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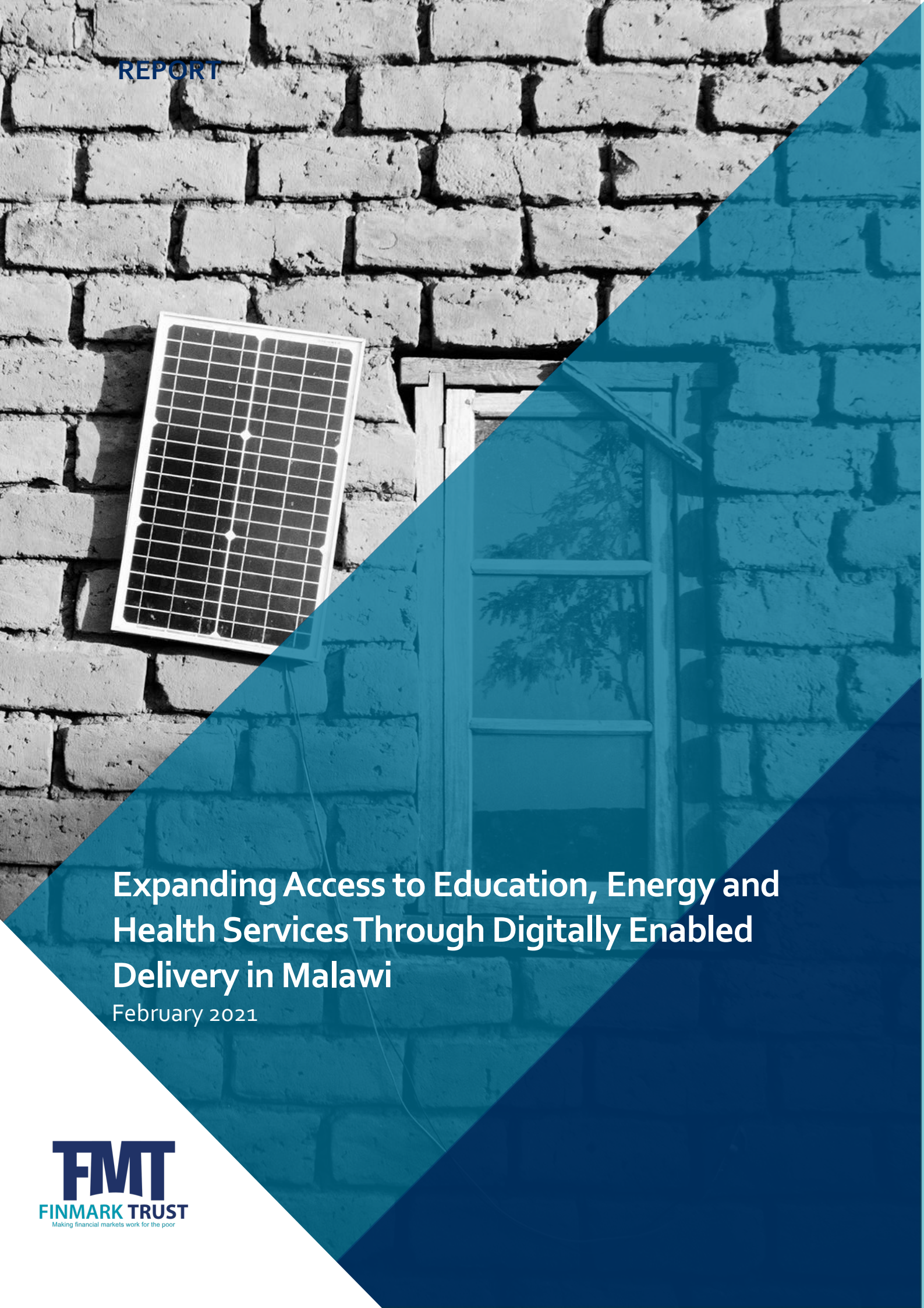

Expanding Access to Education, Energy and Health Services Through Digitally Enabled Delivery in Malawi

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FINMARK TRUST
Making financial markets work for the poor

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About FinMark Trust

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'. We pursue our core objective of making financial markets work for the poor through two principle programmes. The first is through the creation and analysis of financial services consumer data to provide in depth insights on both served and unserved consumers across the developing world. The second is through systematic financial sector inclusion and deepening programmes to overcome regulatory, supplier and other market level barriers hampering the effective provision of services. Together, these programmes unlock financial inclusion and sector development through a symbiotic relationship between rigorous data collection and research activities. Our work can be found in South Africa, throughout the SADC region and the global arena.

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Access to Basic Services – 1 of 5 reports

Innovative programmes are required to help the poor rise out of long-term poverty and link vulnerable communities to services that build their human capital, like health and education. Affordable and more easily accessible access to basic services is likely to increase productivity, enabling individuals and households to strengthen and diversify their livelihoods.

This study focuses on five countries in the SADC region – Botswana, Lesotho, Madagascar, Malawi and Eswatini.

This scoping study has been conducted to identify the barriers and opportunities to enable affordable digital delivery and access to basic services.

- **Purpose:** New and existing knowledge is developed and utilised to improve access to education, health and clean energy service delivery systems.
- **Overall objective:** To generate insights from selected countries about the countries' landscape across these basic services and to identify blockages, partners and potential digital interventions that will broaden access.
- **COVID-19:** Align with COVID-19 recovery strategies and policies at a country level and identify intervention areas to support COVID-19 recovery.

CONTENTS

List of boxes

List of figures

List of tables

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Executive summary

Broad-based access to quality basic services such as **clean energy**, **health** and **education** is important to Malawi's quest to achieve the 2030 Sustainable Development Goals (SDGs). Yet the country faces many development challenges that make this hard to achieve. Malawi continues to rank amongst the poorest countries in the world. Approximately half of the population live below the poverty line, and 80% live in rural areas that are poorly served. Fiscal and infrastructure constraints play out across each of the three basic services sectors:

- In **energy**, distance to the grid is not a major constraint: more than 95% of the Malawian population live within 10km of the grid and 40%–45% live within 1km of existing power lines. Yet, Malawi is one of the least electrified countries globally, mainly due to a lack of capacity to efficiently connect households to the national grid.
- In **health**, underfunding, distance to service facilities, lack of coordination, limited essential supplies, technical staff shortages and dilapidated infrastructure all challenge the roll-out of quality health services.
- In **education**, completion rates at primary and secondary level are low, relative to comparative global statistics and vary significantly depending on the poverty status of learners. The COVID-19 pandemic has accelerated the need for more rapid digital transformation.

Given this context, this study set out to assess what the scope is for *digitally enabled delivery models to enhance basic service delivery* in these three sectors in Malawi.

Digitally-enabled delivery models refer to a broad set of implementation models that leverage digital technologies (digital tools and digital channels) in order to enhance the delivery of a product and/or a service to consumers. This might be in the form of connecting users to digital content, virtual access to service providers or digital means of payment for services. The rate of digital transformation means that a wide range of digitally-enabled models are already being used to enhance access to basic services, globally:

- In **energy**, solar home systems and solar or hydro mini-grids are emerging as the main digital delivery models to extend electrification beyond the reach of the national grid.
- In **health,** telehealth is used to connect users to healthcare practitioners, m-Health models provide users access to health information and digital diagnostic tools and digital marketplaces connect health product supply chains
- In **education**, e-Learning/tutoring and digital content libraries provide a digital platform for learners to access teachers and educational resources

Based on desktop research, regulatory review and consultations with market and regulatory stakeholders, the study finds that the socio-economic profile and challenges to public sector reach and delivery in Malawi present a clear need for digital delivery. There are some existing examples of digital delivery innovations across the three sectors, but with limited scale so far. This includes the Mulanje Electricity Generating Agency (MEGA), an example of a hydro mini-grid in Malawi; Pay-As-You-Go solar home systems by Yellow Solar; small-scale initiatives facilitating learner access to digital educational resources such as Padziwe and m-health initiatives to deal with the implications of pregnancy and child health such as the Village Reach, which is grant-funded and receives in-kind support from the Ministry of Health.

However, not all models will be viable or even appropriate in the local context. A feasibility assessment of potential digital delivery models across the three basic services sectors suggests that:

- In the **energy** sector, the relatively slow pace of last-mile household connections to the grid, coupled with progress in the regulatory environment for mini-grids and the existing traction of mini-grids, may mean that mini-grids are the preferred way forward to compensate for grid connection challenges, while solar home systems serve more limited energy needs in parallel.
- In **health**, mHealth models are likely to be the most feasible of the models assessed, with scope to introduce models applied with success elsewhere on the continent to target Malawi's specific disease burden. However, the state of digital readiness, notably low smartphone penetration, suggests that no digital health solution is likely to be a quick win.

- In **education**, low ownership of mobile devices and laptops limits the potential market size of students who can benefit from e-learning or digital content solutions, and digital skills and adoption threshold barriers are likely to be substantial – a fact borne out by the very limited edtech activity in the country at present.

Across the three sectors, the energy space holds most potential, given current levels of activity. Digital payments are an important enabler across the three basic services sectors, but free public education and healthcare erode the direct use cases for digital payment for public service delivery, and digital payments are not widely used across these basic service sectors at present. Further financial services innovation, like innovative insurance models to facilitate access to health services, also hold potential, but there is again limited innovation so far.

Overall, limited progress to date in digital delivery means that in many instances a market would need to be 'made': through convening of public and private stakeholders to build an enabling environment for innovation, and via facilitation of partnerships across the financial inclusion and basic services spheres – a key role for a market systems facilitator like FinMark Trust, but one where there are unlikely to be quick wins.

1 Introduction

Malawi is a landlocked country in the south east of Africa. Known as the Warm Heart of Africa, it is bordered by Mozambique, Tanzania and Zambia and had an estimated population of 18.6 million people in 2019, 43% of whom were under 15 years (World Bank,2021). The country is divided into three administrative regions: North, Central and South. These regions are subdivided into 28 districts, which are further divided into traditional authorities and villages.

Significant socio-economic challenges. Despite significant economic and structural reforms, the country remains one of the poorest in the world; ranked sixth-poorest in 2020 (Ventura, 2020). The economy depends heavily on agriculture, which employs nearly 80% of the population, and it is vulnerable to external shocks, particularly those related to climate change (World Bank, 2020). Those in rural areas are especially vulnerable to climate shocks, and there is a big difference between urban and rural poverty, with 57% of the rural population poor, compared to 17% of the urban population (IMF, 2017).

The latest poverty figures indicate that the national poverty rate increased slightly between 2010 and 2016 (50.7% to 51.5%); however, extreme national poverty has decreased between the same period to 20.1% (World Bank, 2020). These figures were impacted by COVID-19, as in 2020 roughly 1.1 million people fell into poverty, most of whom were in rural areas (IFPRI, 2020). The pandemic further exacerbated or exposed several of the country's challenges.

Economic challenges faced by Malawi include low productivity, a narrow and raw export base with high reliance on few commodities; a poor business environment, an underdeveloped financial sector, inconsistency in planning, weak formal and informal sectors, a lack of alternative energy sources; and poor transport networks and ICT facilities. The country also faces natural disasters,

land degradation and diminishing natural resources. Corruption scandals, such as the 2013 Cashgate scandal[1] create further challenges for the Government.

Challenges in basic service provision. The result of these challenges is a country that struggles to provide its population with quality basic services or invest adequate amounts of resources towards these services, as can be seen in Table 1. Electricity access in rural areas is less than one-third of the SSA average, and health and education expenditure per capita are also well below the average for the region.

Table 1: Indicators comparing Malawi with SSA and high-income countries

Indicator/Region	Malawi	SSA	High income
Access to electricity (% of rural population)	10%	32%	100%
Total expenditure on education per capita	USD18	USD73	USD2,003
Current health expenditure per capita	USD32	USD84	USD5,284

Source: World Bank, UNICEF (2019) and UNICEF (2019)

The impact of low expenditure on key sectors such as education and health has led to a myriad of challenges, from limited numbers of healthcare facilities and workers in the healthcare sector, to understaffing at schools leading to poor educational outcomes. Electrification has positive impacts on health, education, income and environment and is a great driver of productivity, which is key especially in poorer, rural areas of Malawi, yet rural electrification is less than one-third of the SSA average.

[1] A 2013 scandal where certain government officials allegedly exploited a loophole in the computer-based financial information storage system to divert millions from government coffers, stealing up to $250m. The result was that international donors withheld funding from Malawi; donors withheld roughly USD150 million or 40% of the country's budget. Additionally, the government was forced to borrow domestically leading to high inflation (Chiwala, 2018). DFID not only removed general support provided to the government but also sector specific support including for health and education while a forensic audit was undertaken (Tran, 2014).

Government commitment to sustainable development solutions. The Government is aware of the challenges faced by the country and aims to address them through the Malawi Growth and Development Strategy (MGDS), a series of five-year plans that guide the country's development. The current MGDS III (2017–2022) focuses on education, energy, agriculture, health and tourism. The MGDS III operationalises key development frameworks such as the African Union Agenda 2063 and the Sustainable Development Goals (SDGs).

Innovation needed to realise sustainable development targets. Malawi has made progress on 29 of the 169 SDG targets, moderate progress on 59 and poor performance on 81 of the targets. The 29 targets on which Malawi is making progress include Good Health and Well-Being (under-five mortality rates are significantly declining and likely to be met) and Education for All (gender parity in primary schools and Net Enrolment in Primary Schools is close to target). However, most SDG targets are not being met. As the Government faces a number of challenges, it needs innovative solutions to help ameliorate access to basic services and reach the SDGs – a plan for a better and more sustainable future. Digital models present such an opportunity to bypass some of the current delivery challenges.

There are many examples in Africa where digital delivery models are helping with basic service delivery. CityTaps is one such company. It received a grant to launch smart prepaid water meters in Niamey, Niger, in partnership with the local water utility. Following the grant and the rollout of the water meters, 72% of users opened mobile money accounts and almost 90% of users preferred paying with mobile money. The service was also 16% cheaper than piped delivery (Bauer, 2019).

Constrained digital readiness. For digital technology to be part of the solution in Malawi, the country needs a basic level of "digital readiness", including having the infrastructure, connectivity and device access to enable scaling of digital models. According to the World Bank's digital adoption index, Malawi scores in the bottom group of countries, at an index score of just more than 0.2. Mobile phone ownership is not as high in Malawi as it is in other east African countries (51.7% of Malawian

households have a mobile phone) and mobile phone ownership differs across regions; from 48.5% in the Central Region to 66% in the Northern Region (Malawi National Statistics Office, 2019). However, mobile phone ownership is increasing rapidly, by 12% between 2019 and 2020 (Kemp, 2020).

Positive trend in digital payments uptake. According to the World Bank Global Findex database,20.3% of Malawian adults had a mobile money account in 2017[2] and this number has continued to grow since. The mobile money payments sector reflected a 55% increase in the number of 60-day active customers between September 2018 and 2019. Over the same period, both utility payments and merchant payments (P2B) made with mobile money increased by 78% and 63%, respectively. By March 2019, Malawi had a density of 357 mobile money agents per 100,000 population, up from 186 in March 2017. For every 10,000 of the population, there were 7,840 mobile money accounts in March 2019 (Owolade and Borgstein, 2019). This suggests that both the uptake and scope of usage of mobile money in Malawi is expanding and may provide a further mechanism to enhancing access to basic services.

The rest of this report assesses the feasibility of digital models in extending access to energy, health, and education in Malawi against this context.

The report is structured as follows:

- Section 2 describes the research methodology.
- Section 3 presents a framework for assessing the feasibility of digital delivery models for basic service delivery.
- Sections 4 to 6 outline the country context, model overview, feasibility assessment and practical recommendations on the role of development actors and agencies in overcoming access and delivery challenges in each of the focus sectors. Section 5 considers education, Section 6 energy, and Section 7 health.
- Section 7 draws cross-cutting conclusions and recommendations.

2 Adults are defined as 15 years and older in the findex database. Data available on the FinMark Trust data porta: https://finmark.org.za/data-portal.

2 Methodology

FinMark Trust commissioned Cenfri to undertake this research between October 2020 and January 2021. A mixed-research-methods methodology was followed. It focused on crowding in the insights of key experts, industry and other ecosystem stakeholders and consisted of the following core activities:

- A literature review and desktop scan of global and local best-practice digitally-enabled delivery models for expanding service delivery in the sectors of education, energy and health
- A desk review of the macroeconomic, policy and sectoral landscape of Malawi to provide a diagnosis of the country's context as it relates to basic services access and delivery
- Expert interviews with ecosystem actors, including those from the public sector, the private sector, civil society organisations, development actors and donors
- The development of a conceptual framework for assessing the feasibility of different types of digitally-enabled delivery models for each sector,[3] as a basis for conducting qualitative and quantitative feasibility assessments that identify those models with the highest potential for impact and reach
- Testing the feasibility assessment results with ecosystem actors during an interactive virtual workshop

Key terms or definitions referred to throughout this report are:

- **Digital transformation** is defined as the transformation of economic activities through digitisation and/or digitalisation. Digitisation entails converting analogue processes into digital processes, while digitalisation entails inserting digital processes into the workings of businesses or everyday life (The Enterprisers Project, 2020).
- **Digitally enabled models** are models that leverage digital technologies, including both digital tools and digital channels to

[3] These assessments were conducted for the sectors of energy, education and health, but the conceptual framework and assessment approach could well be refined and applied to other sectors of service delivery and additional countries.

enhance the delivery of a product and/or a service to consumers (Fourweekmba, 2020).

- **Digital tools** are programmes and website and/or online resources that make it easier to complete a task, e.g. machine-learning applications (Department of Health and Social Care (UK), 2020).
- **Digital channels** refer to digital communication and/or payments platforms, e.g. mobile money channels.

3 A framework for assessing the feasibility of digitally enabled delivery models

Digital transformation enhancing access to basic services. A growing body of global evidence suggests that the process of digitalisation and uptake of digital tools in business processes is rapidly advancing the ability of providers, public-sector bodies and development agencies to expand access to basic services[4]. We have reached a pivotal point, at which long-held socio-economic development theory is being evolved, incorporating "new" development models of digital transformation which have the potential to allow for more effective scaling strategies to expand access to underserved population segments. Some of these models are still in prototype phase, while others have been scaled effectively for impact and reach. This report considers the potential of global best-practice models across the education, energy and health sectors to expand access to these services in Malawi.

Sectoral feasibility highly dependent on context. To address the country's unique basic service delivery challenges and reach scale, digital delivery models need to be context-appropriate. This report therefore also assesses the feasibility of the various models identified for each sector in the country context.

Feasibility framework at the nexus of affordability, access, regulatory and market dynamics. The analytical framework used to assess the feasibility of the different models within their sectoral context consists of four feasibility criteria: affordability, access, regulatory feasibility, and market dynamics:

4 In Appendix A of this report, we provide scatterplots based on data for 62 countries globally (for which data are universally available, including Malawi) which suggest that there is a correlation between the state of digital maturity of a country, and access to basic services' proxy indicators. The positive relationships this report finds, seems to be strongest in the education space, followed by energy, while in the case of health there seems to be no significant relationship. Observational correlation analysis does however not speak to causality.

- **Affordability.** To determine the affordability of digital models for specific target groups, elements such as the cost of accessing and using the model, consumer or household disposable income, and expenditure habits all need to be considered.
- **Access.** Various factors contribute to the proportion of the population that will ultimately be able to access the model. These include:
    - **Digital connectivity.** Digital connectivity is a decisive factor when seeking to exploit the opportunities of digitalisation through digitally enabled delivery models. It is therefore important to understand the availability of ICT infrastructure and mobile devices for communication and transactional purposes in Malawi – this would also consider whether public institutions such as schools and medical facilities have internet access, for example.
    - **Analogue support infrastructure**. Digitally enabled delivery models rely on a combination of digital and physical layers to be effective. One of the physical layers needed is a distributed agent network that enables ongoing person-to-person engagement for customer onboarding, delivery and product maintenance, among other things.
    - **Basic physical infrastructure.** Finally, it is important to consider the accessibility of basic physical infrastructure such as road networks, national power grids and basic service institutions such as schools and clinics.
- **Regulatory feasibility.** This refers to government structures, regulations, policies and incentives that either support or impede the delivery of basic services either through existing channels or through digitally enabled delivery models.
- **Market dynamics.** This refers to the viability of the digital model from the provider's perspective. This is affected by a number of factors, but for the purpose of this research the focus is on the level of competition in the market and the scalability, given any potentially large barriers that may need to be overcome.

Sections 4 to 6 layer up a feasibility assessment for digital delivery models in the education, energy and health sectors in Malawi, respectively, covering:

- **Context:** the sector context to which digitally enabled solutions can be applied and the core challenges faced in expanding access to these services.
- **Best-practice models:** an overview of African and global models that could help to overcome the specific delivery and access challenges faced, alongside specific examples found in the Malawian context.

- **Feasibility**: an assessment of the feasibility in the Malawi context of each key model of digital delivery at the hand of the analytical framework as set out above, to form the basis for recommendations per sector.

4 Education

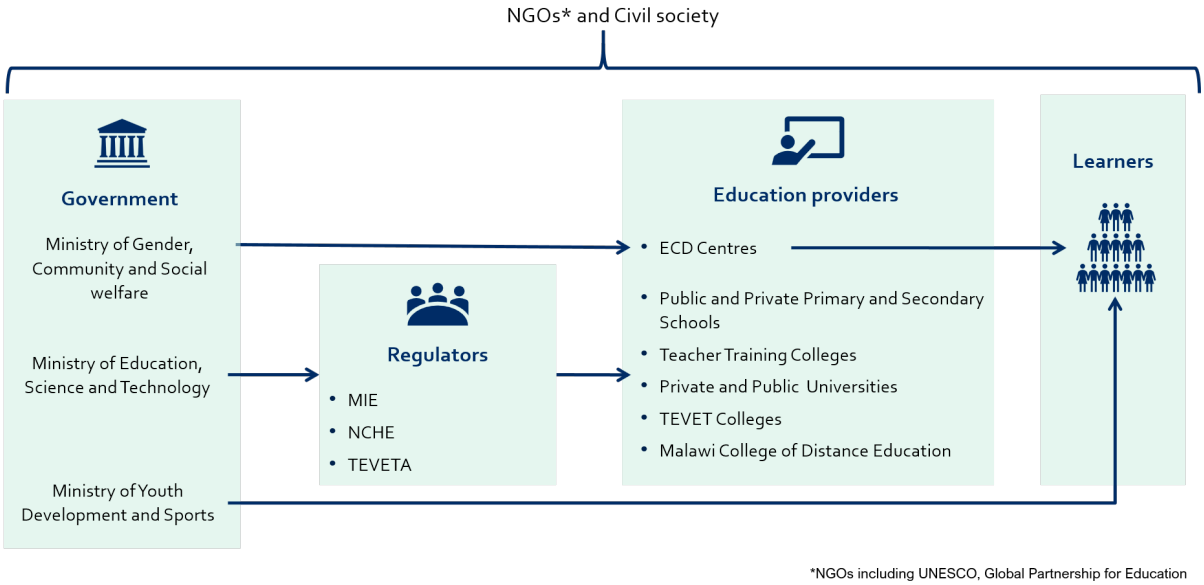
Despite free primary education policies enacted from 1994 in the country, poor retention and completion rates at both the primary and secondary school levels continue to contribute to relatively low levels of national literacy in Malawi[5]. Most learners do not reach a 40% mark in the national primary curriculum performance standards so only 38.4% of primary education graduates are absorbed into existing secondary schools (Malawi Education Sector Analysis, 2019). This report finds that deficits in physical school infrastructure and educator resources further exacerbate access to education for all and have dampened the ability of policy actors to make meaningful gains in achieving their sustainable development goals for the education sector.

4.1 Institutional arrangements and supply-side dynamics of the education sector

Figure 2 depicts the interlinkages between actors on the supply side and regulatory side of Malawi's education sector. The Ministry of Education, Science and Technology (MEST) has the primary mandate over the education sector, while the Ministry of Gender, Community and Social Welfare oversees Early Childhood Development (ECD) Centres. Relevant regulatory authorities are the Malawi Institute of Education (MIE), the National Council for Higher Education (NCHE) and TEVETA, the Technical, Entrepreneurial and Vocational Education and Training Authority. Finally, there are both public and private schools, as well as a range of colleges and universities.

5 According to data retrieved from the World Bank (2020), the adult literacy rate of Malawi is only 62% of the population in 2015

Figure 1: Supply-side actors and interlinkages in Malawi's education sector



Sources: Government of Malawi (2008), Ministry of Gender, Community and Social Welfare (2013) and TEVETA (2020)

Severe infrastructural and resource challenges. According to Sichone (2019), only 18.7% of primary schools in Malawi had access to electricity in 2016, and schools are often outside of easy reach for rural population segments. Moreover, although the Government's spending on education (6% of GDP) is slightly higher than the SSA average (5%), more granular fiscal data exposes a key contrasting insight; the variance between approved and revised budgets is large, suggesting that there are persistent budget credibility issues for this country (UNICEF, 2019). Consultations with ecosystem stakeholders further suggest that the low levels of resources available in Malawi's education space are poorly managed. Thus, the supply-side challenges to broadening access to education are extensive.

4.2 Access, usage and affordability of education services

Free education policy unlikely to have long-term sustainable impact on access. Universal free education, which has been enacted since 1994, has improved enrolment for primary education learners and in some part secondary school enrolment rates as well. For example, according to UNICEF (2019) the net enrolment rates for primary school learners in Malawi is relatively high at 88%,

however the transition rate to secondary school only 38.4%. Moreover, historical public-sector investments to advance enrolment outcomes have come at a great cost to the fiscus, and the relatively high trends in subsidization potentially unsustainable. Through consultations with sector stakeholders, this report finds that the public sector will need to partner with social impact enterprises through public-private partnerships (PPP) which can achieve efficiencies in scale, in order to secure continued progress in learner enrolment rates. Donor funding is key and donors include governments (such as those of Norway, Germany and the UK) as well as multilateral institutions such as UNICEF and the World Bank.

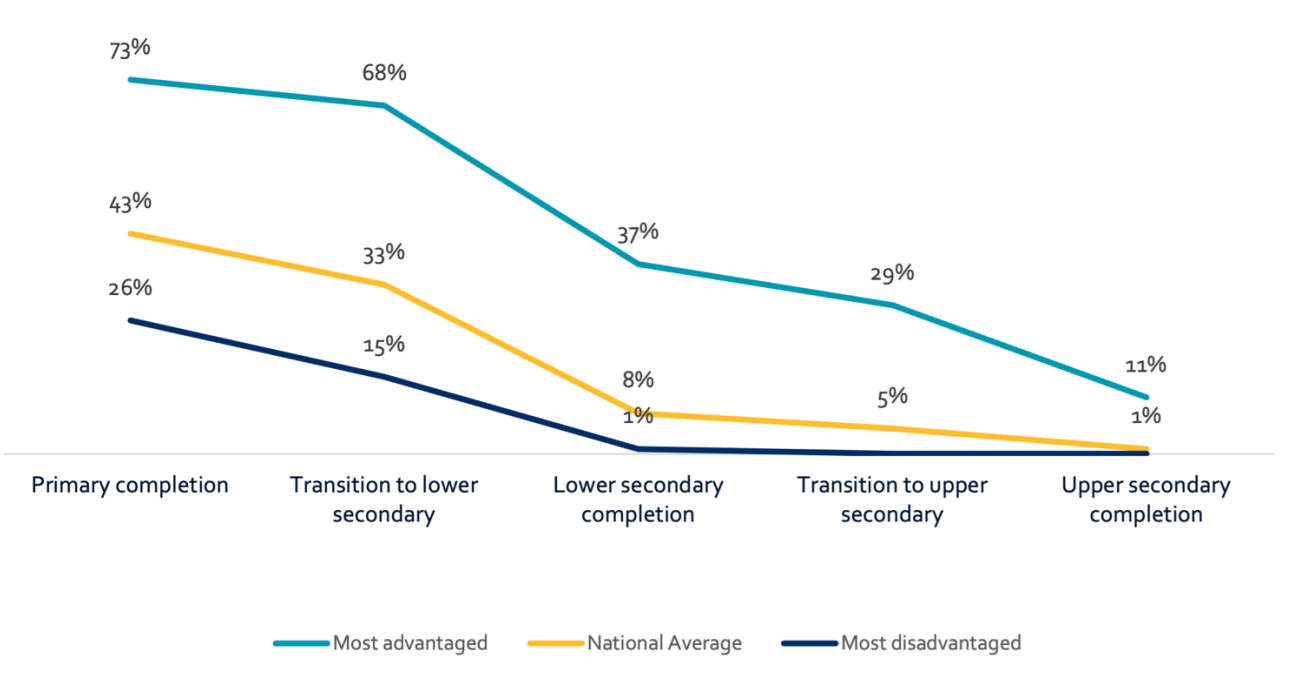
Cultural norms historically negatively impact on girl learners' education continuation. Historically, Malawi has had one of the highest rates of child marriages globally, with negative implications for the continuation of schooling for girl learners, especially: 50% of girls in Malawi were married before the age of 18, according to a study conducted by Robertson (2017). In early 2017, the Government raised the legal age for marriage from 15 years to 18 years as a push toward promoting education for girls (Robertson, 2017). Data compiled by Indexmundi (2018) show that male and female primary and secondary school enrolment rates are now relatively equal.

Low completion rates at national level, and further divide on poverty and gender lines. Not only are Malawi's education completion rates at primary and secondary level learners low, relative to comparative global statistics[6] – but educational outcomes also vary significantly depending on the poverty status of learners. Figure 3 shows the completion and transition rates of Malawian learners by poverty status, and it is clear from this data that the most disadvantaged learners experience significantly poorer educational outcomes than the national average and/or most advantaged learners. Furthermore, only

[6] According to data retrieved from the World Bank (2020) and Ministry of Education (2020), on average over 70% of learners globally complete primary school and move onto secondary school; in Malawi, only ~35% of learners complete primary education level and move onto secondary school.

15 out of 100 of the poorest girls in rural areas successfully enter secondary school in Malawi, according to World Education Blog (2020).

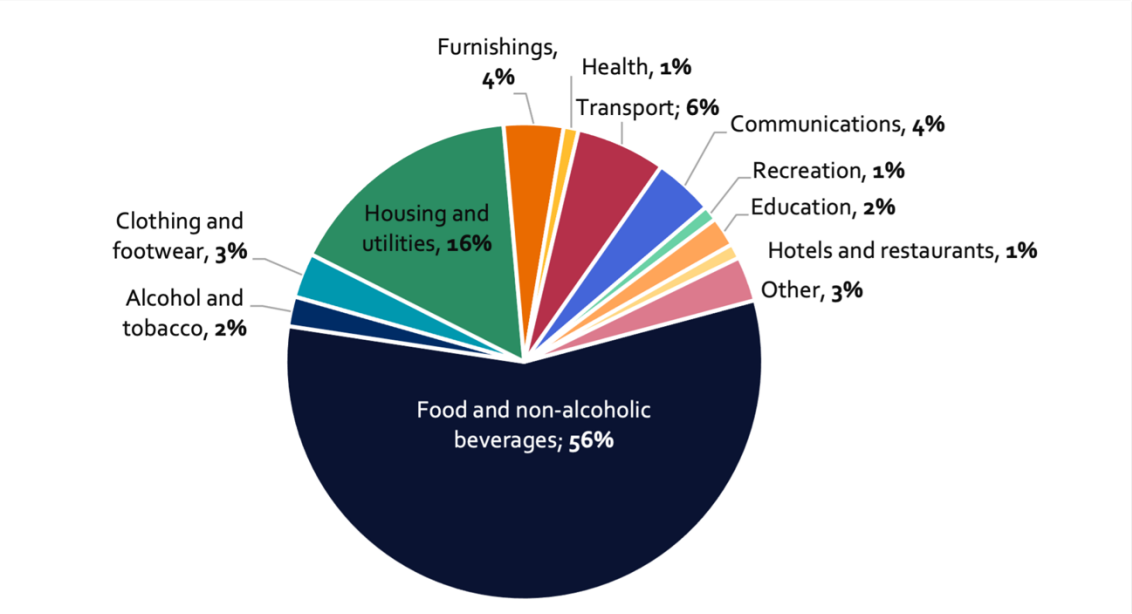
Figure 2: Basic education completion rates by poverty status



Source: Kadzamira et al. (2018)

Affordability in principle due to free public schooling, but ancillary costs in practice. Across Malawi, 90% of schools are publicly run, implying that education is free for most primary and secondary learners (Ministry of Education, Science and Technology, 2020). However, ancillary costs associated with uniforms, travel expenditure and school lunches will still be incurred. On average, Malawian households spend 2% of total expenditure on education-related expenses – see Figure 3 below.

Figure 3: Malawi household expenditure profile



Source: Government of Malawi (2011)

4.3 Best-practice digitally enabled delivery models in education

According to literature, there are three major digital delivery models in the education sector. These models are e-learning and tutoring, school-fee payment or management and digital content library. This section will review the three models.

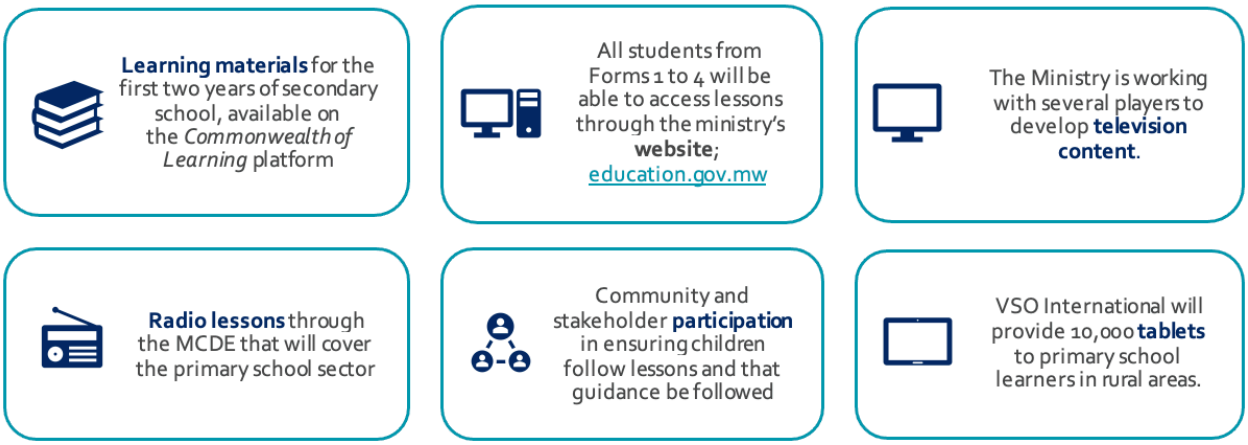
E-learning and tutoring

E-learning and tutoring can help to provide education services remotely. This model enables primary and secondary school learners, as well as tertiary education students, to engage interactively with teachers or with tasks and exercises for remote learning purposes. Furthermore, learners can ask content questions and track their development. These models can include language learning apps, virtual teaching or tutoring, video conferencing or online learning software. Research suggests that this type of learning can increase information

retention and decrease education time required. In many examples, this type of model is adaptive and able to provide the correct level of support for students.

Imperative for e-learning and tutoring during COVID-19 lockdowns. It was estimated that globally, there were more than 1.2 billion children in 186 countries affected by school closures in 2020. E-learning and tutoring provided many of these students the opportunity to continue their education at home (Li and Lalani, 2020). In Malawi, likewise, COVID-19 has created an imperative for digitalisation of education channels. Like so many countries globally, Malawi's schooling system has been extensively affected by the pandemic restrictions. Schools were reportedly closed between March and September 2020, and then again from January 2021 for three weeks (Masina, 2021). Although the education sector is in crisis, many initiatives were rapidly piloted to relieve barriers to access for learners (see Figure 2).[7] These are positive steps, yet there has been limited scale to date[8].

Figure 4: Responses to COVID-19 in Malawi's education sector



Sources: Masina (2021), Kaponda (2020) and Gondwe (2020)

7 While some of the initiatives could be regarded as e-learning, others relate to digital content as will be discussed lower down.

8 Later in sub-section 5.3, this report discusses best-practice digitally enabled models which could be considered for adoption in Malawi, for more effective impact to be achieved with support from technologically fuelled providers.

Limited examples in Malawi. Beyond these initiatives**,** a recent report (Briter Briges, 2020) found only one example of an edtech start-up in Malawi, Padziwe. This start-up provides learning software that simplifies content by adding media, including videos, interactive animations, audio and self-assessments tools. However, it can only be used on smartphones, tablets, laptops or desktops. They also sell educational tablets pre-loaded with software for USD109 to USD122 (Padziwe, 2021), but the scale of impact has been minimal.

Challenges related to both outcome and provision of service. Research suggests that at younger ages, e-learning may not be as successful, as young children require more structure. Additionally, most teachers have not been trained in e-teaching methods, making them potentially less effective. The provision of e-learning services requires digital infrastructure, which many in developing countries do not have access to (e.g. a smartphone, tablet, laptop, internet connection), thereby increasing education inequality. There are, however, examples such as M-Shule in Kenya or Eneza Education that operates in Kenya, Ghana and Rwanda, that use SMS technology for e-learning purposes. Thus, this type of model can be adapted to low resource settings.

Box 1: Eneza Education

Eneza is an edtech company operating in three African countries: Kenya, Ghana and Rwanda. It provides curriculum-aligned revision material in all primary and secondary subjects, on any device (SMS or web-based).

Over 10 million students across the three countries have used the service, and over 2 million messages are exchanged daily. After using the programme for nine months, students increased their academic performance by 23%.

In Rwanda, Eneza partnered with Mastercard Foundation to launch SMS-based learning. Students can send questions via SMS 2910 on the MTN network and get responses from the Eneza pool of teachers for free until July 2021.

In Kenya, the MNO partnered with Safaricom. Teachers design content, and there is curriculum-based revision and an ask-a-teacher service.

Source: Eneza Education (2019)

School-fee payment or management

Paying for school fees with mobile money brings efficiency gains. There are many examples in Africa where school fees are payable via mobile money. This can bring large efficiency gains. In Zambia, for example, a study found that the transportation costs parents and guardians incur to make school payments in cash can amount to up to 12% of the school fee and that the payment process itself can take up to two days. Beyond these costs are the lost wages and recurring costs of paying fees in instalments (CRS, 2018). Paying school fees electronically overcomes all of these challenges. The benefits of mobile money are also felt by schools, who, due to upfront payments, can budget better. It also can lead to an increase in fees collecting, providing schools with bigger budgets (GSMA, 2015). In Malawi, however, the fact that public education is free makes digital school payments less relevant.

Digital models can help with school management. They can help teachers and schools to grade tests, provide homework or schoolwork reminders, or stay in contact with parents for updates. They can also help schools to stay in contact with the national education department and manage and share their data (such as school registration and attendance).

Digital content library

Digital content libraries can provide a cost- effective way for students to access educational content remotely. Students are able to download books either for free or at a nominal cost, and these books could be downloaded permanently or for a specific period. Organisations such as eKitabu also teach those using the programme how to publish their own e-publications online. The challenge with these types of models is that they usually require internet access and a digital device that can read these types of programmes. The research for this report did not find any such models operating at scale in Malawi.

Box 2: eKitabu

eKitabu was founded in 2012 in Kenya and since then has lowered the cost of delivering accessible content for quality education in local languages through open architecture, global collection of digital content, and ecosystem partners. It has won seven international awards for its provision of digital books and operates in 14 countries.

It allows learners to buy books, download books for free, download revision exercises and even create their own epubs for others to download. In 2018, there were 450,000 titles, and partnerships with the French Embassy, Moran Publishers, Oxford University Press and Education Development Trust have added to this total. eKitabu has partnered with 1,500 schools in Kenya to enable access to content approved by the Kenya Institute of Curriculum Development.

Sources: eKitabu (n.d) and Nyayieka (2018)

4.4 Feasibility assessment

As mentioned in Section 3, assessing the feasibility of these kinds of models requires us to consider affordability, access, regulatory feasibility and market dynamics. This section will review e-learning and tutoring and educational content models for their implementation and prioritisation feasibility in the Malawian context.

Figure 5 Feasibility assessment of digital education models

E-Learning and tutoring	Digital content library	Public education
• Enables continued learning to take place remotely, i.e. teaching, exercises, etc • Low digital skills levels required for usage • Feedback loop with schools	• Enables remote access to educational content • Improves affordability of textbooks • Requires data connectivity • May require smartphone	• Free primary education • Lack of resources to maintain the infrastructure • Distance to schools challenging for learners • Cost of secondary school difficult for many households to meet

	• Low-to-no data required (USSD/SMS mobile channel) • Regulatory approval typically required		
Affordability	✓✓✓	✓✓✓	✓✓
Access	✓✓✓	✓✓	✓
Regulatory feasibility	✓✓	✓✓✓	✓
Market dynamics	✓✓✓	✓✓	✓
		✓ Low ✓✓ Medium	✓✓✓ High

E-learning and tutoring

Affordability: **E-learning and tutoring can provide an affordable way to educate or supplement in-person education at schools, especially during COVID-19**. Our non-exhaustive desktop scan indicates a range of prices for these kinds of services, sometimes going up to USD23 per month as well as data costs. However, African examples such as M-Shule and Eneza Education rely on SMS/USSD technology, which makes them cheaper to roll out. The cost for families is also significantly more affordable (USD1 per month for M-Shule and USD0.2 per week for Eneza). During COVID-19, many of these e-learning platforms reduced their price.

Access: **E-learning/tutoring on basic phones using SMS/USSD is significantly more accessible than those requiring smartphones and data.** As mentioned, there are edtech solutions in Africa that rely on basic phone technology, which makes them more accessible in Malawi. Slightly over half (51.7%) of households in the country have access to a mobile phone, but the figure is increasing rapidly. These types of platforms also do not require significant levels of digital skills to use, which increases their accessibility.

Regulatory feasibility: **Regulatory framework likely to be required.** Regulatory feasibility would depend on the type of e-learning model applied, but some form of regulation would typically be required. This would especially be the case where students register, or where the service is linked to schools as personal information would be requested. In a common-law country such as Malawi, models would still be able to operate in the absence of dedicated regulation, but some regulatory uncertainty may arise.

Market dynamics: **The Malawian market is open for e-learning, with little competition**. E-learning solutions relying on SMS/USSD show promise in the Malawian market, as they would be affordable and relatively accessible for learners. However, there is limited activity currently. Partnerships with MNOs are key in ensuring that the service can be provided efficiently and affordably.

Educational content

Affordability: **Digital content can be significantly more affordable than buying textbooks or books.** Our non-exhaustive desktop scan indicates various payment models for educational content globally and on the continent, including subscriptions (USD20 to USD60 per year) and free or pay-per-product (up to USD10). These may still be too high for many in Malawi, even though they are much cheaper than the alternative (physical textbooks). However, as mentioned, there are a number of free books that can be downloaded.

Access: **Need for devices and connectivity may limit access.** Educational content models typically require smart device and internet connectivity, which will constrain accessibility. Nevertheless, there are modalities that mean that this model could accommodate limited connectivity or shared access to be devices, which could be particularly helpful in a school setting. There are, for example, organisations that provide schools with tablets, or who open learning centres where students learn by using digital technology.

Regulatory feasibility: **Regulatory feasibility would depend on the digital book being downloaded.** While some books can be self-published, copyright laws still need to be followed. This is particularly true in the case of textbooks.

There may also be regulation on language or on age suitability of books that may need to be considered.

Market dynamics: **The Malawian market is open for educational content**. There are a number of digital content organisations in Africa that could expand into the country, such as eKitabu. It could be useful for these organisations to work closely with schools due to low smartphone ownership in the country.

4.5 Recommendations for Malawi's education sector

Reducing the costs of mobile devices is key to increasing uptake of edtech solutions. As mentioned, just over half of Malawian households own mobile phones. Further, less than 5% of households own laptops or tablets (Government of Malawi, 2019). This severely limits market size of students who can benefit from these types of solutions. Another way to think of it is that it limits the types of edtech solutions that would be feasible in the country. For example, solutions that require smart devices would probably have limited traction in the country. Working with governments to enhance accessibility of devices, for example through reducing import tariffs of devices, could help to create and boost realistic demand of edtech solutions and help to create a favourable environment for edtech players.

There is little action in the market, so it is important to encourage edtech providers to enter the space. As discussed in Section 5.3, only one education start-up has been recorded in Malawi. Malawi needs an enabling environment and development support for more edtech players to enter the country, particularly those who are able to cater to the students who have access to basic phones. Government and relevant stakeholders therefore need to work together to create an enabling environment for local and international edtech players through partnership establishment and more regular convening. More specifically, open dialogue is needed to consider whether the current regulatory framework in the education space needs to be updated to facilitate clarity around the entry of edtech providers. The current regulatory framework is set up for in-person tuition through the official schooling system. In 2018, government launched the Open/Innovative Schooling (OIS) Model to help

address the challenge of out of school youth. The approach focuses on the training of teachers in e-Learning and using open educational resources (OER), indicating that government is open to the use of e-Learning, at least for specific purposes.

Edtech players can benefit from using freemium models to help testing and scaling. Testing and scaling are important aspects of new business (or business entering a new market). Based on the low income of the average Malawian, freemium models can be helpful for testing the country's market. Our desktop scan found a wide range of prices, globally. Many of the educational content models use a freemium model, allowing learners (or guardians) to gauge the usefulness of the product before making the decision to spend additional money.

Digital upskilling of educators. It is important that educators be able to use digital technology accurately. Where schools are provided with educational tablets, educators need to be able to support children's learning through these digital devices. Edtech also has the ability to simplify school administration, and teachers need to be able to use this technology to support efficient school administration.

Learning lessons from other low-resource countries. A takeaway from other low-resource countries is the importance of a consolidated government effort. For example, in countries including Benin, Lesotho, Botswana, Burkina Faso, Cameroon, Uganda, South Africa and Seychelles (list not exhaustive) governments have worked to establish online learning platforms. Further, partnerships with MNOs have proven to be fruitful globally, with MNOs providing key technological support such as zero-rating data for educational purposes, bandwidth shaping, lifting data caps, distributing mobile phones, creating public hotspots, SMS campaigns and providing free SIM cards.

5 Energy

More than 95% of the Malawian population live within 10km of the grid and 40%–45% live within 1km of existing ESCOM lines (World Bank, 2019). Yet, Malawi is one of the least electrified countries globally, currently at 11% overall, with 42% of the urban and only 4% of the rural population is considered to have access[9]. This inconsistency between population proximity versus current access dynamics is a key feature of this market and stems mainly from a lack of capacity to efficiently connect households to the national grid. It is this challenge that has opened the door to the use of alternative renewable energy solutions as a means of improving access to electricity in the country.

5.1 Energy supply dynamics and institutional arrangements

Strong reliance on hydropower; solar historically untapped. Malawi's on-grid electricity generation mix is strongly hydro-powered (representing 97% of the total on-grid generation produced) according to the World Bank (2019). The four major hydropower stations are Nkula, Tedzani, Kapichira and Wovwe. There are also three thermal plants in Lilongwe, Mzuzu and Mapanga. In total, the grid has 422.45 MW generation capacity, of which 371.1 MW is generated from hydro and 51.4 MW from standby diesel power plants. Additional hydropower potential of the national river systems is estimated at 1,000 MW (World Bank, 2019). That said, according to the US International Trade Administration (2019), installed generation capacity is lower than demand by approximately 17%, which means that Malawi remains dependent on electricity imports from neighbouring countries via the Southern African Power Pool. Malawi also has an average of 3,000 hours of sunshine per year. By 2017, two solar PAYG companies were in operation with an installed capacity of only 84 KW (Lighting Global, 2018), suggesting that this source of power remains

9 SEforALL Africa Hub (2021)

largely untapped as a strategy through which the country can become less dependent on external supply.

Mix of players in the supply ecosystem. Figure 5 outlines the key actors and interdependencies in Malawi's energy sector:

- Grid electricity in Malawi has traditionally been the domain of the **Electricity Supply Company of Malawi (ESCOM**). In 2017, ESCOM Limited unbundled into two separate institutions: one for generating electricity (Energy Generating Company of Malawi, EGENCO) and the other for transmission and distribution (ESCOM).

- The **Ministry of Natural Resources, Energy and Mining**, via the Department of Energy Affairs, is the policymaker for the energy sector in Malawi and, as such, coordinates with other Ministries, including Finance, Planning and Local Government. The main policy framework for the energy sector is the **Malawi Rural Electrification Programme (MAREP).** MAREP launched in the 1980s to increase access to electricity for people in peri-urban and rural areas as part of Government's effort to reduce poverty, transform rural economies, improve productivity and improve the quality of social services.

- The regulator is the **Malawi Energy Regulatory Authority** (MERA). MERA has a mandate to regulate the energy sector in Malawi in a fair, transparent, efficient and cost-effective manner for the benefit of the consumers and operators in the sector. Tariffs are also set by MERA and should be reflective of the social economic costs of the energy technologies used. Time-of-use (ToU) tariffs may also be used to cover the high costs of renewable energy technologies in an integrated grid. As part of its mandate, MERA is charged with licensing of energy undertakings by new independent power producers (IPPs).

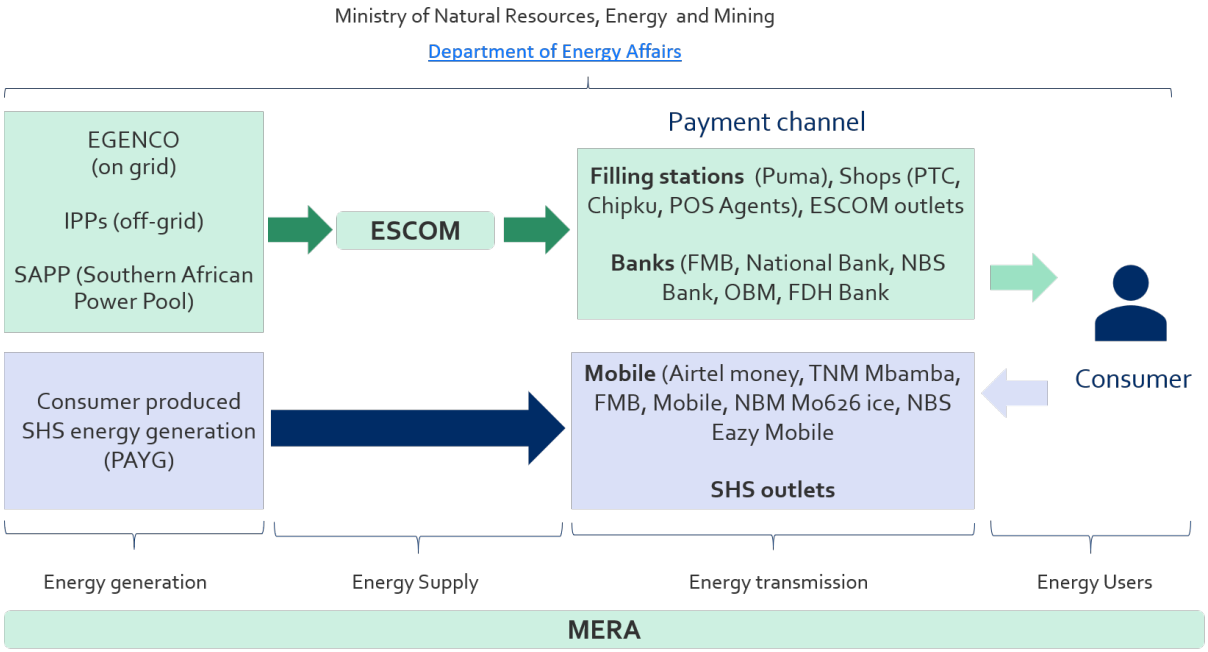
- Apart from these public players, the Malawian energy sector incorporates **independent power producers (IPPs).** Some sell solar home systems (SHSs)10 directly to the public (see Box 4 below for an example). Moreover, as will be discussed below, recent developments under the National Electrification Plan allow for mini-grid11 providers to

[10] SHSs are innovative and clean electricity sources systems based on smaller stand-alone photovoltaic technology and offer power for lighting and some appliances to remote off-grid households.

[11] A mini-grid or microgrid is a miniaturized version of the larger grid, a configuration of energy resources, distribution wires and buildings, all within a distinct geographic footprint.

play a more active role in contributing to the grid and being linked into ESCOM's distribution networks, which ultimately feed electricity supply to the end-user.

Figure 6: Energy sector supply-side actors and interlinkages



Source: Escom (2020)

Progressive regulation supportive of private provider entry. The Malawian public-sector bodies have been progressive in establishing an Independent Power Producer (IPP) Framework, which was first published in October 2019 (PPP LRC, 2019). This framework supports competitive market entry and sets out the conditions for electricity supply by IPPs in Malawi, covering IPP roles, responsibilities and rules of engagement, solicitation processes, general procurement processes, solicited IPP (SIPP) procurement and unsolicited IPP (UIPP) procurement [12]. It also sets out evaluation approaches, tariff structures and financial evaluation of IPPs. According to stakeholder consultations, the establishment of the framework allowed for ESCOM to sign 14 PPAs with

[12] UIPP involves the Government of Malawi's (GoM) receipt of an Expression of Interest from an IPP as the first step of a tender procurement process. SIPP involves a feasibility study conducted by government ahead of a Request for Expression of Interest (RFI) being advertised as part of the procurement process.

several IPPs by 2019, and the off-grid supply dynamics of the country has subsequently improved. The Ministry of Natural Resources, Energy and Mining has, however, indicated there is a need to develop the technical capabilities of the national utility to enable the national grid to more easily integrate mini-grids and excess power generated by IPPs.

Box 3: Yellow Solar

Yellow Solar is an IPP founded in 2017 and based in Malawi with a primary focus on providing pay-as-you-go solar home systems to African households. Yellow Solar initially marketed smaller systems as a way to provide easy access to basic electricity services to low-income households in Malawi. These systems were also able to power a phone charger, a radio. and four lights.

Agent networking has formed a key part of Yellow Solar's business model in Malawi. Their approach has been to recruit and train agents to service their local communities. This involves customer education, onboarding and selling of SHSs to local households. At the start of 2020, Yellow Solar had 60 agents, and by the end of the year their network consisted of 380 agents (skewed towards the south because of population density). To ensure efficiency and high performance from their agents, Yellow Solar is considering ways to introduce digital solutions that enable the alignment of agent and Yellow Solar incentives.

Yellow Solar takes payment exclusively through mobile money, relying on a partnership with Airtel. This takes place through a Lease-to-own model, also referred to as the "consumer finance retail" model, and involves customers paying for the entire generation capacity (i.e. SHS) in small instalments over a period of one to three years.

The cost of a Yellow Solar SHS is a USD12 deposit upfront with the balance being paid in instalments. The total system cost to the consumer is USD130. The effective annualised interest rate is around 32% in local currency. The aim is to get to a price point that is low enough so that the consumer gets additional value from the project and keeps up payments. In this way, Yellow Solar's bad debts would be much lower than is typical for this segment, allowing Yellow Solar to afford a lower interest rate. At present, Yellow Solar's bad debts stand at around 2% of the portfolio.

Yellow Solar had sold 10,000 SHS units in 2019 and went on to reach 47,000 in 2020, despite the impact of COVID-19. By the end of 2021, Yellow Solar anticipate they will have sold 100,000 SHS units.

Sources: Yellow Solar (2020)

Pace and cost of new connections remain key barriers. Stakeholder discussions suggest that the key constraint to electricity in Malawi are long lead times for new connections: Data from the World Bank (2021) suggests that, between 2010 and 2020, customers would have to wait an average of 174 days for a new connection to be successfully installed in the country. ESCOM faces significant capacity constraints, which have led to a backlog in new connections to the grid. Stakeholder consultations indicate grid connections incur a cost to the user of around USD64 which represents a third of the average monthly income earned in Malawi (at USD211) (SalaryExplorer, 2021). Obtaining a grid connection is therefore prohibitive for a large percentage of the low-income population in the country.

Mixed experiences of mini-grids in Malawi. Since 2006, a number of mini-grids have been implemented in Malawi by both government and non-government organisations, with mixed experiences and lessons learned – refer to Appendix C for an overview of specific mini-grids. The existing mini-grid systems have often been left to the administration of the developer institutions to manage, operate and maintain, without a dedicated regulatory framework for support. This has, to an extent, undermined the monitoring and enforcement of compliance standards for these initiatives. Ownership and organisational structures of mini-grid governance have also been unclear in the past, along with a lack of accountability and transparency procedures, thereby presenting challenges for MERA to manage supporting and regulatory structures effectively (Eales et al., 2020). Stakeholder consultations indicate that going forward, MERA plans to introduce more flexible and attractive tariff structures for mini-grid developers as a way to create a more enabling environment for them to operate sustainably in Malawi. In this way, mini-grid prices remain

regulated, ensuring that customers are not exploited, but mini-grid operators are able to operate profitably in this space.

5.2 Access, usage and affordability issues in the energy sector

Electricity access unequal on geographic and income lines. As noted, electricity access is limited in Malawi. According to USAID (2018), just under 11% of Malawians have access to electricity, with less than 4% access in rural areas while in urban areas the access rate is much higher at 46%. By income level, only 1% of the poorest 20% of the population have electricity access, while across the richest 20% of the population 31% have access (World Bank, 2019). In terms of livelihoods, while only 3% of farmers have access to electricity, 33% of those who receive wages or salaries do (Naidoo and Loots, 2020)

Households mainly reliant on battery-generated power. Lighting remains the main use case for electricity, and most households rely on batteries for lighting (52.9%), followed by the grid (11.4%), solar (6.6%), candles (6.2%) and firewood (4.4%) (Government of Malawi, 2018).

MSMEs struggle with low and unequal access to electricity. While 26% of MSMEs have access to electricity; higher than the average access rate, only 18% have access to grid electricity while the rest use solar or generator electricity. As with the rest of the country, access for MSMEs is highly unequal, with 51% of urban MSMEs with access compared only 9% in rural areas. Gender also plays a role with male owned MSMEs having an access rate of 25% but women only 11%. There are also differences in access based on business size (13% for micro entrepreneurs and 43% for medium enterprises) and age (14% for businesses 0-2 years to 25% for businesses more than ten years old) (Naidoo and Loots, 2020).

Wide variety of payment channels available to consumers. As indicated in Figure 5, consumers of electricity in Malawi, including individuals and businesses have various payment rails through which they can pay for electricity. These include filling stations, shops, ESCOM outlets, banks, mobile

payment channels and direct payments to SHS providers. Grid electricity is typically purchased by households through prepaid meter devices, mobile payments and the ESCOM Management Information System[13] (EMIS), while off-grid electricity is typically paid via mobile money channels. Challenges, however, do exist in the use of mobile payments for electricity in Malawi. At present, mobile money operators, including Airtel and TNM, have not yet reached a critical mass to allow cheap enough transaction fees for customers. Further challenges to uptake of mobile payment services in Malawi include mobile signal strength, coverage and reliability; high cost of metering and payment technology and platforms; risk of non-payment from customers and customer inability to pay; lack of experience with relevant business models and lack of technical knowledge and experience within communities (Eales et al., 2020).

Limited pass-through to consumers of tariff increases, placing financial pressure on ESCOM. Electricity tariffs in Malawi are not reflective of the costs incurred by ESCOM. Households in Malawi pay USD0.127 per kWh, compared to USD0.14 globally. Businesses pay USD0.174 per kWh, compared to USD0.12 per kWh globally (Global Petrol Prices, 2021). MERA approved a tariff increase for EGENCO from MWK19.68/kWh to MWK25/kWh, which cannot be passed through to ESCOM's customers, resulting in payment arrears to EGENCO that represent 67% of ESCOM's current liabilities. ESCOM is further owed MWK5 billion by the government and quasi-government entities (World Bank, 2019).

The Government of Malawi is focused on improving the energy situation. There are multiple projects being undertaken in the sector. This includes large projects funded by the UNDP, DFID, USAID add World Bank being undertaken in the past 7 years. They range in value from USD1.5 million to USD105 million.

[13] A management system that allows for a customer web portal, new bill payment channels (mobile money), immediate reflection of bill payment and sending bills electronically

5.3 Overview of best-practice digitally enabled delivery models for expanded access to energy

Given the challenges in expanding connections to the national grid in Malawi, solar home systems (SHSs) and mini-grids have been identified as two digitally enabled delivery models that may contribute to Malawi's energy sector. These models could provide individuals and households with access to clean, reliable and cost-effective energy through the use of innovative off-grid infrastructure and technology. Below, each of these models is outlined at the hand of global best-practice features.

Solar home systems (SHSs)

Plug-and-play solution to rural household electrification. SHSs are innovative and clean electricity source systems, based on smaller stand-alone photovoltaic technology and offer power for lighting and some appliances to remote off-grid households. These relatively simple, plug-and-play type solutions can be quickly set up and start offering the user near-immediate generation capabilities. Currently, a wide range of SHSs are available globally, both in terms of their generation capacity and their cost to the user. Smaller SHSs typically consist of one photovoltaic panel and a battery, to which devices can be connected.

A small SHS, for instance, could power a charger for a mobile phone along with several power-efficient light bulbs, while larger SHSs may have the capacity to power devices such as a TV or radio. A large SHS can power electricity-intensive devices such as fridges, geysers and even stoves/ovens, but these may be prohibitively expensive for most households in low-income markets in Africa.

This system can therefore be divided into multiple tiers based on the types of household appliance it can power (see Table 2 below).

Table 2: Multi-tier matrix for measuring access to household electricity services

Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Task lighting **AND** phone charging	General lighting and phone charging **AND** television **AND** fan (if needed)	Tier 2 **AND** any medium-power appliances	Tier 3 **AND** any high-power appliances	Tier 4 **AND** any very high-power appliances

Source: World Bank (2015)

Based on current electricity consumption trends in rural households in Malawi, SHSs that provide enough electricity for Tier 1 and Tier 2 appliances are likely to be the most beneficial.

SHSs rely on incremental payment structure. Because of the relatively high upfront cost of SHSs (the average upfront cost of a Tier 1 system is USD23, whereas a Tier 2 system is USD45[14] and low levels of disposable income at the household level in Malawi), energy service providers (ESPs) often permit customers to pay for the SHS through small incremental payments over a longer period, and in this way they incur a lower upfront cost that may be more affordable. This is known as a pay-as-you-go (PAYG) payment structure. This structure not only provides greater flexibility to customers but also offers ESPs a way of reaching price points that are more accessible to households and a way of providing greater control over the payment for and usage of the SHS.

Innovative financing schemes key to uptake of energy models. Accessing finance remains a key challenge for low-income households in SSA and becomes a focal issue when considering appropriate energy models for widespread use. Stakeholder consultations suggest low-income individuals are

[14] Refer to the Appendix of this report for more detailed costing information and assumptions.

often seen as higher risk by banks and can therefore be charged substantially higher interest rates – up to 60%–90% annualised according to the stakeholder consultations. SHS providers have therefore acknowledged the need to offer lower-cost financing solutions to their customers as a way to make their products more affordable and accessible.

Maintenance of SHSs an ongoing concern. When compared to other models, such as a national grid or a solar mini-grid, the SHS represents a relatively lower-quality device that is designed to meet the basic electricity needs of households quickly, but it is not necessarily built to be operational for extended periods. This can create ongoing maintenance risks and associated costs, should it be overused. Stakeholder consultations revealed that common maintenance issues arising with these systems include: customers using the system to drive appliances the system is not designed to support; and users being unfamiliar with these systems and their vulnerabilities, which leads to a breakdown of these systems. For instance, the batteries sold in SHSs deteriorate quickly when drawn below 50% of their charge. Where this is done continually, the battery is destroyed, rendering the system unusable. From the provider's perspective, the cost of sending out maintenance staff to each house and address where these faults occur can become unproductive, particularly where these products are fully paid off or fall outside of their service plan or warranty.

Physical distribution a key consideration for the SHS model. Product distribution in Malawi can be problematic since some rural areas are difficult to reach and become inaccessible during the rainy season (roughly November to April). In addition, there is negligible purchasing power outside cities. Some companies have a network of rural distributors, but many firms opt to reach rural markets through wholesale arrangements with local entrepreneurs (SelectUSA, 2019). One of the keys to the scalability of the SHS model is the ability to establish or leverage an effective distribution network. A distribution network in this context comprises a combination of supporting infrastructure such as roads, warehouses for storing goods, vehicles for delivery of SHSs to households and an agent network to service various locations.

Mini-grid

An off-grid community electrification solution. A mini-grid or microgrid is a miniaturised version of the larger grid, a configuration of energy resources, distribution wires and buildings, all within a distinct geographic footprint. There is no size limit, but mini-grids tend to be scaled to discrete operations, such as a small village, neighbourhood, community, business park, education campus, mine or an industrial facility. There are several reasons why mini-grids may be introduced in an area, including the following:

- Mini-grids may be developed in response to the growth in distributed generation, which brings generation closer to the point of consumption, and the microgrid concept allows local control over localised generation.
- Mini-grids also allow renewable energy resources to be used efficiently in communities isolated from the national grid. The size and development of mini-grids allow smart grid features to be incorporated, which optimises power generation, storage and use (Energize, 2020).

Box 4: Mulanje Electricity Generating Agency (MEGA) – example of a hydro mini-grid in Malawi

In Malawi, the concept of a community-based mini-grid hydropower project was first discussed in 2008 and led to the establishment of the Mulanje Energy Generation Agency (MEGA) in 2011 by three founding partners. These are MMCT (majority owner) and the Mulanje Renewable Energy Agency (MuREA, itself an implementing arm of MMCT), while the third founding partner, the international NGO Practical Action, has been providing project management and technical assistance. As a social enterprise and the first operational private energy company in Malawi, MEGA operates independently of ESCOM to serve households living in mountainous areas with fast flowing water, where there is potential for micro-hydro power generation.

MEGA also works with Fairtrade Foundation on community development and the Scottish consultancy SgurrEnergy in project engineering and management. MuREA in partnership with Practical Action and with financial support from EU Commission established the first licensed micro hydro scheme on Lichenya River in Malawi. Currently, MuREA is responsible for the

Productive Use of Electricity component in the Scottish Government/GEF-funded Powering Development in Mulanje (PDM) Project.

The installed system capacity is 80 kW and provides electricity to about 3,500 households in the service area, two to three maize mills, around five shops, two primary schools and one clinic. MEGA continues to receive financial support from a variety of donor funders. Being a socially oriented company, MEGA does not seek to maximise profits but will balance the pricing of its electricity tariffs between its social objective of offering low-cost electricity and being financially viable. The business plan forecasts that revenue from sales will cover all running costs, including staffing, operations, maintenance, VAT, site insurance and a 1% annual contribution to a community fund. The MEGA business model aims to achieve economies of scale for central operations by developing multiple sites.

Sources: (Eales, 2018)

Mini-grids experiencing growth in Africa. According to a 2018 Navigant report, the Middle East and Africa are forecast to be the world's fastest-growing market for mini-grids – at a compound annual growth rate of 27%, representing almost 1,145 MW by 2027. African governments are beginning to recognise the negative financial and environmental impacts of reliance on fossil fuels or biomass for energy, so forward-looking countries are shifting their policies to prioritise distributed renewable energy (Homer Energy, 2019). Mini-grids offer longer-term energy solutions and arguably more sustainable development impact. Most systems have a productive life span of 15 to 25 years, which is longer than many other clean-energy technologies such as SHSs.

Mini-grids not in competition with SHS. Owing to similarities in the technology used and the consumer segments targeted, SHSs and mini-grids are often perceived to be direct competitors in low-income markets. However, instead of competing, the two technologies serve different use cases. SHS electricity has immediate appeal to householders because of its relative simplicity, but it serves only limited household electricity needs. Moreover, it cannot be scaled

up to adequately power commercial businesses, health clinics, schools and other resources required for rural economic development. For that transition to occur, it is necessary to take the next step up the energy ladder to mini-grids, which can handle more robust electricity generation.

Mini-grid maintenance is crucial. The importance of effective maintenance in achieving sustainable mini-grids cannot be overemphasised. Appropriate systems design and routine maintenance are a necessary technical aspect that is a priority in mini-grid planning, development and management. A lack of local expertise often means that renewable energy contracts are awarded to foreign experts[15]. The issue with this arrangement is that some of these experts are not familiar with the local conditions and they may not be available for the continuous operation and maintenance of the systems. For example, the maintenance exercise includes cleaning the dust on solar PV modules, checking the battery contacts and replacing battery cells or failed inverter/controllers and circuit breakers. Theft of and security for these systems may be another maintenance consideration.

Regulatory environment still a grey area, although progress has been made. Many countries in Africa still lack specific policies for mini-grids in their national electrification plans, which makes planning difficult for private developers. Regulatory issues impact site selection, licensing and permitting procedures, future grid integration, and the access of developers to national subsidy schemes. Projects are often delayed due to the long lead time required to apply for concessions, licences and environmental approvals. Regulatory requirements are often fixed costs, independent of the size of the project, and can be very expensive. This situation is starting to change, however; and there is increasingly widespread support from local governments and rural

[15] Local and foreign investment is encouraged by the government in all sectors of the economy and there are no restrictions on the size of investment, the source of funds, or whether products are destined for export or for the domestic market. However, non-Malawian firms are not allowed retail operations in rural areas (export.gov, 2019).

electrification agencies (REAs), including co-funding for infrastructure in some places (EEP, 2018).

5.4 Feasibility assessment

Figure 6 summarises the feasibility assessment for each of the two digital energy models in the Malawian context, as compared to the national grid, followed by a discussion on each assessment. This is done according to the same four feasibility assessment criteria introduced in the framework described in Section 3 of this report.

Figure 7: Digital energy models feasibility assessment

	Solar Home System (SHS)	Mini-grid	National grid
	• Lighting + mobile charger • High flexibility • Regulatory requirements minimal • Maintenance and repair complex in rural areas • Distribution capacity	• Lower cost of energy • Lower investment for villages • Regulatory complexity • Local management required • Business case not always clear	• Most affordable for consumers • Centralises energy generation and distribution • Subsided by government • Unreliable supply • Low network coverage
Affordability	✓	✓✓	✓✓✓
Access	✓✓✓	✓✓	✓
Regulatory feasibility	✓✓✓	✓✓	✓✓✓
Market dynamics	✓✓	✓✓	✓
		✓ Low ✓✓ Medium ✓✓✓ High	

Solar home system

Affordability: SHS cost a key consideration for low-income users. Despite the gains provided by SHSs (such as lighting, the removal of air pollution and the lower cost from kerosene replacement), the upfront costs of an SHS remain high for many of Africa's poorest. In Malawi, around half of employed individuals earn USD204 or less per month, meaning disposable income is limited (Salary Explorer,2021). However, stakeholder consultations suggest that while a grid connection in Malawi can cost around USD65 and requires a long period to get connected (sometimes six months or more), a SHS can be obtained for an initial deposit of around USD12 or 6% of the average monthly income for a large portion of the population. The introduction of PAYG by providers is an attempt to make these products more affordable to low-income users by lowering the upfront cost and making possible smaller incremental payments over a longer period (10 to 30 months).

Access: Distribution networks play an important role in rural areas. Stakeholder consultations revealed the importance of establishing effective distribution networks to enable broad-based access to SHSs, particularly in rural areas. While 84%[16] of people in Malawi live in rural areas, households tend to be spread out, and supporting infrastructure such as roads is limited. To overcome challenges related to distribution, agent networks will be key. Successful models currently operating in Malawi use agents to sell SHSs to individuals. According to stakeholder consultations, what has worked well in Malawi is recruiting local agents that are familiar with the people and the communities they are serving. These agents are then well placed to receive stock and deliver it to these communities as well as host community-based meetings to educate customers about costs and use of the product. Developing smart rural networks may be a key factor in overcoming structural barriers to last-mile distribution and improve access in these communities.

[16] Oxford University Press (2019)

Regulatory feasibility: Low regulatory barriers for SHS providers. Stakeholder consultations revealed that the Government is encouraging the entry of independent power producers (IPPs) such as SHS providers, as a way to increase competition in this space. There are several reasons for this, including an acknowledgment of the current grid's shortcomings and that rural households that remain out of reach of more conventional solutions, may benefit from smaller alternative systems such as the SHS model. The Rural Electrification Act, 2004[17], supports this stance by stating as one of its objectives that the majority of the Malawian population in peri-urban and rural communities have access to efficient, sustainable and affordable energy for their social economic development through grid extension and off-grid electricity supply, including SHS technologies.

Market dynamics: Market open for new players. For SHS providers considering entering Malawi, the market conditions are largely favourable and present a good opportunity to achieve scale. First, there remains a large unserved consumer segment in Malawi, predominantly in the rural areas, that could benefit from the SHS model to provide lighting and mobile phone charging. It is estimated that approximately 300,000 to 2.1 million adults could be reached with a Tier 1 SHS (see Appendix B for calculation assumptions). However, new providers would need to consider whether there are existing distribution networks they can leverage or whether they would need to establish an agent network from scratch, which may be costly and take time, but may add significant value to the service offering for the customer. Yellow Solar, for instance, has relied heavily on its agent network to reach unserved households. In 2020, Yellow Solar grew their agent network from 60 agents to 380 by digitally aligning the incentives of agents with the incentives of the digitally-enabled solution - they earn commission not just based on sales, but also are able to earn points based on customer satisfaction, how quickly they complete technical call outs, etc. In this way, agents are incentivised not only to join the

[17] Rural Electrification Act, 2004

Yellow Solar network, but also to ensure ongoing quality and efficiency in their operations.

Mini-grid

Affordability: Mini-grids more affordable than traditional energy sources in the medium term. Solar mini-grids offer a good option when the goal includes sustained impact and local business development. Most mini-grids are designed and constructed to provide access to energy for the whole village and also to support the productive use of energy. They can generate enough capacity to stimulate and support small and medium-sized businesses, and they can continue operating for 20 years or more. Owing partly to improving technology, the operating costs are also becoming more competitive. Once a mini-grid is installed and operational, it can save households USD6 to USD24 per month compared to the cost of diesel generators, kerosene lamps or SHSs (Energy and Environment Partnership Trust Fund, 2018).

Access: Mini-grids an existing solution in Malawi. In rural Malawi, mini-grids have been used over the last 10 years (e.g. to serve a specific tea estate) and are recognised as a potential solution for improved electricity access (see Appendix C for examples). These systems are particularly suited to a rural Malawian context, due to compounding economic and geographical factors: limited rural coverage from the Malawian centralised grid; a mainly rural population; and low capital expenditure for mini-grid system investment (when directly compared to other renewable energy solutions). Mini-grids have the added benefit of being relatively quicker to connect to households than is currently the case for many still waiting to be connected to the national grid.

***Regulatory feasibility*: Positive regulatory developments boost feasibility of mini-grids**. The outlook for mini-grids in Malawi has become much more positive in recent years, following the release of the National Electrification Plan (NEP). Regulation now clearly seeks to promote mini-grids as one way of accelerating electrification in locations where grid extension cannot be an economically viable electrification approach. The mixed experiences of previous mini-grids due to limited long-term support mechanisms have resulted in the

development of legislation provisioning for more deliberate and effective mini-grid support from the Government of Malawi, including more fit-for-purpose licensing requirements and the need for streamlined regulations that are proportionate to the scale of mini-grid developments. There has also been a deliberate effort by regulators to demarcate certain areas and communities for the use of mini-grids so as to avoid any competition with the national grid network. Overall, the recent developments signal a much more attractive environment for prospective mini-grid providers to operate in than has been the case previously.

Market dynamics: Progress being made, but market conditions remain challenging. In Malawi, a general lack of rural businesses makes it a challenge to implement robust mini-grid business models due to the low ability and willingness of customers to pay (Eales et al., 2020). In the absence of subsidies, microgrid developers will likely face challenges to set tariffs that balance customers' limited ability to pay with sufficient income for financial sustainability. The more accommodating regulatory environment may, however, represent an opportunity for prospective providers to serve a substantial segment of the population without facing high barriers to entry and operation.

5.5 Recommendations for Malawi's energy sector

While both SHSs and solar mini-grids have the potential to contribute to improving access to household electricity in Malawi, each model serves different parts of the market and fulfils different long-term and short-term electrification objectives:

- SHSs offer a good option when the goal is to reach as many off-grid households as possible at a low initial cost. SHSs can be quickly distributed and installed in rural homes, and they usually require no licensing or tariff frameworks. Solar PV mini-grids, on the other hand, offer a good option when the goal includes sustained impact and local business development.

- Most mini-grids are designed and constructed to provide access to energy for a whole village and also to support the productive use of

energy. They can generate enough capacity to stimulate and support small and medium-sized businesses, and they can continue operating for 20 years or more. Owing partly to improving technology, the operating costs are also becoming more competitive. Therefore, a mini-grid model may be most appropriate in the Malawi context if the intention is to achieve sustainable impact in the energy sector.

Specific areas where there could be a role for a development partner as market system facilitator in the mini-grid, SHS and grid space, respectively, are outlined in Table 3 below:

Table 3: Energy-sector recommendations overview

Proposed solution	Mini-grid
Partnership opportunity	*Mini-grid providers* *MNOs*
Intervention areas	*Stakeholder convening around regulation and competition* *Integrating mobile payments*

Advocacy and dialogue for advancing mini-grids. Consultations suggest that although the market environment has recently become more accommodating of mini-grids, there are still challenges with realising sustainability of these models. While regulatory progress is being made, work is still needed in putting policy into practice and ensuring there is industry-wide adherence of these standards. In the medium term, this suggests the need for a development partners to fulfil a facilitation role between the national power utility, regulators and mini-grid providers around how new frameworks can be effectively introduced to realise desirable outcomes. To this end, mini-grid providers may benefit from assistance in navigating the regulatory framework, finding and processing new sites and negotiating reasonable tariffs for their projects.

Supporting the integration of digital payment channels. Technical innovations for mobile payments, smart metering and datalogging are key for improving sustainable microgrid service delivery and provide primary data for further

research. Utilising such technologies will also promote transparency and accountability in microgrid business strategies. Practical barriers such as high transaction fees and upfront costs associated with the inclusion of such technology still need to be addressed. This creates an opportunity for development partners to broker partnerships between mini-grid providers and key MNO players to support the widespread use of mobile payments in these models.

Solar home system (SHS)

Reduction in SHS costs a way to provide access to electricity in the short-term. The SHS represents the most realistic model to enhance access to electricity in Malawi in a relatively short period, compared to the mini-grid model and national grid extension. The national grid is likely to be the most desirable solution for extending access to electricity in a way that could serve all household and business use cases. Where national grid connections are not feasible, mini-grids may be able to provide localised solutions, but still require regulation and significant upfront investment. SHSs, however, require no specific regulation or any large infrastructure investment by providers. Any household could procure a system, though a SHS will not necessarily serve all household needs and is unlikely to be able to serve small business needs. There may also be affordability constraints. For low-income households in particular, upfront costs remain high. This suggests a role for a development partner as market system facilitator to partner with existing SHS players to help them obtain funding or make connections between existing/new players and networks that can accelerate marketing. They could also help SHS players to identify areas that are most promising and avoid direct competition with the mini-grid players as the latter grows. In terms of ensuring affordability of SHSs, FMT could also advocate for reductions in import tariffs on both mobile devices and solar systems ranging from SHSs to larger solar units.

National grid

Public-private collaboration can help to address national grid connection backlog. The national grid can still be regarded as a desirable electricity delivery

model in Malawi from a cost and a consumer needs perspective; but, as discussed, a number of significant barriers are limiting its reach and impact. One of the primary barriers is the lack of capacity of the national energy utility, ESCOM, to provide efficient last-mile services that enable households to connect to the national grid. This suggests a potential role for a development partner to explore whether the Government is open to private-sector players getting involved in connecting customers to the grid. This may involve private providers making the final connection between the main national grid line and the household, or they may provide the expertise to ensure the connection and operation of prepaid boxes, after which a portion of the prepaid fee will go to them as payment.

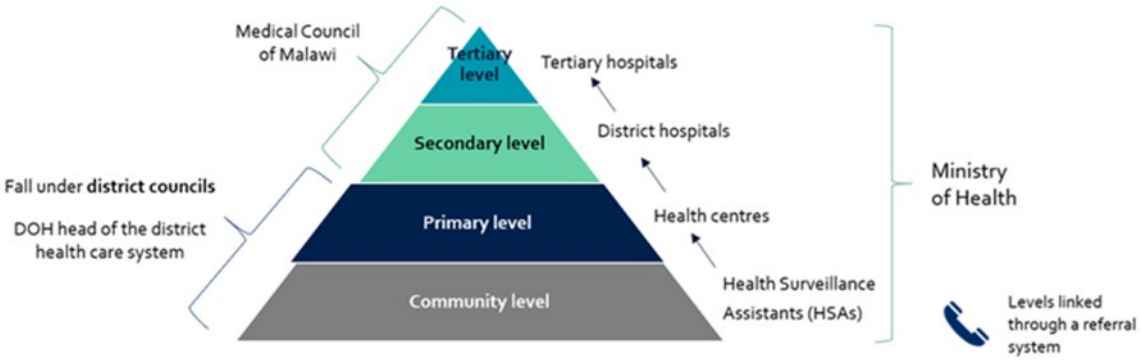
6 Health

Malawi faces a heavy disease burden, especially in Malaria and HIV. Malaria accounts for over 30% of outpatient visits in Malawi and 8.8% of the population aged 15 to 49 years are infected with HIV, with 34,000 new infections recorded every year (WHO, 2018). Tuberculosis also poses a challenge. The country has a high but declining infant mortality rate of 349 per 100,000 live births in 2017. In Africa, this figure ranges from 53 in Seychelles to 1,150 in South Sudan (World Bank, 2021). Other diseases include tuberculosis and tropical diseases such as leprosy. Further, there has been a rise in non-communicable diseases such as hypertension and diabetes (WHO, 2018).

Health sector needs innovative solutions to help address its disease burden, considering its limited funding capacity. Donor funding is key to the health budget, with the health sector receiving the largest share of all donor funding between 2012 and 2015. Donor resources constituted 25% of the FY2018/2019 budget allocated to the Ministry of Health, though the true value of support is significantly higher, as this figure excludes most of the spending through NGOs. Nevertheless, even when combining public and private resources, per capita health spending is the fourth-lowest in SADC. It is 8.2 times lower than the WHO recommended USD86 (excludes off-budget funding). When donor and private contributions are included, spending remains 2.4 times lower than the minimum recommended (UNICEF, 2018).

6.1 Institutional arrangements and supply-side dynamics of the health sector

Figure 8: Institutional arrangement in the health sector



Source: Adapted from information from the Government of Malawi (2017)

The healthcare system is split into four levels, under the overall auspices of the Ministry of Health. Most care happens at community and primary level, falling under district councils. The top of the pyramid has the tertiary level hospitals, secondary care consists of district hospitals, primary level has health centres and community level consists of health surveillance assistants (HSAs). Health services are provided by HSAs in communities, health posts, dispensaries, maternity clinics, health centres and community hospitals. There are roughly 11,000 HSAs, and each is responsible for roughly 1,000 people. They mainly provide promotive and preventive healthcare through door-to-door visitations, village clinics and mobile clinics.

Referrals take patients up the pyramid; however, the referral system is inefficient. In a 2015 study at Queen Elizabeth Central Hospital (QECH), 80% of referrals were sent by government district hospitals but one-third were unnecessary referrals. The study found that in 82% of cases, there was no communication with QECH prior to referral. Additionally, 41% of patients had either incorrect or incomplete diagnosis by referring clinicians, and 39% of referrals were delayed (Pittalis et. al, 2020).

Within the different levels of healthcare, there are four models of service provision: public, private for profit, public–private partnership and private not-for-profit. The Christian Health Association of Malawi (CHAM) is a key player, providing roughly 37% of the country's health services. This figure increases to 84% in rural areas (CHAM, 2020). It is a private not-for-profit religious institution and is in a public–private partnership with the Ministry of Health. These partnerships help to address some of the major challenges faced by the Ministry because of its limited budget.

There are significant health service supply challenges. There are a limited number of facilities, and many have inadequate infrastructure; only 59% of health facilities had access to regular electricity from the grid as of 2013/14 (UNDP, 2019). There are also major issues surrounding medical supplies and drug shortages. For medicines earmarked to be available on all levels, the availability was 47% in the primary health centres, 56% in the district and 66% in the central hospitals (Khuluza et al, 2019). This indicates worse shortages at health facilities that most Malawians access. There is also a severe shortage of healthcare professionals; 0.04 physicians and 0,44 nurses and midwives per 1,000 (World Bank, 2020) while available healthcare workers have been described as unprofessional (late reporting for duty, harassment of patients, demand for payment).

6.2 Access, usage and affordability issues in the health sector

Public health services account for less than half of all facilities. In total, there are 1,060 health facilities in the country (5.8 per 100,000 people) and less than half are provided by government. There seems to be a particular shortage of government clinics; and though government is the single biggest hospital owner, they still own less than half of all hospitals.

Table 4: Health facilities in Malawi

	Government	CHAM	Private	NGO	Company	Total	Per 100,000 people
Hospital	51	44	22	2	0	119	0.6
Health centre	360	112	5	5	7	489	2.7
Dispensary	46	2	2	0	5	55	0.3
Clinic	25	11	223	52	58	369	2
Health post	27	1	0	0	0	28	0.15
Total	**509**	**170**	**252**	**59**	**70**	**1,060**	**5.8**

Source: Government of Malawi (2017)

No centralised digital management information system. While Malawi operates with a Health Management Information System (DHIS), there has up until now been no system in place to let frontline health workers make use of the information it generates. As it stands, healthcare workers must record patient data on paper, which is then forwarded to the district level and eventually entered into the Ministry's central data repository. GIZ was part of a project that helped better connect health facilities to this repository (German Information Centre Africa, 2019).

Public facilities are free at the point of access, including for medication, provided patients have a referral letter. Recently, a by-pass fee of USD3.4 has been introduced in tertiary hospitals for patients arriving without a referral letter from a secondary (district) hospital. This creates barriers for people living

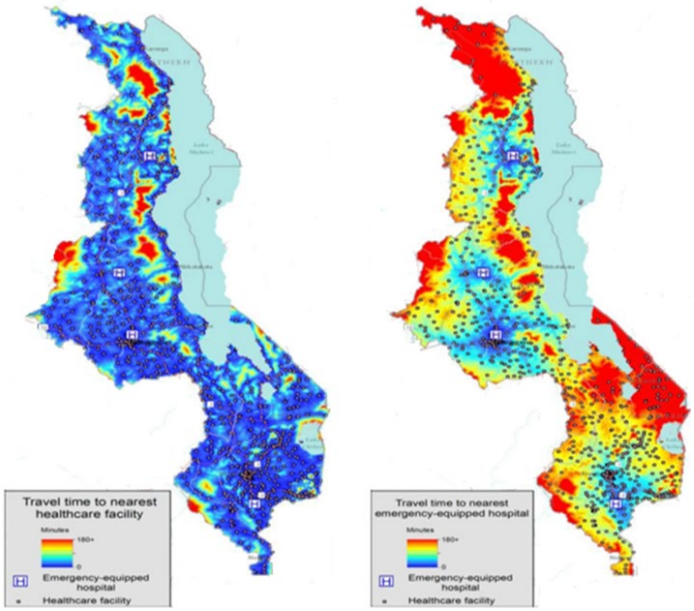
in cities who do not have access to secondary health facilities. Additionally, if government-run facilities do not have required medication, patients are forced to buy their own out of pocket, which adds to the health cost.

All non-government providers charge a fee for their services. Private for-profit, private not-for profit and public–private partnerships all charge Malawians a fee to use. Given generally low income levels[18], this creates affordability challenges (Chansa, 2018). Only 1.2% of the population has some form of medical aid; therefore insurance is not currently easing affordability constraints to any significant extent.

Transport adds to the cost of healthcare, and most people are quite a distance from secondary or tertiary hospitals. The image below shows that geographically most of the country has a short journey to the nearest health facility (the areas in blue). However, on the right, we can see that only urban residents are close to emergency-equipped hospitals (the areas in blue). In the areas in red, the time to the closest emergency-equipped hospital is over three hours.

[18] The minimum wage in Malawi is USD47 (Manganzi, 2019) per month and that the national poverty rate was 51.5% in 2016 (with extreme national poverty at 20.1%) according to the World Bank (2019).

Figure 9: Time to nearest healthcare facility



Source: Johannson et al (2020)

6.3 Overview of best-practice digitally enabled delivery models for expanded access to health

According to e-health literature, there are three types of digital delivery models in the healthcare sector globally: Health services on demand (in turn consisting of telehealth and mHealth), supply chain management and health supplies on demand.

1. Health services on demand. These types of models provide users with direct digital access to medical practitioners and other health services. Users could be patients or healthcare workers, and it includes telehealth, mHealth and ambulance services.

Telehealth

Telehealth refers to a service that can connect a patient (or a health professional) with a health professional. It can therefore be used to offer support directly to patients or to offer training to professional healthcare workers. It can also connect a healthcare worker with a health professional that would allow for more effective diagnosis and care of a patient. In this regard,

Malawi already has *Virtual Doctors*, a programme that was piloted in 2018, supported by the mobile network operator TNM and the Ministry of Health. UK-based NPO Virtual Doctors partnered with the MNO for a smartphone application that connects rural health specialists with UK specialists. If a rural health worker encounters cases that require directions from a specialist, they enter a patient's symptoms and pictures into the application, which is sent to a volunteer doctor for diagnoses and treatment options. For the pilot, TNM provided five doctors with mobile connectivity and contributed USD4,500 towards the project, targeting six sites in rural areas of Lilongwe in Malawi in 2018 (Maravi Post, 2020). A recent report has shown the pilot to have had only limited impact in saving lives so far. Just across the border in Zambia, however, Virtual Doctors – which started as an in-country charity in 2012 and launched telehealth (technologically enabled health services) from 2017 – has shown some impressive impact results having scaled to 140 sites in 27 districts, further covering a reported population of 2 million people, with 6,000 cases having been treated so far (Maravi Post, 2020).

Telehealth benefits both patients and public health workers; this is key during the COVID-19 pandemic. According to Monaghesh & Hajizedah (2020), telehealth has the potential to reduce the use of resources in health centres and to improve access to care (for those who can afford it). It also reduces the risk of person-to-person infection. During COVID-19, this is vital, as people who are quarantining or self-isolating are able to receive medical care. For healthcare workers the benefits extend to being able to consult/obtain expert inputs to help with the fulfilment of their services. Telehealth can also be used as a training tool to reach those healthcare workers in rural areas. Despite the initial pilot challenges, as noted above, Virtual Doctors was repurposed as part of the COVID-19 response. It partnered with the Ministry of Health on an SMS awareness campaign during the pandemic – enabling end-of-call notifications with COVID-19 advisory messages to the population. This has reportedly enabled education and awareness push notifications to 3.6 million TNM subscribers.

Significant challenges in adopting telehealth solutions. A significant challenge of telehealth is its reliance on a computer or digitally enabled mobile device that has a camera, microphone and an internet connection (Iafolla, 2020). Telehealth also requires some degree of digital skill to utilise. There may furthermore be a need for additional equipment (e.g. blood pressure machines). Moreover, there is a higher risk of misdiagnosis in using this solution, potentially adding to health costs (University of Chicago, 2020).

mHealth

Helps to overcome supply-side or demand-side challenges of medical care. mHealth models are generally related to treatment compliance, data collection and disease surveillance, health information systems and point-of-care support, and health promotion and disease prevention.

On the demand side, literature indicates that services can either be "push" or "pull". The services or health interventions are usually reminders, informational messages, or supportive content. Pull treatments refer to those that an individual initiates, so requires them to be aware of when they need support. Push treatments are those services that the provider sends out to a specific group. This model uses mobile apps or SMS/USSD technology, which can be useful on basic phones. An African example is *Momconnect*, a South African service that sends information to pregnant women. mHealth can also be used by healthcare providers, particularly with regard to capturing or registering patient data so it can be saved to a central database. It can furthermore be used by community health workers to help them diagnose the support needed by patients through specific health tools.

mHealth has shown great promise in low resource situations, but challenges remain. Benefits include patient education, health promotion, disease self-management, decrease in healthcare costs, and remote monitoring of patients (Alghamdi, M. et al, 2015). The box below on WelTel, an mHealth solution in Kenya, demonstrates how mHealth can promote positive outcomes in target groups and could result in significant cost savings for government. However, infrastructural and cultural issues such as reliability, network availability,

illiteracy and social acceptability could hold back the adoption of mHealth solutions (Nsor-Anabiah, S. et al, 2019).

Box 5: WelTel

WelTel is an mHealth app supported by USAID, CDC and a variety of Canadian and American universities. It is focused on improving ARV adherence among target groups. The idea was started in 2005 in Kenya when founders noted the high number of mobile phones and non-compliance with anti-retroviral treatment. (WelTel, 2021)

Clinicians use WelTel to send patients automated texts once a week to inquire about their wellbeing. Patients can respond that they are doing well or that there is a problem, and any indication of a problem triggers clinician outreach. If users do not respond to clinicians' texts within 48 hours, clinicians attempt to call the user.

Numerous studies have been conducted on its approach, and overall results are positive. They showed that a higher percentage of those receiving the reminders said they took their drugs regularly but also that viral loads were suppressed in 57 %, compared with only 48%t of the control group. Additionally, about 98% of participants who received WelTel reported that they would like to continue and 98% reported that they would recommend it to a friend. Another study found that WelTel did not impact participant retention in care but did improve quality of life (Centre for Technology and Behavioral Health, 2021).

WelTel estimated in 2012 that expanding that system to all 410,000 Kenyans on ARVs would suppress HIV in 36,000 people, saving USD17.4 million in healthcare costs (MIT Technology review, 2012).

Several mHealth initiatives piloted in Malawi, but no model has yet reached scale. There are many examples of mHealth pilots in Malawi; however, research indicates that most of these do not go further than pilot stage and are very region specific. Pankomera and van Greunen (2019) identified 12 mHealth applications in Malawi, none of which were able to scale up. All of the applications, except one, were funded by donors or government, and most were

focused on child and maternal health. Funds were generally grants and cooperative agreements on three-to-five-year timescales, with continuation not guaranteed despite positive outcomes.

Box 6: Village reach

Village reach targeted both demand-side and supply-side actors, including community health workers, pregnant women, caregivers of young children and women of childbearing age in four regions of Malawi: Balaka, Ntcheu, Nkhotakota and Mulanje

It provided an Integrated Maternal and Child Health service that included a toll-free case management hotline offering protocol-based health information, referrals and automated and personalised tips and reminders service for pregnant women, guardians of young children and women of child-bearing age.

The programme was grant-funded and the Ministry of Health offered in-kind support. It reached 15,000 callers, and 8,000 of those registered into tips and reminders service.

Source: GSM (2014)

Supply chain management refers to models that create efficiencies in the health products supply chain, which (as indicated) is a weakness in Malawi. A big challenge is supply of medication to health facilities and patients. The use of digital technology for supply chain management could help create efficiencies in managing the medication supply ensuring that healthcare facilities have the medication they need (no stock-outs). Specific examples of supply chain management include: e-pharmacy systems and automated medical deliveries.

3. Health supplies on demand refer to delivery models that connect providers and consumers of health products, such as digital marketplaces. Digital marketplaces allow consumers to buy genuine medication online, ensuring they receive the medication they need at a time that is convenient. However, this type of digital model faces significant challenges in lower-income market segments.

Overall, digital models have great potential in fighting the key diseases faced by Malawi, but success has not been proven in Malawi. There are examples globally of digital solutions targeted at specific disease burdens in Malawi, notably malaria, but no such specific initiatives are found in Malawi. For example: the Gates Foundation provides grants to those developing mHealth products or services combatting malaria. One such beneficiary was SmartMD in Cameroon, which is adapting a smartphone to fit a traditional microscope to detect malaria, and another was funded to use digital data to map malaria outbreaks (Gates Open Research, 2019). The box below outlines the case of *SMS for Life*, a mix of mHealth and supply chain management focusing on malaria. It relies on mobile phones and SMS technology but is focused on supply chain issues.

Box 7: SMS for Life

The SMS for Life programme started in 2009, to ensure that there would be no stock-outs of malaria medication. Today it is used by more than 10,000 public health facilities in Kenya, Ghana, the Democratic Republic of the Congo, and Cameroon. Over the years, the scope of the programme has also expanded to more disease areas and health parameters.

It is a public–private partnership led by Novartis under the umbrella of the Roll Back Malaria Partnership. Novartis partners with donors (such as USAID), local governments, international and local NGOs, telecoms companies, and even Google.

SMS for Life uses mobile phones, SMS messages, smartphones and tablet computers, the internet and electronic mapping to help primary health facilities dispense essential medicines, and report their stock levels and key disease surveillance indicators to the district medical officers who are responsible for treatment availability. This ensures that sufficient stock is in the correct locations.

With the addition of the tablet, the programme also offers high-quality training programmes and educational video resources to support the continuous education of health workers.

Source: Global Health Progress (2021)

6.4 Feasibility assessment

For a specific model to be feasible, it needs to have affordable, accessible, feasible regulations and market dynamics. This section will review the feasibility of telehealth, mHealth and digital marketplaces in Malawi at the hand of the feasibility assessment model introduced in Section 3.

Figure 10: Digital models in the health sector feasibility assessment

	Telehealth	M-health	Health marketplace	Public healthcare
	• Remotely extending the reach of healthcare practitioners • Improved access and use of existing human resources • Reduce time and cost for consumer • Physical mediator plays a role	• Enables remote health data capture, diagnosis and information sharing • Preventative healthcare solutions • Build local capacity to address health issues	• Online marketplace for medical products • Effectively connects suppliers and consumers • Includes distribution of products • Structural cross-border trade challenges e.g. road infrastructure	• Universal health coverage for citizens accessing primary healthcare services • Secondary and tertiary healthcare services require payment fees • In 2014 a typical consultation fee was USD1.50 • <9 healthcare centres per 100 000 people in Lesotho
Affordability	✓✓	✓✓✓	✓✓	✓✓✓
Access		✓✓	✓	✓
Regulatory feasibility	✓✓	✓✓	✓✓	✓
Market dynamics	✓✓	✓✓	✓✓	✓
			✓ Low ✓✓ Medium	✓✓✓ High

Telehealth

Affordability: **An expensive option for much of the population but highly affordable for others.** With telehealth there tends to be a subscription, and there may be additional costs incurred as and when health services are sought. Even when there is no subscription cost, there would be a cost for consultations. Where a consultation cost applies, it would be largely unaffordable to large portions of the Malawian market. Further, only 1.2% of the population has some form of private health insurance coverage (Chansa, 2018). As such, targeting medical aid companies or consumers with medical aid for such a programme would probably not be widely adopted. There is the possibility that the cost is not borne by the patient (as with Virtual Doctor); but in this case, service is provided through a community health worker and supported by an MNO (TNM) and the Ministry of Health. The cost of a subscription and a consultation limits the potential of telehealth for the poorest in the country; however, it can provide cost and time savings for wealthier consumers.

Access: **Low smartphone ownership limits the possibility of telehealth for the poorest, leaving it solely for the wealthy in urban areas**. As noted in Section 1, 51.7% of Malawian households have a mobile phone) (Malawi National Statistics Office, 2019) and mobile phone ownership is increasing rapidly, increasing by 12% between 2019 and 2020 (Kemp, 2020). However, most of these phones are basic phones. A 2015 ICT study in Malawi found that 74% of individuals with a tertiary education or higher had access to a smartphone, but the figure was only 20% for those with primary education (Malawi Communications Regulatory Authority, 2015). This would mean that for a telehealth solution to be accessible for most of the country, strong analogue support would be needed. However, as mentioned, telehealth solutions would by their nature require a digitally enabled device and internet connection. A solution that targets HSAs, rather than healthcare service seekers, as users of the telehealth application could increase access significantly (similar to Virtual Doctor).

Regulation: **No explicit regulation, but also not prohibited.** There is little regulation surrounding telehealth, though the Ministry supports the implementation of telehealth according to the 2011–2016 e-health strategy.

The Ministry is also involved with Virtual Doctor, indicating an openness to the model, though regulation concerning issues such as privacy, consent and data storage is lacking.

Market dynamics: **Open market with some opportunities, but challenges remain.** The lack of consumer smartphones is a major setback for the model, but this can be mitigated through the adoption of hybrid digital–analogue models (such as relying on local healthcare workers or even healthcare centres). However, infrastructure challenges such as limited electricity connection also hinder scalability of telehealth. This is further impacted by the cost of care to the consumer, should telemedicine merely facilitate a virtual paid-for consultation. The Zambian example of Virtual Doctors quoted in Section 6.3 suggests that there is a potential opportunity to resolve scaling challenges for telehealth going forward in Malawi. However, this may take large-scale programmatic interventions by donors over a long timeframe. Moreover, the poor internet connectivity in rural areas and limited use of smartphones mean that feasibility of such models will remain constrained in the foreseeable future.

mHealth

Affordability: **mHealth applications generally low-cost for the consumer.** As discussed, these applications are focused on self-care/medication adherence or providing key health information to targeted groups. The cost to the consumer is generally low (or free), only being the cost of the SMS. As the content requires limited need for health specialist engagement, this is generally an affordable option where it is applied globally. Refer to Appendix B for a calculation of likely affordability to the Malawian population.

Access: **Higher access as able to run on basic phones**. Unlike telehealth, mHealth generally runs on USSD/SMS technology, and basic phones are more widely owned. However, a large portion of the population still do not have mobile phones. In addition, where mobile devices are shared among household members, it may mean that they are reluctant to use the phone for health information purposes, as it might raise privacy concerns. Nevertheless, mHealth

can still be considered accessible due to its low cost, its reliance on basic technology and the growing numbers of mobile subscribers in the country.

Regulation: **No explicit regulation but presumed free to operate**. There is no mention of mHealth in the Public Health Act of Malawi (Sambala et al, 2020). However, the Ministry is comfortable with mHealth as a strategy, as it is mentioned in the current Health Sector Strategic plan (2017–2022). It is viewed in terms of the support it can provide to the Ministry for data collection by healthcare workers and facilities, not support directly to consumers.

***Market dynamics*: Challenges to scalability.** The market in Malawi is generally open, and the use of basic phones creates a larger potential market. However, scalability could be impacted by potential difficulty in coordinating different players. As discussed, currently, mHealth solutions are generally regionally based and unable to scale up from pilot stage due to funding issues.

Digital health marketplace

Affordability: **Likely low affordability.** Despite digital marketplace solutions generally offering free-to-use platforms, the cost of health supplies or medication could mean it is too expensive for much of the country. This is especially when compared to free medication provided by government facilities.

Access: **Likely limited to the upper end of the income spectrum.** Few Malawians have access to smartphones or laptops, limiting their ability to access a platform. Additionally, if medical goods are to be delivered, it could add to the difficulty as much of the country is rural. However, it could be helpful in urban areas where delivery is possible, and consumers are already paying by-pass fees to visit the hospital due to lack of secondary facilities.

Regulation: **No dedicated regulation.** Regulation is key in building consumer trust by determining what can be sold, ensuring the medication is safe, and potentially limiting prices of medication so that more of the population could afford it. There is no current regulatory framework that applies to digital health marketplaces.

Market dynamics: **Inactive market.** This is still a nascent model globally, and no examples are found in Malawi. The challenges mentioned above (costs, infrastructure and accessibility) reduce the feasibility in Malawi outside of a very targeted portion of the population.

6.5 Recommendations for Malawi's health sector

No quick wins. Overall, the Malawian context and state of digital "readiness", notably low smartphone penetration, mean that no digital health solution is likely to be a quick win.

mHealth models show the most promise. Among the models assessed, mHealth models are most likely to be feasible. They are straightforward to introduce, but experience globally has shown that it is vital that they be free or low cost to reach the financially vulnerable – thus they may not be commercially viable without donor funding in the short term, at least. This is borne out by the mHealth pilot examples in Malawi: No pilot has yet scaled. This suggests that success requires ongoing funding and committed partners. Many of the mHealth pilots in Malawi were on the supply side and were used to assist HSAs in collecting data and in providing the correct support to communities. In these use cases, mHealth would have the furthest reach if there are links between the central health databases[19] and private operators, as it would allow for efficient and accurate health support and provision of health resources in areas with specific demand. This suggests a clear role for a market facilitator to link health facilities to mHealth providers. However, this is a long-term approach. It ties in closely with creating regulatory clarity to create an enabling environment for innovators to enter the market. A current challenge of mHealth models in

[19] Central Health Databases are nationally held databases storing health information providing an overall view of the health situation in the country. According to the 2015 Malawi National Health Information System Policy, databases include Health Management Information Systems, Logistics Management Information Systems, Laboratory Information Management Systems and the Malawi Hospital Management Information System (Ministry of Health 2015)

Malawi is the sheer number of them used in different regions and their lack of interoperability when it comes to central health databases.

In-principle role for telehealth. Telehealth can help to make more efficient use of existing human resources. It can make doctors accessible in rural areas and help to provide training to medical professionals (but this would probably need significant input from government). However, this would be limited by the lack of smartphone ownership, cost of internet or data and network issues. Virtual Doctor was piloted with only five local healthcare workers who were all provided with mobile connectivity. In order for it to be scaled up, it would require more healthcare workers to receive mobile phones and data. Additionally, the UK-based doctors are volunteers, thus there could be a shortage of support based on doctors able to donate their time, should the model switch to local health practitioners.

Learning from previous models. The best interventions may be those that build on global or regional examples to pave the way for their introduction in the Malawi context. Such an approach would take Malawi's development level and challenges into account (e.g. limited smartphone ownership) and be targeted at front-of-mind disease burdens for Malawi, notably malaria. Cases such as WelTel or SMS for Life work in multiple countries and, with committed partners, could be replicated in the Malawian context. With SMS for Life, what is relevant is the number and types of different partnerships involved in its implementation (from MNOs to NGOs to government and donors). This suggests an important potential role for a development partner as relationship broker.

Introducing digital payment link. The research found no reference to mobile money being used for payments in the healthcare sector in Malawi, although it could provide opportunities for health providers and consumers alike. On the demand side, mobile money payments hold the potential of enhancing efficiencies in healthcare payments, given that more than half of all health facilities are outside of the public health system and charge an access fee. Again, partnerships would be important – this time between an MNO and health facilities. On the supply side, mobile payments could be used for

financial transfers to HSAs as an incentive. This was, for example, the case with MAMA in Bangladesh. Introducing mobile payments reduced the time it took Community Health Workers to be paid from 40 days to 11 days (Imran, n.d).

Scope for microinsurance innovation to enhance access to health services. The average Malawian cannot afford medical insurance, as the very low uptake of health insurance shows. This is despite the fact that 45% of the population would want health insurance. Health insurance would be greatly beneficial in Malawi, as 27% of the population see illness as the biggest threat to income, and 39% see it as their costliest life events (Thom et al. 2015). There are numerous examples globally of health micro-insurance, such as hospital cash insurance paid for via mobile money, to enhance access to health services, but again no examples are found in Malawi. According to the Microinsurance Network[20], there is no microinsurance regulatory framework in the country, but research is underway to assess how to regulate and supervise the microinsurance market. Also possible is a medical savings account using mobile money. These types of solutions would require strong partnerships between MNOs, healthcare facilities and insurance companies, indicating an important role for a market facilitator.

Scope to enhance regulatory clarity. The fact that there is no set regulation on digital delivery models is likely to create regulatory uncertainty that may challenge the implementation of digital models in the country. Thus, supporting government and relevant stakeholders to draft supportive regulation could have positive impacts on the entire digital health sector in the medium term.

[20] No date on the document but it references 2017 statistics.

7 Conclusion

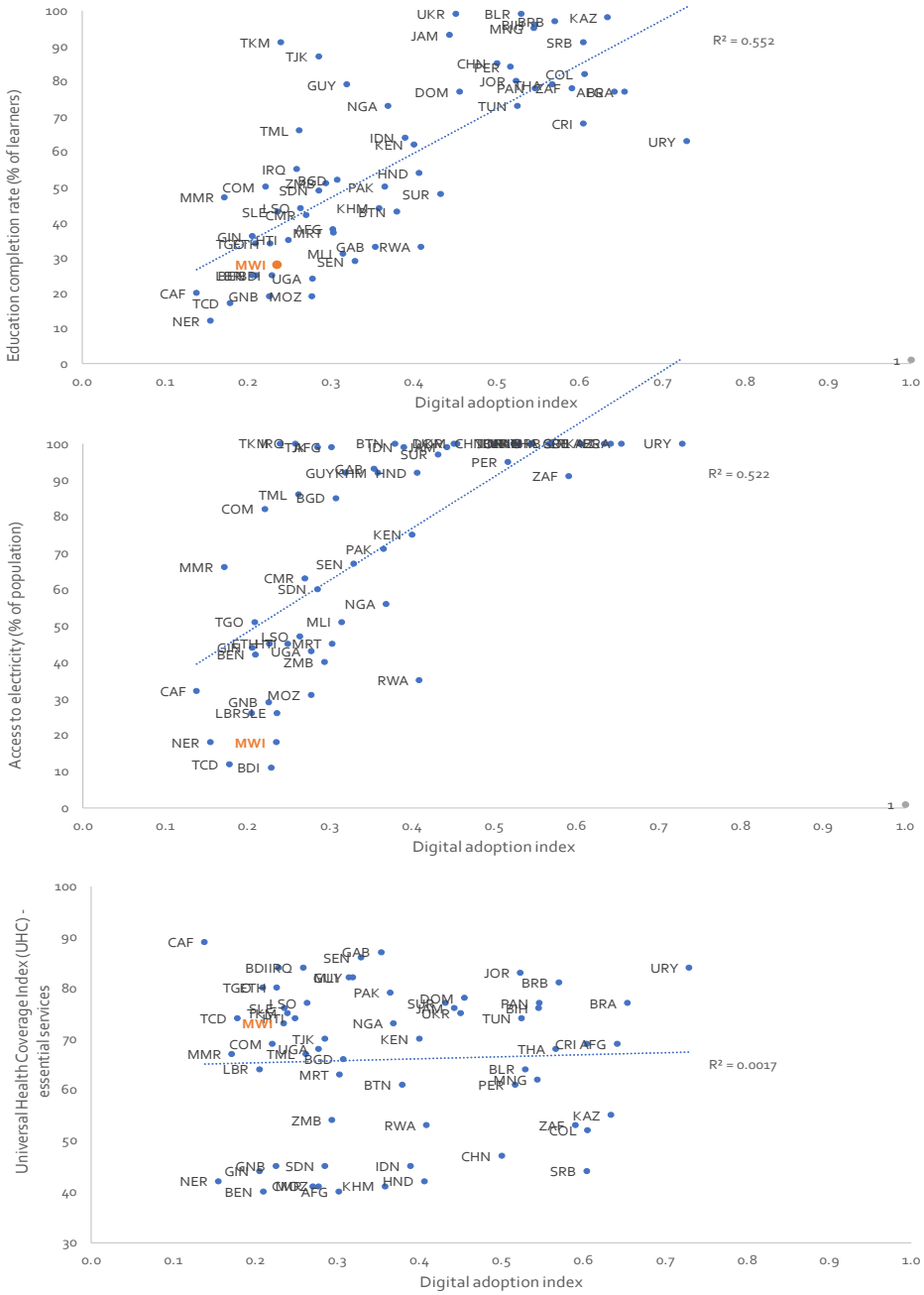
This report has shown that access to basic services remains a challenge in Malawi. While several global best-practice digital delivery models have scope to serve valuable use cases in the local context, their feasibility is not automatic. Limited digital adoption, including smartphone reach, infrastructure constraints, as well as the absence of dedicated regulation mean that reaching substantial scale is likely to be a long-term play. There are also not many existing innovations on the market, signalling that in many instances a market would need to be 'made' through convening of stakeholders and facilitation of partnerships.

Most potential probably lies in the energy space, where existing players could be supported in their efforts to scale, and in mHealth, where models can be introduced to target Malawi's specific disease burdens, replicating models applied with success elsewhere on the continent. In both cases, there is an important role for digital payments, and in the latter also potentially for innovative insurance solutions. Thus, it is important to facilitate public-private dialogue for enabling environment and partnership building across the financial inclusion and basic services spheres.

For countries like Malawi, increasing digital maturation may continue to realise gains to be achieved through piloting and scaling of digital delivery models to expand access to basic services. This could potentially be a strong key to unlocking the SDGs as economic development theory is rapidly shifting. However, for innovative and technologically fuelled providers to bring social impact solutions to the field with scale, creating a supportive regulatory and enabling policy environment and continuing to build the necessary infrastructure will remain important imperatives.

Appendix

Appendix A: Scatter plots for the correlation between digital readiness and basic services access



Sources: Multiple World Bank datasets (latest data available per country) and UNICEF (latest available data per country)

Note: Three letter country codes adopted for scatter plot labelling, with Malawi (MWI) marked in orange

Appendix B: Feasibility assessment assumptions

As part of this research, a feasibility assessment was conducted to identify the digitally enabled delivery models that have the highest potential for impact and reach in Malawi. The potential market that could be reached for the energy, education and health sectors was estimated by drawing on FinScope data, national CPI data and market research on product prices across SADC and by making several assumptions to ensure the data reflected the current reality in Malawi.

To estimate the potential market that could be reached for each of the sectors, the following data was used:

- **FinScope data was used to estimate household and individual incomes along with mobile access.** As the latest available dataset was several years old, we adjusted the income brackets in the data using official CPI inflation rates. The intention was to arrive at a conservative estimate of the potential market, and therefore a conservative approach was taken in the assumption on likely income growth during recent years.

- **Token costs for each of the sectors are based on a desktop scan of products within the sectors from across SADC.**

    - For the energy sector, SHSs were divided into two tiers. Tier 1 includes basic products that offer lighting and phone charging, while Tier 2 products offer these capabilities along with the ability to power one or more devices, such as a radio or TV. For the market estimate, a price was taken that reflected the typical cost of a Tier 1 product: USD6.40 per month. Data points on the upfront costs and ongoing monthly payments for the SHS model were drawn from the public websites of SHS providers.

    - For the education and health sectors, many products offered free access, making their potential markets theoretically equivalent to all adults who have access to the required type of phone. However, many services that have free access have additional costs that are carried by the user, and these vary

considerably, making it difficult to estimate the size of these markets. Therefore, a USD1 subscription service was chosen, as this is sufficiently close to the cost of many subscription services that are available in these sectors.

- To estimate the portion of household and individual income that is allocated to various expenditure categories, including electricity (5.3%), education (2.2%) and health (1.4%), we drew on the Statistics Bureau's monthly CPI calculations and the weights for each of these consumption categories.

The analysis proceeded in the following steps:

- Estimate household and individual income levels and create a grid with numbers and percentages of adults within specified income brackets (the brackets are predefined by FinScope).
- Adjust incomes using CPI and convert to dollars in real terms.
- Adjust the income grid further by reducing cells to reflect access to feature or smart phones
  (as a digital connection is required to make use of these services).
- Use the resultant grid to create three new grids for each of the sectors, by multiplying the figures in each cell with the percentage that households and individuals have available to spend on products from each sector.
- Calculate the total number of adults who could afford a product at various price points, using the sector-specific grids.
- Create ranges for the number of adults who would have access to products at different price points and income allocation per sector to test the sensitivity of the results to the assumptions.

The final single figures for each sector are:

- Energy: Approximately 300,000 to 2.1 million adults could afford a Tier 1 SHS based on their likely income, access to a phone, product cost and available income for electricity consumption.
- Education: Approximately 880,000 to 2.6 million adults could afford a USD1 monthly subscription for an edtech product.

- Health: 1.3 to 2.6 million adults could afford a USD1 monthly subscription for a health-tech product.

Appendix C: Mini-grid initiatives in Malawi

Figure 11: Summary of past and present mini-grid initiatives in Malawi

Name and Location of Mini-grid	Key Stakeholders And Funders	System description	End Users and Business Model	Status	Notes on Successful or challenging aspects
MEGA, Mulanje	MMCT, Practical Action SG, Sgurr	Hydro 80kW	Domestic	Active since 2014	Only breaks even after 5 sites are installed, heavily reliant on funding
SE4RC: Nyamvuwu, Chimombo in Nsanje district (30KW and 15 KW respectively) and Mwalija and Oleole in Chikwawa (55kw and 30KW)	PAC, CARD, FISD	55KW, 30KW,3OKW and 10KW	Domestic, Irrigation	Active since 2018	Improved access to modern energy services that has contributed to better well-being Enhanced community participation and skill transfer. Increased business operation hours and study time in the evening Crop production has increased through irrigation schemes
Sitolo , Mchinji	CEM, CES	Solar 80KW	Domestic	On-going implementation	Financed by UNDP, community participation, skills transfer commercialization and

Name and Location of Mini-grid	Key Stakeholders And Funders	System description	End Users and Business Model	Status	Notes on Successful or challenging aspects
					entrepreneurship development strategy.
Solar Villages Mini-grids, Nkhata Bay, Nkhotakota; Chiladzulu; Mzimba; Thyolo, Ntcheu	GoM	Hybrid (solar and wind) 35KW in all sites	Domestic	None is working currently since 2012	No community participation during implementation Lack of financial and business model No skills transferred to communities Lack of PUE activities
Likoma Island	GoM	Three diesel generators each rated 250kVA	Domestic and institutional	Still active with periodic power cut. 14 hour supply daily	The intermittent electricity supply affects medical care, education services, and the business sector leading to increased vulnerability of livelihoods. It is difficult to supply electricity to whole mainland for 24 hours daily because fuel consumption is higher. There is a need to integrate PV and wind electricity to reduce fuel cost

Name and Location of Mini-grid	Key Stakeholders And Funders	System description	End Users and Business Model	Status	Notes on Successful or challenging aspects
Usingini	PAC	Hydro (300KW)	Domestic and commercial	On going project (still at implementation stage)	Financed by UNDP, community participation, skills transfer commercialization, and entrepreneurship development strategy
Mthengowathenga	Roman catholic Church	Solar Mini Grid (50KW)	Domestic and commercial	Active since 2017	Appreciable reduction of energy costs Reliable and sustainable energy In the hospital, which is connected to the public grid, longer power cuts take place almost every day. Supply but now the power cut has been minimised
ST Gabriel	Roman catholic	Solar-diesel Mini-grid (35KW)	Domestic and commercial	Active since 2017	The costs for public electricity and fuel for the two diesel generators a significant financial burden. Reliable 24 hours energy supply. Programmable, fully automatically working system, switching on

Name and Location of Mini-grid	Key Stakeholders And Funders	System description	End Users and Business Model	Status	Notes on Successful or challenging aspects
					and off, according to energy demand.
Nkhata Bay Hospital	GoM	Solar Mini Grid and solar Geyser	Institutional	Active since 2015	Programmable system automatically guarantees a 100% safe and uninterrupted energy supply with high ecological sustainability and economical use of the available energy sources.
Dedza Microgrid	United Purpose, University of Strathclyde	Solar Micro-grid (5kW)	Domestic and Productive Users	Feasibility study complete	Successful business model relies on CAPEX funding, however smaller capacity means lower upfront costs

Source: (Eales, 2018)

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