



# Mozambique

*Energy and the poor*  
Unpacking the investment  
case for clean energy

## The Making Access Possible Programme

Making Access Possible (MAP) is a multi-country initiative to support financial inclusion through a process of evidence-based country diagnostic and stakeholder dialogue, leading to the development

of national financial inclusion roadmaps that identify key drivers of financial inclusion and recommended action. Through its design, MAP seeks to strengthen and focus the domestic development

dialogue on financial inclusion. The global project seeks to engage with various other international platforms and entities impacting on financial inclusion, using the evidence gathered at the country level.

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The views expressed in this publication are those of the author(s) and do not necessarily represent those of the United Nations, including UNDP, or the UN Member States.

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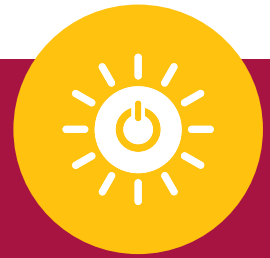
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## The cover symbol and artwork

Through the MAP programme, we hope to effect real change at country level and see the impact of financial inclusion on broader national growth and development. The cover graphic features a Maroon Bell Bean flower (*markhamia zanzibarica*), the national flower of Mozambique. The flower symbolises growth and development while the circle represents inclusive growth. Each flower is an example of the successful growth in a unique environment.







# Working together to support implementation of Agenda 2030

*Countries are seeking new ways to address complex and interconnected challenges. Reaching the promise of the SDGs requires multisectoral approaches that brings together expertise from a range of perspectives. By harnessing our comparative advantage and working within the context of our respective mandates, we can collectively make significant progress towards achieving the vision of the Sustainable Development Goals (SDGs).*

This diagnostic on access to clean energy is a collaboration with the United Nations Development Programme (UNDP) and the United Nations Capital Development Fund (UNCDF) to jointly address UNDP's Signature Solution 5 that seeks to work with countries to close the energy access gap.

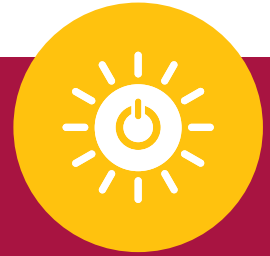
Signature Solution 5 focuses on increasing energy access, promoting renewable energy and enhancing energy efficiency in a manner that is inclusive and responsive to the needs of different sectors of the population, in line with the aspirations of Sustainable Development Goal 7.

This will support countries to transition to sustainable energy systems by working to de-risk the investment environment; attract and leverage private and public-sector resources. In contexts, where energy does not yet reach everybody, it will be necessary to focus on supporting innovative private and public solutions that increase energy access and delivery.

In contexts where energy is already available to most or all people, the focus will be on transitioning to renewable energy and energy efficiency measures and policies.



*UNCDF offers “last mile” finance models that unlock public and private resources, especially at the domestic level, to reduce poverty and support local economic development.*



## Partnering for a common Purpose

*By combining inspiration, ideas and resources with our partners, we become more than the sum of our parts.*

We are committed to empowering investors—public and private—with the clarity, insights and tools they need to optimize the positive impact of their investments, closing the gap between high-level principles and financial performance to make a positive contribution to society.

FinMark Trust is an independent non-profit trust whose purpose is ‘Making financial markets work for the poor, by promoting financial inclusion and regional financial integration’, by using both the creation and systematic analysis of financial services consumer data to provide in depth insights and following through with systematic financial sector inclusion implementation actions to overcome market level barriers hampering the effective provision of services, thus working to unlock real economic sector development through financial inclusion.

The UNDCF, together with MAP partner FinMark Trust, commissioned Nova Economics to undertake a market assessment of the energy needs, usage and market potential, focusing on the potential for cleaner off-grid energy solutions across five countries in the Southern African Development Community (SADC) region, namely Lesotho, eSwatini, Malawi, Mozambique and Madagascar. The objective of this study is to provide insight into the potential to develop the market for, and promote access to, cleaner off-grid energy solutions in the selected countries. This includes insight into the current programmes and initiatives in each market, to assess the current supply and demand for off-grid cleaner energy solutions and the scope for partnerships and innovative financing models to move forward the clean energy agenda under SDG 7 as it relates to financial inclusion and inclusive growth.

This report represents the country analysis and findings for Mozambique only. A separate report for each country is available, as well as a summary report drawing together the findings for all five countries.

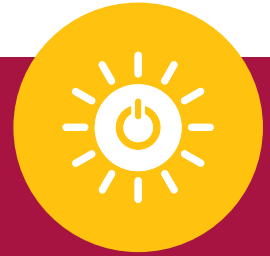
### *Note on the use of household data*

Within this document (unless otherwise referenced), demographic, income and financial usage data is obtained from the 2019 FinScope Consumer Survey undertaken in Mozambique, while MSME data is obtained from the 2012 MSME FinScope for Mozambique. A summary report and presentation of FinScope is available as a separate deliverable, and the FinScope dataset is available for future research at <https://uncdfmapdata.org>.



*The transition to clean and affordable energy helps countries reduce the impacts of indoor and outdoor air pollution, particularly in rapidly developing urban areas.*





## Our technical response

The MAP target market segmentation model identified four crucial consumption needs that households are regularly fulfilling out of their income. Payments for energy and utility services are consistently highlighted as the single most crucial need. The methodology as applied here seeks to address the need for access to energy as it relates to current usage, affordability and access to infrastructure in order to identify and quantify the financing necessary to accelerate the transition to clean energy.

### *UNDP's work on Energy*

UNDP is the leading United Nations organization fighting to end the injustice of poverty, inequality, and climate change. Working with our broad network of experts and partners in 170 countries, we help nations build integrated, lasting solutions for people and planet.

UNDP's Energy team focuses on clean and affordable energy development; low-emission, climate-resilient urban and transport infrastructure; and access to new financing mechanisms. Learn more at [undp.org](http://undp.org) or follow at [@UNDP](https://twitter.com/UNDP)

### *UNCDF's work on Energy*

UNCDF's energy programme aims to improve access to clean energy finance for poor and low-income people. By partnering with energy and financial service providers and offering capital, data analytics, capacity building and policy advocacy services in the off-grid energy finance markets, UNCDF has scaled energy business models for cleaner, efficient and more effective sources of energy for poor people. As of 2019, UNCDF digital energy finance activities have enabled over three million people to benefit from clean energy solutions through micro and PayGo financing.

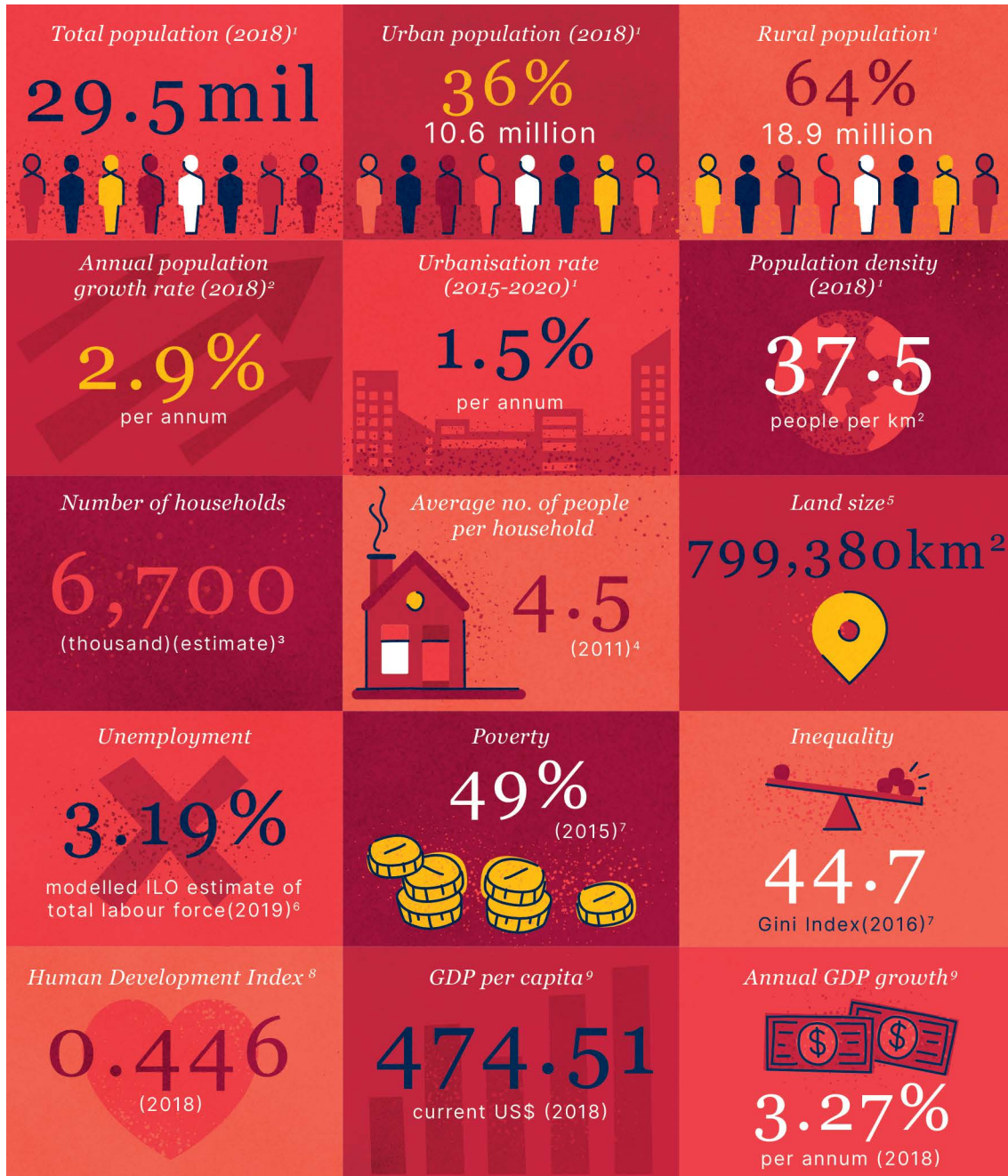


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# Mozambique at a glance

While Mozambique has a population of 29.5 million (2018), it also a large land area (roughly 800 000 km<sup>2</sup>), making it a sparsely populated country.



Sources: 1) UN population division, World Population Prospects 2019; 2) UN World Urbanisation Prospects: The 2018 Revision; 3) Derived (population/average household size); 4) UN statistics database, household size and composition; 5) CIA World Factbook; 6) CIA World Factbook; 7) IMF, World Economic Outlook database; 8) UN Statistics Division 9) IMF, World Economic Outlook database, 2018

It is one of the poorest countries in the world with a gross domestic product (GDP) per capita of USD 474, scoring 0.446 on the United Nations (UN) human development index (HDI). The majority of Mozambicans (64%) live in rural areas. Three out of four people are involved in agriculture, earning their livelihoods through farming.<sup>1</sup> The population is growing at 2.9%, with 45% of the population younger than fifteen.

Economic conditions improved in the decades following the civil war (1977-1992), with poverty decreasing from 69% in 1996 to 49% in 2015. Mozambique's economic growth slowed after the collapse of global commodity prices in 2015. A domestic debt crisis in 2016 further impeded growth and foreign investment.<sup>2</sup> In 2019, two cyclones, Idai and Kenneth, caused hundreds of deaths, severe property damage and the destruction of crops and livestock. Real GDP growth have been estimated to slow to 2% in 2019 (compared to 3.3% in 2018). This would be the lowest GDP growth since 2000 when devastating floods hit southern Mozambique.

## Energy sector overview

Mozambique has a total installed grid electricity generation capacity of 2,827 megawatts (MW), the majority of which is generated from renewable sources - 2,184 MW is from hydroelectric sources<sup>3</sup>. The remainder is mostly from gas power plants. Hydroelectric generation, in turn, is mostly from the Cahora Bassa dam, with a capacity of 2,075 MW, and situated at the Zambezi River in Tete province in the Northwest. However, most of the dam's electricity is exported to South Africa, Zimbabwe and Botswana<sup>4</sup>, and there is no direct transmission line from the dam to Maputo (the main consumption centre), other than a line going through South Africa. A single transmission line delivers power to the North-eastern region, making power supplies vulnerable to outages on the line. As a result, domestic electricity use is much lower than total installed capacity in Mozambique. Peak electricity demand was 831 MW in 2014 with an annual energy consumption of approximately 3,032 gigawatt hours (GWh)<sup>5</sup>. A second line to the Northeast would improve the security of supply for existing customers while providing additional transmission capacity to meet future demand.

Electricidade de Moçambique (EDM) is the sole electricity utility in the country. However, EDM is not the sole generator of electricity. In fact, EDM only generates a small portion of electricity, through an ageing generation fleet which supplies



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1 Kathryn Larcombe and Jamie Anderson, *Understanding the Demand for Financial, Agricultural, and Digital Solutions from Smallholder Households: Insights from the Financial Diaries and Household Survey in Mozambique*, Consultative Group to Assist the Poor (CGAP) (2017), <https://www.cgap.org/research/slide-deck/insights-household-survey-mozambique>.

2 Aled Williams, *The Mozambique hidden loans case: An opportunity for donors to demonstrate anticorruption commitment*, Chr. Michelsen Institute (CMI) (2018).

3 Power Africa. <https://www.usaid.gov/powerafrica/mozambique>

4 Electricity sales account for a meaningful share of Mozambique's total exports - 7.7% of the total USD 5.2 billion exported in 2018. "Mozambique: Economic and Political Overview," 2020, <https://www.nordeatrade.com/en/explore-new-market/mozambique/trade-profile>.

5 This excludes demand from BHP Billiton's Mozal Aluminium plant, situated close to Maputo, which is supplied by South Africa's Eskom, i.e. which uses imported electricity from South Africa.



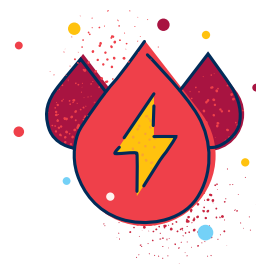


approximately 136 MW (61 MW from hydro and 75 MW from gas and diesel). On average, only ~76% of EDM's installed generation capacity is available, due to ageing plant and system infrastructure and a lack of routine maintenance. Some sources point to a shortage of technical staff needed to service the growing number of grid connections. Administrative, transmission and distribution losses of up to 27% of the power generated exacerbate the generation deficit. Long delays in the rehabilitation of existing generation and the development of new generation is such that demand growth has outstripped generation, reducing exports to the potentially lucrative South African market, and increasing needs for high-cost short term power options.<sup>6</sup> The remaining electricity demand is therefore supplied through a public-private agreement with government-owned Hidroelectrica de Cahora Bassa (HCB) that operates Cahora Bassa hydroelectric plant.

By 2018, EDM has connected 1.89 million households to the grid (out of a total of around 6 million households in Mozambique). The connected households are concentrated in urban areas, and the majority (1.76 million) are served through prepaid meters. EDM's consumer base grew at an annual average rate of 8.5% between 2013 and 2018. Electricity consumption, on the other hand has increased at an average annual rate of 7% over the last ten years. These figures reflect supply to domestic, commercial, and industrial consumers. Domestic electricity consumption was estimated at 62 kilowatt-hours (kWh) per capita in 2017, which works out to only about 170 watt-hours (Wh) per person per day.<sup>7</sup>

EDM has been operating at a loss for the past several years. This is largely due to electricity tariffs not being cost-reflective. This situation is compounded by the requirement to purchase electricity from independent power projects (IPPs) and foreign sources. EDM subsidises tariffs to poor residential consumers, a strategy that has been deemed unsustainable. A third of EDM's customers account for 65% of revenue. EDM is making major structural and operational changes to finance its generation projects. The first IPPs were introduced in 2015. These projects have paved the way for future IPP negotiations and, more recently, the standardisation of tendering documents.

Mozambique has considerable energy resources with an estimated hydropower potential of 12,000 MW, gas reserves estimated at reaching 700 billion cubic metres, and vast coal reserves (estimated to reach 140 million terajoules [TJ]).<sup>8</sup> Mozambique also has plans to substantially expand their generation capacity by 2022 and leading up to 2030. Increasing electricity access is a key part of the Mozambican government's strategy to reduce inequality and to enable the wider population to benefit from the use of natural mineral and agricultural resources.<sup>9</sup> In its most recent five-year plan, the overnment highlights the need to promote – inter alia – the agricultural and industrial development as the basis for socio-



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6 Hussain et al., *Mozambique Energy Sector Policy Note*.

7 IEA, *World Energy Outlook 2017*, IEA (Paris), <https://www.iea.org/reports/world-energy-outlook-2017>.

8 "Mozambique Energy Situation," EnDev, 2020, [https://energypedia.info/wiki/Mozambique\\_Energy\\_Situation](https://energypedia.info/wiki/Mozambique_Energy_Situation).

9 Mustafa Zakir Hussain et al., *Mozambique Energy Sector Policy Note*, World Bank Group (Washington, D.C., 2015), <http://documents.worldbank.org/curated/en/135711468180536987>.



economic development of the country. The key to achieving the objectives set out in the plan is to develop the electricity infrastructure required to support value-adding activities.

The off-grid market is undeveloped and currently mainly driven by donors and FUNAE (Fundo de Energia) - a government-owned and operated fund mandated to advance energy access. Market penetration is however very low. FUNAE claims that about 3.7 million people have gained access to modern energy services through its off-grid programmes (mostly with solar power systems – between 2005-2014).<sup>10</sup> See more details on FUNDAE in box.

The FUNAE fund receives capital from foreign governments and international non-government organisations (NGOs) in the form of donations and loans, public funding allocated by local government and levies on the sale of electricity by EDM. FUNAE’s mandate shifted in 2016 and now fulfils the role of an implementation agency, intending to promote private sector investment in off-grid generation.<sup>11</sup> FUNAE currently acts as both financier and operator of off-grid electrification projects.

Solar power systems installed by FUNAE have been mainly in schools, administrative offices and health centres. Only a small proportion of the fund’s installations target households, and many of these failed due to operation and management issues. A limited number of solar lanterns have been distributed around the Maputo area by FUNAE.

According to FUNAE, 11 cities, 669 schools, 623 health centres and 77 public buildings were electrified through off-grid PV installations during 2005-2014. The fund also installed approximately 70 diesel-based mini-grids operated by local communities, and approximately 1,500 solar home systems (SHS) as of end 2015. It also manages 50 Vilas Solaires project, which installs 4 kW solar plants with battery backup to electrify rural institutions, micro-enterprises and households in 50 villages. FUNAE installed 60 solar irrigation systems between 2006 and 2016.

A recent report by the World Bank notes, however, that the cost of electrification programmes delivered by FUNAE is not covered by electricity tariffs, nor is EDM receiving subsidies from the government for this purpose. So far, EDM and FUNAE have been implementing the electrification investments with limited available resources based on unclear priorities set at the political level and without proper planning following low-cost prioritisation. The sustainability of the service provided by FUNAE that operates on a fee-for-service model also remains a challenge due to an unproven business model.



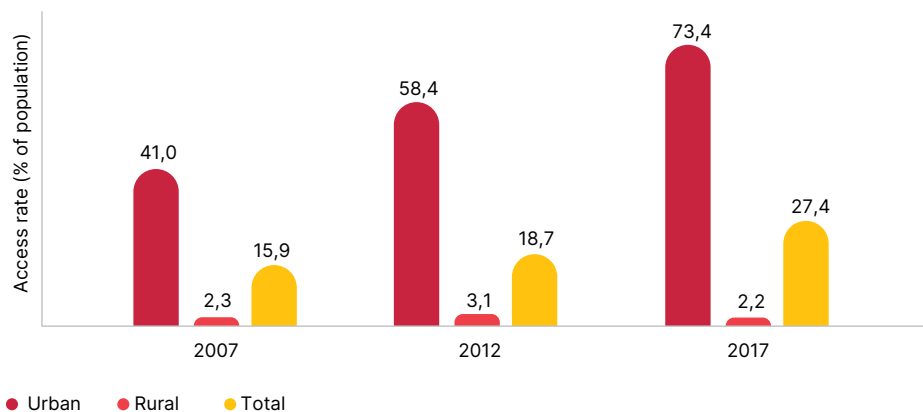
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10 Pranab Baruah and Brendan Coleman, *Off-grid solar power in Mozambique: Opportunities for universal energy access and barriers to private sector participation*, Global Green Growth Institute (GGGI) (2019).

11 Mokveld and von Eije, *Final Energy report Mozambique*.

## Electricity access rate and deficit

Mozambique has a very low electricity access rate compared to other countries in Sub-Saharan Africa. In 2017, only 27.4% of the population had access to electricity, according to the World Bank. However, there has been a systematic increase in access over the ten years between 2007 and 2017. Access to grid-supplied electricity is extremely low in rural Mozambique, and there is a very large difference in access between rural and urban areas. In 2017, 73.4% of Mozambicans living in urban areas had access to electricity, while only 2.2% of the rural population was connected to the grid (Figure 1).



**Figure 1: Electricity access (%), Mozambique (2007, 2012, 2017)**

Source: Own analysis based on data sourced from the World Bank Development Indicators Database

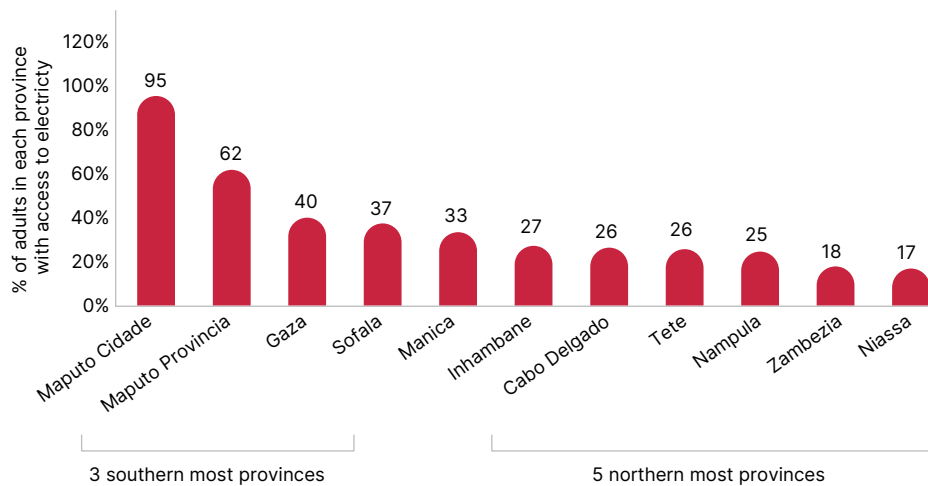
FinScope (2019), which measures access only for the adult population, provides an update of the 2017 World Bank figures. Overall access to electricity was found to be 32.7% in 2019, which is an increase of 5.3 percentage points over two years, or about 2.7 percentage points per year. This would mean there was an increase in the rate of electrification compared to the previous five years (2012 to 2017), where the implied average increase was about 1.7 percentage points per year. Furthermore, FinScope 2019 finds an access rate for urban areas of 71.7% and for rural areas of 9.4%, which would imply a rapid increase in rural areas over the period (2017 to 2019), with a slight decline in urban areas (or similar levels of access, as almost half the population is youth, which is not included in FinScope).

Another geographical lens, those of administrative areas, provide further insight to access to electricity. Mozambique has 11 provinces and 130 districts. The rate of access to electricity varies substantially across provinces, from a minimum of 17% for Niassa to 95% for Maputo Cidade. However, there is a correlation between the distance from Maputo city and overall access levels, with the three provinces with the highest access levels being closest to Maputo (the three Southernmost provinces), and the five provinces with the lowest levels off access to electricity being the furthest away from Maputo (the most Northern provinces).

At a district level, there are even greater variances. However, this does not follow the same trend as for provinces. For instance, 29% of districts (38) reported no access to electricity, but the provinces with the highest rate of



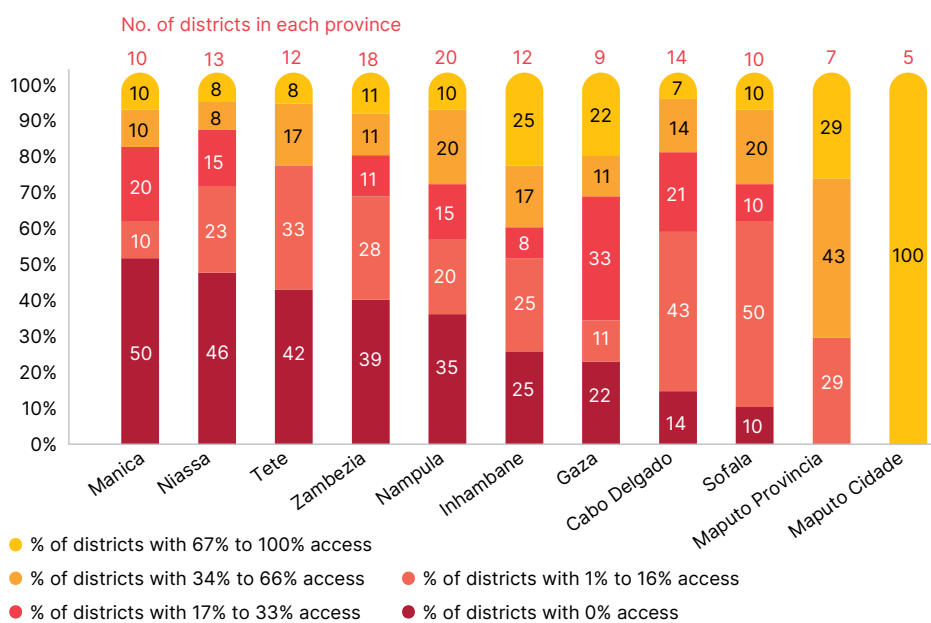




**Figure 2: Percentage of adults with access to electricity by province**

Source: FinScope Mozambique 2019

districts with no access are not the Northernmost provinces. Instead, these are the provinces in the North and Central parts of Mozambique that are most inland (Westernmost provinces), i.e. Manica, Niassa and Tete. This correlates with the electricity distribution network as reported by EDM, as the majority of EDM's distribution network is reported to be situated on or near the coastline, with the density increasing in the three Southernmost provinces (see Figure 5). However, Zambezia and Nampula (two coastal provinces) also have fairly high rates of districts with no access. Furthermore, it's only in the three Southernmost provinces where more than half of districts have access levels higher than the average of the country (higher than 33%). Only 21 districts have electricity access rates of 67% to 100% percent for adults (more than double the rate for the country on average). Interestingly though, every province had at least one district with access in this range (Figure 3).



**Figure 3: Percentage of districts per province with access to electricity**

Source: FinScope Mozambique 2019



It must be noted that these districts tend to be smaller than usual. For instance, 31 of Mozambique’s 130 districts (31%), have adult populations of 100,000 or more, and an additional 30 districts (23%) have populations between 50,000 and 100,000 (54% total), while only 29 (22%) have adult populations smaller than 10,000. When looking at districts with access of 76% or higher though, this changes drastically, with only 5% (or one district) having a population of 100,000 or more, and only 15% (three districts, including previous) having populations of 50,000 or more. In contrast, 43% of these districts (nine) have populations of less than 10,000 adults (including the three provinces with the highest access rates).

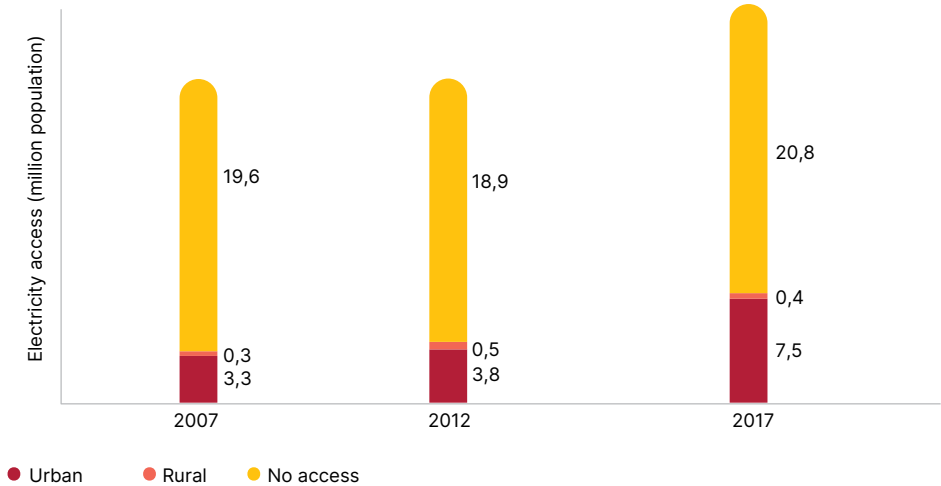
### Rate of electrification, electrification plans and need for off-grid solutions

While the access rate in Mozambique has improved between 2007 and 2017, the access deficit (the number of people without access to electricity) has risen as population growth outpaced growth in new connections. In 2017, 20.8 million Mozambicans lacked access to electricity, up from 19.6 million in 2007 (Figure 4).

In terms of the UN’s Sustainable Development Goals (SDGs), the goal concerning energy access (SDG7) is to ensure that all people have access to affordable, reliable, sustainable and modern energy by 2030. To estimate the likely future electricity access deficit in 2030, we estimate the electrification rate required for countries to meet SDG7. Assuming that governments will be able to continue with electrification at the same rate as what they historically achieved, we were able to forecast what the access deficit would be in 2030, taking into account population growth over the same period. We conducted our analysis on a rural and urban level and aggregated these figures to a national level. Based on population size and electricity access rates, we calculated the number of people with electricity access. This also gave us the nominal electricity access deficit. Using these figures, we calculate the nominal change in electricity access (Table 2). For our projection, we assume electricity access increase at the highest



*In 2017, 20.8 million Mozambicans lacked access to electricity, up from 19.6 million in 2007.*



**Figure 4:** Electricity access deficit (millions), Mozambique (2007, 2012, 2017)

Source: Own analysis based on data sourced from the World Bank Development Indicators Database

annual average achieved between either 2007 and 2012 or 2012 and 2017. This allows some leeway for the multitude of factors that could impact the pace of electrification. We forecast the number of people with access to electricity by applying the assumed annual average change to the existing electricity access base while accounting for population growth. We do not account for significant reductions in the number of people connected to the grid due to, for example, natural disasters. By subtracting the projected number of people with electricity access from the estimated 2030 population, we determine the projected nominal electricity access deficit.

Our analysis has shown, that between 2012 and 2017, Mozambique connected an average of 465,000 people to the grid annually (Table 2 below). Assuming that EDM continues to connect the same number of people annually and that Mozambique’s total population increases from 29.7 million to 41.2 million by 2030, only 4% of the rural population and 76% of the urban population will have access to the grid by 2030, falling far short of the SDG7 targets.<sup>12</sup>



*Between 2012 and 2017, Mozambique connected an average of 465,000 people to the grid annually.*

**Table 2: Nominal change in electrification (average annual), by country**

| PERIOD       | MOZAMBIQUE |
|--------------|------------|
| <b>Urban</b> |            |
| 2007 – 2012  | 389,945    |
| 2012 – 2017  | 487,072    |
| 2017 – 2030* | 487,072    |
| <b>Rural</b> |            |
| 2007 – 2012  | 38,219     |
| 2012 – 2017  | -21,719    |
| 2017 – 2030* | 38,219     |

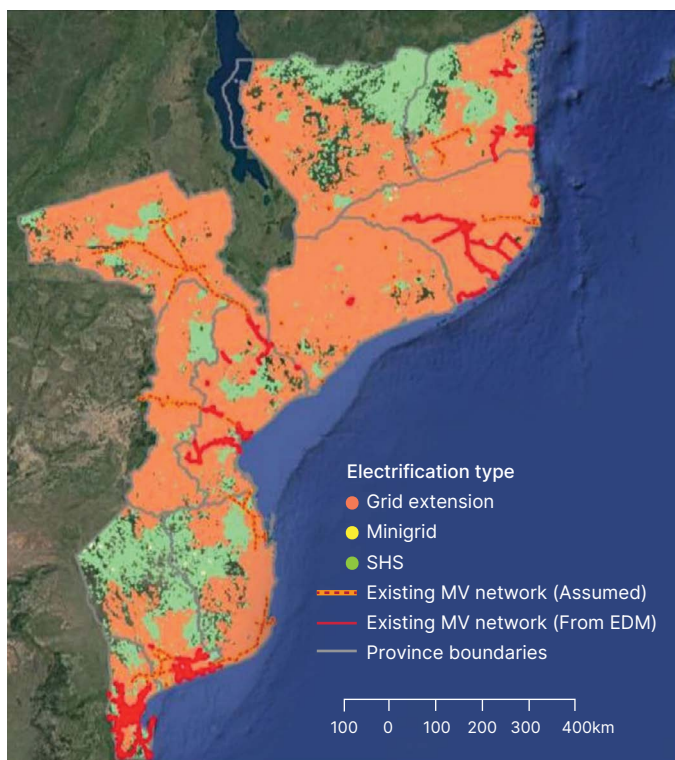
\* Projected  
Source: Own analysis

In other words, at the current electrification rate, there will still be 26.8 million Mozambicans without access to the grid in 2030 – the vast majority of these (22.6 million) would be in rural areas. To achieve universal access to the grid by 2030, the Mozambican government would have to significantly ramp up its current electrification programme. Our analysis suggests that they would have to connect an average of 1.8 million rural people annually, which is 46 times the current number (38,000) and an average of 810,000 urban people annually (roughly 1.7 times the current number -419,000). However, the rural electrification rate does not take into account the potential increase in rural access between 2017 and 2019, based on the FinScope data.

As the above estimates shows, it is fairly unrealistic for Mozambique to aim for 100% electrification by 2030. Perhaps being cognisant of this, Mozambique aims to provide 50% of all households with grid-electricity by 2030. The government estimated that this would require EDM to connect roughly 175,000

12 Based on UN population estimates and projections





**Figure 5: Preliminary grid extension and mini-grid options for Mozambique based on Geospatial analysis**

Source: World Bank (2019), Mozambique - Energy for All (ProEnergia) Project.

households to the grid every year for the next ten years. However, current EDM plans only budget for 100,000 new connections per annum which would result in approximately 38% of all households being connected to the grid by 2030. Regardless of how successful they are at extending the grid, off-grid solutions will remain an important element of Mozambique’s national electrification plans<sup>13</sup>.

The World Bank through its Mozambique Energy For All (ProEnergia) Project,<sup>14</sup> will support the Mozambican Government’s plan “Programa Nacional de Energia para Todos” for the expansion of electricity access to peri-urban and rural areas by extending and densifying the existing grid network and by promoting the use of off-grid energy solutions in those areas where the grid extension is considered economically unfeasible. According to preliminary conclusions of the Mozambique Geospatial Options Analysis, around four million people who are not currently connected are in the proximity of the national grid and could potentially be connected through grid-densification (Figure 5). This represents around 19% of people who are currently not connected, or 14% of the total population. Those areas that are not currently served by EDM, or are not in close proximity to the current grid, could be served either by extending the grid, which requires investments in transmission and distribution, or otherwise by mini-grids or by SHS.

13 Mokveld and von Eije, *Final Energy report Mozambique*.

14 World Bank, *Mozambique - Energy for All (ProEnergia) Project*.

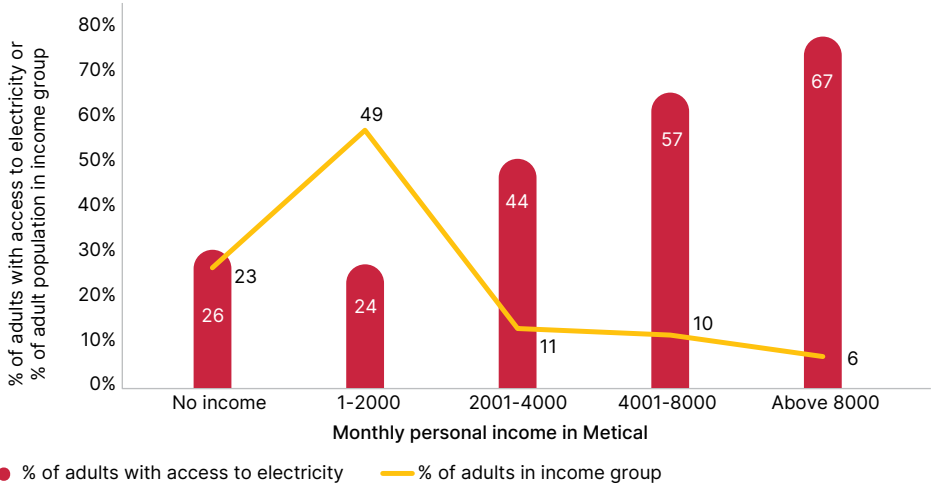
The number of potential beneficiaries varies depending on the priorities for expansion of the national network and the rate at which the population migrates to urban settlements, but the World Bank intends to support the connection of about 272,000 new households (1.35 million people) with electricity services through a combination of grid densification, mini-grids and stand-alone SHS.<sup>15</sup> The plan includes connecting 250,000 customers through grid densification, 4,000 through mini-grids and 18,000 by incentivising the private sector-led SHS market. However, over a five-year project period (2019 to 2023), this only equates to 54,400 additional households per year, which is not sufficient to cover EDM's shortfall of 75,000 households per year if it is to reach the government's target of 50% electrification by 2030.



*The World Bank intends to support the connection of about 272,000 new households (1.35 million people) with electricity services through a combination of grid densification, mini-grids and stand-alone SHS.*

### A closer look at access: consumer realities on the ground

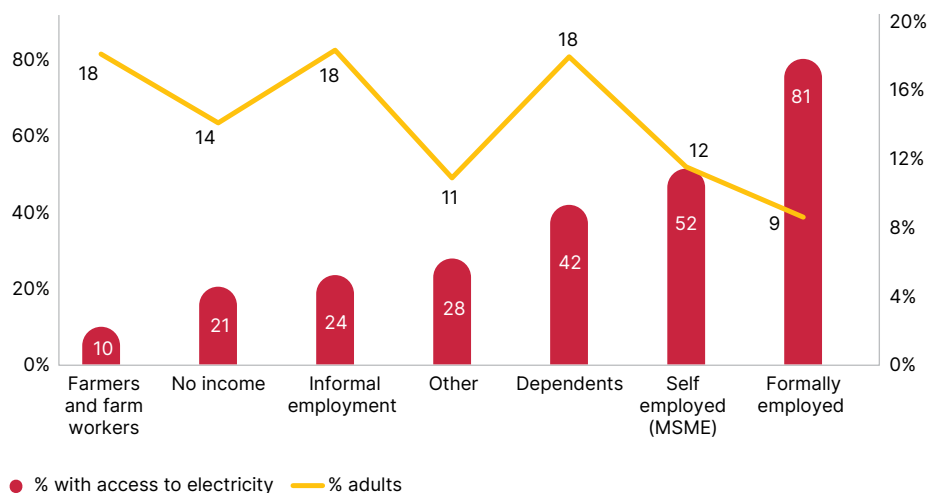
Geographic location has an obvious impact on access, given the infrastructure requirements for distribution. However, there are other demographic indicators that also provide useful insights into the drivers of access to electricity. For instance, access increases significantly over income, with the poorest (and also largest) groups, having the least access, while those who earn more have higher access. Interestingly, in Mozambique, even the lowest income groups have levels of access not far below that of the population average of 32.7%, while the average rate of access for the highest income group – those earning MZN 8,000 (USD 122) a month or more – is only about double the national average (see Figure 6).



**Figure 6:** Percentage of adults with access to electricity by income level

Source: FinScope Mozambique 2019

15 World Bank, Mozambique - Energy for All (ProEnergia) Project.



**Figure 7: Percentage of adults with access to electricity by income source**

Source: FinScope Mozambique 2019

To a large extent, income correlates with access because income is influenced by geographic location, however, it does provide a useful breakdown within the same location as well. Income source is another useful indicator, as those with the same income source tend to have similar demographic characteristics (including income), and also tend to live in similar types of locations. Access to electricity by income group negatively correlates almost directly with the proportion of adults in each income group that are rural. For instance, only 23% of the formally employed are rural, versus 87% of farmers and farm workers. In other words, the income groups that are the most rural, have the lowest access rates to electricity, and vice versa. Income groups with the highest access to electricity in general also tend to have the highest income (the formally employed, and the self-employed), and those with the lowest access tend to have the lowest income (farmers and the informally employed).

Education is another demographic indicator (perhaps the best indicator) that correlates strongly with access to energy. For instance, of those who have no education, only 10% have access to electricity (25% of the population). Those with a primary education (in full or in part) have between 18% and 29% access (another 47% of the population). Those with a secondary education (in full or in part) have between 55% and 85% access (another 25% of adults), while those that have an education in addition to secondary (vocational or tertiary) have the highest levels of access - between 88% and 93%, but this is only 3% of the population.



*Income groups with the highest access to electricity in general also tend to have the highest income, and those with the lowest access tend to have the lowest income.*

## Programmes and initiatives to promote the uptake of off-grid cleaner energy.

The main donors or development partners currently active in the off-grid space in Mozambique are the African Enterprise Challenge Fund's (AECF) REACT programme funded by the Swedish Embassy (USD 6.5 million), the Department for International Development (DfID) BRILHO programme (USD 30 million), the



World Bank's ProEnergia Project (USD 16 million). Most of these programmes are still however in their infancy or at the market scoping phase and according to industry stakeholders interviewed,<sup>16</sup> while funds have been committed, they have not been disbursed. Power Africa is also planning to develop significant additional electricity generation capacity by 2030, but is currently only in the feasibility study phase. Power Africa is also supporting EDM to develop a new transmission line that would link a gas power plant with Maputo.

One of the largest development partners in terms of funding is DfID's BRILHO energy access programme, which is part of an 'Energy for Africa' programme. The programme aims to improve access to energy for rural households by encouraging the development of private sector investment and innovations in the SHS, improved cook stoves (ICS) and mini-grid segment through a market development fund. It offers selected companies a mix of structured non-reimbursable funding and specialist support to de-risk business initiatives that aim to achieve competitive commercial returns and provide off-grid energy solutions to the low-income market. However, BRILHO spent at least three years in the market scoping phase and took about five to appoint a consultancy firm to manage the funds but have not appointed any implementation partners. After finally going to the market to get a program manager, something went wrong in the process and they had to do it twice. They then finally emerged with a company towards the end of 2019, so they have to set up the process of bids and allocating the funds.<sup>17</sup> The first call for applications was in February 2020 and offers selected businesses a mix of non-reimbursable funding for up to GBP 1,500,000 per company and specialised technical support.

The World Bank ProEnergia project is focused on providing funding for grid electrification but the second component of USD 16 million will provide support for the development of mini-grids, and off-grid results-based financing (RBF) for SHS. The European Commission to Multi-Donor Trust Fund (MDTF) is also preparing a programme to support the development of mini-grids and off-grid subsectors as part of the ProEnergia project. The World Bank had set up a financing programme via local banks, but according to one of the industry stakeholders interviewed,<sup>18</sup> it has a complicated application procedure and is not 100% effective as local banks are not necessarily interested in the micro, small, and medium enterprise (MSME) space.

The Embassy of Sweden, through the AECF, will provide up to USD 6.5 million for private sector companies to access capital and technical assistance to accelerate access to low cost, affordable, high-quality off-grid solutions by providing a matching grant to renewable energy solution providers and will also support mini-grids, SHS and ICS. The REACT programme has run challenge funds in Mozambique, but the criteria included that only already established businesses could apply and they had to invest at least 50% of the funding



*Most of these programmes are still in their infancy or at the market scoping phase and according to industry stakeholders, while funds have been committed, they have not been disbursed.*

16 Clear Cape, in conversation with the authors, 7 February 2020.

17

18 Kevin Kennedy (Clear Cape), in conversation with the authors, 7 February 2020





requested from the AECF themselves. The issue, however, is that the distressed economy has discouraged business and accordingly there has been few start-ups who would qualify.

Energising Development (EnDev), a programme coordinated by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) had been promoting the uptake of pico PV, SHS and ICS since 2005 through RBF but the programme ended in 2019 and it does not appear there have been any RBF calls for Mozambique since then.<sup>19</sup> In terms of cookstoves, the objective of the EnDev programme was to provide affected populations of previous flood disasters in Zambezia, Sofala, Manica, Inhambane and Gaza provinces with industrially produced highly efficient cookstoves. Families received the stoves at highly subsidised rates so that they were priced only slightly above the rate of traditional cookstoves. It was envisaged the sustainability of sales could be achieved through carbon financing mechanisms.<sup>20</sup> The Ministry of Land, Environment and Rural Development had also pursued a United Nations Framework Convention on Climate Change (UNFCCC) Redd+ initiative pilot in 2018.

Development partners are now beginning to realise that Mozambique, while a difficult operating environment, is an overlooked market and that despite commitments by many donors, few are successfully disbursing assistance. A list of development partners that have committed to support the off-grid cleaner energy sector in Mozambique is provided in Table 3.



*Development partners are now beginning to realise that Mozambique, while a difficult operating environment, is an overlooked market.*

**Table 3: Development partners committed support for off-grid cleaner energy, Mozambique**

| DONOR                         | FUNDING          | DATES        | TECHNOLOGY                               | OBJECTIVES  |
|-------------------------------|------------------|--------------|--|---|
| EnDev                         | USD 18.1 million | 2006 to 2019 | Solar PV (pico), SHS, grid densification | Coordinated by GIZ, the programme entailed Solar PV, ICS market development component aimed to support the accelerated distribution of energy technologies in the country. The current phase of EnDev program ended in 2019, and an upscaling program beyond 2019 was being negotiated. The principal instrument of support is RBF mechanism.   |
| DfID - Energy Africa (BRILHO) | USD 30 million   | 2019 to 2024 | SHS, ICS, mini-grids                     | BRILHO is a Part of 'Energy Africa' program which aims to improve access to energy for rural households and businesses. It will encourage private sector innovation and investments in the SHS, ICS, and mini-grid segments. It has four components: (1) Market Development Fund and Technical Assistance to enterprises; (2) Demand Activation; (3) Research and Dissemination; (4) Policy Reform and Institutional Strengthening. |

<sup>19</sup> Energypedia, "Mozambique Energy Situation."

<sup>20</sup> Simone Fehrenbach, *Energising Development - Phase 2: Annual Planning*, EnDev (2019), [https://endev.info/content/File:Annual\\_Planning\\_2019\\_final\\_short\\_version.pdf](https://endev.info/content/File:Annual_Planning_2019_final_short_version.pdf).

**Table 3: Development partners committed support for off-grid cleaner energy, Mozambique**

| DONOR                                     | FUNDING          | DATES        | TECHNOLOGY                          | OBJECTIVES  |
|---|------------------|--------------|-------------------------------------|---|
| AECF React (Embassy of Sweden)            | USD 6.5 million  |              | SHS, ICS, mini-grids                | Embassy of Sweden, through the AECF, is investing USD 6.5 million into Mozambique for private sector companies to access capital and technical assistance to accelerate access to low cost, affordable, high-quality products and services by rural poor households and communities across Mozambique. AECF provides a matching grant to renewable energy solution providers, including mini-grid, SHS and ICS.   |
| Belgium (Enable)                          | USD 13.8 million |              | Hydro mini-grids                    | Rural Energy for Rural Development (RERD). The objective is to support FUNAE to improve its capacity on planning and project management, and fund the construction of hydro mini-grids.   |
| ProEnergia - World Bank                   | USD 16 million   | 2019 to 2023 | Mini-grids, SHS, grid-densification | The aim of ProEnergia Project is to increase access to electricity service in Mozambique. There are three components to the project, the first component being peri-urban and rural electrification (this has a separate budget of USD 66 million). The second component is the off-grid electrification - this includes two subcomponents: mini-grids, and off-grid RBF. Finally, the third component is the technical assistance and implementation support to EDM and FUNAE. |
| ProEnergia - European Commission to MDTF. | USD 17 million   |              | Mini-grids, SHS,                    | A program under preparation to support mini-grids and off-grid subsectors   |
| Embassy of Sweden                         | USD 11 million   |              |                                     | The Beyond the Grid Fund for Africa focuses on providing a financial incentive for private firms for energy solutions for off-grid. Funded by Sweden, managed by NEFCO and implemented by REEEP, aims to replicate the results of the Beyond the Grid Fund for Zambia ( <a href="http://www.bgfz.org">www.bgfz.org</a> ) and bring clean, affordable off-grid energy access to millions of people in Burkina Faso, Liberia, Mozambique and Zambia                               |

Source: World Bank (2019) Mozambique - Energy for All (ProEnergia) Project.

# 2

## Access to energy

### A framework for access to energy

Typical measures of energy access include the proportion of households that have access to electricity via the national grid. Simple measures like this, however, cannot provide an accurate view of the quality and quantity of energy provided. Our series of reports on the Southern African Development Community (SADC) countries, which this report is part of, applies a more detailed framework for the evaluation of access to energy, based largely on the ESMAP/SEforALL multi-tier framework.

Access to energy is an enabler of socio-economic development. Universal access to 'modern energy' by 2030 is one of the three key pillars of the Sustainable Energy for All (SEforALL) programme. SEforALL is an initiative co-chaired by the Secretary-General of the UN and the President of the World Bank. The SEforALL multi-tier framework provides three main sources of energy used by households: 1) electricity, 2) solid fuels and 3) modern fuels. Solid and modern fuels are used primarily for cooking and heating. Solid fuels as defined in the multi-tier framework include biomass such as wood, charcoal and dung, as well as coal. Modern fuels include liquefied petroleum gas (LPG), natural gas, kerosene (including paraffin), ethanol, and biofuels.<sup>21</sup>

The multi-tier approach measures access to household electricity as a continuum of improvement (as opposed to a binary metric like access vs. no access) by reflecting all attributes of electricity supply that affect the user's experience while being technology and fuel neutral. Different energy services (such as lighting, television, air circulation, refrigeration, space heating, etc.) require different levels and quality of energy. The actual use of energy might be constrained by factors such as capacity, availability, affordability, and convenience amongst others. In terms of the framework, households in Tier 0 are said to have no access to electricity while households in Tier 5 have full access to reliable, safe and good quality electricity. Access to all sources of energy can be measured using multi-tiered standards, including access to cleaner off-grid electricity. The relevant ESMAP/SEforALL multi-tier standards for household access to grid-supplied electricity are presented in Table 4.



*Different energy services require different levels and quality of energy. The actual use of energy might be constrained by factors such as capacity, availability, affordability, and convenience amongst others.*

21 Mikul and Angelou, "Beyond Connections - Energy Access Redefined."



**Table 4:** Multi-tier energy framework to measure access to household electricity supply

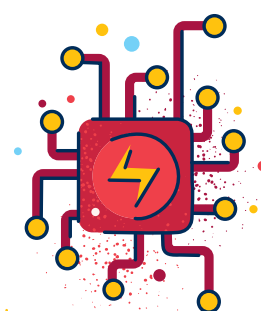
| ATTRIBUTES                                    | TIER 0 | TIER 1                           | TIER 2  | TIER 3  | TIER 4   | TIER 5  |
|---|--------|----------------------------------|---|---|--|---|
| Power capacity ratings (daily watt-hour - Wh) |        | Min 12 Wh                        | Min 200 Wh  | Min 1.0 kWh   | Min 3.4 kWh  | Min 8.2 kWh   |
| Supported appliances                          |        | Task lighting and phone charging | General lighting, phone charging & television/fan (if needed) | Tier 2 and medium power appliances  | Tier 3 and high-power appliances   | Tier 4 and very high-power appliances               |
| Typical supply technologies                   |        | Solar lantern                    | Small solar home systems, Re-chargeable battery               | Medium solar home systems, Fossil fuel-based generator, Mini-grid               | Large solar home systems, Fossil fuel-based generator, Mini-grid, Central grid | Large fossil fuel-based generator, Central grid     |
| Availability (Duration)                       |        | Min 4 hrs                        | Min 4 hrs   | Min 8 hrs   | Min 16 hrs   | Min 23 hrs  |
| Reliability                                   |        |                                  |   |   | Max 14 disruptions per week  | Max 3 disruptions per week of total duration <2 hrs |
| Quality                                       |        |                                  |   |   | Voltage problems do not affect the use of desired appliances                   |   |
| Affordability                                 |        |                                  |   | Cost of a standard consumption package of 365 kWh/year <5 % of household income |  |   |

Source: ESMAP, SEforALL (2015) Energy Access Redefined.

Off-grid technologies such as SHS can be used to provide electricity services from Tier 2 to Tier 4, while mini-grids are typically used to provide services from Tier 3 to Tier 4. Table 5 illustrates which energy services can be accessed by households at each tier and which of the services could be met using either solid or modern fuels. While solid and modern fuels can often be used instead of electricity for cooking, heating and lighting, access to electricity is required for most other energy services.

### Availability, reliability, and quality of grid electricity

The quality of grid-supplied electricity is poor (Mozambique ranks 114<sup>th</sup> out of 137 countries). The average interruption time increased from 30 minutes in 2009 to 68 minutes in 2013. Grid breakdowns have led to widespread electricity outages – there were over 59 hours of transmission interruptions in 2013. Flooding in 2015 caused damage to EDM’s transmission infrastructure and cut off electricity supply to 350,000 EDM connected customers (two million people altogether) for roughly four weeks.<sup>22</sup> The single line to the Northeast is also overloaded, resulting in load shedding in the region of over four hours per day.



*The quality of grid-supplied electricity is poor. The average interruption time increased from 30 minutes in 2009 to 68 minutes in 2013.*

22 Hussain et al., Mozambique Energy Sector Policy Note.



**Table 5: Access to energy services by tier and source of energy**

| Energy services                    | ELECTRICITY |        |        |        |        |        | MODERN FUELS | SOLID FUELS |
|------------------------------------|-------------|--------|--------|--------|--------|--------|--------------|-------------|
|                                    | Tier 0      | Tier 1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |              |             |
| 1. Lighting                        |             | ✓      | ✓      | ✓      | ✓      | ✓      | ✓            | ✓           |
| 2. Entertainment and communication |             | ✓      | ✓      | ✓      | ✓      | ✓      |              |             |
| 3. Space cooling and heating       |             |        | ✓      | ✓      | ✓      | ✓      | ✓            | ✓           |
| 4. Refrigeration                   |             |        |        | ✓      | ✓      | ✓      |              |             |
| 5. Mechanical loads                |             |        |        | ✓      | ✓      | ✓      | ✓            |             |
| 6. Product heating                 |             |        |        |        | ✓      | ✓      | ✓            | ✓           |
| 7. Cooking                         |             |        |        | ✓      | ✓      | ✓      | ✓            | ✓           |

Source: Own analysis based on ESMAP SEforALL. 2015. Energy Access Redefined

More than 56% of EDM customers rate the quality of grid-supplied electricity to be poor and 26.7% rate their services as bad. Only 16.7% consider the service provided to be acceptable.<sup>23</sup> More than 63% of customers believe that the quality of energy and the tariff represent the most important considerations. The fact that nearly 80% of the EDM customers surveyed indicated that they also rely on private generators to fulfil their electricity needs provides evidence that grid-supplied electricity is unreliable.<sup>24</sup>

**Table 6: Energy access, usage, and reliability, Mozambique**

| MEASURE                                       | SOURCE  |
|---|---|
| Quality of electricity supply (on-grid) index | World Economic Forum Global Competitiveness Index |
| Rating (1 – 7)                                | 3.0   |
| Rank  | 114   |

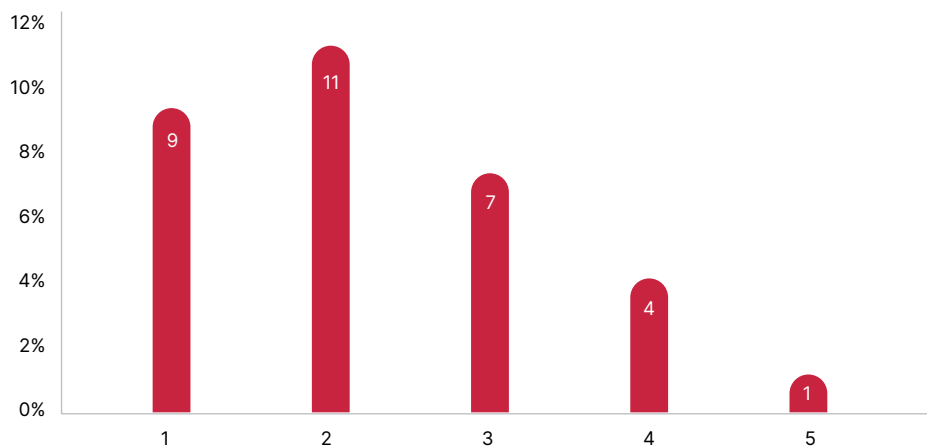
In terms of the ESMAP multi-tier framework, the electricity supply in Mozambique would be rated between Tier 1 and Tier 3 for availability and reliability (Table 2). Note that this only applies to the proportion of the population that has access to grid-supplied electricity (about a third). We do not have data on the voltage quality of EDM's supply.

Using the reported energy source for lighting and cooking, as well as reported asset ownership of electric appliances (TV's, electric fans, refrigerator's and air conditioners), FinScope (2019) is able to categorise all adults into the 6 tier's as set out by the framework. These take into account users who do not have access to electricity (Tier 0), users who have access to electricity but use very limited electricity only for lighting/

23 Electricidade De Mozambique, *EDM Strategy 2018 - 2028: Lighting Mozambique's Transformation* (2018), <https://www.edm.co.mz/en/document/reports/edm-strategy-2018-2028>.

24 Electricidade De Mozambique, *EDM Strategy 2018 - 2028: Lighting Mozambique's Transformation*.

charging purposes (Tier 1), and those who use electricity for lighting and who has a TV or an electric fan, but no other electric appliances (Tier 2). Tier 3 include those who use electricity for lighting, has a TV or electric fan, but also has a refrigerator (medium power appliances), while Tier 4 is equal to Tier 3 but also include those who uses electricity for cooking (high power appliance). Tier 5 are the highest end users, who, in addition to Tier 4 criteria, have air conditioners (very high power appliances). As 33% of adults have access to electricity, this means that 67% fall in Tier 0. The remainder of the adults



● % of adults in each tier of grid electricity use

**Figure 8: Percentage of adults in each tier of grid electricity use**

Source: FinScope Mozambique 2019

(33%), are split into the remaining 5 tiers (1 to 5) as follows:

This would imply that the majority of adults with access to the grid fall in Tier 1 and 2 (64% or 20% of all adults in Mozambique). This increases to 84% of adults with access to electricity if Tier 3 is included (or 27% of all adults). Only 16% of adults with access (or 5% of all adults) have access levels equal to Tier 4 and 5 usage, allowing them to use electricity for cooking (Tier 4) and things like air conditioners or water heaters (Tier 5). Using the ESMAP/SEforALL multi-tier standards framework, this would imply that almost two thirds of adults who report having access to electricity (those in Tier 1 & 2, or 64%), use less than 1 kWh per day (the minimum daily watt-hour usage for Tier 3).

**Table 7: Grid-supplied electricity rating, Malawi**

|                            |                   | TIER 0 | TIER 1    | TIER 2    | TIER 3    | TIER 4   | TIER 5  |
|----------------------------|-------------------|--------|-----------|-----------|-----------|--|---|
| AVAILABILITY<br>(DURATION) | HOURS PER DAY     |        | Min 4 hrs | Min 4 hrs | Min 8 hrs | Min 16 hrs   | Min 23 hrs  |
|                            | HOURS PER EVENING |        | Min 1 hr  | Min 2 hrs | Min 3 hrs | Min 4 hrs  | Min 4 hrs   |
| RELIABILITY                |                   |        |           |           |           | Max 14 disruptions per week                                  | Max 3 disruptions per week of total duration <2 hrs |
| QUALITY                    |                   |        |           |           |           | Voltage problems do not affect the use of desired appliances |   |

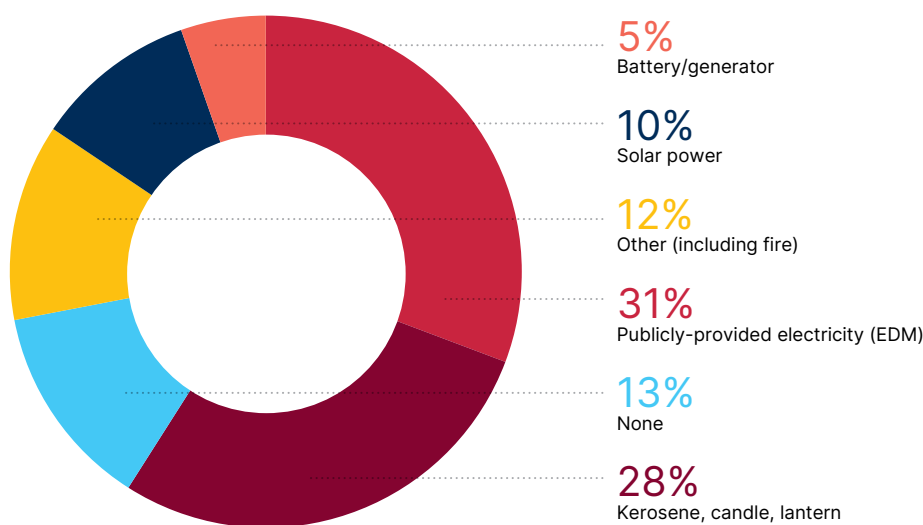


# 3

## Consumer profile of energy needs and usage

*In countries where electricity is not yet widely available or reliable, and where affordability is still an issue for the majority of the population, electricity usage is mostly limited to lighting, and not for higher intensity purposes like cooking, refrigeration, etc. In Mozambique, most people rely on non-electrical means of lighting because electricity access overall is so low.*

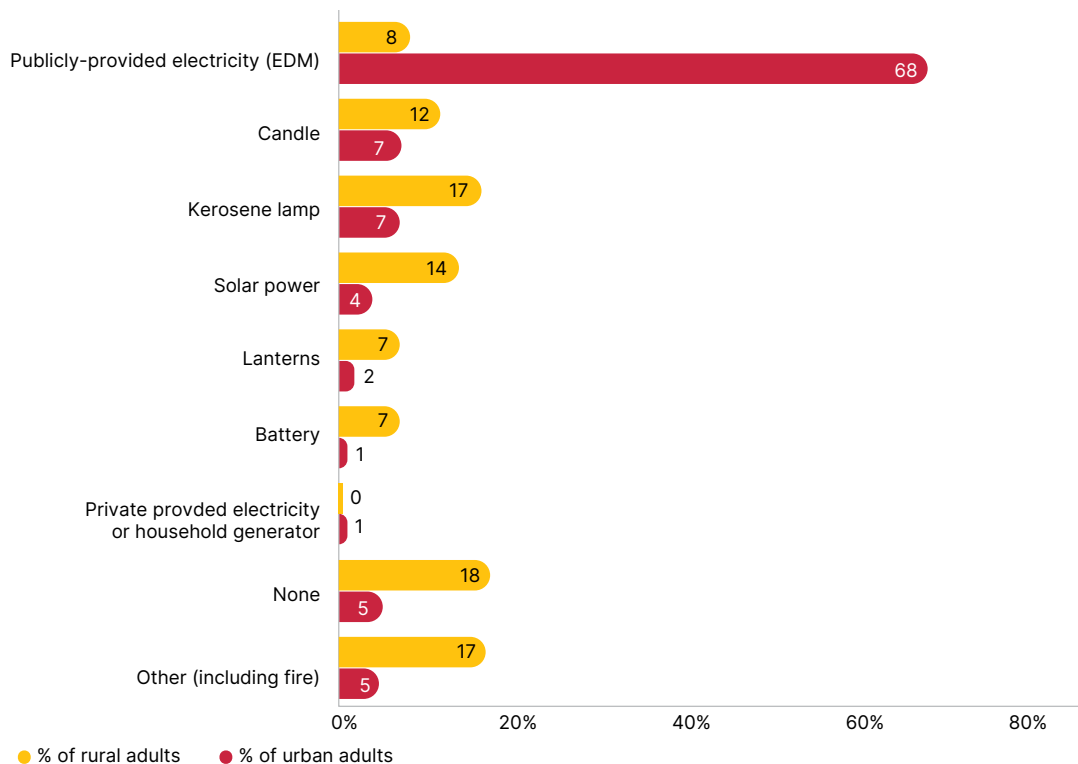
Electric lighting is therefore still uncommon (used by 31% of adults), although this is higher than countries like Malawi and Madagascar. Furthermore, although the majority of Mozambicans use sources other than grid electricity for lighting, grid electricity is now the single biggest source of energy for lighting, and if solar power and electricity from a battery or generator is included, almost half of adults (46%) uses an electric source for lighting. This is a vast improvement from 2014, when FinScope found that the majority of adults used biomass for lighting, and a very small minority used electrical sources. Currently, less than 12% of adults report using other sources (including fire) as a source of lighting, although a slightly bigger portion (13%) report not using any source. A substantial



**Figure 9:** Fuel sources used for lighting, Mozambique (2014)

Source: Own analysis based on the 2019 Mozambique FinScope Survey

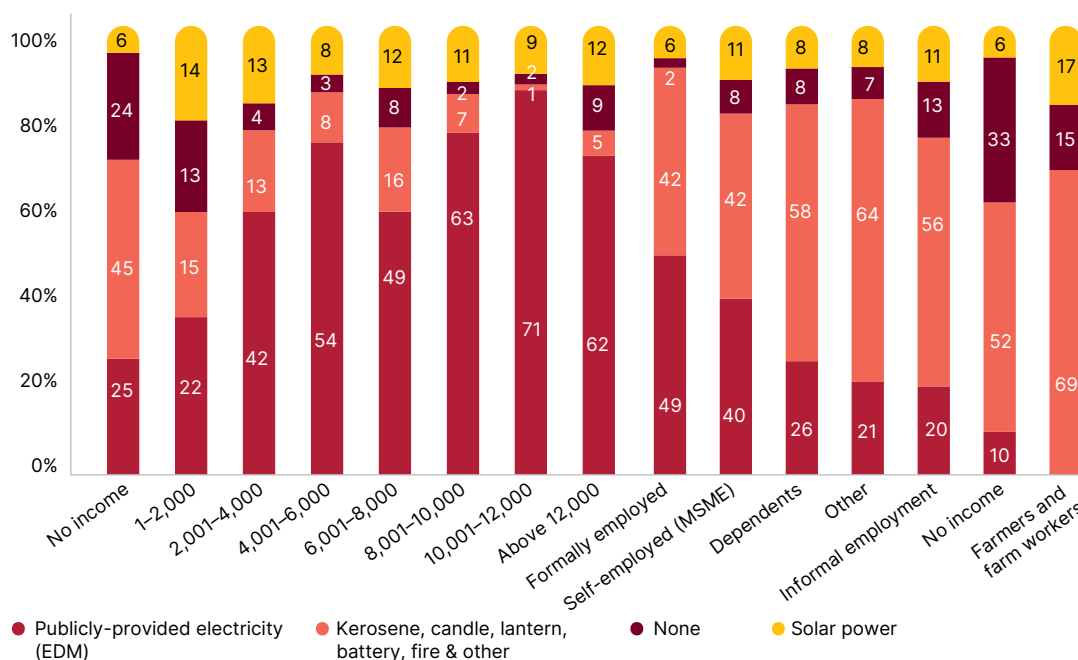




**Figure 10: Energy sources used for lighting by urban/rural**

Source: FinScope Mozambique 2019

portion (28%) are also still reliant on kerosene lamps, candle's and lanterns as a source of lighting. The proportion of adults who use grid electricity for lighting, which is comparable to the overall proportion of adults who have access to grid electricity, indicates that most people who have access to grid electricity use it for lighting purposes.



**Figure 11: Energy sources used for lighting by urban/rural**

Source: FinScope Mozambique 2019



However, there are significant changes in the energy sources used for lighting based on geographic location. For instance, grid electricity is the single largest energy source for lighting in urban areas, at 68% of adults. In rural areas, many more adults report using no lighting source, or using other sources (including fire). The use of kerosene lamps is comparable to these first two groups (at 17% of adults), while solar power and candles are also fairly popular (14% and 12%). The use of lanterns and batteries, while lower (at 7% each) is still much more popular than in urban areas (where it is 2% and 1%).

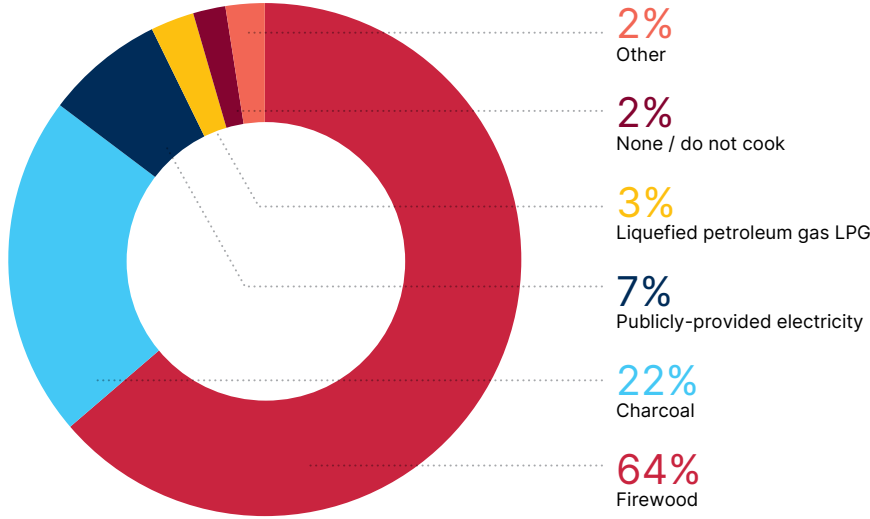
The use of kerosene lamps, candles, lanterns and other sources (including fire) decreases as income increases, from 45% to 51% for the lowest income groups to below 20% for the highest income groups, while the use of grid electricity increases substantially from only 25% for the lowest income groups to above 60% for the highest. The proportion of adults that report not using any source also decrease as income increases, but interestingly, the use of solar remain fairly similar across all income groups, ranging between 6% and 14%. Similarly, for income source, farmers and those with no income source are the least likely to use grid electricity for lighting (0% and 10%), while those who are formally employed (receive a salary or wage) have the highest usage (49%).

Perhaps the biggest impact on the use of electricity is from education. Of those with a tertiary education, 91% report using grid electricity for lighting, versus 10% for those with no education. Interestingly, solar power usage for lighting actually decreases over education, especially for those with more than a primary education - increasing from 10% for those with no education to 16% for those who completed primary education, and then decreasing to only almost 0% for those with a tertiary education. Usage of various energy sources for lighting varies little between men and women, with slightly more women using grid electricity (30% versus 28%) and slightly more men using solar (12% versus 10%).

Unlike for lighting, Mozambican adults are heavily reliant on biomass for cooking (85%), with firewood being by far the most predominant fuel source (64%). There



*The use of grid electricity increases substantially from only 25% for the lowest income groups to above 60% for the highest.*



**Figure 12: Fuel sources used for cooking, Mozambique (2014)**  
 Source: Own analysis based on the 2014 FinScope Household Survey for Mozambique.



is also limited use of charcoal (22%). Only a small portion of the population has access to cleaner fuel sources or energy-efficient technologies for cooking, however, 7% use electricity for cooking and an additional 3% use LPG.

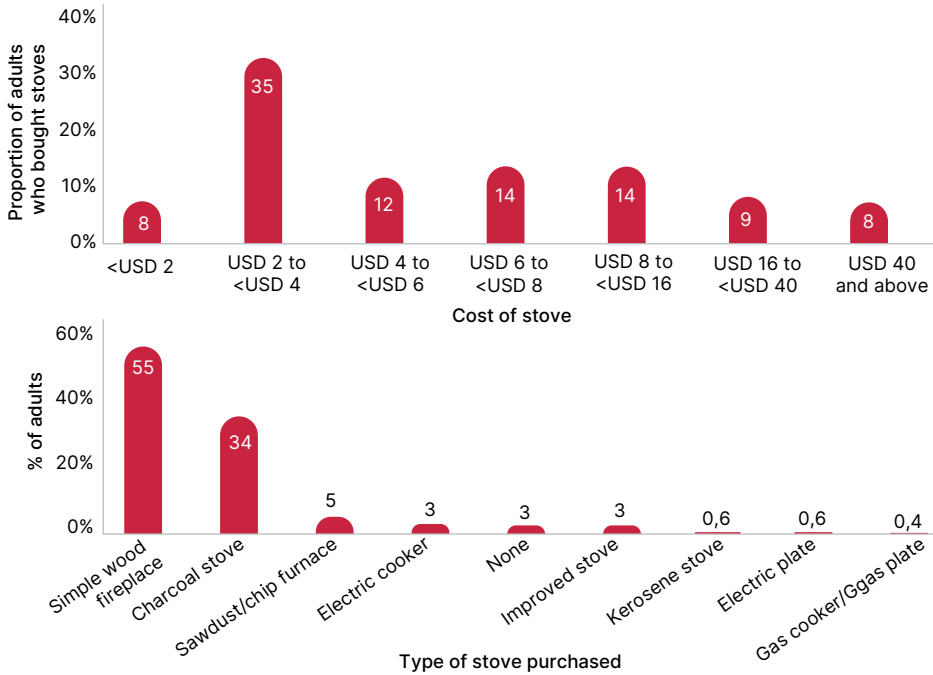
Similar to lighting, there is also a difference in the energy sources used for cooking based on geographic location. For instance, charcoal is the predominant source used in urban areas (44%), while firewood is the predominant source in rural areas (84%). However, firewood is the second most used source in urban areas (29%), while charcoal is used second most in rural areas (8%). Electricity is only really used for cooking in urban areas, where 17% of adults use it to cook, but 2% of rural adults also report using grid electricity for cooking. Similarly, LPG is only really used in urban areas, at 7%. Solar power is used for cooking by 0.5% of urban adults and 1% of rural adults.

The use of firewood decreases over income, while the use of charcoal, grid electricity and LPG increases. However, even for the highest income groups, around a quarter of adults still use firewood, and 40% still use charcoal. Farmers, those in informal employment, and those with no income are most likely to use firewood (82%, 74% and 71%), while the formally employed and self-employed are most likely to use charcoal (46% and 38%) as well as grid electricity to cook (24% and 12%). Education again has a big impact, as 82% of those with no education use firewood, compared to 4% of those with a tertiary education. Charcoal, grid electricity and LPG on the other hand increase over education, from 10% of adults with no education using these three sources, to 94% of those with a tertiary education (charcoal being the largest component at 41%).

Respondents were asked what type of cooker they used. By far the most common method was a simple wood fireplace (55%), followed by a charcoal



*Electricity is only really used for cooking in urban areas, where 17% of adults use it to cook, but 2% of rural adults also report using grid electricity for cooking.*



**Figure 13:** Types of cook stoves used, and cost of purchased cook stoves

Source: FinScope Mozambique 2019

stove. A saw dust/chip furnace or improved (wood) stove accounted for another 8%. Respondents were furthermore asked how they obtained their cook stoves (kitchen stoves). Just over half indicated that they made it by their own means, while 37% said they bought it. The remainder inherited it, collected it for free or from a programme, or obtained it via other methods. Those who said they bought it were also asked about the cost of the stove. The majority of stoves purchased cost less than USD 6 (55% of stoves purchased), while only 16% cost USD 16 or more (and only 8% cost USD 40 or more).

Every year it is estimated that 16 million cubic meters (m<sup>3</sup>) of biomass is harvested from roughly 30.6 million hectares of forest land and burnt to meet rural energy requirements.<sup>25</sup> A study by the Mozambique Ministry of Land, Environment and Rural Development found that while agriculture is the major cause of deforestation in Mozambique (responsible for ~65%), extraction of timber products (8%) and production of firewood and charcoal (7%) are also significant contributors.<sup>26</sup> A study on the benefits of clean cookstove programmes estimated that the resulting household air pollution from the use solid fuels (woodfire and charcoal) for cooking was responsible for approximately 18,000 premature deaths and 696,000 disability-adjusted life years in Mozambique.<sup>27</sup>

Furthermore, respondents were asked whether they have heard about solar energy or domestic solar systems, and whether they are interested in owning a solar energy or SHS. In total 61% of adults have heard of it, while only 11% said they were not interested in owning it. Awareness (having heard about it), was highest in the provinces that also had the highest access to grid electricity, and it increased over income. Awareness was also highest for the groups with the highest and most stable income sources (formal employed and self-employed), and for those with the highest education. Men were more likely to be aware of it (66%), compared to women (56%). Those who use electricity or solar for lighting were more aware than those who used kerosene, candles, lanterns, etc. indicating an opportunity to target those who do not already use electricity or solar better. Those who use charcoal for cooking were also more aware than those who use firewood.

Awareness is one thing, but actual interest in owning a solar system is perhaps more useful as a business case indicator. Encouragingly, the proportion of people who are not interested declined in provinces where electricity access was lower. However, there is a clear indication that a solution for lower income groups would need to be found - the proportion of people not interested in owning a solar system increased over income, to as much as 34% for the highest income groups. Similarly, the formally employed were the least interested in owning solar at 39%, and interest also declined as education increased, with 48% of those with a tertiary education not interested. Women were only slightly less interest



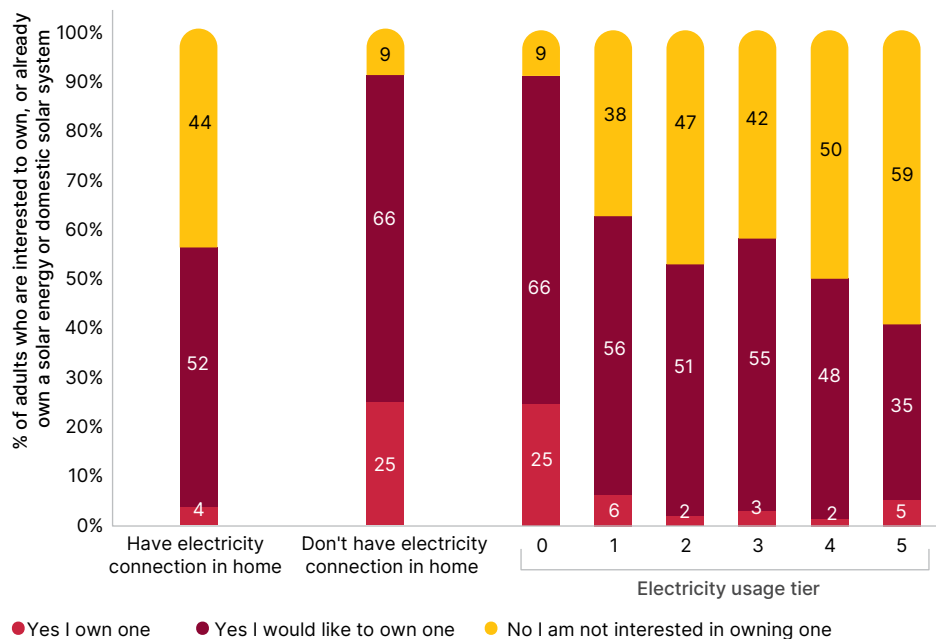
*While agriculture is the major cause of deforestation in Mozambique (~65%), extraction of timber products (8%) and production of firewood and charcoal (7%) are also significant contributors.*

25 Mokveld and von Eije, *Final Energy report Mozambique*.

26 Environment and Rural Development (Republic of Mozambique) Ministry for Land, "Mozambique's Forest Reference Emission Level for Reducing Emissions from Deforestation in Natural Forests," (2018). [https://redd.unfccc.int/files/2018\\_frel\\_submission\\_mozambique.pdf](https://redd.unfccc.int/files/2018_frel_submission_mozambique.pdf).

27 Susan C Anenberg et al., "Air pollution-related health and climate benefits of clean cookstove programs in Mozambique," *Environmental Research Letters* 12, no. 2 (2017).



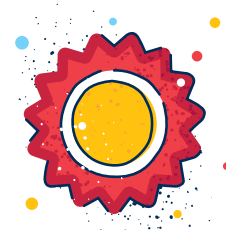


**Figure 14:** Interest in owning a solar home system by electricity access and usage

Source: FinScope Mozambique 2019

than men (23% versus 20%). Those who use grid electricity for lighting were also less interested (46%), perhaps because lighting is the main use case for grid electricity in Mozambique. However, those who use charcoal for cooking were less interested compared to those that use firewood (35% versus 12% were not interested), despite the former being more aware of solar than the latter.

Despite substantial interest in owning a solar system across both, those who have access and those who do not have access to electricity grid connection, and across all tiers of electricity usage, there are noteworthy differences in the degree of current ownership, and the degree to which people are not interested in ownership. For instance, those who have an electricity connection in their home are both the least likely to already own a solar system, and the least likely to say they are interested in owning one. Furthermore, the higher the tier of electricity usage, the more this pattern expresses itself. In other words, those who use less electricity (Tier 1 to 3), are less likely to say they are not interested in owning a solar system.



*Those who have an electricity connection in their home are both the least likely to already own a solar system, and the least likely to say they are interested in owning one.*

## Affordability of grid-supplied electricity and cost-reflectivity of tariffs

### *Cost and affordability of grid-supplied electricity*

The EDM has a stepped tariff structure linked to consumption and application (i.e. residential, agriculture, and general). A social tariff of MZN 1.07 (USD 0.015) per kWh applies to the first 100 kWh of consumption per month, and the standard residential tariff is MZN 6.63 (USD 0.10) per kWh (Table 3).<sup>28</sup> The affordability of consumers has been an important attribute of tariff design.

<sup>28</sup> "Electricity Tariffs," Electricidade de Mozambique (EDM), 2020, <https://www.edm.co.mz/en/website/page/electricity-tariffs>.





**Table 3: Cost of grid-supplied electricity, Mozambique (2020)**

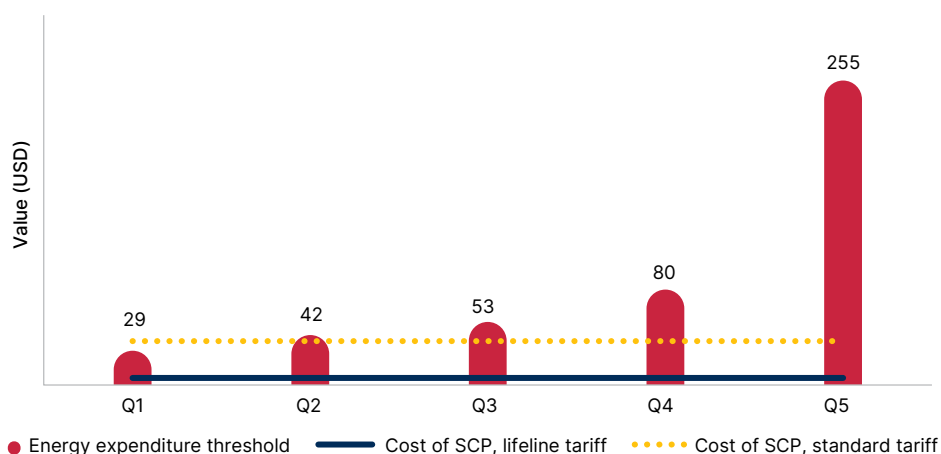
|                             | CURRENCY | COST PER KWH | COST OF SCP (365 KWH) |
|-----------------------------|----------|--------------|-----------------------|
| Lifeline tariff, prepaid    | MZN      | 1.07         | 390.55                |
|                             | USD      | 0.02         | 5.94                  |
| Residential tariff, prepaid | MZM      | 6.63         | 2 419.95              |
|                             | USD      | 0.10         | 36.83                 |

Source: Own analysis based on tariff data from EDM

Under the Government of Mozambique’s universal tariff policy, this tariff would apply for both grid connection and mini-grid connection, ensuring that the electricity service is affordable to the poor segments of the Mozambican population. A standard consumption package (SCP) at the lifeline rate is only MZN 391 (USD 5.94) per year – the lowest among the five target countries of this study. At the standard residential tariff, the SCP would cost MZN 2,420 (USD 37), although this would be less based on the discount for the first 100 kWh.

The ESMAP/SE4ALL multi-tier framework measures the affordability of grid electricity by comparing the cost of a SCP of 365 kWh per year to a maximum energy expenditure threshold, set at 5% of total household expenditure (Figure 2). According to this metric, we find that a SCP at the standard residential tariff is too expensive for households in the bottom expenditure quintile (Q1) and likely some households in the second-lowest quintile (Q2). All Mozambican households can, however, afford a SCP at the lifeline tariff.

A World Bank report from 2014 shows that electricity consumption across the bottom four income quintiles is relatively equal (around 40 to 50 kWh per month), nearly half that of the top quintile.<sup>29</sup> This is very low however, given that the SCP implies usage of 30.4 kWh per month, which means even for the richest quintile in Mozambique, average usage is at most three times the SCP (versus



**Figure 15: Affordability of grid electricity, Mozambique (2020)**

Note: Cost of standard consumption package (SCP): Lifeline tariff = USD 5.94; Standard tariff = USD 36.83

Source: Own analysis.

29 Masami Kojima et al., *Who uses electricity in Sub-Saharan Africa? Findings from household surveys*, World Bank Group (Washington, D.C., 2016), <http://documents.worldbank.org/curated/en/967821470756082684>.

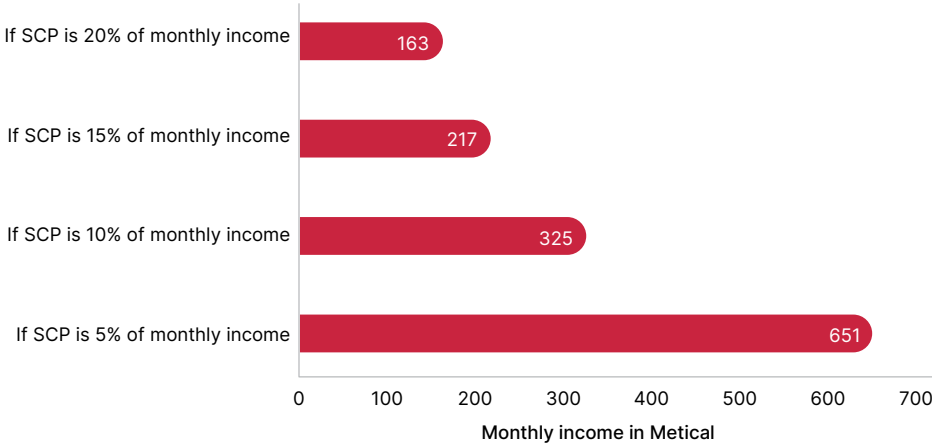
probably around ten times the SCP for a middle income household - i.e. not the richest quintile - in a developed country).

FinScope can assist to provide more insight into the affordability of electricity in relation to segments of the adult population (or segments of households), and their level of use of electricity. Firstly, it is important to note that those who are currently in Tier 1 actually uses less than the SCP per month, while those in Tier 2 use at most up to the SCP per month. Secondly, the lifeline tariff actually applies to a fairly generous allocation of usage when compared to the SCP – as it provides a discount on usage of up to three times the SCP. In other words, the SCP implies a monthly usage of 30.4 kWh whereas the lifeline tariff applies to the first 100 kWh usage per month – or about three times the SCP. Lastly, it is worth noting that even with the current generous discount, the majority of electricity users (62%) purchase less electricity than the SCP, and most of the remainder (another 22%) purchase less than the 100kWh that the lifeline tariff applies to. The standard tariff therefore only applies to 16% of users, and only on the part of their electricity usage that exceeds 100 kWh per month<sup>30</sup>.



*The SCP implies a monthly usage of 30.4 kWh whereas the lifeline tariff applies to the first 100 kWh usage per month – or about three times the SCP.*

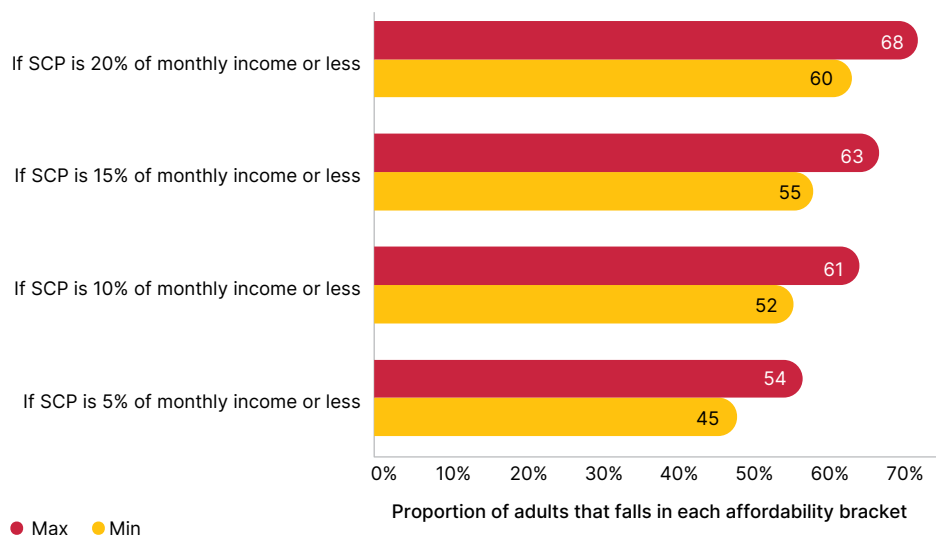
The monthly cost of the SCP, at the lifeline tariff, is MZN 32.5 (USD 0.5). We can therefore calculate the minimum household/personal monthly income required to fall into specific brackets of affordability of the SCP. For instance, in order for the SCP to be 5% of your monthly income or less, you would need to earn MZN 651 (USD 10) per month, either as an individual or as a household (Figure 16). Although FinScope only provides income ranges for households (as opposed to exact incomes), we can calculate from this data that 42% of households would only have to pay 1.6% of their monthly income or far less than this to purchase the SCP. This is far below the minimum threshold of 5% as set out by the ESMAP/ SE4ALL multi-tier framework.



**Figure 16:** Minimum monthly income required to fall into different brackets of affordability of the SCP

Source: FinScope Mozambique 2019

<sup>30</sup> Calculated using the minimum and maximum energy use thresholds for the 5 Tiers under the ESMAP/ SE4ALL multi-tier framework, and the proportion of the adult population that falls into each tier



**Figure 17: Proportion of adults that fall into different brackets of affordability of the SCP**

Source: FinScope Mozambique 2019

Furthermore, household income is higher than personal income, so by looking at personal income, we can draw more conclusions of the overall affordability of electricity in Mozambique. For individuals, the proportion for which affordability of the SCP would be 1.6% or less is 23% (those earning MZN 2,001 / USD 30 per month or more). However, we have a more detailed breakdown of personal income, so we can get a better estimate of the proportion of adults that would fall in each affordability bracket. Accordingly, we estimate that 45% to 54% of adults would pay 5% or less of their monthly income if they purchased the SCP, and this increases to 60% to 68% if the SCP cost's 20% of monthly income or less. In other words, even at the 5% threshold – given the current discount of the lifeline tariff, up to 54% of adults would be able to afford the SCP at the minimum affordability standard – far higher than the 33% of adults that currently have access to electricity (and ignoring the fact that more than half of those who currently have access do not even purchase as much as the SCP). The majority of households (whose income exceed individual income) should therefore be able to both access electricity and buy at least the SCP – yet we don't see this happening.



*The majority of households (whose income exceed individual income) should be able to both access electricity and buy at least the SCP – yet we don't see this happening.*

## Cost reflectivity of grid-supplied electricity

Electricity tariffs in Mozambique are not fully cost-reflective. EDM does not generate enough revenue from electricity sales to fund operating and maintenance costs, not to mention capital expenditure for transmission, distribution and grid expansion. The company is running a deficit on electricity sales, purchasing at between USc (USD cents) 9 and USc 10 per kWh, and selling at an average of USc 7.6 per kWh, while being additionally constrained by the devaluation of the Metical (MZN).<sup>31</sup> Tariffs are currently uniform across

31 Get Invest, "Energy Sector: Mozambique," Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2016, <https://www.get-invest.eu/market-information/mozambique/energy-sector/>.



the country with large customers (supplied at a voltage level of 66 kV or higher) required to negotiate their tariffs with EDM. Tariff-based customers account for 90% of EDM's non-export energy sales.

EDM connection fees do not recover the full cost of connecting new customers. In 2012, customers on the lifeline tariff paid about MZN 875 (USD 31 at the 2012 exchange rate) while connections for normal household customers was about MZN 3,630 (USD 128). The 2015 World Bank policy note estimates that it costs EDM an additional USD 1,000 for each ordinary connection.<sup>32</sup>

Taking into account the minimum and maximum kWh usage per day for each Tier of electricity users, we can calculate the total minimum and maximum kWh usage per month for each Tier, as well as the total monthly kWh usage for all retail clients (individuals and households) of EDM. This allows us to also calculate the revenue that EDM receives by Tier and in total each month - taking into account the discount provided on the first 100 kWh per month per client. The total monthly estimate amounts to USD 4.4 million for the minimum usage estimate, and USD 26.1 million for the max estimate. This means that EDM generates revenue from its retail clients of between USD 52.8 million to USD 313.3 million per year (min and max estimates).

However, we can also calculate the discount (and the cost of the discount) provided to retail customers per Tier and in total. We calculate that the total cost of the discount per month is between USD 9.7 million (min) and USD 19.8 million (max), or USD 116.9 to USD 237.4 million per year. This translates to a substantial subsidy of 43% to 69% per year that EDM provides to all its retail clients per year. By Tier customers receive an even greater subsidy - 84% for Tier 1 to 3 clients, as well as Tier 4 clients at the minimum usage, and between 19% (max usage for Tier 5) and 56% (min usage for Tier 5 and max usage for Tier 4) for the remainder of clients. The vast majority of EDM's retail clients (84% to 96%) therefore gets a monthly discount of 84%, while the remaining 4% to 16% of retail clients get a monthly discount of between 19% and 56%.



*The total monthly estimate amounts to USD 4.4 million for the minimum usage estimate, and USD 26.1 million for the max estimate.*

32 Get Invest, "Energy Sector: Mozambique."

# 4

## MSME energy use for productive uses

### Small business profile

There are 4.9 million MSMEs in Mozambique, all classified as micro-enterprises - no more than five employees (93% have no employees besides the owner and the remaining 7% have employed one to four people). More than 85% of MSMEs are in rural areas and are informal.<sup>33</sup> Retail accounts for 44% MSMEs activities, while a further 22% are engaged in small-scale or subsistence farming (Figure 18).

In terms of the specific business activities undertaken, the majority of MSMEs (94%) are retailers. Many sell products they have bought or collected from nature (Figure ). Only 6% classify themselves as service providers, providing mainly skilled services (e.g. mechanic or plumber), followed by professional services (e.g. medical, legal and accounting services).

Many MSMEs operate from residential premises (46%) (Figure 20), suggesting that there is a lack of available and affordable operational space.<sup>34</sup> A further 28% operate from a stall, table or container which reflects a large number of MSMEs involved in retail. A further 16% operate as street vendors, while only 3% are based in shopping malls.

94%

94% MSMEs are retailers. Many sell products they have bought or collected from nature. Only 6% classify themselves as service providers, providing mainly skilled services, followed by professional services.

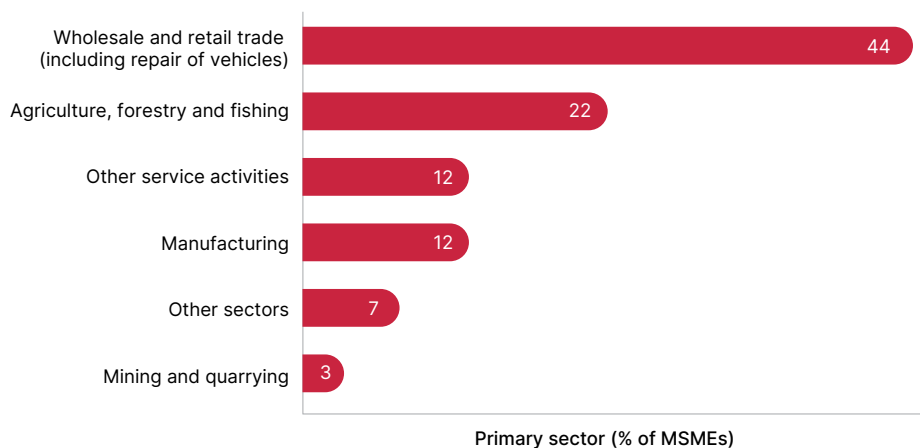


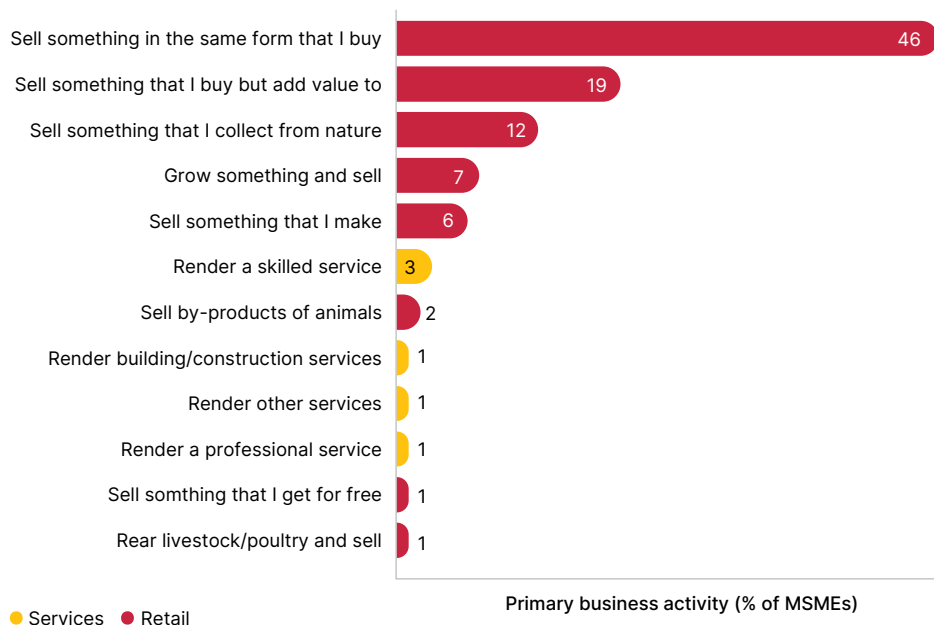
Figure 18: MSMEs by sector composition, Mozambique (2012)

Source: Own analysis based on 2012 FinScope MSME Survey for Mozambique.

33 Cenfri and ICC Mozambique Lda, *FinScope Micro, Small and Medium Enterprise Survey: Mozambique*, FinMark Trust (2012), [http://www.finmark.org.za/wp-content/uploads/2016/01/Rep\\_FS\\_Mozambique\\_MSME\\_20121.pdf](http://www.finmark.org.za/wp-content/uploads/2016/01/Rep_FS_Mozambique_MSME_20121.pdf).

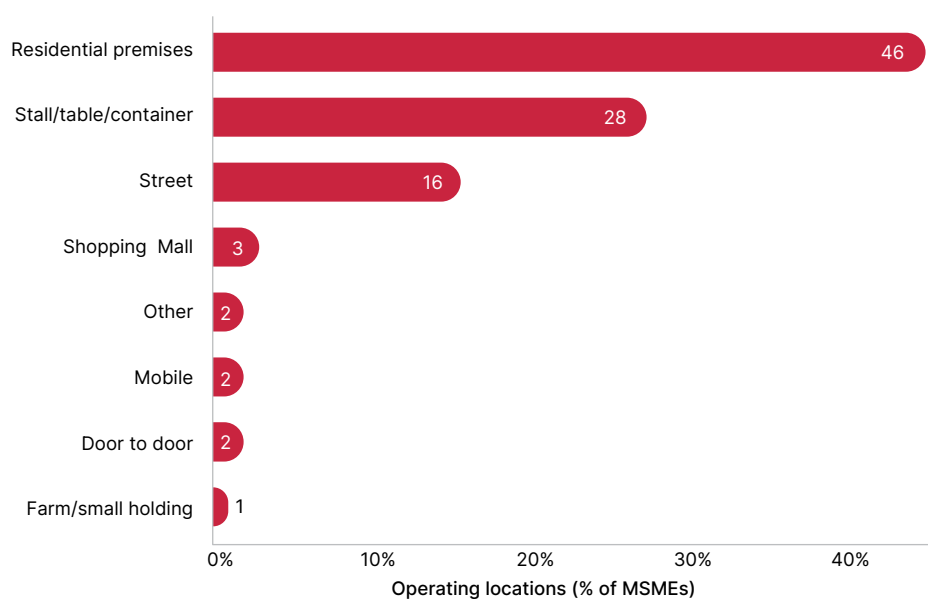
34 Cenfri and ICC Mozambique Lda, *FinScope Micro, Small and Medium Enterprise Survey: Mozambique*.





**Figure 19: Activities undertaken by MSMEs, Mozambique (2012)**

Source: Own analysis based on 2012 FinScope MSME Survey for Mozambique.



**Figure 20: Operating locations of MSMEs, Mozambique (2012)**

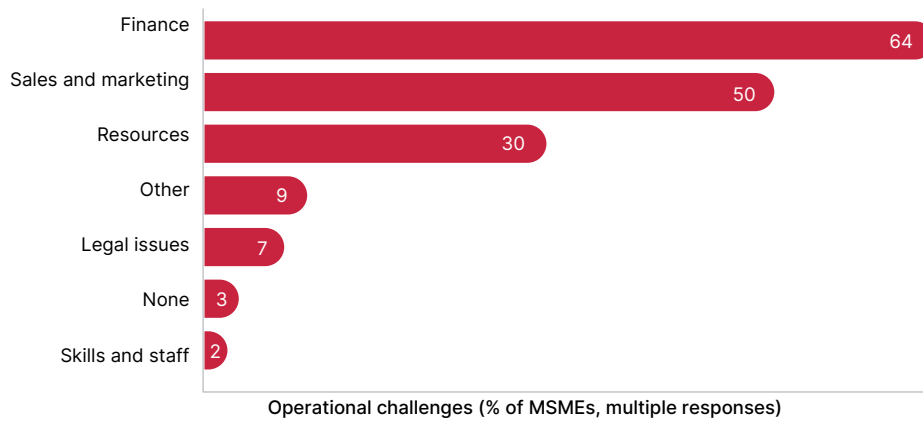
Source: Own analysis based on 2012 FinScope MSME Survey for Mozambique.

## MSME access to electricity

MSME access to electricity is very low - only about 7% of Mozambican MSMEs have access to electricity in their business. The FinScope survey asked business owners “what problems, if any, do you face in your operations?” and respondents could select all applicable options. Results show that finance (especially in terms of cash flow) is reported as the most prevalent (64%) challenge (Figure 21).

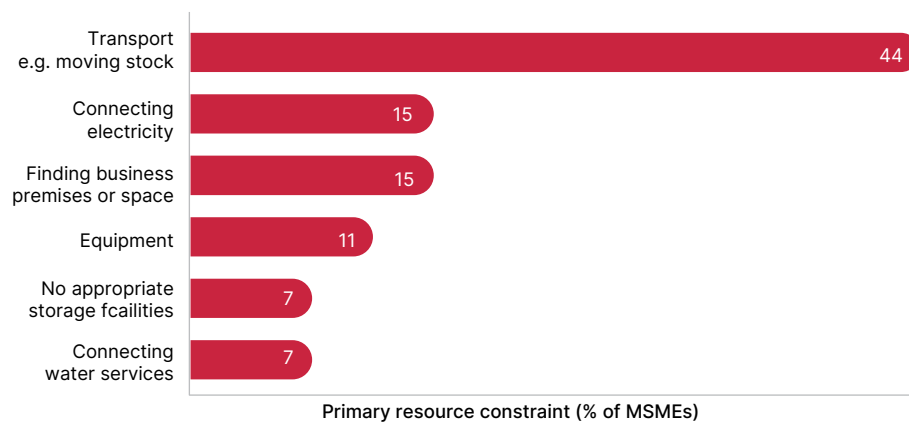
The majority of MSME owners do not have a bank account for business purposes which prevents them from saving and borrowing from commercial banks.





**Figure 21: Challenges faced by MSMEs, Mozambique (2012)**

Source: Own analysis based on 2012 FinScope MSME Survey for Mozambique.



**Figure 22: Primary resource constraints for MSMEs, Mozambique (2012)**

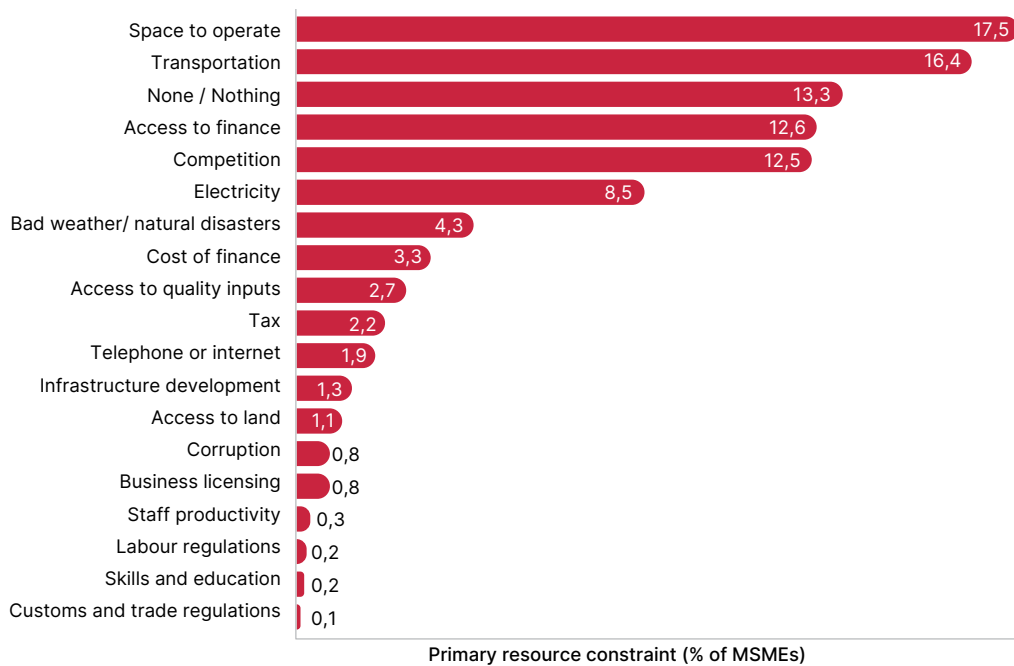
Source: Own analysis based on 2012 FinScope MSME Survey for Mozambique.

Only 0.3% have a separate business bank account in the name of the business. Often, business and personal finances are not separated, which affects the financial management of the business.

About 50% reported to have challenges with sales and marketing and 30% of MSME owners had problems with resources which includes but is not limited to electricity. The “Resources” category includes finding business premises or space; connecting water services; no appropriate storage facilities; connecting electricity; transport. Of these, the lack of access to transport, to move stock or equipment was identified as the biggest obstacle to daily operations. Only 15% identified electricity as being a major constraint to their daily operations (Figure 22).

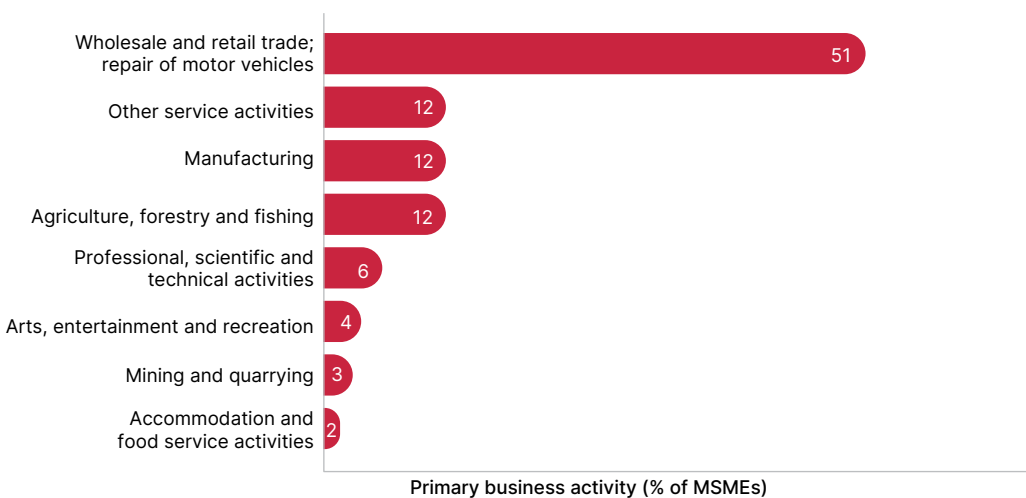


*Often, business and personal finances are not separated, which affects the financial management of the business.*



**Figure 23: Most significant barrier to business growth, Mozambique (2012)**

Source: Own analysis based on Cenfri's 2012 FinScope MSME Survey for Mozambique.



**Figure 24: Sectoral profile of MSMEs that identify electricity access as the most significant barrier to business growth, Mozambique (2012)**

Source: Own analysis based on Cenfri's FinScope MSME Survey for Mozambique.

MSMEs were also asked to identify the single biggest obstacle to growing their businesses. The most-cited constraint to business growth is insufficient space to operate (17.5%), followed by transport (16.4%) (Figure 23). Access to electricity was cited as the most significant barrier to growth by 8% of MSMEs in Mozambique. Of these, roughly 50% operate in the retail sector (Figure 24). This suggests that MSMEs engaged in retail activity may be more willing to pay for off-grid cleaner energy solutions than those in the agricultural sector (that employs 80% of the workforce).

# Potential to deploy off-grid power solutions for productive applications

Off-grid solar power could greatly support the agriculture sector and other income-generating productive uses for rural development in Mozambique. Irrigation is one of the areas where off-grid solar power could play a major role in promoting sustainable rural development. Mozambique has roughly 3.3 million hectares of potentially irrigable land with only about 50,000 hectares of operational irrigation infrastructure – much of these are concentrated around the centre and south of the country and largely for high-value crops such as sugarcane. Most farming activity, however, is small-scale, or subsistence and farmers face several constraints in trying to scale their operations. For example, the lack of mechanical power is a bottleneck for transporting produce to the nearest milling facility and markets. Adoption rates for productivity-enhancing agricultural inputs and technologies are very low. In these circumstances, access to electricity is one of a host of interventions required to increase the output of small-scale farmers and give them access to markets and services.

Widespread lack of grid electricity services means that farmers are dependent on diesel-powered systems when they can afford it. Enhancing the reach of irrigation is a key objective in the Government’s Strategic Plan on Agriculture Development 2010-2019 to increase yield for both smallholder and larger farmers.<sup>35</sup> Solar-powered drip irrigation systems could support the growth in yield and greater crop variety while managing resilience in the agriculture sector (e.g. by minimising the use of fossil fuels and the use of water in an increasingly drought-prone country).<sup>36</sup> An interviewed legal advisor,<sup>37</sup> noted that since 70% of the rural population relies on agricultural activity for their livelihoods, there should be an opportunity to provide solar-powered water pumps to farmers. She noted that the United States Agency for International Development’s (USAID) Washfin programme was funding water pumps, but it seems these are for household water and sanitation rather than for irrigation.



*Widespread lack of grid electricity services means that farmers are dependent on diesel-powered systems when they can afford it.*

35 Ministry of Agriculture (Republic of Mozambique), “Strategic Plan for Agricultural Development 2010 - 2019.” <https://www.grain.org/attachments/2686/download>.

36 Pranab Baruah and Brendan Coleman, “Country Brief - Mozambique Off-Grid Solar Power in Mozambique: Opportunities for universal energy access and barriers to private sector participation,” (2018).

37 Independent legal advisor), in conversation with the authors, 6 February 2020.

# 5

## Access to financial services

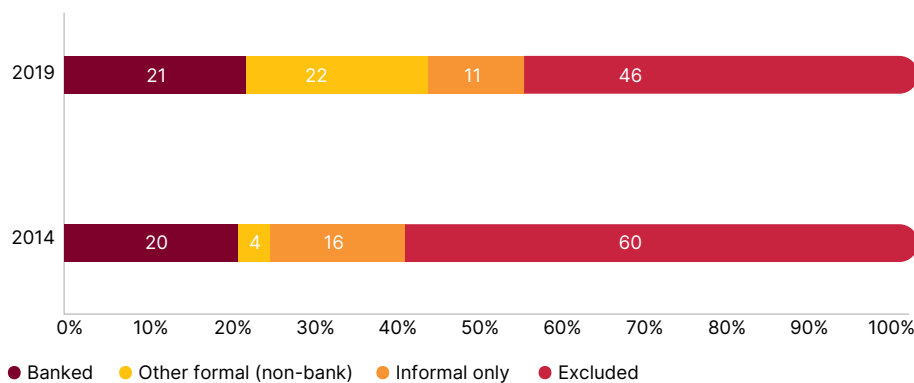
*Overall access to financial services is still relatively low in Mozambique, with 46% of adults not having formal or informal access in 2019, although this decreased from 60% in 2014.*

Access to a bank account is fairly low, and remains stable at 21% in 2019. An additional 22% have access to other formal financial services (but not a bank account), and a further 11% have access to informal financial services (but no formal financial services). Total usage of other formal products is 41% (including those who also have a bank account), while total usage of informal services is 32% (including those who also have formal financial services). There is therefore substantial overlap between those who have bank accounts, and those who use other formal or informal financial services.

The uptake of credit is very low with 93% of adults saying they do not borrow, and only 6% saying they borrow from formal sources. Access to credit is also constrained for MSMEs and agriculture producers, with interest rates on commercial loans close to 30% on average. The real cost of borrowing in Mozambique is high compared to peer countries and has increased significantly in 2018 as inflation has come down to single digits. High-interest rates are cited as the main reason for not applying for loans. The number of borrowers from commercial banks is low (69 per 1,000 adults in 2016).<sup>38</sup> In 2016, the Bank of Mozambique, in the hope of improving access to financial services, published



*The uptake of credit is very low with 93% of adults saying they do not borrow, and only 6% saying they borrow from formal sources.*



**Figure 25: Mozambican financial access strand 2019 and 2014 (% of adults)**

Source: FinScope Mozambique 2019

38 World Bank, "The World Bank Mozambique: Financial Inclusion and Stability Project: Project Information Document."

the National Financial Inclusion Strategy, a medium-term plan aimed at improving inclusion over the period 2016–2022. To date, there has been limited information on the effectiveness of the strategy.

The Mozambican banking system comprises of 17 banks. Most of the system's activity is focused on three large banks, however, who collectively control 72% of banking system assets. Almost all banks are subsidiaries of foreign banks, primarily from Portugal and South Africa. According to Mozambique's Making Access Possible country diagnostic, in 2014, 20% of the population was banked, while a further 20% used other formal or informal channels to access financial services, leading to a 60% financial exclusion rate.<sup>39</sup> The Bank of Mozambique, the country's central bank, estimated that at the end of 2015, 24% of the population was banked.<sup>40</sup>

The microfinance sector is developing and is expected to play a key role in promoting financial inclusion, especially in rural areas, as most formal bank access points are in urban areas. For example, 35% of bank branches are in Maputo. However, about 68% of the adult population live in rural areas. Microfinance institutions are also expected to play a key role in the provision of credit to MSMEs. According to the findings of the FinScope MSME Survey, about 75% of micro-enterprises and 50% of small enterprises lack access to financial services and products in the country.<sup>41</sup> In 2018, the World Bank reported that 11 microfinance institutions operated in the country, represented by approximately 330 agents.

Mozambique has inadequate credit infrastructure, which undermines the efficient financing of private sector activity. There is only one private credit reference bureau in the country, Compuscan, which was registered in 2019. Before this, credit reporting was carried out by the Central Bank's credit registry, which only covered reporting on high-value credit by commercial banks and reported on less than 1% of the adult population. This weak credit reporting infrastructure assists in explaining why banks in Mozambique primarily provide asset-based lending and offer little cash flow-based lending or start-up financing, and why they provide limited credit to small and medium-sized firms.



*The microfinance sector is developing and is expected to play a key role in promoting financial inclusion, especially in rural areas, as most formal bank access points are in urban areas.*

39 Chamberlain et al., "Making Access Possible- Mozambique Financial Inclusion Country Report."we hope to effect real change at country level and see the impact of financial inclusion on broader national growth and development. The cover graphic features the Devil Thorn, a flower synonymous with Mozambique. The flower symbolises growth and development while the circle represents inclusive growth. Each flower is an example of the successful growth in a unique environment. By combining the flower with the currency symbol of Mozambique we represent the characteristics of the country, linking financial inclusion with successful growth. PARTNERING FOR A COMMON PURPOSE Making Access Possible (MAP)

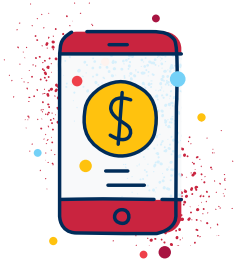
40 Chamberlain et al.we hope to effect real change at country level and see the impact of financial inclusion on broader national growth and development. The cover graphic features the Devil Thorn, a flower synonymous with Mozambique. The flower symbolises growth and development while the circle represents inclusive growth. Each flower is an example of the successful growth in a unique environment. By combining the flower with the currency symbol of Mozambique we represent the characteristics of the country, linking financial inclusion with successful growth. PARTNERING FOR A COMMON PURPOSE Making Access Possible (MAP)

41 FinScope Micro, Small and Medium Enterprise Survey: Mozambique.

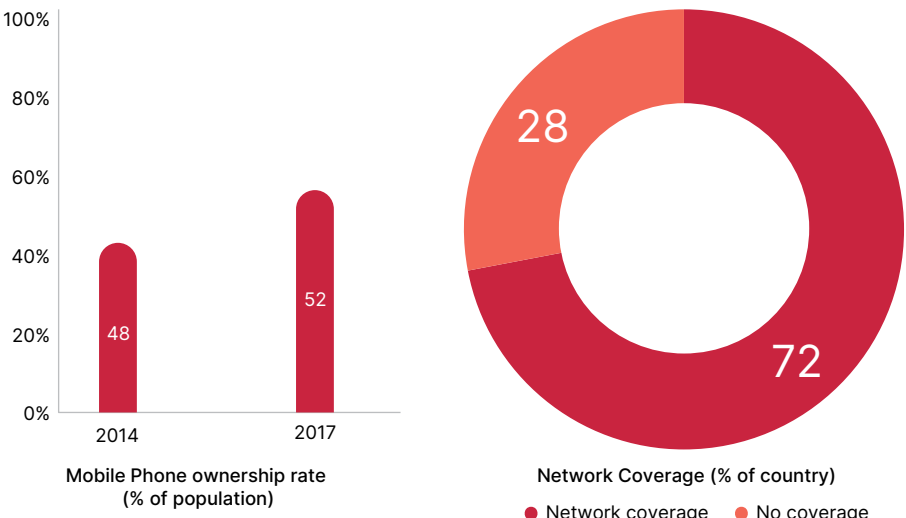
While mobile network coverage is relatively high in Mozambique, only 48% of the population owned a mobile phone (Figure 26). Mobile phone ownership does not seem to have increased meaningfully over the past few years - a study, conducted in 2017 by Research ICT Africa, suggests that 52% of the population own and use mobile phones.<sup>42</sup>

The ability to continuously use and access mobile phones in low resource settings is often dependent on the availability and/or cost of electricity to charge the device. The USAID's mSTAR programme reported that the costs to charge a device can range from MZN 10 to 50. Among those who charge the mobile phone they use, nearly half (47%) do so from home, while one-third (31%) must pay to charge from a charging station.<sup>43</sup> However, FinScope 2019 finds that 72% charge their phone at home, and another 22% charge it at their neighbour's home (or family's home). Only 4% charge it at a nearby shop.

Mobile money services have been available in Mozambique since 2010, first via mCel's mKesh and now through two providers with the entrance of Vodacom's M-PESA in 2013. USAID's mSTAR reported that over one-third of mobile phone users had sent or received money via phone in 2015.<sup>44</sup> Research ICT Africa estimates that mobile money use grew and that 50% of individuals who owned mobile phones used a mobile money solution in 2017.<sup>45</sup> This is roughly in line with the findings of FinScope 2019, which finds that 55% of those who have a mobile phone also have a mobile money account. Geographically, mobile money use varied notably across urban versus rural areas and between provinces. A greater proportion of respondents in urban areas had both sent and received money as opposed to those in rural areas.



*The ability to continuously use and access mobile phones in low resource settings is often dependent on the availability and/or cost of electricity to charge the device.*



**Figure 26: Mobile phone access and network coverage, Mozambique**  
 Source: Own analysis based on 2014 FinScope survey for Mozambique, USAID's mSTAR report on Mobile Access and Usage, 2016 and Research ICT Africa's The State of ICT in Mozambique, 2018.

42 Gillwald, Mothobi, and Rademan, "The State of ICT in Mozambique 2018."  
 43 Eichleay et al., *Mozambique Mobile Access and Usage Study: Household Survey Results*.  
 44 Eichleay et al., *Mozambique Mobile Access and Usage Study: Household Survey Results*.  
 45 Gillwald, Mothobi, and Rademan, "The State of ICT in Mozambique 2018."



# 6

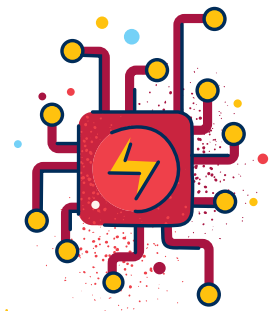
## The investment case for cleaner off-grid solutions

*Mozambique continues to have a significant electricity access deficit. While most Mozambicans living in urban areas have access to electricity, the rural population is far less connected to the grid.*

Some areas are not currently served by EDM, that could be served either by extending the grid requiring investments in transmission and distribution, mini-grids or by SHS. The number of potential beneficiaries varies depending on the priorities for expansion of the national network and the rate at which the population migrates to urban settlements.

In terms of the UN's Sustainable Development Goals, the goal concerning energy access (SDG7) is to ensure that all people have access to affordable, reliable, sustainable and modern energy by 2030. Our analysis has shown, that if EDM continues to connect the same number of people annually, there will still be 26.8 million Mozambicans without access to the grid in 2030 – the vast majority of these (22.6 million) would be in rural areas. To achieve universal access to the grid by 2030, the Government of Mozambique would have to dramatically accelerate its current electrification programme. Given the extreme discount on the first 100 kWh of electricity usage per user of 84% (see section 4.2), which apply to 84% to 96% of clients, this may actually be a disincentive to private providers to invest in mini-grid power generation, unless they can find clients who uses more than 3kWh a day (discount drops to 56%) or in excess of 30 kWh a day (discount drops to 19% a day). In fact, given the tight margins on investment, it may incentivise private investment to only invest in intensive use cases of say 100 kWh a day or more – in other words industrial enterprises or medium to large businesses. This makes private sector investment as a solution for expanding access a tenuous proposition

It is thus unrealistic that grid electricity alone would provide energy to all by 2030. Consequently, Mozambique aims to provide 50% of all households with grid-electricity by 2030. Yet even with this reduced target, only about 38% of all *households* would likely be connected to the grid by 2030.<sup>46</sup> Regardless of how successful both the government and donors are at extending the grid,



*If EDM continues to connect the same number of people annually, there will still be 26.8 million Mozambicans without access to the grid in 2030 – the vast majority of these (22.6 million) would be in rural areas.*

<sup>46</sup> Mokveld and von Eije, *Final Energy report Mozambique*.



off-grid solutions will remain an important element of Mozambique’s national electrification strategy.

As a first step to address and achieve the objectives of increased access to households, we have attempted to size the market, based on two typical stand-alone solutions currently available in SADC markets.



**Option 1 - Tier 1 SHS solution or ‘pico-solar’ solution**

Total cost is USD 60, providing a low-end solution with a one light and charging solution. This is typically sold for cash but assumed it could be sold on an instalment basis over a maximum repayment period of 12 months.

**Option 2 - high-end Tier 1 SHS**

Package includes three lights, a mobile device charger, and possibly a low power appliance (e.g. radio) with a purchase price of USD 150, repaid over a 24-month period. This solution is more typical of the products currently available in Mozambique.

**Table 8: Typical standalone Tier 1 SHS solution**

| SOLUTION             | BENCHMARK PRICE (USD) | FUNCTIONALITY   |
|----------------------|-----------------------|---|
| Pico-solar (low-end) | 60                    | Single light and mobile device charging<br>                                |
| Basic SHS (high-end) | 150                   | Three lights, mobile device charging, low power appliance (e.g. radio)<br> |

Source: Own analysis

93% of adults do not use electricity for cooking, and the market for improved efficiency, non-electrical or clean energy products for cooking would therefore also be substantial – depending on their cost and affordability in relation to current methods used for cooking (see the analysis in Section 4). However, given that the above solutions cannot be used for cooking (which require at least a Tier 3 solution), the market for these two options is therefore limited to those households who currently don’t have access to grid electricity or solar/generator power (used for lighting). This equates to about 3.6 million adults (60% of adults). However, despite this substantial market for clean energy products for lighting (and potentially cooking), affordability remains a major constraint to the market for SHS in Mozambique. There is however a clear incentive for households to purchase small SHS systems as they can replace candles and paraffin typically used for lighting and phone charging services which are estimated to cost about USD 10 per month in Mozambique.

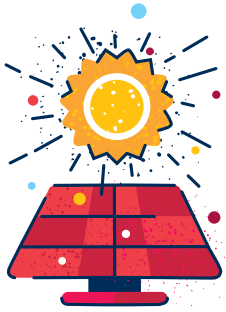
The addressable market for Tier 1 SHS products is a subset of the potential market - it includes only those who both need an off-grid solution and who

can also afford it. The monthly instalment on the option 1 product would be USD 5 (MZN 329), based on an assumed interest rate of 13.5%, while the monthly instalment on option 2 would be USD 7 (MZN 460) at the same rate. We can consider two thresholds of affordability for these two products: (1) The instalments noted are equal to 5% of monthly income or less. In other words, this would apply to the proportion of the population that earns enough monthly income that the noted instalments would be 5% of their monthly income or less. This threshold is based on the ESMAP/SE4ALL multi-tier framework measures for the affordability of grid electricity; and (2) An affordability threshold of 15% - based on typical monthly total energy expenditure as a portion of income in comparable countries.

According to these assumptions and using FinScope 2019 income distributions for individuals and households, we calculate both the proportion and the number of adults and household that would be able to afford option 1 and option 2 at the two levels of affordability thresholds. The proportion of adults that can afford these products at the 5% affordability benchmark is 10% to 11% (option 1) and 4% to 6% (option 2). At the 15% affordability benchmark, the proportion is 23% or more (option 1) and 11% to 23% (option 2).

For households, the proportions that can afford the products increase substantially, given that household income exceed individual income. At the 5% affordability threshold, 19% to 20% of households can afford option 1, while 6% to 11% can afford option 2. At 15% affordability threshold, 42% or more can afford option 1, while 20% to 42% can afford option 2. Accordingly, between 1.1 million and 2.6 million households (but potentially much more) would be able to afford option 1, while 381,000 to 2.6 million households would be able to afford option 2.

This however should then be balanced with the proportion of these households (which can afford the two products), that simultaneously also need it – i.e. those who do not have access to grid electricity or solar power already. However, due to Mozambique’s unreliable grid, the potential and addressable market for off-grid cleaner energy potentially also include those who already have access to grid electricity, especially in rural areas, where interest in owning a solar system was high despite access to electricity.



*Due to Mozambique’s unreliable grid, the potential and addressable market for off-grid cleaner energy potentially also include those who already have access to grid electricity, especially in rural areas, where interest in owning a solar system was high despite access to electricity.*

# 7

## The market for off-grid cleaner energy solutions

*For further insight into the market for off-grid energy solutions, we conducted three interviews with individuals involved in the promotion of off-grid energy solutions in Mozambique.*

These included a legal advisor and independent consultant in the Mozambican energy, mining and infrastructure sectors, an experienced consultant who specialises in end-user finance for renewable energy and who is an owner of Epsilon Energia Solar – a distributor of small solar home systems in Mozambique, and someone from the financial services sector who previously worked for Opportunity Bank in Mozambique.

There is a small but emerging market for stand-alone off-grid energy solutions in Mozambique. According to a World Bank report, pay-as-you-go (PayGo) providers including Logos, Solarworks and Green Watts are currently supplying about 15,500 customers. These providers tend to focus on urban and peri-urban markets. The representative of Epsilon Energia Solar (EES) noted that in addition to EES there were two other active energy service companies – Fenix International (a subsidiary of Engie) and Ignite Moçambique.<sup>47</sup> Ignite Mozambique was chosen by the Mineral Resources and Energy Department (MIREME) after an evaluation process as its partner in rolling out SHS to a targeted 300,000 households across Mozambique. In February 2020, the Development Bank of South Africa announced it would be investing in Ignite in the form of a structured project preparation facility that would allow the firm to grow its portfolio to become commercially bankable.<sup>48</sup>

Ignite currently provides a SHS (a 10 W to 15 W panel, three to four lights and a lithium-ion battery and USB charger) for as little as USD 6 per month on an instalment basis over 24 months in Rwanda and presumably a similar price in Mozambique.<sup>49</sup> Fenix was acquired by Engie in 2018. It provides a high-quality upgradable ReadyPay Solar system. Fenix has partnered with Vodacom and



*There is a small but emerging market for stand-alone off-grid energy solutions in Mozambique.*

47 Kevin Kennedy (Clear Cape), in conversation with the authors, 7 February 2020.

48 Sebolelo Matsoso, “DBSA invests in Ignite Mozambique, a rural off-grid energy provider,” (2020). <https://www.dbsa.org/EN/DBSA-in-the-News/NEWS/Pages/20200220-DBSA-inest-Ignite-Mocambique.aspx>.

49 Adrian Frey, “Solar power to deliver electricity to 300,000 families - Mozambique,” (2019). <https://clubofmozambique.com/news/solar-power-to-deliver-electricity-to-300000-families-mozambique/>.



Mpesa in Mozambique to facilitate mobile money payments. The Fenix Tier 1 SHS cost between USD 99 and USD 160 and provide 10 W panel 2 lights, charging and a radio.<sup>50</sup>

**Table 9: Standalone SHS solutions available in project countries**

| STANDALONE SHS SOLUTIONS   | TIER | ANNUAL COST (USD) | REPAYMENT PERIOD |
|--|------|-------------------|------------------|
| Solarworks SW 40<br>Three lights and phone charging<br><10-watt solution             | 1    | 136               | 24 months        |
| Fenix Solar Home System Power 2<br>Two lights and phone charging<br>10-watt solution | 1    | 107               | 30 months        |
| Fenix Solar Home System Power 3+<br>Three lights, phone charging and a<br>radio      | 1    | 149               | 24 months        |
| 10-watt solution   |      | 122               | 30 months        |
|  |      | 188               | 24 months        |

According to Epsilon Energia Solar's owner,<sup>51</sup> a three-light SHS provided by Epsilon will retail for between USD 130 and USD 150, the cost price is about USD 60 and USD 90 including logistics and taxes, but with the retail and finance charges between USD 130 to USD 150 over a year. While households currently pay around USD 10 per month for candles, batteries and phone charging. When Epsilon was in operation, they used to provide an option of paying back their SHS over three, six, 12 and 18 months.

Epsilon Energia Solar's owner, says that while people are aware that a shorter repayment period means that the total cost is lower than a longer repayment period, many cannot afford the high monthly cost associated with paying it off over a short period.<sup>52</sup> Other companies like Ignite and Fenix are offering 24 to 30-month repayment periods.

Uptake of larger systems, such as mini-grids, has been limited. The few mini-grids installed by FUNAE have mostly been diesel-powered and have been plagued with operational and reliability issues. Three solar PV-based mini-grids have been installed in Niassa Province, financed by the Government of South Korea, with capacities of 400 kW (Mavago), 400 kW (Mecula) and 500 kW (Muembe).

Some of the main barriers to uptake of off-grid solutions in Mozambique include limited access to credit and financing alternatives to PayGo, relatively low mobile penetration rates (and mobile money use) and the lack of a regulatory environment conducive to the development of mini-grids. These are discussed in turn below. Other constraints to the uptake of off-grid electricity<sup>53</sup> include affordability and lack of skilled personnel to facilitate distribution, and import duties and taxes levied on imported SHS solutions.



*Some of the main barriers to uptake of off-grid solutions include limited access to credit and financing alternatives to PayGo, relatively low mobile penetration rates and the lack of a regulatory environment conducive to the development of mini-grids.*

50 Fenix, *Para comprar o Sistema Solar Fenix Power o cliente deve ter*, (2019), [https://www.fenixintl.com/wp-content/uploads/2019/10/Mozambique-flyer.Oct\\_-2019.pdf](https://www.fenixintl.com/wp-content/uploads/2019/10/Mozambique-flyer.Oct_-2019.pdf).

51 Clear Cape, in conversation with the authors, 7 February 2020

52 Clear Cape, in conversation with the authors, 7 February 2020

53 Clear Cape, in conversation with the authors, 7 February 2020.





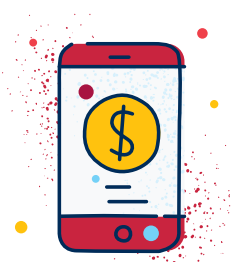
### *The regulatory environment is not currently conducive to the development of mini-grids.*

One of the largest barriers to electricity access (affecting both uptake of utility-scale IPPs and mini-grids) is the current legal framework.<sup>54</sup> Since 2018, USAID has been assisting the Government of Mozambique with the revision of the regulatory framework governing the sale and distribution of electricity (more specifically, the national electricity law). The revision of the electricity law aims to improve market conditions in the country to provide adequate legal guarantees for private investors in the sector. As it pertains to off-grid solutions, the new law seeks to simplify authorisation procedures for mini-grid projects which is a priority to increase electricity access. The new electricity law has however been pending approval by the Council of Ministers since early 2019. The government realises the need to liberalise the market and open it to private sector investment to meet the UN SDG 7.



### *Low access to credit and few alternatives to PayGo.*

A hurdle to the addressable market is the lack of access to credit. Access to finance, particularly for individuals, MSMEs and agriculture producers, is constrained with interest rates on commercial loans close to 30% on average. The microfinance sector, however, is developing and is expected to play a key role in promoting financial inclusion, especially in rural areas, as most formal bank access points are in urban areas. Microfinance institutions are also expected to play a key role in the provision of credit to MSMEs. The issue with microfinance providers is that they typically target a narrow band of salaried employees, who are likely to already have electricity access.



### *Relatively low mobile phone penetration and the use of mobile money.*

Only 50% of the Mozambican population own a phone. Mobile money services have been available in Mozambique since 2010, first via mCel's mKesh and now through two providers with the entrance of Vodacom's M-PESA in 2013. USAID's mSTAR reported that over one-third of mobile phone users had sent or received money via phone in 2015.<sup>55</sup> Research ICT Africa estimates that mobile money use grew and that 50% of individuals who owned mobile phones used a mobile money solution in 2017.<sup>56</sup> The relatively low use of mobile money makes PayGo models as a financing mechanism to households difficult. A possible opportunity might lie in microfinance providers partnering with energy service companies that provide solutions on a PayGo basis if they can find a way of jointly serving the lower end of the market profitably.

54 Clear Cape, in conversation with the authors, 7 February 2020.

55 Marga Eichleay et al., *Mozambique Mobile Access and Usage Study: Household Survey Results*, Mobile Solutions Technical Assistance and Research (mSTAR) (2016).

56 Alison Gillwald, Onkokame Mothobi, and Broc Rademan, "The State of ICT in Mozambique 2018," (2019).



## Acronyms and abbreviations

|          |   |
|----------|---|
| AECF     | African Enterprise Challenge Fund                                 |
| BRILHO   | DFID Programme meaning “brightness” (Portuguese)                  |
| CGAP     | Consultative Group to Assist the Poor                             |
| EDM      | Electricidade de Moçambique                                       |
| EES      | Epsilon Energia Solar   |
| EnDev    | Energising Development  |
| ESMAP    | The world Bank Energy Sector Management Assistance Program        |
| FUNAE    | Fundo de Energia  |
| GDP      | Gross Domestic Product  |
| GIZ      | Deutsche Gesellschaft für Internationale Zusammenarbeit           |
| Gwh      | Gigawatt hours  |
| HCB      | Hidroelectrica de Cahora Bassa                                    |
| HDI      | Human Development Index   |
| ICS      | Improved Cook Stove   |
| IDS      | Institution of Development Studies                                |
| IFC      | International Finance Corporation                                 |
| IPP      | Independent power projects  |
| kWh      | Kilowatt-hour   |
| LPG      | Liquid petroleum gas  |
| MAP      | The UNCDF Making Access Possible programme                        |
| MDTF     | Multi-Donor Trust Fund  |
| MIREME   | Mineral Resources and Energy Department                           |
| NGO      | Non-government organisation                                       |
| MSME     | Micro, Small and Medium sized enterprise                          |
| mSTAR    | Mobile Solutions Technical Assistance and Research                |
| MW       | Megawatts   |
| MZN      | Mozambican Metical (national currency)                            |
| NEFCO    | The Nordic Environment Finance Corporation                        |
| PAC      | Practical Action Consulting                                       |
| PayGo    | Pay-as-you-go   |
| Pulse    | The Market Opportunity for Productive use Leveraging Solar Energy |
| RBF      | Results-based financing   |
| REACT    | Renewable Energy and Adaptation to Climate Technologies           |
| REEEP    | Renewable Energy and Energy Efficiency Partnership                |
| RERD     | Rural Energy for Rural Development                                |
| SADC     | Southern African Development Community                            |
| SCP      | Standard consumption package                                      |
| SDGs     | Sustainable Development Goals                                     |
| SEforALL | The Sustainable Energy for All programme                          |
| SHS      | Solar home systems  |
| TERI     | The Energy and Research Institute                                 |
| TJ       | Terajoules  |
| UN       | United Nations  |
| UNCDF    | United Nations Capital Development Fund                           |
| UNDP     | United Nations Development Programme                              |
| UNEP     | United Nations Environment Programme                              |
| UNFCCC   | United Nations Framework Convention on Climate Change             |
| USAID    | United States Agency for International Development                |
| USc      | Unites Stated Dollar cents  |
| Wh       | Watt-hour   |

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## About the UNCDF

The UN Capital Development Fund makes public and private finance work for the poor in the world's 47 least developed countries (LDCs). UNCDF offers "last mile" finance models that unlock public and private resources, especially at the domestic level, to reduce poverty and support local economic development. UNCDF's financing models work through three channels: (1) inclusive digital economies, which connects individuals, households, and small businesses with financial eco-systems that catalyze participation in the local economy, and provide tools to climb out of poverty and manage financial lives; (2) local development finance, which capacitates localities through fiscal decentralization, innovative municipal finance, and structured project finance to drive local economic expansion and sustainable development; and (3) investment finance, which provides catalytic financial structuring, de-risking, and capital deployment to drive SDG impact and domestic resource mobilization.





# 7 Affordable and Clean Energy

