REPORT

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

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FINMARK TRUST
Making financial markets work for the poor

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cenfri

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.

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- Accessmad
- ADER
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Prices provided in Malagasy Ariary and the USD equivalent provided by the source. Exchange rate calculated in two instances:

1. Box 3: Accessmad. Amount provided in EUR and exchanged to USD using the rate provided by google on 4 May 2021 (EUR1= USD1.2)
2. Box 4: HERi. Amount provided in MGA and exchanged using the rate provided by google on 4 May 2021 (MGA100= USD0.026)

Executive summary

Across sub-Saharan Africa (SSA) the delivery of basic services in the energy, health and education sectors remains a challenge to the achievement of the sustainable development goals. Relative to its peers, Madagascar is especially constrained where widespread access to quality education, energy and health is concerned, leading to sub-optimal outcomes for its population.

Digitally-enabled delivery models, defined as any implementation models that leverage digital technologies to enhance the delivery of a product and/or service to consumers, have the potential to assist in bridging the service delivery gap and have been making headway across developing countries worldwide.

This study explores the current landscape for each of the three focus sectors in Madagascar and takes stock of existing digitally-enabled initiatives and their future capacity, to conclude on the potential support role for FinMark Trust in each sphere.

Education synopsis

The education system is challenged by funding gaps, a heavy reliance on donor funding, poor quality outcomes and high repetition rates. Enrolment in pre-primary and secondary school is considerably lower than in compulsory primary school. Although the Constitution of Madagascar requires free, accessible public education, in practice, parents and guardians must pay substantial fees.

Where the scope for digital delivery is concerned, a lack of access to electricity, hardware and the internet poses the first significant hurdle. Current innovation in the education sector is very limited and there are hardly any digital initiatives present. As such, the feasibility for digital models is likely to be limited in the short-term. Digital payments have also not made significant inroads in the education sector.

Energy synopsis

Renewable energy is a key government priority to enhance access to electricity in Madagascar. This is especially important, given that the connection rate to the national grid is very low and concentrated in urban centres, which creates significant disparities in access between urban and rural areas.

Madagascar has seen a proliferation of digital delivery models in response to the low grid connectivity, although the widespread roll-out of solar home systems (SHSs) and mini-grids is impeded by challenges where the physical distribution, quality and maintenance of these solutions are concerned – especially in the most remote parts of the country. Thus, although alternative delivery models are already prevalent in Madagascar, there is considerable future potential for digital delivery to further enhance access to energy and to support local SMEs and economic growth. Digital payments have already been integrated into many of these alternative delivery models, but further growth potential remains.

Health synopsis

Quality universal healthcare access in Madagascar is severely challenged by limited resources. Health infrastructure (especially for advanced care), skills and professionals are in short supply, especially in rural areas. Government spending is constrained. This contributes to a reliance on donor funding and means that private healthcare plays a significant role in the provision of services. As such, healthcare is expensive for the majority of the population (despite government interventions aimed at subsidising the cost of medication, for example).

The current scope for digital delivery to enhance access to healthcare services in Madagascar is limited and the challenges facing the sector are likely to remain in place going forward. Although there have been a range of donor-funded pilot projects, the opportunity to catalyse sustainable new initiatives is limited. Digital payments have made some headway in the health sector, including as part of the options to pay for the National Health Solidary Fund (CNSS), which is currently at the pilot stage.

What can be done?

In **education**, there is scope to kick-start and facilitate a dialogue among relevant ecosystem actors through stakeholder coordination – a longer-term endeavour focused on relationship-building and advocacy for the benefits of digital delivery, given the limited innovation in the market at present.

In **energy**, the potential for digital delivery is considerable, as illustrated – and bolstered – by the many active stakeholders in this sector. Engagement in existing conversations to identify where value can be added to on-going activities is key. Moreover, linking alternative delivery models in energy to the other sectors of interest – namely education and health – constitutes a unique opportunity to use digital delivery in energy to simultaneously enable enhanced access to other basic services.

In **health**, as in education, stakeholder coordination and convening, as well as engagement with existing players in the market offer the greatest potential.

Across all three of the focus sectors, there is scope to leverage **financial inclusion** as a tool to extend reach. While digital payments have already made some headway in the focus sectors, they could be further leveraged to enhance efficiencies in delivery. Other financial services such as credit, savings or insurance could also be leveraged to extend the reach of basic service provision. Making the linkage between the financial inclusion and basic services sphere requires engagement with the National Coordination of Inclusive Finance (CNFI), the main mobile network operators (MNOs), as well as sector-specific authorities and innovators in education, energy and health, respectively.

1 Introduction

1.1 Context

Madagascar is the fifth largest island in the world, rich in natural and mineral resources, with a population of 25.6 million inhabitants (Crosse, 2014).

Democratic transition brings economic upswing. The country had its first democratic election in 2018 (USAID, 2021). This followed the 2009 coup that led to five years of political deadlock, international condemnation and economic sanctions (BBC, 2018). Since this deadlock, growth accelerated to an estimated 4.8% in 2019, its fastest pace in over a decade (World Bank, 2020). This growth has been attributed to the return to constitutional order and peaceful political transition (Society General, 2021).

Persistent poverty. Despite the political stability and economic growth, the country remains poor: it is ranked as the poorest non-conflict country in the world (USAID, 2021) and its GDP per capita is less than half of the sub-Saharan African (SSA) average (World Bank, 2019). In 2019, around 75% of the population was estimated to live below the international poverty line of USD1.90, which is significantly higher than the regional average of 41% (World Bank, 2020) and the country is ranked 164th out of 189 countries in terms of the Human Development Index (UNDP, 2019). Most (64.2%) of the country's employed work in agriculture according to the UNDP (2020) and the informal sector. Despite an unemployment rate of less than 2%[1], the working poor (those earning PPP[2] USD3.20 per day) are 85.3% of those employed (UNDP, 2020).

[1] Percentage of the labour force population ages 15 and older that is not in paid employment or self-employed but is available for work and has taken steps to seek paid employment or self-employment

[2] PPP (purchasing power parity) is a rate of currency conversion eliminating differences in price levels among countries so that comparisons between countries reflect differences in the volume of goods and services purchased for a specific amount (UNESCO, 2021).

Stark regional poverty divide. There are wide inter-regional and urban-rural disparities. In the largely rural regions of Androy, Atsimo-Atsinanana and Sofia[3], the poverty rate exceeds 90%, but in the urban areas Analamanga (Antananarivo) and Diana (Antsiranava)[4], poverty rates are 43.5% and 54.5% (African Development Bank Group, 2017). The urban-rural disparity is particularly pertinent as only 37,9% of the population lives in urban areas (O'Neill, 2021).

***Number of development challenges*.** These high poverty levels are indicative of severe development challenges. The country's reliance on agriculture makes it vulnerable to climate change – Madagascar is one of the African countries most severely affected by climate change impacts, experiencing an average of three cyclones per year (World Bank, 2020). Further, despite the political improvements, corruption remains a challenge, with the country ranked 149/180 countries with a score of 25, decreasing by 7 since 2012 (Transparency International, 2020). This is a particular challenge as the country is heavily reliant on bilateral donors and multilateral institutions to support basic services such as education and health (USAID, 2020). Adding to the challenges is the county's terrain, which creates many isolated villages (Roberts, 2019).

***Situation worsened by COVID-19*.** Due to international travel restrictions as well as the financial impacts of the pandemic, there has been a drop in tourism activities[5], exports and domestic demand. The decreasing tax revenues led to a deteriorating fiscal situation, with the domestic primary balance turning from a small surplus in 2019 to a deficit of about 3% GDP in 2020. Government's response to the pandemic was the implementation of short local lockdowns, with schools being closed for longer periods (Reuters, 2021). A social protection programme was launched to assist urban and suburban families in 3 regions impacted by the COVID-19 outbreak through the payment of a once-off, unconditional cash transfer of USD26 in March 2020, using mobile money or vouchers collected by beneficiaries. It reached nearly 189,400 households (APO

3 These are rural areas according to Citypopulation.de (2020)

4 Classified as urban areas according to Citypopulation.de (2020)

5 Travel and tourism contributed 16.1% of GDP in 2019 (Knoema, n.d)

group, 2020). This programme, *Tosika Fameno,* was then continued and expanded, both geographically and in terms of number of beneficiaries, to include over than 345,000 beneficiaries by October 2020 (Rakotoarison, 2020).

Particular challenges in basic service delivery. Government expenditure on basic services does not meet the SSA average for health or education. Rural electrification levels are also lower than average.

Table 1 Key figures in Madagascar

Indicator	Madagascar	SSA	High income countries
GDP per capita	USD1,647	USD3,758	USD49,919
Government expenditure on education (% of GDP)	2.8%	4.3%	4.9%
Access to electricity	25.9%	47.7%	100%
Domestic general health expenditure (per capita)	USD28.25	USDD84.84	USD37,15.71
Mobile cellular subscriptions (% of total population)	41%	82%	128%

Source: World Bank (multiple databases)

The result of these challenges, as well as the low spending ability of government, is poor service delivery and negative outcomes for the population.

Digital services can help increase access to basic services. Internationally, innovative digital solutions have helped to increase access to basic services. For example, in Ivory Coast 99% of all students paid their fees digitally (94% by mobile money) in 2014, up from 60% during the 2011–2012 school year, when the payment initiative was first launched. The impact of the adoption of these digital fee payments has been drastically reduced lost payments, fraud, and theft. It also reduced the cost and administrative burden of managing cash, and the risks associated with it (Frydrych et al, 2015). Digital models are already being used for basic services in Madagascar, notably for pay-as-you-go electricity payments (PAYG)

This report evaluates the viability of digital models in extending access to education, energy, and health in Madagascar.

Digital infrastructure a challenge, but some positive indicators. The scope for digital innovation to support basic service delivery depends on the digital "readiness" of the country in terms of infrastructure and technology adoption. Madagascar is rated as having a connectivity index score of 31.3[6] by GSMA, placing it in the low connectivity or "discoverer" group. It scores particularly poorly on content and services (21.3) and affordability (24.1). Consumer readiness is the highest scoring category at 49.2 (GSMA, 2020). Madagascar has relatively low mobile phone ownership; 52% of households have a mobile phone according to INSTAT (2019), but ownership is increasing rapidly[7]. There are large regional variations in mobile phone usage, linked to the rural/urban split; usage ranges from a low of 21% to a high of 83% (INSTAT, 2019). Variances also exist by employment, according to the 2016 FinScope survey (e.g. 16% of farmers vs 61% of the formally employed have a mobile phone). Mobile money is already used in Madagascar, with over 2 million adults using the service according to the 2016 FinScope survey. As with mobile phone ownership, mobile money usage also varies by employment type (e.g. 4% of subsistence farmers vs 23% of those formally employed) (Thom, 2017). The country is regarded as well positioned for mobile money growth and was, in 2016, one of the first countries with live interoperability between all mobile providers (Naji, 2020)[8].

1.2 Structure

The report is structured as follows:

- Section 2 presents the research methodology.

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6 All indices out of 100

7 According to the World Bank (2018), in 2009, only 30.55% of the population had mobile cellular subscriptions

8 The impact of interoperability is undermined because the "client surcharge" has been left to the discretion MNOs, leading to mixed pricing models with differing values for cross-net transactions; with some mobile money providers (MMPs) charging cross net senders, but others charging cross net receivers (Naji, 2020).

- Section 3 outlines a framework for assessing the feasibility of digital models for basic service delivery.
- Sections 4 to 6 consider the scope for digital technology to enhance access to basic services in each of the three focus sectors.
- Section 7 presents cross-cutting conclusions and recommendations.

2 Methodology

The research comprised:

- A desktop scan of the country context and of digitally enabled delivery models for expanding service delivery (internationally, as well as any examples found in Madagascar) across the education, energy and health sectors.
- Key informant interviews with stakeholders in the basic services ecosystem.
- A qualitative feasibility assessment of different types of digitally enabled delivery models for each sector.
- Quantitative estimates of the potential reach of different types of digital models in the context of Madagascar.
- Throughout this report, the following key terms and definitions are used:
- **Digital transformation:** the transformation of economic activities through digitisation and/or digitalisation. The former entails converting analogue processes into digital processes; the latter entails inserting digital processes into the workings of businesses or everyday life (The Enterprisers Project, 2021).
- **Digitally enabled models:** a broad set of implementation models underpinned by technological innovations; essentially, these models leverage digital technologies (e.g. digital tools, digital channels) to enhance the delivery of a product and/or a service to consumers (FourWeekMBA, 2020).
- **Digital tools:** programs and websites and/or online resources that make it easier to complete a task, such as machine-learning applications (Department of Health and Social Care (UK), 2020).
- **Digital channel:** a digital platform through which communications and/or payments can occur, for example mobile money channels.

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

As noted in Section 1, Madagascar is lagging substantially behind its regional peers on certain indicators for access to quality basic services. Digitally enabled delivery models could play an important role in helping to support and improve Madagascar's performance on these indicators. Although there is a range of digitally enabled models that are already being used around the world to enhance access to basic services, the local context means that not all models will be equally appropriate or viable for adoption in Madagascar.

Sections 4 to 6 outline and assess the feasibility of different digital delivery models in each of the focus sectors. The analytical framework[9] that is applied consists of four key criteria for feasibility: affordability, access, regulatory feasibility, and market dynamics:

- **Affordability.** How affordable is the digitally enabled delivery model? This question is answered by considering the cost of accessing and using the model. The size of the target market for whom the model would be affordable is then calculated by considering disposable income and making assumptions on percentages to be spent on basic services – see the Appendix for an overview of the estimation for each sector.
- **Access.** How accessible is the model to the population at large? The factors that determine the answer to this question include:
    - *Physical infrastructure*. To what extent is physical infrastructure – such as road networks, national power grids and basic service institutions (such as schools and clinics) – present and accessible?
    - *Digital connectivity.* To what extent are ICT infrastructure and mobile devices readily available for communication and transactional purposes?

9 This analytical framework is also applied to other country studies in this series.

- **Regulatory feasibility.** Do government structures, regulations, policies, and incentives support or impede digitally enabled delivery models?
- **Market dynamics.** How viable is the digital model from the provider's perspective? Although there are numerous factors that can affect this criterion, here the focus is on the level of competition in the market and the scalability of the model, given any potentially large barriers that the provider may need to overcome.

In Sections 4 to 6, the starting point for the feasibility assessment is understanding the context within which digitally enabled solutions can be applied in each of the focus sectors, as well as the core challenges faced in expanding access. Next, the best-practice models identified as having the most potential to help to overcome the specific delivery and access challenges faced in each sector are introduced. The best practice models were selected based on a non-exhaustive desktop scan of models that are currently operational around the world, but especially in Africa. The prevalence and feasibility of each of these key models in the Madagascan context is then assessed by applying the analytical framework, on the basis of which we derive sector-specific recommendations for Madagascar

4 Education

This section describes the potential for digital delivery to enhance access to education in Madagascar. Firstly, the institutional landscape is outlined, secondly, the extent to which Madagascar's population currently access and use this basic service is described, before turning to those digitally enabled delivery models that have the greatest potential to increase access, given the local country context. Lastly, the extent to which the best practice digital delivery models are viable or feasible to implement and scale in Madagascar, as basis for concluding on recommendations for Madagascar's education sector is considered.

Key findings: education

- The education system is marked by funding shortfalls, a heavy reliance on donor organisations, poor quality outcomes and high repetition rates
- Enrolment in pre-primary and secondary school is lower than in compulsory primary school
- The Constitution of Madagascar requires free, accessible public education, but in practice fees are charged
- A lack of access to electricity, hardware and the internet impede digital delivery of education
- Current innovation very limited; hardly any digital initiatives present
- Feasibility likely limited for digital models in the short-term

4.1 Institutional landscape

Grounded in Education Sector Plan (2018-2022). The education system is currently governed by the Education Sector Plan for 2018 to 2022. Education forms part of the National Development Plan (2015-2019) goals. The Education Sector Plan emphasises strengthening the management and governance of the education system but also responds to education challenges such as a high

dropout rate and disparities in access (GPE, 2020). It seeks to reduce the repetition rate and ensure that schooling is free at primary level (Ministry of National Education, 2017).

Changing structure. Schooling in Madagascar is divided into six levels: (i) pre-school; (ii) five years of compulsory primary education (Basic 1); (iii) four years of lower secondary (Basic 2); (iv) three years of upper secondary (general secondary); (v) technical and vocational education and training (TVET); and (vi) higher education. The first five subsectors are governed by the Ministry of National Education and Technical and Vocational Education (MENETP), whereas the higher education subsector is overseen by the Ministry of Higher Education and Scientific Research (World Bank, 2018). This structure is in the process of changing, however. The current Education Sector Plan seeks to implement a 9-year basic education programme (which combines Basic 1 and Basic 2). This includes three sub-cycles of three years, each of which has exit profiles and evaluations. It is planned that the third sub-cycle will be assessed by a national examination, which, if successful, will enable students to receive a diploma marking the end of basic education (Madagascar Ministry of National Education, 2017). However, while this has bee agreed, it has not yet been implemented and there remains opposition to the change (KII, 2021).

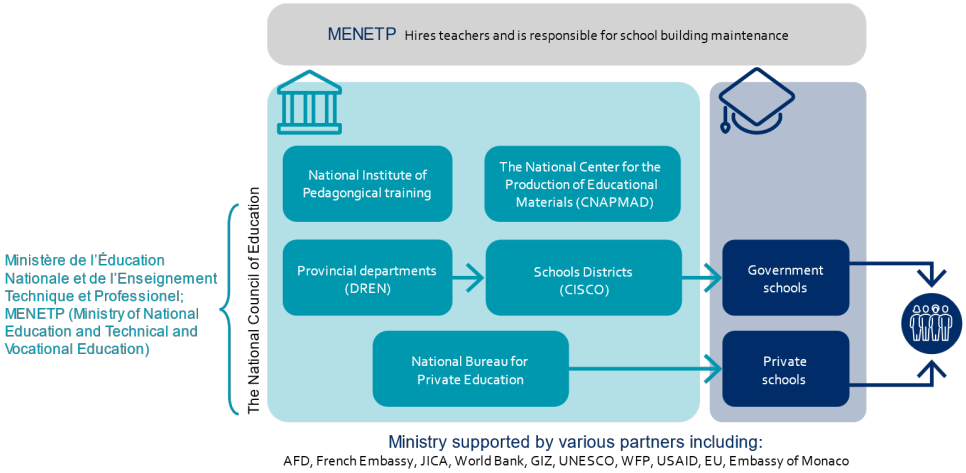

Figure 1: Education sector institutional landscape

Sources: Madagascar Ministry of National Education and Technical and Vocational Education (2017) and Wolhuter and Steyn (2003)

MENETP[10] oversees education sector. The MENETP is directly involved with many aspects of school management, such as recruitment and hiring of teachers and the maintenance of school buildings. As illustrated in Figure 1, it oversees the National Council of Education, which includes the Provincial Education Departments (DREN) and the school districts (CISCO), which are responsible for public schools across Madagascar, as well as the National Bureau for Private Education, which is responsible for supervising Madagascar's private schools. Private schooling plays a large role in the education ecosystem of Madagascar, particularly at the upper primary and secondary school levels, where private schools outnumber public schools.

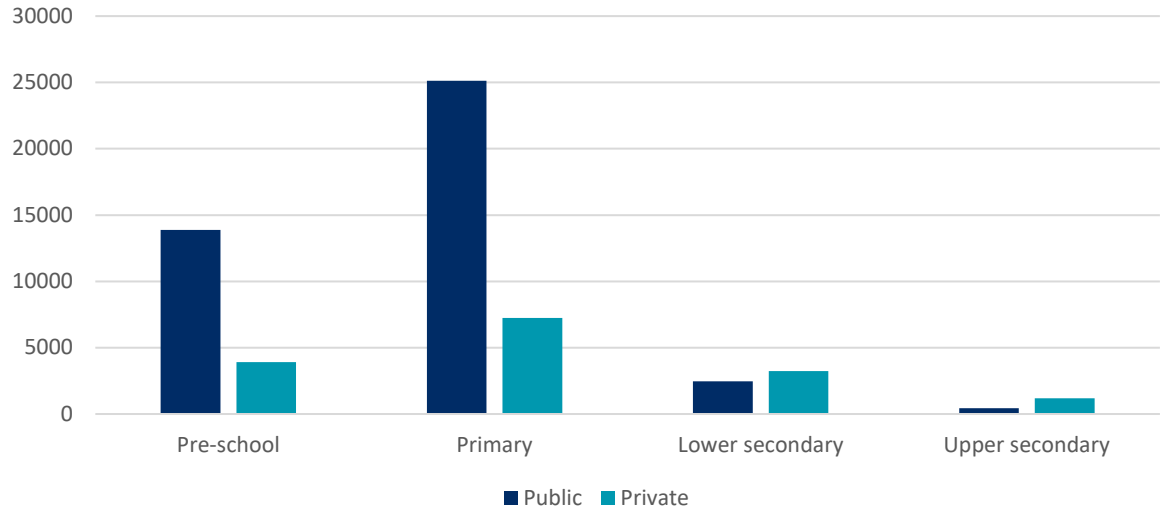

Figure 2 Number of public and private schools in Madagascar (2016-2017)

Source: Ministry of National Education (2016)

Relatively low public spending on education; reliance on development partners for funding. Government expenditure on education as a percentage of GDP was 2.8% in 2018, which is lower than the SSA average of 4.3% (2017) and the global average of 4.5% (2017)[11]. Moreover, spending on education has decreased as a percentage of the Government's total budget since 2014[12] and, as can be seen in Figure 3, there is a considerable gap between the amount

[10] Previously the Ministry of National Education

[11] Most up-to-date data provided by the World Bank.

[12] From 22% in 2014 to 15% in 2019, although this decrease has not been linear.

required for the Education Sector Plan (2018-2022) and the amount allocated in the Medium-term Budgetary Framework. As such, the functioning of the education sector relies considerably on donor funding. The MENETP is supported financially to fulfil its functions by various development partners, including the French Development Agency (AFD), GIZ, The World Bank and UNESCO. The high reliance on donor funding means that the sector is vulnerable to fluctuations in donor spending. For example, after the 2009 coup, there was a freeze on donor funding. To address the resultant lack of funding, fees were re-introduced for public education (Reliefweb, 2011).

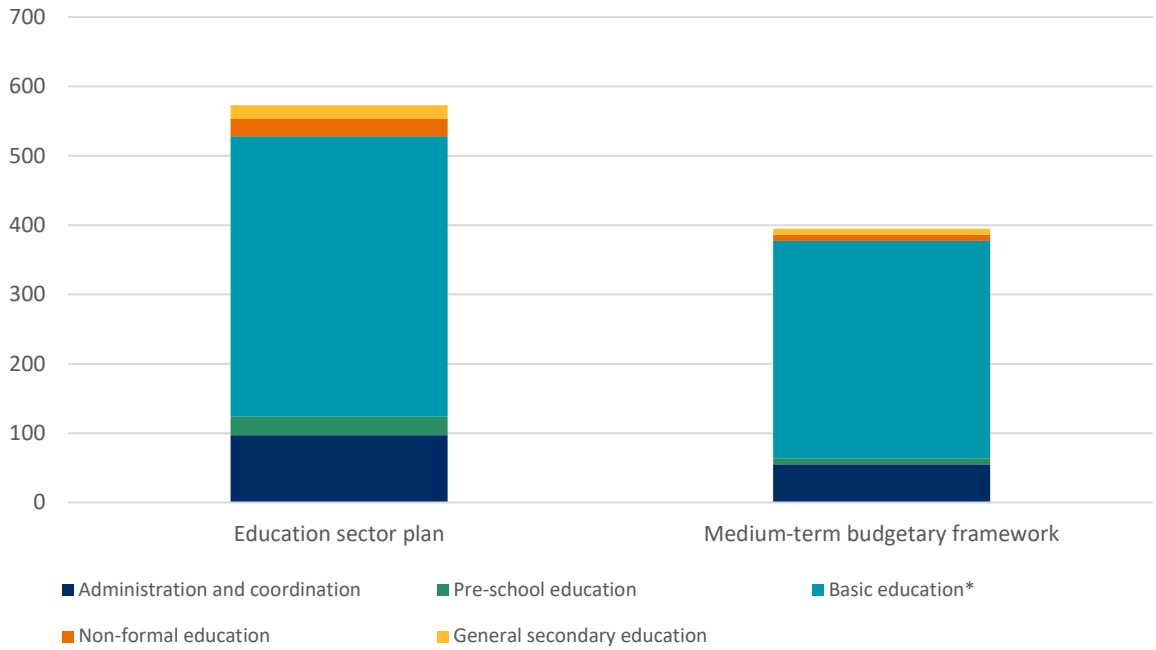

Figure 3 2019 Education budget breakdown by programme (excluding balance) in MGA billions (2019)

Source: UNICEF (n.d)

Digital not currently part of government education strategy. The Education Sector Plan (2018-2022) does not explicitly mention digitisation or digitalisation in its logframe. This indicates that digitalisation does not form an explicit part of the government's implementation strategy for expanding access to education at present.

4.2 Access and usage

Quality of education challenging, dependent on wealth. Madagascar performs poorly relative to its peers on standardised tests measuring the quality of education. In 2019, only 17.5% of children in their final (6th) year of primary school met minimum competencies in reading compared to 47.9% in Francophone SSA; 21.6% had minimum competencies in mathematics compared to 38.1% in Francophone SSA (PASEC, 2019). Beyond these averages, according to Oxfam, lies an even starker reality – by the end of primary school, 97% of the richest pupils have learnt the basics in reading, but this figure drops to only 15% among the poorest (Waler et. 2019).

Basic infrastructure, access and affordability constraints contribute to the poor quality outcomes. As will be described in the Section 5, access to electricity is particularly low in Madagascar. This is also the case at schools. It is unclear how many of the schools in Madagascar have electricity. According to research by Enclude BV (2019), in 2016 only 379 (1.6%) of the 23,090 primary schools and 212 (9.8%) of the 2,173 secondary schools were electrified – and these are mostly located in urban areas. Data from UNICEF (n.d.) suggests significantly higher rates of electricity access at schools (51.9% at upper secondary but only 8.3% at primary level). Irrespective of the source, it is clear that the rate of electrification in Madagascan schools is relatively low. Computers at schools are also rare. According to UNICEF (n.d.), only 24.9% of upper secondary schools, 13.1% of lower secondary and 1.6% of primary schools have access to computers. Schools lack even basic hygiene facilities and, when available, students are sometimes forced to pay a "maintenance fee" each time they use the facilities (Reliefweb, 2020). Students also contend with long distances to schools (particularly in rural areas) and limitations on the availability of textbooks (World Bank, 2018).

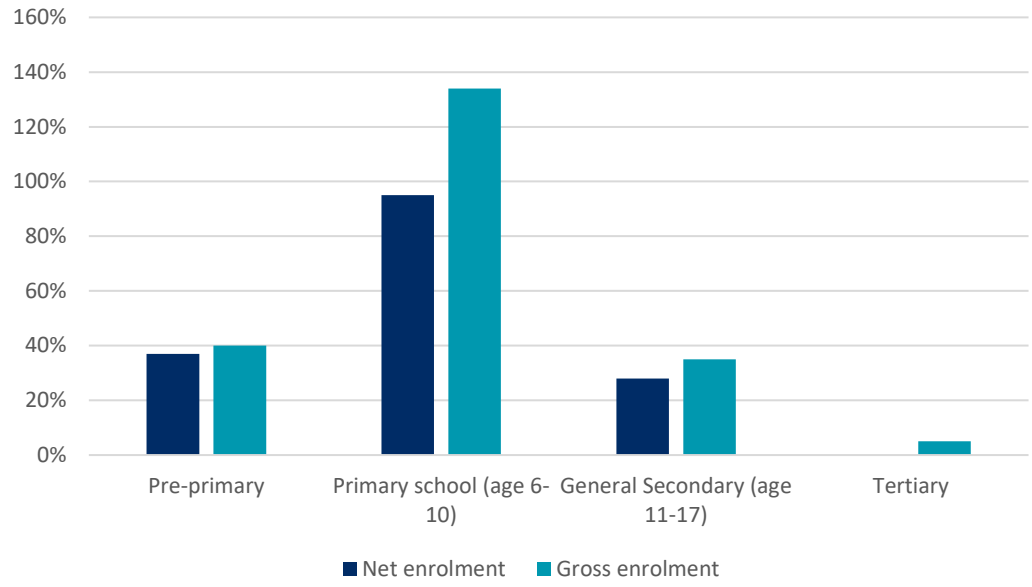

Figure 4 Education enrolment rates (2019)

Source: UNESCO (2021)

Agricultural responsibilities lead to absenteeism. The school calendar in Madagascar is not linked to or in sync with the seasons, despite Madagascan households' heavy reliance on agriculture and the transport challenges associated with the rainy season, which makes it difficult to access schools (World Bank, 2018). By the end of primary school, almost 75% of Madagascan children had taken part in agricultural activities (PASEC, 2019). The necessity to participate in agricultural activities results in absenteeism among learners and teachers (World Bank, 2018).

Low enrolment rates in pre-primary school. As indicated in Figure 4[13], only about 40% of pupils are enrolled in pre-primary school. As such, the level of school readiness among new school entrants poses a problem, which has repercussions for pupils' ability to successfully complete primary school and thus be eligible to attend secondary school (World Bank, 2018).

High enrolment rates in primary education, coupled with high repetition rates. Enrolment in Basic 1 and Basic 2 is compulsory. As illustrated in Figure 4, in 2019

[13] Enrolment data is from 2019, with the exception of tertiary education, where the data is from 2018.

the net enrolment rate was close to 100%, while the gross enrolment rate[14] was 134% (UNESCO, 2021). Repetition rates are high, bolstered by a culture among teachers and parents of accepting repetition because it is believed to increase learning (World Bank, 2018).

Lower enrolment rates in secondary school linked to quality of primary education. There is a significant drop in enrolment rates in general secondary school as a result of relatively higher cost of secondary school and constraints on the quality of teaching in primary school (World Bank, 2018). Teachers in Madagascar generally have limited subject knowledge and teaching time (World Bank, 2018). In addition, the language policy in Madagascar requires a switch to French instruction in the third grade, despite a lack of French language skills on the part of teachers (and students).

Tertiary education reserved for wealthiest. Gross enrolment in tertiary education was only 5% in 2018 (UNESCO, 2021). Internationally, according to the World Inequality Database on Education, the three poorest quintiles have a less than 1% chance of completing tertiary education, whereas the richest children have a 20% chance (Walker, 2019). In Madagascar, 2009 data indicates that less than 0.5% of the poorest people aged 25-29 years completed 2 years of tertiary education compared to 13% of the richest (UNESCO, 2019).

Rural-urban disparities leave rural students at significant disadvantage. There are stark rural-urban and regional differences in accessibility. For example, access to secondary education is just 17% among rural pupils, whereas it is 78% among urban pupils. Teacher-pupil ratios also illustrate the urban-rural divide: for every civil servant teacher in an urban school, there are 96 pupils, whereas this number jumps to 196 pupils for rural schools (World Bank, 2018).

Access and usage constrained by affordability. The Constitution of Madagascar (1992) stipulates that public education should be free and

[14] The net enrolment rate refers to pupils in school who are the official primary school age. Gross enrolment, however, includes pupils of any age (UNECE, 2021).

accessible, but, in practice, it is not[15]. Parents and guardians have to pay fees to provide extra support to schools and these fees can be quite significant –the reduction of out-of-pocket costs for parents is one of the key objectives of the Education Sector Plan (2018-2022). The minimum wage in Madagascar is MGA208,000 per month (USD58), but initial school fees, uniform and equipment average is a lump sum payment of MGA150,000-MGA200,000 (USD41-USD55) (Bass, 2020) – thus constituting a considerable cost. For the 30.6% of primary students that attend private school (PASEC,2019), fees can range from USD1 to USD39 per month (Agence Ecofin, 2020).

4.3 Best practice digitally enabled delivery models in education

A first level of digitalisation in education lies in the way in which schools are administered and school payments are facilitated. In Madagascar, this is still largely based on analogue systems. According to stakeholder consultations, some private schools do accept mobile money payments, but this practice does not seem to be widespread and there is evidence of schools using notebooks to keep track of payments.

A scan of global best-practice models shows that digital delivery can also be used to enhance educational content access or to provide complementary tutoring and learning outside of the classroom. This section introduces these models and considers their current relevance and potential in Madagascar. It shows that, despite their relevance in the developing country context, at present, the potential of **e-learning and tutoring** and **digital content libraries** in Madagascar is still severely constrained by the lack of physical infrastructure and digital connectivity and that there are very few examples operating in the country at present.

[15] In 2020, schools were required to remove their fees. However, they were not provided with financial support to compensate for the drop in income. Consequently, there are still cases of schools charging registration or other fees (RFI, 2020).

The sub-sections to follow then assesses the future feasibility of each of these two models in the Madagascan context.

E-learning and tutoring

Interactive learning model. Internationally, the e-learning and tutoring model offers a simple platform that lets learners use a mobile device to engage and interact with digital educational content, such as courses, modules and training, for remote learning purposes. This can be done either via an online app, or via SMS messages and USSD[16] and typically takes the form of a monthly subscription. Educational resources are meant to supplement the national curriculum. These models often include an "Ask a Teacher" function, which enables students to ask questions to and receive answers from a pool of teachers/tutors who are also connected to the platform and who may receive a financial incentive for their participation. One of the key benefits of this model is that it allows teachers/tutors to reach a greater number of learners and to engage with learners in a more targeted/focused way. Learners are also able to access lessons and quizzes to supplement their revision and homework. This type of model is currently operational in countries such as Kenya and Zambia[17]. See, for example, Box 1 on Eneza Education.

16 While many educational technologies rely on an internet connection, given the lack of mobile connectivity and the cost of data, an increasing number of e-learning and e-tutoring models in Africa are shifting their focus to enabling learning via SMS or USSD.

17 Briterbridges (2020).

Box 1: Eneza Education

Eneza Education is an edtech company that operates in three countries: Kenya, Ghana and Ivory Coast. It provides curriculum-aligned revision material on all subjects for primary and secondary learners on any device, using either SMS (USSD) or internet technology.

Across the three countries, Eneza has assisted over 10.2 million learners, answered over 6.1 million questions on Shupavu291, (the learning platform) and seen a 23% improvement in learners' results after nine months of use. Over 2 million messages are exchanged daily across its learning platforms.

The application has slightly different functionalities across the three countries in which it is operational, depending on its partnerships with MNOs.

In Kenya, learners are able to study lessons, take quizzes, access revision papers, ask a teacher and access *Wikipedia. Source: Eneza Education (2019)*

Accreditation may be required. Stakeholder consultations with providers of similar models in other African markets emphasised that, before launching operations, it is crucial to engage with key stakeholders, such as MNOs/telcos and the regulatory authorities in charge of education. Service providers may also need to seek approval from the relevant education board for the content used and from the relevant education board for the accreditation of teachers/tutors on the platform. To ensure the appropriateness of content used, service providers may also seek to collaborate with private publishers, schools and various ministerial bodies (in the case of Madagascar this would be the MENETP).

No current examples in Madagascar. The research conducted for this report did not identify any current e-learning or tutoring models in Madagascar. The BriterBridges 2020 edtech startup map also did not identify any edtech startups in Madagascar. The only tangentially relevant initiative identified (see Box 2) focuses on providing children with the hardware, skills and internet access

needed to learn computer coding. Another example is the two-year project that Orange, in collaboration with the Agence universitaire de la Francophonie (AUF) and AFD started in 2017 to enhance the skills of, and train, approximately 1,000 primary school teachers (Orange, n.d.). Like CoderDojo, however, it is not an explicit e-learning initiative.

Box 2: CoderDojo

CoderDojo is a volunteer-led and community-based movement that began in 2014 that seeks to provide free computer programming initiation to children aged 7 to 17.

Classes are based on cartoon animations and videogame creations on Scratch, which is a free visual programming language that was developed to help simplify programming animations and games.

In Madagascar, CoderDojo started with borrowed laptops and classes were hosted by Habaka (an innovation hub). With Airtel Madagascar's subsequent support, which included 15 laptops, accessories and unlimited internet access, 45 children could be accommodated per CoderDojo session.

By 2015 CoderDojo remained the only active coding club in Madagascar. Its geographical limitations (to a specific area) resulted in the creation of the CoderBus: a bus transformed into a classroom that transports mentors, computers and coding knowledge to kids in local communities.

From 2017, the CoderBus visited schools in underserved communities and by the end of 2018 it had reached a total of 4,000 children (with some visits serving just to provide children with exposure to the internet and not to train them in coding).

Source: Ravololonjatovo, A (2019) and STEM4good (2018)

Digital content library

Enabling access to digital educational content. The digital content library model gives learners access to educational content (such as textbooks and study aids) in a digital medium and through a mobile device. The digitisation of

educational content has the potential to extend the range of materials to which learners have access and removes the cost of physical distribution. Platforms such as Snapplify[18] (which operates in South Africa), Classmate (which operates in Botswana[19]) and Accessmad – a local example as outlined in Box 3 – illustrate this type of model well. The Orange Foundation, working with the MENETP, also launched the Digital Schools Programme to provide schools with a mobile kit[20] and a Raspberry Pi mini server that contains educational content[21] and is linked to 50 tablets.

Multisided platform, not content developer. Providers of digital content libraries act in a way similar to multi-sided platforms: suppliers and consumers are brought together to enable the purchase of educational content. In this way, platform providers act as ecosystem facilitators. One of the key benefits of this model is that, through partnerships with different publishers, a range of digital textbooks – which vary in quality and price point – become available to schools and learners, allowing them to adjust their purchases on the basis of their needs and income limitations.

Box 3: Accessmad

Accessmad is a French NGO founded in 2003 that manages an electronic media library and gives high school students access to mathematics, chemistry and physical and natural sciences courses. Accessmad also seeks to train teachers to use the media library that it

[18] Snapplify is a South African edtech company that establishes a marketplace for digital education content, related educational services, and devices. Snapplify provides institutions with everything they need to create a secure, collaborative e-learning environment for students. Since starting their operations in 2011, Snapplify has been able to reach a range of institutions (7,196) and learners (369,988) in the South African education sector. For more, see: https://www.snapplify.com/.

[19] Classmate, a USSD-based edtech initiative that operates in Botswana, is an example of a digital content library that creates and markets content from tutors and educators and provides feedback on assessments and quizzes taken on the platform. Classmate currently has 13,000 active users on its platform (Dunn et al, forthcoming).

[20] The mobile kit includes a tablet, SD card, mini speakers, solar chargers and a booklet, as well as packages for monthly calls, SMS and internet access.

[21] This educational content includes school textbooks and a range of online resources, such as Khan Academy lessons, MOOC online teaching and the Wikipedia encyclopaedia.

provides, plus gives schools the digital infrastructure required (IT equipment). The AFD, the French Embassy in Madagascar and the Grand Est region in France are the largest donors of the organisation and programme.

Accessmad has over 100 partner schools and is active in five of the country's six provinces. More than 55,000 high school students and 25,000 college students are able to benefit from more than 5,000 educational documents (including lessons, exercises, answers and practical work).The organisation has provided almost 1,300 computers and, since 2008, roughly 1,500 teachers have followed the training courses organised by EDUCMAD, a programme led by French and Madagascan non-profit organisations that are focused on education in Madagascar.

Accessmad has recently partnered with a solar innovator, Jirogasy, for their solar powered computers, (Jirodesk 2) to be installed in schools. This innovation helps to mitigate the challenge of low electricity access at schools.

To be part of the programme, schools must approach Accessmad and while the media library is free, schools must sign a project membership agreement and contribute financially (it costs about USD12 per year and per computer accessing the media library). This price does not cover the cost of the computers or of the library but, instead, is meant to incentivise schools to value and make use of the service once they have access to it. Accessmad are currently considering how the payment of these contributions can be made digital (given that the process of collecting cash from remote schools can be costly, dangerous and inefficient).

Sources: Key informant interview (2021) and Accessmad (2021)

4.4 Feasibility assessment

As outlined, there is very limited current presence of either e-learning and tutoring or digital content models in Madagascar. Moreover, the scope for replication of regional models (such as M-Shule or Snapplify) is likely to be challenged by infrastructure constraints, as well as the fact that they would

need to be adapted, from a language perspective, to cater to a population for whom English is not an official language.

This section considers the future feasibility of the e-learning and digital content models, respectively, applying the feasibility criteria introduced in Section 3. As outlined in the Appendix, which captures the assumptions that inform these indicative estimates, we estimate that a very basic edtech model (costing USD1 per month) could be affordable and accessible for around 10% of Madagascar's total population. It also applies the feasibility criteria to the public education system as baseline. Note, however, that the digital models considered are not substitutes or competitors to the education system, but rather complementary initiatives in the effort to provide high quality education to all in Madagascar.

The table below (and in each of the subsequent feasibility assessment sections) summarises the feasibility of the different models, applying the criteria from Section 3. The ticks provide an indication of how viable we consider the model to be, with one tick indicating low feasibility, and three ticks indicating high feasibility.

Table 2 Feasibility of digital models in education

	E-Learning and tutoring	Digital content library	Public education
	• Enables remote learning • Limited in Madagascar • May require a smartphone and data connectivity, but can also be rolled out via SMS/USSD	• Enables remote access to educational content • Improves affordability of textbooks • Requires data connectivity • Requires hardware access: computer, smartphone or tablet	• Primary education meant to be free • Cost for parents and guardians still a barrier • Significant regional differences in access • Distance to schools a challenge
Affordability	✓✓	✓✓	✓
Access	✓	✓	✓✓
Regulatory feasibility	✓✓	✓✓	✓✓✓

Market dynamics	✓	✓	✓✓
		✓ Low	✓✓ Medium ✓✓✓ High

Baseline: public education. As discussed, parents and guardians pay significant fees to support the functioning of schools, even though primary education is meant to be free. This diminishes the affordability of public education considerably. Enrolment at the primary level is high but drops sharply beyond this level and disparities between regions and urban and rural areas undermine overall accessibility of the system. From the perspective of regulatory feasibility, public education is fully supported by the MENETP and the current Education Sector Plan. Public education scores high on scalability. It faces competition from private schools – especially in the urban areas, where the difference in quality means that parents and guardians have a strong preference for sending their children to private schools if they can afford to do so.

E-learning and tutoring

Affordability: Challenged due to low household income. Typically, when looking at international examples, e-learning models are quite affordable. For example, M-Shule costs only USD1 per month. However, when you put even a small amount in the context of already constrained incomes in Madagascar, e-learning expenditure is unlikely to be afforded priority in household budgets. Thus, e-learning scores two ticks on affordability.

Access: Severely constrained by lack of infrastructure and devices. In Madagascar, 52% of households have mobile phones, but only 13% have access to the internet and a mere 5% have a computer (INSTAT, 2019). As discussed in Section 1, although mobile phone ownership is increasing, these statistics suggest that there is a considerable segment of the population that would be unable to access an e-learning and/or an e-tutoring model – especially in cases where a smartphone or a reliable internet connection is needed. This lack of infrastructure and devices challenge access through this tool, especially for

those living in rural areas, where most of the population lives, which is why it receives only one tick.

Regulatory feasibility: No apparent barriers, but no encouragement either. Desktop research does not indicate that regulatory authorities in Madagascar prioritise e-learning and tutoring or any digital education initiatives in general. However, stakeholder interviews suggest that the MENETP is open to engaging and collaborating with innovators in the education sector. As such, the analysis suggests that, as long these types of models do not attempt to create new material that needs to be compliant with the curriculum, there would not need to be explicit regulatory approval – thus rendering regulatory feasibility high in Madagascar. However, it would still be important to consult with the relevant authorities, in this case the MENETP, before attempting to launch such an initiative. Hence, e-learning is awarded two ticks for regulatory feasibility.

Market dynamics: Hardly any players in the market; scope of opportunity unclear/limited. None of the limited number of digital initiatives identified in the education market in Madagascar have so far been sustainable. Despite the fact that the teacher training provided by Orange, for example, was free, the initiative still could not reach scale. Any existing e-learning and tutoring initiative from elsewhere in the world would also need to be adapted for/available in French, to be viable in Madagascar. The scale of opportunity for launching/implementing this model is thus very limited, as is illustrated by the lack of players in this space, affording it one tick for market dynamics.

Digital content library

Affordability: Challenged due to low household income. As with e-learning models, generally low incomes in Madagascar challenge affordability for digital content. Affordability will depend on what content is to be purchased. For example, a model like Snapplify is just a platform through which to access e-versions of textbooks and other content, which means that the price of the e-versions themselves play a role in what consumers pay. Digital content is usually more affordable than physical content but may still pose significant affordability challenges. There will also be data costs. In models where digital

content is provided by or in partnership with MNOs, however (such as MTN Educare in Eswatini or Classmate in Botswana), some digital content may be provided free of charge (for Classmate, content was made free for one month in 2020 due to COVID-19), and the cost of data may be subsidised. In Madagascar, the Accessmad initiative attracts only a minimal fee, and the Orange initiative is free, sponsored by the Orange Foundation. In such specific instances, the affordability barriers will fall away. Overall, we rate digital content models two ticks for affordability.

Access: Constrained by lack of infrastructure and devices. Access to educational content libraries is constrained in the same way as access to e-learning models by the availability of the infrastructure and devices required for consumers to use these models. Hence digital content is awarded one tick for accessibility.

Regulatory feasibility: No apparent barriers. As with e-learning and tutoring models, the relevant authorities seem to neither prioritise nor pose a significant challenge to the launch of digital content libraries in Madagascar, leading to two ticks.

Market dynamics: Hardly any players in the market; scope of opportunity unclear. Only two educational content models were identified in Madagascar, both of them funded by donors. This illustrates the constrained business case for private sector players. Hence digital content models are awarded one tick for market dynamics.

4.5 Recommendations for Madagascar's education sector

Limited scope for intervention; need to focus on current developments. The analysis has shown that, at present, the scope for digitally-enabled delivery models to enhance access to education in Madagascar is limited to a considerable extent. There are structural challenges to basic infrastructure that curtail how far digital can be leveraged to improve or extend the current system. Consumer affordability and willingness or ability to adopt digital models are also likely to be limited. Against this background, the best course of

action would be to support what has already been put in place and to develop those initiatives further. As such, the following opportunities were identified:

- ***Stakeholder coordination for dialogue across public and private spheres, funding partners and key sectors.*** The most significant opportunity in the education sector lies in stakeholder coordination and in the creation, facilitation and strengthening of dialogue among stakeholders to bolster the nascent edtech ecosystem in Madagascar. This longer-term role entails bringing the public and private spheres together to explore and collaborate on digitisation and digitalisation. This would include bringing funders, market players and public stakeholders together for funding partnerships.
- ***Collaborate with an MNO to provide free/low-cost content and e-learning.*** There may also be a specific opportunity to partner with an MNO (such as Orange, given their signalled interest in education initiatives to date) to provide educational content and e-learning to their subscribers that is free or significantly subsidised. The scale of the existing initiative appears to be limited to date. Meaningful support could entail helping to create an understanding of what is needed to strengthen MNOs' efforts in this sphere, as well as exploring the digital payment link for the education system more broadly.
- ***Leverage financial inclusion to extend reach.*** Digital innovation in financial services – especially digital payments – has the potential to help extend reach and build efficiencies in education delivery, for example by enabling mobile money payments. Engagement with the CNFI, with MNOs and with other actors in the education sector constitutes the first step.
- ***Novel opportunity to bring solar providers into education dialogue.*** As will be discussed in Section 5, there is already good traction in solar energy in Madagascar. Further, as discussed in Section 1, there are significant infrastructure constraints that challenge any digital delivery models. As such, bringing solar energy providers/innovators into the education dialogue (as is already done by Accessmad) presents an opportunity that has not yet presented itself in other countries in the SADC region[22] – the scope to bring digital delivery across the two sectors together to supply electricity as part of targeted initiatives for digital content at schools. This is crucial, given the current lack of basic infrastructure across many schools and the need to support any digital

[22] As is apparent from similar country studies that FinMark Trust has conducted in Lesotho, Malawi, Eswatini and Botswana.

delivery initiatives with basic physical infrastructure and analogue support infrastructure. However, it is likely that the feasibility of playing this role without an on-the-ground presence in Madagascar is limited.

5 Energy

This section considers the energy sector in Madagascar. It reviews the current landscape of provision, reach and access challenges, then uses this as a basis for considering the feasibility of different types of digital delivery models in Madagascar.

Key findings: energy

- Renewable energy is a key government priority
- Very low grid connection rate, concentrated in urban centres, creates significant disparities in access between urban and rural areas
- Digitally enabled delivery models already prevalent in Madagascar; explicitly form part of government energy strategy
- Physical distribution, quality and maintenance of solar home systems (SHSs) and mini-grids key challenge
- Considerable future potential for digital delivery to enhance reach – especially if linked to enhancing productive opportunities and to expand reach in other basic services sectors

5.1 Institutional and supply landscape

Energy sector overseen by Ministry of Energy and Hydrocarbons (MEH) and the Office of Electricity Regulation (ORE). Figure 6 illustrates the institutional landscape for the provision of electricity in Madagascar. The MEEH is the government ministry in charge of the energy sector. ORE, the energy sector regulatory body, was established in 2002 and has the mandate to: a) agree, publish and oversee price tariffs and their application; b) oversee the quality of the services being offered on the grid (through licenses, norms and contracts) and c) oversee free market competition (Lane et al, 2019). On-grid energy is generated by JIRAMA (the state-owned electricity and water company), which also generates off-grid energy, in collaboration with independent power providers (IPPs) who sell electricity to JIRAMA to supply to consumers.

JIRAMA most significant player in urban electricity generation. Although the country has privatised the energy sector, JIRAMA still fulfils a significant role in energy supply. It produces about 50% of electricity and buys and distributes electricity from private players to urban areas (SE4All, 2019). Despite its dominant market role, JIRAMA faces significant challenges where financial sustainability is concerned (SE4All, 2019).

The Rural Electrification Agency (ADER) responsible for rural electrification. ADER works under the MEEH to develop rural electrification. It collaborates with JIRAMA for network extensions as well as with the private sector for access to infrastructure. Furthermore, it commissions IPPs to supply electricity to rural areas. Stakeholder interviews indicate that ADER's priorities are, at least to some extent, externally influenced by the priorities of its collaborators and funders.

Consumer-produced energy. SHSs already have a foothold in the country and, as such, there are many instances of consumer-produced solar electricity (as will be discussed further in Section 5.3). However, most solar systems are small, usually a single light system (31%) or a single light with a phone charger (37%) (Naidoo & Loots, 2020).

Various digital payment options. For those accessing electricity through JIRAMA, payments can be made at JIRAMA offices, post offices, ATMs or bank branches, as well as through mobile money. JIRAMA has introduced a pre-paid smart meter system that allows the company to track electricity usage and allows consumers to buy prepaid electricity. By the end of May 2018, it had installed 3,600 smart meters. Customers who consume more than 900kw/h received these smart meters first, followed by customers who had already committed payment fraud, in order to monitor and control usage as well as ensure payment (Towerco of Madagascar, 2017). For IPPs and self-generated electricity, mobile money is a key payment method, although in some cases consumers are also able to pay in cash at the kiosks or stores.

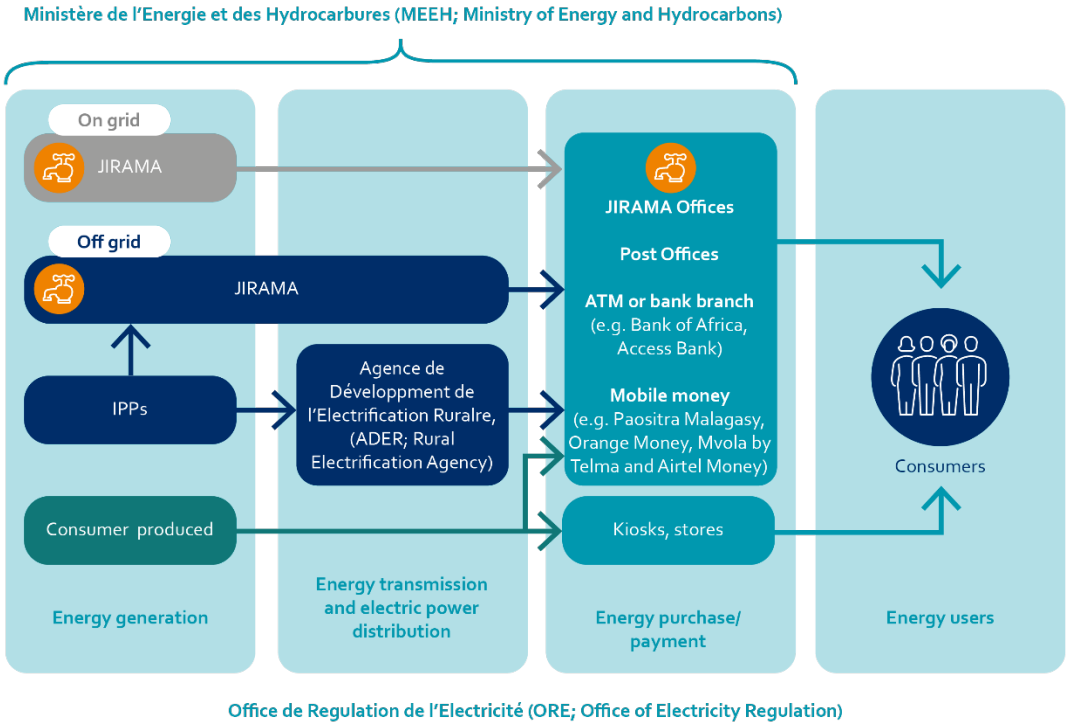

Figure 5 Energy sector institutional and supply side landscape

Source: Authors' own, based on : L'express de Madagascar (2020), Midi Madagasikara (2020) and World Bank (2020)

Reliance on external funding. Stakeholder interviews indicate that the government of Madagascar has the will but not the means to expand access and that it is very reliant on donor funding and partnerships with private sector for developing the energy sector. Stakeholder interviews also suggest that ADER's priorities are, at least to some extent, externally influenced by the priorities of its collaborators and funders. According to ESI Africa (2020), the AfDB provides the most funding to Madagascar's energy sector, but The World Bank and GIZ are also active in this sector.

Increased access, renewable energy major focus of energy sector policies and regulation. Supported by the European Union Energy Initiative (EUEI), Madagascar developed the New Energy Policy (*Nouvelle Politique de l'Energie* – NPE) for 2015 to 2030. It sets out the country's energy targets, including increasing the population's access to modern energy to 70% by 2030. This is equivalent to 7,900 GWh (*Get invest*, n.d). Of the 70%, 20% are expected to be

connected to an off-grid, renewable energy supply[23]; in reality this will need to be higher if the 70% target is to be met (Lane et al, 2019). Moreover, the NPE aims to produce 85% of power from renewable sources by 2030. The new Electricity Code (2017) aims to simplify procedures and liberalise the market further, especially on where the transport and distribution of energy is concerned. The Code is also the basis for the creation of the new National Sustainable Energy Fund (FNED), which is meant to replace the old National Electricity Fund (FNE), and which is aimed at financing rural electrification programmes, including through mini-grids (Lane et al, 2019). According to stakeholder interviews, however, the fund is not operational yet and only receives 8% of the budget it requires.

5.2 Access and usage

Very limited grid access. Only 25% of the population has access to grid electricity and only three of Madagascar's 22 regions have grid connections (Lane et al, 2019; World Bank, 2019). Furthermore, even when consumers are connected to the grid, energy is not reliable; an estimated 36% percent of adults who have access to electricity do not have continuous access for all hours of the day (Naidoo & Loots, 2020).

Considerable disparities in access. Electricity access ranges from 3% in Anosy, Toliara to 64% in Analmanga, Antananarivo; and whereas 55% of urban households have access to electricity, only 5% of rural households do (Naidoo & Loots, 2020; Lane et al, 2019). Moreover, while only 8% of people with no formal education have access to electricity, 86% of people with vocational training or a tertiary qualification have access (Naidoo & Loots, 2020). Inequality in access to electricity – among regions, locations and individuals with different levels of education – is thus a major challenge in Madagascar.

[23] Of this, 5% is earmarked for SHSs (Get invest, n. d).

Majority of energy-related spending on other sources of energy (beyond electricity). Annually, people in Madagascar report spending USD 626 million on all energy sources (Naidoo & Loots, 2020). Of this spending, only 38% is spent on electricity. Of the remaining expenditure, 58% is spent on other energy sources such as charcoal, oil or candles and the remaining 4% is spent on gas. Nationally, the average spending on energy is approximately USD1.08 per week. This amount reduces to USD0.85 in rural areas, where 65% of the population lives. Average overall spending on fuel for kerosene lamps is around MGA500 (USD0.13) per week while MGA1,000 (USD0.26) is spent on candles. On average, about 35% of the population are "sometimes" and 31% "frequently" unable to afford to buy the energy source they currently use (Enclude BV, 2018). Based on current expenditures, it is estimated that between 30% and 65% of all households can spend between USD1 and USD2 on their energy needs (Enclude BV, 2018).

5.3 Best-practice digitally enabled delivery models for expanded access to energy

Grid reach in Madagascar is severely constrained, rendering alternative delivery models crucial to filling the gap. Internationally, SHSs and mini-grids are the main digitally enabled delivery models to enhance access to electricity beyond the reach of on-grid electricity generation. These models are already prevalent in Madagascar and have been shown to provide individuals and households with access to energy that is clean, reliable and cost-effective. Indeed, across the five FMT access to basic services country studies[24], these models have found the most traction in Madagascar. There is much further potential, as acknowledged in the NPE and the Electricity Code. It is estimated that, optimally, about 75% of new connections under the government's National Energy Policy should be provided through off-grid technology; mini-grids and stand-alone solar devices (World Bank, 2018).

[24] Across the other countries studied as part of the series of country studies commissioned by FinMark Trust, namely Lesotho, Malawi, Eswatini and Botswana.

Solar home systems

Plug-and-play solution for electrification of rural households. SHSs are a source of clean electricity – which means that they do not entail air pollution, noise pollution or greenhouse gas emissions. The photovoltaic (PV) technology used in SHSs is a relatively efficient way of delivering uninterrupted but limited amounts of electricity to remote, off-grid households, which can be used for lighting and appliances. Internationally, SHSs have thus been used to meet a portion of such households' energy demand and to fulfil their basic electricity needs. This model can be divided into multiple tiers, based on the types of appliance used in the household (see).

Table 3: 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 a fan	Tier 2 uses AND any medium-power appliances	Tier 3 uses AND any high-power appliances	Tier 4 uses AND any very high-power appliances

Source: (ESMAP, 2015)

SHSs already reaching significant numbers in Madagascar, important for future electrification. In 2018, it was estimated that roughly 830,000 SHSs had been sold in Madagascar. There are nine major SHS providers in the country, plus a number of additional small providers. At the end of 2018, it was estimated that nearly 10% of Malagasy households accessed electricity through stand-alone solar systems such as SHSs or solar lanterns (E3 Analytics, 2019), though the figure by Loots and Naidoo (2020) was 15%. These devices had been sold mainly to higher-income households in cities and rural towns. Furthermore, quality and after-sales service of the market are still underdeveloped. Nevertheless, a high-level least-cost snapshot of the country indicates that optimally about 75% of new connections under the government's National

Energy Plan should be provided through off-grid technology; mini-grids and stand-alone solar devices (World Bank, 2018). Thus, there is much potential for further expansion of SHS reach. There are various models used by SHS and solar lantern companies to distribute their goods. An interesting model found in Madagascar is the solar kiosk model, as exemplified by HERi (see Box 4).

Box 4: HERi

For less than MGA200 per day (around USD0.053), customers in Madagascar can rent a solar lantern from HERi that is charged in HERi kiosks during the day and delivered to their home before nightfall. Consumers can also rent a SHS.

There are 110 kiosks in the country. These kiosks are franchised and managed by local businesswomen. They can be found in nine regions and are estimated to benefit 150,000 people. Through these solar kiosks, 372 jobs have been created.

There is no typical village for kiosks but there are selection criteria to ensure that the kiosk will be viable in a particular village. The criteria include: non-connection to the national grid, accessibility by motorcycle even during the rainy season, a minimum of 250 households and GSM coverage.

Once local authorities have confirmed their interest in a kiosk in the village, the authorities will recommend women involved in the social life of the community who have business experience to open and run the kiosks, turning them into entrepreneurs. HERi also invites applications through poster advertising.

The kiosks provide a multitude of services, many of which are decided upon by the female entrepreneur, taking into account local demand, potential socio-economic impacts and profit opportunities. Examples of services include printing and copying services, refrigeration of fresh products and video projection. Standard offerings of the kiosks are related to charging (lamps, built-in battery radio and mobile phones) and sales (autonomous solar lamps, mobile phones, SHSs and energy saving stoves).

Sources: HERi (2017), Tavenier, L and Rakotoniaina, S (2016), SE4All and AfDB (2019)

Many 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[25]) and the very low level of disposable income at the household level in emerging markets such as Madagascar, energy service providers (ESPs) often permit customers to pay for the SHS through small, incremental payments over a longer period. In this way they incur a lower upfront cost that may be more affordable. The PAYG[26] payment structure not only provides greater flexibility to customers but also offers ESPs a way of making price points more accessible to households and of providing greater control over the payment for and usage of the SHS. In Madagascar, this payment structure is applied by a number of SHS providers, including Baobab+, as seen in Box 5.

Box 5: Baobab+

Baobab+ was launched by the Baobab group (an inclusive digital finance organisation) in 2016. It offers solar lanterns and SHSs through its PAYG lease-to-own model, which allows customers to spread their payments for the SHS over a one- to two-year period (based on the specific product selected). Customers pay their instalments using mobile money from all three of the main MNOs (Orange, Telma and Airtel) are accepted. Twenty- eight percent (28%) of customers report that they chose Baobab+ because of the ease of payment. Once consumers make a payment, they receive a pin to insert into their Baobab+ boxes and are able to access electricity.

Baobab's network of agents is key to its success and it created the Baobab+ Academy to share good practices and information with its agents. Additionally, the company is careful

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

[26] ESPs can provide either a "lease-to-own" model or a "usage-based payment" PAYG model. The former model involves customers paying for the entire generation capacity in small instalments over a period of one to three years. If a customer consistently fails to pay the daily, weekly or monthly rates, the ESP will go to the customer's house and remove the system. The latter model involves customers prepaying for the electricity supply (in kWh) by loading money onto a prepaid meter (usually via mobile credit).

with its PAYG sales, ensuring that consumers will be able to pay future instalments by using vetting calls as a means to determine the ability of consumers to adhere to payments.

Baobab+ is more expensive than other PAYG systems on the market, as it is a higher quality product. However, Baobab+ consumers who are entrepreneurs also have the benefit of being able to access microcredit from Baobab once their SHS is fully paid, on the basis of their payment history.

Since its creation, 200,000 homes have been equipped with SHSs and, in those homes, there has been a 75% increase in study time for learners and a 25% increase in income.

Sources: Enea consulting 2020; Baobab+ (n.d)

Physical distribution a key consideration for the SHS model. One of the key factors influencing the scalability of the SHS model is the ability to establish or leverage an effective distribution network. In this context, a distribution network consists of a combination of supporting infrastructure (such as roads; warehouses for storing goods and vehicles to deliver the SHSs to households) and an agent network to service various locations. Given the lack of basic infrastructure in Madagascar, a well-functioning agent network for physical distribution of SHS products and for consumer onboarding and education in rural areas is crucial.

Maintenance of SHSs an ongoing concern. Relative to other models (such as mini-grids), the SHS represents a lower-quality device that is designed to meet the basic electricity needs of households quickly but that is not necessarily built to be used for extended periods of time. If these devices are overused, ongoing maintenance risks and associated costs may arise[27]. Stakeholder consultations with providers in other jurisdictions revealed that these devices may break down because consumers use them to drive appliances that they are not designed to support and because users are unfamiliar with these devices and

[27] Some providers, such as ACE in Lesotho, are however able to collect data on usage using the Global GSM technology, which may help to identify and address harmful customer behaviour going forward.

their vulnerabilities[28]. From the provider's perspective, the cost of sending maintenance staff to each house to address the faults that occur is high, especially in instances where the devices have been fully paid off or fall outside of their service plan or warranty. Providers such as Boabab+ make use of their agent network to educate consumers on the safe use of their products, which offers a potential approach to ensuring products are well-maintained.

Mini-grids

An off-grid community electrification solution. A mini-grid 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.

Mini-grids not in competition with SHSs. Given that the technology used and the consumer segments targeted are similar across the two models, SHSs and mini-grids are often perceived to be direct competitors in low-income markets. However, the two technologies are in fact complementary. SHS electricity has immediate appeal to householders because of its relative simplicity, but it serves limited household electricity needs. Moreover, it cannot be scaled up to adequately power commercial businesses, health clinics, schools and the other resources required for rural economic development. Mini-grids, however, represent the next step up the energy ladder, given that they can handle more robust electricity generation.

Mini- grids cater for growth in demand. Another advantage of mini-grids is that they allow for growing electricity demand. The introduction of electricity may support local economic development, which will generate additional electricity

[28] For example, the batteries sold in SHSs deteriorate quickly when drawn below 50% of their charge and if this is done frequently, the battery may be destroyed, thus rendering the device unusable. Interviews with stakeholders in Madagascar emphasise that the island has not developed a fully-functional system for disposing of these types of batteries in a sustainable way, which further exacerbates the consequences of this issue.

use cases. Mini-grid providers model for current demand as well as potential future demand, largely based on data from recently electrified communities to build a probability function and generate realistic forecasts of a community's electricity demand. Mini-grid systems can then be built to allow room for expansion as demand grows.

Potential to link mini-grids to SME and economic growth. Stakeholder interviews reveal that there is considerable potential in Madagascar to bolster the revenue generated by small and medium enterprises (SMEs) through access to electricity, which, in turn, can generate growth in local industries, thereby bolstering employment and household income. This opportunity is recognised by public and private sector stakeholders alike.

Mini-grid maintenance is crucial. Research across jurisdictions indicates that 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.

Madagascar a strong adopter of mini-grids, facilitated by government regulation. There are at least 30 organisations operating mini-grids in Madagascar, providing electricity to around 200 villages, thereby serving approximately 7,000 consumers. This places Madagascar ahead of the curve, relative to other SADC countries. These mini-grids are operated by private companies who receive concessions from ADER to operate in specific locations and can also be funded by donor organisations such as USAID (USAID, 2020). Currently, electricity prices for mini-grid are set in collaboration with ADER and have to be viable for both the consumer and energy company. The final price is approved by the ORE.

Challenges in mini-grid sector. Nevertheless, Madagascar's rugged landscape, especially in isolated rural areas, makes the installation, operation and maintenance of mini-grids challenging. At present, mini-grid operators in Madagascar generate power by using diesel, biomass or small hydro generators, with capacities ranging from 40kW to 200kW. There are also

examples of solar mini-grids, an example of which is included inthe Box below. Stakeholder interviews emphasise that there is scope and an opportunity to move to a cleaner model by combining solar and hydro generators to supplement one another (for example, during the rainy season when solar generation is less feasible and hydro generation is likely to be stronger, and vice versa) – but it is unclear whether this hybrid model has been implemented in Madagascar so far.

Box 6: WeLight

Started in 2018 by Accion (a global non-profit organisation), Telma (an MNO) and Électricité de Madagascar (a local Malagasy energy company), WeLight is an impact business working in rural electrification by providing solar mini-grids with batteries. It started as a pilot mini-grid project in a village and is currently in the fourth stage of the pilot, active in 23 villages.

Villages are chosen based on their potential and economic feasibility and factors such as size of population, telecom connectivity, and future electricity usage are considered. Telecom providers also assist in deciding the viability of the model in the village. WeLight accepts mobile money for the electricity payments from both Orange money and Mvola.

Through its mini-grids, the organisation supplies electricity to 3,200 households. It provides energy to roughly 400-500 MSMEs who use it to power their equipment (for example, to refrigerate items, operate hairdryers, de-husk agricultural produce, weld and do carpentry) and to 100 medium to large entrepreneurs who require electricity.

WeLight does not pay tax on the material used to build the batteries or the mini-grid. Article 12 of the electricity code relates to the General Tax and Customs Codes; in 2015, the Malagasy Government introduced incentives for companies investing in the production and distribution of renewable energy in the tax code. This includes a corporate income tax reduction allowance equivalent to 50% of investments in qualifying equipment and VAT exemptions for renewable energy equipment. The Government has also introduced exemptions on import taxes for specific goods such as solar PV equipment.

There are significant challenges in rural electrification and WeLight has 12 sites that are unreachable during the rainy season, except by boat. These types of challenges make WeLight more expensive in terms of cost per kWh than JIRAMA. However, JIRAMA does not provide electricity in these deeply rural areas.

WeLight is keenly focused on the productive uses of electricity and can aid entrepreneurs with their endeavors. They partner with microfinance providers and work with the EU and World Bank to help develop economic activities. They are also finalising a project with GIZ on the productive use of energy that helped startups create mini business plans.

Source: KII, 2021; SE4All & AfDB, 2019

Nano-grids also present in Madagascar. In addition to mini-grids, there is also a nano-grid company, Nanoé, in Madagascar[29]. Formed in 2017, Nanoé is active in the richer northern parts of the country. Their nano-grids provide energy to roughly five households per grid at USD0.13 to USD0.53 per customer per day, depending on consumers' energy consumption and customers pay daily via mobile money. They have reached 350 households so far. Nanoé's nano-grids can be connected to the main grid. It relies on (and is building) a local decentralised electrification platform of small entrepreneurs (called "nano entrepreneurs") who build and operate their nano-grids (Nanoé, 2021).

5.4 Feasibility assessment

As discussed, national grid alternatives are already present and growing in Madagascar. There are examples of mini-grids, nano-grids, SHSs and even solar kiosks. This section will discuss the feasibility of the two most prominent models – namely SHSs and mini-grids – relative to the national grid.

[29] The only such initiative that we could identify in the SADC region.

Table 4 Feasibility of digital models in energy

	Solar Home System (SHS)	Mini grid	National grid
	• Lower electricity output so lower productive use possibility than mini grids • High flexibility • Regulatory requirements minimal • Maintenance and repair complex in rural areas; challenge of low-quality materials	• Prices determined in collaboration with ADER, but more expensive than national grid • Challenges in electrifying rural areas because of country's topology • Regulations support mini grids	• Most affordable for consumers • Centralises energy generation and distribution • Subsided by government • Unreliable supply • Low network coverage, and unlikely to cover the whole country in the foreseeable future
Affordability	✓✓	✓✓	✓✓✓
Access	✓✓✓	✓✓	✓
Regulatory feasibility	✓✓✓	✓✓✓	✓✓✓
Market dynamics	✓✓✓	✓✓✓	✓✓
			✓ Low ✓✓ Medium ✓✓✓ High

Baseline: national grid. The national grid is the most affordable source of electricity, but there is considerable inequality in access (only three regions are currently connected and plans to expand are limited to urban areas). Given that JIRAMA and ADER are supported by the government and the MEEH, this model is very feasible from a regulatory perspective. Where market dynamics are concerned, JIRAMA has a monopoly in urban areas, but is struggling financially (although it is being reformed and there is hope that it will improve). ADER's priorities are affected by external funding from donors and private sector players. As discussed, JIRAMA already accepts mobile money payments and used PAYG technology through its pre-paid boxes.

Solar home systems (SHSs)

Affordability: Less affordable than on-grid electricity. The prices charged and quality of SHSs vary considerably, depending on the model – but PAYG (through digital payments) helps to make SHSs more affordable by enabling households to pay in instalments rather than having to incur a large upfront cost, which earns SHSs two ticks for affordability. It has been estimated that 10-15% of Malagasy households accessed electricity through stand-alone solar systems such as SHSs or solar lanterns (E3 Analytics, 2019; Naidoo and Loots, 2020). Our feasibility assessment (captured in the Appendix) suggests that at a cost of USD2 per month and if we restrict our population to those with mobile phones so as to enable payment via mobile money, around 2 million adults (just under 10% of the population[30]) can afford SHS services.

Access: Topography poses access challenging, but still more feasible than other solutions. Access to SHSs in Madagascar is already very high compared to other countries in the region, at an estimated 10% of households. Transporting SHSs to the remote rural areas of Madagascar is difficult, given limited access to road infrastructure, but relative to the challenges posed by on-grid extension and even the delivery of mini-grids or nano grids, access to these solutions is relatively easier/more viable; hence the three ticks allocated to this model.

Regulatory feasibility: Incorporated into government strategy for energy provision. The NPE targets 70% of households to be provided with access to modern energy, with 5% earmarked for SHS by 2030. This is equivalent to 7,900 GWh – of which 5% is planned to be provided through SHSs (*Get invest*, n. d). As such, SHSs form an explicit part of the Madagascan government's plan for the energy sector and are thus unlikely to face any regulatory barriers, scoring three ticks for regulatory feasibility.

Market dynamics: Many players in the market, but considerable further scope. There are many SHS companies already operating in Madagascar, providing

30 Based on calculations from Indexmundi (2021)

different offerings in terms of generation capacity and price points. The high number of market players is indicative of a strong market that caters to different income levels. Potential scalability is high: it is estimated that Madagascar has a potential customer base for solar products of 2.5 to 5 million households (OMDF, 2020). There is also significant funding available for entrants through the recently launched Off-grid Market Development Fund (USD40 million capitalisation). The project is led by the MEH, financed by the World Bank and managed by Bamboo Capital Partners in partnership with Banque Société Générale Madagasikara as financial partner (OMDF, n.d).The fund aims to provide access to electricity using solar products to at least 300,000 households and SMEs in Madagascar by June 2024. It also intends to develop the off-grid solar market by mobilising the private sector to make it a commercially successful market (OMDF, 2020). Hence SHS scores three ticks for market dynamics. There is, however, a challenge that poor quality SHSs could disincentivise consumers from buying these devices if the perception prevails that the devices are likely to break down and require costly replacement soon after they are purchased. Only two providers were identified as consistently selling Lighting Global31-verified products, namely Baobab+ and HERi (World Bank, 2018). This means that there is considerable scope for the provision of high-quality SHS products to the market.

Mini-grids

Affordability: Less affordable than on-grid electricity, but ORE monitors costs. Stakeholder interviews indicate that ORE oversees the price that private sector players can charge consumers for electricity, taking into consideration the need to balance affordability for consumers with profitability for energy producers. Due to terrain and transport challenges, installing mini-grids is an expensive endeavour. This increases the prices of mini-grid providers compared to JIRAMA, affording mini-grids two ticks for affordability. On the plus side,

31 Lighting-Global is a World Bank innovation that sets the international baseline level of quality, durability, and truth in energy products related advertising to protect consumers (World Bank, 2021).

access to mini-grid electricity can expand entrepreneurs and SMEs' production and revenue generation opportunities in rural areas, thereby enhancing their ability to pay for mini-grid electricity. In general, mini-grid electricity is more expensive than SHS produced electricity.

Access: Relatively more challenging than SHSs, but easier than national grid extension. As with SHSs, there are challenges in electrifying rural areas via mini-grids because of the country's topography. These challenges are even more pronounced for mini-grids than for SHSs given the need to install and maintain the mini-grid infrastructure. Nevertheless, access to mini-grids is more viable for the rural population than extending the national grid. There is also the opportunity to use different kinds of grids – whether solar, hydro or a hybrid model – depending on the region and the availability of a sustainable water source. On this basis, mini-grids earn two ticks for accessibility.

Regulatory feasibility: Regulatory framework in place, but challenges remaining. The nature of the energy sector across SSA means that models such as mini-grids are usually heavily regulated. The reason is that mini-grids tend to form a local monopoly (meaning that one village can only sustain one provider). This is an inherent part of the business model of a micro-utility such as a mini-grid and for this reason the close regulation of tariffs and services in such instances is necessary. One of the main challenges in other jurisdictions is that regulators and policymakers are still developing the policy framework for renewable energy and mini-grid deployment, making it difficult to navigate this space (*International Review of Electrical Engineering*, 2015). This is not an issue in Madagascar, however, given that it has an existing regulatory framework that applies to mini-grids, thanks to the 2015 public-private partnership (PPP) law, that represents a commitment by the government of Madagascar to develop PPPs for infrastructure such as energy. However, the application of this law is not always consistent and transparent (SE4All, 2019). Nevertheless, the NPE plans that 20% of its energy target be provided through mini-grids and 5% through SHSs (*Get invest*, n. d), which is why this model receives three ticks for regulatory feasibility.

Market dynamics: Many players in the market, with considerable further opportunity. The relatively enabling regulatory environment has facilitated market entry and the policy emphasis on renewable energy will continue to do so. The low rural electrification rate creates many opportunities for mini-grid providers, with much potential for scale. Hence, mini-grids are scored three ticks for market dynamics. However, any player's success will depend on the price they are able to charge for electricity (and consumers' ability to pay) – as agreed upon with ADER. Distribution challenges given the difficult topography are also a factor for mini-grid installation and maintenance. This makes certain regions more viable markets than others.

5.5 Recommendations for Madagascar's energy sector

Considerable potential for digitally-delivered energy models in Madagascar. Based on this feasibility assessment, it is clear that digital delivery models already have, and are likely to continue to have, broad reach in the Madagascan energy sector. Although there are challenges to the successful implementation of both SHSs and mini-grids, these complementary solutions provide a much more viable solution to the challenge of expanding access to electricity in Madagascar than on-grid extension does – and this is clear from the fact that these solutions are also included in the government's own strategies. The energy sector in Madagascar is where there are the most developments in digital delivery across the three sectors considered in this report. This is witnessed in the fact that there are many development agencies, donor-funded organisations and private sector players already active in the energy space in Madagascar.

Enter the conversation. Although the extent of the need and the scale of the opportunity are considerable, the proliferation of interested and relevant stakeholders means that it is important for any new player in the space to find touch points into the existing conversation and activities, so as to establish where best it could add value and strengthen complementarities. Engagement with ADER (the rural electrification agency) and ORE (the energy regulator) would be important as entry point into the regulatory landscape if the focus is

on expanding access to electricity in rural areas via the digital models identified. Donor organisations, such as The World Bank, GIZ and the AfDB, and telcos such as Airtel, Telma and Orange, would also be key to engage with. An organisation like FinMark Trust's established track record and expertise in financial inclusion would be valuable to add as angle to these entities' existing activities and interventions. Although digital payments seem to pose less of a challenge in the energy sector than in the education or health sectors, it is not a ubiquitous feature.

Cost-benefit analysis to target support to providers focused on productive opportunities for entrepreneurs/SMEs via access to electricity. Mini-grids have already expanded their reach to specifically focus on (M)SMEs in Madagascar. Moreover, the virtuous circle whereby productive use of electricity leads to a greater demand for electricity (which is good for mini-grid providers) and higher efficiency and income for businesses (which is good for individual enterprises and the local economy) has been firmly established in the narrative conveyed in our stakeholder consultations by government agencies and providers alike. The further promotion of this virtuous cycle would require a cost-benefit analysis of the different solutions offered by various providers, keeping in mind that their reach, partners and the quality of their infrastructure and maintenance abilities are relevant to consider, too. For example, certain providers charge consumers a higher price for electricity because the costs that these providers need to incur in order to be able to serve (i.e. install, repair and maintain) very remote locations are considerable.

Search for opportunities to link to other sectors of interest. Apart from entering the energy conversation directly, there is also an opportunity to link the conversations across sectors that is unique within the Madagascan context. As discussed in Section 4 on the education sector, and as will be discussed in Section 6 on the health sector – there is a need to establish basic infrastructure to serve as the rails or foundation for digitally-enabled models to be launched. As such, bringing stakeholders from across the different priority sectors together – for example, connecting the providers of mini-grids to the creators of digital content libraries and bridging the policy and donor discussions across

the two sectors – has the potential to simultaneously enhance access to more than one basic service.

6 Health

This section will consider Madagascar's health sector and the current and potential role for digital delivery models in delivering access to this basic service. It will review the current landscape of provision, reach and access challenges, and use this as a basis for considering the feasibility of different types of digital delivery models in Madagascar.

Key findings: health

- Limited resources challenge quality universal healthcare access
- Specific challenges in rural population's access to healthcare
- Low public budget goes hand in hand with reliance on donor funding; private healthcare plays significant role in service provision
- Healthcare expensive for most of the population
- Limited current scope of digital delivery; challenges likely to remain in place going forward
- Unique healthcare platform model also underlines constrained opportunities to catalyse new initiatives

6.1 Infrastructure and institutional landscape

Government working towards Universal Health Coverage (UHC). The Ministry of Public Health oversees the healthcare sector, although there are also different regional bodies responsible for the different levels of health services. In 2014, the government of Madagascar developed a national strategy on Universal Healthcare, one of the main objectives of which is to ensure that the population has access to quality health services that are affordable (Government of Madagascar, 2015). Part of this strategy emphasises prepayment for health services. However, at 28%, UHC (a service coverage index), Madagascar lags considerably behind the SSA average of 43.9% (World Bank, 2017).

Relatively low public spending on healthcare. As shown in Table 1 in Section 1, domestic general health expenditure (per capita) is low – less than half of the SSA average and the minimum suggested spend by the WHO of USD86 in resource poor countries (McIntyre, 2017).

High reliance on external funding. Although the government of Madagascar is motivated to improve healthcare outcomes and has demonstrated its willingness to collaborate with innovative players in the healthcare space, it is constrained by a lack of funding and facilities, which means that it relies heavily on private sector and donor funding to achieve results in this sector.

All national- and regional-level facilities public. Figure 6 shows that there are four levels of facilities: community, district, regional and national.

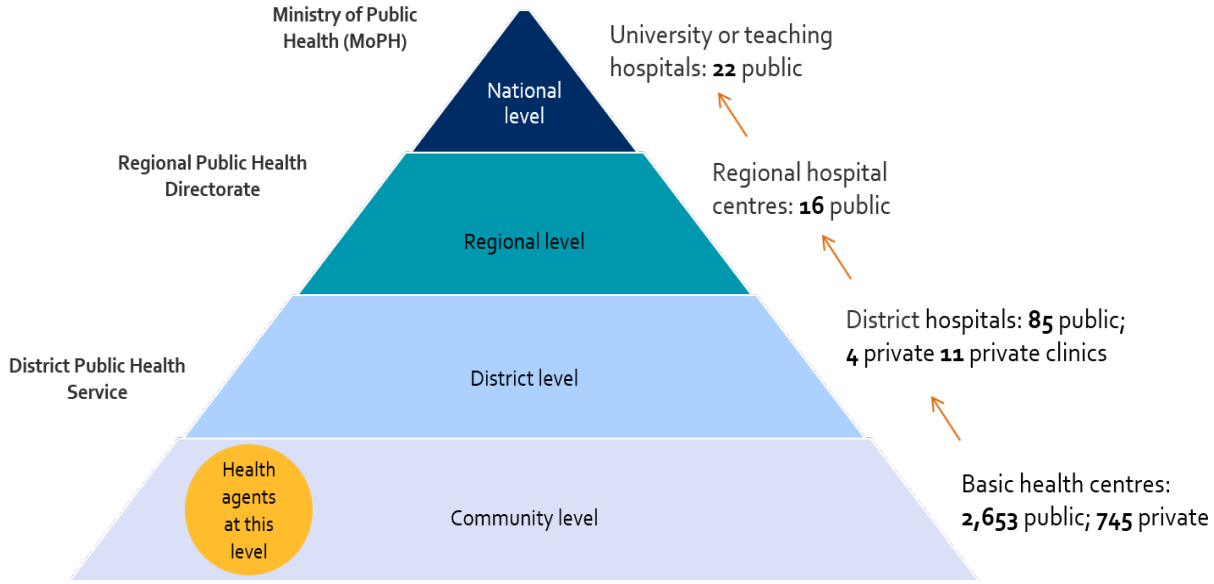

Figure 6 Health sector institutional and supply-side landscape

Sources: author's own based on Brunner et al (2018); AGMED (2020); WHO (2014); and Ministry of National Health (2016)

Private healthcare fulfilling important role. Private healthcare includes private hospitals, basic health centres, NGOs, faith-based organisations, clinics and traditional healers. As illustrated in Figure 6, private healthcare provides much of the service at lower levels. Indeed, research by SHOPs in 2017 indicated that the private sector accounted for one third of total service provision in the country , about 20% of primary care facilities and 50% of first-level referral

hospitals. Further research found that 32% of all caregivers, and more than 25% of the poorest, go to the private sector when seeking care for sick children outside of the home (SHOPS Plus, n.d.). However, there are no private regional hospital centres or university/teaching hospitals (Brunner et al, n.d.).

Health infrastructure unequally distributed, dominated by basic and primary healthcare. As in other sectors, a key challenge facing the healthcare system in Madagascar is the inequity of access to services between households in urban areas and those located in rural areas[32]. For example, the ratio of healthcare professionals in the capital versus rural areas is 12:1 and all advanced healthcare facilities are concentrated in/near Antananarivo, making it challenging for those in rural areas to access advanced healthcare. Thus, over 60% of the population do not have easy access to advanced healthcare (Macrotrends, 2021). Figure 6 also shows the small number of tertiary care providers in the country, compared to primary healthcare.

Shortage of healthcare skills and healthcare professionals. There is a scarcity of human resources and healthcare personnel in Madagascar; there are only 0.15 nurses and midwives per 1,000 people and the specialist surgical workforce numbers only 1 per 100,000 people (in 2016), compared to an average of 2 per 100,000 people in SSA (World Bank, 2021, quoting latest available figures from 2015, unless otherwise specified). Stakeholder interviews suggest that 50% of health worker positions are currently unfilled, which means that healthcare facilities in some areas are closed, leaving people who are seeking healthcare to travel considerable distances only to find no help available. This situation has been exacerbated by the COVID-19 pandemic, which has resulted in staff members being sent to tertiary hospitals to assist with COVID-19. Stakeholder interviews also reveal considerable gaps in medication, materials and transport; with health facilities often running out of drugs and medical supplies in some areas.

[32] The result is unequal health outcomes. A 2014 study found one rural region had maternal mortality and under-5 mortality rates of more than double the national estimate—and nearly double as high as the Sub-Saharan African average (Roberts, 2019).

6.2 Household engagement with the healthcare system

Access and usage constraints. More than 40% of the population lives more than 5km away from healthcare centres and in rural areas, 35% of the population lives more than 10 km from a health facility (USAID, 2021). The level of utilisation of health services is also still low: only 31.2% of the population visit basic healthcare centres and numerous communities are seasonally isolated for months at a time, leaving entire populations with little access to basic healthcare infrastructure (USAID, 2021). Moreover, it was estimated in a 2016 study that only 60%-70% of Madagascar's inhabitants have access to any form of primary healthcare (Marks et al, 2016).

Relatively high household expenditure and out-of-pocket medical expenses. At present, consumers pay out of their own pockets for most healthcare services, including medical consultations, drugs[33] and laboratory tests. The main exceptions are medical consultations in primary/basic healthcare facilities, some preventive services (e.g. child vaccination campaigns), therapeutic treatment of severe acute[34] malnutrition in young children, certain family planning services and the treatment of some chronic diseases (e.g. tuberculosis, HIV/AIDS, leprosy, and bilharzia). In 2010, 82.4% of the population was living on less than USD1.25 per day, and those who consulted a healthcare provider spent on average USD4.73 on medication (up from USD1.65 in 2005) – a considerable out-of-pocket expense. A 2017 study in rural Madagascar also found that fewer than 33% of those who needed healthcare accessed the treatment when point-of-service fees were in place. Removing the fees for targeted medicines and services increased the use of healthcare by 65% for all patients (Garchitonera, 2017). Stakeholder interviews indicated that COVID-19 has increased the cost of medication/drugs – making people even more reticent to make the journey to healthcare facilities. For-profit private sector healthcare

33 The National Health Policy (2003) requires that most medication be paid for at point of care.

34 Severe acute malnutrition is defined by a very low weight for height (below -3z scores of the median WHO growth standards), visible severe wasting, or the presence of nutritional oedema (WHO, 2021).

provision is considerably more expensive than faith-based organisations and NGO network facilities, as well as public sector healthcare.

Various government interventions to increase equity. The Madagascan government is trying to increase equity by subsidising the cost of medicine for the indigent population (the definition of which is delineated at the district level, given stark regional differences) via a tax on the sale of medication. The National Health Solidarity Fund (CNSS), a healthcare social security scheme that was launched in 2018, also has the objective of ensuring that members' cost of care at basic health centres and district referral hospitals is fully covered (Ramamonjisoa and Lang, 2018).

Digital payment methods already used. The CNSS's annual contribution of MGA9,000 (~USD3) can be paid in two instalments via an electronic payment terminal or by using mobile money from the three main MNOs (i.e. Airtel, Orange and Telma). As such, the CNSS is already running on mobile money rails, but the fund has only been piloted in three of Madagascar's 22 districts so far (i.e.Vatomandry, Faratsiho, and Manandriana).

Limited role for private health insurance to expand access to healthcare. Less than 15% of the population has private health insurance. The low average income of the population of USD440 per year (McDowell, 2019) means that private medical insurance is out of range for the average population. Microinsurance has shown some promise, though there is little updated information about the one mobile-money micro-insurance programme identified (Antoka) seen in Box 7.

Box 7: Antoka

Antoka is mobile-enabled insurance provided to Airtel clients in Madagascar that was launched by Airtel Madagascar and Allianz in 2014 (and relaunched in 2017).

The programme was piloted as a freemium product (free enrolment of existing Airtel clients, although they had to register separately by filling out a form) and in 2017 it had over 70,000 subscribers. Antoka allowed clients who maintained certain levels of credit on their Airtel account

over consecutive billing cycles to receive benefits in case of accidental death, permanent disability, or hospitalisation (over three nights).

The benefits vary depending on the customer's monthly telephone usage. The minimum monthly consumption threshold is MGA3,500 (USD0.93), which automatically guarantees insurance coverage over the following month. Unfortunately, there is little information available on the programme beyond 2019.

Sources: Brunner et al (2018); Airtel(n.d) and Matin Madagascar (n.d)

6.3 Best practice digitally enabled delivery models for expanded access to healthcare

Based on desktop research covering other jurisdictions, coupled with contextual information on Madagascar specifically, two main digital models have potential in the Madagascan health sector: telehealth (also referred to as telemedicine) and mHealth. The following sections outline the features of each model as found internationally, with reference to any examples found in Madagascar. Included is also healthcare platforms as a third, unique, model found in Madagascar.

Telehealth/telemedicine

Extending health services through digital means. Telehealth/telemedicine models allow healthcare providers and patients to connect remotely, for example for patients to access remote healthcare consultations, or for healthcare workers to access advice or diagnostic inputs from offsite specialists. Such remote connections are especially important in contexts like Madagascar where there is a shortage of healthcare practitioners and facilities and a considerable access discrepancy between urban and rural areas.

Global relevance of telehealth in response to COVID-19. Although telehealth was possible before COVID-19, it was not particularly popular as it was seen as less effective that traditional face-to-face consultations. The pandemic,

however, popularised and helped to contribute to the evolution of telehealth due to the necessity for social distancing. A 2020 review found that telehealth improved the delivery of healthcare services during the pandemic, minimising COVID-19 transmission and reducing morbidity and mortality (Bence, 2021). As people experience the ease and convenience of telehealth, its global popularity is expected to continue. In a 2020 survey by McKinsey & Company, 76% of respondents were highly or moderately likely to use telehealth going forward (AZ big media, 2021).

Legal, regulatory and ethical considerations. There are significant issues (such as liability, licensure, jurisdiction, quality and continuity of care, confidentiality, data security, consent, authentication and remuneration) that need to be considered when providing remote patient care. In many countries across SSA, these issues are still largely unaddressed, making it difficult to provide and govern these services effectively. These questions still need to be confronted in regulations if telehealth is to become a more widespread and safer digital model in SSA.

Scale and sustainability of telehealth examples in Madagascar unclear. There is little evidence of telehealth being used sustainably to provide care to patients in Madagascar as those telehealth initiatives identified seem to be pilot projects assisting service providers to provide higher quality care to patients. This could be linked to the relatively low smartphone ownership and internet penetration in the country.

mHealth

Mobile self-care solution. mHealth solutions provide consumers with access to health-related information through digital channels, usually a mobile phone. mHealth services can include patient education, health promotion and disease self-management. It can also be used to decrease healthcare costs and for remote monitoring of patients (Alghamdi et al, 2015). For example, Momconnect in South Africa is a mobile phone application that sends pregnant women messages based on the stage of their pregnancy to help them improve their health and that of their babies (Ojo, 2018). The Be He@lthy programme in

Tunisia sends messages to users who have registered to help manage their diabetes when fasting (ITU news, 2019). On the supply side, mhealth apps can be used by community healthcare workers to collect patient data or to help them provide services.

mHealth solutions can be "push" or "pull". Push offerings provide subscribers with reminders, informational messages, or supportive content. Pull services refer to those that an individual initiates, so these offerings require individuals to be aware of when they need support. Both push and pull models use mobile apps or SMS/USSD technology, which means that they can be used on basic phones.

Box 8 outlines an example of an mHealth initiative in Madagascar.

Box 8: USAID Mikolo project (2013-2018)

The USAID Mikolo project was an example of a donor funded mHealth project. This five-year project, aimed at supporting the Ministry of Public Health, included an mHealth smartphone app to replace the paper-based system that community health volunteers (CHVs) used to manage health services, for record keeping, and to disseminate information.

The focus of the project (overall) was specifically on reproductive health; family planning; maternal, newborn, and child health; and malaria prevention and care. Across eight of Madagascar's regions, it served an estimated 4,6 million people who live more than 5km away from a health facility.

The smartphone app (a sub-component of the overall project) pilot ran between April and September of 2017 and there was an agreement that the app would be rolled out to an additional 550 users after the pilot came to an end. Among the 35 CHVs in the mHealth pilot, between 88.5% and94% reported monthly health service data on time, compared to between 46% and 75% among CHVs still using the paper-based system.

Moreover, after almost one year without any supervision by the USAID Mikolo Project, 60% of the 500 CHVs were still using the application and timely data reporting among these CHVs was at 83.

Sources: Ranaivo (2019) and USAID (n.d)

Significant potential in low resource situations, but challenges remain. Given the disparity in availability of healthcare resources between the different regions in Madagascar, mHealth has considerable potential to improve the reach of relevant health services in Madagascar. It also has significant potential to overcome supply side medical challenges and inefficiencies. Remote monitoring of patients is particularly relevant in Madagascar. However, challenges related to the reliability of the service, network availability, illiteracy and social acceptability could hold back the adoption of mHealth solutions (Nsor-Anabiah. et al, 2019).

Sustainability of pilots – across the continent but also in Madagascar – unclear. Although there has been a proliferation of mHealth pilot projects across the continent and in Madagascar[35], many of these projects expire once initial funding is exhausted, signalling that they are unsustainable as a market-based initiative.

Healthcare platform

A unique model. Madagascar has a unique model[36] in M-Tomady – a platform that is linked to healthcare facilities and that can be used to access a range of financial services (see Box 9 for an overview). M-Tomady integrates different ways of health financing: allowing consumers to pay for medical services and insurance and to save for health-related expenses via mobile money.

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[35] Examples include the Marie Stopes Madagascar programme (2010-2011), One SMS saves lives (2018), and the ongoing USAID Community Capacity for Health Program (Mahefa Miaraka).

[36] Across the other countries studied as part of the series of country studies commissioned by FinMark Trust, namely Lesotho, Malawi, Eswatini and Botswana.

Consumers only need a sim card to be able to access the M-Tomady platform; it is not even necessary for them to have their own phones, given that they can access mobile phones at affiliated healthcare centres.

Box 9: M-Tomady

M-Tomady is a GIZ-funded platform that wants to work towards implementing UHC with government. It connects multiple stakeholders in the health space, including the Madagascan Government, donors, healthcare providers, and patients, by providing a platform that integrates different health financing methods. The app allows consumers to pay or save for healthcare, receive electronic health vouchers (such as those provided by The World Bank), pay insurance premiums or save for insurance. It also allows donors to pay money to patients.

Providers are able to use the platform to submit claims and receive payments, while those paying for healthcare can manage their beneficiaries, validate claims, and get real-time data. M-Tomady supports fraud mitigation and allows providers and payers to set up and automatically manage behavioural nudge schemes to encourage healthier behaviour. For example, when after making a savings payment, consumers receive a 50% bonus up to a certain amount; encouraging savings.

M-Tomady also works with private companies who want to provide healthcare, for example companies in the agriculture sector who want to provide healthcare for farmers, and has a programme that focuses on digitizing tuberculosis testing and treatment and distribution of health care vouchers to mitigate the impact of COVID-19.

The platform is interoperable across network providers and relies on SIM card ownership. Thus, users do not need to own a mobile phone (as they can use the phones at the healthcare facilities) and it is free for the user as it runs on USSD. Each individual user has a USSD menu and the language of the menu is determined by phone language settings.

Although illiteracy is high in rural areas (over 70%), users are able to use the menu numbers or sequences to receive their balance and if they struggle, they are able to get help in the community or from a healthcare facility/CHW.

M-Tomady has started digitising the operational processes of three health mutuals and aims to onboard all mutual members in the near future. By 2023, it aims to be available in/have integrated with 500 health care facilities in Madagascar (and it is also aiming to expand its operations to Ghana and Uganda).

Source: Key informant interview (2021)

6.4 Feasibility assessment

It is clear that the healthcare sector in Madagascar faces significant challenges; challenges that digital delivery could help to overcome. However, despite their potential, the current use of digital models in Madagascar is relatively limited. Sustainability has not been proven without donor financing and infrastructural challenges as well as low incomes among the population negatively affect the extent to which these models can reach scale in the short term. This section will discuss the feasibility of these models relative to each other, on the basis of the criteria from Section 3. We estimate that a basic digital health model (with a monthly subscription fee of USD1) could be affordable and accessible for around 12% of Madagascar's total population, based on assumptions captured in the Appendix. It is important to note that target market estimates, across each of the sectors, are indicative and not definitive. The table below illustrates the feasibility of the different models using ticks to illustrate suitability; with one tick being unsuitable and 3 ticks being highly suitable.

Table 5 Feasibility of digital models in health

	Telehealth	M-health	Digital content library	Public education
	• Lower electricity output so lower productive use possibility than mini grids • High flexibility • Regulatory requirements minimal • Maintenance and repair complex in rural areas; challenge of low-quality materials	• Enables remote data capturing, diagnosis and information sharing • Preventative healthcare solutions	• Platform that integrates different ways of health financing: allows consumers to pay for medical services and insurance and to save for health-related expenses via mobile money • Virtually free for consumers • Reach is limited to certain regions/ healthcare facilities, but only requires a SIM card	• Challenges for rural population to access health care because of distances to facilities • Considerable out-of-pocket expenses (but with interventions in the pipeline to cover indigent population's costs)
Affordability	✓✓	✓✓✓	✓✓✓	✓✓
Access	✓	✓✓	✓✓	✓✓
Regulatory feasibility	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Market dynamics	✓✓	✓✓	✓✓✓	✓✓✓

✓ Low ✓✓ Medium ✓✓✓ High

Baseline: public healthcare. As is clear from the low level of healthcare facility utilisation and the considerable out-of-pocket expenses that consumers have to pay for medication and health services, public healthcare is not affordable for a significant portion of the population (hence, two ticks for affordability). Where access is concerned, significant regional and urban-rural disparities mean that the public health system is only assigned two ticks for this criterion. From a regulatory perspective, the Madagascan government supports the public health sector with its policies, which is why it receives three ticks. Although the private sector represents a strong 'competitor' to the public sector, ultimately, the

public sector is the most widely-available and used tier of the Madagascan health sector, leading to three ticks for market dynamics.

Telehealth

Affordability: Affected by private versus public healthcare. Where telehealth services are used for public healthcare and as part of the offered free services, this solution is very affordable to consumers (assuming that they have access to a mobile phone and the analogue infrastructure required). Where telehealth services are used as paid-for services, the same affordability challenges as for face-to-face services would still apply, though there may be a reduction in transaction cost (because consumers would not need to, for example, miss work or incur costs to travel to the nearest healthcare facility). Some telehealth examples are based on a software-as-a-service model, for example Vula[37] in Eswatini, where the telehealth model is used by health practitioners to consult with specialists and there is a central sponsor so that the interface is free for the end-user . However, as no examples of telehealth were found in Madagascar and affordability is so dependent on what the service and business model is, it is difficult to pronounce on affordability in the hypothetical for Madagascar. However, given the efficiencies of digital delivery, any model implemented is likely to be at least as affordable as the public healthcare system – hence the two ticks allocated.

Access: Potential to increase reach of healthcare practitioners in Madagascar but constrained by infrastructure and access to mobile phones. Where telehealth models rely on smartphone-compatible mobile apps, for households without access to a smartphone accessibility becomes challenging, thereby undermining the scalability of these models in the short-term. TeleHealth can, however, also be provided via SMS or USSD services, which enhances accessibility. Nevertheless, given that access to basic mobile phones and the internet – and even electricity – is limited in Madagascar, this model receives

[37] Vula is a smartphone app that connects healthcare workers, providing a secure platform to receive advice on patient treatment plans and refer patients to specialist services and departments (Vula, 2021).

only one tick for access. If the model is not aimed at individual citizens as end-consumers, but rather at healthcare practitioners, with equipment and service access centrally sponsored, access may be less of a constraint. This would require substantial external or donor funding, however, hence limiting reach.

Regulatory feasibility: No dedicated framework, but no regulatory barriers. Although the country has a data protection law, in 2020 it was not yet being enforced. There was also no data protection authority (Data protection Africa, 2020). Hence regulatory requirements are unlikely to pose a constraint to telehealth operations and receive three ticks.

Market dynamics: Limited scale and private sector players. It is unclear whether there are currently any telehealth examples operational in Madagascar, hence it is difficult to pronounce on market dynamics. International examples would suggest that there is a potential for scale. There is the potential for demand-side barriers to be present, however, because people are used to accessing medical services in person or face to face and there may be trust barriers to overcome for digital engagement. There may also be digital skills barriers – in that consumers' levels of digital skills are insufficient for them to meaningfully engage with the model and derive benefit from it. This has implications for market dynamics, hence the allocation of two market dynamics ticks to this solution.

mHealth

Affordability: Potential to be affordable to poor households. As long as consumers have access to a digital device (such as a mobile phone), mHealth should not face considerable affordability barriers– unless the model relies on high volumes of data or airtime to run successfully. As such, three ticks are assigned to this model for affordability. In Madagascar so far, mHealth pilots have generally been on the supply side, improving the quality to primary services provided to patients and thus had no costs for patients.

Access: Constrained by access to basic physical infrastructure and analogue support infrastructure. As with access to any digitally-enabled solution, access

to mHealth in Madagascar is constrained by the availability of basic and analogue infrastructure. Consumers need access to electricity and to mobile phones in order to reap the benefits of this solution, hence this model receives two ticks.

Regulatory feasibility: No dedicated framework, but no regulatory barriers. Desktop research does not reveal a dedicated framework for mHealth initiatives, but there also do not seem to be specific barriers to implementing this solution.

Market dynamics: Dominated by donor-funded pilots; limited scale and private sector players. The mHealth pilots encountered in Madagascar are dependent on donor funding. Hence, their ability to sustainably reach scale is constrained and the number of private sector players making inroads into the market is limited. Consumers' willingness and ability to use this type of model is also likely to be adversely affected, as is the case for telehealth solutions, by a mistrust of digital solutions and an inability to use them proficiently. Hence the score of two ticks for market dynamics.

Healthcare platform

Affordability: Free for consumers but subsidised by donors and/or private sector players. The only costs that consumers need to incur to access M-Tomady is the cost of buying a SIM card (0.5 Euro cents) and the cost of travelling to the nearest linked health facility (given that USSD is free, too). The costs for consumers to use the platform are covered by donor organisations or subsidised by the healthcare facilities themselves, hence it scores three ticks for affordability.

Access: Physical infrastructure poses greatest challenge. Consumers do not even need to own a mobile phone to access the platform – all that they need is a SIM card, as M-Tomady has ensured that consumers are able to borrow a phone from a linked medical facility to access the platform's USSD menu. This represents a major stride towards enhancing access; however, the M-Tomady

platform is only available at the approximately 100 health facilities to which it is linked. On this basis, it is awarded two ticks for accessibility.

Regulatory feasibility: No regulatory barriers. The fact that M-Tomady engages with regulatory authorities and has continued its operations indicates that regulatory barriers to this model are limited: three ticks

Market dynamics: Only one existing player. It is likely that the niche opportunity presented by this model has already been taken up by M-Tomady. As such, although M-Tomady seems to be feasible (albeit supported by donor funding), it is unlikely that there is a broader market for further similar initiatives to enter (one tick only). Instead, M-Tomady itself seems worth supporting for further sustainability, to extend reach to more rural areas and build scale.

6.5 Recommendations for Madagascar's health sector

Although the need for digital initiatives is substantial, the feasibility of the models explored (beyond those that are already operational or those that have received donor funding during their pilot period) appears limited in Madagascar. As such, it is unlikely that there is a niche opportunity in catalysing *new* initiatives in either the mHealth or telemedicine space. Instead, we identify the following opportunities:

Stakeholder coordination and convening. Given the lack of basic infrastructure, there is a need to link players within different sectors with each other – for example, as also noted in the education and energy sections, to get the players in the renewable energy sector to work with players in the health sector, thereby establishing a cross-sector linkage to help overcome the basic infrastructure challenges that curtail digital delivery. Moreover, given that there are numerous actors working in digital health models, it is important to ascertain the extent to which there is currently coordination to bring the disparate actors together; if not, doing so would be a distinct opportunity.

Engage with and support existing players in the market. There is an opportunity to engage players who are already relatively successful in expanding access, such as M-Tomady, to understand how best to provide

support to them so that they can reach scale and so that the role of financial services and financial inclusion in supporting digital delivery of basic services can be deepened.

7 Conclusion

This report considered the potential for digital delivery to enhance access to basic services – education, energy and health – in Madagascar. It is clear from the research that the basic service delivery faces substantial challenges across all three focus sectors and that the baseline of basic service delivery is nascent at best (in urban areas) and virtually non-existent at worst (in rural areas). As such, there is a substantial need to explore lower-cost alternatives and complements to what is already in place, especially given that public funding and household incomes are severely constrained.

Digitally-enabled delivery models hold the promise of extending the reach of an already-constrained system, but cannot fulfil this promise in the absence of sufficiently-established infrastructure. Lack of access to electricity, the internet and mobile devices (including basic/feature phones) – resulting in relatively low levels of digital readiness – poses the first major hurdle to digital delivery of basic services in Madagascar.

Recommendations for enhancing access to basic services in Madagascar converge in the energy sector. Given how severely limited on-grid electricity provision is, Madagascar has already taken relatively large strides towards embracing alternative and digitally-enabled models. The business case for SHSs and mini-grid models to provide electricity to remote regions is currently being established, with the prevailing narrative supporting the potential of alternative models to bolster productive opportunities for local communities and (M)SMEs.

Where education is concerned, the current scope for enhancing access through digitally-enabled delivery models is limited, which is illustrated by the fact that there are few examples of innovation in this space. Nevertheless, stakeholder coordination to kick-start and facilitate a dialogue among relevant ecosystem actors presents an important opportunity to bolster future access to education. This will require a longer-term commitment to building relationships and demonstrating the benefits of digital delivery models to generate buy-in and commitment from stakeholders.

In the health sector, as in the education sector, digital innovation is restricted to initiatives that are funded by donors. So far, there has been limited reach and no sustainability beyond donor-funded pilots. Engagement with existing players operating in the market could add value to generate and enhance coordination and complementarities among them. However, this is likely to require a longer-term vision for the sector, as well as an established presence in the country.

Ultimately, leveraging and deepening FinMark Trust's existing relationships with the CNFI and drawing on FinMark Trust's expertise on financial inclusion may be the best entry point into the conversation – even in the absence of an established in-country foothold. Building new relationships with the major MNOs/telecommunications companies (Telma, Airtel and Orange) also has the potential to open doors for further collaboration among stakeholders to coordinate across the digital payments/financial inclusion, telecommunications and basic services spheres.

Appendix

Market potential assessment assumptions

As part of this research, a feasibility assessment was conducted to identify those digitally enabled delivery models with the highest potential for impact and reach in Madagascar. As part of the feasibility assessment, the potential market was estimated that could be reached for the energy, education and health sectors by drawing on FinScope data, literature on expenditure at household and individual levels and market research on product prices across SADC and by making several assumptions to ensure the data reflected the current reality in Madagascar.

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, the income brackets in the data were adjusted using inflation. 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, solar home systems 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 operating in other jurisdictions including Sunfire Solutions, The Solar Company, African Clean Energy, Suntransfer, Zonful energy and Solar Works.
    - For the education and health sectors, many products offer 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.

- FinScope 2016 data was used for household spending on education, energy and health.

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 inflation and convert to dollars.
- 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 using FinScope data on expenditure combined with the income grids, create three new grids for electricity, health and education that depict the dollar amount per income bracket and the corresponding number of adults at those dollar values who can afford the product at that price point.
- 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: 2,030,647 users could afford a Tier 1 SHS based on their likely income, access to a phone, product cost and available income for electricity consumption.
- Education: 2,644,801 users could afford a USD1 monthly subscription for an EdTech product.

- Health: 3,179,276 users could afford a USD1 monthly subscription for a health tech product.

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