Making Access Possible

2020

Creating a greener future for the poor

Unpacking the investment case for clean energy

SADC Cross country synthesis

SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD

UNCDF Unlocking Public and Private Finance for the Poor

UNDP

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 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 circular globe which spins with life and energy. The smaller circles and icons are energetic light moving off the globe and represent the SADC countries and the UNCDF's work on energy.

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 insight note is based on a series of five country diagnostics on access to clean energy to 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 is based on a series of five country diagnostics on access to clean energy in SADC. Unless otherwise stated, sources in this summary note is as per the sources stated in the underlying country reports. A separate country report for each country is available.

Note on the use of household data

Within this document (unless otherwise referenced), demographic, income and financial usage data is obtained from the latest FinScope Consumer Survey undertaken in each country, while MSME data is obtained from the latest MSME FinScope for each country. A summary report and presentation of FinScope for each country 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.

We conducted a five-country study in SADC to provide insight into the potential to accelerate the uptake of cleaner off-grid energy solutions, in contribution towards the SDGs and particularly SDG7 – universal access to clean and modern sources of energy by 2030.

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 or follow at @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.

1 Universal access to affordable and clean electricity

There are only ten years left to achieve the United Nations Sustainable Development Goals (SDGs), a set of universally adopted, holistic goals to achieve human development and better equality in a sustainable way by 2030.

A strong focus of the SDGs is an attempt to address the root causes of poverty and inequality within and between countries. Few of the SDGs, however, can be classified as a prerequisite for human development to the degree that access to energy can. In order to eradicate poverty, hunger, and human indignity, people need access to resources or basic services, which in turn allow them to access greater opportunities. Countries in turn need to create more and better opportunities, by growing enterprise, and creating enabling infrastructure.

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In most MAP countries, including those in the Southern African Development Community (SADC), there are broad segments of the population that require a more level playing field when trying to access opportunities. Inequitable distribution of resources and basic services exacerbates social and economic exclusion for individuals, households and communities, setting up complex and multi-layered barriers to opportunity (and social mobility over time). MAP is, therefore, increasingly focused on the four crucial needs - infrastructure and services (utilities), education, healthcare, and entrepreneurship. As the data shows, these are the areas that individuals and households tend to prioritise in their own spending and are areas that government can pursue to foster more inclusive growth.

In SADC, investment in improved social outcomes, to a large extent implies investment in physical infrastructure and in particular, people's proximity to such infrastructure (e.g. schools, hospitals and clinics, electricity grids). While SADC countries have infrastructure, it is usually more concentrated and better developed in urban areas. Given the large proportion of adults residing in rural areas in SADC countries, infrastructure investment in rural areas is perhaps the single biggest lever governments have to influence access to resources for vulnerable groups. To a large extent, improving access to basic services infrastructure in rural areas is contingent on improving energy infrastructure in terms of both consumer proximity and quality. Where governments and providers can achieve this, investment in basic services infrastructure such as healthcare, education and communications, is the logical follow-on.

A unique aspect of the SDGs is that they are targeted at governments, the private sector and civil society collaborating for a shared solution: using data to match existing opportunities with people's existing needs and priorities, investment in social outcomes, and a new way of partnering and collaboration to achieve such investment. Given the shortening timelines to the 2030 goalposts, as well as the current regression in global development indicators, the urgency is more tangible than ever to move the needle on bringing everyone along. Despite current increasing global hardships, consumers find clever, ingenious and practical workarounds in order to meet their needs. In the long term, however, workarounds like this are not sustainable. What is needed is structural economic transformation, to make it possible to offer people sustained and integrated access to resources and coherent access to opportunities – rather than piecemeal access to resources and opportunities.

In the course of the past ten years, many countries have extended the reach of their public electrical grids; nevertheless, large numbers of people, especially in rural or peri-urban areas, still lack access to electricity. Even where there is access to electricity, MAP data shows there is large scale use of bio-mass energy – especially for poorer households. This is a key issue for the climate – ensuring not just access to energy but access to clean energy. For instance, the average level of access to electricity across all 16 MAP countries was 48% in 2016, up from 32% in 2006. In rural areas, though, the 2016 average level of access was 34% (World Bank 2019).

Off-grid solar energy has tapped around 17% of the addressable market overall. Off-grid solar energy in Africa has been promoted largely by private actors which have raised close to USD 700 million of grant, social impact and commercial capital to fund rapid growth. According to a 2018 report from GOGLA (an off-grid solar energy industry body), some 130 million devices are now deployed worldwide, of which the bulk are in sub-Saharan Africa, with special concentrations in East Africa.

This concentration is no surprise: the growth of off-grid energy solutions has been closely linked to a digital financial innovation: the spread of mobile money which enabled remote, cheap micro-payments to be collected, also known as pay-as-you-go (PAYGO). However, even more interestingly, the appeal of this real sector innovation has also 'pulled' excluded people into opening mobile money accounts: according to the Consultative Group to Assist the Poor (CGAP), some 30-50% of PAYGO users had not been mobile money customers at the time.

In addition to promoting access to basic energy (SDG7), off-grid solar is a far cleaner source of energy compared with alternatives, such as kerosene for lighting. This enables the promotion of other SDGs, such as Climate Action and Good Health and Well-being. Off-grid energy solutions have also opened up new possibilities to support micro, small, and medium sized enterprise (MSME) energy requirements to create alternative revenue streams and fund asset building (for instance cell phones charging, buying refrigerators, etc). It is a 'real' economy sector in which financial interventions are both necessary and potentially helpful. It is also within this context of financing for the SDGs to address issues of multi-dimensional poverty through real economic growth, that we also seek to investigate the space of clean energy within the wider SDG financing investment agenda as it relates to financial inclusion and economic growth for low-income people.

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Country overview

The five countries in the study include four Least Developed Countries (LDCs) and one lower middle-income country, three of which are among the poorest countries in the world.

	Malawi	Mozambique	Madagascar	Lesotho	eSwatini
	COUNTRY CLUSTER 1	COUNTRY CLUSTER 1	COUNTRY CLUSTER 1	COUNTRY CLUSTER 2	COUNTRY CLUSTER 3
POPULATION (MILLION) 2018	18.1	29.5	26.9	2.3	1.1
RURAL POPULATION 2018	83.1%	64.0%	63.5%	71.8%	76.2%
POPULATION DENSITY PER KM2 2017/18	192.4	37.5	45.8	69.4	66.1
NUMBER OF HOUSEHOLDS (MILLION) (ESTIMATE) 2016-2018	4.0	6.7	5.7	0.5	0.3
LAND SIZE (THOUSAND KM2)	119	799	587	30	17
POVERTY HEADCOUNT RATIO AT $1.90 A DAY (2011 PPP) (% OF POPULATION)* 2012-2017	70.3	62.9	77.6	26.9	28.4
INEQUALITY (GINI INDEX) 2009, 2016, 2018	44.7	44.7	42.6	44.6	51.5
HUMAN DEVELOPMENT INDEX	0.49	0.45	0.52	0.52	0.61
GDP PER CAPITA, PPP (CURRENT INTERNATIONAL $)** 2019	1,067	1,320	1,651	2,813	8,809

Sources are as per country clean energy diagnostic reports, unless otherwise indicated.
* World Bank Development Indicators (2019) **World Bank Development Indicators (2019)

These countries span across Clusters 1 to 3 in terms of MAP's inclusive growth country clusters (see MAP Insights Series, Volume 3, Note 1). Indicators like gross domestic product (GDP) per capita and Human Development Index (HDI) is therefore low, while poverty headcounts are high – more so for Cluster 1 countries.

The total population across the five countries is almost 78 million, or 17.3 million households. Of these, the majority still reside in rural areas (64% to 83%). However, the country sizes and population densities differ widely, with Mozambique (the largest country of the five) having a population density which is five times less than that of Malawi, and eSwatini (the smallest country) being almost 50 times smaller than Mozambique in terms of land area.

These five countries have relatively low CO2 emissions, together accounting for only about one percent of world CO2 emissions in 2012. However, all five countries have committed to voluntary pledges on CO2 reductions under the Paris Climate Agreements in 2015. While Cluster 1 countries have some of the lowest CO2 per capita emissions in the world, two of these countries account for the majority of emissions among the five countries studied, based on their population size, as well as one of these (Mozambique) exporting the majority of its electricity to South Africa. Furthermore, the majority of electricity output in these five countries are already generated through renewable sources, ranging between 47% (eSwatini) and 100% (Lesotho) (excluding electricity imports from South Africa).

Intended nationally determined CO2 emission contributions
(INDC, 2015)

Malawi

1 Lists a series of actions, conditional and unconditional, that would reduce emissions per capita down to 0.7-0.8 tCO2e by 2030, compared to a business-as-usual scenario of 1.5 tCO2 per capita (a reduction of approximately 47%).

Mozambique

1 A 23 million tonnes of CO2 equivalent cut in emissions from 2020-2024 and 53.4MtCO2e from 2025-2030. Baseline not specified. The pledge is conditional on international support.

Madagascar

1 A 14% reduction in emissions by 2030, based on a business-as-usual scenario - or a 32% reduction, if the land use sector is included. Conditional upon international finance.

Lesotho

2 An unconditional 10% reduction in emissions compared to a business-as-usual scenario by 2030, or a conditional reduction of 35% by 2030, dependent on international support.

eSwatini

3 Aims to double the renewable share of its energy mix by 2030, compared to 2010 levels. Also pledges to develop a national emissions inventory, baseline and business as usual projections, in order to draw up a national mitigation goal by 2020.

Based on INDC submitted by each country in 2015, as summarised at: https://www.carbonbrief.org/paris-2015-tracking-country-climate-pledges

Renewable electricity output versus CO2 emissions by country

Malawi

91%
RENEWABLE ELECTRICITY OUTPUT (% OF TOTAL ELECTRICITY OUTPUT)[1]

1,298
CO2 EMISSIONS (KT)[2]

0.08
CO2 EMISSIONS (METRIC TONS PER CAPITA)[3]

0.04%
SHARE OF GLOBAL EMISSIONS (2012)[4]

Mozambique

86%
RENEWABLE ELECTRICITY OUTPUT (% OF TOTAL ELECTRICITY OUTPUT)[1]

7,943
CO2 EMISSIONS (KT)[2]

0.29
CO2 EMISSIONS (METRIC TONS PER CAPITA)[3]

0.73%
SHARE OF GLOBAL EMISSIONS (2012)[4]

Madagascar

55%
RENEWABLE ELECTRICITY OUTPUT (% OF TOTAL ELECTRICITY OUTPUT)[1]

3,905
CO2 EMISSIONS (KT)[2]

0.16
CO2 EMISSIONS (METRIC TONS PER CAPITA)[3]

0.22%
SHARE OF GLOBAL EMISSIONS (2012)[4]

Lesotho

100%
RENEWABLE ELECTRICITY OUTPUT (% OF TOTAL ELECTRICITY OUTPUT)[1]

2,512
CO2 EMISSIONS (KT)[2]

1.21
CO2 EMISSIONS (METRIC TONS PER CAPITA)[3]

0.01%
SHARE OF GLOBAL EMISSIONS (2012)[4]

eSwatini

47%
RENEWABLE ELECTRICITY OUTPUT (% OF TOTAL ELECTRICITY OUTPUT)[1]

1,155
CO2 EMISSIONS (KT)[2]

1.04
CO2 EMISSIONS (METRIC TONS PER CAPITA)[3]

0.01%
SHARE OF GLOBAL EMISSIONS (2012)[4]

1) World Bank Development Indicators 2019 (2015 data used); 2) World Bank Development Indicators 2019 (2016 data used); 3) World Bank Development Indicators 2019 (2016 data used); 4) Based on INDC submitted by each country in 2015, as summarised at: https://www.carbonbrief.org/paris-2015-tracking-country-climate-pledges

2 Realities on the ground

As of 2017, 57 million people across the five countries do not have access to electricity, or 74% of the population. The issue in these SADC countries is not that their energy consumption is not clean – being among the lowest emitters in the world, and their current output already being enviously green.

The issue is that access to electricity in these countries is still very low in most cases, and to reach the goal of universal access, significant additional clean energy generation capacity is needed over the next decade. For instance, the three Cluster 1 countries had a total level of access to electricity in 2017 of between 13% and 27% of the population. Lesotho, a Cluster 2 country, only had slightly higher access of 34%. Out of the five countries, only eSwatini had significantly higher access, at 74% in 2017. Nevertheless, all five countries have made significant progress over the last ten years to increase access, growing the proportion of the population with access by around 60% (Madagascar) to 150% (Lesotho). There are indications that this rate of growth is set to continue.

However, our five-country diagnostic study found that this rate of increase falls far short of what is necessary to reach the 2030 goal of universal access. From the 2017 figures, there are 13 years left to reach the SDGs. Using the rate of electrification between 2012 and 2017, and predicted population growth,

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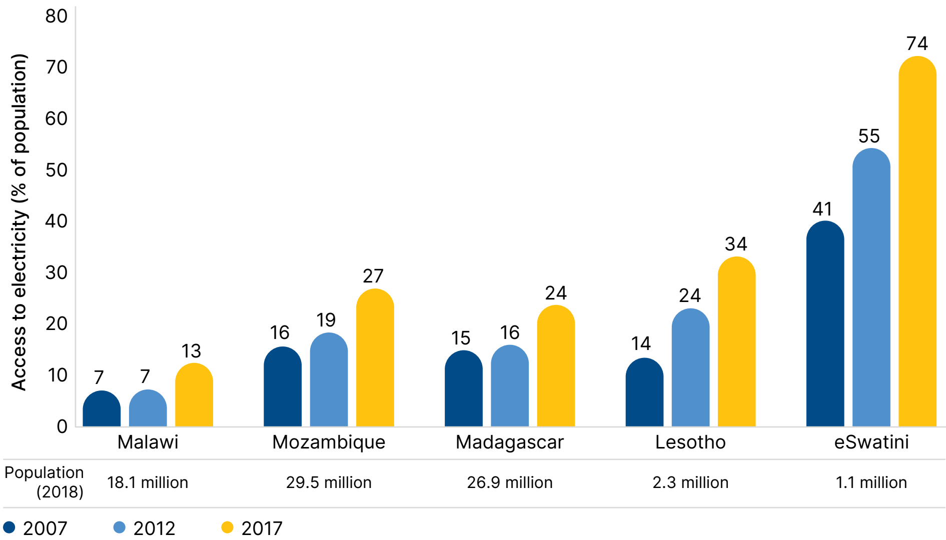


Figure 1: Access to electricity as percentage of population
Source: World Bank Development Indicators 2019

the country diagnostics predict total levels of access for 2030 if the rate of electrification does not change. While countries like eSwatini and Lesotho can conceivably come close to universal access (predicted to reach 99% and 57% access by 2030), there are additional challenges for these countries in reaching the remainder of the population, who are increasingly more rural, and in Lesotho's case, located in inaccessible areas. For the Cluster 1 countries though, the rate of growth simply would need to increase drastically in order to make any substantial impact – our predictions show access rates of between 22% and 36% by 2030.

Although all countries have increased their rate of access over the last ten years, the amount of people in Cluster 1 countries who do not have access to electricity has grown by over seven million, due to population growth.

While these projected growth rates are nevertheless remarkable for most countries – suggesting an increase of almost 50% or higher between 2017 and 2030 for three countries (Madagascar, Lesotho and Malawi), our country diagnostics estimate that these Cluster 1 countries would need to accelerate their rate of electrification by between 5 and 11 times in order to reach universal access by 2030. Lesotho, on the other hand, has to accelerate less than two times, while eSwatini is more or less on track already.

Although all countries have increased their rate of access over the last ten years, the amount of people in Cluster 1 countries who do not have access to electricity has actually grown (by over seven million), due to population growth. Based on the predicted 2030 access rates, this trend is only set to accelerate up to 2030. By then, another 13.5 million people will not have access, meaning almost 70 million people in these three countries will not have access to electricity (an increase of 40% since 2007). Despite the projected deficit rate falling from 74% to 69% over the same period, this is still far-off from the 2030 goals.

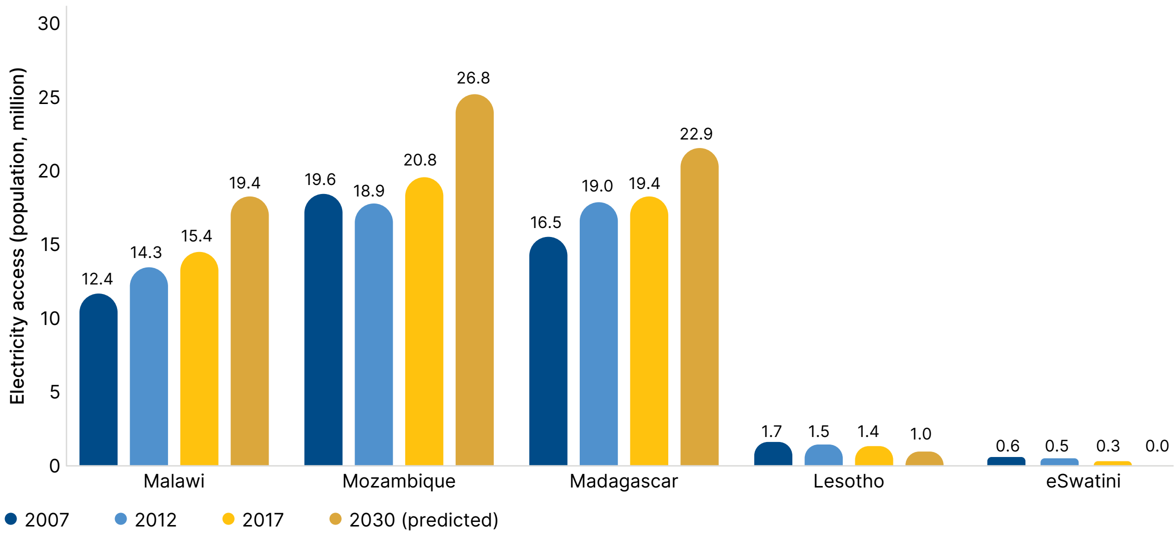
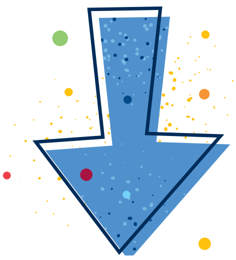


Figure 2: Access to electricity deficit in millions of the population

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

3 Energy sector overviews

To understand the scale of the problem, as well as possible remedies, an overview of the supply landscape and energy environment in these countries are useful. Our country diagnostics highlight several cross-cutting characteristics and issues with the overall landscape of electricity provision across the five countries:



Lack of electricity generation capacity.

A general feature of electricity production across the five countries is that production capacity is extremely low. Generation capacity ranges from about 70 megawatts (MW) each for Lesotho and eSwatini, to around 500 to 600 MW for Malawi and Madagascar. Perhaps the only outlier is Mozambique, which has a much higher electricity generation capacity close to 3,000 MW (more than two thirds of this is from one plant [Cahora Bassa dam], which is mostly exported to South Africa and other neighbouring countries). Total production for domestic consumption across all five countries is therefore only around 2,000 MW.

Dependence on hydro creates seasonal shortfalls.

In all five countries, the vast majority of domestic grid electricity generation comes from hydro stations, with Madagascar being the lowest at over two thirds, and three countries relying close to or 100% on hydro. While good for clean energy goals, this is not without its own problems. For instance, all five countries are susceptible to droughts and floods, making hydrological conditions unpredictable, and at least three countries noted this as a reason for periodic deficits in domestic electricity supply. For eSwatini in particular, the natural geography does not allow for many dams to be built. As a result, their existing hydro stations (which constitutes almost all domestic generation capacity), cannot function as base stations, but are rather used to supplement the grid during peak demand.

Ageing infrastructure and weak maintenance.

The issues experienced with electricity generation are also directly linked to the age of existing infrastructure, coupled with low capacity for maintenance, particularly in Madagascar and Mozambique. For instance, in Madagascar, grid electricity is mainly generated by six aging hydro plants that provide over two thirds of capacity, but available capacity is only around 60% due to maintenance issues. Low collection of (high) tariffs also result in subsequent plant failures due to unfunded maintenance. As a result, existing efforts focus on assisting with governance and capacity building of the state provider, especially to improve maintenance. In Mozambique, similarly, only about three quarters of generation capacity is available due to ageing plant and system infrastructure and a lack of routine maintenance. The state provider does not generate enough revenue from electricity sales to fund operating and maintenance costs, but some sources also point to a shortage of technical staff needed to service the growing number of grid connections. The country diagnostic also noted long delays in the rehabilitation of existing generation.

Dependence on energy imports.

Despite an abundance of energy sources in most of these countries, they are heavily dependent on imports to meet their domestic energy requirements. However, this varies substantially from country to country. Lesotho and eSwatini, perhaps due to their small population sizes and the easy availability of imported electricity through South Africa's distribution network, imports between 50% and 66% of their domestic electricity consumption from South Africa and Mozambique. Mozambique on the other hand 'imports' electricity through South Africa – meaning that electricity that is exported from the North of the country to South Africa comes back into the South of the country from South Africa. Madagascar is entirely bordered by the Indian Ocean, yet a third of its electricity consumption is dependent on imports – mostly that of diesel which powers diesel generator mini-grids – contributing significantly to Madagascar's carbon emissions.

Lack of sufficient distribution infrastructure.

In addition to generation capacity, distribution of electricity via the national grid is also a major issue across three of the five countries, which is hampered by two main factors: geography and ageing infrastructure. In Madagascar and Mozambique (the two largest, lowest population density countries), the national grid simply does not reach most of the country, being concentrated around urban areas, while smaller countries like Lesotho faces particular barriers in expanding the grid given its mountainous terrain. However, the maintenance and state of distribution infrastructure is perhaps the bigger concern. In Mozambique, the limited existing infrastructure make power supplies vulnerable to outages. Administrative, transmission and distribution losses of up to 27% of the power generated exacerbate the generation deficit. Low revenue also hinders capital expenditure for transmission, distribution and grid expansion. For example, in Madagascar, the fractured nature of the grid means that electricity loads cannot be shifted outside areas of generation, but grid infrastructure is also deteriorating due to age and insufficient maintenance.

Barriers to further infrastructure expansion.

Malawi and eSwatini faces additional barriers to the above. In Malawi, although 95% of the population lives within ten kilometres of the grid, and the grid is therefore the most likely least-cost electrification technology in the long-term, the rate of electrification is simply not high enough. Similarly, in eSwatini, grid electricity for the remainder of the population is the least cost option, however, the business case for connecting the remaining population (high capital and maintenance cost, but a low return expected from poor rural areas) makes further investment less attractive.

Heavily subsidised electricity, not reflecting the cost of production.

In all five countries, the business case for electricity provision is hindered by the set electricity tariffs, which are not fully cost reflective (revenue from the tariff does not cover the full costs of producing power plus a market-related return on capital invested). Perhaps the single largest factor impacting the cost reflectivity of tariffs are that at least four countries set some type of floor on electricity pricing for usage below a minimum threshold (called the lifeline tariff) in order to assist poor consumers. This ranges between 25 kilowatts (kW) per month to as much as 100 kW per month. Given that the majority of retail users consume even less than this amount, electricity tariffs are essentially heavily subsidised. However, even when taking into consideration users that consume more than the minimum threshold into account, the effective tariff on average which electricity is sold at is higher than the cost of producing or purchasing the electricity. Although subsidies are beneficial to expanding access, it undermines the sustainability and business case for provision. Across countries, electricity prices have to increase by between 11% and 40% in order to be cost reflective, while certain segments of users enjoy discounts as much as 84%. This is compounded by requirements for power purchase agreements from independent power producers (IPPs) (for instance Madagascar and Mozambique) – where these agreements cost more than the selling price of electricity, and by imports (electricity or fuel) which can also push up costs due to exchange rate volatility.

Generation and distribution of electricity tend to be unbundled.

In each country, there are state owned public utilities that are responsible for the transmission and distribution via the national grid. However, in only three countries (Mozambique, Madagascar and eSwatini) are these utilities also involved in electricity generation, and in only one country (Madagascar) is it responsible for the majority of electricity consumed in the country. This is not the result of deliberate unbundling between generation and distribution[1], but rather, these countries have allowed for electricity to be purchased from independent providers as well as the Southern Africa Power Pool (SAPP). In Mozambique, the electricity utility purchases the majority of locally consumed electricity through a public-private agreement with a government-owned hydroelectric plant, while an aluminium plant near Maputo purchases electricity directly from South Africa's Eskom, but there are also requirements to purchase electricity from IPPs. In Madagascar, the state utility is responsible for the majority of electricity provision – solely responsible for grid generation and distribution, while IPPs compete with the state utility for the provision of mini-grids. In Lesotho and eSwatini, the majority of locally consumed electricity is purchased by the state utility from South Africa, Mozambique, and the SAPP. The state utility in eSwatini generates some of its own electricity, while in Lesotho, the state utility purchases electricity domestically from a government owned hydroelectric plant, operated through a joint venture between Lesotho and South Africa.

Despite the apparent drawbacks in the electricity sectors of the five countries, there are also significant benefits that they can draw on. In most countries, the expansion of clean energy access enjoys broad government support.

Countries with good natural resource endowments for clean energy, like Madagascar, Mozambique and Lesotho can also benefit, and indeed have plans to expand their clean energy generation capacity utilising available natural resources (mostly hydro, but also natural gas in the case of Mozambique). The availability of regional distribution infrastructure, and a common SAPP, which some countries already procure from also opens up the door for greater regional collaboration and a cross border energy market.

1 Except for the case of Malawi – where the Electricity Act (2016) specifically mandated this

4 Going beyond the citadel walls

In all five countries, regardless of the overall levels of access to grid electricity, rural areas are substantially lower than in urban areas. Although this was also the case ten years ago (2007), access to electricity in urban areas have increased drastically over the last ten years, with most countries achieving an increase in access of between 45% (eSwatini) and 89% (Lesotho). As a result, urban access rates of around 60% and higher is now seen in four of the countries.

The only exception is Madagascar, where current urban access is 49%, and the growth in the access rate in urban areas over the last ten years has only been 26%. Based on current trends, it is not inconceivable that four of the five countries could be able to achieve close to universal energy access in urban areas by 2030.

Despite the encouraging growth rates in urban areas, it is perhaps more encouraging that rural growth rates have matched or exceeded urban growth rates in all but one country. Other than Mozambique (where rural access stagnated between 2007 and 2017), countries managed to expand their rural access at a rate on par with (Malawi) or faster than the rate of expansion in urban areas. However, given the very low rates of access to start with in rural areas, a vast rural-urban divide still exists. In all countries except perhaps eSwatini, universal access by 2030 is not achievable based on current trends.

Despite the encouraging growth rates in urban areas, it is perhaps more encouraging that rural growth rates have matched or exceeded urban growth rates in all but one country.

The rural-urban divide results from barriers to infrastructure expansion, as well as the business case for serving rural areas – where the capital costs for expanding and maintaining infrastructure exceeds the revenue potential from areas where poor consumers translate to lower revenue. Urban populations tend to be smaller and have higher electricity access rates, as traditional electrification programmes targeted more accessible and densely populated towns and cities. MAP classifies this rural-urban divide as the 'citadel economy' – where everyone within urban areas is 'safe' behind the walls, while those in the outer reaches (beyond the walls) are largely left to fend for themselves. Given the large proportion of adults residing in rural areas in these five countries, electricity distribution infrastructure investment in rural areas is perhaps the single biggest lever governments have to influence access to energy for vulnerable groups.

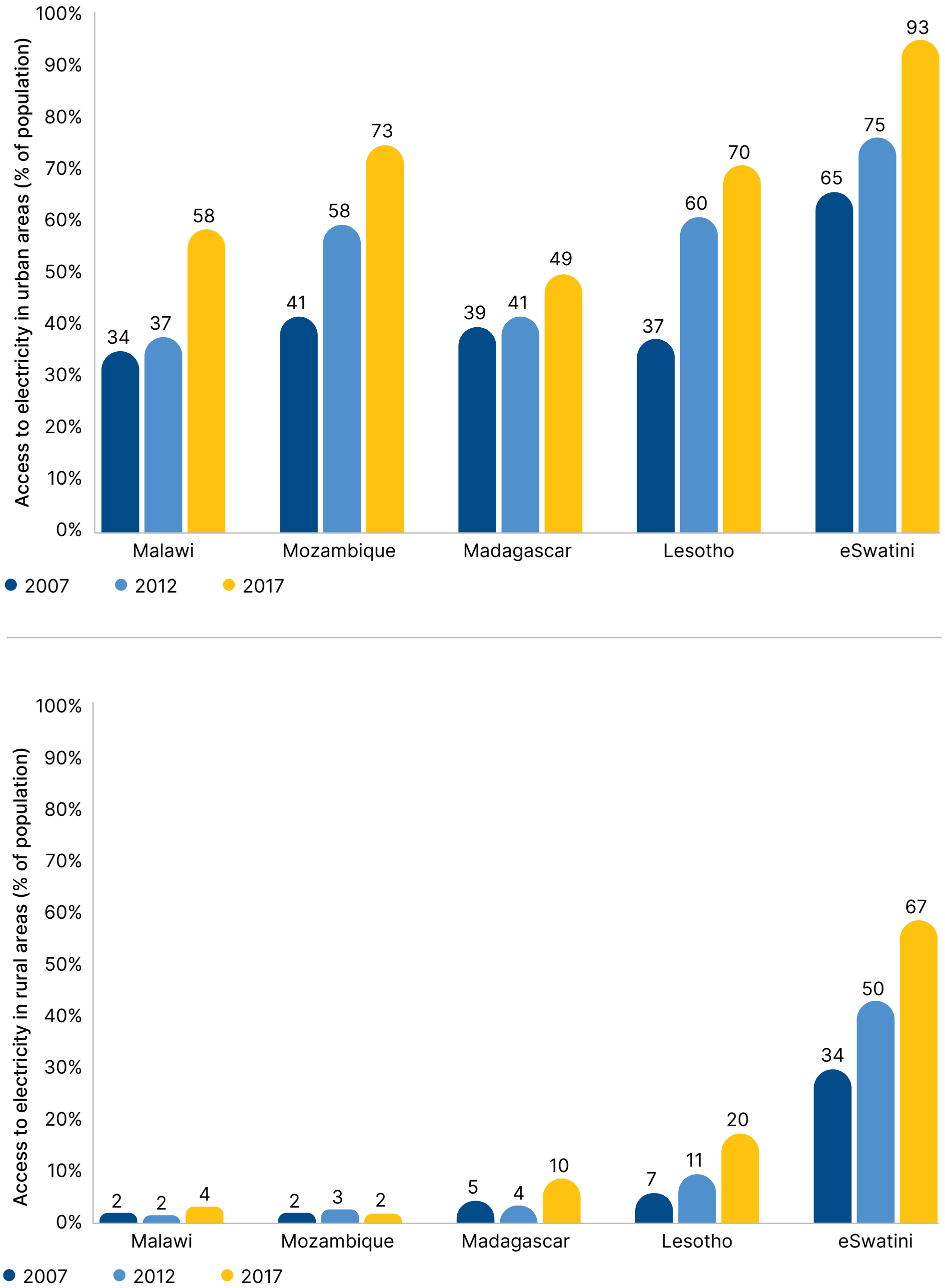


Figure 3: Access to electricity as percentage of urban and rural populations
Source: World Bank Development Indicators 2019

The FinScope data at country-level provide a more detailed geographical analysis of access at a provincial, district or sub-district level (varies by country). This allows for granular exposition of access, which is valuable to inform any effort to expand the reach of distribution infrastructure. At a district level, there are clear geographic areas where access is either non-existent or much lower than at higher geographic levels like provincial or national.

5/ Missing the mark: Stakeholders and initiatives

Given the country realities, levels of access to energy, the electricity generation and distribution context, and the large and persistent rural-urban divide, the country diagnostics also uncovered a number of arrangements, stakeholders and policies or plans at country level that informs the current energy sector context. It also reveals the possibilities to expand energy provision in each country, summarised as follows:

Energy policies mostly does not include specific rural focus.

Although most countries have some form of national energy expansion policy in place, very few have an explicit policy for rural expansion (Malawi and Lesotho have one, in addition to its main energy policy). Instead, countries focus more on off-grid in terms of their policies, which by implication would include rural areas, while environmental or renewable considerations also form explicit areas for some.[2] This is less beneficial perhaps for rural expansion (as in the case of Lesotho – despite the rural policy, the majority of expansion is focused on connecting high and medium demand customers in urban and peri-urban areas to the national grid), but it is beneficial for mini-grids and clean energy (solar).

Despite policy support for off-grid, the regulatory frameworks currently in place still act as a barrier, rather than a catalyst for off-grid energy provision.

The regulatory environment is not currently conducive to the development of off-grid solutions.

Despite policy support for off-grid, the regulatory frameworks currently in place still act as a barrier, rather than a catalyst for off-grid energy provision. For instance, tariffs are often regulated, and undermines investor returns given the particular risks associated with mini-grids (poor, rural areas, direct agreements with customers, no mass-offtake agreements, lack of adequate legal guarantees etc. [Malawi, Lesotho]), while authorisation procedures can be complex for mini-grid projects (Mozambique) or require some reform (Madagascar). In Lesotho's case, mini-grid's in rural areas also have to adhere to technical rural electricity service standards (to be approved by both the regulator and the community),

2 Malawi for instance has an explicit focus to shift energy reliance from biomass to modern sources such as electricity, modern fuels and renewables, while one focus area of eSwatini's National Energy Policy is ensuring environmental and health sustainability

which makes provision more difficult. In addition, there is often a lack of regulation around quality standards (especially for solar products [Madagascar & eSwatini]), leading to low quality products in the market which undermines trust. While some countries are working on amending legislation (Mozambique), or developing specific regulatory frameworks for off-grid (Lesotho), this process has been slow and have mostly not concluded yet (Mozambique).

Environment not conducive for clean energy investment.

As a result of regulatory restrictions affecting the return on investment, there also seems to be little to no investment in off-grid alternatives. For instance, the only existing mini-grid projects in Malawi have been donor-funded. While Mozambique has seen some success with the introduction of IPP's in 2015, these are limited to grid electricity provision, and the off-grid market remains undeveloped and driven by donors and a government-owned and operated fund mandated to advance energy access. Madagascar had some success in IPPs who compete with government to deliver mini-grid electricity, but these are mostly diesel powered, and government remains the largest driver of clean energy off-grid efforts. Similar, off-grid initiatives have mostly been driven by government in Lesotho, but their main interest is the expansion of the current grid and building additional national generation capacity. For the most part, government efforts are supported by donors, as in the case of eSwatini as well, where a framework to achieve affordable clean energy for all in eSwatini was developed in conjunction with UNDP, which will be leveraged to mobilise investment.

Limited success in off-grid initiatives, not concurrent with the scale of the problem.

Despite many ongoing initiatives by government and donors, there has been limited success. Where successful, initiatives have not been sufficient given set targets in order to narrow the access gaps. For instance, Malawi's Rural Electrification Program has been operating since 1980, and to date only 375 trading centres have been connected to the national electricity grid. In Mozambique, the off-grid market is undeveloped and driven by donors and FUNAE (Fundo de Energia) - a government-owned and operated fund mandated to advance energy access. The FUNAE fund 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). However, this has 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. In Madagascar, the Ministries of Water, Energy and Hydrocarbons and Rural Electrification have included the explicit target of providing 500,000 solar home systems to households by 2025. While ambitious, this is not sufficient to enable Madagascar to reach its 2030 targets. In Lesotho, a project to promote off-grid renewable energy access in three districts faced many challenges, and was ultimately unsuccessful. Only 1,537 of the 5,000 Tier 1 solar home systems targeted were ultimately rolled out. In eSwatini, a new

The FUNAE fund claims that about 3.7 million people have gained access to modern energy services through its off-grid programmes. However, this has been mainly in schools, administrative offices and health centres.

partnership between government and donors for affordable renewable energy has the target of establishing at least four mini-grids and roll out 200 solar home systems. In all these countries, the size of targets come in vastly below what is required, or, where projects have been implemented for a period already, have failed to deliver as intended.

Lack of scale or implementation of donor programmes.

Similar to government initiatives, most donor initiatives seem to lack the scale required to achieve meaningful impact in terms of the 2030 goals. For instance, in Madagascar, a tally of donor initiatives to invest in electricity generation capacity, which the country sorely needs, is at best sufficient to maintain the proportion of the population that have access to electricity through to 2030 (when accounting for expected population growth). In Mozambique, the World Bank has set ambitious targets for expanding access to electricity services through a combination of grid densification, mini-grids and stand-alone solar home systems. However, the proposed targets are only sufficient to cover around two thirds of the shortfall the government has identified to reach their reduced target of 50% access by 2030. In Lesotho, a donor partnership aims to establish ten renewable energy mini-grids. In Malawi, work to expand clean energy access has been similarly scarce, especially prior to 2019. Currently, initiatives include a solar mini-grid which connects 150 households, a maize mill, primary school, health facility, and churches (which will be expanded to connect a further 800 households) and another programme has a mini-grid that connects 179 households to 1,250 households, one health centre, four maize mills, five primary schools, and shops.

Similar to government initiatives, most donor initiatives seem to lack the scale required to achieve meaningful impact in terms of the 2030 goals.

Most donor initiatives and funding focus on grid electricity.

In eSwatini, there are two programmes running (through to 2024) with combined funding of about USD 9.7 million focusing on off-grid and on-grid solutions. In Lesotho, there is a much larger programme (about USD 53 million) that focus on grid extension to peri-urban areas, and the establishment of mini-grids. Another programme focusing on solar and off-grid solutions is much smaller at EUR 1.25 million. In Malawi, the combined funding of three donors that focus on off-grid solutions is USD 7.5 million. However, in addition to this, the World Bank will run two larger projects – one for off-grid (USD 30 million), and one for grid densification (USD 105 million). The World Bank follows a similar approach in Madagascar, where grid electricity receives the larger share of funding (USD 80 million) while off-grid receives less (USD 55 million). But in Madagascar's case, a second large player – the African Development Bank (AFDB) – also has a programme for USD 100 million, focusing on grid and off-grid. Mozambique seems to be the only country that bucks the trend – a larger collection of donors are involved (seven donors, combined funding of USD 112 million), and the majority is going to off-grid work (five donors and USD 78 million).

6 Understanding consumer realities

Given the realities surrounding the domestic energy ecosystems in most of these countries, and the gap between the intended 2030 goals and what has been practically achieved, supply-side interventions, if done in isolation, will not be sufficient to achieve meaningful impact.

Although regulatory support will help, MAP has learned from extensive experience that supply and regulatory efforts need to be based on a deep and granular understanding of consumers in order to be effective. While government and private sector investment is clearly required, financial inclusion co-opts households into the rollout and accessibility of basic infrastructure, including access to electricity.

Our understanding of demand-side dynamics, based on the work done in five countries, include the following aspects: 1) An understanding of the different degrees of access (tiers); 2) an understanding of how access varies by different demographic and geographic groups; 3) an understanding of the energy needs of different demographic and geographic groups (sources of energy), and 4) an understanding of the way that people meet these needs (affordability). Lastly, we also explore the financial inclusion realities across countries, and the potential or limitations that this places on countries to leverage financial inclusion as an enabler of 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.

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 five SADC countries, applies a more detailed framework for the evaluation of access to energy, based largely on the multi-tier framework of the Energy Sector Management Assistance Program (ESMAP) and the Sustainable Energy for All (SEforALL) programme - an initiative co-chaired by the Secretary-General of the UN and the President of the World Bank.

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. 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. The relevant ESMAP/SEforALL multi-tier standards for household access to grid-supplied electricity are presented in Table 1.

Table 1: 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.

Based on the multi-tier standards, countries can be assessed in terms of the overall availability and reliability of electricity through their national grids. This allows for the classification of the overall state of electricity provision to those that have access. Across the five countries, availability and reliability of electricity provision largely follows levels of access to electricity, with Lesotho and Malawi having more reliable electricity provision, and the other three countries less so. However, Malawi seems to be a slight outlier – with the number of disruptions a week being less than those of Mozambique and Madagascar, even though the availability and overall access to electricity levels are lower in Malawi.

Table 2: Overview of grid access, quality, and cost, by country

	MALAWI	MOZAMBIQUE	MADAGASCAR	LESOTHO	ESWATINI
Availability of grid supply (hours per day)	<4	<8	<8	>23	>23
Reliability of grid supply (disruption per week)	<14	>14	>14	<3	<3

Source: Assessment by Nova of availability and reliability of electricity by country

The quality of electricity supply also differs across countries. The World Economic Forum measures quality of supply on a scale from one to seven. Between 2007 and 2017, the quality of electricity supply scores received by each country also follows the overall levels of access, availability and reliability fairly well. Mozambique, in general, received the highest score of the three Cluster 1 countries, and almost comparable to Lesotho (a Cluster 2 country). Only eSwatini received a score of higher than four out of seven, a rating which it held for only two years nonetheless. These scores are also used to rank countries, and only one country in the pool of five have ranked consistently in the top 100 countries over the last ten years (eSwatini – ranked in the 90's). Lesotho and Mozambique have received rankings ranging mostly in the low 100's, while Malawi and Madagascar received rankings mostly from 120 upwards (to mid-130's).

Based on the availability and reliability of electricity supply information, countries can be classified across the following tiers, in terms of their overall provision. Additional information from the country diagnostics indicate that the quality of grid-supplied electricity is low in Malawi, Madagascar, and Mozambique. There are often multiple disruptions per day, resulting in long periods of grid downtime and no electricity supply. This means that even the few households with electricity access need to make use of alternative sources to meet their energy needs. Although the availability of grid-supplied electricity in Malawi would only

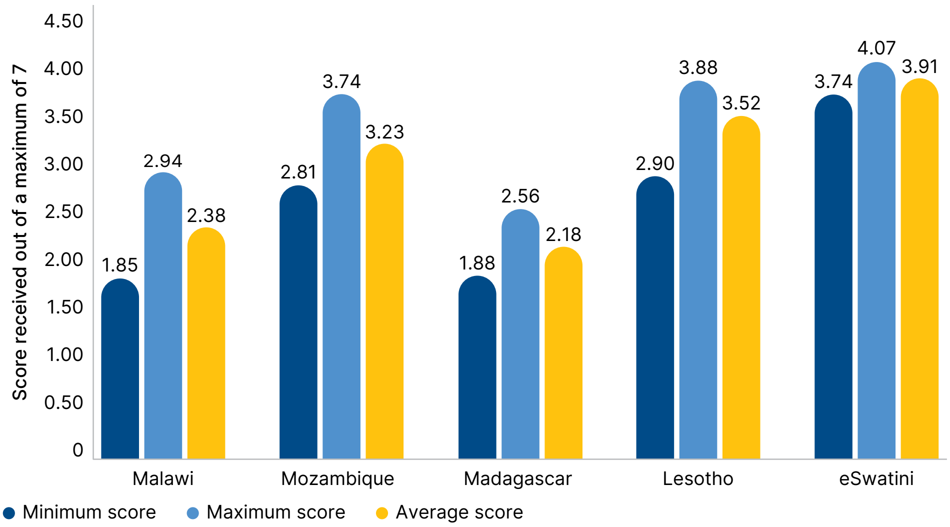


Figure 4: Quality of electricity supply

Source: World Economic Forum 2019

meet Tier 2 requirements. The most recent ESCOM[3] electricity supply schedule, from December 2019, shows planned outage of four and six hours a day, every day of the week. This limits Malawi's maximum electricity supply rating to Tier 4.

Table 3: Electricity Tier by country

	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Mozambique						
Madagascar						
Malawi						
Lesotho						
eSwatini						

Source: Nova economics

However, the above assessment of the overall reliability, availability and quality of electricity supply still does not reflect the actual levels of usage that individuals and households get by with. By using the actual expenditure on electricity (coupled with the cost of electricity), or – where not available, the asset ownership of individuals and households, FinScope allows us to estimate electricity use of the entire adult population, and categorise this usage according to the six tiers – Tier 0 being those who don't have access to electricity. This analysis shows that while countries are classified according to specific tiers overall, consumers generally fall across all tiers in terms of the amount of[4] electricity they use. Furthermore, across all countries (even Lesotho and eSwatini), the majority of electricity users fall across Tiers 1 to 3[5].

While the majority of adults in almost all five countries do not have access to electricity, we also find that the majority of those who do have access use very little electricity, and can only power a rudimentary set of appliances as a result.

Therefore, while the majority of adults in almost all five countries do not have access to electricity, we also find that the majority of those who do have access use very little electricity, and can only power a rudimentary set of appliances as a result. For instance, around 18% of adults across the five countries would only be able to power lights for tasks and charge their phones. Another 33% would be able to power general lighting, phone charging and maybe a small appliance like a television or fan. This means that around half of adults who do have access to electricity are using less than 1 kWh of electricity a day (Tier 1 and Tier 2 usage). An additional 33% would be able to the same, but also have a medium power appliance like a refrigerator. In other words, around 84% of adults fall into Tiers 1 to 3, while the remainder fall into Tier 4 (11%) and Tier 5 (5%).

As a result of both the large access deficit (people who do not have access), as well as the low usage by those who do have access, domestic annual electricity consumption is among the lowest in Africa and the world for Madagascar, at 53 kWh. Malawi has domestic consumption almost double that of Madagascar

3 Electricity Supply Commission of Malawi

4 Estimates does not include adults in Lesotho, although indications from the affordability analysis for Lesotho indicates similar usage patterns.

5 For Lesotho, actual usage could not be calculated, but only 8% of adults in eSwatini would be able to afford Tier 5 electricity usage, while only 19% (including previous) would be able to afford Tier 4 usage. The majority of adults in Lesotho will therefore only be able to afford Tier 1 to 3 usage.

(102 kWh), while Mozambique and Lesotho exceed usage in Malawi by a factor of four or more (462 kWh and 409 kWh). eSwatini has the highest per capita usage, at 1,033 kWh, due to its high rates of access and small population.

Consumer profile of access to energy

Figuring out how best to serve low-income people through the use of financial services can facilitate co-dependent pathways to broaden the reach of such infrastructure and services. This approach to financial inclusion entails developing domestic financial markets based on a sound grasp of consumers' real economic needs at ground level. It is also about appreciating the potential represented by 'people's money' – that is, existing individual and household expenditure – in helping governments fund investment using local financial systems.

However, to do so, we need a granular understanding of people's daily realities, including their real economic needs, and how they use financial services (formal and informal) to meet those needs (in this case, the need for access to energy). The scoping study and five country diagnostics leveraged MAPs extensive data resources, i.e. nationally representative demand-side surveys, in order to understand how different groups of people have unique and particular energy needs and constraints – and how they leverage their available means (income and other available mechanisms) in order to satisfy those needs. This in turn allows for insight into the business case for various types of energy provision, including expanding access to grid supplied electricity.

Access to education, which tends to be lower in rural areas due to the infrastructure deficit, also influences employment and income opportunities, and as a result, is one of the strongest predictors of access to particular energy sources like grid electricity.

Geographic location has an obvious impact on access, given the infrastructure requirements for distribution. However, the MAP data allows for additional granularity to unpack differences in access for different groups of consumers based on their demographic and livelihood characteristics. These additional indicators are, however, substantially intertwined, in the sense that having a particular characteristic also makes it more likely to have a second (or a third) characteristic. For instance, as there are less opportunities and overall development in rural areas (compared to urban), employment in rural areas tend to largely revolve around agriculture or informal businesses. This in turn affect the income of rural adults – who are substantially poorer than those in urban areas. Access to education -which tends to be lower in rural areas due to the infrastructure deficit - also influences employment and income opportunities, and as a result, is one of the strongest predictors of access to particular energy sources like grid electricity.

Income source is another useful indicator, as those with the same income source tend to have similar characteristics, and also tend to live in similar types of locations. Access to electricity by income group negatively correlates almost directly with both the size of the income group (proportion of population income group), as well as to the proportion of adults in each income group that are rural.

Across the five countries, we therefore find the following trends across different sets of demographic characteristics:

Income

Access to electricity increases significantly over income, with the poorest (and also largest) groups, having the least access, while those who earn more (the smallest groups) have higher access to grid electricity. This also becomes apparent even if other proxies for poverty is considered. For instance, of those who have experienced one of three poverty related events in the last year[6], access to electricity tends to be lower compared to those who have not experienced these events in the past year.

Income source

Income groups that are both the largest and most rural, have the lowest access rates to grid electricity, and vice versa. For instance, farmers and informal workers tend to be the largest and most rural income groups, and also have the lowest rate of access to grid electricity. Salaried workers and the self-employed, on the other hand, tend to be much smaller groups (especially salaried workers), but they are much more urban based and have higher levels of access to grid electricity. 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

Education is another demographic indicator that correlates strongly with access to energy. For instance, of those who have no, or only primary education, very few tend to have access to electricity, even though this group usually represents a large portion of the population. Those with a secondary education have higher levels of access (even though this group can also be substantial in some countries), but those with an education in addition to secondary (vocational or tertiary) have the highest levels of access – but usually constitute a very small portion of the population.

Gender and age

The correlation between gender or age and access to grid electricity is less clear across countries. Women seem to enjoy marginally higher access to electricity in most countries. In terms of access to electricity – we do sometimes see higher rates of access for middle aged adults, with youth and elderly having slightly lower rates (for instance Lesotho), although in other countries access to electricity increases with age. However, particular age groups and men and women do demonstrate slightly different preferences when it comes to alternative energy sources (see next section).

6 These include skipping a meal, or not being able to pay medical or educational expenses due to a lack of money.

Despite these common characteristics, it is important to note that even groups who are higher income, more urban, or have more consistent income sources contain large numbers of households and individuals who still have relatively low rates of access to electricity.

This means that there is also lower hanging fruit in the short term to expand access, which can be addressed if supply-side constraints are alleviated. Nonetheless, with half the population (or more) often deriving their income from agricultural activities, it is worth exploring clean energy and off-grid solutions both as a climate mitigation response as well as alleviating poverty for those most in need.

Energy usage and expenditure is intrinsically woven into both poverty and climate change. Making progress towards the SDGs requires the ability to deal with both these issues concurrently.

High levels of poverty in these countries as well as the extensive use of biomass energy for cooking are by far the largest proportion of the population (see next section). This highlights that energy usage and expenditure is intrinsically woven into both poverty and climate change. Making progress towards the SDGs requires the ability to deal with both these issues concurrently.

Consumer profile of energy needs and usage

Despite the large access to electricity deficits noted at a country, geographic and demographic level, people find ways to meet their energy needs. These methods differ based on the particular use cases for energy at a household level, as well as the availability and affordability of alternative sources of energy. Households need energy for a variety of energy services, including cooking, lighting, space heating and cooling, powering various appliances, and charging mobile devices.

The ESMAP and SEforALL programme 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, lighting 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.[7]

Table 4 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 (in addition to electricity). 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. However, as a result of the much lower access rates in rural areas, the reliance on less efficient, safe or clean energy sources for things like lighting and cooking is much higher in rural areas than in those urban areas.

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

Table 4: Access to energy services by tier and source of energy

		ELECTRICITY						MODERN FUELS	SOLID FUELS
	Energy services	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

Furthermore, even where people have access, affordability of electricity is still a driver of people using modern fuels and solid fuels for higher intensity energy requirements like cooking. People that are poor purchase less electricity than those that are not, and are more likely to use other sources of energy such as biomass (firewood, charcoal) or modern fuels (e.g. LPG). Firewood in most cases, especially in rural areas, can be obtained for free to use for cooking and heating, while charcoal, a costlier option, is used widely by those who can afford it. Similarly, candles and paraffin lamps are less costly alternatives to electricity for lighting. However, even the poor are more likely to use electricity for low energy uses cases like lighting or charging a phone – when they do have access. For higher energy use cases like cooking or space heating though, the poor (and even higher income households) are more likely to use alternative, and less costlier sources of energy.

In most countries, the proportion of the population that uses electricity for lighting is close to the proportion of the population that have access to energy. However, given low levels of access to electricity in most countries, the majority of people (around two thirds or more in most countries) still rely on alternative forms of energy for lighting – not electricity. There are further clear trends in energy use for lighting across the five countries. As access to electricity increases, the dependence on biofuels and off-grid electricity solutions seems to decrease. Cluster 1 countries in particular are still more reliant on these two sources. In Malawi, many people use battery-powered torches as their primary light source, while solar power or home generators is also used in the three countries. It's notable in particular that solar power is more likely to be used as an energy source in these countries – by as many as 10% in Mozambique, and 6% in Madagascar.

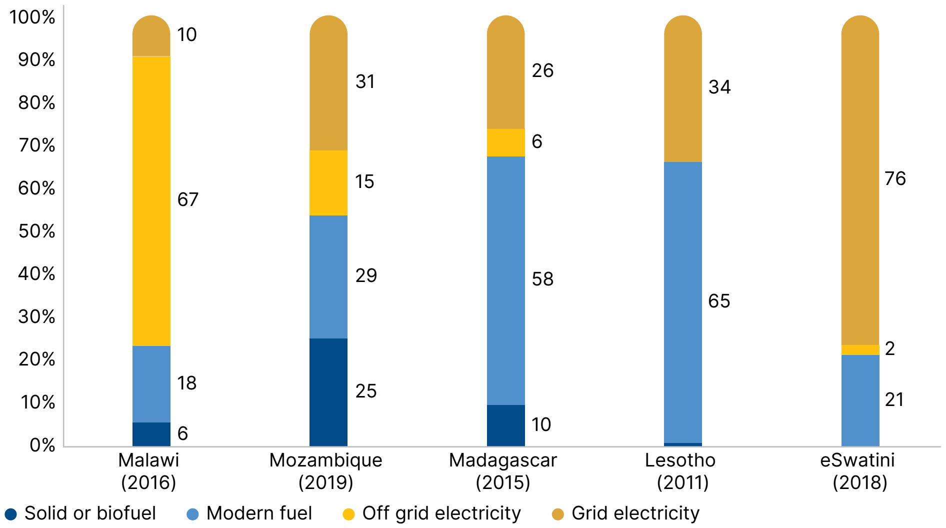


Figure 5: Primary energy sources used for lighting, by country

Source: Most recent FinScope surveys for each country (date noted on graph).

However, Cluster 2 (Lesotho) and Cluster 3 (eSwatini) countries are not as reliant on these sources. Instead, countries with higher GDP (including Cluster 1 countries like Madagascar) seem to initially switch from using solid/biofuel or off-grid solutions, to steadily using more modern fuels for lighting - such as paraffin, candles, and oil lamps, torches and lanterns. This trend continues for Cluster 2 countries, up to a point where electricity access become sufficiently high for the majority of people to rely on grid electricity for their lighting needs (as is the case in eSwatini).

Modern fuels and electricity are therefore much more likely to replace biomass as the primary source of energy for lighting compared to cooking. This can be attributed to the relative difference in energy consumption (and therefore the fuel cost) and the quality of the energy service. Lighting requires much less fuel compared to cooking, which means it is more affordable for a household to adopt modern fuels for lighting. In addition, modern fuels and electric lighting produce a far safer, reliable, and higher quality light than solid fuels.

In addition to the differences across countries in terms of energy sources for lighting, there are also differences within countries, based on geographic, demographic and livelihoods factors. The largest driver of this is again geography – access to electricity in urban areas is higher. Far more people in urban areas, across all five countries, rely on grid electricity for lighting, and consequently, they rely less on all three other sources. But there also seem to be more substitution from off-grid solutions and solid/biofuel to modern fuels for urban adults who do not have access to electricity, perhaps due to higher income of urban households, which makes modern fuels more affordable. Other demographic factors that are more likely to increase access to electricity (see section 7.2) also increases the likelihood of using electricity as an energy source for lighting, or substituting of- grid and solid/bio fuel for modern fuels. These include higher incomes, more stable income sources, and a higher education.

Far more people in urban areas, across all five countries, rely on grid electricity for lighting, and consequently, they rely less on all three other sources.

Whereas electricity is much more likely to be used as an energy source for lighting where people do have access, very few people who have access to electricity use it for cooking purposes. Even in eSwatini, where 74% of the population has access to electricity, only 26% report using electricity for cooking, while in countries like Malawi and Madagascar, almost no one uses electricity for cooking. Instead, most people continue to rely on biomass (wood, coal, charcoal, animal dung, sawdust, etc.), and in particular, firewood for cooking in all five countries – around 90% or more of people in Cluster 1 countries, and more than half of people in both Cluster 2 and 3 countries.

The demand and preference for biomass can be attributed to its availability, accessibility, and the fact that it is usually inexpensive, if not free (safe for the opportunity cost of time spent gathering firewood or animal dung from nature, which is relatively low, given the limited earning potential of people in the target countries), especially in rural areas. Nevertheless, biomass comes in different forms, some of which, can mostly only be obtained by spending money. For instance, coal and charcoal mostly have to be purchased, while urban adults have a harder time collecting free biomass from nature.

Therefore, some trends do emerge when looking at energy uses across countries, and across geographical, demographic and livelihood groups. Firstly, there seems to be some increase in the use of either grid electricity or modern fuels (mostly LPG) for countries with higher GDP per capita – especially for Cluster 2 and 3 countries. The same also holds for urban adults, higher income groups, groups with more stable income sources, and higher educated individuals. Secondly, even though the use of biomass is extremely high for Cluster 1 countries, and remain high across Cluster 2 and 3 countries, there is substantial substitution between firewood and charcoal as per capita income increase – especially in Cluster 1 countries (Lesotho instead relies largely on LPG as opposed to charcoal as a substitution source, while data on the use of charcoal versus firewood is not

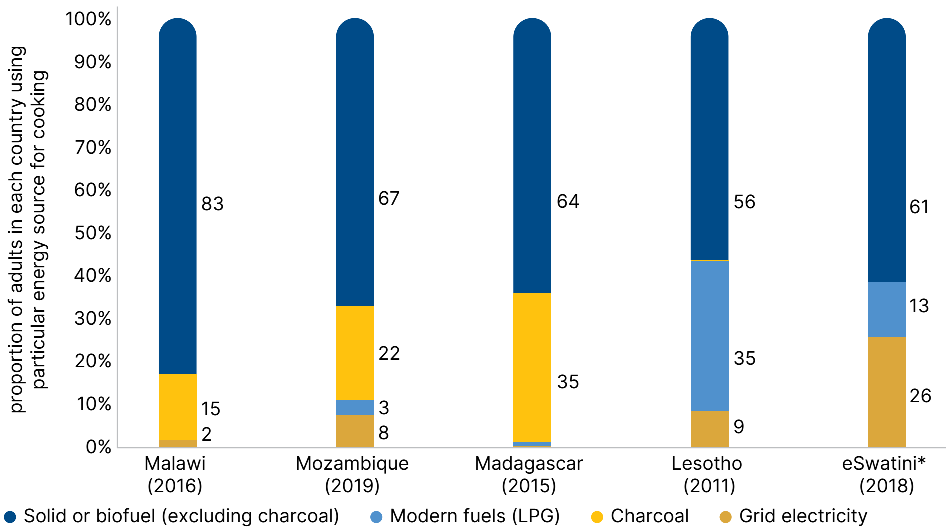


Figure 6: Primary energy sources used for cooking, by country

Source: Most recent FinScope surveys for each country (date noted on graph).
*Note: Solid or biofuel category for eSwatini may include charcoal, as it is not asked for specifically

available for eSwatini). The same is true within countries where individuals with a higher income, or those who are formally employed, urban, and higher educated are more likely to use charcoal as a substitute for firewood.

Modern fuels and electricity are therefore much less likely to replace biomass as the primary source of energy for cooking than it is for lighting. According to the World Energy Council, poor households consume nine times more energy on cooking than is used for lighting.[8] It is difficult to persuade poor or even lower-middle-income households to invest in clean or efficient cookstoves when biomass is free.[9] By comparison, an electric stove, although much safer and less harmful, only marginally improves the quality of cooking compared to traditional cooking methods – if at all. Some stakeholders indicated that a large driver of the preference for using biomass for cooking may also be the taste – fire cooked food just tastes better.

Modern fuels and electricity are much less likely to replace biomass as the primary source of energy for cooking than it is for lighting.

Biomass resources have come under intense pressure through the overreliance on fuelwood, combined with the clearing of land for agricultural production, contributing to environmental degradation, rural poverty and rural energy shortage. The significant dependency on biomass is undesirable as it is not only inefficient but also has a negative climate and health impact. It is estimated that fuelwood and charcoal emit between 1 and 2.4 gross tonnage (Gt) of carbon dioxide equivalent (CO2eq) greenhouse gases annually. This amounts to 2% to 7% of global anthropogenic emissions. These emissions are largely due to inefficient biomass (particularly fuelwood and charcoal) combustion, unsustainable harvesting of forest resources (particularly fuelwood), and environmentally damaging charcoal manufacturing. The emission from solid fuels used for cooking in Sub-Saharan Africa alone is estimated to account for 6% of global black carbon emissions and 1.2% of carbon dioxide emissions.[10]

Cost and affordability of grid-supplied electricity and other forms of energy

In addition to having full access to reliable, safe and good quality electricity that meets the particular needs of consumers, the business case for electricity provision is underpinned by the cost of production – for producers in relation to the selling price, and for consumers in relation to their income. In other words, producers need to produce or buy electricity at a price which makes it worth selling, while consumers need to be able to access electricity at a cost that fit their budget. Unfortunately, these two objectives are not easily married, and across countries we find issues on both sides – utility companies are not

8 World Energy Council and Food and Agriculture Organisation of the United Nations. 1999. The challenge of rural energy poverty in developing countries. WEC: London

9 Why would households invest in an efficient cookstove that helps them use less firewood, if the firewood is free? In cases where the fuel source is not free (e.g. charcoal), the business case is stronger. Even in these cases, a market lead approach is unlikely to generate significant demand (uptake in Malawi, Mozambique and Madagascar is in the single digit percentages).

10 UNEP. "Review of Fuelwood Biomass Production and Utilization in Africa: A Desk Study."

procuring electricity at sustainable rates (as discussed earlier), while consumers struggle to afford already subsidised electricity.

We collected electricity tariffs for domestic, single-phase, prepaid supply from the respective electricity utilities in each of the five target countries (Table 5). All utilities have poverty alleviation or social lifeline tariffs. The standard consumption package (SCP), based on only 1 kWh per day (or 365 kWh per year), falls completely or partially within the criteria of these reduced tariffs. eSwatini's lifeline tariff is based on capacity, not usage (a 20 Amp supply), while Lesotho and Madagascar allow for slightly less than the SCP in their lifeline tariffs (i.e. some usage up to the SCP is charged at the normal tariff). The lifeline tariff for Malawi and Mozambique on the other hand, applies to more electricity than is required for the SCP.

Table 5: Electricity tariffs and cost of standard consumption package, by country (2020)

		MALAWI	MOZAMBIQUE	MADAGASCAR	LESOTHO	ESWATINI
LIFELINE	Tariff (local currency/kWh)	47.50	1.07	251.95	0.73	1.65
	Tariff (USD/kWh)	0.06	0.02	0.07	0.04	0.10
	Cost of SCP (USD)	23.49	5.94	24.69	16.38	36.50
STANDARD RESIDENTIAL	Tariff (local currency/kWh)	67.25	6.63	431.00	1.48	1.75
	Tariff (USD/kWh)	0.09	0.01	0.12	0.09	0.01
	Cost of SCP (USD)	33.26	36.83	42.23	32.70	38.71

The ESMAP/SEforALL multi-tier framework includes a metric for the affordability of grid-supplied electricity. The cost of a SCP should not exceed 5% of a household's income. However, across countries, (using FinScope data) we find that individuals and households in fact spend more than this threshold, especially if all their energy expenditure is included. For instance, in Madagascar, the expenditure on electricity - for those who have access - is 11% of all monthly expenditure, while the expenditure on all energy sources - for everyone who has access to energy is 15% of all monthly expenditure. Furthermore, this can be higher for both electricity and all energy sources, when looking at specific sub groups, going as high as 20% for the elderly (61 plus) for all energy sources.

This is despite the fact that most people with access to electricity fall in Tier 1 and 2, and that those who are currently in Tier 1 actually use less than the SCP per month, while those in Tier 2 use at most up to the SCP per month. Nevertheless, there is a trade-off between affordability, and both the quantity of electricity consumed, as well as the mix of energy sources used.

Using FinScope data, we calculated the proportion of adults (using monthly personal income) that falls into different affordability groups. In other words, the proportion of adults where the SCP (at the lifeline tariff) would be in a

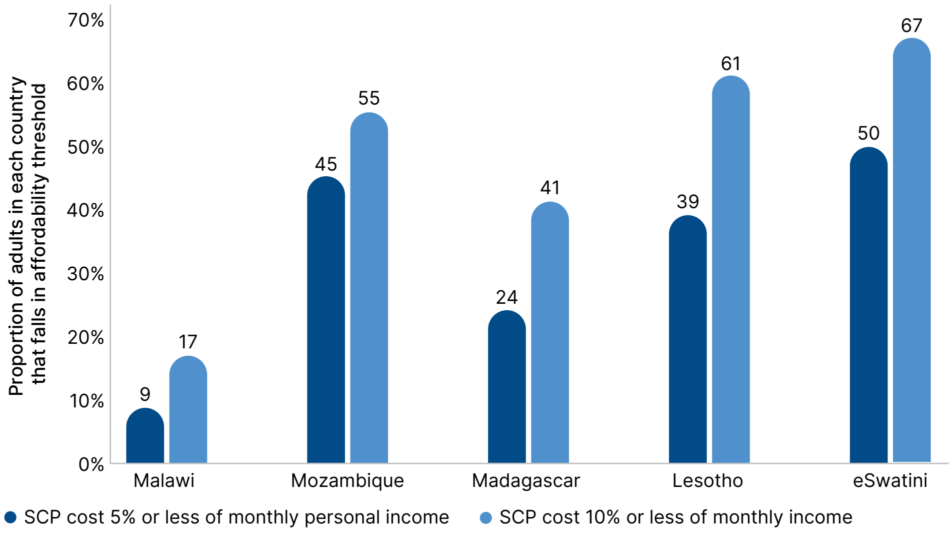


Figure 7: Proportion of population in each country that falls in affordability thresholds of the SCP at lifeline tariff, by country

Source: Author's analysis based on most recent FinScope surveys for each country.

specific range of affordability, in relation to monthly income, starting with the ESMAP/SEforAll threshold of 5%, as well as a threshold of 10% (based on actual observations of expenditure in countries like Madagascar and eSwatini). Using this measure, it is clear that the majority of the population in fact would struggle to afford electricity at the 5% affordability threshold, and that a substantial proportion would struggle even at the 10% threshold of affordability.

Malawi has the most constrained grid affordability. Malawi has the lowest GDP per capita of all five countries, yet its discounted (lifeline) tariff is the third highest of the five countries. The discount provided between the standard tariff and the lifeline tariff ranges between 6% (eSwatini) and 84% (Mozambique). Malawi provides the second lowest discount (29%) of all five countries. As a result, Malawi's lifeline tariff is also almost 400% higher than that of the second poorest country - Mozambique. Given Malawi's current access rate to electricity, affordability will soon become a serious constraint in expanding access, regardless of supply-side and regulatory interventions.

In countries where expenditure data was available, we found that the poor spend a higher proportion of their monthly income on electricity, but less of the poor make this expenditure, and the absolute amount spent is less. The same trend can be observed for those who are not formally employed, rural, female or uneducated, as well as younger adults. However, when it comes to expenditure on all energy sources, similar proportions of the poor make expenditures, more comparable to higher earning individuals, and the proportion of their monthly income spent is actually less than those of higher income people. Clearly, most people do spend on energy sources, but if you are richer, more of your energy requirements are fulfilled by electricity.

Given Malawi's current access rate to electricity, affordability will soon become a serious constraint in expanding access, regardless of supply-side and regulatory interventions.

Access to financial services

Poor consumers prioritise meeting particular economic needs (like the need for access to energy) over others, and find different ways to meet these needs (e.g. through informal financial mechanisms, less-than-optimal mechanisms, etc.). When low-income consumers spend their own money to meet their economic needs, considerable financial and capital resources are mobilised in the process, even if individual household expenditure is modest. However, such expenditure mostly do not flow through formal channels and, as a result, cannot be leveraged by governments (who struggle to raise capital or generate investment in services like energy), or financial markets as a mechanism for investment.

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By being more intentional, governments can co-opt households into sharing the work of improving access to resources, leaving households better off in the process. Governments can leverage existing individual and household expenditure to fund investment in energy using local financial systems. Better understanding consumers' priorities also helps business and service providers identify pockets/communities/groups that present promising business cases for strengthening existing provision or enabling innovation. Thus, it is beneficial for financial service providers to understand how to meet consumers' real economic needs. And where the financially excluded do not immediately present viable business case, identifying them enables government to determine and define better public sector provision of services, based on need.

Governments therefore have the difficult task of harnessing micro-level economic activity to help achieve macro-level economic objectives. Through expanding access to appropriate formal financial services, particularly in relation to access to energy, financial inclusion plays a much-needed intermediating role in the economy.

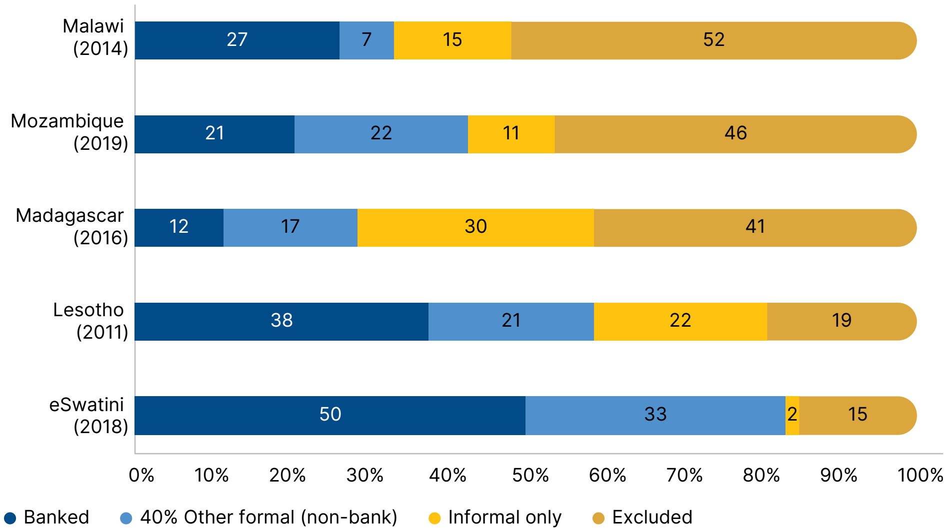

Figure 8: Financial access strand, by country

Source: Most recent FinScope surveys for each country.

Micro-level

Financial inclusion policies and interventions meet poor individuals, households and communities without delay and where they are – often in the informal sector of the real economy – to support them in fulfilling their economic and life needs and priorities. As people's access to resources, such as electricity, increases, so too does their access to the benefits in wider society – along with increased likelihood of their contributing to and being included in the benefits of their country's economic growth.

Macro-level

Financial inclusion supports economically excluded countries to access pathways out of poverty, realise their inclusive growth aspirations and gain access to a confident voice and presence on the world stage. Financing and capacity gaps are greatest in the countries with the least ability to close them; the MAP inclusive data affords a country's financial inclusion stakeholders a clear picture of existing market demand for services (both financial services and real-economy services such as education, healthcare and energy) as a business proposition. This provides a sense of the potential for existing national businesses to scale within this context or for new players to enter the market, and also of the business cases (for providers) and infrastructure investment requirements (for governments and investors) to expand supply to meet market demand.

At the micro-level (households), people self-fund increased access to resources (like energy), in the process contributing to government's achievement of macro-level objectives (like the expansion of the electricity grid). By looking at

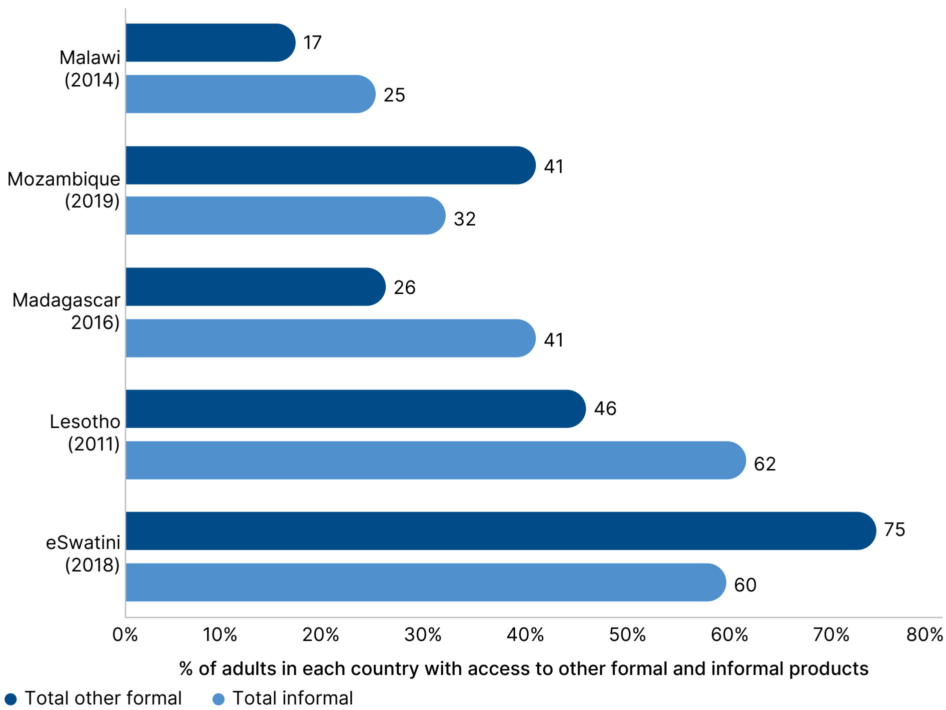

Figure 9: Total access to other formal and informal financial products, by country

Source: Most recent FinScope surveys for each country.

the financial inclusion realities across countries, we can explore the potential or limitations that countries face in terms of leveraging people's money as an enabler of access to energy. The financing options for energy can also be explored from a channel perspective – based on the realities of consumers versus the existing provider landscape and focus. For instance, mobile payments can make purchasing electricity more convenient but for equipment costs, which can be larger, bank and non-bank channels are perhaps more suitable formal options for clean energy credit financing.

Across countries, access to financial services increases as country GDP per capita increases. However, the composition of financial services used differ substantially between countries, and formal financial services do not increase concurrently.

Across countries, access to financial services increases as country GDP per capita increases (from Cluster 1 to Cluster 3). However, the composition of financial services used differ substantially between countries, and formal financial services do not increase concurrently, especially across Cluster 1 countries. In other words, although more people may be using financial services as countries develop, they do not necessarily use formal financial services more – at least not in Cluster 1.

Countries also have far higher access to other formal financial services than the access strand shows, due to an overlap between people who have access to bank accounts, and people who have access to other formal services. Similarly, there is a substantial overlap between people who have informal financial services, and those who have formal. People therefore rely on a variety of financial services to meet their needs. In addition, there is generally an increase in access to other formal and informal financial services usage as GDP per capita increase, with Cluster 2 and 3 countries having the highest access to both. In Cluster 1 and 2 countries, there is therefore a large portion of the population who simply do not have access at all – other than assistance and loans from family and friends and saving at home (both not shown).

Across the five countries, financial services provision is dominated by a highly concentrated banking sector, where a limited number of banks usually have the majority of market share. However, banks tend to have limited infrastructure and reach, and although access to banking is broader in the more lucrative salaried employee market, access to bank credit remain highly restricted. Similarly, insurance companies have limited reach and focus on a highly concentrated group of high-income urban adults.

Microfinance institutions (MFIs) on the other hand are available in all countries, although the level of market development differs. Nonetheless, MFIs have much better reach, and play a key role in promoting financial inclusion, especially in rural areas. Yet even these institutions have their limits in terms of reach and their business case - microfinance portfolios, especially ones that contain loans to lower-income or unemployed people, is risky and unappealing to for-profit financial institutions. This means that provision of credit is primarily limited to salaried employees. The provision of credit to low-income people and non-salaried entrepreneurs is reliant on credit institutions funded by donors or government grants. As a result, the financial services sector is segregated heavily by income and location. Extremely poor, rural people tend to be fully financially excluded or rely on informal options and friends and family.

Mobile money is playing an increasing role in some countries, and offer new ways to extend the reach, especially for payments services, but additional products through this channel still has limited application. Many informal and formal money lenders exist, as well as informal savings groups that serve a large proportion of the population. At a more granular level, current access, particularly to formal financial services, is mostly driven by payments and remittance products, as formal access to savings, credit and insurance products are very low. Nevertheless, when it comes to energy provision, it is often credit that is of most interest. In the countries included in the study, credit is most often obtained from informal sources, or from family and friends. Yet even these sources are used to a limited degree. In Malawi, 72% of the population has no access to any source of credit, while in Mozambique, this is 93%.

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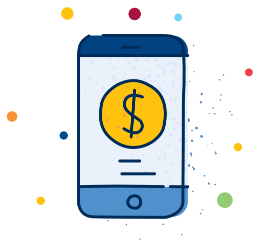
The credit gap is determined largely due to low-income groups and a weak credit culture. Countries also struggle with weak credit infrastructure (coupled with the lack of a proper functioning and comprehensive national ID system), which cover only minor portions of the population, while interest – particularly for the non-bank sector is high. Banks on the other hand, as explained, do not serve close to a broad section of the population, particularly when it comes to credit provision. MFIs, even where they have an explicit mandate to serve rural or poor people, face high credit risk, due to high operating costs and a significant ledger of non-performing loans. Little value can also be recovered on non-performing loans, and can take very long (up to three years in the case of Madagascar). There is also limited examples of financial service providers having explicit loan products to finance energy or clean energy products. It is no wonder than that most people who do get credit, do so from family and friends, followed by the informal sector.

The use of cash, rather than other forms of payment, is still pervasive across all countries, with the exception of remittances, which is more likely to happen through formal channels. Currently, those that use electricity are therefore likely to use cash as a payment option. Payment solutions that lower the cost, particularly for the informal and excluded will be significant to their daily needs. The use of mobile payments can also make purchasing electricity more convenient. Although specifically for bill payments, people still largely prefer cash.

Mobile money offers solutions, but is dependent on the level of mobile ownership, and network coverage (as a minimum – although other factors become significant once these are pervasive). Although both penetration and coverage are substantial, even in Cluster 1 countries, significant issues remain. For instance, in countries like Malawi, Mozambique and Madagascar, substantial portions of the population do not yet own or use a mobile phone (70%, 48%, and 65%). Where mobile phones are used, many people still use 2G phones, although 3G has increased in recent years. And in terms of coverage, although it is good in urban areas, it is patchy or sometimes non-existent in remote rural areas. However, both coverage and penetration are much higher in Lesotho and eSwatini, covering closer to the entire population (coverage above 90%, and penetration 80% and 86%). In addition, 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. So precisely the areas that can most benefit from mobile payment solutions, are also the areas that struggle with access to energy. Even where energy is available, consumers often have to pay to charge their devices with shops and/or neighbours. Lastly, although mobile money solutions are available in all five markets, take up is much lower than actual mobile phone penetration or ownership. For instance, in Madagascar, FinScope suggests that approximately 69% of adult citizens have heard of mobile money, but only 13% are current users of mobile money solutions.

There are encouraging signs. Although Lesotho's economy remains highly cash-based, in the two years after the introduction of mobile money solutions, nearly 450,000 Basotho had subscribed to one of the two services available. In Malawi, mobile money accounts increased from 2% of the population in 2014, to 10% in 2015. In Mozambique, FinScope (2019) finds that 55% of those who have a mobile phone also have a mobile money account. The quick adoption of mobile money indicates a need for cheap, safe payment solutions with good distributional reach.

In two countries, access to financial services was also explored in relation to access to electricity and, in both, access to electricity is influenced by access to finance. The banked population has the highest levels of access, followed by those who use other formal services, while those who use only informal services and the financially excluded are most likely to not have access to electricity. However, even for groups with high levels of access to electricity (those using formal financial services), a large proportion remain in Tiers 0 to 2, with less than half of this group in Tiers 3 to 5 (Madagascar). The use of electricity for lighting is quite high for the banked population (66%) and those who use other formal financial services. However, even these groups do not use electricity for cooking much. Interestingly, solar panels as a source of electricity is the highest for those who use informal services (Madagascar) as well as those who only use informal services – surpassing formal financial services, likely because a higher proportion of formal financial service users are using electricity for lighting purposes. This again points to the fact that the poor and the vulnerable present significant risks to the climate change agenda through lack of choice of more climate friendly alternatives, as a result of having no money.



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7 MSME energy use for Productive purposes

A well-functioning financial sector can unlock economic opportunity. Between the larger financing system that fund and grow the economy and the individual level of financial inclusion, however, lies a vital missing level and link: the real economy.

It is in the real economy that the majority of a country's population (and not least the poor) generate their livelihoods. Other than agriculture, entrepreneurs (and those who work for them) typically comprise the majority of the population, and the majority of these typically operate in the informal economy. For the majority of a country's MSMEs, the same approach can be applied as when targeting the support and improvement of livelihoods for households. For entrepreneurship support to power economic growth, there is a need to be extremely selective in identifying which MSMEs to support; and targeting these enterprises with support that is highly differentiated and hands-on to the point of being almost bespoke.

There is a fun interconnectedness between business and personal financial services. Younger, informal and smaller MSMEs, in particular, rely on these to fund business operations or investment.

MSME owners rely on a range of their personal financial mechanisms to meet their business needs. In addition to drawing on personal savings, MSME owners obtain loans in their personal capacity, using their personal collateral to fund sunk costs and operating expenses. In other words, there is a fundamental interconnectedness between business and personal financial services. Younger, informal and smaller MSMEs, in particular, rely on these to fund business operations or investment. The market has typically struggled to serve MSMEs, even those that are clearly high potential and high impact. Existing funding models – small business credit markets and banks alike – are for the most part incompatible with smaller-scale credit needs of MSMEs. It is also expensive for MSMEs and funders to find each other. Diversifying financial products to service the missing middle – including incubation and nurturing through government support so as to make such enterprises credit and investment worthy – is an important element of the structural transformation of developing economies.

Small business profiles

Across the five countries considered in this report, many households are dependent on contributions from family members, aid or grants (Figure 10). Small-scale or subsistence farming is still the primary means of livelihood for

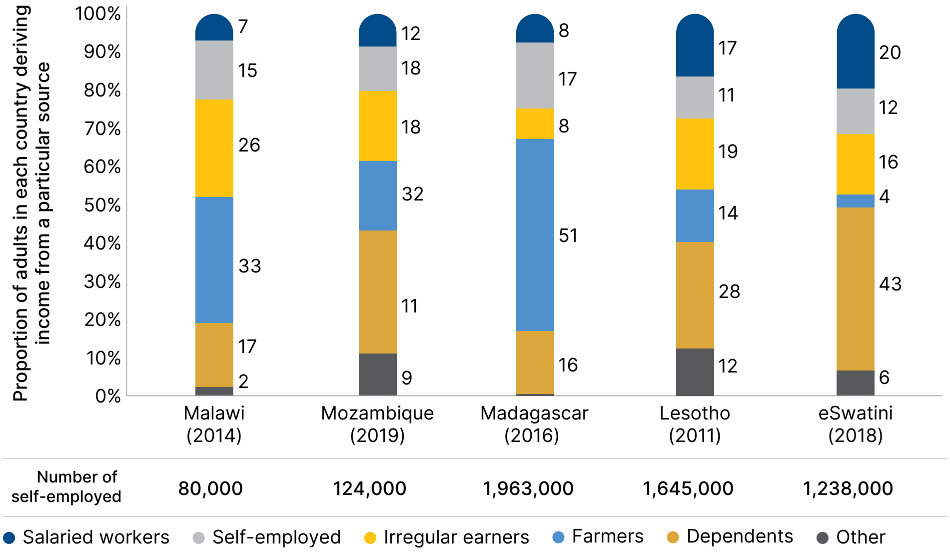


Figure 10: How households earn their livelihoods, per country (% of households)
Source: Most recent FinScope surveys for each country.

many households, and the main source for those who are employed in all Cluster 1 countries. Formal employment, although increasing with GDP per capita, is scarce. Even in eSwatini, where it is the main source, only 20% of adults derive their income from this source. Informal employment also provides a substantial portion of income in most countries.

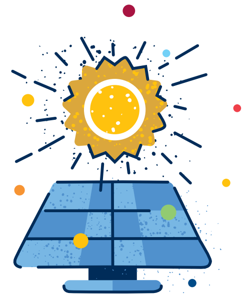
Other than these sources, a substantial portion of each adult population rely on self-employment to derive their income – even more so in Cluster 1 countries, ranging from a maximum of 17% in Madagascar, to a minimum of 11% in Lesotho. Across the five countries, the sector provides a direct source of livelihood for five million adults, not including those who are employed by the self-employed, which is also substantial.

Although a large number, the vast majority of these MSMEs are subsistence businesses – operating very informally, having very small turnovers, employing few to no other people, and not looking to expand. Most of these businesses are also micro-entrepreneurs. However, a much smaller proportion of the self-employed (for instance 26% in Malawi and 17% in Lesotho) are small or medium-sized business. These are more likely to be registered (formal), employing other people, and located in urban areas. They are also more likely to be owned by men, as self-employed women tend to have micro or subsistence businesses. The main sectors that the self-employed work in tend to be either retail (e.g. trading foodstuffs and basic goods [between 50% and 70%]), or agriculture.

Due to the informal and small nature of MSMEs, most businesses either operate from their residential premises (61% in Lesotho, 46% in Mozambique), from the roadside, or a stall, table or container. Only a small portion operate from a business premises (3% in Mozambique, 21% in Lesotho). This has implications for the energy requirements of small businesses, as residential and business energy requirements are often intertwined. Those who operate from the street may have different energy needs.

Electricity access to MSMEs varies by country, in relation to the access level of the overall population. For instance, while Lesotho's level of access is on par with that of its population (34%), Malawian MSMEs report a higher rate of access to grid electricity (18% versus 13%). Mozambican MSMEs, on the other hand, report lower rates of access (7% versus 27%), and so does eSwatini (56% versus 74%). The latter is even lower than the rural population access rate (67%). Low access for businesses is therefore either driven by the nature of small business (largely informal, with many operating door-to-door or on the street, and therefore not needing electricity), or could be due to supply-side factors.

Similarly, for Lesotho, even though the overall access rate is comparable, urban MSMEs have a much lower rate of access, which is therefore a potentially low hanging fruit to address. Access also varies by sector, size, age of business, and even the gender and education of the business owner (Malawi). Male-owned MSMEs have higher access, and so do MSMEs owned by more educated individuals. Access improves for increasing sizes of enterprises, as well as for increasing age of businesses.



The use of solar or generator power also seem to be a substitute for businesses who require access to energy, but do not have access to the grid. For instance, rural businesses and trade and agricultural businesses are more likely to use solar, while being less likely to have access to electricity.

To a large extent though, this can be driven by the geographic location of certain sectors (for instance agriculture and tourism), or by the types of businesses selected by the owner (women tend to participate more in trade, while the higher educated participate more in professional services). Being a registered business, or a business who employ someone also makes the likelihood of having access to electricity greater (being registered also increases the amount of electricity likely to be used). The use of solar or generator power also seem to be a substitute for businesses who require access to energy, but do not have access to the grid. For instance, rural businesses and trade and agricultural businesses are more likely to use solar, while being less likely to have access to electricity.

Productive applications of energy by MSMEs tend to be highly particular to the sector that MSMEs operate in. For instance, retailers might typically require lighting, the use of small appliances (e.g. television or radio) and refrigeration (e.g. cold drinks), while agricultural MSMEs could require refrigeration, cold storage, water pumping and irrigation, milling, husking, and pulping of rice, grain and other agricultural produce and transport. More specialised MSMEs (which is a minority) could require additional energy services, including small-scale food processing (drying, oil press, juice making, etc.), small-scale sawmills and carpentry, metal workshops, wielders, repair shops, while more professional MSMEs may require commercial services such as print shops, internet cafés, hairdressing, cloth making, etc.

Challenges faced by energy service companies in addressing the market for productive applications

An observation drawn from the analysis of productive applications across the countries is that while in many cases the majority of MSMEs lack access to electricity, this was not identified as the most significant constraint to operating or growing a business. MSMEs identified several constraints, often identifying limited access to credit or finance as the major constraint followed by other challenges such as the lack of suitable premises, unfavourable regulations or tax regimes and or sales/marketing. This again varies by size of business and location - small enterprises struggle with electricity the most, while medium enterprises do so the least, and rural enterprises struggle more than urban ones. However, while MSMEs would certainly benefit from electricity access, the lack thereof is not nearly as great a concern as that of access to finance (sourcing money) in most cases.

The low importance of access to electricity reported by MSMEs relative to other business constraints may mean that although there is a significant access deficit, uptake may be limited by low willingness to pay. However, while electricity access was not identified as the major constraint, it may be a widespread constraint that is relatively easy to address, compared to risk protection and access to credit.

In Madagascar, electricity is perceived as the second most important barrier to doing business after political instability.

There are however notable exceptions. In Madagascar, electricity is perceived as the second most important barrier to doing business after political instability. Small and medium sized businesses also experience an average 6.7 power outages per month with an average duration of 1.5 hours each (about 2.5 hours per week). Furthermore, high connection fees (USD 165 on average) make grid electricity unaffordable for many small businesses, while those that can afford grid electricity have to wait up to 18 months to get connected, which is unfavourable for the development of productive uses.

The challenges of serving the market for productive uses are threefold. Firstly, there is little readily available information on the potential size of the market or access deficit. Secondly, the market is more fragmented – i.e. different types of micro-enterprises need different types of energy solutions and it is more difficult to reach economies of scale in distribution. Thirdly, small and microenterprises have irregular income and often require broader assistance to generate a steady cash flow and become credit worthy (e.g. improvements in financial literacy and farming practices) in conjunction with improved energy inputs.

Although financial inclusion remains low for MSMEs, in countries like Malawi and Madagascar, they do have higher access than the general population, and access improved significantly from a previous survey in Malawi. However, access to credit and insurance products, in particular, are very low – in Madagascar, only 15% has any type of formal credit. In most cases, therefore, access to appropriate financial products for MSMEs in these income constrained countries would be a central part of an off-grid energy adoption strategy.

Potential to deploy off-grid power solutions for productive applications

The market for off-grid cleaner solutions for productive uses remains undeveloped, and a lot less is known about the potential market for cleaner off-grid power solutions for productive use than for the household segment. This is partly because existing programmes have focused on the deployment of Tier 1 solutions for household use, and partly because the market for productive uses is more fragmented and difficult to serve. As a result, there are very few energy service companies that are successfully addressing the market for productive applications.

Although a substantial proportion of MSMEs do not have access to electricity, this is not the main constraint to operating or growing a business. Rather, access to finance is a more pressing constraint to operating or growing a small business than electricity access. Projects aimed at deploying off-grid power solutions for productive applications are unlikely to be successful when MSMEs face barriers to accessing finance. This is because of supply-side issues for financial services (small pool of MFIs for instance, with limited reach), but also because of the importance of accessing relevant finance to addressing potential affordability barriers to adopting off-grid solutions.

Although a substantial proportion of MSMEs do not have access to electricity, this is not the main constraint to operating or growing a business. Rather, access to finance is a more pressing constraint to operating or growing a small business than electricity access.

The market for off-grid solar for productive use is therefore determined by the affordability and accessibility of these solutions. However, at the levels of use found for MSMEs, off-grid solutions would have to be high capacity Tier 5 solutions (or as a minimum Tier 4 solutions). These systems cost significantly more than Tier 1 to 3 solutions, which can mostly just be used for lighting, charging phones, or maybe running a low powered appliance. Since the owners of MSMEs are typically not much better off financially than the average household, the market for off-grid solar for productive uses (which are typically much more expensive than basic Tier 1 solar home systems for household use) are severely constrained by affordability.

Furthermore, a lack of providers in this space, as well as the proximity of MSMEs to existing grid infrastructure results in a general dearth of cleaner off-grid solutions for MSMEs. The problem with productive applications is that they are context and case-specific – the solution required will depend on where the farmer is, what crops they grow, what inputs they have access to, etc.

Based on the lack of sophistication of MSMEs, and the fact that many of them operate on the street, the opportunity for large-scale deployment off-grid power solutions appears low. Nevertheless, there is evidence that MSMEs are interested in alternative energy sources, and willing to invest in these if access to finance can be obtained. Based on the profile of MSMEs in these countries, there may also be scope for niche productive applications.

Off-grid solar power could greatly support the agriculture sector and other income-generating productive uses for rural development in all five countries. Irrigation is one of the areas where off-grid solar could play a major role in promoting sustainable rural development. Mozambique for example 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.

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

While it's obvious that irrigation will assist farmers in improving their yield, smallholder farmers need a lot of support. The co-founders of SunCulture note that while the price of the cheapest solar-powered irrigation kit has fallen sharply from USD 5,000 in 2013 to USD 500 in 2018 (for the *Rainmaker2* excluding battery costs), affordability remains a challenge. The upfront deposit required is about USD 70 and monthly instalments are in the region of USD 30 for 18 months. SunCulture customers in Kenya who have used a Rainmaker to irrigate maize reported a doubling of their yield which meant an additional USD 600 in revenue per acre per year, making irrigation affordable. However, it was not affordable before irrigation, so the upfront cost could be unaffordable.

The One Acre Fund (OAF) has a lot of experience in supporting the development of small-scale farmers in Malawi, Zambia, and East African countries. OAF has recognised that there was no single solution to the challenges that small-scale farmers face and they offer a complete package of support including asset-based loans for high-quality seed and fertiliser, delivery of the inputs to a location within walking distance, and trading and market facilitation (e.g. crop storage and education).[11] OAF provides credit primarily for seed and fertiliser, but also offers a range of additional add-ons including solar lights. OAF closely tracks monthly spending on kerosene, flashlight batteries, cell phone charging, and other related expenditures to understand the amount of savings a solar lamp provides at each price point. They price the lights at a level that generates energy cost savings of between USD 0.45 and USD 0.70 a day in Kenya and Rwanda.[12] It appears the OAF has piloted the use of solar pumps but the solutions, such as the RainMaker2 with a 310 watt roof-mounted panel, costs roughly about USD 500 and would still be unaffordable, even on an instalment payment basis for the majority of small-scale and subsistence farmers.

11 One Acre Fund
12 One Acre Fund

Figure 11: Potential uses of off-grid solar energy in agriculture (not-exhaustive)
Source: World Bank. 2019.

There are generic productive applications that leverage off-grid solar energy in the agriculture space (Figure 11). A study of these applications by the World Bank suggests that water pumps are most ready to scale, cooling solutions are relatively expensive, and agro-processing units are still at the pilot stage. The market readiness of productive uses that leverage solar technology varies significantly depending on the use case and associated energy consumption and system requirements.[13] Understanding market readiness in countries will require an analysis of the energy needs of (for instance) farmers to design appropriate products.

A pilot project to provide retail and service MSMEs in Malawi access to electricity from standalone solar systems (SOGERV) demonstrated that there is demand and willingness to pay for basic services that require electricity as an input. Electricity services with the highest potential in the pilot villages include phone and battery charging services and supplying wired electricity connections for lighting and basic appliances to co-located micro-enterprises (e.g. cold drink vendors, barbershops, video shows and hardware stores).[14]

The results suggest that few Malawian MSMEs could afford to rent standalone solar home systems capable of powering refrigerators, basic appliances and shop lighting at a monthly price of between USD 20 and USD 27. Wired connections at a cost of USD 14 per month, however, appeared to be affordable.[15] The monthly earning potential of energy supply companies appears to be in the region of USD 60 based on income from four wired connections to co-located micro-enterprises and income of roughly USD 5 per month from battery and phone charging services.

With the decreasing costs of solar PV hardware, battery storage and metering technology, there is an opportunity to hybridize and densify existing systems

13 World Bank. "The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" p. 9

14 Frame, Dauenhauer, Eales *et al.*, "Experiences from Deploying Solar PV Energy Businesses in Rural Malawi" p.16

15 Frame, Dauenhauer, Eales *et al.*, "Experiences from Deploying Solar PV Energy Businesses in Rural Malawi" p.16

and build new solar-powered mini-grids that could promote both rural economic development and electricity access.

In Lesotho, some MSMEs are involved in "accommodation and food service activities", and where they are operating in rural areas, there is an opportunity for a positive externality to stem from the existing deployment of solar lanterns, solar kits, solar home systems, and mini-grids.

A World Bank study on the opportunity for solar solutions for productive uses in Sub-Saharan Africa recommended that solar-powered or hybrid solar and diesel multifunctional platforms (MFP), as is common in West Africa, be introduced to equip small business in Madagascar. It appears that this may feasibly be rolled out in the balance of the target countries.[16] Some energy service companies are already able to viably supply co-located micro-enterprises with access to electricity for lighting and basic appliances from a solar home system via wired electricity connections.

The MFP is a simple, inexpensive energy source at the village level that is built around a diesel or solar-diesel-hybrid electrical generator and which can power various tools, such as a cereal mill, husker, alternator, battery charger, pump, welding and carpentry equipment, etc. Several thousands of MFPs have gone into operation in West Africa in the last 20 years, creating local jobs and adding value to local production.[17]

However, even with decreasing technology costs and upfront capital expenditures, the business case for mini-grids such as MFP's remains tenuous because of limited ability to pay. The World Bank has suggested that mini-grids servicing both households and businesses may be more viable and noted that operation and maintenance remains a major issue particularly in the less accessible rural areas.

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16 World Bank, "Doing Business Survey: Madagascar, 2013-2014" p.8
17 World Bank, "Doing Business Survey: Madagascar, 2013-2014" p.12

8 / The market for off-grid solutions for households

Given the addressable market for off-grid energy solutions, it is useful to assess the current state of development in this market across countries and to demonstrate market potential and competition.

The market for off-grid cleaner energy products is small in all five countries. However, there are signs of new emerging market players and developments in technology that lower the barriers to entry and the upfront investment costs. Until recently, it consisted mostly of lanterns and other small products sold on a cash basis or through donor initiatives. However, there have been several recent market entrants in the clean energy space with a range of different products addressing various kilowatt outage. As a result, there are several types of products that address energy requirements to various degrees, many of which are available on credit (ranging from 6 to 30-month payment periods).

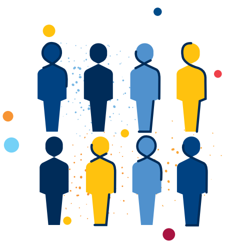
The market for off-grid cleaner energy products is small in all five countries. However, there are signs of new emerging market players and developments in technology that lower the barriers to entry and the upfront investment costs.

The easiest, entry level product is solar powered or battery powered light (Pico solar or lanterns). These are typically broadly available in all countries (and have been for longer) and can sometimes also be used to charge phones. A rechargeable light can cost as little as USD 6, while Pico solar solutions can be rented for USD 12 to USD 37 (Madagascar), or purchased for USD 42 (Malawi). Solar home systems are also increasingly becoming available, mostly Tier 1 products, that can run two to four lights, charge a phone, and sometimes allow for a radio. These can cost as little as USD 69, and as much as USD 204. Tier 2 products (or higher) are very limited, and much more expensive, although this can be used for four lights, charging a phone, and running a television. A standalone Tier 2 solar home system product is available in Malawi (USD 437 to 612), while Madagascar has a nano grid product, which links several solar home systems for more than one home. Cost varies depending on usage, but is typically between USD 58 to USD 237 per user per year – depending on the amount used. Lastly, Lesotho and Madagascar have mini-grids (Tier 2-3), but cost would also vary based on actual usage, as this is priced per kWh used. An SCP would cost USD 164 in Lesotho, and varies in Madagascar but could be as high as USD 292.

There are a larger number of companies or individuals involved in energy installation or distributors (for instance 71 in Malawi). Typically, most countries have a handful of providers that distribute solar home systems. The remainder are mostly trading in the plug-and-play household solar market and sell smaller lanterns. Energy service companies have typically been slow to enter these markets, as the perception was that the population was too poor on a GDP per capita basis, and the market was therefore too small. Furthermore, consumers are very price-sensitive and affordability is a major constraint. Providers have learned that consumers are astute and will not buy solar solutions if it costs them more than the existing alternatives (for instance candles, battery-powered torches or paying someone to charge a phone). Households in Mozambique, for example, currently pay around USD 10 per month for candles, batteries and phone charging. However, due to affordability, in some markets, financing solutions are required for even the most inexpensive of products such as daily rental of pico solar or rechargeable lights (Madagascar).

In both Madagascar and Lesotho, the government is supportive of developing off-grid solutions, both in terms of smaller solutions (such as Tier 1 to Tier 3 solar home systems and lanterns) and mini-grids (Tier 3 to 5). While a national strategy is being developed in Madagascar (for off-grid), in Lesotho, the government is waiting to asses a pilot project before allocating further resources to developing this regulatory framework. However, in the case of Lesotho, while the government is cognizant of the impact of a well-developed and regulated off-grid space, their main interest is the expansion of the current grid and building additional national generation capacity.

Barriers to the uptake of off-grid solutions across countries varies, but there are some commonalities. These include high distribution costs (particularly in remote rural areas), limited access to credit and financing alternatives, relatively low mobile penetration rates (and mobile money use), a lack of funding, and the lack of a regulatory environment conducive to the development of off-grid clean energy. Other constraints to the uptake of off-grid electricity include affordability and lack of skilled personnel to facilitate distribution, and import duties and taxes levied on imported solar home system solutions:



Economies of scale in some countries is problematic.

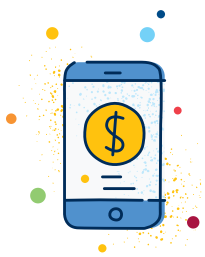
Given the population size of two of the countries, the potential market for off-grid solutions (the grid access deficit) in eSwatini and Lesotho is relatively small. While it would be difficult to achieve economies of scale for any specific clean energy product, these are ideal markets to test solutions especially in rural areas and at a community level to understand market uptake and switching from biomass to clean energy solutions. Limited private sector participation in the pico-solar PV, solar home system or mini-grid space is likely due to this difficulty in achieving economies of scale in distribution, especially given the fast pace and scale of electrification in both countries. However, in both countries, off-grid solutions may be required, and could also be the least cost option, given that the remaining areas that are not electrified are also the hardest, and most costly to reach.

High-distribution costs.

The key to a viable operation selling standalone off-grid solutions in Southern Africa is minimising the cost of last-mile distribution. The low population density in Southern African countries (relative to East and West African countries) means that distribution is a significant cost as the large physical distances between customers is a challenge for both sales and after-sales service. An additional difficulty is that the remaining unelectrified population in most countries are increasingly rural, and increasingly in remoter and harder to reach areas. For instance, in Lesotho, the mountainous nature of the country renders many villages relatively inaccessible. While solar home systems offer solutions for such areas, the cost of reaching these areas for distribution, as well as maintenance, are much higher. Typically, solar home systems are set-up by installers who are urban-based. When these systems malfunction, replacement parts and repairs are not easy to dispatch and apply, again pushing up costs.

Limited financial solutions to offer alternatives to the cash and daily rental/PAYGO models.

One of the most important dimensions of the enabling environment for off-grid cleaner energy solutions is the extent to which people can access finance to purchase these products. Given relatively large upfront costs of the products relative to income in developing countries, few consumers can buy the solutions on a cash-basis and rely on either daily or monthly rentals (PAYGO), access to credit from microfinance providers or through instalment payment mechanisms paid to providers. However, as noted, access to credit is particularly low across almost all five countries (and more so in rural areas), while the cost of credit is high, and therefore there are currently limited alternative financing mechanisms for larger products like solar home systems. The cost of formal credit is lower, but access to bank credit is very constrained - banks target high-net-worth individuals and do not provide loans for solar home systems. They also require forms of collateral that most of the unelectrified population are unlikely to have (e.g. land). MFI's can potentially play a bigger role in this space, given their rural infrastructure footprint, but currently, at least in some countries, they typically target a narrow band of salaried employees, who are likely to already have electricity access, or they provide finance at one level below which the banks provide and one level above what is required for Tier 1 solar customers.



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

Another barrier to the uptake of both PAYGO and alternative financing models is the relatively low penetration of mobile phones in Cluster 1 countries, the relatively low update of mobile money in all countries (despite high growth), and the lack of reliable mobile coverage in rural areas. The cost and availability of mobile money services is another barrier, especially given demand-side factors, like income and affordability. Although mobile money can facilitate clean energy sales, people who cannot afford a mobile phone are also less likely to be able to afford a solar product.

Regulatory environment currently not conducive to higher tier off-grid solutions.

The current regulatory environment in most countries is not conducive to the development of off-grid solutions, and in particular utility-scale IPPs and mini-grids. While the returns on mini-grids are similar to that of a utility-scale or IPP project, the issue is trying to fund their development because the risk profile is significantly higher. After all, the off-taker is not the government but a community of rural households. The tariffs that mini-grids can charge are often regulated (and sometimes even subject to community approval) and typically not enough to provide the investor with an adequate return for the underlying risk. The lack of cost-reflectivity of grid electricity or adequate legal guarantees for private investors, as well as authorisation procedures for mini-grid projects, also act as a deterrent to private investors in alternative solutions. As a result, most activity in this space remain donor funded. Government will need to work towards establishing a regulatory framework and business model that can attract the private sector into this space. In some countries, government is developing new regulations to this affect, while others are waiting for proof of concept from donor projects on off-grid solutions.

Lack of appropriate quality standards for lower tier clean energy solutions.

Most governments do not require imported standalone solar PV systems to meet any quality standards, nor do they have standards to control the quality of installation, operation and maintenance of such products. As a result, the market is experiencing an increasing influx of low-quality products. There are also no systems in place for the accreditation of installers. This could lead to poor quality imports and installations, which could have a shorter lifespan. Malfunctioning equipment, without proper maintenance support from suppliers, can also undermine trust in clean energy solutions, especially given the affordability issues (and comparatively high cost) of such solutions for the low end of the market. Furthermore, value-added tax (VAT) rules do not differentiate between levels of quality in applying for exemptions. This contributes to a large supply of low-quality solar products and equipment, damaging the product image for solar home systems in domestic markets. The VAT exemption is inconsistently applied and fines are inconsistently enforced. In some countries, donors are working with government to put quality standards in place, but in others, even where regulation is being considered for off-grid, this mostly focus on mini-grids, and there is currently no regulation planned for smaller pico solar or solar home system solutions.

9 / Investment case for cleaner off-grid solutions

Given the fast approaching SDG deadline, and that around 70 million people in these five countries are likely to be left behind, it is necessary to draw in broader support in the achievement of the goal of access to energy.

Our analysis demonstrates that people already spend money on alternative energy sources, and even people who already have access to energy only use it for specific applications. Higher energy use cases are more likely to be met through alternative, cheaper energy sources. Although access to electricity is expanding, and will continue to do so, there is also a rural/urban divide, which will be difficult to breach before 2030.

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However, market, public and development investment can be leveraged to provide access to cleaner alternatives – where it makes sense (where it fills specific gaps), and based on a thorough understanding of consumer realities and needs, as illustrated in this report. This can allow for a greater number of people being included by 2030 – if investment catalyses relevant products that both speak to the needs of consumers, as well as fits specific market gaps. The latter is informed by countries options for least cost electrification, while the former also need to take consumer affordability into account. In order to adhere to the SDGs, solutions also need to be clean (energy). In addition to electricity grid extension, clean energy mini-grids, as well as solar home systems or pico solar products therefore offer opportunities.

In each of the countries, the options for least cost electrification has been assessed by donors and/or government. These options can be classified as long-term least cost electrification. Based on the current rate of electrification in each country though, in relation to the 2030 deadline for the SDGs, the short-term electrification focus for each country may be different to the long term least cost electrification options.

Grid electrification appears to be the least cost electrification option in all countries except Madagascar (where mini-grids and solar home systems are the best options) over the longer term (more than 15 years). However, in all four countries where grid is the least cost option, both mini-grids and solar home systems have a role to play in the longer term, but also over the short term. For instance, in Lesotho, mini-grids make sense for over a third of the population –

those in more remote and mountainous areas. Similarly, in eSwatini, mini-grids are being considered for isolated rural communities. In Mozambique, 25% of the population can benefit from mini-grids and solar home systems, while in Malawi, even though only 5% of the population lives more than 10km from the grid, many will wait longer than 10 years to be connected due to the slow rate of electrification. In all five countries, solar home systems, and by extension pico solar, can play a larger role over the short-term, while mini-grids will play a larger role in the short term in countries like Mozambique and Malawi – where higher grid electrification will take many years to achieve.

While mini-grids offer opportunities in all five countries in the short term, their application to date indicates that they are more suitable for niche markets, including that of MSMEs. In the longer term, countries like Lesotho and Madagascar also offer opportunities for the use of mini-grids. In other words, there are opportunities for MSMEs (see section 8.3), and opportunities for households.

Countries with large populations and low electricity access rates have large access deficits and, consequently, large potential for the off-grid market. Mozambique and Madagascar have the largest potential off-grid markets, closely followed by Malawi. The potential markets in Lesotho and eSwatini are much smaller by

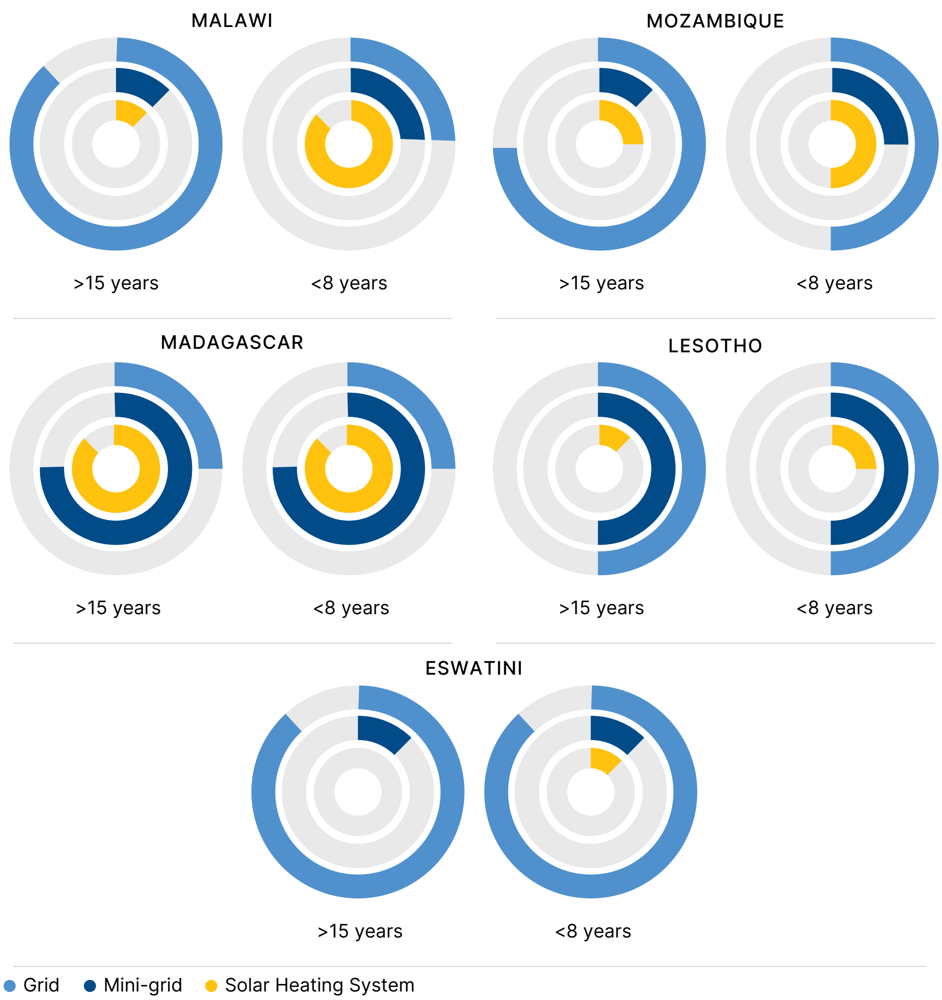


Figure 12: Least-cost electrification options versus short term focus across countries

Source: Nova Economics – based on World Bank and country master plans comparison as populations are smaller and grid access rates (particularly in eSwatini) are much higher. Given the size of the access deficit in each country, as well as the importance of solar home systems in both the short and long term, Mozambique, Madagascar and Malawi offers the largest market opportunities for investing in solar home systems as a means of addressing the access deficit.

The least cost options across countries also speak indirectly to the needs and realities of users. While grid electricity could, if functioning properly provide electricity from Tier 1 to 5, mini-grids are often more appropriate for use between Tier 2 and 4. Solar home systems on the other hand mostly speak to Tier 1 to 3 (but most often only Tier 1 and 2), while pico solar solutions only speak to Tier 1. We also know from the demand-side analysis that electricity users from Tier 1 to Tier 3 are less likely to use electricity for higher energy uses like cooking, and much more likely to use it for lower energy uses like lighting and charging a phone. We further know that most who do have access are in fact in these lower tiers. While waiting for grid electricity access, solar home systems and pico solar products should be able to address the current/short term needs of most users. Off-grid solar is also a far cleaner source of energy compared with lighting alternatives like kerosene, enabling the promotion of climate and health-related SDGs as well.

However, given the income and employment realities described in this report, affordability remains the single largest barrier to the use of particular energy sources for particular use cases. It is therefore essential to size the market for lower tier solar home system and pico solar products. However, even common Tier 2 solar home system products are too expensive (costing around USD 200 per year) for almost all these countries (with the exception of eSwatini). There is, however, a clear incentive for households to purchase small solar home systems as they can replace candles and paraffin typically used for lighting and phone charging services which currently cost about USD 6 to USD 10 per month in the respective countries.

We limited our assessment to the market for standalone Tier 1 solutions. This limits options to solar home systems and pico solar products. 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 Tier 1 solutions currently available in the five markets:

Option 1 - Tier 1 SHS solution or 'pico-solar' solution

The cost of these solutions varies between USD 42 and USD 69 across the five markets, providing a low-end solution with three lights and charging solution. This is typically sold for cash but we assumed it could be sold on an instalment basis over a maximum repayment period of 12 months.

Option 2 - high-end Tier 1 Solar Home System

Package includes four lights, a mobile device charger, and possibly a low power appliance (e.g. radio) with a purchase price of USD 102 to USD 150 per year over a 24-month repayment period.

Table 6: Typical standalone Tier 1 SHS solution

SOLUTION	BENCHMARK PRICE (USD)	FUNCTIONALITY
Pico-solar (low-end)	42 to 69	Up to three lights and mobile device charging
Basic SHS (high-end)	102 to 105	Four lights, mobile device charging, low power appliance (e.g. radio)

Source: Own analysis

The addressable market for Tier 1 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. Based on the monthly instalment on the two product options above (which would be more affordable than the cash price as a proportion of monthly income), we could estimate the proportion of each population that would fall in certain affordability thresholds. We considered an affordability threshold for these two products of 15%. In other words, this would apply to the proportion of the population that earns enough monthly income that the noted instalments would be 15% of their monthly income or less. This threshold is higher than the ESMAP/SEforALL multi-tier framework measures for the affordability of grid electricity, but rather based on typical monthly total energy expenditure as a portion of income in comparable countries.

Table 7: Proportion of population in each country that can afford option 1 & 2 Tier 1 Pico solar and SHS products

COUNTRY	PROPORTION THAT CAN AFFORD OPTION 1	PROPORTION THAT CAN AFFORD OPTION 2
Malawi	19%	8%
Mozambique	23%	11%
Madagascar	33%	29%
Lesotho	30% to 61%	30% to 61%
eSwatini	59%	56%

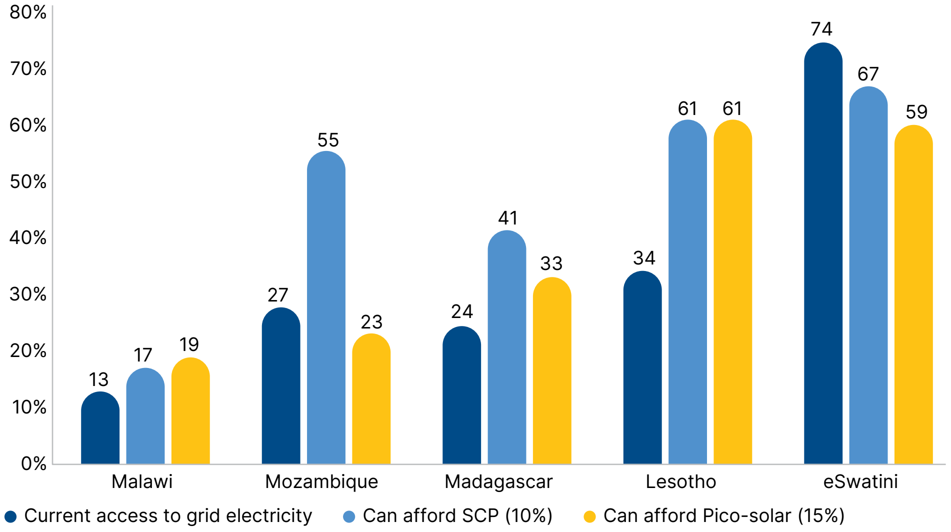


Figure 13: Access to grid electricity versus affordability of grid electricity and alternatives
Source: Most recent FinScope surveys for each country.

Based on the affordability analysis of Tier 1 products across countries, the market opportunities for off-grid becomes clearer. For instance, in Malawi – there are more people that can afford grid electricity (17%) than currently have access (13%), but there are even more people that can afford a Option 1 off-grid product (19%). This is also the case in Madagascar and Lesotho – where the proportion who do not have access to grid electricity but can afford the cheapest of grid option (Option 1) is 9% and 27%. However, in Mozambique – affordability of off-grid options is less than the affordability of grid access. Although there would still be a need in the short and medium term for such products – affordability would need to be addressed in order to develop a viable market. In eSwatini, affordability of off-grid is also less than for grid, but in this case, the current rate of grid expansion is sufficient to reach the 2030 goal of universal access. For remote rural villages though, off-grid may still be an option – but affordability may be an issue.

The SDG7 for 2030 is of course not to get everyone to Tier 5, but simply to get them on a Tier – the minimum being Tier 1. In addition to the size of the opportunity, there are several other recommendations arising from the diagnostics that can help catalyse the off-grid market in some or all of the five countries. These include:

Potential to investigate regional equipment manufacturing.

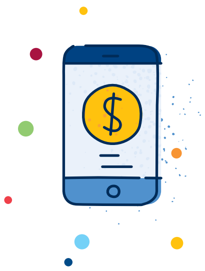
There are strong regional dependencies on electricity provision already in the region with South Africa providing a large amount of the access to countries. Given the existing relationships, there is a strong potential to create regional relationships for clean energy solutions, including local manufacture of equipment to bring down equipment costs, regional financing mechanisms, and leveraging the existing prevalence of strong national banks operating across the region.

Potential for agent distribution.

Some providers have overcome distribution problems by partnering with local entrepreneurs who act as agents that facilitate last-mile distribution (both sales and after-sales servicing). However, population density is still a factor. An agent selling Tier 1 systems needs to be able to reach at least 1,000 households within a 5 to 10 km radius for the agent economics to work. If the population density is lower than this, it will be difficult to run a profitable agency.

Potential for partnerships in distribution.

There may be an opportunity for microfinance providers to partner with electricity service companies that currently provide solutions on a PAYGO basis as they may be able to leverage the PAYGO providers distribution networks to profitably serve a segment of the market that was not previously served.



Potential to leverage mobile payment solutions.

Given growing numbers of mobile phone subscribers, as well as mobile money users, which in most cases is greater than the proportion of the population that have access to electricity, there are opportunities to expand access through mobile payment solutions. PAYGO solutions could therefore be a viable solution for consumers to finance purchases of off-grid solutions.

Acronyms and abbreviations

AFDB	African Development Bank
CGAP	Consultative Group to Assist the Poor
CO2	Carbon dioxide
ESCOM	Electricity Supply Commission of Malawi
ESMAP	Energy Sector Management Assistance Program
GDP	Gross domestic product
GOGLA	Off-Grid Solar Energy Industry
Gt	Gross tonnage
HDI	Human Development Index
IPPs	Independent power producers
kW	Kilowatts
kWh	Kilowatt-hour
LDCs	Least Developed Countries
LPG	Liquefied petroleum gas
MAP	Making Access Possible
MFI	Microfinance institution
MFP	Multifunctional platforms
MSME	Miro, small, and medium sized enterprise
MW	Megawatts
OAF	One Acre Fund
PAYGO	Pay-as-you-go
SADC	Southern African Development Community
SAPP	Southern Africa Power Pool
SCP	Standard consumption package
SDGs	Sustainable Development Goals
SEforALL	Sustainable Energy for All
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
VAT	Value-added tax
Wh	Watt-hour

List of references

African Development Bank. *Mozambique Country Strategy Paper 2018 - 2022*. African Development Bank (2018).

Anenberg, Susan C, Daven K Henze, Forrest Lacey, Ans Irfan, Patrick Kinney, Gary Kleiman, and Ajay Pillarisetti. "Air Pollution-Related Health and Climate Benefits of Clean Cookstove Programs in Mozambique." *Environmental Research Letters* 12, no. 2 (2017): 025006.

Baez, Javier Eduardo, German Daniel Caruso, Chiyu Niu, and Cara Ann Myers *Mozambique Poverty Assessment: Strong but Not Broadly Shared Growth*. World Bank Group (Washington, D.C.: 2018). http://documents.worldbank.org/curated/en/377881540320229995.

"Pay-as-You-Go." Baobab Group, 2020, https://en.baobabplus.com.

Baruah, Pranab, and Brendan Coleman. "Country Brief - Mozambique Off-Grid Solar Power in Mozambique: Opportunities for Universal Energy Access and Barriers to Private Sector Participation." (2018).

GGGI, *Off-Grid Solar Power in Mozambique: Opportunities for Universal Energy Access And barriers to Private Sector Participation*. Global Green Growth Institute (GGGI) (2019).

Bhatia, Mikul, and Niki Angelou. *Beyond Connections: Energy Access Redefined*. Energy Sector Management Assistance Program (Esmap). World Bank Group, The International Bank of Reconstruction and Development, 2015. doi:10.1596/24368.

Boardman, Brenda. *Fuel Poverty: From Cold Homes to Affordable Warmth*. Pinter Pub Limited, 1991.

Cenfri. *Financial Inclusion Diagnostic Findings: Map Madagascar*. FinMark Trust (2017). https://cenfri.org/map/madagascar/.

Finscope Micro, Small and Medium Enterprise Survey: Malawi. FinMark Trust (2012). http://www.finmark.org.za/wp-content/uploads/2016/01/FSMalawiMSME_Rep2012FNL1.pdf.

Finscope Consumer Survey Highlights: eSwatini. FinMark Trust (2018). http://finmark.org.za/wp-content/uploads/2019/05/FS_Consumer_eSwatini_English-2018-pocket-guide.pdf.

Finscope Micro, Small and Medium Enterprise Survey: eSwatini. FinMark Trust (FinMark Trust, 2017). http://www.finmark.org.za/wp-content/uploads/2018/06/FinScope_MSME_Report_eSwatini_2017.pdf.

Finscope Micro, Small and Medium Enterprises Survey: Lesotho. FinMark Trust (2016).

"Finscope Micro, Small and Medium Enterprise Data." FinMark Trust, 2020. https://i2ifacility.org/data-portal/msm-enterprises.

"Micro, Small and Medium Enterprise Survey: Malawi." In *FinScope MSME*, FinMark Trust, 2012. http://www.finmark.org.za/wp-content/uploads/2016/01/FSMalawiMSME_Rep2012FNL1.pdf.

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.

"The World Factbook." Madagascar, CIA, 2020, https://www.cia.gov/library/publications/resources/the-world-factbook/geos/ma.html.

"The World Factbook." Mozambique, CIA, 2020, 2020, https://www.cia.gov/library/publications/resources/the-world-factbook/geos/mz.html.

"The World Factbook " Lesotho, CIA, 2020, https://www.cia.gov/library/publications/resources/the-world-factbook/geos/lt.html.

Charron, Daba, Nick Lam, David Pennise, Todd Wofchuck, Nigel Bruce, Kristie Jagoe, Dan Pope, Steven Hunt, and Ewan Bloomfield. *Ethanol as a Household Fuel in Madagascar: health Benefits, Economic Assessment, and Review of African Lessons for Scaling Up*. Practical Action Consulting (2011). https://www.cleancookingalliance.org/resources_files/ethanol-assessment-madagascar-a.pdf.

Cipriano, Amilcar, Colin Waugh, and Mathikizana Matos. *The Electricity Sector in Mozambique: An Analysis of the Power Crisis and Its Impact on the Business Environment*. United States Agency for International Development (USAID) (2015). https://www.powerutilityleadership.com/wp-content/uploads/2018/02/Mozambique_Power_Crisis.pdf.

Clean Start Programme. *2018 Progress Report & 2019 Plan*. United Nations Capital Development Fund (UNCDF).

D'Hoore, Alain, Victor Sulla, Patrick Randriankolona, Dominique Van Der Walle, Giovanni Vecchi, Nicola Amendola, and Marina Sorrentino. *Face of Poverty in Madagascar*. World Bank Group (2014).

Department of Energy Affairs (Republic of Malawi). "Malawi Rural Electrification Programme (Marep)." (2020). https://energy.gov.mw/index.php/services/rural-electrification-programme.

Eichleay, Marga, Hannah Skelly, Dominic Nyasente, and Hilda Kiritu. *Mozambique Mobile Access And usage Study: Household Survey Results*. Mobile Solutions Technical Assistance and Research (mSTAR) (2016).

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

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

Enclude BV. *Off-Grid Solar Market Assessment Madagascar*. World Bank Group (2018). https://www.lightingafrica.org/wp-content/uploads/2020/01/Madagascar-Off-Grid-Market-Assessment-Report.pdf.

"Mozambique Energy Situation." EnDev, 2020, https://energypedia.info/wiki/Mozambique_Energy_Situation.

"Current Tariffs." ESCOM, 2018, http://www.escom.mw/current-tariffs.php.

"Electricity Management Program: Southern Region." 2020, http://www.escom.mw/electricity-management-south.php.

eSwatini Electricity Company. *Annual Reports*. (2009 - 2019). http://www.eec.co.sz/aboutus/reports/index.php.

"Eec Planned Major Capital Projects." 2018, http://www.eec.co.sz/projects/index.php#4.

———. "Planned Power Outage Notification." (2020). http://www.eec.co.sz/media/notices/index.php.

———. *Tariff Increase Proposal for the Financial Years 2020/21 and 2021/22*. (2018). http://www.sera.org.sz/administrator/files/1576909964.pdf.

Fehrenbach, Simone. *Energising Development - Phase 2: Annual Planning*. EnDev (2019). https://endev.info/content/File:Annual_Planning_2019_final_short_version.pdf.

Fenix. *Para Comprar O Sistema Solar Fenix Power O Cliente Deve Ter*. 2019.

Fernandez, David, and Ralf Tobich. *Formulation of the Lesotho Electrification Master Plan: Off-Grid Master Plan Report*. AETS Consortium, European Union (2018). https://nul-erc.s3.amazonaws.com/public/documents/reports/lesotho-electrification-master-plan-off-grid-1532184941.pdf.

Frame, Damien, Peter Dauenhauer, Aran Eales, and Stuart Galloway. "Experiences from Deploying Solar Pv Energy Businesses in Rural Malawi." *Energising the Sustainable Development Goals Through Appropriate Technology and Governance* (2019).

Frey, Adrian. "Solar Power to Deliver Electricity to 300,000 Families - Mozambique." (2019). https://clubofmozambique.com/news/solar-power-to-deliver-electricity-to-300000-families-mozambique/.

"Energy Sector: Madagascar." 2016, https://www.get-invest.eu/market-information/madagascar/energy-sector/.

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

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

Gogla. "Usaid-Power Africa Solar Home System Kick-Starter Program for Malawi." (2019). https://www.gogla.org/usaid-power-africa-solar-home-system-kick-starter-program-for-malawi.

Green Climate Fund (GCF). *Nda Strengthening and Country Programming Support for Lesotho through Dbsa*. (2018). https://www.greenclimate.fund/publications.

Handforth, Calum, and Matthew Wilson. *Digital Identity Country Report: Malawi*. GMSA (2019). https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/02/Digital-Identity-Country-Report.pdf.

Hewitt, Joseph, Charlotte Ray, Sarah Jewitt, and Mike Clifford. "Finance and the Improved Cookstove Sector in East Africa; Barriers and Opportunities for Value-Chain Actors." *Energy policy* 117 (2018): 127-35.

Hussain, Mustafa Zakir, Isabel Neto, Mariano Salto, Ewa Klimowicz, and Meer. Marial. *Mozambique Energy Sector Policy Note*. World Bank Group (Washington, D.C.: 2015). http://documents.worldbank.org/curated/en/135711468180536987.

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

International Bank for Reconstruction and Development. *Project Appraisal Document on Network Reinforcement and Access Project (P166170)*. World Bank (2019). http://documents.worldbank.org/curated/en/232091560442722757/pdf/eSwatini-Network-Reinforcement-and-Access-Project.pdf.

IRENA. *Renewables Readiness Assessment: Swaziland*. (2014). https://www.irena.org/.

"Tarification-Electricité." 2018, http://www.jirama.mg.

Kammila, Srilata, Jan Kappen, Dana Rysankova, Besnik Hyseni, and Venkata Ramana Putti. *Clean and Improved Cooking in Sub-Saharan Africa: A Landscape Report*. World Bank Group (Washington, D.C.: 2015). https://openknowledge.worldbank.org/handle/10986/22521.

Kapatuka, Nellie. "Government Committed to Providing Rural Malawians with Electricity." (2017). https://www.manaonline.gov.mw/index.php/business/item/4775-government-committed-to-providing-rural-malawians-with-electricity.

Kapika, Joseph Mwelwa. *Environmental and Social Commitment Plan - Network Reinforcement and Access Project*. World Bank Group (Washington, D.C.: 2019). http://documents.worldbank.org/curated/en/389311556882204896/Environmental-and-Social-Commitment-Plan-Network-Reinforcement-and-Access-Project-P166170.

Korkovelos, Alexandros, Babak Khavari, Andreas Sahlberg, Mark Howells, and Christopher Arderne. "The Role of Open Access Data in Geospatial Electrification Planning and the Achievement of Sdg7: An Onsset-Based Case Study for Malawi." *Energies* 12, no. 7 (2019): 1395. https://www.mdpi.com/1996-1073/12/7/1395.

Larcombe, Kathryn, 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.

Larkin-Connelly, Brendan, Deborah Ong, Dillan Patel, and Chris Parcels. *Scaling-up Renewable Energy in the Kingdom of Lesotho*. DH Infrastructure (2017). https://dhinfrastructure.com/wp-content/uploads/2018/10/srep_investment_plan_lesotho.pdf.

Lesotho Electricity Company. *Annual Report 2016 - 2017*. Lesotho Electricity Company. https://www.lec.co.ls/Documents/Publications/LEC%20Annual%20Report%202016%20-%202017.pdf.

LEC, *Schedule of Tariffs and Charges*. Lesotho Electricity Company, 2019.

Lighting Global. *The Market Opportunity for Productive use Leveraging Solar Energy (Pulse) in Sub-Saharan Africa*. International Finance Corporation (IFC) (Washington, D.C.: 2019). https://www.lightingglobal.org/wp-content/uploads/2019/09/PULSE-Report.pdf.

Matsoso, Sebolelo. "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.

Mayer-Trasch, Lucius, Mohua Mukherjee, and Kilian Reiche. *Productive Use of Energy-Produse: Measuring Impacts of Electrification on Small and Micro-Enterprises in Sub-Saharan Africa*. GIZ, 2013.

Micro Finance Unit, and Micro Finanza Rating. *State of the Micro Finance Sector in Swaziland*. Government of eSwatini (2016). http://www.cfi.org.sz/download/state-of-the-microfinance-sector-in-swaziland-final-report-august-2016/.

Ministry for Land, Environment and Rural Development (Republic of Mozambique). "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.

Ministry of Natural Resources and Energy of the Government of eSwatini. *Kingdom of eSwatini Energy Masterplan 2034*. (2018). http://sera.org.sz/administrator/files/1550235366.pdf.

Mokveld, Kees, and Steven von Eije. *Final Energy Report Mozambique*. Netherlands Enterprise Agency (2018). https://www.rvo.nl/sites/default/files/2019/01/Final-Energy-report-Mozambique.pdf.

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

"Momo Help." 2020, http://www.mtn.co.sz/momo/help/.

"Mozambique: Economic and Political Overview." 2020, https://www.nordeatrade.com/en/explore-new-market/mozambique/trade-profile.

One Acre Fund. "Insights Library." (2020). https://oneacrefund.org/insights-library/.

Pueyo, Ana. "The Evidence of Benefits for Poor People of Increased Renewable Electricity Capacity: Literature Review." (2013).

Pueyo, Ana, and Mar Maestre. "Linking Energy Access, Gender and Poverty: A Review of the Literature on Productive Uses of Energy." *Energy Research & Social Science* 53 (2019): 170-81.

Puri, Manas. *How Access to Energy Can Influence Food Losses. A Brief Overview*. FAO, 2016.

Reserve Bank of Malawi. *National Payment Systems (Nps) Report- Fourth Quarter 2019*. Reserve Bank of Malawi. https://www.rbm.mw/Home/GetContentFile/?ContentID=35444.

Styvanley, Dias. "Madagascar: $150 Million to Increase Access to Electricity Services for Households, Enterprises, and Health Facilities." (2019). https://www.worldbank.org/en/news.

Thom, Mia, Barry Cooper, Jeremy Gray, Catherine Denoon-Stevens, Albert van der Linden, and Tyler Tappendor. *Demand, Supply, Policy and Regulation: Diagnostic Report*. Centre for Financial Regulation and Inclusion (CENFRI) (FinMark Trust, 2015). http://finmark.org.za/wp-content/uploads/2019/04/Malawi_Diagnostic_2015.pdf.

Trimble, Chris, Masami Kojima, Ines Perez Arroyo, and Farah Mohammadzadeh. *Financial Viability of Electricity Sectors in Sub-Saharan Africa: Quasi-Fiscal Deficits and Hidden Costs*. World Bank Group, 2016.

United Nations. "Achieving Targets on Energy Will Help Meet Other Sdgs." (2019). https://eswatini.un.org/

en/30307-achieving-targets-energy-will-help-meet-other-sdgs.

United Nations Development Programme. *Inequalities in Human Development in the 21st Century*. (2019). http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/MDG.pdf.

United Nations Environment Programme (UNEP). *Review of Woodfuel Biomass Production and Utilization in Africa: A Desk Study*. Environmental Pulse Institute (EPI) (2019). https://wedocs.unep.org/bitstream/handle/20.500.11822/28515/WoodfuelRpt.pdf.

"Power Africa Fact Sheet: Madagascar." 2020, https://www.usaid.gov/powerafrica/madagascar.

WEC, FAO. "The Challenge of Rural Energy Poverty in Developing Countries." Londres, 1999.

Willcox, Mary, A Pueyo, L Waters, R Hanna, H Wanjiru, D Palit, and KR Sharma. "Utilising Electricity Access for Poverty Reduction." *Practical Action Consulting (PAC), Institution of Development Studies (IDS), The Energy and Research Institute (TERI): Rugby, UK* (2015).

Williams, Aled. *The Mozambique Hidden loans Case: An opportunity for Donors to Demonstrate Anticorruption Commitment*. Chr. Michelsen Institute (CMI) (2018).

World Bank. *Comparing Business Regulation for Domestic Firms in 190 Economies - Economy Profile of North Macedonia*. World Bank Group (Washington, D.C.: 2019). http://documents.worldbank.org/curated/en/617871575018593658.

World Bank. "Gini Index (World Bank Estimate)." edited by World Bank Group, 2012. https://data.worldbank.org/indicator/SI.POV.GINI.

World Bank, *Lesotho Renewable Energy and Energy Access Project (P166936)*. World Bank Group (Washington, D.C.: 2020). http://documents.worldbank.org/curated/en/808341580698850813.

World Bank. *Madagascar - Electricity Sector Operations and Governance Improvement Project: Additional Financing*. World Bank Group (Washington, D.C.: 2018). http://documents.worldbank.org/curated/en/656871529206294346.

World Bank, "Madagascar - Overview." World Bank Group, 2020, https://www.worldbank.org/en/country/madagascar/overview.

world Bank. *Madagascar - Smarter Regulations for Small and Medium-Size Enterprises: Comparing Business Regulations for Domestic Firms in 185 Economies* World Bank Group (Washington, D.C.: 2012). http://documents.worldbank.org/curated/en/519011468053368548.

World Bank. *Malawi - Electricity Access Project (P164331)*. World Bank Group (Washington, D.C.: 2019). http://documents.worldbank.org/curated/en/520771561341715792.

World Bank *Mozambique - Energy for All (Proenergia) Project*. World Bank Group (Washington, D.C.: 2019). http://documents.worldbank.org/curated/en/594061554084119829.

Zhou, Peter P., and Tichakunda Simbini. *Rapid Assessment and Gap analysis for Lesotho*. Sustainable Energy for All (SE4All) (2012).

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