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## **Barriers and Policy Solutions for Off-Grid Energy Development:** Evidence from a Comparative Survey of Private Sector Developers in Eastern Africa

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### Summary

Off-grid solutions with falling costs and maturing business models could fulfil the energy needs of remote low-income communities. Yet, numerous barriers impede their implementation and understanding perceptions of key barriers and opportunities among private developers remains limited. Survey data from nearly 200 companies in Ethiopia, Kenya, Tanzania, and Uganda reveal common and differentiated challenges within and across countries and different

types of firms, as well as important trade-offs in regulatory designs and support for the sector. While the policy climate makes a big difference in the perceptions of opportunities and barriers, companies' preferences regarding tariffs, grid encroachment, and licensing alternatives differ according to their business models, which challenges construction of simple and workable solutions. Achieving SDG7 (sustainable, modern, affordable, and reliable energy for all) needs more policy attention.

## Key Policy Recommendations

- Solutions to challenges facing private off-grid energy firms in eastern Africa must address common and country-specific impediments.
- Enhanced market information, building of technical capacity, comprehensive and harmonized regulation, and different financing resources are needed to address common sector challenges.
- Country-specific solutions should reduce informal sector competition (Tanzania); lower the cost of doing business (Ethiopia); and ease access to financing (Uganda).
- Different solutions are preferred by different firms. Stand-alone system providers would benefit from capacity-building, information, and less informal sector competition. Larger-scale suppliers (e.g., mini-grids) need greater regulatory clarity and tariff policy stability.
- While perspectives on the most essential solutions vary, subsidies, early stage equity and medium-to-longer-term debt finance, access to foreign exchange, support with regulatory matters, and capacity building appear vital to achieve the countries' energy access goals.



The views expressed in this material do not necessarily reflect the UK government's official policies.

# Introduction

The falling costs of solar technology and development of cost-effective batteries have made off-grid solutions the least-cost technology for electrification in many rural African communities [1, 2]. However, numerous barriers impede the development of the sector [3]. Literature on these barriers is ample and growing, but evidence on the perspective of private off-grid firms remains largely anecdotal [4].

We studied these barriers and opportunities in four important countries in East Africa where electricity access ranges from 38–70%, and whose off-grid sectors vary in maturity: Ethiopia, Kenya, Tanzania, and Uganda (Table 1 presents relevant country statistics).

VARIABLE	ETH	KEN	TZ	UGA
Population (mill.)	115.0	53.7	59.7	45.7
Urban share (%)	22	28	35	25
GDP per capita (PPP-adjusted)	2421.9	4576.2	2780.1	2293.5
Access to electricity (%)	48	70	38	41
Urban	93	91	73	71
Rural	36	62	19	32
% renewable [5]	98	74	39	90
Energy intensity (MJ/USD), 2018 [6]	7.9	5.4	6.2	10.1
Intl' finance for energy (mil US\$), 2018 [6]	34.7	257.6	13.2	236.3

Table 1: Summary of demographic, socio-economic, and energy access indicators.

Notes: Data are for 2020 and from data.worldbank.org, except as indicated by other references. PPP = Purchasing Power Parity.

# Data and Methods

We began with a listing of enterprises located in each of the national capital cities that either promote off-grid energy technologies or, where there are few such firms, offer a range of energy services. To obtain sufficiently large samples to analyse country-specific patterns, we preferentially selected firms involved in off-grid energy provision. Then completed the sample with a random selection of other energy firms, aiming to enroll fifty in each country. In Ethiopia, the sector is very nascent, so only 41 firms could be enrolled; in Kenya, Tanzania, and Uganda, final sample sizes were 50, 50, and 49, respectively. The survey was conducted in person with a company owner or manager, except when COVID-19 disruptions required remote surveying.

We used descriptive analysis to obtain a quantitative understanding of perceptions of barriers, opportunities, and the regulatory environment facing firms, and about preferences for various institutional supports.

About 55% of sample organizations identified off-grid energy provision as one of their main offerings (**Figure 1**); this share was highest in Kenya (98%), where the sector is most mature,

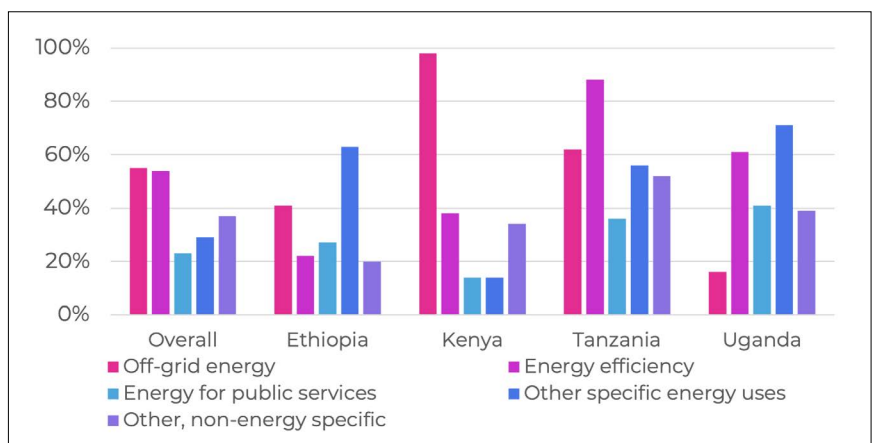


Figure 1: Main business activities, overall and by country

and lowest in Uganda (16%). The surveyed firms were also heavily involved in energy efficiency (54% of firms overall), provision of energy for public services (23%), and other specific energy uses, for example water pumping (29%), as well as non-energy activities (37%). Thirty-five percent of included firms are part of an off-grid energy association. Nearly half of the surveyed firms identified stand-alone solar home systems as their main revenue-generating product, with other main products at smaller shares (**Figure 2**). Other information on the sample firms is available here [\[7\]](#).

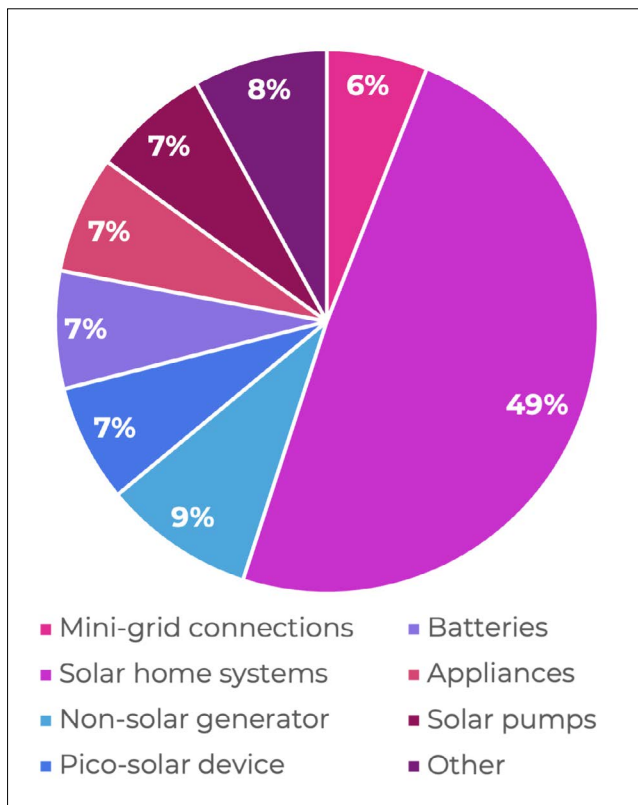


Figure 2: Main source of revenue for each surveyed company

## Results

Several characteristics of the sampled firms illustrate the structural challenges facing the off-grid sector. The firms are relatively young,

with a mean time since establishment ranging from 3 to 13 years across countries. Most are small, sole proprietorships (33%) or limited liability corporations (55%). Very few utilized debt finance, either in the form of access to any loan in the prior year (only 26%) or as a share of their resource portfolio (15%). These data highlight the difficulty these firms face growing their businesses.

Firms' familiarity with national off-grid regulations, on average, was slightly better than moderately familiar (**Table 2**). Familiarity was highest in Kenya and lowest in Ethiopia. On average, firms reported that off-grid regulations are only somewhat clear, with clarity rated highest in Tanzania and lowest in Kenya. Governments were also judged to have capacity to implement regulations at a level midway between moderate and weak capacity (weakest in Tanzania and relatively better in Ethiopia). Thus, clarity in regulations does not indicate ability to implement, and governments' regulatory capacity requires further strengthening.

VARIABLE	ALL	ETH	KEN	TZ	UG
Familiarity w/ national regulations <sup>1</sup>	2.8 (1.3)	3.3 (1.5)	2.4 (0.88)	3.0 (1.5)	2.8 (1.0)
Clarity of regulatory framework <sup>2</sup>	2.8 (1.1)	2.7 (0.89)	3.2 (0.92)	2.3 (1.4)	2.8 (0.88)
Government capacity to implement <sup>3</sup>	2.6 (0.8)	2.3 (0.74)	2.6 (0.69)	2.7 (1.0)	2.5 (0.62)
Number of sampled firms	190	41	50	50	49

Table 2. Firms' perceptions of the regulations of off-grid energy in each country

Notes: Mean responses, with standard deviation shown in parentheses. <sup>1</sup>On a scale of 1 to 5: Extremely familiar (1) to not familiar at all (5). <sup>2</sup>On a scale of 1 to 5: Extremely clear (1) to not clear at all (5). <sup>3</sup>On a scale of 1 to 5: Very strong (1) to very weak (5).

The most common perceived barriers to off-grid investment, according to the sample firms, are given in **Figure 3**. These include a lack of market information (30% of respondents), comprehensive policy (25%), technical capacity (22%), import restrictions (20%), and limited funding (18%). There was much variation in these perceptions within countries, so issues that appear least frequently in one setting may nonetheless greatly affect some firms. Perceptions also likely reflect the maturity of the sector in each country. For example, in Ethiopia, more firms identified lack of market information (37%) and the high cost of doing business (29%) as major barriers, but many other issues were also mentioned. In Tanzania, the most severe barrier by far was informal sector competition (60%), an issue that most affects smaller firms such as those operating there, followed by inconsistent tariff policy (34%). Finally, in Uganda, where the sector is trying to expand, the top three issues were limited funding (46%), and lack of technical capacity and economic uncertainty (38% each).

Overall, firms were somewhat optimistic about sector opportunities, with 51% saying that these had recently increased, in spite of COVID-19. However, perceived opportunities differed across countries: increasing in Uganda and Kenya but declining in Ethiopia and Tanzania. This may reflect political instability in Ethiopia at the time of the survey and the recent re-centralization of the energy sector in Tanzania. Respondents also noted that facilitated finance and subsidies were the most needed policy supports. In Ethiopia and Tanzania, easier access to foreign currency was also deemed most essential.

We analysed the relative weighting that firms would assign to different off-grid institutional supports, using a discrete choice experiment (DCE) [8]. This provides deeper insight on firms' attitudes regarding potential policy and regulatory levers for the sector. Attributes considered were a) size of capital subsidies; b) tariff regulation alternatives; c) scope of licensing regulations; d) facilitated access to foreign currency; and e) grid encroachment policies.

Unsurprisingly, we found that off-grid firms tended to prefer higher (relative to lower) subsidy support and more (relative to less) foreign currency availability. A decentralized or less demanding centralized licensing regulation regime (required only for large projects) was favoured over an expansive, centralized scheme. On average, firms also preferred a tariff policy imposing the grid rate (relative to cost recovery or open tariff-setting), likely because many of the companies' business models (especially solar home system companies) are agnostic about the price of power. Finally, firms preferred a buyout grid

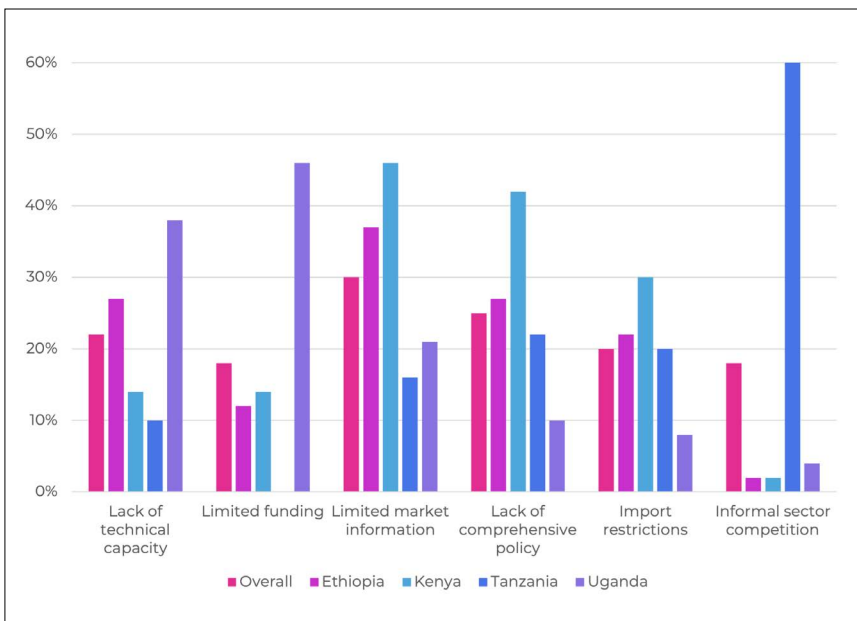


Figure 3: Main impediments to off-grid business identified in the survey, overall, and by country (Note: less frequently-identified barriers, in a list of 17, are not shown)

encroachment policy, where developers would be compensated for investment costs should the grid displace their projects.

Despite these general patterns, there was considerable diversity in preferences and weighting of these different dimensions, which is logical given the diversity of business models represented. For example, mini-grid developers preferred cost recovery over grid tariffs. About 35% of (cash-constrained and risk averse) firms especially value subsidy, foreign exchange, and grid buyout policy supports. Meanwhile, 40% of firms heavily weighted regulatory stability along with set tariffs and decentralized licensing and a buyout guarantee, plus subsidy support. The remaining firms are solar home system firms whose competitive edge is enhanced by the requirement for larger suppliers to operate at the grid rate and obtain central government licences. There were also country differences: Ethiopian firms weight subsidy support heavily, and have the most favorable view of tariff regulation at the grid rate, which is subsidized and among the lowest in Africa. Firms in Ethiopia and Uganda expressed the greatest need for additional foreign exchange.

## Policy Implications

Our analysis shows that policy and the regulatory climate, and implementation of these aspects, make a big difference in firms' perceptions of opportunities. In the absence of general and targeted policy supports, several obstacles will continue to challenge achievement of the Sustainable Development Goal 7: sustainable, modern, reliable, and affordable energy for all.

The survey findings reveal that a set of common challenges confront off-grid firms in these countries, despite differences that relate to the

maturity of firms and features of each country's regulatory environment. **Thus, policy solutions must address common and country-specific impediments if they are to unlock the potential of the sector, while carefully balancing trade-offs.**

Specifically, **enhanced market information, building of technical capacity, comprehensive and harmonized regulation, and different financing resources are needed to address common sector challenges.** Even in Kenya, the most mature off-grid sector, firms noted that the regulatory framework is only slightly better than "somewhat clear"; thus, all **countries' regulations must be clarified and harmonized.**

**Country-specific solutions should aim to reduce informal sector competition and inconsistent tariff policy (Tanzania), lower the cost of doing business (Ethiopia), and ease access to capital (Uganda).** A striking finding is that most surveyed firms cannot access reasonably priced debt financing to grow their businesses (echoing findings on the high cost of capital for off-grid identified in other research [9]).

Off-grid firms tend to prefer certainty over tariffs that may be charged, a less onerous or decentralized licensing regime, and a buyout grid encroachment policy. **Yet tradeoffs are apparent in the fact that different policy solutions are preferred by different types of firms.** Stand-alone system providers would benefit from capacity-building, information, and less informal sector competition. Larger-scale suppliers (e.g., mini-grids) need greater regulatory clarity and tariff policy stability.

Finally, **the analysis suggests the need for a battery of interventions to grow the sector and achieve countries' energy access goals: higher capital subsidies, enhanced access to early stage equity and medium-to-longer-term debt finance and foreign exchange, support with regulatory matters, and capacity building.**

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