them relying on charcoal (see figure 3.1). A concerning 83 percent of these households are still in Tier 0 for Cooking Exposure due to poor ventilation (indoor cooking without an exhaust system). The remaining 17 percent have good ventilation, because they cook outdoors or on a veranda (see box 3.2). To improve access to modern energy cooking services, households cooking indoors using improved cookstoves must address ventilation issues, by using external or embedded exhaust systems.

Households using traditional stoves could also improve their access to modern energy by switching to improved cookstoves with exhaust systems, without switching fuel. This opportunity applies to 46 percent of urban households.

Most households using charcoal report no issue with Affordability, Fuel Availability, or Safety, regardless of whether they use traditional or improved cookstoves. However, stove preparation time remains a major drawback, with most users spending on average 24–27 minutes per meal preparing the stove. Charcoal users might find fast-ignition improved cookstoves with exhaust systems highly attractive.

Of households using charcoal as the primary fuel for their primary cookstove (9 percent overall, but 82 percent of urban households), 41 percent are willing to pay FBu 15,000 (US\$5.32) up front for improved cookstoves like the Kamaro or Biikigiti, with another 24 percent opting for payment over 6–24 months (figure 3.13).²⁹ Reducing the price to FBu 4,950 (US\$1.75) increases the WTP up front to 62 percent, with 12 percent choosing to pay in installments.

FIGURE 3.13 • Willingness to pay for a Kamaro cookstove (or a metallic Biikigiti) among households primarily using charcoal (nationwide)



Source: Original compilation based on 2021 MTF survey results.

Note: FBu = Burundian Franc.

Among the 91 percent of households relying on wood for cooking nationwide, 56 percent are willing to pay FBu 7,333 (US\$2.60) up front for a low-end wood-based improved cookstove³⁰ (corresponding to 66 percent of the full price). An additional 23 percent are willing to pay in installments over 6–24 months. Conversely, only 9 percent of the abovementioned households are willing to pay the full price (FBu 100,000 or US\$35.45) of a high-quality improved cookstove up front (and an additional 24 percent over time).³¹ Reducing the price to FBu 33,333 (US\$11.82) significantly boosts the WTP, to 24 percent up front and 36 percent over time.

²⁹ The improved cookstoves presented in the WTP module are the Kamaro and metallic Biikigiti. These stoves are designed to significantly reduce fuel consumption and smoke and potentially decrease cooking time, enabling charcoal users to have a more efficient cooking experience (see annex 4).

³⁰ The improved cookstove presented in the WTP module for wood users is the foyer Canarumwe Ceramique (ILF). It is designed to significantly reduce fuel consumption and smoke and potentially decrease cooking time, offering an efficient and cleaner cooking solution for wood-using households (see annex 4).

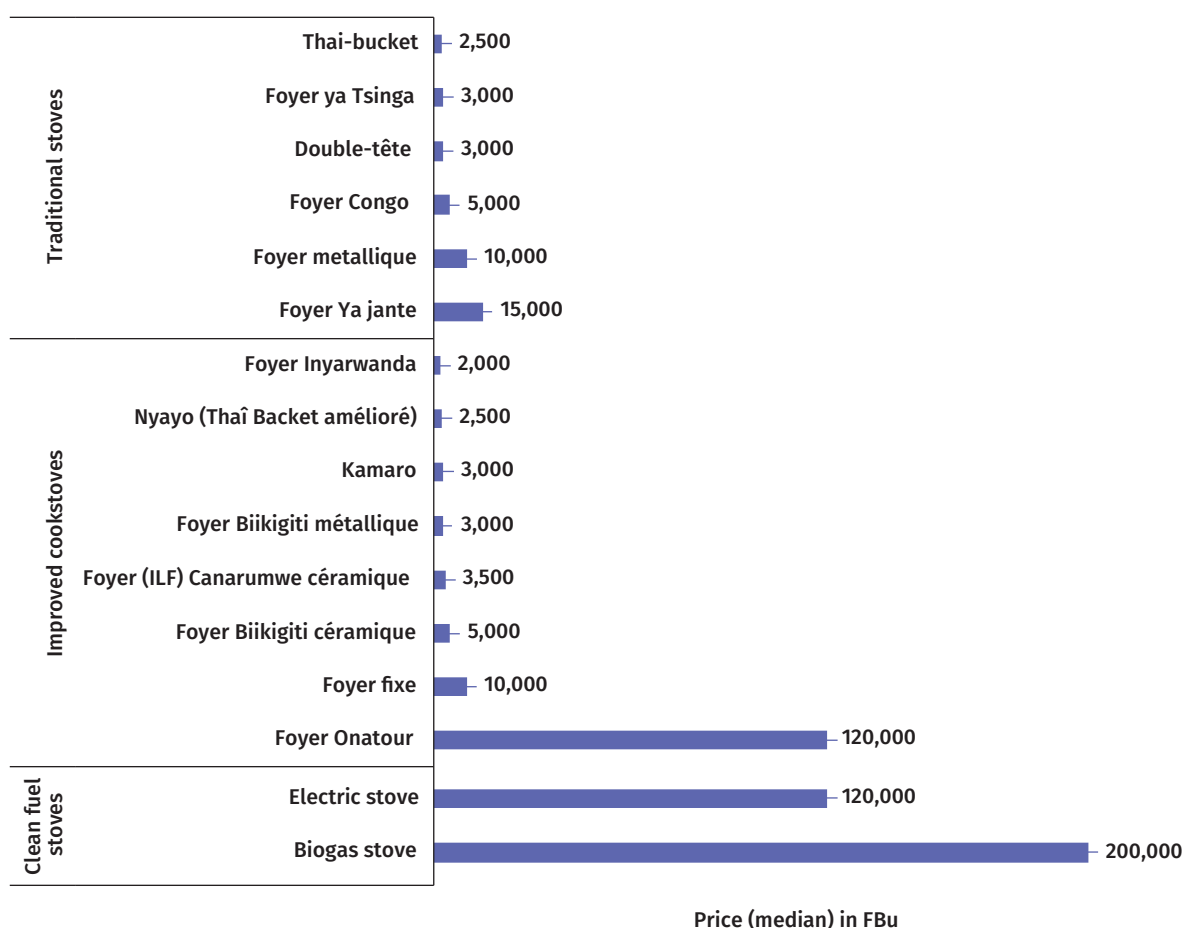
³¹ The high-quality improved cookstoves presented in the WTP module are the BURN and Envirofit models. These significantly reduce fuel consumption and smoke and enable fast cooking and boiling. Both models represent a safer, more durable stove with a warranty. The stove is easier to light up, and easier to clean.

IMPROVING ACCESS TO CLEAN FUEL STOVES

A mere 0.1 percent of households (N=32)³² use clean fuel stoves as their primary cooking method at the national level, restricting detailed analysis. These users are exclusively urban (1.5 percent of urban households) and in the wealthiest quintile. Of the clean fuel stoves used, 59 percent are biogas and 41 percent electric. No LPG stoves were reported. Only 0.6 percent of urban households use electric stoves as the primary cookstove despite high urban electricity access, likely due to the higher up-front purchase costs (figure 3.14). Interestingly, no clean fuel stove user reported using a secondary stove.

Burundi needs a national clean cooking strategy for increasing the use of clean fuels and improving access to modern energy cooking services, particularly by addressing the Availability and Affordability of fuels. The strategy should include targeted awareness campaigns highlighting the health benefits of clean fuels and the dangers of indoor air pollution.

FIGURE 3.14 • Stove purchase price (in FBu) paid by households



Source: Original compilation based on 2021 MTF survey results.

Note: FBu = Burundian Franc.

³² Only 32 households in the unweighted sample reported using clean fuel stoves.

POLICY RECOMMENDATIONS

Burundi must support the 95 percent of households at Tier 0-1 in terms of access to modern energy cooking services to transition to higher tiers through the adoption of improved cookstoves and clean fuel stoves. Key steps toward this goal are outlined below.

Address poor ventilation among traditional and improved cookstove users. Campaigns to raise awareness of indoor air pollution's health impacts, coupled with affordable stoves and exhaust systems, can be leveraged to promote external or integrated exhaust systems among households cooking indoors. The main households to target are those using traditional and improved stoves, which, although meeting Tier 1 for Cookstove Emissions, push over 50 percent of traditional and 80 percent of improved cookstove users to Tier 0 for Cooking Exposure, due to poor ventilation. Simply improving ventilation could elevate 8 percent of households to Tier 2 for Cooking Exposure.

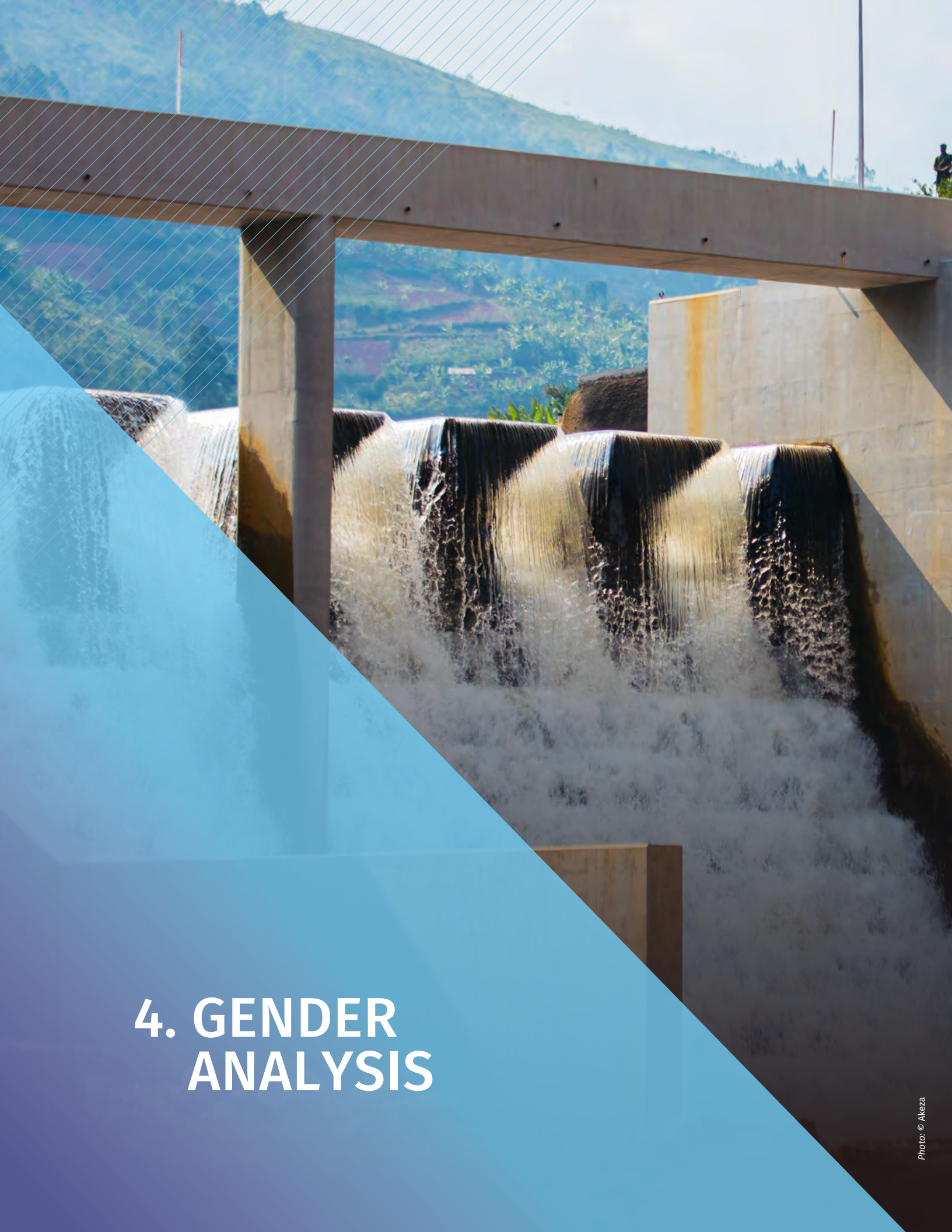
Accelerate the adoption of improved charcoal cookstoves in urban areas. Offering fast-ignition improved cookstoves and addressing fuel affordability through reduced up-front costs and flexi-payment options can help urban households adopt improved cookstoves—without switching fuel. The segment to target is the remaining 35 percent of urban households using charcoal but not yet with an improved cookstove (of the 82 percent of urban households using charcoal). Notably, the improved cookstoves should have exhaust systems. Over 65 percent of charcoal users are willing to pay for stoves like the Kamaro or Biikigiti, and their willingness increases as prices decline.

Promote improved wood-based cookstoves in rural areas. Considering 91 percent of households rely on wood, primarily collected for free, switching to improved wood-based cookstoves is the most viable solution, especially in rural areas. While many are willing to pay a reduced price for low-end stoves, adoption of high-end stoves requires consumer finance or subsidies. These mechanisms are crucial for driving stronger rural adoption.

Develop a comprehensive strategy to drive the adoption of clean fuel stoves. Given the low penetration of electric stoves in urban areas and the absence of reported LPG use, targeted interventions are needed. Consumer finance or subsidies can address the high up-front costs of electric stoves, though ongoing electricity costs remain a barrier. In rural areas, both biogas potential and LPG adoption should be assessed, placing priority on Fuel Availability and Affordability. A comprehensive plan, including supply and demand considerations and awareness campaigns, is essential.

Integrate planning and electrification strategies to support the rollout of modern energy cooking services. Integrated planning is key to successfully rolling out modern energy cooking services in grid-connected areas. By treating cooking as a core electrical load during the planning phase, utilities can properly size and reinforce the grid to handle new demand without causing overloads. This unified approach also allows for the creation of special tariffs that make electric cooking more affordable for households. Coordinating grid expansion with initiatives promoting modern energy cooking services creates economies of scale, lowers costs, and speeds up the shift from traditional fuels. Ultimately, this strategy not only helps meet climate and public health goals but also strengthens the business case for electrification by boosting electricity sales and revenue.

As part of the Burundi Energy Compact, the Government of Burundi aims at connecting 40 percent of the population to modern energy for cooking services, requiring an investment estimated at \$350 million. A national strategy will be defined and approved to set the vision and approach. Support to the sector in terms of investment and technical assistance will be critical to encourage retail and adoption.



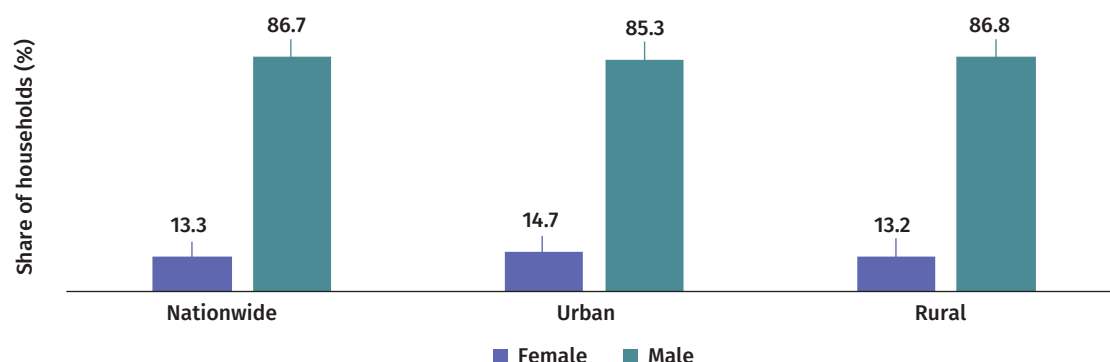
4. GENDER ANALYSIS

KEY MESSAGES

- **About 13 percent of households in Burundi are headed by women.** An overwhelming share of female heads are widowed or divorced. Unlike other African countries, these households are not disproportionately located in urban areas.
- **Female-headed households are more likely to be poor than male-headed households.** This economic disparity is especially pronounced in rural areas.
- **While there is only a slight gender gap in urban areas, female-headed households in rural Burundi are significantly less likely to have electricity access than male-headed households.** The disparity is particularly pronounced for off-grid solutions, which male-headed households are twice as likely to use.
- **Financial and cultural barriers make female-headed households more vulnerable to energy poverty, especially in rural areas, where they lack the resources to invest in off-grid technologies.** This cycle deepens existing gender inequalities.
- **Female-headed households are more likely than male-headed households to be at Tier 0 for all attributes of energy access, indicating a significant gap.** Despite this, both household types have equal representation in the higher tiers (Tier 3 and above).
- **Nationwide, male- and female-headed households face similar challenges with grid connection.** However, urban female-headed households are more likely to see high connection costs as the primary barrier.
- **While appliance ownership in Burundi generally shows little gender disparity, a significant gap exists among grid-connected households, with female-headed households far more likely to own only low-power appliances.** This disparity is much smaller for households using off-grid solar solutions.
- **Access to modern energy cooking solutions is comparable among both male- and female-headed households nationwide.** In urban areas, female-headed households even show a slight advantage, with more of them reaching higher tiers of access than their male-headed counterparts.
- **Female-headed households are more financially and socially vulnerable, enjoying only limited access to electricity, particularly off-grid solutions.** Future efforts should target these households with specific financial support, such as interest-free credit and subsidized connections.
- **Despite comparable access to modern energy cooking solutions among male- and female-headed households, culturally sensitive services and targeted financing are crucial for increasing adoption.** Future efforts should include educational campaigns, research into local preferences, and financing mechanisms specifically for vulnerable and female-headed households.

Approximately 13 percent of Burundian households are headed by a woman (figure 4.1). Contrary to trends in other Sub-Saharan African countries, female-headed households are not significantly concentrated in urban areas. A stark marital status disparity exists between the genders: 90 percent of female heads are widowed or divorced, compared with 2 percent of male heads, and only 9 percent of female heads are married, versus 96 percent of male heads.

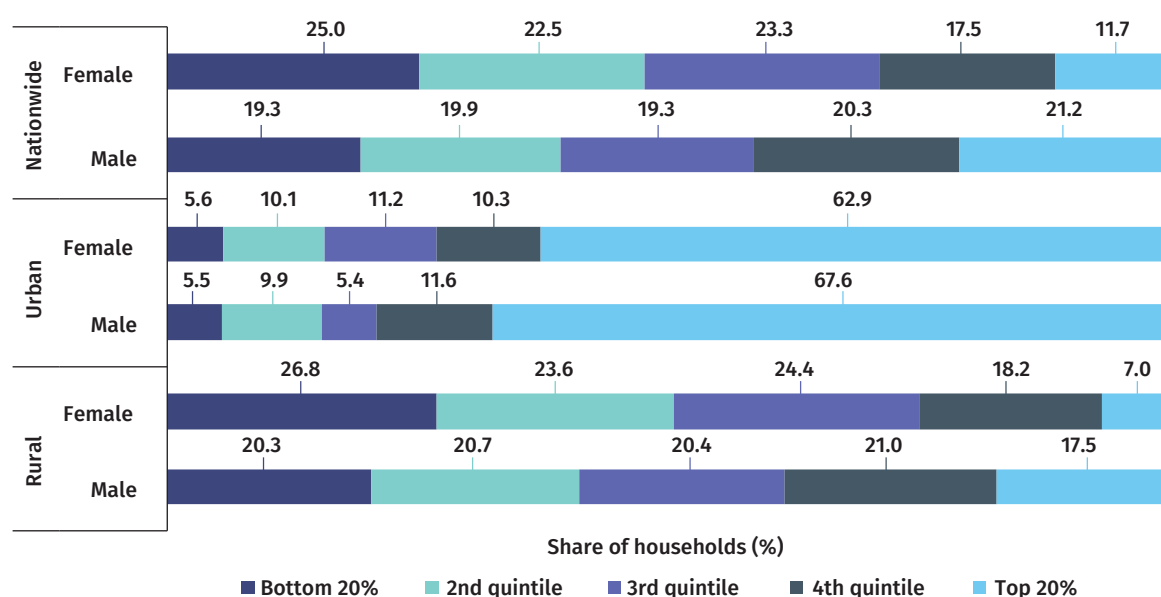
FIGURE 4.1 • Household distribution, by sex of the household head (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Female-headed households in Burundi are generally poorer than male-headed households (figure 4.2). Approximately 48 percent of female-headed households are in the bottom 40 percent, compared with 39 percent of male-headed households. Conversely, only 12 percent of female-headed households are in the top quintile, versus 21 percent of male-headed households. These gender gaps are more pronounced in rural areas.

FIGURE 4.2 • Distribution of male- and female-headed households by expenditure quintile (nationwide, urban, rural)



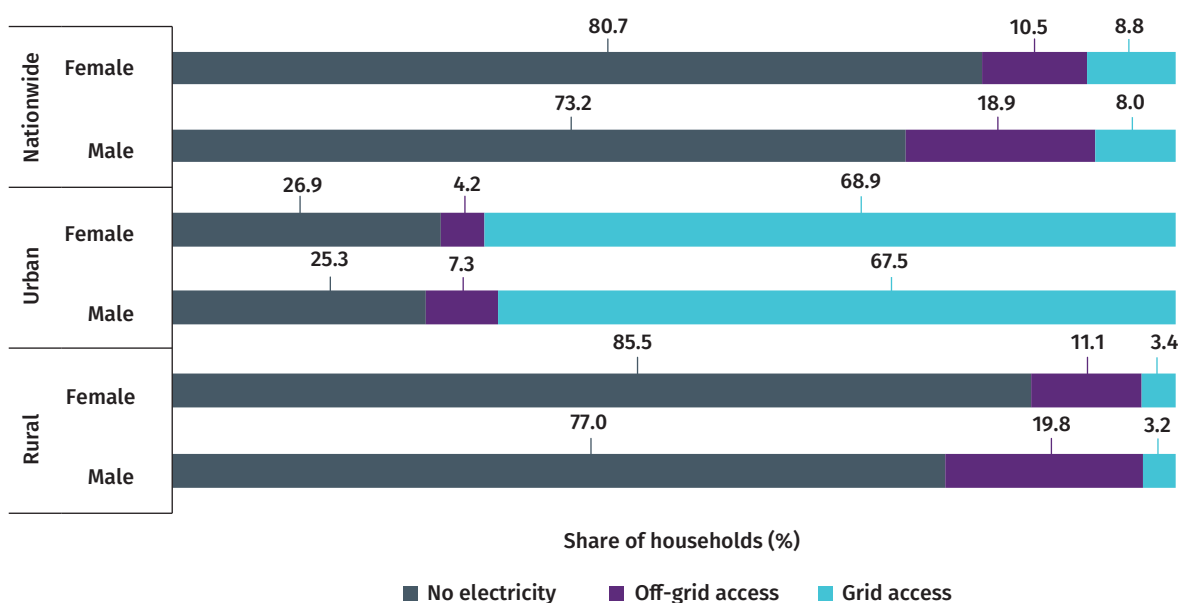
Source: Original compilation based on 2021 MTF survey results.

MEASURING ACCESS TO ELECTRICITY BY GENDER

Nationwide, female-headed households in Burundi are less likely to have access to electricity than male-headed households (19 percent versus 27 percent, respectively) (figure 4.3). In urban areas, the gender gap is under 2 percentage points in favor of male-headed households (75 percent versus 73 percent). Notably, female-headed households in urban areas are more likely to access the grid than male-headed households, but less likely to access off-grid solutions (particularly solar home systems and mini-grids). In rural areas, the gap widens significantly, reaching 9 percentage points in favor of male-headed households (23 percent versus 14 percent), which are twice as likely to access off-grid solutions.

Socioeconomic and cultural factors are the primary drivers of disparities in energy access between male- and female-headed households. Female-headed households are often more financially vulnerable and lack access to the resources, information, and financial services needed to invest in off-grid technologies, particularly in rural areas. They are thus less able to afford the high up-front costs of off-grid solutions. Although female-headed households in urban areas may have similar, or even greater, levels of access to the grid than male-headed households, this parity may often be a result of infrastructure proximity rather than a true indicator of their economic empowerment. In contrast, the gap in rural areas is significant, as cultural barriers like limited control over assets and finance, as well as constrained mobility, further prevent women from adopting off-grid technologies, a solution that is more common in remote regions. This reinforces a cycle where gender inequalities are deepened by energy poverty.

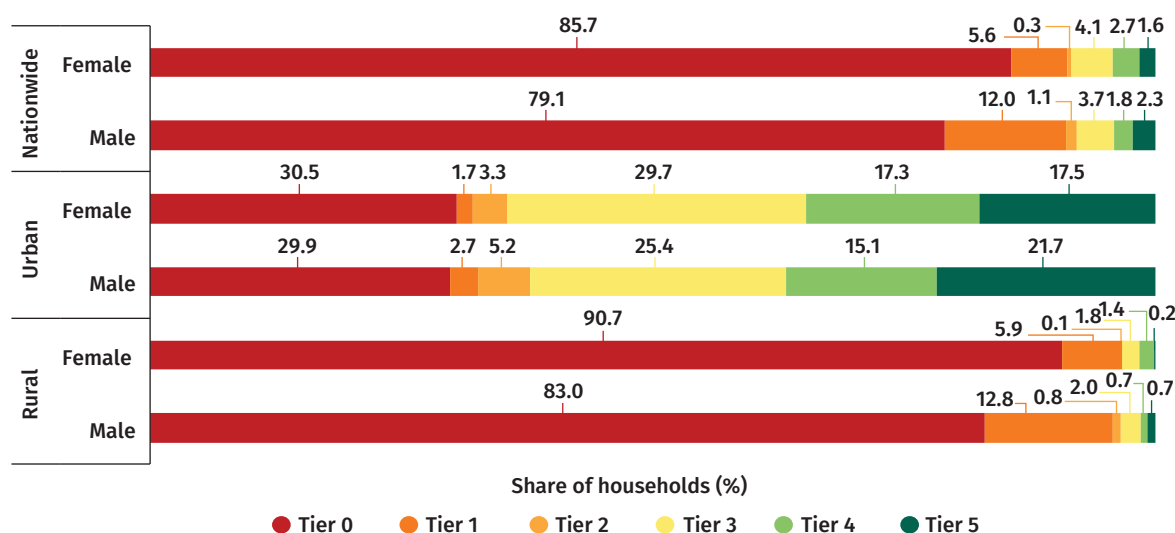
FIGURE 4.3 • Household access to electricity, by technology and sex of the household head (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Female-headed households are more likely than male-headed households to fall in Tier 0 (86 percent versus 79 percent) (figure 4.4), consistent with gaps in access by technology (figure 4.3).³³ Notably, both household types have equal representation in Tier 3 and above.

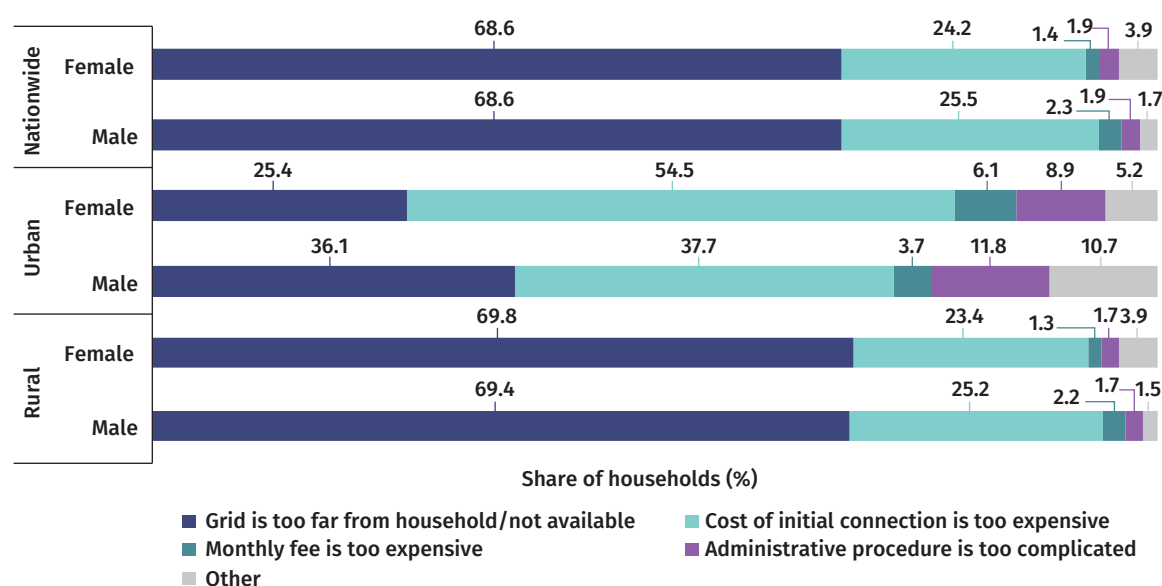
FIGURE 4.4 • Tier distribution, by sex of the household head (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Nationwide, both male- and female-headed households cite similar reasons for lacking a grid connection (figure 4.5). However, in urban areas, female-headed households more frequently report high connection costs as the primary barrier (54 percent versus 38 percent).

FIGURE 4.5 • Barriers to gaining access to the electricity grid, by sex of the household head (nationwide)

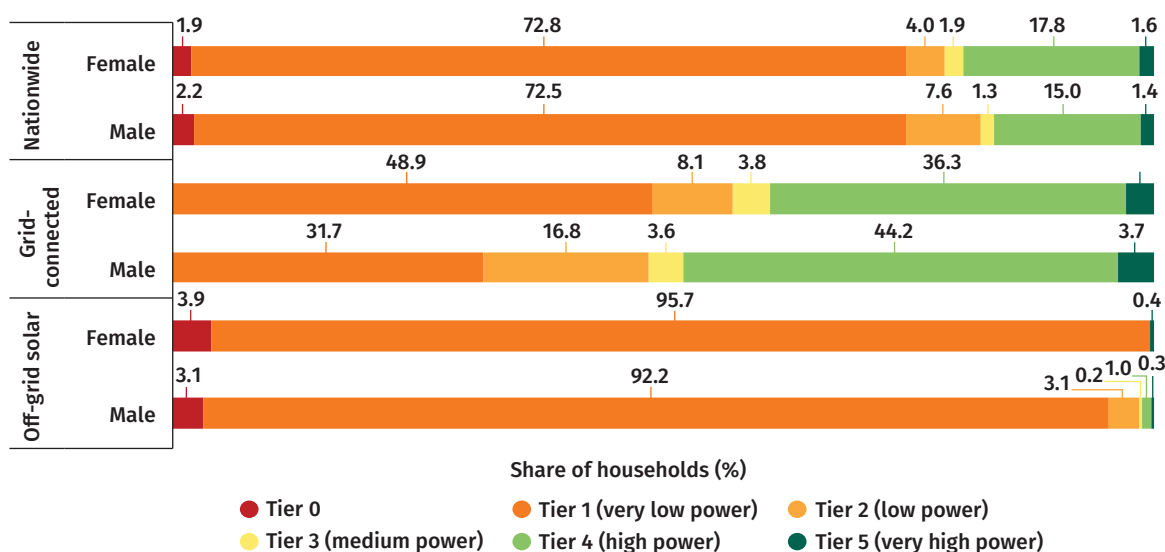


Source: Original compilation based on 2021 MTF survey results.

³³ For a definition of the MTF electricity tier distribution, please see annex 1.

Appliance ownership shows little gender disparity at the national level (figure 4.6). However, a significant gap appears among grid-connected households, with 49 percent of female-headed households owning only very low power appliances, compared with just 32 percent of male-headed households. In contrast, the gender gap for off-grid solar households is much smaller.

FIGURE 4.6 • Appliance ownership among electrified households, by load level and sex of the household head (nationwide, grid, off-grid solar)

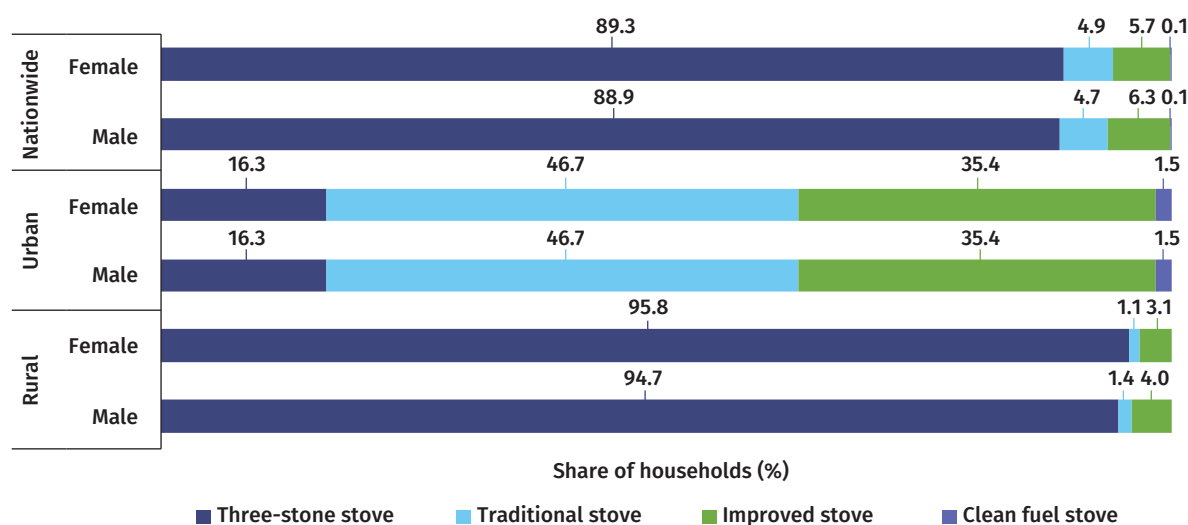


Source: Original compilation based on 2021 MTF survey results.

MEASURING ACCESS TO MODERN ENERGY COOKING SERVICES BY GENDER

Nationwide, access to modern energy cooking services is comparable for female- and male-headed households (figure 4.7). This parity extends to both urban and rural areas.

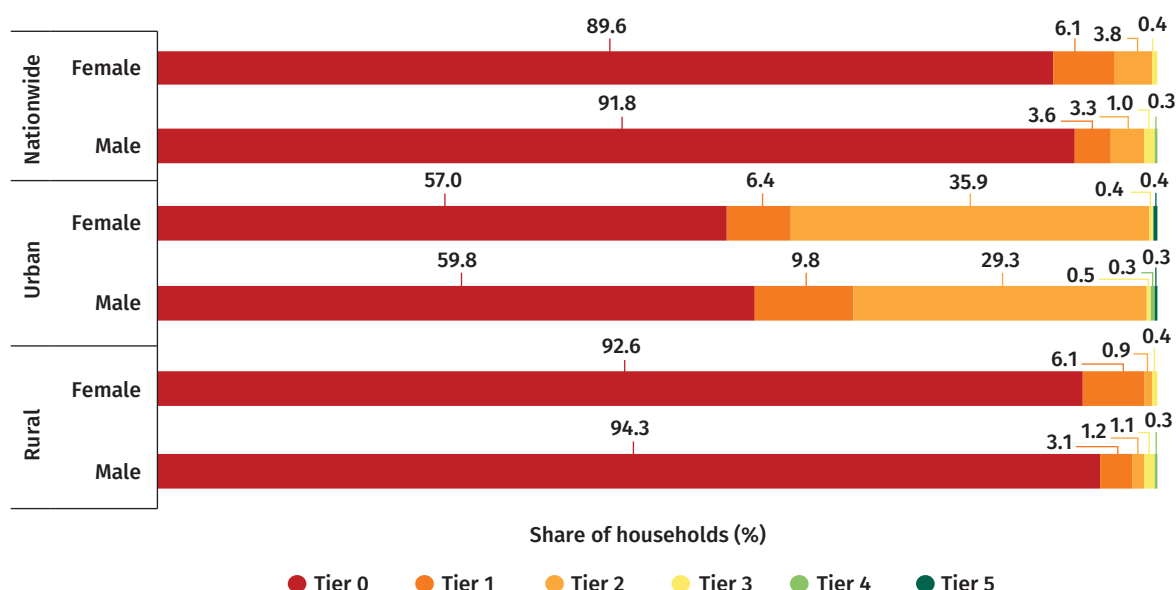
FIGURE 4.7 • Access to cooking services, by type of primary cookstove and sex of the household head (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

Nationwide, the Multi-Tier Framework (MTF) tier distribution for modern energy cooking services shows minimal gender gaps (figure 4.8). In urban areas, female-headed households are less likely to fall in Tier 0 and more likely to reach Tier 2 and above.

FIGURE 4.8 • MTF cooking tier distribution, by sex of the household head (nationwide, urban, rural)



Source: Original compilation based on 2021 MTF survey results.

POLICY RECOMMENDATIONS

Female-headed and other vulnerable households require support through targeted pro-poor interventions, such as interest-free credit, flexible connection fee payments, subsidized connections, and lifeline tariffs. Female-headed households are financially and socially more vulnerable than male-headed households and are less likely to have access to electricity, particularly to off-grid solutions. Meanwhile, further research is needed to identify access barriers for both female- and male-headed households.

While male- and female-headed households generally have equal access to modern energy cooking services nationwide, culturally sensitive service design is crucial. Research should explore culinary traditions, fuel preferences, acquisition methods, and barriers to clean cooking. Targeted financing mechanisms are needed to address affordability for vulnerable and female-headed households. Education campaigns for both genders are essential to promote clean and efficient cooking.

A photograph of a large industrial facility, possibly a power plant or manufacturing plant. The image shows a high ceiling with a complex steel truss structure and several yellow overhead cranes. Large blue pipes run diagonally across the frame. In the foreground, a person in a dark jacket is standing next to a row of electrical control panels, looking at them. Another person in a white shirt and hard hat is visible on a raised platform on the right. The scene is lit with a mix of warm and cool lights, creating a blue-tinted overlay on the left side.

5. ACCESS TO ELECTRICITY IN EDUCATION AND HEALTH FACILITIES

KEY MESSAGES

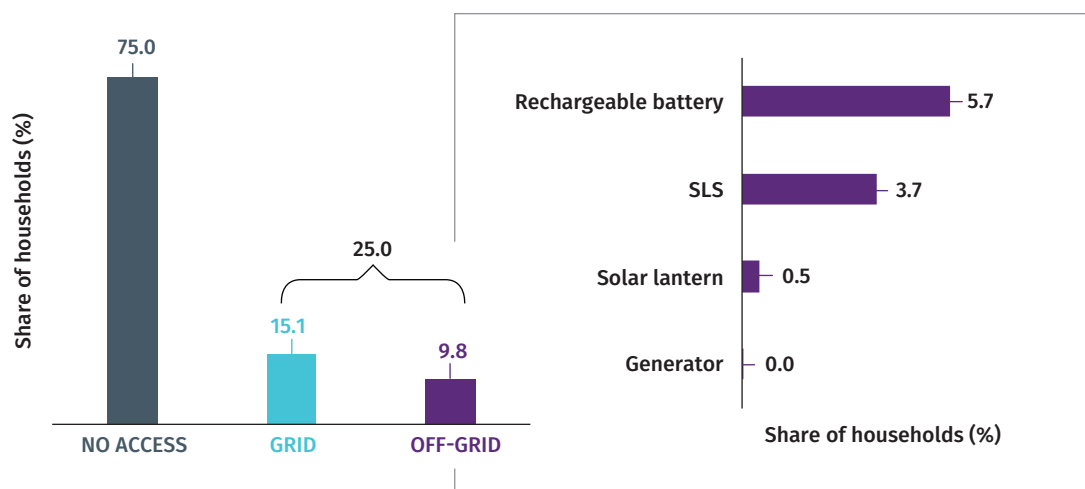
- **A vast majority of education facilities—especially in rural areas—lack access to electricity.** The electrification rate for education facilities is just 25 percent nationwide, with a significant urban-rural divide: 78 percent of urban facilities have electricity compared with only 22 percent of rural facilities.
- **A large majority of health facilities—85 percent nationwide—have access to electricity.** While urban facilities are all electrified, rural facilities also have a high electrification rate of 84 percent. Off-grid solar solutions are more common than grid connections in rural facilities.

ACCESS TO ELECTRICITY IN EDUCATION FACILITIES

The Multi-Tier Framework (MTF) survey in Burundi covered 396 education facilities, 94 percent of which are in rural areas. Elementary/middle schools constituted 77 percent of the sample, followed by general (17 percent) and technical (4 percent) secondary schools. Only 9 percent of these facilities provide on-campus meals, primarily using three-stone fires and collected wood.

Only 25 percent of education facilities have access to electricity (figure 5.1). Approximately 15 percent are grid connected and 10 percent use off-grid solutions, mainly rechargeable batteries (6 percent) and solar lighting systems (4 percent). Most (86 percent) facilities without access to electricity lack any lighting source, whereas 12 percent use flashlights or torches.

FIGURE 5.1 • Access to electricity in education facilities, by technology (nationwide)

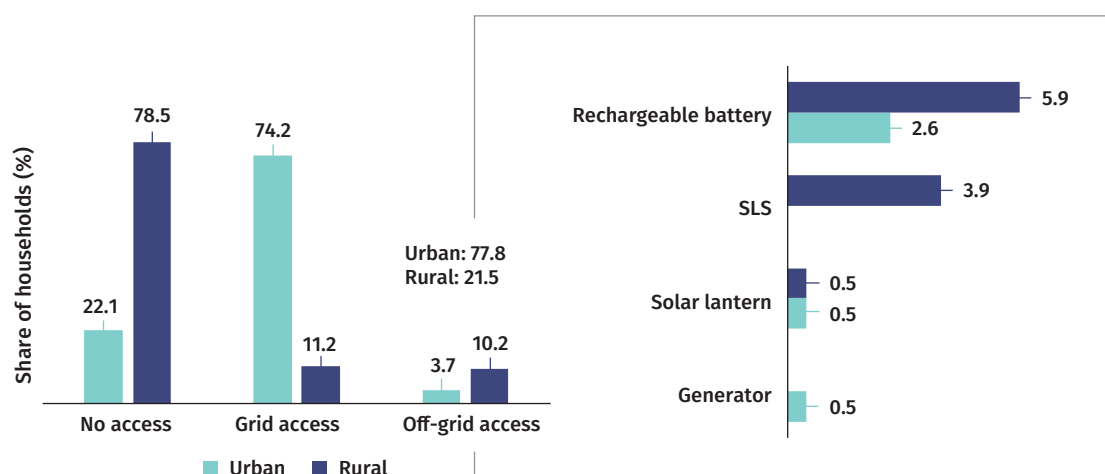


Source: Original compilation based on 2021 MTF survey results.

Note: SLS = solar lighting system.

Electrification of education facilities varies by location. In urban areas, 78 percent of education facilities have access to electricity, mainly through the grid (figure 5.2), whereas in rural areas, only 22 percent have electricity access, split evenly between a grid connection and off-grid solutions.

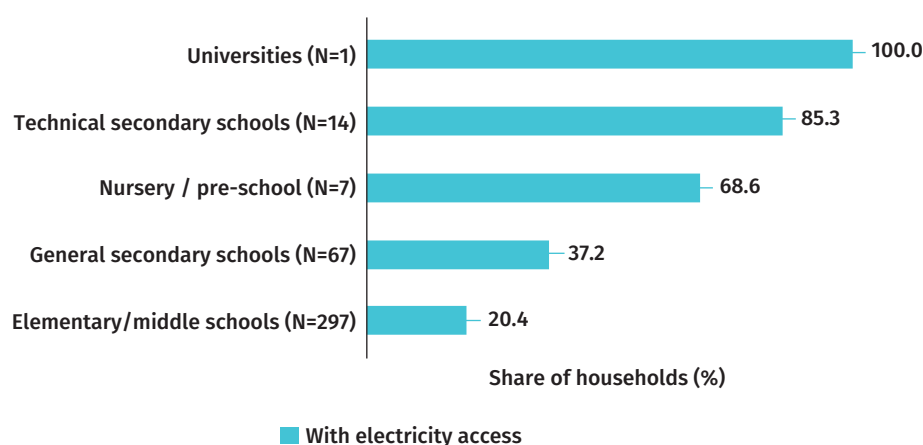
FIGURE 5.2 • Education facilities' access to electricity, by technology (urban, rural)



Source: Original compilation based on 2021 MTF survey results.

According to the Burundian Ministry of Education's 2018 diagnostic report on public schools, only 5 percent of 4,000 elementary/middle schools (*écoles fondamentales*), 36 percent of 980 secondary schools (*écoles post-fondamentales pédagogique générales*), and 67 percent of technical secondary schools (*écoles post-fondamentales techniques*) have functional electrical installations (off-grid solar or grid) (World Bank 2020). According to the MTF survey, 20 percent of elementary/middle schools and 37 percent of general secondary schools have electricity access (figure 5.3). Electricity access is higher in other facility types, though sample sizes are limited.

FIGURE 5.3 • Education facilities' access to electricity, by type of facility

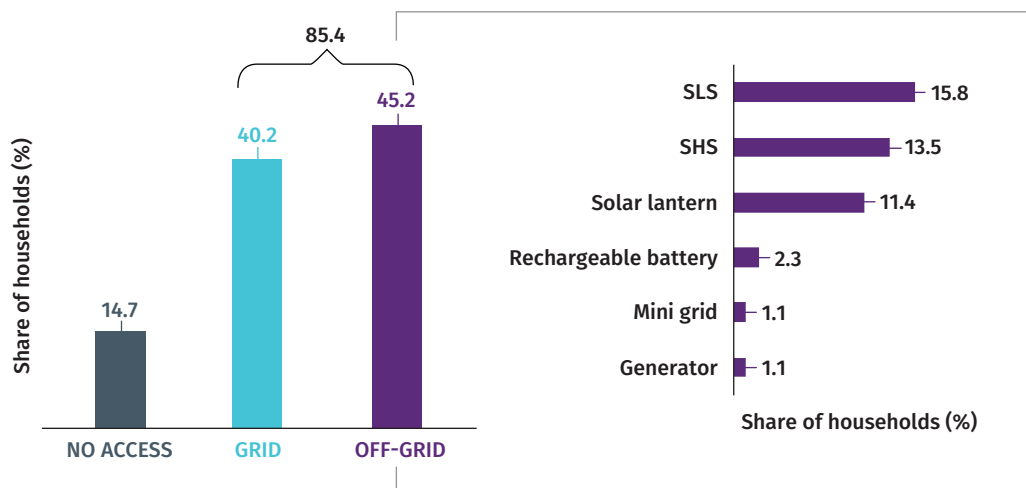


Source: Original compilation based on 2021 MTF survey results.

ACCESS TO ELECTRICITY IN HEALTH FACILITIES

The MTF survey in Burundi covered 189 health facilities, 91 percent of which are in rural areas. Health centers constituted 80 percent of the sample, followed by clinics and municipal hospitals (both 5 percent). Notably, 85 percent of health facilities have access to electricity, with a near-even split between grid (40 percent) and off-grid (45 percent); most of the off-grid solutions are solar (figure 5.4).

FIGURE 5.4 • Access to electricity in health facilities, by technology (nationwide)

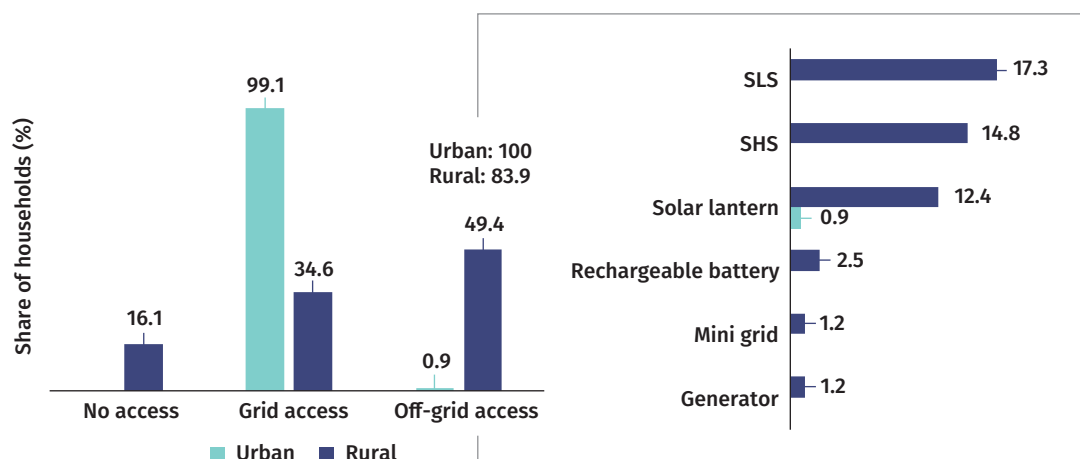


Source: Original compilation based on 2021 MTF survey results.

Notes: SHS = solar home system; SLS = solar lighting system.

Health facility electrification varies by location. In urban areas, 100 percent of facilities have access to electricity, primarily through the grid, although the sample size is small (16) (figure 5.5). Rural areas show 84 percent electrification, with 35 percent grid and 50 percent off-grid, mainly solar.

FIGURE 5.5 • Health facilities' access to electricity, by technology (urban, rural)

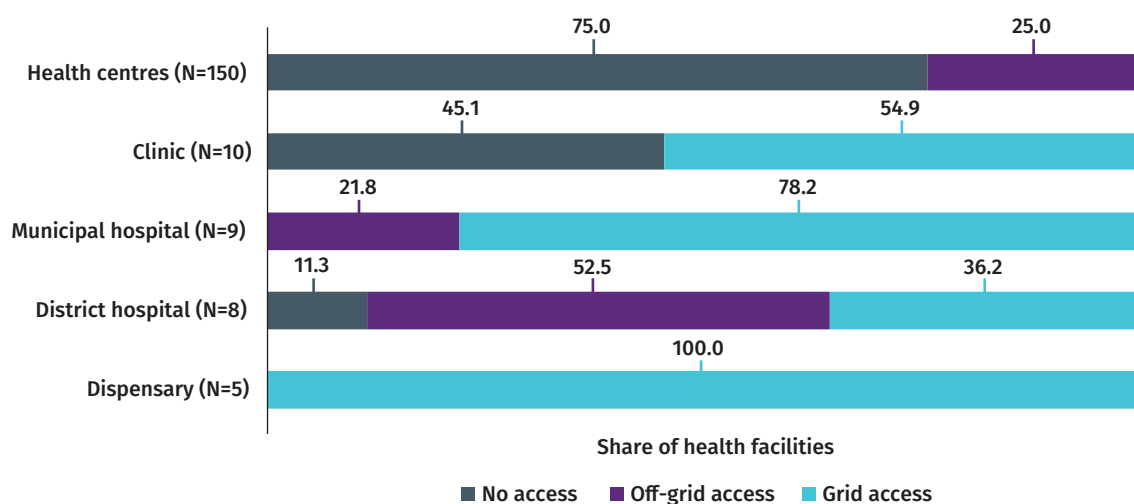


Notes: SHS = solar home system; SLS = solar lighting system.

According to the Belgian development agency ENABEL,³⁴ national, regional, and district hospitals in Burundi are typically electrified, although the performance of the electricity supply may not always be adequate. In contrast, only 30 percent of 943 health centers are electrified (11 percent through the grid and 19 percent via solar off-grid solutions) (World Bank 2020). Around 750 health centers offering vaccination services received self-standing solar fridges from the United Nations Children’s Fund, which also plans to install solar systems in health centers.

According to the MTF survey, hospitals report high levels of electrification (despite the small sample size) whereas only 25 percent of health centers are electrified—using off-grid solutions (mainly solar) (figure 5.6).

FIGURE 5.6 • Health facilities’ access to electricity, by facility type



Source: Original compilation based on 2021 MTF survey results.

³⁴ ENABEL financed solar systems in health centers, along with maintenance training centers.

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ANNEX 1 • MULTI-TIER FRAMEWORK FOR MEASURING ACCESS TO ELECTRICITY

The Multi-Tier Framework (MTF) measures electricity access provided by any technology (grid or off-grid) used as a main source of electricity, through seven attributes that capture key characteristics of the energy supply that affect the user experience. Households without any source of electricity (also including those using dry-cell batteries as their main source) are designated as having **no access** to electricity.

The seven attributes are Capacity, Availability, Reliability, Quality, Affordability, Formality, and Health and Safety. Based on the combination of the attributes, the MTF defines six tiers of access with minimum requirements, ranging from Tier 0 (no access) to Tier 5 (full access) along a continuum of improvement (table A1.1). Each attribute is assessed separately, and the overall tier of electricity access for each user (household, enterprise, education facility, or health facility) is calculated by applying the lowest tier obtained in any of the attributes.

TABLE A1.1 • The Multi-Tier Framework for measuring access to electricity

Attributes	Indicator	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity	Peak power capacity ratings (in W or daily Wh)	< 3W	Min 12 Wh	Min 200 Wh	Min 1 kWh	Min 3.4 kWh	Min 8.2 kWh
Availability	Hours per day (24 hours)	< 4 hrs	Min 4 hrs		Min 8 hrs	Min 16 hrs	≥23 hrs
	Hours per evening (6–10pm)	< 1 hr	Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	
Reliability	Number and duration of disruptions per week	>14 disruptions per week				Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hours
Quality	Voltage problems damage appliances	No				Yes	
Affordability	Cost of standard consumption package as a share of total HH expenditure	≥ 5%			< 5%		
Formality	HH pays for electricity	No				Yes	
Health and Safety	Past accidents	Yes				No	

Notes: HH = household; W = watt; Wh = watt-hour.

The attributes are defined and discussed below.

CAPACITY (WHAT APPLIANCES CAN BE POWERED?)

The Capacity attribute of the main electricity source (or peak capacity) is the ability of the system to provide a certain amount of electricity to operate various appliances, ranging from a few watts for light-emitting diode lights and mobile phone chargers to several thousand watts for space heaters or air conditioners. Capacity is measured in watts for the grid, mini-grids, and generators and in watt-hours for rechargeable batteries, solar lanterns, solar lighting systems (SLSs), and solar home systems (SHSs). It is often difficult to determine the Capacity of the system by simple observation. Thus, Capacity is approximated either based on the electricity source or based on the appliances owned by the surveyed entity (e.g., a household). Appliances are classified into tiers based on their power ratings. The Appliance tier of a surveyed entity corresponds to the highest tier of all the appliances it owns. For example, if a household owns several appliances, the highest-load appliance determines the Appliance tier for the household and thus the Capacity tier. If a household does not own any appliance (in working condition)—including lighting—the Capacity tier is 0. Households without any access to electricity (and households using dry-cell batteries as the main electricity source) fall by default into Capacity tier 0. All households are included in the calculation of this attribute. The tiers of various electricity sources are outlined below.

Grid: Capacity is by default Tier 5.

Mini-grid: Capacity is Tier 5, unless the entity surveyed (e.g., household) experiences a load limit or cannot power all its appliances, in which case the Capacity tier corresponds to the highest appliance tier reached by the appliances (in working condition) owned by the entity.

Generator and rechargeable battery: Capacity corresponds to the highest Appliance tier reached by the appliances (in working condition) owned by the household.

Solar home system: Capacity is by default Tier 2, unless the household owns appliances that reach an Appliance tier above Tier 2, in which case the Capacity tier will correspond to the highest Appliance tier reached by the appliances (in working condition) owned by the household.

Solar lantern and solar lighting system: Capacity tier is Tier 0 or Tier 1, depending on a score calculated based on the number and type of solar devices used, the number of household members, and the possibility of charging a mobile phone or powering a radio (box A1.1)

BOX A1.1 • CALCULATING THE CAPACITY TIER FOR SOLAR LANTERNS (SLS) AND SOLAR LIGHTING SYSTEMS (SLSS)

SLs and SLSs will fall in either Tier 0 or 1 depending on their score. The score will depend on (1) the possibility of charging a mobile phone or powering a radio (weight of 0.3) and (2) the level of the lighting service calculated based on the ratio of the number of people served with adequate lighting and the household size (weight of 0.7). The highest total score is capped at 1. To make things simple, it is estimated that an SL can serve one person with adequate lighting and an SLS can serve two people with adequate lighting. The average (mean) score is then calculated, including all scores above 0 and below 1. The mean score will determine the benchmark below which a household is placed in Tier 0 and above which a household is placed in Tier 1. Since all solar devices used in the household are taken into account (not only the main solar device), the lighting score for each household will be calculated based on the number and type of solar devices. If any of the devices used has the possibility to charge a phone or power a radio, then the charging part of the score is 0.3 (if not, it is 0). Some indicative examples are provided in table A1.2 for clarification purposes.

TABLE A1.2 • Examples of calculating the solar lantern and solar lighting system (SL/SLS) score

Household	SL or SLS as main source	Number of SL	Number of SLS	Possibility of charge phone/ power radio from any of the devices?	Score for charging phone/ powering radio	Number of people served with adequate lighting	Household size (nb of hh members)	Ligthing score	Total score	Is score included in the mean?	Mean score	Tier
A	Yes	1		No	0	1	5	0.20	0.20	Yes	0.66	Tier 0
B	Yes		1	Yes	0.3	2	3	0.67	0.97	Yes	0.66	Tier 1
C	Yes	2		Yes	0.3	1+1	4	0.50	0.80	Yes	0.66	Tier 1
D	Yes		2	No	0	2+2	6	0.67	0.67	Yes	0.66	Tier 1
E	Yes	1	1	Yes	0.3	1+2	2	1.50	1.80	No	0.66	Tier 1
F	Yes	1		No	0	1	1	1.00	1.00	No	0.66	Tier 1
G	Yes		1	Yes	0.3	2	6	0.33	0.63	Yes	0.66	Tier 0
H	Yes	2		Yes	0.3	1+1	8	0.25	0.55	Yes	0.66	Tier 0
I	Yes		2	No	0	2+2	5	0.80	0.80	Yes	0.66	Tier 1
J	Yes	1	1	Yes	0.3	1+2	9	0.33	0.63	Yes	0.66	Tier 0

Notes: SL = solar lantern; SLS = solar lighting system.

Key questions related to the Capacity attribute are:

- What is the household's main source of electricity?
- If a mini-grid is the main source of electricity: Are you able to power all your appliances with the mini-grid? Is there a load limit?
- If a generator, solar home system, or rechargeable battery is the main source: How many [TYPE OF APPLIANCE] in working condition does your household own?
- If an SL or SLS is the main source: How many light bulbs do [ALL SOLAR DEVICES] have? Can you charge a phone with [ALL SOLAR DEVICES]? Can you power a radio with [ALL SOLAR DEVICES]?
- What is the number of household members?

AVAILABILITY (“IS POWER AVAILABLE WHEN NEEDED?”)

The Availability of the main electricity source refers to the number of hours during which electricity is available. It is measured through two indicators: daily Availability, measured by the total number of hours per day (24-hour period) and evening Availability, measured by the number of evening hours (the four hours after sunset) during which electricity is available. Availability is measured only for households with access to electricity. Initially, the Availability attribute was named the Duration attribute. Only households with access to electricity are included in the calculation of this attribute.

The questions related to this attribute are:

- How many hours of electricity (maximum 24 hours) are available each day and night from [MAIN SOURCE]?
- How many hours of electricity are available during the evening (between 6pm and 10pm) from [MAIN SOURCE]?

RELIABILITY (“IS SERVICE FREQUENTLY INTERRUPTED?”)

The Reliability of the main electricity source is measured through a combination of the frequency and duration of unscheduled outages or blackouts. Reliability is measured only for households with access to the grid and a mini-grid.

The questions related to this attribute are:

- How many unscheduled outages/blackouts occur in a typical week?
- What is the total duration (hours and minutes) of all the unscheduled outages/blackouts in a typical week?

QUALITY (“WILL VOLTAGE FLUCTUATIONS DAMAGE MY APPLIANCES?”)

The Quality attribute of the main electricity source is defined by voltage adequacy. Electric appliances generally require a certain level of voltage to operate properly. Inadequate or fluctuating voltage can damage appliances and even result in electrical fires. A low or fluctuating voltage supply tends to result from an overloaded distribution system or from long-distance low-tension cables connecting dispersed households to a single grid. The MTF survey does not measure voltage adequacy directly but uses incidents of appliance damage as a proxy. Quality is only measured for households with access to the grid or a mini-grid.

The question related to this attribute is:

- In the past 12 months, did any of your appliances get damaged because the voltage from [MAIN SOURCE] was going up and down?

AFFORDABILITY (“CAN A HOUSEHOLD AFFORD TO PURCHASE THE MINIMUM AMOUNT OF ELECTRICITY?”)

The Affordability attribute of the main electricity source is determined by comparing the yearly cost of a standard electricity service package (30 kilowatt-hour [kWh] per month for one year) with total household expenditure. Total household expenditure corresponds to the aggregated and annualized amount of money that a household spends on goods and services—including the value of consumption of 13 categories of food items during the past week, of 8 categories of goods and services during the past month (such as medical expenses, house rent, and utility bills), and 13 categories of good and services purchased during the past year (such as education expenses, clothing, electronics, and vehicles). Electricity cost is calculated based on the corresponding grid tariff in the country. If the household spends more than 5 percent of household expenditure on electricity, then the electricity service is considered unaffordable for that household. Affordability is measured only for households with access to the grid (and a mini-grid for certain countries).

FORMALITY

The Formality attribute of the connection to the main electricity source is determined based on whether the household pays for the electricity used (supplied by the grid or a mini-grid). Reporting on the Formality of a connection is challenging. Households may be sensitive about disclosing such information in a survey. The MTF survey therefore asks the household who is the recipient of the payment of the electricity bill. The connection is considered informal if the recipient of the payment is “no one.” Formality is measured only for households with access to the grid (and a mini-grid for certain countries). Initially, the Formality attribute was named the Legality attribute.

The question related to this attribute is:

- Who receives the payment for your electricity service?

HEALTH AND SAFETY

The Health and Safety attribute of the main electricity source is determined based on whether household members have experienced any permanent injury or death in the past 12 months because of the main electricity source (such as burns or electrocution). Such accidents can occur due to faulty wiring, incorrect use of or faulty appliances, or negligence. Health and Safety is measured only for households with access to the grid (and a mini-grid in certain countries).

The question related to this attribute is:

- In the past 12 months, did any household members die or have permanent injury because of [MAIN SOURCE]?

ANNEX 2 • SOLAR OFF-GRID SOLUTIONS IN BURUNDI

Several examples of popular solar lanterns, lighting systems, and home systems are graphically represented in table A2.1.

TABLE A2.1 • Examples of solar off-grid solutions

Brand name	Solar lantern	Solar lighting system	Solar home system
Sun King	Pico Plus 	Home 60 	Home 400 
	Pro 200 	Home 120 	
	Pro 300 		
	Boom 		

Bright Products	SunBell Smart  Start+ 	Home 29 	
d.light	A2  S3  S30  S200/T200 		

ANNEX 3 • MULTI-TIER FRAMEWORK FOR MEASURING ACCESS TO MODERN ENERGY COOKING SERVICES

The MTF measures access to modern energy cooking services (MECS), provided by any cookstove and fuel, using six attributes that capture key characteristics of the cooking services that affect the user experience: Cooking Exposure, Cookstove Efficiency, Convenience, Safety, Affordability, and Fuel Availability. Based on the combination of the attributes, the MTF defines six tiers of access with minimum requirements, ranging from Tier 0 (no access) to Tier 5 (full access) along a continuum of improvement (see table A3.1). Each attribute is assessed separately, and the overall tier of access to MECS for each user (household, enterprise, education facility, or health facility) is calculated by applying the lowest tier obtained in any of the attributes.

TABLE A3.1 • The Multi-Tier Framework for measuring modern energy cooking services (MECS)

Attribute	Indicator	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Exposure	Default ventilation*						
	PM2.5 (mg/MJd) and	>1030	≤1030	≤481	≤218	≤62	≤5
	CO (g/MJd)	>18.3	≤18.3	≤11.5	≤7.2	≤4.4	≤3.0
	High Ventilation*						
	PM2.5 (mg/MJd) and	>1489	≤1489	≤733	≤321	≤92	≤7
	CO (g/MJd)	>26.9	≤26.9	≤16.0	≤10.3	≤6.2	≤4.4
Exposure	Low Ventilation*						
	PM2.5 (mg/MJd) and	>550	≤550	≤252	≤115	≤32	≤2
	CO (g/MJd)	>9.9	≤9.9	≤5.5	≤3.7	≤2.2	≤1.4
Cookstove Efficiency	ISO’s voluntary performance targets	≤10%	> 10%	> 20%	> 30%	> 40%	> 50%
Convenience	Fuel acquisition and preparation time (hours per week) ^a	≥7		< 7	< 3	< 1.5	< 0.5
	Stove preparation time (minutes per meal) ^b	≥10			< 10	< 5	< 2
Safety	Severity of accidents caused by the stove over the past year ^c	Fatal	Serious		Minor	None	
Affordability	Fuel cost as a share of household expenditure ^d	≥ 10%			< 10%	< 5%	
Fuel Availability	Availability ^e of primary fuel when needed (% of the year) ^f	Rarely			Some-times	Mostly	Always

Notes: *ISO's voluntary performance targets on emissions; CO = carbon monoxide; g = gram; ISO = International Organization for Standardization; mg = milligram; MJd = megajoule delivered; PM = particulate matter. The old framework was applied in the MTF Country Diagnostic Report for Bangladesh, Cambodia, Ethiopia, Honduras, Kenya, Liberia, Myanmar, Niger, Nigeria, Nepal, Rwanda, São Tomé and Príncipe, and Zambia. The MTF website data follow the new framework for all countries.

a. In the old framework, the thresholds were: ≥ 7 (Tier 1); < 7 (Tier 2); < 3 (Tier 3); < 1.5 (Tier 4); < 0.5 (Tier 5).

b. In the old framework, the thresholds were: ≥ 15 (Tier 1); < 15 (Tier 2); < 10 (Tier 3); < 5 (Tier 4); < 2 (Tier 5).

c. In the old framework, the thresholds were: Serious (Tier 3); Not serious (Tier 5).

d. In the old framework, the thresholds were: ≥ 5% (Tier 3); < 5% (Tier 5).

e. In the MTF survey questionnaire, the options offered to respondents are: Rarely available (Tier 2); Sometimes available (Tier 3); Mostly available (Tier 4); Always available (Tier 5).

f. In the old framework, the thresholds were: < 80% (Tier 3); > 80% (Tier 4); 100% (Tier 5).

Each attribute is defined as follows.

COOKING EXPOSURE

The Cooking Exposure attribute refers to the personal exposure to pollutants from cooking activities, which depends on stove emissions, ventilation structure (which includes cooking space location and kitchen volume), and contact time (time spent in the cooking environment).³⁵ It is a proxy indicator to measure the health impacts of cooking activities on the household's main cook. In the MTF, Cooking Exposure is determined by two indicators: (1) emissions of the main cookstove and (2) ventilation of the main cooking area.

Cookstove Emissions tiers are defined based on the International Organization for Standardization (ISO) methodology. In case of missing data, approximate tiers are established (see table A3.2).³⁶ Ventilation tiers are defined based on the location of the main cooking area and the number of openings to the outside (see table A3.3). Cooking Exposure tiers are derived from the combination of Cookstove Emissions tiers and Ventilation tiers (see table A3.4).

The questions related to this attribute are as follows.

Cooking emissions

- In the past 12 months, which cookstove(s) did your household use for preparing meals (including cooking, boiling water, baking, or other purposes)?
- Is this [COOKSTOVE] your main cookstove for cooking meals?
- What exhaust system, in working condition, do you use with [MAIN COOKSTOVE]?

Ventilation of cooking space

- In the past 12 months, where did you normally cook with [MAIN COOKSTOVE]?
- What exhaust system, in working condition, do you use with [MAIN COOKSTOVE]?
- How many doors and windows (opening to the outside) does the cooking space have?

TABLE A3.2 • Cookstove emissions tiers

EMISSIONS TIER	COOKSTOVE TYPE
TIER 0	Three-stone stove
TIER 1	Traditional stove ^a or improved cookstove ^b without embedded exhaust system ^c
TIER 2	Improved cookstove with embedded exhaust system
TIER 3	Kerosene stove or biomass rocket stove with high insulation
TIER 4	Clean fuel stove (biogas) or processed biomass gasifier stove
TIER 5	Clean fuel stove (electricity, ethanol, liquefied petroleum gas, piped natural gas, or solar)

a. Traditional stoves refer to fixed/self-made stoves, traditional metal stoves, and self-built/traditional stoves.

b. Improved cookstoves include rocket stoves (chimney, fan, and grate), ceramic stoves, ceramic stoves in metal buckets, and locally manufactured

³⁵ Due to data quality issues, kitchen volume and contact time are not used to calculate Cooking Exposure in MTF survey data.

³⁶ Cookstove emissions are estimated for the main cookstove used in the household for preparing meals (including cooking, boiling water, baking, or other purposes).

kerosene stoves.

c. A chimney, fan, or grate attached to the cookstove (as observed on product flyer).

TABLE A3.3 • Ventilation tiers

VENTILATION TIER	COOKING AREA
TIER 0 (BAD)	Cooking inside without external exhaust system ^a and no opening ^b
TIER 1 (BAD)	Cooking inside without external exhaust system, with one opening
TIER 2 (BAD)	Cooking inside without external exhaust system, with two or more openings
TIER 3 (MEDIUM)	Cooking inside with external exhaust system (regardless of number of openings)
TIER 4 (GOOD)	Cooking on a veranda
TIER 5 (GOOD)	Cooking in the open air

a. The exhaust system refers to a fan attached to the fireplace, a chimney, or a hood, and the information is provided by the respondent.

b. An opening refers to a door or a window to the outside.

TABLE A3.4 • Cooking exposure tiers

COOKING EXPOSURE TIER	EMISSIONS TIER AND VENTILATION LEVEL
TIER 0	Emission Tier 0 with bad or medium ventilation Emission Tier 1 with bad ventilation
TIER 1	Emission Tier 0 with good ventilation Emission Tier 1 with medium ventilation Emission Tier 2 with bad ventilation
TIER 2	Emission Tier 1 with good ventilation Emission Tier 2 with medium ventilation Emission Tier 3 with bad ventilation
TIER 3	Emission Tier 2 with good ventilation Emission Tier 3 with medium ventilation
TIER 4	Emission Tier 3 with good ventilation Emission Tier 4 with medium or bad ventilation
TIER 5	Emission Tier 4 with good ventilation Emission Tier 5 regardless of ventilation level

COOKSTOVE EFFICIENCY

The Cookstove Efficiency attribute is determined based on a combination of combustion efficiency and heat transfer efficiency. Cookstove Efficiency is assessed based on laboratory measurement under standard conditions or field testing under actual conditions. In cases where the cookstove also serves for space heating, the efficiency parameter is ignored (because heat transfer efficiency becomes irrelevant). Due to lack of data, Cookstove Efficiency could not be assessed in MTF surveys.

CONVENIENCE

The Convenience attribute refers to the amount of time household members spend collecting or purchasing fuel and preparing the fuel and stove for cooking. Thus, the Convenience attribute combines

two indicators: (1) fuel acquisition and preparation time (hours/week), and (2) stove preparation time (minutes/meal). The lowest tier of each of the two indicators determines the overall Convenience tier. The tier thresholds for this indicator have been updated.

The questions related to this attribute are:

Fuel acquisition and preparation time (hours per week)

- In a typical day, how many minutes in total do [ALL HOUSEHOLD MEMBERS] spend gathering, collecting, or purchasing fuels for the household and home-based income-generating activities, including travel time?
- In a typical day, how many minutes in total do [ALL HOUSEHOLD MEMBERS] spend on fuel preparation (i.e., combined time of chopping wood, igniting wood for starter, turning on the stove)?

Stove preparation time (minutes per meal)

- How much time do household members spend preparing the [MAIN COOKSTOVE AND MOST USED FUEL] for each meal on average (including setting up the fuel and turning on the stove but excluding gathering fuel and cooking time)?

AFFORDABILITY

The Affordability attribute refers to the household's ability to pay for cooking fuels. It is measured based on the annual cost of all fuels used for cooking as a share of total annual household expenditure. Total household expenditure corresponds to the aggregated and annualized amount of money that a household spends on goods and services—including the value of consumption of 13 categories of food items during the past week, of 8 categories of goods and services during the past month (such as medical expenses, house rent, and utility bills), and 13 categories of good and services during the past year (such as education expenses, clothing, electronics, and vehicles). The tier thresholds for this indicator have been updated.

The questions related to this attribute are:

- What unit do you purchase/collect [ALL COOKING FUELS] in (e.g., kg, liter, etc.)?
- How often do you or a household member purchase/collect [ALL COOKING FUELS]?
- How much [ALL COOKING FUELS] do you buy or collect each time?
- How much [LOCAL CURRENCY] on average do you pay for the amount of [UNIT] that you purchase each time?

FUEL AVAILABILITY

The Fuel Availability attribute refers to the availability of the fuel most often used in the main cookstove used for cooking meals. Fuel shortage can force a household to switch to inferior fuel types. The tier thresholds for this indicator have been updated.

The question related to this attribute is:

- In the past 12 months, how many times was the [MOST USED FUEL FOR MAIN COOKSTOVE] available?

SAFETY

The Safety attribute of the main cookstove is determined based on the severity of reported accidents in the past 12 months caused by the main cookstove used for cooking meals. The tier thresholds for this indicator have been updated.

The question related to this attribute is:

- In the past 12 months, what kind of illness/injury has your household been exposed to as a result of [MAIN COOKSTOVE]?

ANNEX 4 • COOKING SOLUTIONS IN BURUNDI

TABLE A4.1 • Photographs of stove types common in Burundi

Three-stone stove			
			
Traditional stoves			
Foyer ya Tsinga		Thai-bucket	
			
Double-tête	Foyer Congo	Foyer Ya jante	Foyer métallique
			
Improved cookstoves			
Foyer Biikigiti céramique	Foyer Biikigiti métallique	Foyer fixe	Foyer Canarumwe céramique (ILF) ³⁷
			

Nyayo (improved Thai-bucket) 	Kamaro 	Foyer Inyarwanda 	Foyer Onatour 
Clean fuel stoves			
Biogas stove 	Electric stove 		

ANNEX 5 • SAMPLING STRATEGY FOR THE MTF SURVEY IN BURUNDI

SAMPLE SIZE

The MTF survey in Burundi is a multistage survey designed to have a 50:50 ratio between urban and rural areas (first stage) and a 50:50 ratio of (grid) electrified and nonelectrified households (second stage). The sample size was determined using the formula and assumptions listed in table A5.1.

TABLE A5.1 • Formula and assumptions in calculating the sample size

$$n = \frac{z^2 r(1-r)fk}{e^2} = \frac{z^2 r(1-r)[1 + \rho(m-1)]k}{e^2}$$

where:

Symbol	Value	Description
z	1.96	Z-statistics corresponds to the level of confidence desired. The commonly used level of confidence is 95 percent, for which z is 1.96
r	0.5	Estimate indicator of interest to be measured by the survey (50 percent is most conservative for calculating n)
f	4.85	Sample design effect. It represents how much larger the squared standard error of a two-stage sample is compared with the standard error of a simple random sample of the same size. The sample design effect has been included in the sample size calculation formula and is defined as $f = 1 + \rho(m - 1)$.
ρ	0.35	Intracluster correlation coefficient. It is a number that measures the tendency of households within the same primary sampling unit (PSU) to behave alike with regard to the variable of interest.
m	12	The average number of households selected per PSU
k	1.1	Factor accounting for nonresponse (assume 10 percent)
e	5%	The margin of error (5 percent is standard)
n	2,052	Sample size in terms of the number of households to be selected
	342	Number of PSUs required (171 rural and 171 urban)

At a national level, the formula yields a sample size of 2,052 households. However, to meet the urban-rural parity (50-50), we treated the two categories as separate analytical domains and doubled the sample size, bringing the total to 4,104 households. The total number of primary sampling units (PSUs) to be covered was 342.

SAMPLING FRAME

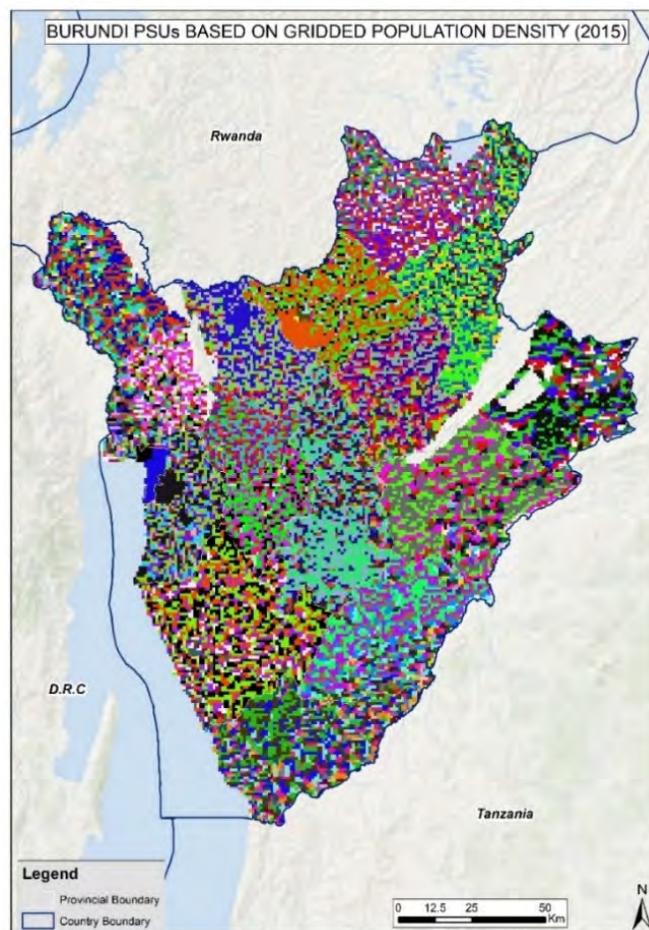
During the inception phase, the initial plan was to utilize the national census sampling frame from l'Institut National de la Statistique du Burundi (ISTEEBU). However, the absence of a recent census (the last one being from 2008) necessitated a more creative approach. To overcome this limitation, a spatial algorithm developed by EED Advisory, the National Autonomous University of Mexico (UNAM), and the Stockholm Environment Institute was used as a sampling frame. This innovative solution allowed us to construct a national sampling frame with PSUs averaging 241 households. While this adaptive methodology enabled us to proceed with the study, it is important to acknowledge the variability in household numbers across these PSUs (table A5.2).

TABLE A5.2 • Distribution of households in selected primary sampling units (PSUs)

Number of households	Number of PSUs
Less than 199	149
200–399	177
400–599	9
600–799	6
800–999	3
Above 1,000	1

The process of generating PSUs for Burundi involved the integration of raster and vector data derived from multiple sources. The raster data, sourced from the Socioeconomic Data and Applications Center, utilized the World Gridded Population Density Version 4.11 (CIESIN 2018) (map A5.1). This comprehensive data set offers a detailed representation of global population distribution. The initial step in this process entailed downloading the aforementioned raster data set, which subsequently served as the basis for subsequent spatial analysis.

MAP A5.1 • Map showing Burundi primary sampling units based on gridded population density (GPWv4), 2015



PROJECTIONS OF POPULATION

According to the official population projections for Burundi in 2021, the country's population was estimated to be 12,551,213 (World Development Indicators). By assuming an average household size of 4.85, we calculated the number of households to be 2,587,879 (table A5.3). Population projections derived from the survey data yielded a nationwide total of 2,523,748 households, a difference of 64,131 households compared to the official estimates.

TABLE A5.3 • Population in Burundi, by source

Source	Population			No of households			Urbanization (%)
	Total	Urban	Rural	Total	Urban	Rural	
World Development Indicators (2015)	10,727,148	1,295,625	9,431,523	2,211,783	267,139	1,944,644	12.1
Sampling Frame 2015 estimate from SEDAC	9,708,726	697,201	9,011,525	2,001,799	143,753	1,858,046	7.2
World Development Indicators (2021)	12,551,213	1,764,450	10,786,763	2,587,879	363,804	2,224,075	14.1
MTF survey (2021)	12,240,178	924,298	11,315,879	2,523,748	190,577	2,333,171	7.6

Notes: MTF = Multi-Tier Framework; SEDAC = Socioeconomic Data and Applications Center.

Once the raster data were acquired, they were imported into ArcMap, a geographic information system (GIS) software. To narrow the focus to Burundi, the global raster data was clipped or delineated to match the country's administrative boundaries. The vector data, representing the provinces and “*collines*” of Burundi, was also downloaded and added into ArcMap (OCHA 2017). Adjustments were made to ensure that the projection of both raster and vector data aligned seamlessly. Additionally, new columns, such as ID_pty (numerical codes for provinces) and ID_admin (numerical codes for the lowest administrative units), were added to the vector data set for processing in R using the spatial algorithm.

After preprocessing in ArcMap, the raster and vector data sets were exported for further processing in R software. R is employed to implement an algorithm designed to generate PSUs. These PSUs are delineated based on the administrative unit boundary (such as *colline* or *commune*) used in the administration vector data, with an average number of households of 241 per unit. However, to account for areas with high population density, such as cities and urban regions, additional steps were taken. In these areas, the raster data for areas with high population density were clipped and resampled (changing the resolution of the raster data set) by “downsampling”³⁸ to ensure that the generated units aligned more accurately with the projected population size, maintaining the representativeness of the sampling process.

Generally, Burundi PSUs' generation involved raster and vector data acquisition, preprocessing in ArcMap or QGIS to align and enhance the data sets, and further algorithmic processing in R to generate PSUs. The inclusion of population density information from the raster data and the adjustment of vector data based on administrative boundaries contribute to a more accurate and representative sampling approach for Burundi. However, this process can lead to data inaccuracies, particularly in densely populated areas where resampling may cause the loss of pixel values. This issue is particularly pronounced in urban areas with high population density, where pixels with both high and low values coexist. When adjusting high-value pixels, low-value pixels are often downsampled, leading to data loss. Additionally, the resampling process operates on cumulative pixels within the area of interest, resulting in most PSUs having the target values while a few are negatively impacted.

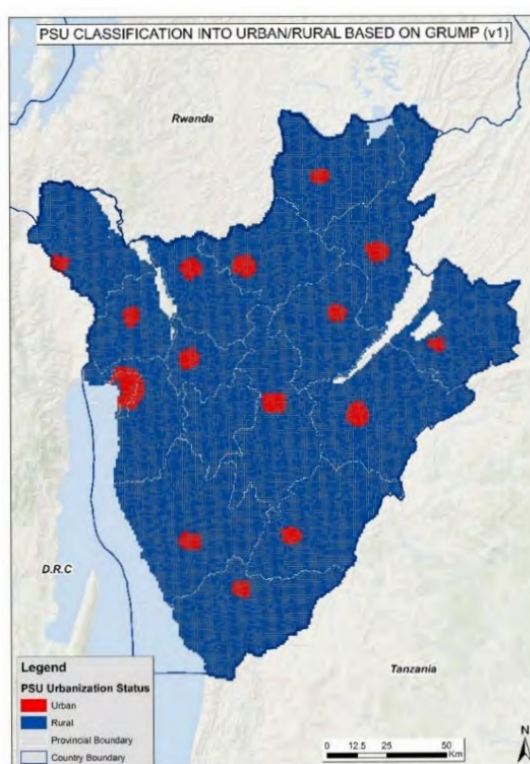
³⁸ Downsampling in this context refers to the process of adjusting the pixel resolution of the raster data. For instance, the default population density resolution is 1,000 by 1,000 meters (m). Downsampling will involve changing the resolution, especially in areas with high population density, to 400 m by 400 m or any other dimension based on mathematical calculation of the pixel with the highest value in the selected area.

TWO-STAGE STRATIFICATION

Urban-rural stratification

Once the PSUs were generated at the national scale, we classified them as either urban or rural using the Global Rural-Urban Mapping Project (GRUMP) data (map A5.2). This data set identifies urban areas based on factors such as population density, population count, and urban settlement patterns. PSUs located within these identified urban areas were categorized as urban, while the remaining PSUs were categorized as rural. To estimate the population of urban and rural areas, we counted the number of PSUs in each category and multiplied them by the average population size of a PSU. However, because the GRUMP data for Burundi is outdated, these estimates may not accurately reflect the current urban and rural populations in the country. Map A5.2 shows how the PSUs were stratified into urban and rural areas based on the 2015 GRUMP data. From each of these strata, we randomly selected 171 enumeration areas (EAs) at the national level. Using GRUMP data, we estimated the urban and rural populations as 697,201 and 9,011,525, respectively. This yields a 7.5 percent urbanization rate, lower than the official 2015 estimate of 12 percent.³⁹

MAP A5.2 • Urban-rural stratification of primary sampling units using the GRUMP v1 data set



Stratification based on electrification status

The second stage of stratification sought to achieve a 50:50 ratio between electrified and nonelectrified households. Due to low electrification rates, we needed to oversample electrified households within the 342 EAs. However, some EAs lacked national grid coverage and were ineligible for oversampling. We categorized EAs into electrified and nonelectrified using the following three steps.

³⁹ World Development Indicators.

Step 1: Isolation of electrified *collines* using ABER data

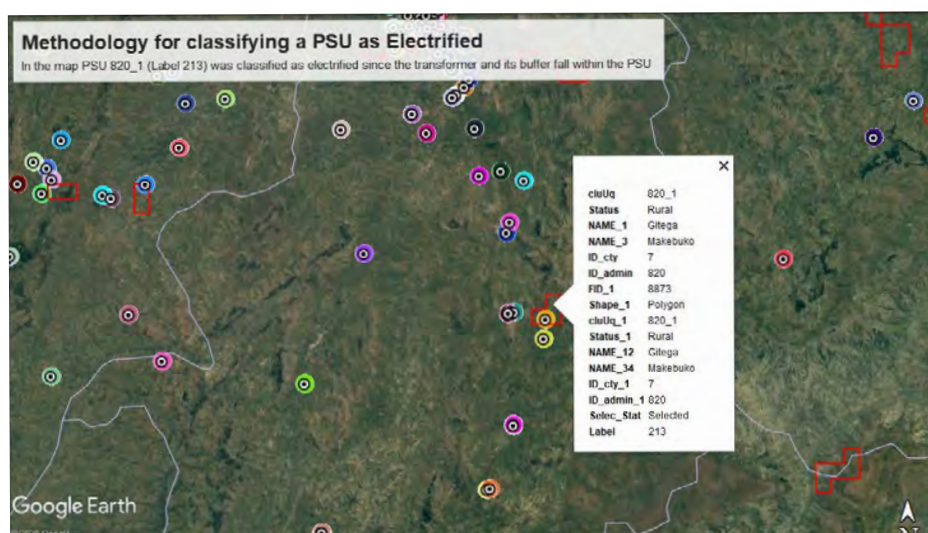
The rural electrification agency Agence Burundaise de l'Électrification Rurale (ABER) provided Excel-based data listing 16 *collines* equipped with transformers across four provinces: Ruyigi, Rumonge, Muramvya, and Karusi. These data were used to determine which rural PSUs within these four provinces were electrified. The electrified *collines* were isolated and selected on the ESRI ArcGIS platform. Subsequently, the *collines* were mapped onto the Google Earth platform, alongside the selected EAs in the four provinces, to determine whether the EAs and the electrified *collines* intersected. All EAs identified as intersecting with the electrified *collines* were classified as electrified. Based on the ABER data set, only one EA (in the Colline of Gasenyi in Ruyigi Province) was categorized as electrified. However, upon further verification by ABER and REGIDESO staff, it was determined that this EA was, in fact, nonelectrified.

Step 2: Overlaying REGIDESO transformer data with the 342 EAs

Next, REGIDESO's Excel-based transformer inventory was used to classify remaining EAs. These data, including transformer power ratings and geo-coordinates, were converted to shapefile format for processing on ArcGIS and Google Earth platforms.

- A 600-meter buffer was created around the transformers on the ESRI ArcGIS platform
- The transformers and their buffers were mapped out on Google Earth alongside the 342 EAs to isolate EAs that were either intersected by transformer buffers or had transformer(s) falling directly within them, as illustrated in figure A5.1.
- All 342 EAs were then analyzed using the abovementioned method and classified as electrified, nonelectrified, or needing further verification. EAs requiring additional verification were close to transformer buffers and were difficult to classify as nonelectrified correctly.
- An Excel list of all the EAs with associated data on their electrification status—the province, *colline*, commune name, and global positioning system (GPS) coordinates—was generated for further verification by REGIDESO and ABER staff.

FIGURE A5.1 • Primary sampling unit (PSU) classification process on Google Earth



Step 3: Additional verification by the REGIDESO team

The finalized list was sent to ABER and REGIDESO for verification using *colline* names. Collines, the second-smallest administrative unit (Hijmans 2015), were used as a reference point.⁴⁰ Given that an EA can encompass multiple *sous-collines*, *collines* were employed to facilitate a more straightforward classification of the EAs by the REGIDESO and ABER teams.

By utilizing the coordinates coupled with the *colline* data for each EA, the teams were able to verify 63 EAs that necessitated additional verification (37) or were incorrectly classified (26). The resulting classification yielded 175 electrified EAs and 167 nonelectrified EAs. This represents a relatively high number of electrified EAs in Burundi, where, given the low electrification rate of 11 percent, one would anticipate a lower number of electrified EAs. The elevated number of electrified EAs can be attributed to the high number of urban EAs (129/171) randomly selected from Bujumbura Mairie Province, which is characterized by a high level of electrification.

HOUSEHOLD LISTING

Initially, the classification between electrified and nonelectrified EAs was conducted utilizing night light satellite imagery (VIIRS DNB)⁴¹ obtained from the National Oceanic and Atmospheric Administration,⁴² resulting in the identification of 65 electrified EAs and 277 nonelectrified EAs. Subsequently, a more rigorous process (as outlined in the previous section) was implemented to reclassify the EAs, yielding a revised ratio of 174 electrified EAs (representing an additional 109 electrified EAs compared to the initial 65 EAs) versus 168 nonelectrified EAs.

This large difference between the two methods can be explained by the limitations of satellite imagery, especially in regions with low-quality electricity services and small EAs. Satellite images have a relatively low resolution and can be affected by factors like cloud cover, moonlight, and missing data. Additionally, satellite images may not be able to detect interior lighting, which can lead to an underestimation of electrification, especially in areas with intermittent power supply. In the case of Bujumbura Mairie, where many EAs are quite small, the low resolution of satellite images may not be able to accurately capture the presence of electricity. Ultimately, using actual ground-based data on transformers, combined with information from utility workers, provided a more accurate estimate of electrification in the region.

Owing to budgetary limitations, the household listing was not conducted in all 174 electrified EAs, but was limited to 65 EAs. Notably, the listing did not extend to the 109 electrified urban EAs situated within Bujumbura Mairie. The three criteria employed to select the 65 EAs included in the household listing are delineated below:

1. All rural EAs classified as electrified (25 EAs);
2. All urban EAs classified as electrified and falling outside Bujumbura Mairie province (20 EAs); and
3. Urban EAs in Bujumbura Mairie falling within a 2.5 kilometer radius of the province border (20 EAs).

⁴⁰ The lowest administrative unit is the *sous-colline*. ISTEEDU uses *sous-collines* as PSUs.

⁴¹ Visible Infrared Imaging Radiometer Suite—Day Night Band.

⁴² <https://www.noaa.gov/>.

The listing exercise identified the following three data points:

1. The head of the household (name, gender);⁴³
2. Electrification status of the household (connected to the grid or not); and
3. GPS coordinates of the household.

Approximately 23,000 households were listed. Of the 65 EAs, 12 had no electrification (10 in rural areas and 2 in urban areas), and 6 had low electrification rates, that is, less than 1 percent (5 in rural areas and 1 in an urban area) (table A5.4)

TABLE A5.4 • Listing results (electricity access)

No.	Province	Locality	EA	Total HH	Nonelectrified HH	Nonelectrified (%)	Electrified HH	Electrified (%)	Oversampling done
1.	Kayanza	Rural	1213_2	203	165	81.3	38	18.7	Yes
2.	Kirundo	Rural	1375_3	254	254	100.0	0	0.0	No
3.	Bujumbura Rural	Rural	166_4	487	446	91.6	41	8.4	Yes
4.	Bujumbura Rural	Rural	174_3	81	81	100.0	0	0.0	No
5.	Ngozi	Rural	2165_1	403	402	99.8	1	0.2	No
6.	Ngozi	Rural	2206_2	1,094	1,048	95.8	46	4.2	Yes
7.	Rutana	Rural	2435_2	207	186	89.9	21	10.1	Yes
8.	Bujumbura Rural	Rural	250_2	87	87	100.0	0	0.0	No
9.	Bubanza	Rural	27_14	452	196	43.4	256	56.6	Yes
10.	Bururi	Rural	320_2	203	203	100.0	0	0.0	No
11.	Bururi	Rural	326_1	356	356	100.0	0	0.0	No
12.	Bururi	Rural	360_5	46	46	100.0	0	0.0	No
13.	Rumonge	Rural	368_2	121	121	100.0	0	0.0	No
14.	Rumonge	Rural	372_2	149	134	89.9	15	10.1	Yes
15.	Rumonge	Rural	373_1	730	584	80.0	146	20.0	Yes
16.	Rumonge	Rural	374_8	20	20	100.0	0	0.0	No
17.	Bururi	Rural	388_2	229	227	99.1	2	0.9	No
18.	Bururi	Rural	390_3	53	47	88.7	6	11.3	No
19.	Bururi	Rural	401_4	168	167	99.4	1	0.6	No
20.	Bubanza	Rural	41_1	502	498	99.2	4	0.8	No
21.	Bururi	Rural	429_4	112	112	100.0	0	0.0	No
22.	Cibitoke	Rural	525_1	290	290	100.0	0	0.0	No
23.	Cibitoke	Rural	586_3	411	251	61.1	160	38.9	Yes
24.	Cibitoke	Rural	615_5	623	420	67.4	203	32.6	Yes
25.	Gitega	Rural	820_1	242	205	84.7	37	15.3	Yes

⁴³ In order to manage budgetary constraints and time limitations, the name and gender were recorded only for respondents who were present during the process. The household listing code (555) had an “unavailable” option for respondent names.

No.	Province	Locality	EA	Total HH	Nonelectrified HH	Nonelectrified (%)	Electrified HH	Electrified (%)	Oversampling done
26.	Bujumbura Rural	Urban	119_4	722	452	62.6	270	37.4	Yes
27.	Kirundo	Urban	1370_2	307	178	58.0	129	42.0	Yes
28.	Kirundo	Urban	1383_3	270	259	95.9	11	4.1	No
29.	Bujumbura Rural	Urban	141_1	394	233	59.1	161	40.9	Yes
30.	Muyinga	Urban	1831_1	530	297	56.0	233	44.0	Yes
31.	Muyinga	urban	1842_4	261	261	100.0	0	0.0	No
32.	Muyinga	Urban	1845_3	333	6	1.8	327	98.2	Yes
33.	Muyinga	Urban	1853_1	303	279	92.1	24	7.9	Yes
34.	Ngozi	Urban	2194_1	679	678	99.9	1	0.1	No
35.	Ngozi	Urban	2209_1	779	741	95.1	38	4.9	Yes
36.	Rutana	Urban	2430_1	386	226	58.5	160	41.5	Yes
37.	Rutana	Urban	2451_3	170	144	84.7	26	15.3	Yes
38.	Ruyigi	Urban	2608_2	285	254	89.1	31	10.9	Yes
39.	Ruyigi	Urban	2626_2	588	430	73.1	158	26.9	Yes
40.	Bururi	Urban	288_3	35	9	25.7	26	74.3	Yes
41.	Cankuzo	Urban	439_1	706	421	59.6	285	40.4	Yes
42.	Cibitoke	Urban	622_6	238	195	81.9	43	18.1	Yes
43.	Gitega	Urban	765_7	263	1	0.4	262	99.6	No
44.	Gitega	Urban	780_2	344	285	82.8	59	17.2	Yes
45.	Bujumbura Mairie	Urban	88_10	268	0	0.0	268	100.0	No
46.	Bujumbura Mairie	Urban	86_43	234	47	20.1	187	79.9	Yes
47.	Bujumbura Mairie	Urban	86_46	231	77	33.3	154	66.7	Yes
48.	Bujumbura Mairie	Urban	86_47	90	0	0.0	90	100.0	No
49.	Bujumbura Mairie	Urban	88_2	911	100	11.0	811	89.0	Yes
50.	Bujumbura Mairie	Urban	88_45	348	116	33.3	232	66.7	Yes
51.	Bujumbura Mairie	Urban	88_8	943	144	15.3	799	84.7	Yes
52.	Bujumbura Mairie	Urban	89_29	419	59	14.1	360	85.9	Yes
53.	Bujumbura Mairie	Urban	89_47	316	151	47.8	165	52.2	Yes
54.	Bujumbura Mairie	Urban	89_54	550	241	43.8	309	56.2	Yes
55.	Bujumbura Mairie	Urban	89_56	205	19	9.3	186	90.7	Yes
56.	Bujumbura Mairie	Urban	89_62	436	37	8.5	399	91.5	Yes

No.	Province	Locality	EA	Total HH	Nonelectrified HH	Nonelectrified (%)	Electrified HH	Electrified (%)	Oversampling done
57.	Bujumbura Mairie	urban	89_65	63	63	100.0	0	0.0	No
58.	Bujumbura Mairie	Urban	89_69	149	78	52.3	71	47.7	Yes
59.	Bujumbura Mairie	Urban	90_23	432	3	0.7	429	99.3	No
60.	Bujumbura Mairie	Urban	91_15	434	420	96.8	14	3.2	Yes
61.	Bujumbura Mairie	Urban	91_17	94	6	6.4	88	93.6	Yes
62.	Bujumbura Mairie	Urban	91_20	337	108	32.0	229	68.0	Yes
63.	Bujumbura Mairie	Urban	91_24	905	96	10.6	809	89.4	Yes
64.	Bujumbura Mairie	Urban	91_5	650	34	5.2	616	94.8	Yes
65.	Bujumbura Mairie	Urban	91_8	54	2	3.7	52	96.3	No

Notes: EA = enumeration area; HH = household.

Households were selected from the EAs as follows:

- In the 17 EAs where the electrification rate was less than 1 percent, 9–11 households were randomly selected.
- In the four EAs where the electrification rate exceeded 99 percent, 16 households were randomly selected.
- In the two EAs where the absolute number of electrified households was less than 12 (while the electrification rate was above 1 percent) and in the one EA where the number of nonelectrified households was less than 4 (while the electrification rate was less than 99 percent), 9–11 households were randomly selected.
- In the remaining 41 EAs, households were stratified into electrified and nonelectrified categories, and 12 electrified households and 4 nonelectrified households (a total of 16 households) were selected from each EA.
- In 168 nonelectrified unlisted EAs, 10–13 households were randomly selected.⁴⁴
- In 109 electrified unlisted EAs, 10 or 11 households were randomly selected.

These households were preloaded onto tablets and overlaid with EA boundaries on SW-Maps, an open-source Android-based mapping application that enables data visualization and real-time navigation.

For the 277 nonlisted EAs, household selection was based on publicly available high-resolution (30M or 1 arc-second) population distribution maps of Burundi, similar to those developed by the Center for International Earth Science Information Network in collaboration with Connectivity Lab at Facebook and

⁴⁴ In one EA (EA 56_1), eight households were selected inadvertently.

Digital Globe. This raster data set of settlements, derived from a land use/land cover classification using Landsat satellite imagery, represents each building or structure on the earth's surface. By converting this data set to point data, a nearly exhaustive household listing was generated for each EA, from which the target households were randomly selected. The final sample sizes are presented in table A5.5.

SAMPLING WEIGHTS

The survey was designed to achieve representative samples independently in rural and urban areas, as well as nationally. This design resulted in oversampling in urban areas and electrified EAs. To rectify this oversampling, sample weights were applied. These weights were calculated for both stages of the sample frame, and the overall weight was determined by multiplying the weights from each stage.

The first stage weight was defined for rural and urban areas as follows:

$$w_{1(R,U)} = \frac{1}{P_{1(R,U)}}$$

Where $P_{1(R,U)}$ is the probability of selecting *EAs* in rural or urban regions.

This is defined as the ratio of the number of *EAs* selected to the total *PSUs* in the region

$$P_{1(R,U)} = \frac{n_{EA(R,U)}}{N_{PSU(R,U)}} \text{ so } w_{1(R,U)} = \frac{N_{PSU(R,U)}}{n_{EA(R,U)}}$$

The second stage was defined twice:

First, for the household selection within the oversampled EAs, it was defined as follows:

$$w_{2,j(E,U)} = \frac{1}{P_{2,j(E,U)}}$$

Where $P_{2,j(E,U)}$ is the probability of selecting electrified or unelectrified *HHs* in *EA j*, defined

as the ratio of electrified or unelectrified *HHs* selected $n_{HH,j(E,U)}$ to total *HHs* $N_{HH,j(E,U)}$.

$$P_{2,j(E,U)} = \frac{n_{HH,j(E,U)}}{N_{HH,j(E,U)}} \text{ so } w_{2,j(E,U)} = \frac{N_{HH,j(E,U)}}{n_{HH,j(E,U)}}$$

Second, for the household selection within the rest of the *EAs*, it was defined as follows:

$$w_{2,j} = \frac{1}{P_{2,j}}$$

Where $P_{2,j}$ is the probability of selecting a *HH* in *EA j* defined as

$$P_{2,j} = \frac{n_{HH,j}}{N_{HH,j}} \text{ so } w_{2,j} = \frac{N_{HH,j}}{n_{HH,j}}$$

And the total weight was the product of both:

$$w_{1 \times 2} = w_{1,(R,U)} \times w_{2,j(E,U)} = \frac{N_{PSU,(R,U)}}{n_{PSU,(R,U)}} \times \frac{N_{HH,j(E,U)}}{n_{HH,j(E,U)}}$$

Given that the use of raster and vector data leads to inaccuracies in estimating the actual population of the PSUs (as variations in population density within a pixel are not accounted for) (see section above on the sampling frame), the PSUs have varying population sizes (resulting in wide variation in the number of households in each PSU). Therefore, calculating the first-stage weights by using the number of EAs and PSUs (as it is generally done) yields inaccurate results. To avoid this, the first-stage weights have been calculated using the number of households in each EA (instead of the number of EAs and PSUs).

For an EA_j falling under the rural or urban stratum, the weights $New_w_{1(j)}$ were calculated as follows:

$$New_w_{1(j)} = \frac{N_{HH(R,U)}}{n_{HH(j)}}$$

where $N_{HH(R,U)}$ is the number of households in the rural or urban stratum at the national level;

and $n_{HH(j)}$ is the number of households in EA_j

The second-stage weights are not affected, as the calculations are done using the number of households. The final weights are the product of the new first-stage weights and the second-stage weights.

TABLE A5.5 • Listing results (after sample weights applied)

	Rural						Urban						Grand Total	
	Electrified		Unelectrified		Total		Electrified		Unelectrified		Total			
Province	EA	HH	EA	HH	EA	HH	EA	HH	EA	HH	EA	HH	EA	HH
Bubanza	2	26	5	54	7	80	0	0	1	12	1	12	8	92
Bujumbura Marie	0	0	0	0	0	0	130	1,501	0	0	130	1,501	130	1,501
Bujumbura Rural	3	34	8	95	11	129	2	32	6	72	8	104	19	233
Bururi	7	70	6	73	13	143	1	16	0	0	1	16	14	159
Cankuzo	0	0	8	98	8	98	1	16	0	0	1	16	9	114
Cibitoke	3	42	10	120	13	162	1	16	3	36	4	52	17	214
Gitega	1	16	12	144	13	160	2	32	0	0	2	32	15	192
Karuzi	0	0	12	144	12	144	0	0	1	12	1	12	13	156
Kayanza	1	16	9	108	10	124	0	0	0	0	0	0	10	124
Kirundo	1	11	10	120	11	131	2	27	1	12	3	39	14	170
Makamba	0	0	4	48	4	48	0	0	1	12	1	12	5	60
Muramvya	0	0	4	47	4	47	0	0	5	60	5	60	9	107
Muyinga	0	0	8	96	8	96	4	58	2	24	6	82	14	178
Mwaro	0	0	8	96	8	96	0	0	0	0	0	0	8	96
Ngozi	2	26	13	155	15	181	2	26	0	0	2	26	17	207
Rumonge	4	50	10	120	14	170	0	0	0	0	0	0	14	170
Rutana	1	16	10	120	11	136	2	32	2	24	4	56	15	192
Ruyigi	0	0	9	107	9	107	2	32	0	0	2	32	11	139
Nationwide	25	307	146	1,745	171	2,052	149	1,788	22	264	171	2,052	342	4,104

Notes: EA = enumeration area; HH = household.

