

# Green Mini Grid Market Development Programme

SEforALL Africa Hub  
African Development Bank



Mini Grid Market Opportunity  
Assessment: Mozambique

April 2017



Prepared by



# PREFACE

This paper, and subsequent papers in the Green Mini-Grid Market Development Programme (GMG MDP) document series, is a market assessment for green mini-grids for rural electrification in Mozambique. These are mini-grids powered by renewable energy resources – solar radiation, wind, hydropower or biomass – either exclusively or in combination with diesel generation.

Mini-grids are not a new phenomenon in Africa. Almost all national utilities own and operate diesel-powered generating facilities not connected to the main grid, which supply electricity to secondary towns and larger villages. This solution to rural electrification inevitably results in significant financial losses for the utility, as it is required to sell power at prices much below the cost of production and delivery. Moreover, it leaves the most remote towns and villages unelectrified. The latest Sustainable Energy for All (SE4ALL) Global Tracking Framework estimates that the urban-rural divide in access to electricity in Africa is as high as 450 percent (69 urban compared to 15 percent rural access).

There are three principal options for providing new connections to currently unserved populations in Africa, namely i) extension of the national grid, ii) installation of separate “mini” grids to operate independently from the main grid, and iii) stand-alone generating systems that supply individual consumers. The most cost-effective approach for powering mini-grids is to use renewable energy sources, which are widely available across Africa. However, the development of GMGs is not without challenges. Barriers to the growth of private sector mini-grids in Africa include gaps in the policy and regulatory framework, the lack of proven business models, the lack of market data and linkages, the lack of capacity of key stakeholders, and the lack of access to finance.

In response to these challenges, the SE4ALL Africa Hub at the African Development Bank (AfDB)<sup>1</sup> designed and launched Phase 1 of the GMG MDP in 2015, with grant funding from the AfDB’s Sustainable Energy Fund for Africa (SEFA). The GMG MDP is a pan-African platform that addresses the technical, policy, financial and market barriers confronting the emerging GMG sector. It is part of a larger DFID-funded GMG Africa Programme, which also includes GMG initiatives in Kenya and Tanzania; country-specific GMG policy development through SEFA; and an Action Learning and Exchange component being implemented by the Energy Sector Management Assistance Program (ESMAP) at the World Bank.

The International Energy Agency (IEA) has predicted (in *Africa Energy Outlook 2014*) that by 2040, 70 percent of new rural electricity supply in Africa will be from stand-alone systems and mini-grids. The GMG MDP, SE4ALL, SEFA, ESMAP and similar programmes, which are contributing to falling costs, technological advancements and more efficiencies in GMG development, will help to ensure that up to two thirds of this supply will be powered by renewables.

The goals of the green mini-grids programme, in all its aspects, are central to AfDB’s mission of spurring sustainable economic development, social progress and poverty reduction in its regional member countries (RMCs). Indeed, off-grid and mini-grid solutions are a key component of the AfDB’s New Deal on Energy for Africa, launched by the Bank’s president in January 2016. The New Deal is a transformative, partnership-driven effort with an aspirational goal of achieving universal access to energy in Africa by 2025.

This report was prepared by the Carbon Trust, UNEP and ECREEE at the request of the AfDB. It was written by Marco Sampablo and Luke Walley of the Carbon Trust and Dean Cooper and Eugene Ochieng of UNEP. The Carbon Trust is a mission-driven organization helping businesses, governments and the public sector to accelerate the move to a low carbon economy. The United Nations Environment Programme (UNEP) is a leading global environmental authority.

The content of this report was reviewed by Jeff Felten of the AfDB’s GMG team and cleared by Dr. Daniel-Alexander Schroth, SE4All Africa Hub Coordinator at the AfDB. The report was edited by Kimberlee Brown.

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1 The SE4All Africa Hub partnership includes the African Union Commission, the New Partnership for Africa’s Development (NEPAD), the United Nations Development Programme (UNDP), and the Regional Economic Communities (RECs), which are represented on a rotating basis. <http://www.se4all-africa.org>

## List of Acronyms

AfDB	African Development Bank
BTC	Belgium Technical Cooperation
CESUL	South-central interconnection
CNELEC	Conselho Nacional de Electricidade/National Council for Electrification
CPI	Investment Promotion Centre
DFID	UK's Department for International Development
DNE	National Directorate of Energy
EDM	Electricidade de Moçambique
EDP	Energia de Portugal
EnDev	Energising Development Initiative
EU-AITF	EU-Africa Infrastructure Trust Fund
EU-EI PDF	EU-Energy Initiative Partnership Dialogue Facility
FIT	Feed-in-tariffs
FRELIMO	Frente de Libertação de Moçambique/Mozambique Liberation Front
FUNAE	Fundo de Energia/National Energy Fund
GIS	Geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit/German International Cooperation
GMG	Green mini-grid
GW	Gigawatt
HCB	Hidroelectrica de Cahora Bassa/Operator of the Cahora Bassa hydroelectric plant
HIO	High Impact Opportunities
IPEME	Institute for the Promotion of Small and Medium Enterprises
IRPC	Taxable corporate income tax
IRPS	Personal income tax
kV/kW	Kilovolt/Kilowatt
LNG	Liquefied natural gas
MDP	Market development programme
MEF	Ministério da Economia e Finanças/Ministry of Economics and Finance
MIREME	Ministra dos Recursos Minerais e Energia/Ministry of Energy and Mineral Resources
MITADER	Ministério da Terra, Ambiente e Desenvolvimento Rural/Ministry of Land, Environment and Rural Development
MMTPA	Million Metric Tonne Per Annum
MOTRACO	Mozambique Transmission Company
MW(h)	Megawatt (hour)
NEP	Equivalent hours at rated power (wind)
PARP	Poverty Reduction Action Plan
PARPA	Action Programme for Reduction of Absolute Poverty
PNDDB	National Programme for the Development of Biofuels
PV	Photovoltaic
RE	Renewable energy
RENAMO	Resistência Nacional Moçambicana/Mozambican National Resistance
RERD	Renewable Energy for Rural Development Project
SEFA	Sustainable Energy Fund for Africa
SE4ALL	Sustainable Energy for All

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## EXECUTIVE SUMMARY

**This country report is one of five pilot country reports to be compiled during the first phase of the African Development Bank's Green Mini-Grid (GMG) Market Development Programme (MDP) Market Intelligence business line.** The MDP has the ultimate objective of fostering access to electricity across Africa by promoting the development of green mini-grids where they are technically and economically a better option than the extension of the main grid. The Market Intelligence business line targets the provision of comparable, actionable data on the potential for GMGs between countries in Sub-Saharan Africa. This report provides an analysis for Mozambique.

**This report's methodology combines a high-level opportunity assessment with practical knowledge and information targeted at mini-grid practitioners.** Information provided covers key stakeholders, raw data on physical and non-physical factors and a policy and regulatory analysis. The potential for mini-grids is a challenging analysis, requiring a great deal of data and assumptions. A thorough assessment must include a number of criteria that are driven by the particular business model and approach of the implementing agency for each case. This report therefore aims to capture the available data and highlight general assessments that would be relevant to most mini-grid stakeholders. Raw data is provided with this report to allow stakeholders to conduct follow-on analyses as required.

**The International Energy Agency estimates that 39% of Mozambique's 28 million citizens had access to electricity in 2013. Of those with access, 27% and 66% resided in rural and urban areas respectively. Only 24.8% of the population used electricity for lighting as of 2014/15—5.7% in rural areas and 68% in urban areas.** Poverty is still a challenge as over half the country's citizens live on less than USD 1 per day. According to the World Bank Group, the geographical distribution of poverty remains largely unchanged over recent decades. It further estimates gross national income per capita at USD 630. About 68% of the population live in rural areas, mostly concentrated in the provinces of Maputo, Gaza, Inhambane, Zambezia and Nampula.

**Currently, the country's southern grid network is not connected to the northern and central grid networks, while the southern capital of Maputo is powered by an interconnector with South Africa.** Mozambique is also interconnected to Zimbabwe and Botswana. Although grid extensions and fortifications are planned, including linkages between the northern and southern regions of the country, grid reliability across the whole network is a concern. The existing grid, operated by Electricidade de Moçambique (EDM), suffers from regular power outages that represent a substantial loss for EDM. This is partially due to a legislated flat rate tariff subsidy and insufficient generation sources, which will be further strained by a projected 12.5% annual load growth. According to the ClimateScope report, which assesses country-by-country climate-related investments, Mozambique had the lowest African clean energy investment between 2009 and 2014, at USD 2.2 million. In comparison, South Africa invested USD 12.2 billion and Rwanda invested around USD 100 million.

**The Ministry of Energy and Mineral Resources (MIREME) has been regulating the energy sector, but the National Council for Electrification (CNELEC) is in the process of becoming Mozambique's fully independent energy regulator.** The objective of MIREME is to plan the use of energy resources and to develop electricity supply and distribution. The government has also created the National Energy Fund (FUNAE), an administratively and financially autonomous public institution responsible for supporting and developing the sustainable management of power resources. Generation, transportation, distribution and commercialisation of electricity is mainly the responsibility of EDM, a 100% state owned institution. The National Council for Electrification (CNELEC) is in the process of becoming Mozambique's fully independent energy regulator, subject to ratification of a draft law submitted to Parliament in July 2016. CNELEC's focus will include, among others, establishing tariffs as well as addressing downstream issues concerning liquid fuels and renewable electricity. The Ministry's responsibility will remain policy development and implementation.

**Given the current lack of off-grid specific incentives or policies, new regulations and/or legislation are needed to attract the necessary investment into renewable energy and mini-grid solutions.** The relevant legal framework, including regulation of GMGs, for example, is critical for future development of the sector. To identify the regulations necessary to enable GMG implementation, MIREME is developing a project in conjunction with Energia de Portugal (EDP)

and the United Nations Environment Programme (UNEP) for the village of Titimane. The project aims to demonstrate the potential for private sector investment and determine the policies necessary to promote it. Development of differentiated tariffs and appropriate feed-in-tariffs (FiT) have also been considered, although in the short term there is a lack of clarity from MIREME about the delivery of such renewable-specific policies. A general FiT was approved by the Council of Ministers by Decree no 58/2014, but is still awaiting implementation guidelines.

**Mozambique has substantial renewable energy potential at utility and micro-scale, including solar, hydro, wind, geothermal and marine powers.** Historical development has focused on large hydro projects, which make up 79% of the total 2.6 GW installed power capacity. The country's solar resources are largely underutilised and existing solar power is captured predominantly through standalone systems. Pilot studies are being conducted for wind projects, with only a single 300 kW turbine currently installed. Development of renewable sources has been hindered in the last two decades by the country's availability of fuel and hydro resources. About 19% of the country's capacity is based on fossil fuels. Substantial offshore gas reserves discovered in 2011 mean fossil fuels are likely to remain a driving economic factor into the future.

**A Renewable Energy Atlas released in 2014 by FUNAE, found strong potential for mini-grids, with over 10,000 villages assessed for renewable, hybrid and diesel off-grid solutions between 5 and 100 kW.** According to the Atlas, pico hydro (hydroelectric power generation of under 5 kW) resources have the lowest estimated cost of energy, at about USD 375 per MWh, but are only viable at 300 village sites. Solar hybrid, wind hybrid and diesel systems are the next least expensive making solar hybrid the primary choice of system for most villages. The Atlas also considered a 100% renewable scenario. In this scenario, biomass is cheaper than 100% solar systems in regions of high agricultural productivity, with a cost of just over USD 500 per MWh. Hybrid wind battery systems bear the highest cost of the options considered at approximately USD 2,550 per MWh due to larger battery requirements necessary to accommodate intermittency.

**We estimate that 22% of the country's population, or 5.6 million people, would be best served by mini-grids.** The high-level analysis segmented the country into three areas: grid, mini-grid and standalone, based upon the distance from the power network and population density. The potential for off-grid solutions is highest overall in the northern half of the country due to sparser grid network in high population areas. Standalone systems are the best option for 31% of the un-electrified population. The highest potential for mini-grids is in the Maputo Province while the lowest potential for mini-grids is found in Manica, where 1.3 million out of approximately 1.4 million un-electrified customers live within 15 km of the grid.

**In addition, 433 of the 1,446 hydro sites identified in the Atlas are within 10 km of a mini-grid region, with a total potential of 2.1 GW.** The country also has a variety of potential biomass sources, including forestry, pulp and sugar industry residues and other industrial waste. Nineteen of the 42 biomass sites identified in the Atlas fall within 10 km of mini-grid areas, with a total potential of just over 1 GW. Solar has significant potential and will form the basis of mini-grids away from hydro or biomass resources. Meanwhile, global horizontal irradiation in Mozambique is comparable with high potential countries such as Portugal, Israel and India. The northern and coastal regions, such as Maputo and Gaza, have wind potential with average wind speeds of over 7 m/s, but other areas are classed as low potential.





# 1. INTRODUCTION TO THE GREEN MINI GRID MARKET DEVELOPMENT PROGRAMME

**Managed by the AfDB-hosted Sustainable Energy for All (SE4ALL) Africa Hub, the Green Mini-Grid Market Development Programme (GMG MDP) has the ultimate objective of fostering access to electricity across Africa.**

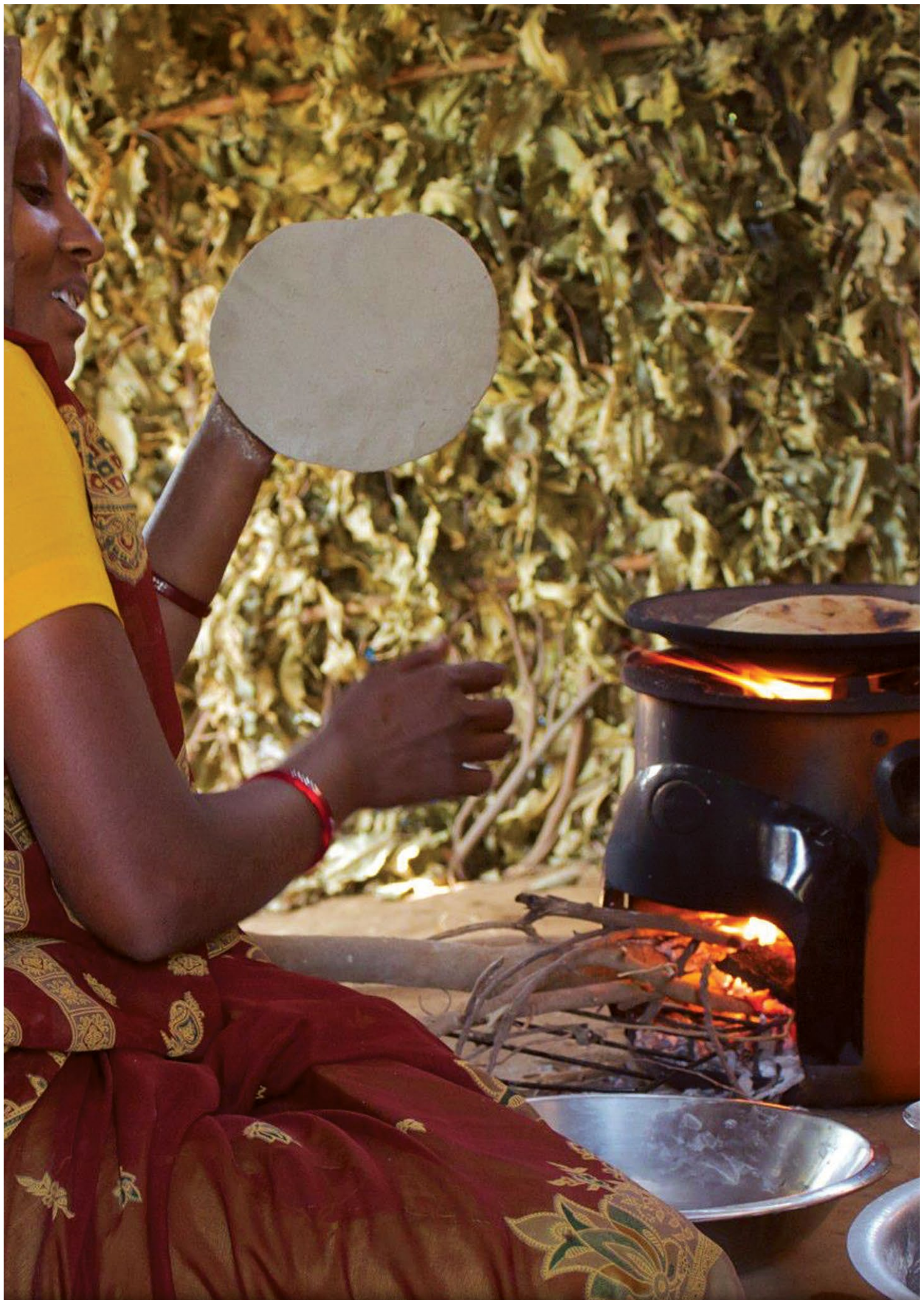
The MDP provides assistance to a range of stakeholders in overcoming the challenges to widespread and sustainable implementation of GMG projects by:

- Establishing a comparable, actionable understanding of the GMG market opportunity in SSA;
- Promoting linkages between communities, public institutions, developers, financiers, and technology providers required for successful mini-grid development;
- Strengthening capacity of developers to develop and operationalize GMG business models;
- Promoting a sound policy and regulatory environment; and
- Engaging project financiers and supporting the development of suitable financial solutions.

**This country report is one of five pilot country reports in the first phase of the MDP's Market Intelligence business line, providing an analysis of the potential for GMGs per country.** Successive phases of the MDP will include additional countries to provide comparable, actionable data on the potential for GMGs between Sub-Saharan African countries.

**The MDP is implemented by the SE4ALL Africa Hub with a grant from the Sustainable Energy Fund for Africa (SEFA).** The AfDB-hosted SE4ALL Africa Hub is a partnership of African institutions dedicated to supporting the continent's progress towards the SE4ALL Initiative's three main objectives on energy access, renewable energy and energy efficiency.

**The development of clean energy mini-grids on the continent is one of the High Impact Opportunities (HIO) under the SE4ALL Initiative for which the Bank is playing a lead role.** The HIO will galvanize action on the barriers facing the sector with the engagement of public, private and civil society expertise and resources. The Clean Energy Mini-Grids HIO, including the coordination group, secretariat and wider membership, is the established forum for discussion and coordination of the efforts of development partners to advance the adoption of GMGs. The MDP is designed from the beginning to be integrated and closely coordinated with the activities carried out in the HIO framework.



## 2. COUNTRY OVERVIEW

**The Republic of Mozambique in Southern Africa has a population of just over 28 million and borders Tanzania, Malawi, Zimbabwe, South Africa and Swaziland.** Mozambique gained independence from Portugal in 1975 and has been a multi-party democracy since 1994, following a devastating 16-year civil war that ended in 1992. The Mozambique Liberation Front (FRELIMO), the country's current political party, has been the dominant political party since that time. Long-standing tensions between FRELIMO and the rival Mozambican National Resistance (RENAMO) party have raised concerns of violence.

**Mozambique is split into two topographical regions, north and south of the Zambezi River.** A narrow coastline north of the river slopes upwards into a series of highland areas and scattered mountains. South of the river is characterised by lowlands, with scattered hills and mountains along the country's borders. The Zambezi River is Mozambique's largest, but the country has 13 main basins, including those that originate from the Limpopo, Pungwe and Ruvuma Rivers.

**Mozambique is divided into ten provinces. Cabo Delgado, Nampula, Niassa, Zambezia and Tete Provinces are located in the north of the country, Sofala and Manica in the centre of the country and Inhambane, Gaza and Maputo in the south.** The capital Maputo, which is sometimes considered the 11th province, is located in the southern tip of the country. The populations of most provinces range between 1.5 million and 2 million people, while Maputo is home to 1.2 million people and the provinces of Zambezia and Nampula have approximately 5 million people each. The majority of the population live along the country's coastal regions, while the majority of renewable resources are found in the northern part of the country.

**Since 1994, the country has been one of the fastest growing economies, fuelled partially by the discovery of oil, gas, coal and titanium reserves.** Between 2000 and 2015, the GDP increased by around 213%, while the discovery of new offshore oil and gas fields in 2011 looks set to be a driver of further economic growth.<sup>1</sup> Although Mozambique has shown improvements in healthcare, education and housing standards, growth has strained the country's infrastructure, creating additional logistical challenges. The power sector, for example, has required frequent maintenance and additional capacity to meet demand. Such challenges will only increase as the country sustains growth.

**Mozambique has been affected by the global economic situation, with growth falling to 6.3% in 2015 as the economy faces depreciation and increased external debt.** Weaker commodity prices, lower demand amongst trading parties and reduced foreign direct investment—down by 24%—have all affected recent growth. Although exports declined by 14% in 2015, the trend is not expected to continue as growth is expected to recover between 2017 and 2020, supported in large part by investment flows to the gas sector. Liquidity will pose a greater concern as current depreciation leads to an increased external debt burden. The Economist Intelligence Unit forecasts a 2.7% and 7.3% reduction in private and government consumption respectively in 2017. Recent concerns over public financial management have resulted in significant amounts of aid funds withdrawn and in a drop of Mozambique's credit rating (from B- to CCC for S&P and to CC for Fitch). The Metical has significantly fallen in value against the dollar, from 26.95 MZN/USD on 10th March 2012 to 78.56 MZN/USD on 3rd October 2016.<sup>2</sup>

**The World Bank Group's Doing Business 2017 report found Mozambique had a strong enabling environment with respect to dealing with construction permits and resolving insolvency.** The country however, scored poorly on enforcing contracts and getting electricity. Other aspects such as registering property and trading across borders were given low to average scores as well.

1 IMF World Economic Outlook database, 2016

2 XE.com

**Poverty is still an important challenge, with over 50% of citizens living on less than \$1/day<sup>3</sup>.** According to the World Bank Group, the geographical distribution of poverty remains largely unchanged over recent decades, and the GNI per capita is estimated at USD 630. Sixty-eight percent of the population live in rural areas, with a majority of the population concentrated in the provinces of Maputo, Gaza, Inhambane, Zambezia and Nampula. Adult literacy stands at 50.6% (2013), but literacy in the youth population is 67%. Despite improvements in the healthcare system, the life expectancy is 54 for men and 57 for women, affected significantly by an HIV prevalence rate of over 10%. Mozambique has one of the lowest levels of water consumption in the world, ranking 128th and 119th out of 135 countries for improved sources of water and sanitation, respectively.





## 3. POTENTIAL OF GREEN MINI GRIDS

### 3.1 INTRODUCTION

**Mozambique has significant renewable energy potential, including solar, hydro, wind, geothermal and marine.** Historic development has focused on large hydro projects, which comprise 79% of the 2.6 GW total installed power capacity.<sup>4</sup> Solar resources are largely underutilised, with a total of 2.7 GW of potential, but only standalone systems have been implemented to date. Pilot studies are being conducted for wind projects, with only a single 300 kW turbine installed to date in Inhambane Province.<sup>5</sup> Development of renewable resources has been hindered in the last two decades by the country's dependency on fossil fuels, 19% of which total capacity is based on fossil fuels. Substantial offshore gas reserves discovered in 2011 further reveal that such fuels are likely to remain a driving economic consideration moving forward.

**The enabling environment for the development of mini-grids is improving, with an increasing governmental focus on off-grid solutions given the country's significant rural access deficit.** The focus on off-grid systems has shifted from standalone systems to mini-grids, due to its greater rural development potential. However, major institutional and regulatory constraints remain, including the lack of a formal regulator or mini-grid specific policies. FUNAE, the National Energy Fund, currently acts as both a financier and operator. Institutional capacities need strengthening, as well as support in developing clear mandates for off-grid development for relevant institutions such as FUNAE. These barriers are discussed in more detail later in this report.

### 3.2 ASSESSMENT BACKGROUND

**Estimating the potential for mini-grids is a challenging task involving considerable data and assumptions.** Certain physical factors, such as resource availability and geographical features may be collected remotely through satellite data, but others require the availability of local datasets and surveys. Some non-physical factors, such as consumption patterns and demand, require precise settlement-level data to be collected. In developing countries, this data is often not available, is out of date or is highly resource-intensive to obtain. An opportunity assessment using this data must therefore include criteria driven by the particular business model and approach of the implementing agency for each case. A private developer may consider purely financial metrics, whereas a community scheme may focus more on the level of service provided. As a result, this assessment is unable to address the needs of all stakeholders for which it is intended. Rather, this report aims to capture available data and highlight general assessments relevant to most mini-grid stakeholders. To allow stakeholders to conduct more specific analyses, raw data is provided.

**The Renewable Energy Atlas, released in 2014 by FUNAE, identifies more than 1,500 renewable energy sites that could power mini-grids.** The Atlas is a result of two years' worth of data collection and site surveys compiled by Gesto Energy Consulting. The Atlas identified 1,446 hydro, 189 solar, 26 wind and 42 biomass sites with potential for grid connection, of which 351, 43, 11 and 7 respectively, were considered priority projects. This prioritisation was based upon cost of energy estimates calculated for each identified site. In total, the Atlas estimated an existing potential of 1.4 GW with respect to priority hydro sites, 600 MW from priority solar sites, 230 MW from priority wind sites and 128 MW from priority biomass sites. The Atlas also examined geothermal and marine energy, and identified three 3.75 MW pilot wave projects and three geothermal sites totalling 47 MW. Overall, hydro was determined to be the most economical technology, with approximately 3.2 GW of capacity estimated to be delivered at below USD 100 per MWh, but solar having the highest total available potential given that it can be deployed virtually anywhere.

4 ClimateScope 2015 Report

5 IRENA Renewables Readiness Assessment 2012

The Renewable Energy Atlas is available for purchase. Pre-feasibility studies for each identified project, as well as solar irradiation data, are also available for purchase. Enquiries should be made to:

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**The Atlas found a strong potential for mini-grids, with over 10,000 villages assessed considering renewable, hybrid and diesel options between 5 and 100 kW.** The Atlas does not consider larger mini-grid systems or systems with grid connection capabilities. Pico hydro (hydroelectric power generation of under 5 kW) resources have the lowest estimated cost of energy, at about USD 375 per MWh, but were only viable at 300 village sites. Solar hybrid, wind hybrid and diesel systems ranked the next most economical options, with solar hybrid as the primary choice of system for the remaining villages that are not served by pico hydro, due to the location-specific nature of wind and the recurrent costs of diesel.

**The Atlas also considered a 100% renewable scenario.** Under such scenario, biomass is estimated to be more affordable than solar systems in regions of high agricultural productivity, with a cost of just over USD 500 per MWh. Wind-battery systems have the highest cost of options considered, with a cost of approximately USD 2,550 per MWh due to the need for larger batteries to accommodate intermittency.

### 3.3 MINI GRIDS POTENTIAL ASSESSMENT

**The potential for mini-grids has been estimated by segmenting the countries into three areas—grid, mini-grid and standalone—based on the distances between the network and the population.** The planned power network through the year 2020 and geospatial data provided in the Annex have also been incorporated. Mini-grid regions are defined based on a distance of greater than 15km from the grid, as well as a household density greater than 50 households per km<sup>2</sup>. Grid regions are defined as within 15 km of the grid, and standalone systems make up the remaining area. Protected and wetland areas are excluded.

**Depending upon the type of off-grid solution, particular developers may also wish to consider regions already serviced by the grid.** In some areas currently reached by the grid, mini-grid market potential exists due to both high main grid connection costs, as well as its lack of reliability due to the aging grid network. Urban electricity access stood at 66% as of 2013. The possibility of mini-grids in proximity to the main grid is not considered in our analysis due to its high dependence on the business model used and local demographics.

**Of the 28 million citizens in Mozambique, the IEA estimates that 39% had access to electricity in 2013.** Of those with access, 27% and 66% lived in rural and urban areas respectively.<sup>6</sup> Only 24.8% used electricity for lighting as of 2014/15—5.7% in rural areas and 68% in urban areas.<sup>7</sup> According to FUNAE it has given access to some 5 million customers, mostly via solar home systems.<sup>8</sup> As of 2011, there were just over one million household connections, with an average connection rate of 120,000 per year. The grid is split into regions, comprising mainly of 220 kV and 110 kV lines, with the northern and central grids only due to be connected with the southern grid by the major network upgrade of the CENLEC transmission line. Mozambique exports to South Africa, Zimbabwe and Botswana, while it imports most of the capital's demand from South Africa.

6 World Energy Outlook 2015, Electricity Access Database

7 INE - Final Report of the Family Budget Inquiry: IOF 2014/15. June 2016.

8 ClimateScope Policies Database - [global-climatescope.org/en/policies/#/policy/4147](http://global-climatescope.org/en/policies/#/policy/4147)



**The government's strategy to extend energy access across the country includes ambitious on- and off-grid extension plans.** The World Bank Group, which is supporting the process of developing a national electrification strategy, estimates that 300,000 to 400,000 new connections will be required annually to meet the SE4ALL target of universal energy access by 2030. EDM's connection rate is approximately 120,000 per year. As a result, a substantial increase in both on and off-grid connections are needed.

**Analysis of the population density and planned grid network shows significant gaps to be filled by off-grid solutions.** Current grid expansion plans extend the network into the provinces of Gaza (via a 110 kV line from Lionde to Mapai), Inhambane (via a 110 kV line from Mavuzi to Lindela) and the northeast of Niassa (via a 110 kV line from Cuamba to Mecula). The grid is being strengthened in many areas, including a 400 kV line between Caia in Sofala to Namialo in Nampula. There remain however, large proportions of each province that are remote from the planned grid, with Manica and Maputo being the most covered. One major population centre, Villa Coutinho, in Tete province, remains un-electrified beyond 2020 under current grid extension plans.

**The highest potential off-grid area is found in the northern half of the country, due to the region's sparse grid network and high population.** Figure 1 shows the population density map of Mozambique together with the transmission network as of 2020. Although there are high-density areas found across all provinces, the population in the southern half of the country is more tightly clustered along the coastline. This area, including the coastlines of Gaza and Inhambane Provinces, will be served by a proposed 110 kV line connecting the Mavuzi substation in Manica to the Lindela substation in Inhambane Province. This will connect to the existing 110 kV line from Lindela to Macia. The greater potential for mini-grids is therefore in the northern provinces.

**The Nampula, Zambezia and Tete Provinces show the highest potential for mini-grid development due to higher density population and sparse grid development, but potential for mini-grids is also found in Cabo Delgado, Inhambane and Maputo.** As shown in Figure 2, the sparser northern grid network means large areas of Cabo Delgado, Niassa, Nampula, Zambezia, Sofala and Tete Provinces are beyond the 15 km radius given as a limit for grid connection. There are clustered populations along the northern coastline in these provinces, as well as inland in the northern parts of Tete, Nampula and Zambezia Provinces. These regions are the priority for mini-grid development and are not to be connected to the grid until at least 2020. Both Niassa and Sofala Provinces do not have a high enough population density outside its grid-connected areas to be a priority. Mini-grid areas were found in Inhambane and Maputo, but these areas are closer to the planned grid network, especially in Maputo, and therefore are more likely to be connected to the grid in the future.

**Some 5.6 million would be best served through mini-grids, with the highest mini-grid population found in the Maputo (1.5 million) and Zambezia (1 million) Provinces.** This is 60% and 29% of the population, respectively, for these regions. The lowest potential population for mini-grids is found in Manica, Niassa and Gaza provinces, with 35,000 people or less in each region. Manica is substantially grid covered, as shown in Figure 1, with 1.71 million out of approximately 1.87 million un-electrified customers residing within 15 km of the grid. Tete Province has approximately 510,000 people to be served by mini-grids (20%), while Sofala has 450,000 (26%). There are also almost 1.5 million people living in protected areas that could additionally be served through mini-grids, depending upon local restrictions on constructing energy infrastructure.

The analysis estimates a market size of USD 63.2 million based on a monthly household energy expenditure of 327 MZN (approx. USD 4).<sup>910</sup> The results of this analysis are detailed fully in Table 1. Only a proportion of household energy spend is typically on electricity, especially in rural households. Table 2 shows the different energy sources used for lighting. The market size estimate includes already electrified citizens (5.6% of rural population)<sup>11</sup>. Populations within mini-grid areas include the settlement of Villa Coutinho in Tete, as shown in Figure 3, which is the only un-electrified major settlement under current grid extension plans. In total, mini-grid areas are found in the Nampula, Zambezia, Tete, Cabo Delgado, Inhambane and Maputo Provinces, shown in Figures 2 and 3. The small area for mini-grids is contrasted against that for standalone systems, which is made up of 6 million people covering an area of over 400,000 km<sup>2</sup>. This is due to the lower population density of such remote regions, as shown in Figure 1. This analysis also highlights that, although there is more clustering in coastal regions, there is a relatively even distribution of settlements even in remote areas.

Table 1. – Estimated market size split by grid extension, mini grid and standalone. Carbon Trust analysis, using an average annual energy expenditure<sup>11</sup> and current conversion rate<sup>12</sup>.

Province	Grid Extension (population)	Mini Grid (population)	Stand Alone Systems (population)	Percentage Mini Grid (%)	Mini Grid Market Size Estimate (\$)
Cabo Delgado	497,884	326,164	1,103,480	16.9	3,668,954
Gaza	844,965	35,039	289,038	3.0	394,147
Inhambane	761,645	288,211	475,893	18.9	3,242,028
Manica	1,713,050	12,788	150,977	0.7	143,850
Maputo	1,012,150	1,889,140	277,503	59.4	21,250,558
Nampula	3,020,700	717,449	1,084,450	14.9	8,070,440
Niassa	738,654	25,853	840,300	1.6	290,815
Sofala	857,987	451,958	431,554	26.0	5,083,985
Tete	788,869	510,900	1,228,760	20.2	5,747,012
Zambezia	1,426,630	1,361,990	1,988,490	28.5	15,320,753
<b>Total</b>	<b>11,662,534</b>	<b>5,619,491</b>	<b>7,870,445</b>	<b>22.3</b>	<b>63,212,530</b>
Area (km2)	242,831	28,702	403,791	4.3	

9 INE - Final Report of the Family Budget Inquiry: IOF 2014/15. June 2016. Gives an average household monthly expenditure of 375 MZN, which is converted to per capita expenditure via an average household size of 4.5.

10 The total market size is estimated from the household energy market size. This assumes that 60% of household energy spend is on electricity, and that household spend makes up 60% of the total revenue of a mini-grid (when including revenue from businesses, public sector buildings and industrial users).

11 INE - Final Report of the Family Budget Inquiry: IOF 2014/15. June 2016. Gives an average household monthly expenditure of 375 MZN, which is converted to per capita expenditure via an average household size of 4.5.

12 \$0.0129 /MZN. [www.xe.com/currencyconverter](http://www.xe.com/currencyconverter). 10.2016

Table 2. – Distribution of household use of energy sources for lighting (%) 2014/15. INE - Final Report of the Family Budget Inquiry: IOF 2014/15. June 2016.

Household	Electricity	Generator	Solar	Oil	Candle	Battery (Portable)	Battery (Pack)	Firewood	Other	Total (%)
Niassa	12,0	0,0	1,0	2,3	3,7	2,7	54,7	20,8	2,6	100,0
Cabo Delgado	12,1	0,2	2,6	3,6	0,9	1,4	67,4	11,7	0,2	100,0
Nampula	20,0	0,1	1,7	18,6	0,3	1,6	37,2	19,3	1,1	100,0
Zambezia	11,5	0,1	1,4	5,6	1,9	2,6	51,4	20,2	5,2	100,0
Tete	11,2	0,0	1,1	2,8	1,8	2,6	63,9	16,0	0,6	100,0
Manica	21,9	0,0	2,4	5,2	3,3	2,9	46,7	16,6	1,0	100,0
Sofala	30,3	0,4	0,8	16,0	1,9	1,5	34,6	14,4	0,2	100,0
Inhambane	14,9	0,0	3,3	41,5	4,1	6,2	20,5	6,2	3,4	100,0
Gaza	34,0	0,0	1,7	45,8	7,5	1,0	6,3	2,0	1,1	100,0
Maputo	73,8	0,1	0,8	15,8	5,6	0,3	3,0	0,3	0,2	100,0
Maputo City	93,4	0,1	0,0	2,9	3,4	0,1	0,2	0,0	0,0	100,0
<b>Rural</b>	5,7	0,1	2,1	13,9	1,7	2,5	51,9	19,5	2,5	100,0
<b>Urban</b>	68,0	0,1	0,3	11,6	4,3	1,3	11,9	2,1	0,3	100,0
<b>Total</b>	24,8	0,1	1,5	13,2	2,5	2,1	39,7	14,2	1,9	100,0

Figure 1. – Population density map of Mozambique. Carbon Trust analysis.

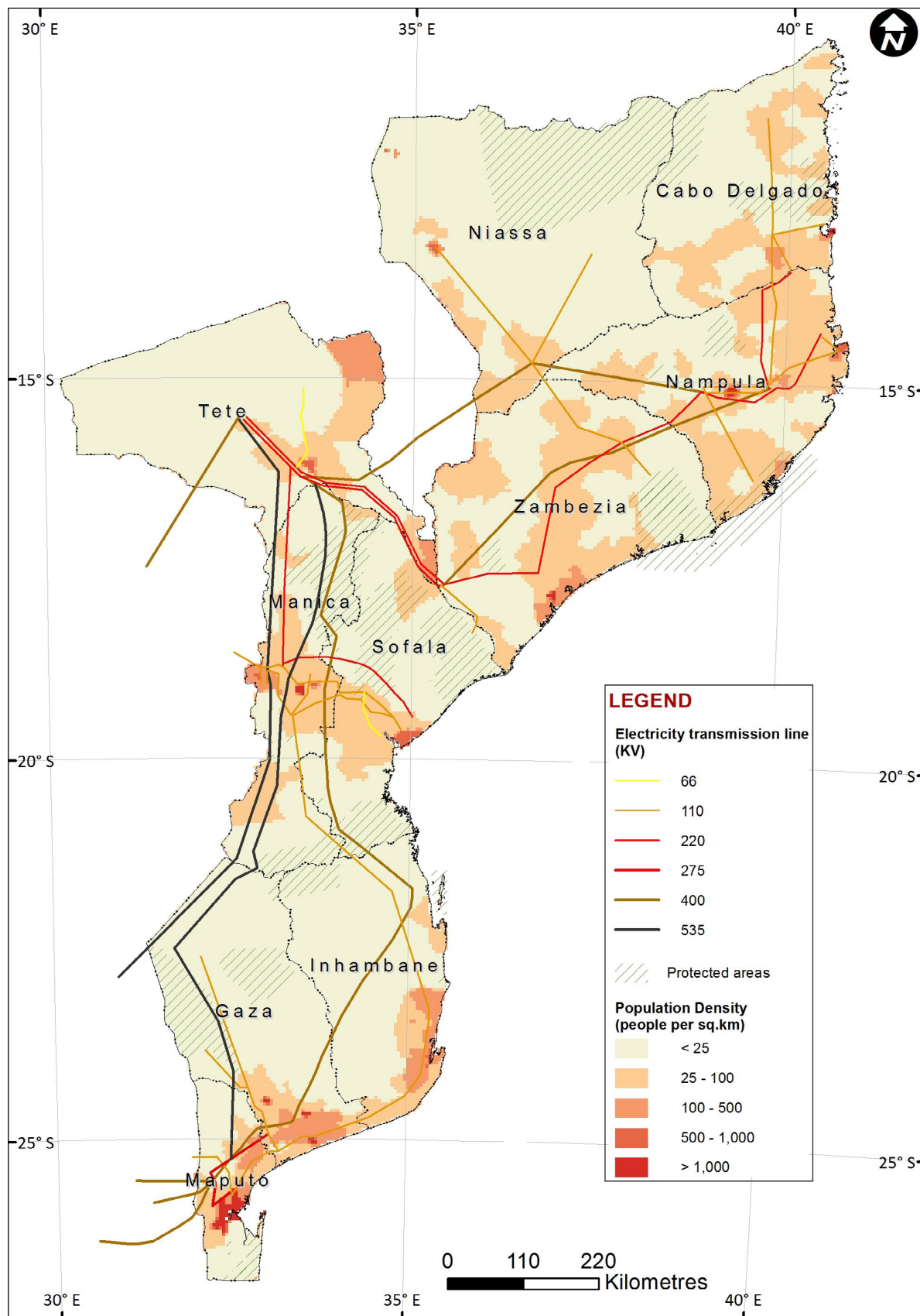


Figure 2. – Split of grid extension, mini grid and standalone systems. Carbon Trust analysis.

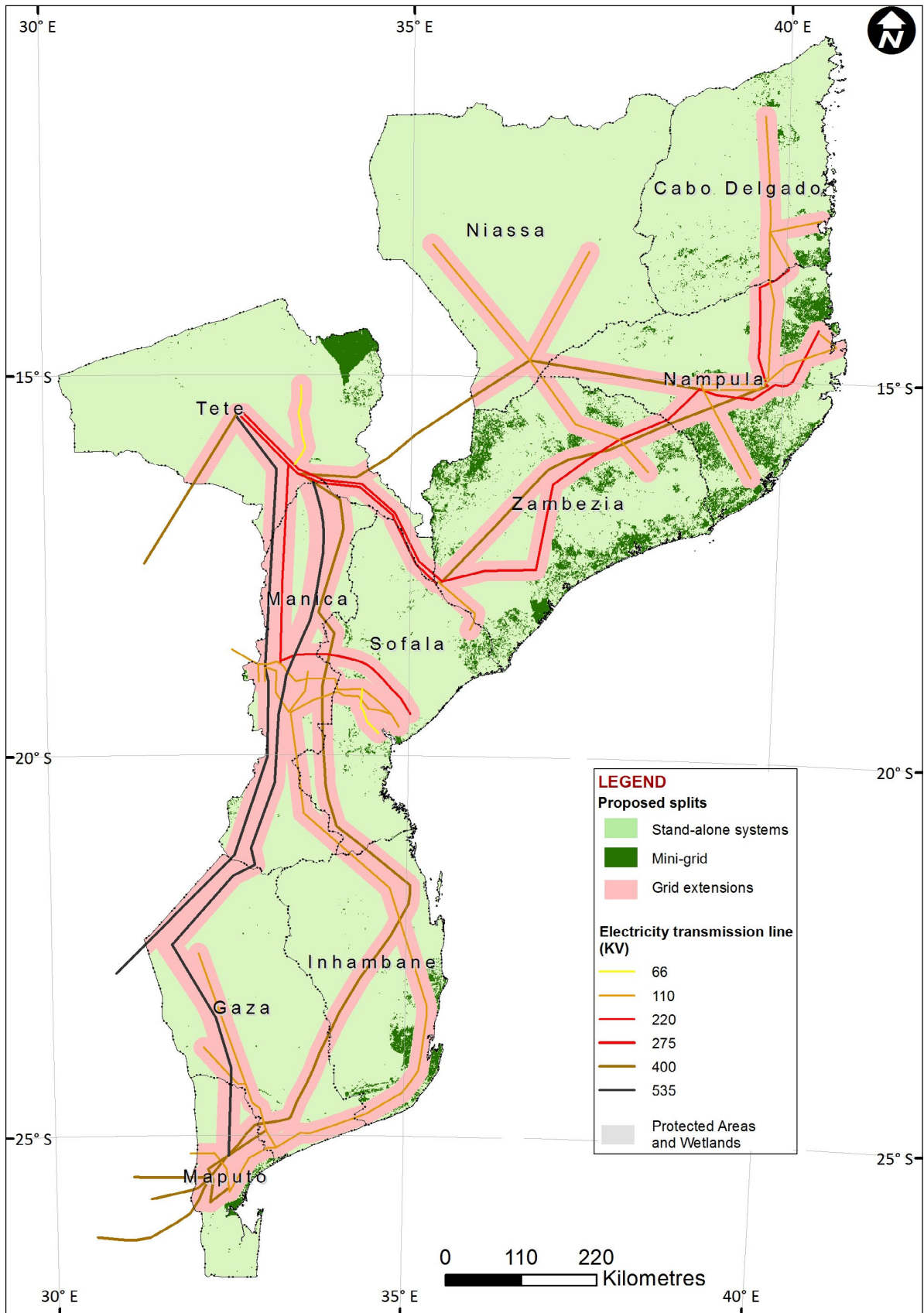
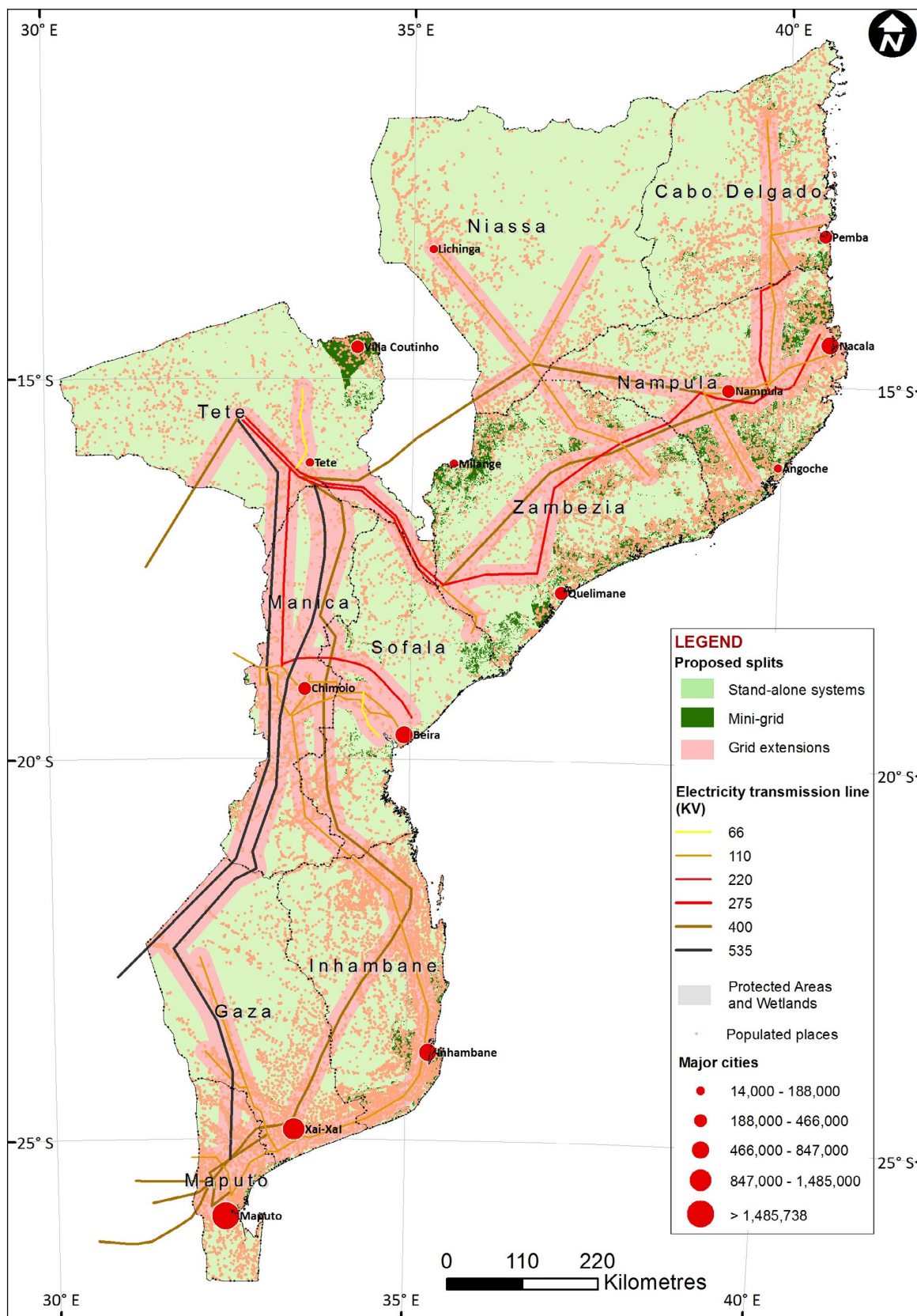


Figure 3. – Split of grid extension, mini grid and standalone systems, shown with major and minor population centres. Carbon Trust analysis.



### 3.4 RENEWABLE ENERGY POTENTIAL FOR MINI GRIDS

#### HYDRO

**Mozambique has a strong hydropower potential at all project scales, with existing experience in large hydropower projects.** Mozambique is one of the biggest producers of large hydropower on the continent, with over 2 GW of installed capacity. Two large-scale planned projects include the expansion of the Cahora Bassa Dam (850 MW) and the development of the Mphanda Nkuwa Dam (2,500 MW). The Renewable Energy Atlas identified a further 1,446 potential sites, of which 351 are given priority on a cost-of-energy basis. An estimated 3.2 GW of capacity is deliverable at below USD 100 per MWh, primarily along the Zambezi River. However, these low cost projects tend to be at grid scale. Approximately 1.4 GW of priority sites were costed between USD 100 and 200 per MWh, and the remaining 1 GW of capacity estimated with varying costs upwards of USD 400 per MWh. This is in the cost range for pico hydro, which was estimated at an average of USD 375 per MWh. The exact cost is highly site specific for hydro generation as it depends upon multiple factors, including the annual head and flow rate.

**433 of the 1446 hydro sites identified under the RE Atlas could power mini-grids, being within 10km of a mini-grid region, with a total potential of 2.1GW.** From these 433 sites, 672 MW may be generated from priority projects, with the largest potential of 245 MW in the region of Nampula, followed by 171 MW in Sofala, and 165 MW in Zambezia. Of the 1.44 GW of non-priority potential, 521 MW exists in Zambezia, and 455 MW in Nampula. Figures 4, 5 and 6 show the distribution of hydro sites within the provinces identified in the Atlas. The total potential for each province is summarised in Table 3. The regions with the lowest potential are Inhambane and Maputo, with only one project each. Tete Province has 120 MW of potential from 77 small projects of around 1 MW each, mostly in the north-eastern region around the settlement of Villa Coutinho designated as mini-grid areas.

Table 3. – Hydro potential within 10km of a mini grid area. Carbon Trust analysis.

Province	Number of sites	Hydro Potential (MW)	
		Priority	Non Priority
Cabo Delgado	50	8.95	136.01
Inhambane	1		93.67
Manica	12	4.27	53.34
Maputo	1	9.86	
Nampula	85	245.61	454.53
Niassa	18	12.86	8.57
Sofala	27	171.29	100.78
Tete	77	53.87	68.01
Zambezia	162	165.35	520.94
<b>Total</b>	<b>433</b>	<b>672.06</b>	<b>1,435.85</b>

Figure 4. – Potential hydro sites within mini grid areas of Zambezia, Nampula, Niassa, and Cabo Delgado provinces. Carbon Trust analysis of data from the Renewable Energy Atlas, 2014.

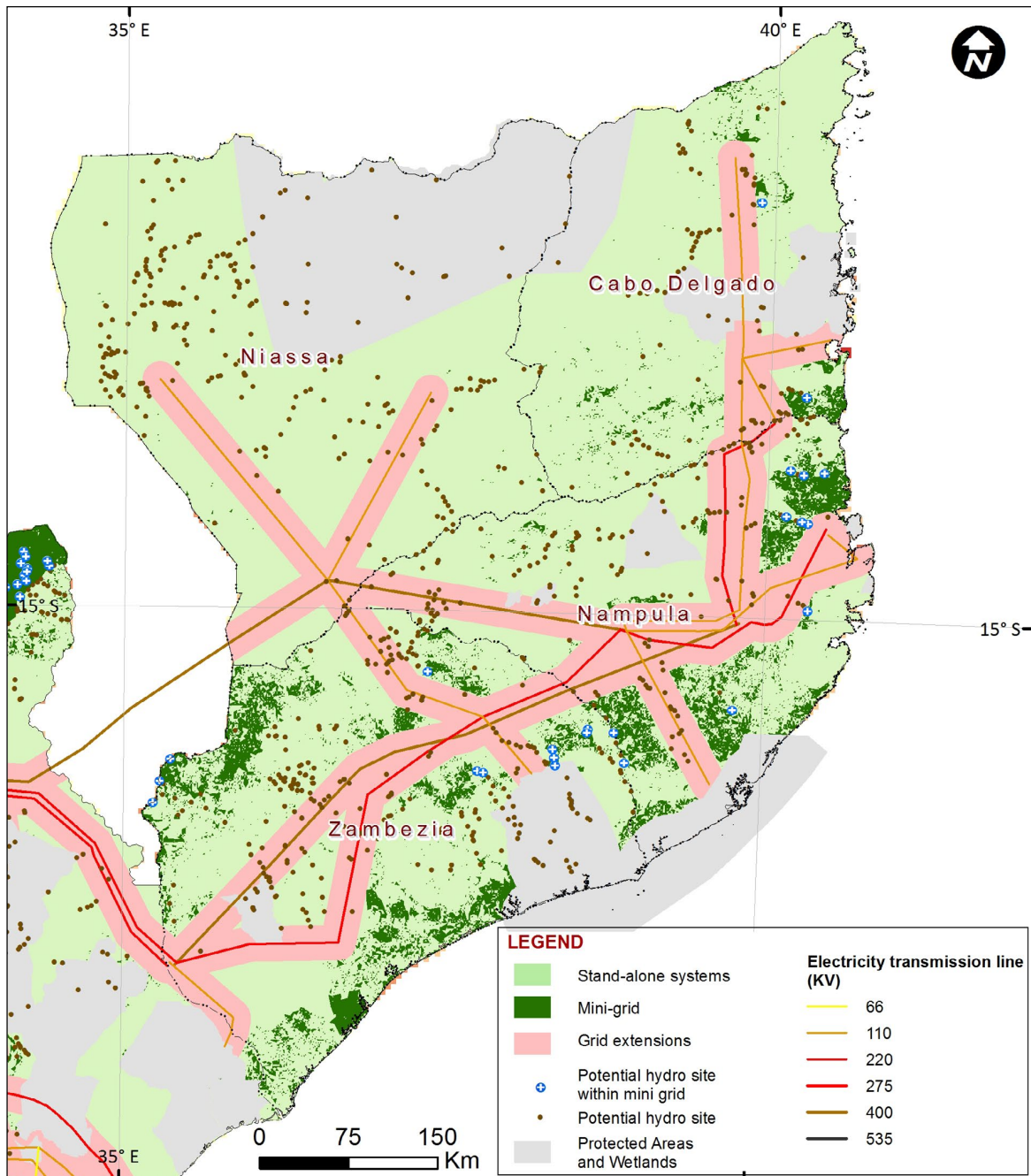




Figure 5. – Potential hydro sites within mini grid areas of Tete, Sofala, and Manica provinces. Carbon Trust analysis of data from the Renewable Energy Atlas, 2014.

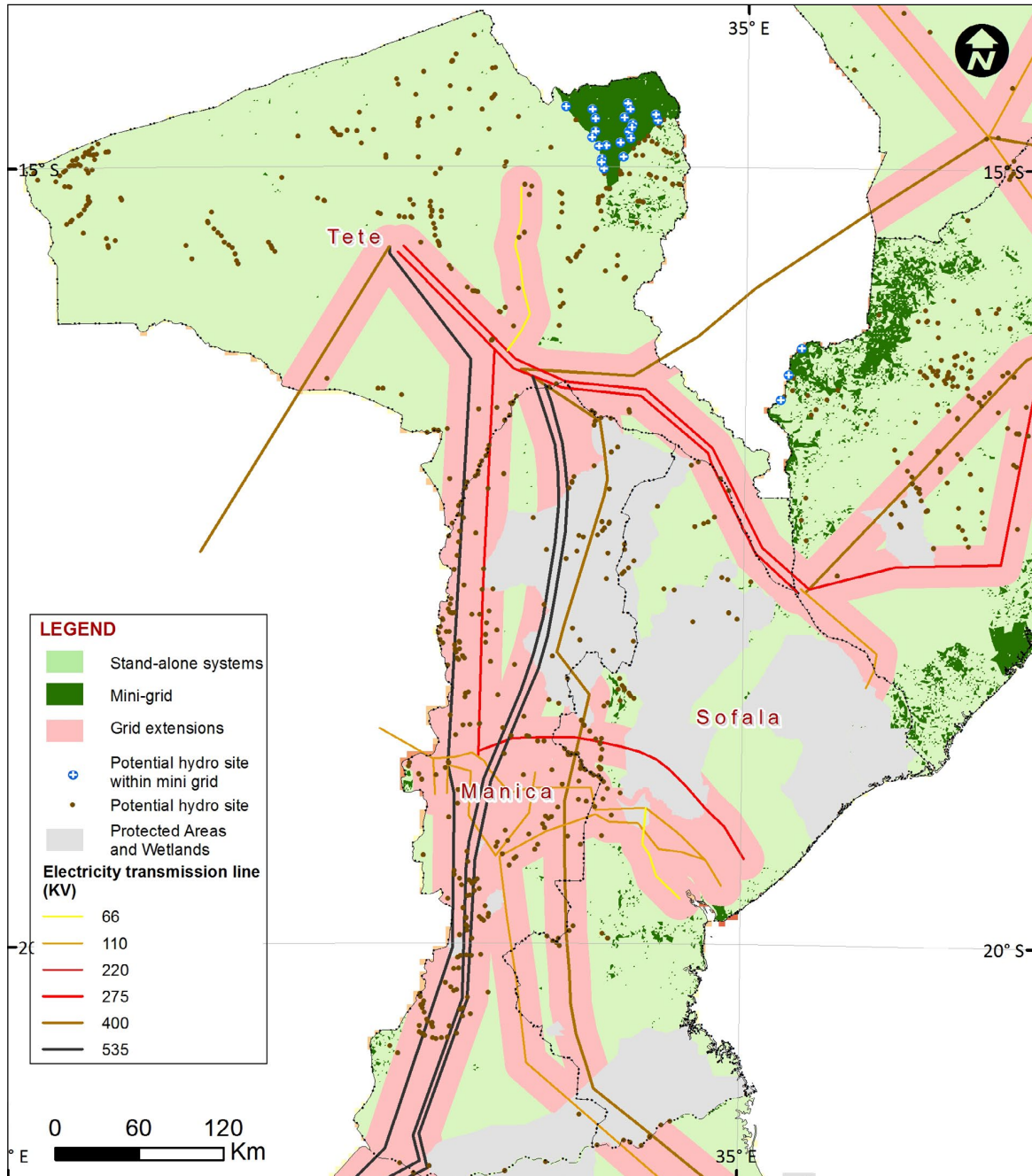
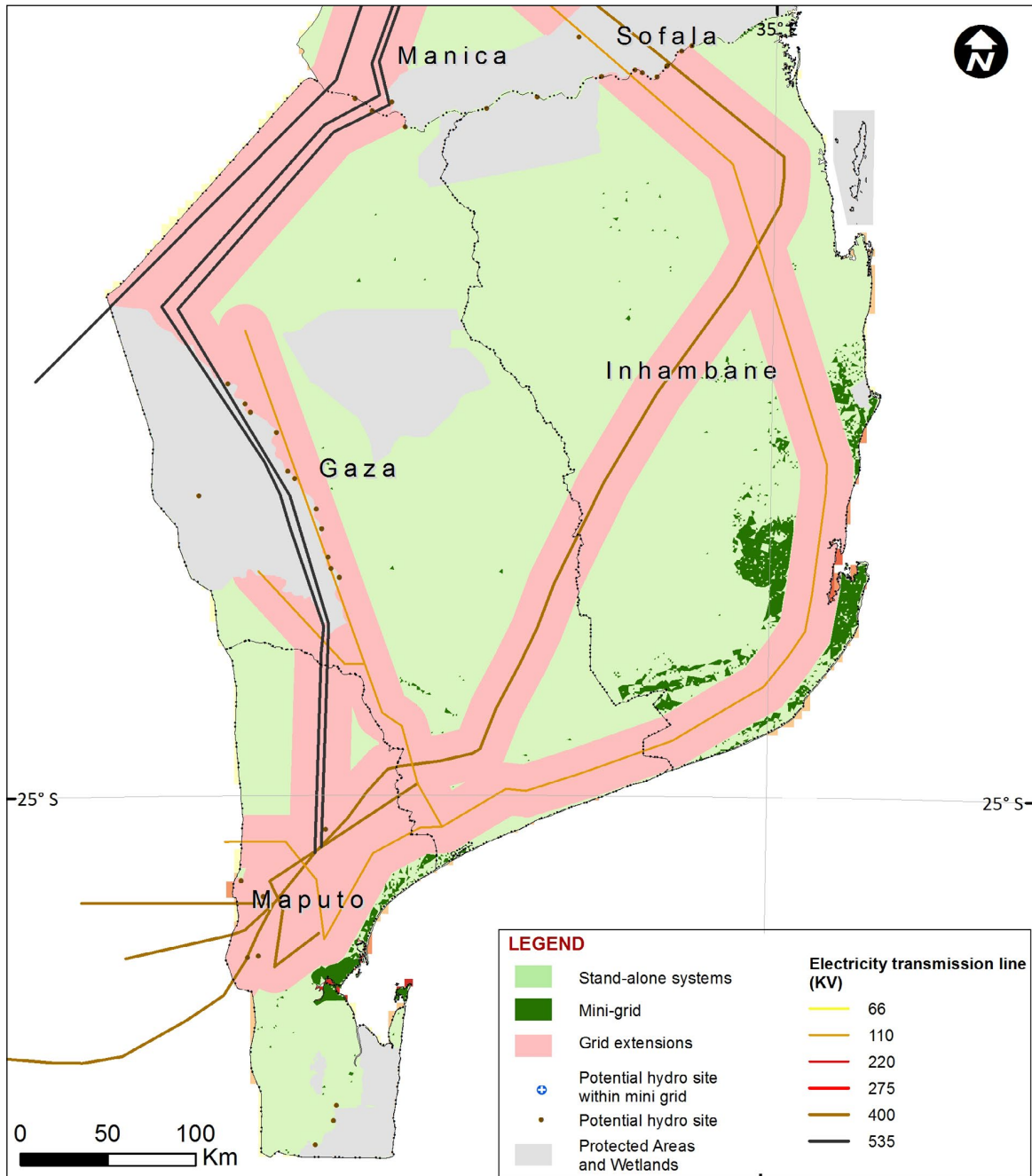


Figure 6. – Potential hydro sites within mini grid areas of Maputo, Gaza, and Inhambane provinces. Carbon Trust analysis of data from the Renewable Energy Atlas, 2014.



## BIOMASS

**Biofuels have been the predominant renewable source in national policy.** The National Programme for the Development of Biofuels (PNDB) targets a fuel mix that includes 20% bioethanol and 10% biodiesel in various phases to 2021.

Mozambique has a variety of potential biomass sources:

- **Forest residues:** Forest-based biomass plants located near forest concessions and/or plantations. Solid performance has been seen to date on the 1.7 million hectares of forest plantation concessions currently awarded.<sup>13</sup>
- **Industrial and agro-industrial waste:** Rice husk, coconut shell, sawdust and other plant materials are examples of common agro-industrial wastes in Mozambique. These are complementary fuels to forest biomass.
- **Pulp industry waste (“black liquor”):** There are currently plans to install cogeneration recovery boilers in several paper pulp production plants to burn black liquor residue.
- **Sugar industry residues:** The sugar industry is well established in Mozambique. Over 40,000 hectares of land are used for four industrial sugar cane production units.
- **Municipal solid waste (MSW):** There is no selective waste collection system in Mozambique. All MSW is currently deposited in open-air dumps without any air recovery. Energy recovery is possible through incineration or through capturing biogas from decomposition.

Currently large-scale biomass is directed predominantly at industrial biofuel production, while small-scale projects focus mainly on efficient charcoal production and improved cookstoves.<sup>14</sup>

**A total of 2.18 GWs of grid connected biomass projects are identified in the Atlas, mainly ranging between 10 MW and 100 MW, of which only 128 MW are prioritised on a cost-of-energy basis.** Uncertainties in the pulp industry, inappropriate existing solid waste collection mechanisms, in addition to new forest holdings and sugar plantations all contribute to the low potential of priority sites. Distributed relatively evenly between the provinces, these grid-connected projects have an estimated average cost of energy of USD 600 per MWh.

**Many areas have potential for biomass mini-grids, but the greatest potential lies in the northern regions with higher agricultural productivity.** The Atlas estimates a cost of energy of approximately USD 550 per MWh for the 10,000 off-grid villages assessed. This was found to be one of the least expensive 100% renewable options, especially in regions with higher agricultural productivity, surpassed only by hydro and hybrid solutions. The regions of higher productivity were found in the northern provinces of Niassa, Nampula, Zambezia, Cabo Delgado and the central province of Manica. In other provinces the cost increased, reaching over USD 900 per MWh in some cases.

**Our analysis shows that 19 of the 42 biomass sites identified in the Atlas fall within 10 km of mini-grid areas, with a total potential of just over 1 GW.** Of this potential, only 71 MW originate from priority projects in the provinces of Sofala, Zambezia and Maputo, and 930 MW from non-priority projects. Figures 7, 8 and 9 show the location of these sites, with more projects spread towards coastal areas, in areas of higher agricultural productivity. Zambezia has the highest total potential of approximately 499 MW, but Maputo has the highest potential for priority sites, with 47 MW. The total biomass potential for each province is summarised in Table 4.

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13 Renewables in Mozambique – National Status Report, ALER, 2016

Table 4. – Biomass potential within 10km of a mini grid area. Carbon Trust analysis.

Province	Number of sites	Biomass Potential (MW)	
		Priority	Non Priority
Cabo Delgado	1		34.80
Maputo	5	47.00	106.00
Nampula	4		153.60
Sofala	3	15.00	146.00
Zambezia	6	9.20	489.80
<b>Total</b>	<b>19</b>	<b>71.20</b>	<b>930.20</b>



Figure 7. – Potential biomass sites within mini grid areas of Zambezia, Nampula, Niassa, and Cabo Delgado provinces. Carbon Trust analysis of data from the Renewable Energy Atlas, 2014.

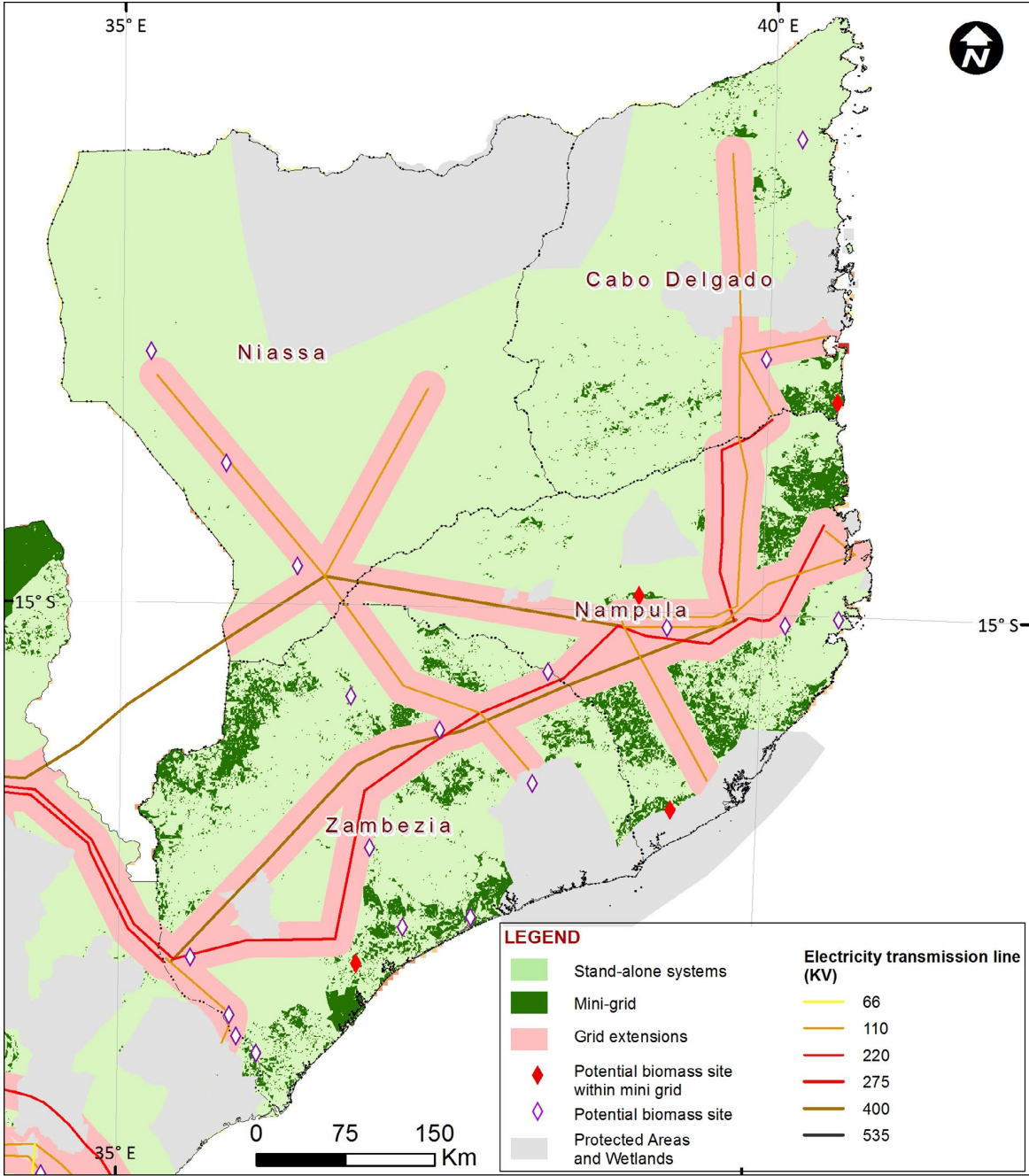


Figure 8: – Potential biomass sites within mini grid areas of Tete, Sofala, and Manica provinces. Carbon Trust analysis of data from the Renewable Energy Atlas, 2014.

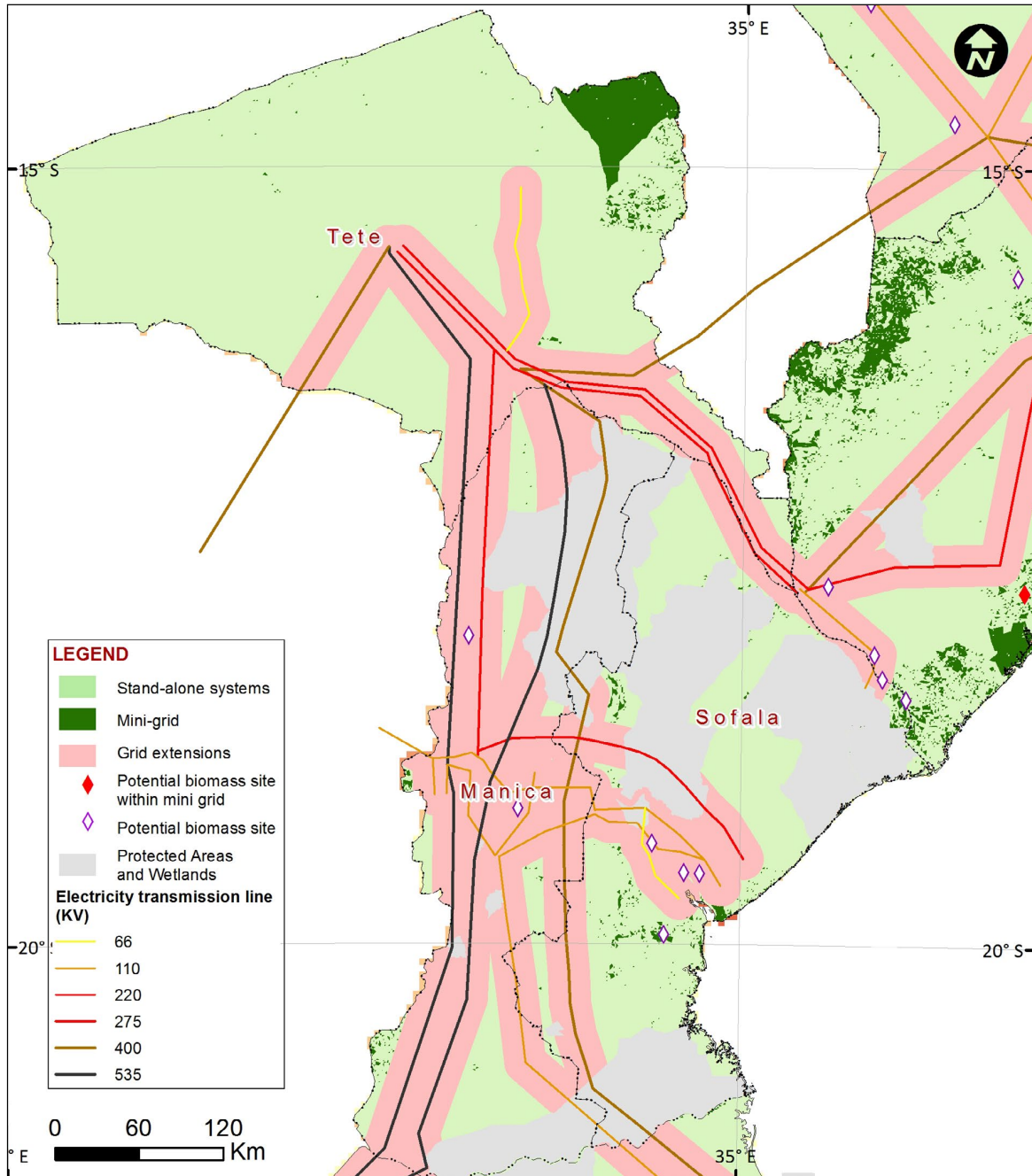
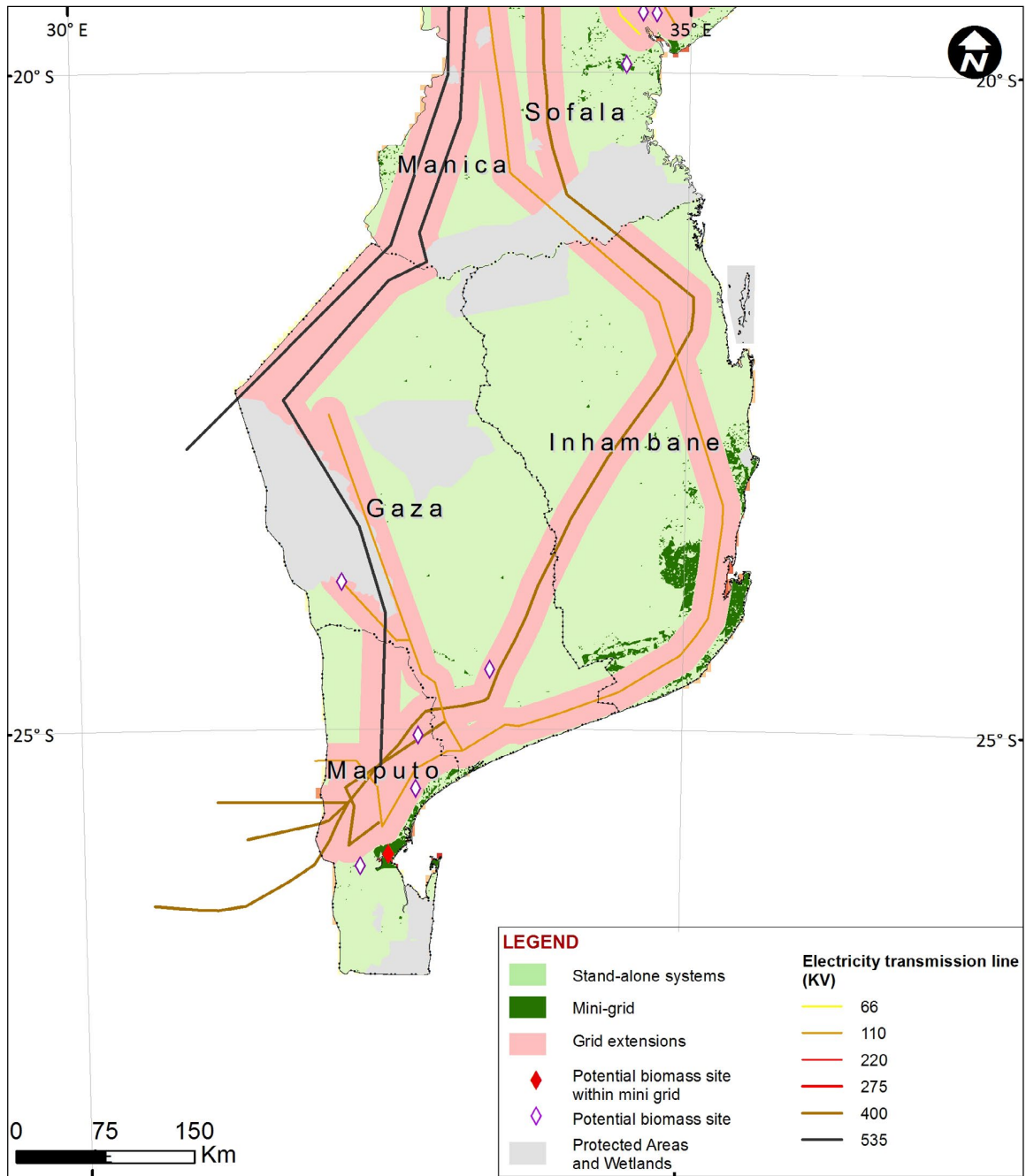


Figure 9: – Potential biomass sites within mini grid areas of Maputo, Gaza, and Inhambane provinces. Carbon Trust analysis of data from the Renewable Energy Atlas, 2014.



## SOLAR

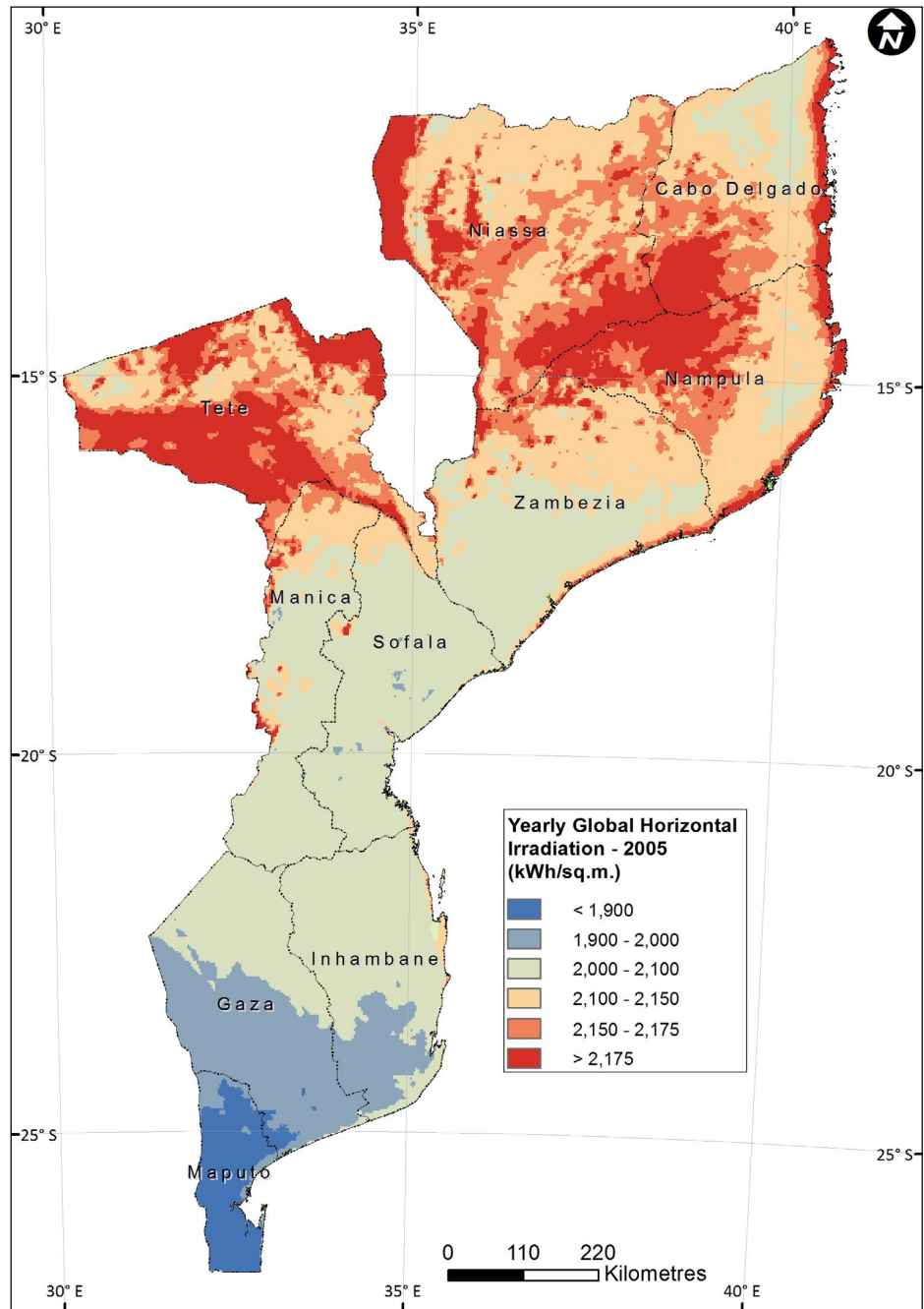
The level of global horizontal irradiation is comparable to high potential countries such as Portugal, Israel and India. From the Renewable Energy Atlas, Tete Province averages 1,927 kWh/m<sup>2</sup>/year compared to 2,015 kWh/m<sup>2</sup>/year in California and South Africa (Kalkbult). The Atlas relied upon a range of data sources, including existing meteorological stations, pyranometers placed as part of the study and historical data, to calibrate satellite measurements. Figure 10 shows the calculated annual average global horizontal irradiation. Northern Mozambique has the best irradiation overall, averaging over 2000 kWh/m<sup>2</sup>/year, with a range between 1,785 and 2,206 kWh/m<sup>2</sup>/year nationally.

The solar irradiation in mini-grid areas varies between approximately 1,800 kWh/m<sup>2</sup>/year in the southern Inhambane Province to between 1,900 and 2,000 kWh/m<sup>2</sup>/year in the Tete and Nampula Provinces. Of an estimated 23TWp of national potential, 2.7 GW was estimated in the Atlas to be near existing substations, with significant potential remaining in off-grid areas. Such availability of resources led to an estimated average cost of energy for off-grid solutions at the 10,000 villages assessed of approximately USD 375 per MWh for hybrid solar and USD 600 per MWh for a 100% solar-battery system. The cost of energy estimates for the Atlas' prioritised grid connected solar projects are between USD 145 and 250 per MWh and did not use batteries. Hybrid solar energy systems are therefore the most economical option for most settlements where hydropower is not available. Solar-battery systems are the most economical 100% renewable option except in regions with high agricultural productivity for biomass.





Figure 10. – Solar annual average global horizontal irradiation 2005 (kWh/m<sup>2</sup>/year). DTU/IRENA.





## WIND

**The wind sector remains underdeveloped, with only a single 300 kW turbine installed in Praia, Inhambane in 2012.**<sup>14</sup> As a result, there is a current lack of skilled technicians and local manufacturing of wind components. However, the resource mapping and sites visited as part of the Atlas should help stimulate the sector and there are already plans to develop a wind farm close to Inhambane.

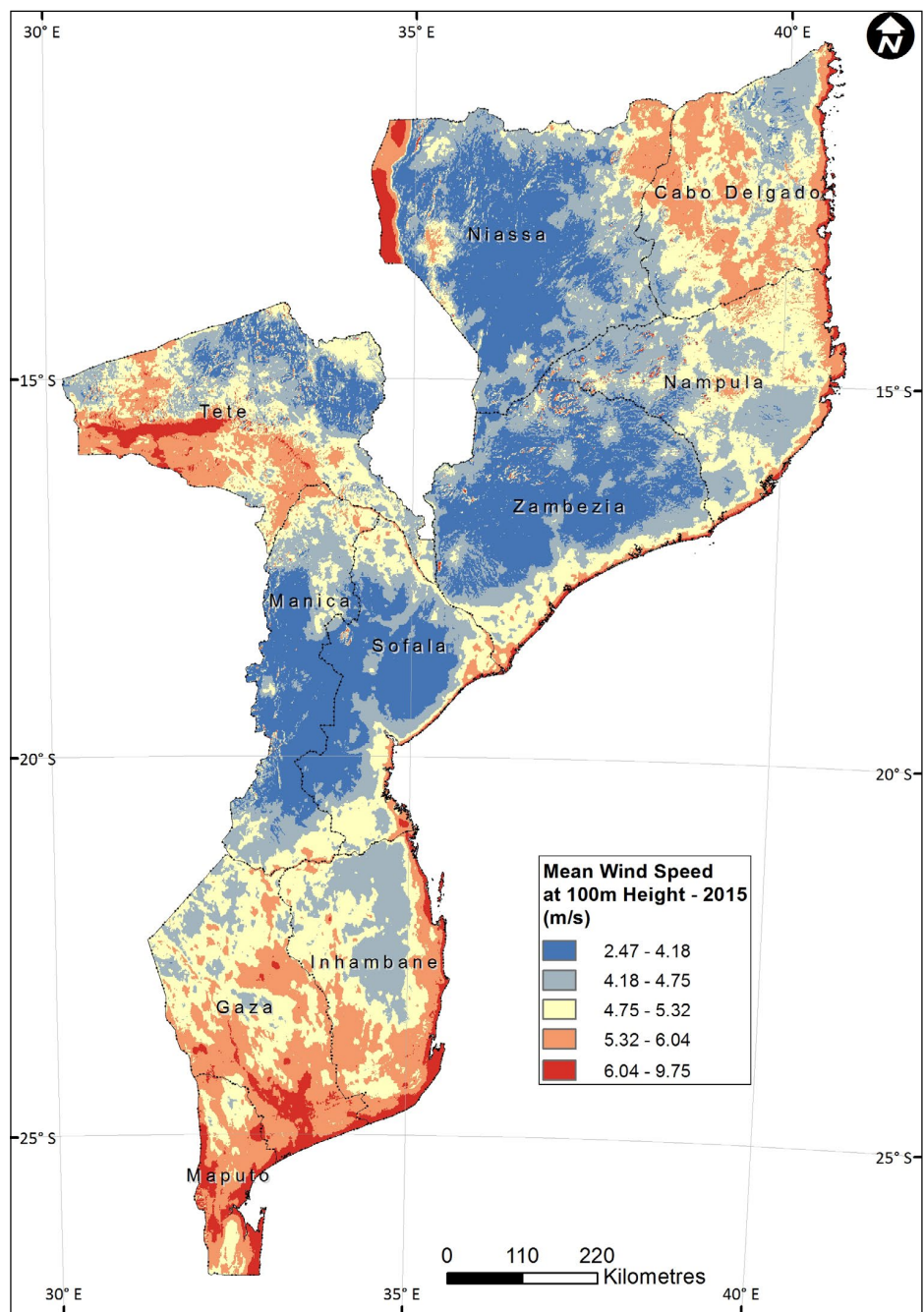
**Wind resources in Mozambique are significant, with an estimated 230MW of high potential sites identified in the Renewable Energy Atlas and average wind speeds of over 7m/s in northern and coastal regions such as Maputo and Gaza.** The projects in these provinces have over 3,000 equivalent hours at rated power (NEPs). Projects were also identified in the provinces of Sofala, Cabo Delgado, Zambezia, Inhambane and Tete, with over 2,500 NEPs. Other areas have low to moderate intensity, with speeds between 4 and 6 m/s, and are therefore not cost competitive. Figure 11 shows the mean wind speed at 100m. Hybrid wind solutions were found to be cost competitive with biomass, hydro and hybrid solar, at approximately USD 375 per MWh. Total wind solutions were estimated at close to USD 1,550 per MWh due to the large batteries required to support intermittency.

## OTHER RESOURCES

**The Atlas identifies localised potential for both wave and geothermal power in Mozambique, although the potential is insufficient overall.** The Atlas finds a mean wave flux of 10 kW/m, which is low for wave power. Three 3.75 MW pilot (grid connected) projects were suggested, but the strongest waves, at over 14 kW/m, are found along the south coast of Inharrime which is not covered by current grid infrastructure. In addition, three geothermal sites are proposed in the districts of Lago (Niassa), Morrumbala (Zambezia) and Marara (Tete), with potential capacities of 20 MW, 20 MW and 7 MW, respectively. Although a number of sites studied are close to the approximate 150 degrees centigrade threshold for feasible geothermal energy, resulting in costs of energy around USD 100 to 215 per MWh, the cost is much higher compared to areas in Kenya in which springs can reach 300 degrees.

14 IRENA Renewables Readiness Assessment 2012

Figure 11. – Mean wind speed at 100m. 2015. DTU/IRENA.



## 4. OVERVIEW OF THE ENERGY SECTOR

### 4.1 OVERVIEW OF RESPONSIBILITIES AND CURRENT CONTEXT

**The energy sector in Mozambique is regulated by the Ministry of Energy and Mineral Resources (MIREME).** The mandate of MIREME is to plan the use of energy resources—including natural gas and petroleum products—and develop electricity supply and distribution. The government has also created the National Energy Fund (FUNAE), an administratively and financially autonomous public institution, which has the responsibility to support and develop the sustainable management of power resources. Generation, transport, distribution and commercialisation of electricity is mainly the responsibility of the Electricidade de Moçambique (EDM), a 100% state owned institution. In addition, a small number of lines are run by Hidroelectrica de Cahora Bassa (HCB), the operator of the Cahora Bassa hydroelectric plant, and by the Mozambique Transmission Company (MOTRACO).

**The National Council for Electrification (CNELEC) is in the process of becoming Mozambique's new energy regulator.** A draft law was submitted to Parliament in July and should be agreed soon. CNELEC's focus will include, among others, establishing different tariffs, downstream issues concerning liquid fuels, renewable electricity.

**Currently, the southern grid network is not connected to the northern and central grid networks.** The grid network comprises mainly 220 kV and 110 kV lines. Higher voltage lines in the north facilitate the generation assets in this region. Although grid extensions are planned, especially to link the northern and southern regions of the country, grid reliability across the whole network is a concern. Lines in Mozambique are also interconnected to South Africa, Zimbabwe and Botswana and all power generated by HCB is exported to these countries directly. The power serving Mozambique's capital, Maputo, comes primarily from South Africa.

**Through a range of programs supported by FUNAE, including off-grid electrification projects, Mozambique reached a rural electrification rate of 27% in 2013, with 5.7% using electricity for lighting in 2014/15.**<sup>15</sup> According to FUNAE, it has given access to some 5 million customers, mostly via solar home systems.<sup>16</sup> As of 2011, there were just over one million household connections, with an average connection rate by EDM of 120,000 per year.<sup>17</sup> The number of districts covered by electricity doubled from 55 districts in 2005 to 110 districts in 2012.

**Energy demand is expected to be driven further by developments in the country's oil, gas and mining industries.** New coal and gas reserves will be exploited to fuel new capacity in Mozambique, with approximately 75 trillion cubic feet of estimated recoverable natural gas discovered in Mozambique's offshore area in 2011. It is estimated that power projects worth USD 12 billion are currently in the pipeline, and that Mozambique has a projected liquefaction capacity of 50MMTPA.<sup>18</sup> Mozambique LNG is advancing an onshore liquefied natural gas (LNG) park on the Afungi peninsula in Cabo Delgado Province, the first of its kind in East Africa. As of 2016 this project is in the stage of finalising legal and contractual frameworks and securing purchase agreements. As a result of large coal reserves, particularly in Tete Province, a number of mining companies are attempting to establish plants and mines in order to sell to South Africa, which relies heavily on coal.

**Ageing assets unable to provide consistent electricity to customers are a key challenge for the government.** The existing grid, operated by EDM, suffers regular power outages, which represent a substantial loss for the operator. EDM therefore operates at a loss due to a legislated flat rate tariff subsidy and insufficient generation sources. With a projected load growth forecast of 12.5% over the coming years, this problem will be even more difficult to address. Especially as the current planned generation is insufficient to address the existing deficit. According to the ClimateScope report, which

15 World Energy Outlook 2015, Electricity Access Database. INE – Final Report of the Family Budget Inquiry: IOF 2014/15. June 2016.

16 ClimateScope Policies Database - [global-climatescope.org/en/policies/#/policy/4147](http://global-climatescope.org/en/policies/#/policy/4147)

17 EDM - Overview of Mozambique Electricity Sector: Opportunities and Challenges Presentation, 2013

18 Wood Mackenzie, Anadarko 2016 Mozambique FactSheet

assesses country-by-country climate related investments, Mozambique had the lowest clean energy investment between 2009 and 2014, at USD 2.2 million. In comparison, South Africa invested USD 12.2 billion and Rwanda invested around USD 100 million.<sup>19</sup>

## 4.2 SUPPORT FOR RENEWABLE ENERGY

**Mozambique aims to diversify available sources of energy.** In 2009, a national policy framework for renewable energy was launched, followed by a national strategy for renewable energy in 2011. The strategy considers grid connection and isolated systems (including mini-grids). Among the key challenges highlighted in the strategy are the non-comparative costs and pricing for grid-connected and non-grid systems. In addition, a feed-in-tariff was approved by the Council of Ministers by Decree no 58/2014 on 17th October 2014, but is still awaiting implementation guidelines. This is being considered by MIREME as a means to promote investments into generation and grid connected networks.

## 4.3 SUPPORT FOR INCREASED ACCESS TO ENERGY

**As of 2013, the rural electrification rate was 27%, with only 5.7% of the population using electricity for lighting. This represents a significant barrier to poverty reduction in the country.**<sup>20</sup> A key priority for MIREME is to achieve access to electricity for the majority of the population and to provide electricity that is affordable, efficient and sustainable. Rural electrification is part of both the Poverty Reduction Action Plan (PARP) and the National Development Agenda known as Agenda 2025.

**The low electrification rate leaves Mozambique more vulnerable to the effects of climate change.** In Mozambique, the majority of the population uses traditional biomass for fuel, sourced mainly from natural forests and woodlands.<sup>21</sup> Only the urban population uses charcoal and LPG more frequently. The resulting deforestation will leave Mozambique more vulnerable to the effects of climate change, as well as lead to further biodiversity loss. Between 1990 and 2005, Mozambique lost 3.8% of its forest cover. This acknowledged vulnerability means access to clean energy is a key government priority.

**The government has ambitious targets to expand rural electrification, mainly through formal grid extension and is in the process of developing a national electrification strategy** with support from the World Bank Group. The World Bank Group estimates that between 300,000 and 400,000 new connections are needed per year to achieve universal energy access by 2030. EDM's current annual connection rate of approximately 120,000 new customers is therefore insufficient to meet these needs.

**The UK's Department for International Development (DFID) is planning to launch a GBP 32.2 million five-year programme to support access to energy.** The programme, called BRIHLO, will target three markets—improved cookstoves, solar household systems and mini-grids—and will provide start-up grants to new businesses and working capital loans to established and emerging firms. The programme will also provide legal and technical support to market participants.

## 4.4 CHALLENGES TO INCREASE RENEWABLE ENERGY UPTAKE AND ACCESS TO ENERGY

**Renewable energy and mini-grids are included in government plans to promote energy access.** Definitive targets for the amount of electricity produced from renewable energy have not yet been set. However, MIREME expects that 250 MW of renewable energy will be fed into the grid based on appropriate feed-in-tariffs (FIT). MIREME understands that

19 ClimateScope 2015

20 World Energy Outlook 2015, Electricity Access Database. INE - Final Report of the Family Budget Inquiry: IOF 2014/15. June 2016.

21 Africa-EU Renewable Energy Cooperation Program – Mozambique Country Profile

universal electricity for Mozambique cannot come from the grid alone and that different solutions are required for optimal complementarity. Green mini-grids (GMGs) have been identified as one solution that has great potential. In addition, MIREME has conducted studies on the potential of electricity from waste (municipal waste and biomass from trees).

**Mozambique has limited experience with green mini-grids, with early pilot projects experiencing a number of challenges.** One such challenge faced by community hydro schemes established under the Energising Development (EnDev) Initiative, an energy access partnership currently financed by six donor countries: the Netherlands, Germany, Norway, the United Kingdom, Switzerland and Sweden, related to increasing costs and affordability of electricity for the target market. To facilitate the development of mini-grids in Mozambique, MIREME must therefore revise the enabling policy framework to increase financial viability of mini-grid projects.

**Further policy measures must be taken to attract the necessary investment into renewable energy solutions including isolated mini-grids.** A relevant legal framework, including regulation for GMGs, for example, must be prepared. To identify the regulations necessary to enable GMG implementation, MIREME is developing a project with EDP and the United Nations Environment Programme (UNEP) for the village of Titimane. The project will demonstrate the potential for private sector investment and determine the policies necessary to promote it. This will be built upon through a Sustainable Energy For Africa (SEFA) funded project, which will look to develop a legal framework for mini-grids. Other measures considered by MIREME include the development of appropriate feed-in-tariffs and differentiated tariffs.

**In the short term, there is a lack of clarity from MIREME about updating the current renewable energy policy framework to address the absence of investment.** Existing documents fail to address the barriers to investment, and the feed-in-tariff proposed in 2014 is still under development. The government believes that different projects need to be implemented to determine the best approach. After this determination, the government will then develop the required policy and legal frameworks to attract the private sector. Attracting local finance is difficult as GMG development is only at the inception stage. Mozambique will require demonstration projects to stimulate a sustainable local market for GMGs.

**The use of renewable energy (excepting large hydro) is still relatively new for Mozambique. Relevant stakeholders will therefore need time to learn about potential opportunities.** Locally manufactured renewable energy systems are unlikely in the short term. Currently, one solar photovoltaic (PV) panel manufacturing plant in Maputo manufactures solar home system panels. It is owned by FUNAE.

**Free access to useful data such as the Renewable Energy Atlas is currently limited.** Sponsored by FUNAE, as previously mentioned, the Atlas aims to identify and promote the use of renewable energies, most notably in rural areas. Nevertheless, the Atlas is available for purchase only.

**Better coordination is required among energy sector stakeholders.** In the process of becoming the country's official energy regulator, CNELEC's role is not defined in terms of grid and off-grid, but rather in terms of type of activity, such as establishing different tariffs, downstream issues concerning liquid fuels, renewable electricity. Some of these activities overlap with those of FUNAE and the Ministry. EDM supports the possibility of establishing an agency for rural electrification. The Ministry of Land, Environment and Rural Development (MITADER) has a particular interest in bio-energy opportunities from agriculture. Meanwhile, the Ministry of Science and Technology is working on renewable energy projects, but separately from MIREME projects. Finally, the Ministry of Economics and Finance (MEF) could also be a critical player regarding tariff structures, in coordination with CNELEC.

## 4.5 POWER NETWORK AND INFRASTRUCTURE

**Mozambique northern and central regions are connected through 220 kV and 110 kV lines.** Numerous grid extensions are planned, including interconnections to Malawi, outlined in EDM's Master Plan 2017-2027. A 200 km, 400 kV interconnector is being constructed between Matambo sub-station to Blantyre West in Malawi, transmitting at least 200 MW. This will provide access for Malawi to the Southern Africa Power Pool market. The CESUL south-central interconnection will connect the southern grid system to the central (and therefore northern) grid systems, via a 400 kV and 800 kV line. Delays in the construction of the Mphanda Nkuwa Dam has slowed progress as the 1.5 GW generated is an

essential baseload customer for the CESUL line. But a preliminary agreement has been reached among investors. Norway has provided funding for feasibility studies of this project, and is also providing technical and financial assistance to four projects focusing on power transmission and distribution in the province of Cabo Delgado.

**Mozambique has 2.64 GW of installed power capacity and relies mostly on large hydro including the largest scheme in Southern Africa, Hidroelectrica de Cahora Bassa (HCB).** Remaining capacity is predominantly small hydro and fossil fuel plants. The construction of the planned CESUL interconnection will enable the construction of further large hydro schemes, including the proposed Mphanda Nkuwa Dam (2,500 MW). In addition, the inability of EDM to meet unpredictable and rising electricity demand has led to an increased reliance on independent power producers (IPPs) to expand its current capacity. Emergency purchases from IPPs are expected to become more frequent and are costly. In order to better facilitate additional private engagement in the sector, the country's regulatory and legislative environment must become more attractive.

**Mozambique's aging grid network is a constraint to overall national growth.** Transmission losses were 17.8% in 2013.<sup>22</sup> Regular blackouts and load-shedding are frequent due to scant backup provisions and the reliance on a single (hydro) energy source. Operating failures, further aggravated by natural disasters, substantially affect the economy. Such challenges will only become more acute as the economy grows.

## 4.6 OFF GRID DEVELOPMENTS

**FUNAE is mainly dedicated to providing off-grid electricity in Mozambique, primarily through solar home systems procured through tied aid programs.** Since 2013, support has been provided by the Belgium Technical Cooperation (BTC), United Nations Industrial Development Organization (UNIDO) and German International Cooperation (GIZ) through separate programs. This has resulted in a large increase in the energy access rate. As of 2014, there were 72 diesel-powered mini-grids owned by FUNAE, mainly used for irrigation, though many have shut down due to the need for repairs, lack of funds or spare parts. These were built before off-grid renewable energy was government mandated, but are now prime targets for re-development using solar technologies. The 50 Solar Mini-Grid Villages Project, funded by Portugal in 2013, led to two PV 4 kW systems being installed in Gaza and Inhambane Provinces. In addition, as part of an aid project agreement signed in 2010 between Hyosung Corporation in South Korea and FUNAE, three 400-500 kWp systems were to be constructed in Mavago, Mecula, and Muembe in Niassa Province. The status of both mini-grid projects is unknown. Due to the lack of local technicians and engineers some companies had to be sourced from Malawi and Zimbabwe.

**Mozambique has an operational solar module assembly plant near Maputo, producing 15 MW of panels per year, which is uncommon in Sub-Saharan Africa.** The plant is operated by FUNAE and is currently producing 10, 75, 100 and 150 Wp panels. The plant, based in a free economic zone is crucial to the future development of solar projects and the sector. The plant has a number of resellers and distributors, such as Blue Zone who produce water pumping systems, and others including Logotipo, Luxuosa, Vasco Equipment and Mozambique General Logistics. Solarkom assembles and markets these systems in the country and are one of the few companies that keep stocks of pico solar systems. Imported systems from China and Europe are also available.

**There is a potential conflict of interest between FUNAE's role as an investor and its role in the production, operation and control of rural energy systems.** FUNAE currently tenders the installation of off-grid projects to project developers and has taken on an operational role in some cases to facilitate project success. To tackle potential conflicts of interest from this new role, through which FUNAE could be funding itself to implement projects, the structure of FUNAE is being reviewed. An additional issue is the implementation of future programs, which remains heavily dependent on donor funding.

**Private sector engagement in solar applications is low, partially due to a lack of suitable incentives.** The Renewable Energy Atlas highlights the need for adequate financing schemes due to the strong initial investment requirements: "An adequate financing strategy, benefitting from concession rates or export credits, could make solar power competitive". So far there are only a handful of solar practitioners in Mozambique, some of whom are listed Section 6.2.





## 5. REGULATORY FRAMEWORK FOR MINI GRIDS

Mozambique began reforming its power sector over two decades ago, including via the 1997 Electricity Act that established provisions for IPPs under a concession system, while maintaining the vertically-integrated national utility EDM.<sup>23</sup> This was done through a series of laws and decrees that are outlined in detail in Section 5.3. The government has traditionally focused on grid extension to reduce energy poverty and relied on the country's significant hydrological resources for power. Grid constraints and a move to diversify national power generation are now leading to a new chapter in Mozambique's power sector reform.

This section gives a high-level overview of the policy and regulatory aspects affecting mini-grid development.

### 5.1 REGULATORY AND POLICY ENVIRONMENT: KEY TAKEAWAYS

	<b>Enabling Factors</b> for the development of clean energy mini-grids	<b>Limiting Factors</b> for the development of clean energy mini-grids
<b>Planning and institutional</b>	<ul style="list-style-type: none"> <li>- The National Energy Fund (FUNAE) implements energy access projects, reportedly providing services to 5m people</li> <li>- Energy access targets exist, through the SEforALL goals, including a household access rate of 56% by 2030</li> <li>- A legal framework for off-grid projects is part of a package of support to be provided by the Sustainable Energy Fund for Africa (SEFA), building on the RECP pilot project in Titimane village</li> </ul>	<ul style="list-style-type: none"> <li>- Currently no dedicated energy regulator. CNELEC is in the process of being legislated into this role, but currently serves as an advisory body</li> </ul>
<b>Data availability</b>	<ul style="list-style-type: none"> <li>- The Renewable Energy Atlas is a significant source of information for mini-grid developers, including pre-feasibility studies for specific sites</li> </ul>	<ul style="list-style-type: none"> <li>- The Atlas, and associated pre-feasibility studies, are not freely available</li> <li>- Greater availability of other data is needed, including public GIS datasets</li> </ul>
<b>Licensing</b>	<ul style="list-style-type: none"> <li>- Private power generation and distribution companies are allowed under the Electricity Law (21/97) and the Public-Private Partnerships Law (Law No. 15/2011)</li> </ul>	<ul style="list-style-type: none"> <li>- No current legal framework for mini-grids</li> <li>- Private-led mini-grids perceived as a threat to public sector business models</li> </ul>

	<b>Enabling Factors</b> for the development of clean energy mini-grids	<b>Limiting Factors</b> for the development of clean energy mini-grids
<b>Tariffs</b>		<ul style="list-style-type: none"> <li>– Mini-grid projects cannot set tariffs higher than EDM in practice. Previous mini-grids stranded by grid extension have been made to charge the same rate as EDM</li> <li>– The national tariff rates, tiered by consumption and customer type, are fixed regardless of location</li> </ul>
<b>Subsidies and incentives</b>	<ul style="list-style-type: none"> <li>– The planned DFID BRIHLO programme may be a future source of subsidies for mini-grids</li> </ul>	<ul style="list-style-type: none"> <li>– FUNAE operates as an implementer of energy access projects rather than as a fund</li> <li>– Energy access projects under FUNAE are heavily reliant on donor funding, which is limited currently</li> <li>– Only general investment incentives are currently available for mini-grid projects, including customs duties, VAT and tax exemptions</li> </ul>
<b>Power Purchase Agreements</b>	<ul style="list-style-type: none"> <li>– Feed-in-Tariffs, once operationalized, would address the lack PPA's for mini-grids through the use of standardised power purchase agreements (SPPA)</li> </ul>	<ul style="list-style-type: none"> <li>– There are no current regulations for power purchase agreements for mini-grids</li> </ul>
<b>Arrival of the grid</b>		<ul style="list-style-type: none"> <li>– A lack of clarity over grid extension timeframes and schedules</li> <li>– No regulatory protection against the arrival of the grid. Several mini-grids have been forced, upon arrival of the grid, to reduce their rates to that of EDM's</li> </ul>
<b>Technical rules</b>	<ul style="list-style-type: none"> <li>– Grid connected mini-grids must adhere to the national grid codes</li> </ul>	<ul style="list-style-type: none"> <li>– No specific mini-grid technical specifications to adhere to</li> </ul>
<b>Mobile services</b>	<ul style="list-style-type: none"> <li>– The telecom sector is liberalised, with revenue collection through mobile technologies allowed</li> </ul>	<ul style="list-style-type: none"> <li>– A lack of financial literacy limits the uptake of mobile payment services</li> </ul>

\* USAID Speed Program – An Analysis of the Power Crisis and its Impact on the Business Environment, February 2015.

## 5.2 THE MINI GRID POLICY AND REGULATORY ENVIRONMENT

### INSTITUTIONS AND PLANNING

**The energy sector is the responsibility of the Ministry of Mineral Resources and Energy (MIREME).** The relevant directorate for mini grid development is the National Directorate of Energy (DNE). The DNE is responsible for all energy-related activity of MIREME. Generation, transport, distribution and commercialisation of electricity is mainly the responsibility of EDM, a 100% state owned institution. There is no dedicated electricity/energy regulator. The National Council for Electrification (CNELEC) is in the process of becoming Mozambique's new energy regulator, subject to ratification of a draft law submitted to Parliament in July 2016. CNELEC's focus will include, among others, establishing tariffs and downstream issues concerning liquid fuels and renewable electricity. Rural electrification is delivered through the National Energy Fund (FUNAE), whose focus is mainly standalone systems and energy efficient cook stoves.

**The off-grid electrification program is part of the Action Programme for Reduction of Absolute Poverty II and III (PARPA II/III). Rural electrification is the responsibility of FUNAE.** PARPA II/III promotes electrification to achieve poverty alleviation and economic development in rural Mozambique and is the medium term planning document within the country's national planning system. Although not formally a rural electrification agency, FUNAE has run programs over the last decade or so involving dissemination of solar home systems, with support of development agencies including BTC, UNIDO, and GIZ.

**Mozambique has a number of energy access targets included in its SE4ALL goals, the primary one being an energy access rate of 38% for households by 2020 and 56% by 2030.**<sup>24</sup> Others include access to modern fuels of above 20% by 2020 and above 30% in 2030, in addition to a reduction in total electricity losses down to 17% in 2020 and 10% in 2030. Although there are no set definitive targets for renewable energy, the National Energy Policy (2015-25) indicates an expected 200 MW in small and mini-hydro, 150 MW wind, 50 MW solar and 50 MW biomass. The government's previous goal of electrifying all 128 districts via the national grid by 2014 was successfully met, with grid access remaining the primary policy vehicle for energy access.<sup>25</sup> Mozambique is part of the South African Power Pool, which targets 50% electricity access and 34% renewable energy penetration by 2020.

**A legal framework for off-grid projects is part of a package of support to be provided by the Sustainable Energy Fund for Africa (SEFA).** This broader package of support is a technical assistance grant with the aim of enhancing the enabling environment for private investments in renewable energy in Mozambique. Specific policy aspects that are expected to be addressed include the regulation of tariffs for off-grid customers, the concessionary requirements, and the ability for off-grid projects to access the recently approved public-private partnership laws. This will build off the recommendations from the Africa-EU Renewable Energy Cooperation Program's 2016 *Mini-Grid Legal Support to MIREME* project. The RECP project aims to support the implementation of a private off-grid enterprise in Titimane village (see section 4.4), to set a precedent for future private sector-led projects in Mozambique. This includes the right to waive certain conditions of the PPP law to be able to achieve a sustainable business model, and the ability to set its own tariffs.

### DATA AVAILABILITY

**The Renewable Energy Atlas is a significant source of information for mini-grid developers, but there remains a need for greater availability of information.** The Renewable Energy Atlas is available through FUNAE, accompanied by solar irradiation data and site pre-feasibility studies. However, none of this information is freely available, costing around \$100 for the Atlas and \$1000 for a single pre-feasibility study. Apart from the Atlas, there is a general lack of access to information in the energy sector. For example, although the energy sector Master Plan outlines at a high-level the energy

24 ClimateScope 2015 Mozambique Country Profile Annex, November 2015

25 EDM Performance and Business Growth Vision - Presentation to the MIREME on the situation point of Mozambique S.E. Electricity in January 2015, and prospects for the future, February 2015.

sector policy, there is no national electrification plan or other detailed implementation strategy document. As discussed in section 5.5, there is also a need to promote longer-term, GIS-based electrification planning, including the regular publication of grid extension plans and schedules.

## LICENCING

**Regulations allow for private and independent power distribution and generation companies to operate under the Public-Private Partnerships Law (Law No. 15/2011) and the Electricity Law (Law. 21/97).** Both laws are detailed further in Section 5.3. The Public-Private Partnerships (PPP) Law sets out a number of provisions for the involvement of local government, local investment and applicable public taxes for a private enterprise in the energy sector operating under a PPP. This potentially threatens the viability of off-grid business models. The energy law defines terms such as applicable taxes and tariffs, conflict resolution mechanisms, guarantees, and applicable law. The responsibility for issuing concession agreements for the generation and distribution of electricity under the Electricity Law, and the duration of these agreements, is specified in Decree 08-2000. Issuing concessions is the responsibility of the Council of Ministers for projects over 100MVA, of MIREME for projects between 1MVA and 100MVA, and of the relevant local authority for projects under 1MVA. MIREME can delegate this responsibility to the relevant local authority for projects under 10MVA that fall within their jurisdiction. Generation concession agreements last 25 years, except for hydro projects, where the duration is 50 years. Concessions for the distribution or transmission of electricity last 25 years. Concessions for the sale of electricity last 10 years.

**There is no legal framework for mini-grids in Mozambique, leaving uncertainty over how the current policy framework can be applied to off-grid projects.** There is a need for clarity in this matter, as in practice there is a lack of public sector championing of private-led mini-grids. This is due to a perceived risk to the business models of organisations such as FUNAE and EDM. In the case of FUNAE, this is as it would be in direct competition in its role as an implementing agency, as detailed below. In the case of EDM, it concerns the ability to set higher tariffs than those applied by the national utility. Therefore there is currently both a lack of regulatory support and of public sector championing for mini-grids. This is detailed further in the sections on *Tariffs* and *Subsidies and incentives*.

## TARIFFS

**Mini-grid projects cannot set tariffs higher than EDM in practice.** Within the current framework, private developers can set their own tariffs through negotiation with the relevant licencing authority. However, there is a lack of clarity over the application of the current framework to mini-grids. In practice, all private mini-grids have been made to apply the same rates as EDM. This includes a number of mini-grids that were reportedly stranded by grid extension. This matter is being addressed by the SEFA and Titimane projects, detailed previously. This must be addressed before private sector mini-grids can be sustainable, as the EDM tariff rate is too low to support off-grid business models.

**The national tariff for electricity is fixed, tiered by level of consumption and consumer type, but not by location. The right to the same cost of electricity, regardless of location, is a political issue in Mozambique.** The current rates can be found on the EDM website ([www.EDM.co.mz](http://www.EDM.co.mz)). The tariff is split into a social, household, agricultural and general tariff. The social tariff is only available for consumers using less than 100 kWh, who are also exempt from collection and value-added tax (VAT) charges for connection. The social tariff is USD 0.015 per kWh and household tariffs range between USD 0.032 to 0.045 per kWh depending on consumption.<sup>26</sup> All IPP's must sell their power to EDM under negotiated prices, as per the Public-Private Partnership Law. The price ceiling is set by the government based on service costs.

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26 BMZ: Factsheet Mosambik. 19.03.2015 ([www.export-erneuerbare.de](http://www.export-erneuerbare.de))

## SUBSIDIES AND INCENTIVES

**The primary source of subsidies for off-grid projects is the National Energy Fund (FUNAE).** However, despite being initially setup as a fund, FUNAE today operates mostly as an implementing agency for off-grid generation and access projects. In its role as a financier and operator of mini-grids and a distributor of standalone systems, FUNAE estimates to have served approximately 5m customers. This impact has been achieved mainly through donor funded, tied-aid programs, including those from the Belgium Technical Cooperation (BTC), UNIDO, and GIZ. The continued development of energy access under FUNAE is dependent on further donor funding being made available. This is currently limited due to a number of macroeconomic factors including conflict, missing donor funds, and corruption.

**A future source of subsidies may be the DFID BRIHLO programme (see section 4.3).** This £32.2m programme is about to be launched, and will provide support to access to energy over 5 years. BRIHLO will provide grants and working capital to businesses to support three markets: improved cook stoves, solar household systems, and mini-grids.

**Historically, only general investment incentives were available for mini-grid projects.** General incentives are normally valid for the first five years of operation. These include customs duties and VAT exemptions (on capital goods and essential infrastructure investments); tax deductions (for professional training and specialised equipment); and numerous rapid development zones, free industrial zones and special economic zones. More detail can be found in Section 5.4 below. To date, the main beneficiary of special incentives is biofuel, supported by government since 2004. Although it is not operational, the feed-in-tariff introduced by the Ministry of Energy in 2014 would suggest that renewable, generation or even mini-grid specific incentives might be introduced in the future.

## POWER PURCHASE AGREEMENTS

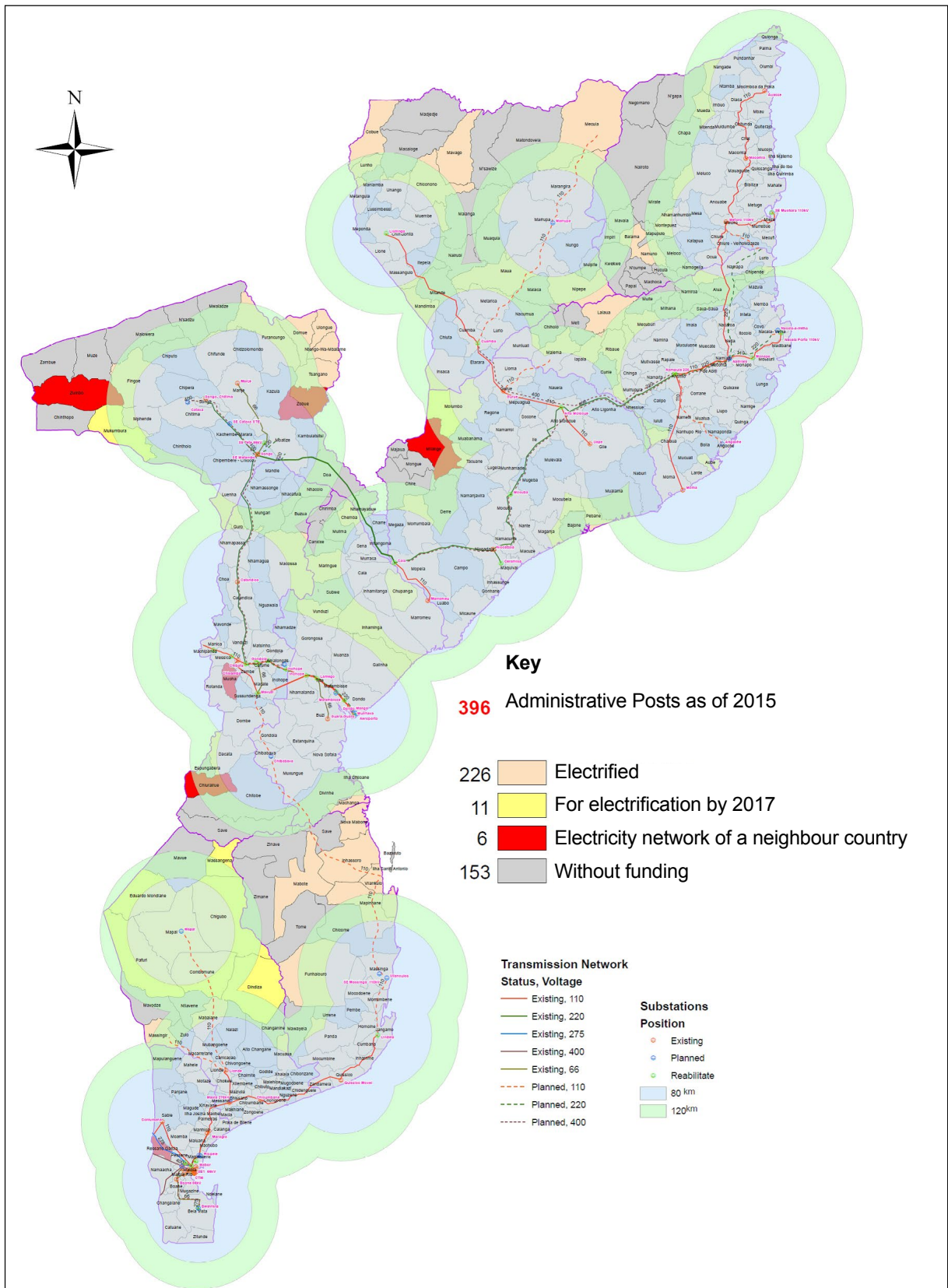
**There are no current regulations for PPAs.** The feed-in-tariff, under development with support from the African Development Bank, would address this through the use of Standardised Power Purchase Agreements. These SPPAs would be based on fixed and non-negotiable tariffs, and would be available for projects between 10 kW and 10 MW.

## ARRIVAL OF THE GRID

**The proposed grid extension plans are available, part of the EDM Master Plan, but construction timeframes are not clear.** Figure 12 shows the state of electrification of the administrative posts in 2015, including planned grid extensions. The main planned development is the 1500km South-Central (CESUL) transmission line, which will be comprised of a 400kV HVAC and 800kV HVDC line. CESUL will connect the power plants of Mphanda Nkuwa and HCB North (HCB phase II) to the national market. Delays in the construction of the Mphanda Nkuwa Dam, as the primary baseload for the CESUL line, have slowed progress, but a preliminary agreement has been reached among investors. A 200 km, 400 kV interconnector is being constructed between Matambo sub-station and Blantyre West in Malawi. This will provide access for Malawi to the Southern Africa Power Pool market. Other plans include a 400 kV line from Caia in Sofala to Namialo in Nampula, a 220 kV line reinforcing the line from Dondo-to Manga in Sofala, and the upgrading and reinforcement of several distribution networks and transmission substations.

**There is no regulatory protection for mini-grids against expansion of the grid, or provision of compensation in this scenario.** As highlighted previously, at least three mini-grids have been forced to apply EDM tariff rates upon arrival of the grid (see sections on *Tariffs* and *Subsidies and incentives*).

Figure 12. – Electrification of Administrative Posts as of 2015, with planned grid extensions. Translated and used with the permission of the Director of Planning, EDM.



## TECHNICAL RULES

In addition to the national grid code, which must be adhered to by all grid-connected projects, there are no specific technical rules or specifications to which mini-grids must adhere.

## MOBILE SERVICES

**Mozambique has a liberalised telecom sector with mobile money technologies available for the facilitation of payments for power services, although penetration of mobile money remains low to date.** Cell phone usage is high in Mozambique, with 74% of the population having a mobile phone subscription in 2015.<sup>27</sup> Introduced in 2011 by Carteria Movel (mCel), Mozambique welcomed its first mobile payment system known as mKesh. In turn, Kenya-based telecom giant Safaricom introduced its mobile money M-pesa service in 2013, following its local success dating back to 2007.<sup>28</sup> In spite of their availability, electronic payment systems are not yet fully established, with a general lack of financial literacy reducing the uptake of mobile payment and other systems. The 2014 FinScope Consumer Mozambique Survey found that only 3% of surveyed adults used mobile payment services.<sup>29</sup> Seventy-nine percent were unaware of it, with 11% not having enough information about it. Only 3% said there were no mobile payment providers in their area, and only 18% of users said there was only one provider in their area. Training around the use of these systems in rural areas is needed to increase trust and capacity for use.

## 5.3 ENERGY SECTOR POLICIES

**Electricity Act**, 1997 (Law. 21/97)

[www.mireme.gov.mz/index.php?option=com\\_phocadownload&view=category&download=25:lei-de-electricidade&id=5:lei&Itemid=150](http://www.mireme.gov.mz/index.php?option=com_phocadownload&view=category&download=25:lei-de-electricidade&id=5:lei&Itemid=150)

The 1997 Electricity Act is the general policy for the organisation of the energy sector and the legal framework for generation, transmission, distribution and sale of energy within the country and outside Mozambique. This act created the National Electricity Council (CNELEC), the informal regulator of both electricity and liquid fuels. This reform, through supporting decrees of the electricity market allows for private generation and distribution of energy, under concessionary contracts from MIREME. It also determines the methodology by which tariffs are set.

**Energy Policy**, 1998 (decree 5/98)

[energypedia.info/wiki/PT\\_Politica\\_Energetica\\_Imprensa\\_Nacional\\_de\\_Mocambique](http://energypedia.info/wiki/PT_Politica_Energetica_Imprensa_Nacional_de_Mocambique)

The 1998 Energy Policy was highly influential. It outlines the government's intent to develop household energy access, competitive business, environmental technology and energy efficiency in the electricity sector. Aims to deliver capacity building and improved management targets are presented, as well as visions for the sector. The Policy continues to inform the governance of the sector today.

**Decree 08-2000**

[http://www.salcaldeira.com/index.php/pt/component/docman/cat\\_view/32-legislacao/71-energia](http://www.salcaldeira.com/index.php/pt/component/docman/cat_view/32-legislacao/71-energia)

Decree 08-2000 establishes the powers and procedures for the attribution of control and extinction of concessions of production, transportation, distribution and sale of electrical energy, as well as their importation and exportation. This includes detailing which authority can grant licences, dependant on project size, and the duration of different concession agreements.

27 World Bank. Mobile cellular subscriptions (per 100 people)

28 Electronic payments in Mozambique: Diagnosis and impact evaluation of dissemination. International Growth Centre, 1 July 2014 - 30 April 2015

29 <http://www.finmark.org.za/launch-of-finscope-consumer-mozambique-survey-2014/>

### **Decree 42-2005**

[http://www.salcaldeira.com/index.php/pt/component/docman/cat\\_view/32-legislacao/71-energia](http://www.salcaldeira.com/index.php/pt/component/docman/cat_view/32-legislacao/71-energia)

Decree 42-2005 establishes standards for the planning, financing, construction, possession, maintenance and operation of production, transportation, distribution and sale of electrical energy, as well as the norms and procedures related to the management, operation and overall development of the national electricity transmission network. This includes detailing the high-level obligations of concessionaries, different responsible authorities and other elements of a concession such as what needs to be included in connection contracts with customers.

### **Decree 48-2007**

[http://www.salcaldeira.com/index.php/pt/component/docman/cat\\_view/32-legislacao/71-energia](http://www.salcaldeira.com/index.php/pt/component/docman/cat_view/32-legislacao/71-energia)

Decree 48-2007 regulates the licencing of electrical installations. This decree defines ten categories of electrical installation, including installations for self-generation, for the sale of electricity, and for generation for sale to the national grid. For each category different rules are detailed, including the responsibilities of the involved parties and various technical requirements.

### **Energy Sector Strategy, 2009 (Resolution No. 10/2009)**

[energypedia.info/wiki/PT\\_Estrategia\\_do\\_sector\\_de\\_energia\\_Imprensa\\_Nacional\\_de\\_Mocambique](http://energypedia.info/wiki/PT_Estrategia_do_sector_de_energia_Imprensa_Nacional_de_Mocambique)

The 2009 Energy Sector Strategy is a detailed government policy instrument for the energy sector and defines the main policy goal of the government. Identified objectives include electricity and fuel access to rural and peri-urban areas, encourage sustainable production of biofuels, diversification of energy sources, engagement in international cooperation, especially with the Southern African Development Community (SADC).

### **New and Renewable Energy Policy, 2009 (Resolution 62/2009, 14 October)**

[energypedia.info/wiki/PT\\_Politica\\_de\\_Energias\\_Novas\\_e\\_Renovaveis\\_Imprensa\\_Nacional\\_de\\_Mocambique](http://energypedia.info/wiki/PT_Politica_de_Energias_Novas_e_Renovaveis_Imprensa_Nacional_de_Mocambique)

The 2009 New and Renewable Energy Policy promotes greater access to clean energy services by using equitable, efficient, sustainable, and culturally sensible sources of new and renewable energies. The objective is to allow better quality and accessible prices, to reduce poverty and to contribute to creation of local and national income and employment.

### **Strategy for New and Renewable Energy Development, 2011 (revision of 2009 policy)**

[energypedia.info/wiki/PT-ENERGIAS\\_NOVAS\\_E\\_RENOV%C3%81VEIS-GelFue](http://energypedia.info/wiki/PT-ENERGIAS_NOVAS_E_RENOV%C3%81VEIS-GelFue)

The 2009 Strategy for New and Renewable Energy Development policy further promoted access to clean energy services, while the 2011 revision targeted increased diversity and capacity of renewable generation. Linked to the Action Plan for the Reduction of Absolute Poverty II/III, this considered both on and off-grid generation, allowing private generators to connect to the grid.

### **Public-Private Partnerships Law, 2011 (Law No. 15/2011)**

[http://www.acismoz.com/lib/services/translations/Law%20no%20%2015%202011%20of%2010%20August%20\(Mega%20Projects%20Law\)%20%20SC%20free%20translation.pdf](http://www.acismoz.com/lib/services/translations/Law%20no%20%2015%202011%20of%2010%20August%20(Mega%20Projects%20Law)%20%20SC%20free%20translation.pdf)

The 2011 Public-Private Partnerships Law established the norms for contracting, implementing and monitoring PPP's. From this multiple projects have been generated, including an 110MW gas-fired plant, two coal-fired power plants (amounting to 900MW) and a 1.5GW large hydro project. All IPPs must sell electricity to EDM under negotiated prices.



## Feed-in-Tariff, 2014 (Decree 58/2014)

[www.portaldogoverno.gov.mz/por/content/search?SearchText=84%2F2014&SearchButton=Search](http://www.portaldogoverno.gov.mz/por/content/search?SearchText=84%2F2014&SearchButton=Search)

The 2014 feed-in-tariff was launched by the Ministry of Energy in 2014, and sets a price premium for small scale solar, wind, biomass and hydro projects (valid for 10kW to 10MW projects). Rates will possibly range between \$0.13-\$0.41/kWh. Regulation to implement this tariff is still pending.

Table 5 lists related decrees that also impact on mini grid developments in Mozambique.

Table 5: – Related decrees

Legal Instrument	Issue Addressed
Decree 28/1995	Creates EDM - EP from EDM EE created in 1977
Decree 24/1997	Creates FUNAE to spur off grid access to modern energy
Decree 8/2000	Regulates the Electricity Law
Decree 25/2000	By laws of CNELEC
Decree 42/2005	Rules for industrial Electrical installations. (Gen, Tran. Distrn.)
Decree 43/2005	Nominates EDM as the RNT concessionaire
Decree 75/2007	Organization chart for the Special Economic Zones Office
Decree 1/2010	Tariff for electricity used in agriculture
Decree 12/2012	Regulation of the PPP law

## 5.4 INVESTMENT INCENTIVE POLICIES

This section references the Trade Knowledge Network/IISD *Investment Incentives for Renewable Energy in Southern Africa: The case of Mozambique* 2013 report, which is a good further reference.

Aiming to attract foreign and domestic investment, the Government of Mozambique has developed broad investment incentives. Apart from the feed-in-tariff introduced in 2014, no renewable energy specific incentives exist. Below are some incentives that may be relevant to renewable investors:

**Investment Law (Law No. 3/93):** Establishes a uniform framework for investments and provides tax incentives for investors. Some of these, usually valid for the first 5 years of operation, include:

- **Capital goods import:** Qualifying investments are exempt from payment of customs duties and value-added tax on the importation of capital equipment, including accompanying spare and accessory parts - Chapter 1 on General Benefits, Section 1, Article 14
- **Specialised equipment:** Investments in specialized equipment shall for first five years of operation benefit from a deduction from taxable corporate income tax (IRPC) and certain activities relating to personal income tax (IRPS) - Chapter 1 on General Benefits, Section 2, Article 17

- **Professional training:** The cost of professional training of Mozambican employees is deductible from taxable income for the purposes of calculating corporate income tax (IRPC) for the first five years of operations - Chapter 1 on General Benefits, Section 2, Article 18
- **Essential infrastructure:** Investments to establish basic public infrastructure, such as roads, rail lines, electricity or telecommunications, is exempt from payment of customs duties and VAT on the import of capital goods - Chapter 2 on Specific Benefits, Articles 20 to 22

**Decree No. 47/2008:** Created the Institute for the Promotion of Small and Medium Enterprises (IPEME), which provides business support and access to finances for MSMEs.

**Law No. 4/2009 the Code of Fiscal Benefits:** Fiscal benefits for investors established, including exemptions and reductions on value-added taxes (VAT), investment tax credits, corporate income and tax deductions.

**Law No. 3/2012:** Change to the VAT calculation, with VAT applied to 40% of price of products or services for public entity-implemented projects. This can apply to private-public partnerships, but currently is not available to purely private projects.

The National Tax System is defined through **Law 15/2002** and **Law 02/2006**, and further incentives through favourable tax rates includes:

**Corporate Tax (IRPC) of 32%:** IRPC is applicable to all income for public and private companies based in Mozambique.

**Exemptions of the VAT at 17%** are available for capital goods and essential infrastructure investment in rural areas, including spare and accessory parts.

**Customs and Import Duties rates:** Electricity, with essential goods, has a rate of 0.0%. Standard duty rates for raw materials stand at 2.5%, intermediate goods, 7.5% and fuel, 5%. However, further reductions are available through location-based incentives, namely the rapid development zones, free trade zones and special economic zones.

For more information on investment incentives, details and opportunities, please refer to the Centre for Promotion of Investments (CPI).

## 5.5 POLICY RECOMMENDATIONS

**Mozambique has made substantial progress towards the creation of a policy environment that is supportive of mini-grid development.** The Renewable Energy Atlas, although not free, provides vital market intelligence to potential mini-grid practitioners on the availability of renewable sources. The created National Energy Fund, FUNAE, has been successful with a number of off-grid electrification programmes, which focus on solar home systems to date. Additionally, the regulation of mini-grids will be further strengthened once the National Council for Electrification, CNELEC, has been formalised as the national energy regulator. Meanwhile, the proposed feed-in-tariff should significantly increase the viability of private-led off-grid generation projects if implemented.

**Further progress is necessary, however, before mini-grid rural energy solutions are viable.** For example, there remains a lack of clarity over the legislative process for private off-grid projects and a need for additional financial support mechanisms. Accordingly, the following high-level policy recommendations are proposed, which:

- Formally recognize the importance of mini-grids to the future development of the energy sector in policies, sector strategies and visions;
- Allow private sector mini-grids to set their own tariffs, and in line with this, enforce this support for private sector mini-grids throughout public sector organisations such as FUNAE and EDM;
- Consider a technology- and size- specific tariff following operationalization of the proposed FIT;
- Develop a simple, fast and transparent licensing process for mini-grids, as well as the respective concession terms;
- Promote longer-term, geographic information system (GIS) -based electrification planning, including the regular publication of grid extension plans and schedules;
- Consider financing mechanisms to reduce the cost of access to electrification for poor communities, such as subsidising connection costs through a levy on grid tariffs;
- Develop future capacity, training and knowledge transfer with respect to mini-grids within the private and public sectors;
- Support the further development of alternative financing solutions, investment funds, microfinance and climate finance mechanisms, to reduce the reliance on donor funding; and
- Support the development of mobile payment coverage and solutions.

**Tanzania offers a potentially valuable case study on successful mini-grid-focused policy measures.** Tanzania has made a number of policy and regulatory changes starting with the inclusion of mini-grids within its 2008 Electricity Act.<sup>1</sup> The first stage was to develop a standardised 15-year power purchase agreement program for projects under 10 MW. Between 2009 and 2015 this was replaced in stages by a feed-in-tariff, which is now both technology- and size-specific, and paid in USD to mitigate high inflation and local currency fluctuations. Tanzania has also a number of financing mechanisms, such as the World Bank Group funded Tanzania Energy Development and Access Expansion Project. This program provides matching grants up to USD 100,000 for feasibility studies, performance grants for connections, a USD 23 million credit line for long-term loans and project financing. It has also waived connection costs for all poor customers supplied via Rural Energy Agency projects. Tanzania now has over a hundred operating mini-grids, and is one of the leading African countries in this space.

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1 Clean Energy Solutions Centre, Mini-Grids in Tanzania Webinar, 2016



## 6. MAIN STAKEHOLDERS

### 6.1 GOVERNMENT AND AGENCIES

Organizations that currently have the greatest impact and influence over prospects for green mini-grids in Mozambique are those in the public sector. Since the whole concept of cost-effective non-grid electrification is relatively new to Mozambique, there is only limited private sector involvement. Relevant governmental departments increasingly recognize the need to attract private investment into areas of energy access, but the public sector remains, for now, the driver of related activities.

The current President of Mozambique is Filipe Jacinto Nyusi (since 15 January 2015) and the Prime Minister is Carlos Agostinho do Rosário (since 17 January 2015). The President is the Head of State, Head of Government, and Commander-in-Chief of the Defense and Security Forces. The Prime Minister's functions include convening and chairing the Council of Ministers (The Cabinet), advising and assisting the President on governance, and coordinating the functions of the other ministries. The Council of Ministers is composed of the President, the Prime Minister and the Ministers.

Two ministries are directly related to the governance of clean energy applications and the required investment into green mini-grids. These are:

- Ministry of Mineral Resources and Energy (MIREME): Minister Pedro Conceição Couto
- Ministry of Land, Environmental and Rural Development (MITADER) : Minister Celso Ismael Correia

Other Ministries are also closely related and have significant influence due to their economic oversight or their need for energy services, e.g.:

- Ministry of Economy and Finance – Minister Adriano Afonso Maleiane
- Ministry of Foreign Affairs and Cooperation – Minister Oldemiro Marques Júlio Baloi
- Ministry of Agriculture and Food Security: Minister José Condugua António Pacheco
- Ministry of Health: Minister Nazira Karimo Vali Abdula (Ms)
- Ministry of Education & Human Development: Minister Luís Jorge Teodósio António Ferrão
- Ministry of Industry and Trade: Minister Ernesto Max Elias Tonela
- Ministry of Transport and Communications: Minister Carlos Alberto Fortes Mesquita
- Ministry of Public Works, Housing and Water Resources: Mr Carlos Bonete Martinho
- Ministry of Science & Technology, Higher & Technical Education: Minister Jorge Olívio Penicela Nhambiu

In 2015, the new President Nyussi indicated that he wanted a leaner Public Sector with a more technocratic approach. Several Ministries were consequently integrated and major Public Sector reforms were undertaken.

#### THE COUNCIL OF MINISTERS

**Contact:** Mr Carlos Agostinho do Rosário

[www.portaldogoverno.gov.mz/por/Governo/Gabinete-do-Primeiro-Ministro](http://www.portaldogoverno.gov.mz/por/Governo/Gabinete-do-Primeiro-Ministro)

Responsible for setting energy sector policy, as well as authorising concessions to allow private sector organisations into the energy market. All IPP generators over 100megavolt ampere (MVA) need authorisation by the council.

#### MINISTRY OF MINERAL RESOURCES AND ENERGY (MIREME)

**Contact:** National Deputy Director of Energy - Marcelina Mataveia, [mam@me.gov.mz](mailto:mam@me.gov.mz)

[www.mireme.gov.mz](http://www.mireme.gov.mz)

The Ministry of Mineral Resources and Energy directs and monitors the implementation of Government policy, in accordance with the principles, objectives and tasks set by the Government, in the areas of geological investigation, exploitation of mineral and energy resources, and the development and expansion of electricity supply infrastructure, natural gas and petroleum products.

The relevant directorate to mini grid development is the National Directorate of Energy (DNE). The DNE is responsible for all energy-related activity of MIREME (this status represents a devaluing by the current administration of the energy sector, which was previously represented by a dedicated Ministry).

Within its policy role MIREME is planning to address the issue of Feed-in Tariffs (FiTs), and is looking for support from multilateral agencies. Such an initiative could help to address one of the key barriers to renewable energy generation, though this is restricted to grid-tied electricity generation. DNE is also engaged with AfDB and EDP to develop the necessary policy and regulation for mini grid applications. This is linked to the UNEP and EDP initiative to develop a Clean Energy Mini grid in the village of Titimane in Mozambique.

#### **MINISTRY OF LAND, ENVIRONMENT AND RURAL DEVELOPMENT (MITADER)**

**Contact:** Olegario dos Anjos Banze, Deputy Director, [olebanze@hotmail.com](mailto:olebanze@hotmail.com)

[www.cgcmc.gov.mz/pt/ministerio-da-terra-ambiente-e-desenvolvimento-rural](http://www.cgcmc.gov.mz/pt/ministerio-da-terra-ambiente-e-desenvolvimento-rural)

The Ministry of Land, Environment and Rural Development is the central organ of the state apparatus that, in accordance with the principles, objectives and tasks set by the Government, organizes, directs, plan, manage and ensure the implementation of policies in the administration of domains and Land management and Geomatics, Forestry and Wildlife, Environment, Conservation Areas and Rural Development. MITADER is the result of a merger of three Public Institutions (the former Ministry of Environmental Coordination and the Institutes for Land and Rural Development) into a new Ministry. In this role the ministry handles both strategy, implementation and finance for rural development and clean energy projects in Mozambique. In particular, MITADER is conducting research into rural finance options, which will be presented at a conference in September 2016.

The “Estrela (Star) Programme” was launched by the MITADER in 2015. This aims to develop physical and social infrastructure in five key sectors (access to markets, water, energy, finance and knowledge) to catalyse sustainable production in rural areas. The intentions of this programme are aligned to the potential impact of GMGs, and MITADER’s interest in energy-related activity, and mini grids in particular, was highlighted by their agreement in 2015 to fund the EDP/ UNEP mini grid programme in the village of Titimane. The Star programme has not attracted the funding required for its activities to be as extensive as planned. The banking component has some support and is ongoing (expanding banking services to villages with no bank), and the water component is active, but no significant resources have yet been allocated to the intended programme for energy. A current assessment of energy sector funding needs being undertaken by FUNAE (as part of an internal positioning review) will help to determine the future prospects for the Star Programme and so clarify whether this can play a significant role in the future development of GMGs.

#### **FUNAE (NATIONAL ENERGY FUND)**

**Contact:** Antonio Saide, Chief Executive Officer, [antoniosaide@funae.co.mz](mailto:antoniosaide@funae.co.mz)

[www.funae.co.mz](http://www.funae.co.mz)

FUNAE is a public institution which is legally, financially and administratively autonomous. Its objectives are the development, production and use of different forms of low cost power, and to promote conservation and rational, sustainable management of power resources. The fund supplies financial aid and financial guarantees for economically and financially viable projects that are in tune with these objectives. Hence, this is the state institution responsible for small scale off-grid energy access and rural fuel distribution (maximum 600 kW for off-grid applications). FUNAE currently has 4 active GMG projects (Majawe 600 kW, Rotunda 530 kW, Zambesia 100 kW, and Mbhoa 62 kW). There are additional systems planned but there is insufficient funding for these. FUNAE is currently the leader in rural energy access in Mozambique and is involved with funding, operation and implementation of systems. While most RE technologies are sourced from outside of Mozambique, FUNAE owns a solar panel factory 25 km from Maputo which produces 15 MW/year of panels (size 14 W, 70 W, 100 W, and 150 W, with plans for 200 W panels) designed for use by individual households.

FUNAE understands the need for a clear methodology to determine when GMGs are the most appropriate solution, and to aid with this process, they have managed the preparation of the national Renewable Energy Atlas. This consists of two books, containing detailed assessments and maps of renewable energy resources (solar, wind, hydro, and biomass) available within the country. The books are available for purchase with a small copy costing 5,000 Mt and a large copy costing 18,000 Mt.

### **NATIONAL ELECTRICITY COUNCIL (CNELEC)**

**Contact:** Guilherme Luis Mavila, Chairman of the Board and CEO, [gmavila@cnelec.org.mz](mailto:gmavila@cnelec.org.mz)

[www.cnelec.org.mz](http://www.cnelec.org.mz)

CNELEC is the National Electricity Board. Its duties are to promote the implementation of relevant legislation for the electricity sector; identify the development needs and expansion of service according to the electricity policy; monitor the granting and the implementation of concessions; to exercise the conciliation functions, and mediation and arbitration on disputes concerning the arising issues between different dealers or between dealers and consumers.

CNELEC is not yet a regulator, and no legal mandate to regulate, but is a Government advisory body. However, it is fairly advanced through the process of transformation to take on formal regulatory duties. It is a member of the regional regulator association (RERA), which provides a good link with other national regulators. CNELEC expects to become the regulator, and can start to implement relevant activity, from the start of 2017. Some staff are then expected to be transferred from MIREME (those already involved with regulation), though the need for capacity building is well-recognised.

As the regulator, CNELEC will aim to introduce whatever legislation is necessary to attract private investment, and will need to assess the requirements for GMGs. CNELEC is currently developing guidelines for FIT implementation, with a focus on those not currently connected to the grid. The current FIT regime is based upon different tariffs for different technologies – there are four different tariffs (which are not dependent upon location).

### **MINISTRY OF PLANNING AND DEVELOPMENT – OFFICE OF ECONOMIC ZONES OF ACCELERATED DEVELOPMENT (“SPECIAL ECONOMIC ZONES”), GAZEDA**

**Contact:** Danilo Nalá, Director General, [info@gazeda.gov.mz](mailto:info@gazeda.gov.mz)

[www.gazeda.gov.mz](http://www.gazeda.gov.mz)

This office has been established to introduce and manage the operation of economic development zones across the country, which provide incentives to business. Six such zones have been established to date, with plans for more in the future. These include:

- Nacala Special Economic Zone - in the far north, on the Mozambican coast, with a deep water port (the third largest on the eastern coast of Africa).
- Mocuba Special Economic Zone – in the east of Mozambique, between Beira and Pemba. Includes an energy substation producing 200MVA and good water resources for potential hydroelectric development.
- Beluluane Industrial Free Zone - located 16kms outside of Maputo City, including 24 hectares serviced with infrastructure to accommodate small and medium industries. Good road access to the Port of Maputo.
- Integrated Tourism Resort Zone (ZETI) – located in the far north east of Mozambique. Privately operated and described as “one of the most attractive luxury tourist destinations in the world”

The factory that is owned by FUNAE and utilises local capacity for the assembly of solar PV panels is located within the Belulane Zone outside of Maputo.

## MINISTRY OF SCIENCE & TECHNOLOGY (MCTESTP)

**Contact:** Antonio Jorge Raul Uaissone, Head of Division for Technology Innovation (and focal point for CTCN), [antonio.uaissone@mct.gov.mz](mailto:uaissone@mct.gov.mz)

[www.mctestp.gov.mz](http://www.mctestp.gov.mz)

The Ministry of Science and Technology determines, regulates, plans, coordinates, monitors and evaluates all activities to do with science and technology. Its duties are to propose new strategies and policies for development; including regulation and coordination of all relevant activities, definition of priorities for scientific innovation, and definition of access to public funding mechanisms for scientific and technological innovation. The strategy scope for technology and innovation is planned to be expanded next year to include GMGs. MCTESTP has good links to other Ministries via the Institutional Group for Climate Change which includes MITADER, MIREME, MEF, Industry & Commerce (MIC), Agriculture, Health, State Admin and Public Infrastructure. This group is already engaged in discussions on investment in GMGs.

The Scientific Council for Energy is run by MCTESTP, which aims to support the government and provide a filter for relevant projects in the absence of an energy regulator. The Council recommends projects to the Ministry for support (as a technical advisor). MCTESTP is also the focal point for a United Nations project concerning climate change mitigation Technical Needs Assessment (TNA) – a consultant from UEM is currently working to identify the best eight technologies for Mozambique (for energy, agriculture, infrastructure and solid waste). MCTESTP aims to provide support to companies that are aiming to develop new energy technology applications in Mozambique. Five sciences parks are being created by MCTESTP (one is established already) where companies don't pay customs tax on imports (no import duty). The National Research Fund is part of the Ministry and can support energy-related activities. If there is a strategic project, the Ministry can recommend that the Fund finances it – this may be the case for GMGs. Project sizes are around US\$50k.

## INVESTMENT PROMOTION CENTRE (CPI)

**Contact:** Sattie Rohit (Ms), Project Management Services, [srohit@cpi.co.mz](mailto:srohit@cpi.co.mz)

[www.cpi.co.mz](http://www.cpi.co.mz)

CPI is the national focus for incentives to investors – it is responsible for increasing investment through support for investor planning and project implementation. Investment Law (Law 3/93) gives CPI responsibility for monitoring and verification of compliance in authorised investment grants.

The aim of CPI is therefore to promote and facilitate investment into Mozambique, with a focus on reducing the risks for private investors. CPI has departments for Project Management, Linkage, Business Development, Marketing and Admin. In their project department, potential private operators can submit an application and qualify for incentives. CPI aims to ensure that all of its activity is well-co-ordinated with the relevant Ministries, and it has good knowledge of available fiscal incentives (Government incentives are included in investment law). Such investment incentives depend upon the sector of activity, and may include for example the right to import equipment without duties or VAT.

## INSTITUTE FOR THE PROMOTION OF SMALL AND MEDIUM ENTERPRISES (IPEME)

**Contact:** Dr Claire Mateus Zimba, General Director

[www.ipeme.gov.mz](http://www.ipeme.gov.mz)

IPEME was created in 2008 by the government with a mandate to undertake three core activities:

- Develop, propose, and implement policies that support SMEs in Mozambique;
- provide services to support SMEs; and
- implement and establish SME platforms.



Since 2008, IPEME has created four SME platforms, called business development centres (in Maputo, Tete, Manica, and Cabo Delgado). An SME Complex in Machava is also under development. From 2010 to 2014, IPEME provided around 11,800 services to SMEs. They aim to act as an intermediary and facilitate SME access to commercial finance, helping them to apply for credit loans, gain financial literacy, and to negotiate with the banks. Enterprise support is also provided, focused on licensing facilitation, business planning and access to finances. This is supervised by the Ministry of Industry and Trade (MIC).

### **ELECTRICIDADE DE MOÇAMBIQUE (EDM)**

**Contact:** Carlos Yum, Director, [cyum@edmdipla.co.mz](mailto:cyum@edmdipla.co.mz)

[www.edm.co.mz](http://www.edm.co.mz)

EDM is the national electricity company of Mozambique, which deals with the generation, transmission, distribution and sale of electricity; both on grid and off-grid. It is responsible for 97% of Mozambique's electricity, managing the national transmission assets and dispatch control centre.

EDM has an Electricity Master Plan that includes the proposed grid expansion (indicating how long until the grid will reach each location) – any GMG programme must be aware of these details in order to avoid conflict. Terms of Reference for a National Electrification Strategy have also recently been prepared by EDM, together with the World Bank. As part of this planning process, EDM is working with FUNAE to map where an 11kV source of power is appropriate – they are looking at a radius of 20-50km from commercial centres. EDM is also trying to classify the administrative districts across the country, aiming to cluster them into groups depending where they are in terms of grid access and renewable energy potential, as indicated by the RE Atlas and population density.

### **HIDROELÉCTRICA DE CAHORA BASSA (HCB)**

**Contact:** Maputo HQ, [hcb.mpt@hcb.co.mz](mailto:hcb.mpt@hcb.co.mz)

[www.hcb.co.mz/eng](http://www.hcb.co.mz/eng)

Cahora Bassa is now a state owned hydropower plant with 2GW. Its construction was completed in 1975 with the establishment of the company Hidroeléctrica de Cahora Bassa, SARL. Only in 2007 did the Mozambican State acquire 85% of the share capital (instead of the previous 17%), thereby taking majority ownership. 90% of the electricity generated is exported to South Africa, but HCB also supplies a significant portion of domestic demand.

### **MOZAMBIQUE TRANSMISSION COMPANY (MOTRACO)**

**Contact:** Maputo Office, [info@motraco.co.mz](mailto:info@motraco.co.mz)

[www.motraco.co.mz](http://www.motraco.co.mz)

MOTRACO is a joint venture founded in 1998, including EDM, Eskom and Swaziland Electricity Company (SEC), that runs an aluminium smelting plant using electricity transported from South Africa. Its mission is to provide efficient power transmission and services related to the businesses of its partners, whilst ensuring acceptable returns for its shareholders.

MOTRACO operates on the purchase of energy from Eskom, for sale to the Mozal aluminium smelter in Maputo. MOTRACO also transports electricity from Eskom for EDM and SEC. This supply is based upon two 400 kV substations and transmission lines each with a capacity of 1340MW, together extending for 565kms. This infrastructure is owned by MOTRACO, which guarantees full operation and maintenance.

## 6.2 MINI GRID PRACTITIONERS OR PRODUCT DEVELOPERS

There are few mini grid practitioners in Mozambique to date, primarily solar PV and solar home systems providers. A non-exhaustive list is provided below:

### **RVESol** – [www.rvesol.com](http://www.rvesol.com)

Contact: Vivian Vendeirinho

Title: Founder & Managing Director

Email: [vivian@rvesol.com](mailto:vivian@rvesol.com)

Social enterprise providing an integrated water, energy, gas and fertilizer system.

### **Martifer Solar** – [www.martifersolar.com](http://www.martifersolar.com)

Contact: Luis Silva

Title: Business Developer

Email: [solar.mz@martifer.com](mailto:solar.mz@martifer.com)

For profit company based in Maputo producing solar PV standalone systems.

### **Fosera** – [www.fosera.com](http://www.fosera.com)

Contact: Mr Steven Dils

Title: Founder of Fosera S.A. Lda

Email: [solarmozambique@gmail.com](mailto:solarmozambique@gmail.com)

German for profit company providing pico solar home systems. Solarkom assembles and markets Fosera systems in Mozambique.

### **SolarWorks!** – [www.solar-works.co.za](http://www.solar-works.co.za)

Contact: Casper Sikkema

Title: General Manager for Southern Africa at SolarWorks! B.V

Email: [info@solar-works.co.za](mailto:info@solar-works.co.za)

Sell high quality solar home systems with a pay-plan in Mozambique.

### **SwissSolar** – [http://www.swissolar.co.mz/index\\_e.html](http://www.swissolar.co.mz/index_e.html)

Contact: Andreas F. Ziegler-Mendonça

Title: Managing Partner

Email: [andreas@SwissSolar.co.mz](mailto:andreas@SwissSolar.co.mz)

Solar SwissSolar is a competence centre for photovoltaics and renewable energy, delivering engineering, procurement and construction for off-grid hybrid and back-up power solutions.

### **Skyline Africa Energy** – <http://www.skyline-africa-energy.biz/>

Contact: Marco Coutinho

Title: Founder

Email: [marco@skyline-africa-energy.biz](mailto:marco@skyline-africa-energy.biz)

Skyline Africa Energy supply and sell sustainable electricity to rural communities from agricultural residues, predominantly rice husk and wood chips.

### **ADPP Mozambique** – <http://www.adpp-mozambique.org/renewable-energy>

Contact: Francis Atsimbom Vitung

Title: Administrator

Phone: [+258 21 750 106](tel:+25821750106)

ADPP is a Mozambican non-governmental association active in four main sectors: Education, Health, Agriculture and Renewable Energies. It engages in several projects related to the development and dissemination of renewable energy

sources, targeting access to alternative energy sources for rural communities. This includes solar energy, biogas and biofuel, to promote the use of energy-saving devices, such as firewood-saving stoves, and to encourage related small-scale business.

**Mocitaly Lda** – <http://www.mocitaly.com/pt/>

Contact: Federico Dotto

Title: Managing Director

Email: [mocitaly@tvcabo.co.mz](mailto:mocitaly@tvcabo.co.mz)

A Maputo based subsidiary of Helipolis Energy, focusing on the study and supply of solar technology market solutions. This includes the design, supply, installation, assistance and maintenance (including training programmes for the end-users) of off-grid PV solar systems.

## 6.3 BILATERAL AND MULTILATERAL DONOR ORGANISATIONS

### WORLD BANK GROUP

**Contact:** Zayra Romo, [zromo@worldbank.org](mailto:zromo@worldbank.org)

[www.worldbank.org/en/country/mozambique](http://www.worldbank.org/en/country/mozambique)

Since 1984, the WBG has been providing development assistance to Mozambique, resulting in the Country Partnership Strategy (CPS) which involves close collaboration with the government, development partners, civil society and the private sector to ensure sustainable and inclusive growth.

The World Bank will assist with the development of a National Electrification Strategy to include what steps are required, the role of institutions, what are the technical spaces to improve, improving operation and maintenance of assets, and financial modelling. The tender for development of the strategy was announced on 6 July 2016 by the WB. The basis for private finance will be provided by the Bank, and they will define the need for institutional investment. According to the Bank, a review of electricity sector policy and regulation was undertaken together with EDM and FUNAE in Nov 2015 to consider the challenges and provide an overview of the sector (EDM and FUNAE identified areas where they would like to be involved). The World Bank is also implementing the first phase of a backbone transmission line for interconnection of the gas region in Mozambique. This is at the initial stage of defining a PPP. EDM has asked the Bank to look at the electricity tariff structure for Mozambique, in order to put EDM in a better financial situation. EDM has finalised the ToRs and the WB is providing comments.

### NORAD - NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION

Contact: Jonas Sandgren, Programme Director, International Department - Director General's Office, Norwegian Water Resources and Energy Directorate; [josa@nve.no](mailto:josa@nve.no)

[www.norad.no/en/front/countries/africa/mozambique](http://www.norad.no/en/front/countries/africa/mozambique)

NORAD provides expert advice about development and aid to foreign services and partners with a range of players in development assistance and grant funding organisations within civil society, research, higher education and industry in developing countries. NORAD has been working with rural energy in Africa since the early 1990s, and have been preparing an energy programme with Mozambique. The focus is on developing the analytical capability of MIREME, developing the legal framework and developing capacity. This capacity building will focus mainly on CNELEC. NORAD will give them the ability to manage information, integral to the licensing process. NORAD also plans to work with MIREME to build a legal framework for electricity.

## UNDP - UNITED NATIONS DEVELOPMENT PROGRAMME

**Contact:** Janeiro Avelino, Climate Change and Environment Specialist, [janiero.avelino@undp.org](mailto:janiero.avelino@undp.org)

[www.mz.undp.org](http://www.mz.undp.org)

The UNDP works in nearly 170 countries to help them develop policies, leadership skills, partnering abilities, institutional capabilities and build resilience in order to sustain development results. The overarching theme of their current programme in Mozambique is capacity development for government counterparts, the civil society, and the academic community to improve development and economic planning and improve delivery of better services to reduce social inequalities. UNDP's regional hub in Ethiopia works with SE4All and can advise on related plans for Mozambique.

UNDP is not directly engaged with GMGs or the energy sector, but is increasingly aware of this aspect of development. UNDP is indirectly engaged through accreditation of schemes such as the new National Sustainable Development Fund (NSDF), which aims to access global financing from initiatives such as the Green Climate Fund (GCF). This NSDF could then be used to finance GMGs. UNDP is also working closely with the Council of Trade Associations (private sector), which shows good Government commitment to attract private investors.

## UNIDO - UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**Contact:** Jaime Comiche, Head of Operations in Mozambique, [j.comiche@unido.org](mailto:j.comiche@unido.org)

[www.unido.org](http://www.unido.org)

The mission of the United Nations Industrial Development Organization (UNIDO) is to promote and accelerate inclusive and sustainable industrial development (ISID) in developing countries and economies in transition, as described in the Lima Declaration adopted at the fifteenth session of the UNIDO General Conference in 2013. The main energy sector focus of UNIDO is productive use – they believe that a single stakeholder entry point is needed that will connect and advise other Departments. With regards to this, UNIDO has been working with provincial and district authorities to set up a one-stop-shop to improve the local business and investment environment. However current instability has meant that future funds will be redirected from government support to project support only. This may provide a longer-term opportunity to support GMGs.

## DFID - UK'S DEPARTMENT FOR INTERNATIONAL DEVELOPMENT

**Contact:** Phil Outram, Infrastructure Adviser, [phil-outram@dfid.gov.uk](mailto:phil-outram@dfid.gov.uk)

[www.gov.uk/government/world/organisations/dfid-mozambique](http://www.gov.uk/government/world/organisations/dfid-mozambique)

DFID leads the UK's work to end development and poverty alleviation. It works in Mozambique to help the country transform itself into a thriving gateway of trade and investment. This program has three interrelated themes; governance and stability, economic development and growth transmission, and human development. Energy is a key focus area of the second theme, and DFID is currently co-chair of the Energy Sector Working Group of donors.

DFID has just approved an £33.7m "BRILHO" Programme to develop the market for off-grid energy in Mozambique, which will be the main vehicle to deliver the UK's Energy Africa campaign in Mozambique and to meet the UK's commitments in the Energy Africa compact. It is expected to be implemented from September 2016 to August 2023, with 50% of the support for policy change and 50% for businesses. The aim of the programme is to increase domestic and business energy access through private sector innovation and investment, and government support, using a supply of dispersed off-grid energy solutions and improved cook stoves. This will involve the expansion of market access to off-grid renewable energy products and related services for rural communities and businesses in Mozambique. BRILHO will provide support to government (in the form of technical assistance rather than direct financial aid) and to non-state energy providers

(private sector and international NGOs) through a comprehensive set of interventions including a Market Development Fund, Technical Assistance, Demand Activation initiatives (based on engagement with rural consumers), Research and Dissemination, Policy Reform and Institutional Strengthening. The programme is being managed directly by the local DFID office based in Maputo.

## EU DELEGATION

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The EU has a 100m EUR allocation for Mozambique, centred on the thematic pillars of agriculture, rural development, transport infrastructure and regional integration. EU places a strong focus on donor coordination and partnership due to the many active donors. The main objectives of the EU's 11th Economic Development Fund (EDF) are to increase food security and enhance productivity, of which productive use of energy is a key element. On this basis, the EU is currently doing a study of the Nampula and Zambesia provinces, with the aim to prepare a sustainable energy action plan at the provincial level. There is particular consideration of mini grids, though scattered populations are a concern.

The EU in Mozambique is implementing a Eur10.5m programme of capacity building for MIREME, EDM, FUNAE and CNELEC. The EU has a particular focus on private sector to accelerate mature projects to implementation. The EU is considering support for a UN Habitat proposal to develop GIS mapping of two provinces (Nampula and Zambesia) with the greatest agricultural potential but currently the lowest Human Development Index. This will involve population density, links between villages, services available in villages. The EU will use these maps as a baseline from which to measure the impact of further intervention.

## US TRADE & USAID – US AGENCY FOR INTERNATIONAL DEVELOPMENT

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USAID is initiating an energy programme in Mozambique with the intention to avoid replicating work by other donors. The main objective areas are agriculture and food security; democracy, human rights and governance; economic growth and trade; education; environment; and global health. Economic growth is focused mainly on the tourism and agricultural sectors. USAID is currently doing some surveys with Vodacom and M-Cell on telephone usage and ownership patterns. A USAID focus area in other countries is using energy for irrigation in remote areas, but for now remains too expensive in Mozambique. USAID is considering support for CNELEC. USAID is the co-ordinator for the Power Africa programme, which is also looking to grow a programme of activities in Mozambique.

## AfDB – African Development Bank

**Contacts:** Joseph Ribeiro, Resident Representative, [jribeiro@afdb.org](mailto:jribeiro@afdb.org); Elizebeth Muguti, Regional Energy Co-ordinator, [e.muguti@afdb.org](mailto:e.muguti@afdb.org)

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AfDB's support to Mozambique is proactively aligned with the countries' Poverty Reduction Strategy, which has the following two thematic pillars: enhanced private sector competitiveness through infrastructure development and governance in support of inclusive growth. Transport is the largest supported sector under this strategy, followed by agriculture, power, mining and water and sanitation. This has traditionally focused on large-scale infrastructure projects such as grid expansion and re-enforcement. Funding under the AfDB is available through two windows, the African Development Fund (public sector with sovereign guarantee) and the African Development Bank Window (commercial).

The Sustainable Energy for All (SE4All) Africa Hub, hosted by the African Development Bank, is currently implementing a green mini grid market development programme (GMG MDP) to facilitate greater investment into GMGs across the continent. To achieve the SE4All objectives, Africa will require substantial investments into national power grids, off grid solar home systems, and isolated mini grids. AfDB's programme will provide business development services to green mini grid developers, assisting them on a wide range of issues, from business planning, market development and grid design to project finance, grid operation and maintenance.

The first phase of the Green Mini Grid Market Development Programme was launched in late 2015. The Programme consists of five business lines:

- Market intelligence relative to GMG development at the African country level
- Business Development Services
- Policy and enabling environment development
- Access to financing for GMG project developers
- Technical standardisation and quality control of mini grids, which will be operationalised in a second phase of the MDP

This Programme works in close collaboration with other partners and was also referenced in the G20 Action Plan on Energy Access in Sub-Saharan Africa adopted in October 2015.

The **Sustainable Energy Fund for Africa**, SEFA, is a multi-donor trust fund administered by the AfDB to support small to medium scale renewable energy and energy efficiency projects in Africa. This is founded on commitments from the United States and Danish Governments. This fund targets the efficient utilisation of clean energy resources, structured under three financing windows: project preparation, equity investments and enabling environment support. The first provides cost-sharing grants and technical assistance to practitioners to facilitate pre-investment project activities. The equity investments window addressed a lack of access to capital and financial capacity of practitioners. The enabling environment support window provides advisory on legal, regulatory and policy regimes. The Technical Secretariat for SEFA is Joao Duarte Cunha – [j.cunha@afdb.org](mailto:j.cunha@afdb.org). The Resource Mobilisation Focal Point is Serign Cham – [s.cham@afdb.org](mailto:s.cham@afdb.org).

#### **BTC - BELGIAN DEVELOPMENT AGENCY**

**Contact:** Erik van Malderen, Senior Expert Hydro Power, [erik.vanmalderen@bctctb.org](mailto:erik.vanmalderen@bctctb.org)

[www.bctctb.org](http://www.bctctb.org)

The general objective of Belgian development cooperation with Mozambique is poverty reduction, aligned as the AfDB with the countries' Poverty Reduction Strategy paper. Initial support focused on health infrastructure, but was expanded to include renewable energy, public sector reform and general government budget support. BTC is officially hosted by FUNAE for its work in the energy sector, so maintains close contact. The first phase of BTC's Renewable Energy for Rural Development Project (RERD) was recently completed. They are now formulating RERD2, which is likely to provide support to initiatives such as Pay-As-You-Go (PAYG), mini grids with metering and energy kiosks. RERD2 will probably have one phase for mini grids. It will also aim to facilitate reduced tax duties and import duties.

#### **GIZ - GERMAN INTERNATIONAL COOPERATION**

**Contact:** Veronique Stolz, Programme Director, [veronique.stolz@giz.de](mailto:veronique.stolz@giz.de)

[www.giz.de/en/worldwide/320.html](http://www.giz.de/en/worldwide/320.html)

GIZ's work in Mozambique started in 1985 and currently focuses mainly on the three provinces of Inhambane, Sofala and Manica and the capital Maputo. This addresses three priority areas; education and vocational training, decentralisation for rural development and sustainable economic development (which includes strengthening the microfinance sector). GIZ's main future focus in energy will be pico solar systems, cook-stoves and grid densification.

The Energising Development, or EnDev, is a multi-donor initiative delivered by the German GIZ and the Netherlands Enterprise Agency (RVO). It is funded by the governments of the Netherlands, Germany, Norway, Australia, the United Kingdom, Switzerland and Sweden. Under the EnDev programme, GIZ had a project implementing and operating 20-30kW mini-hydro mini grids. 11 sites were fully-financed, 6 others were supported. The project targeted dispersed areas, and involved training of local support staff. This mini-hydro programme has now stopped based on EnDev's cost efficiency per beneficiary funding criteria. GIZ is also working with FUNAE for a study on existing pre-paid systems. This was a project development programme and recommended pre-paid systems. BTC may now take this up and finance the roll-out.

## 6.4 OTHER RELEVANT ORGANISATIONS AND INITIATIVES

Other local organisations that can provide useful background information regarding prospects for GMGs in Mozambique include:

### NATIONAL INSTITUTE OF STATISTICS (INE)

**Contact:** Cassiano Chipembe, Director of Demographic Statistics, Vital & Social, [cassiano.chipembe@ine.gov.mz](mailto:cassiano.chipembe@ine.gov.mz)

[www.ine.gov.mz](http://www.ine.gov.mz)

The INE is the principal agency for the collection of statistics in Mozambique, created under Presidential Decree n° 9/96, of August 28, 1996. INE provides services directly to the Government of Mozambique, including surveys and other national statistics. This includes information such as population density and expenditure data, as well as regional electrification levels. Most data is collected at a provincial and district level.

### ACCENTURE DEVELOPMENT PARTNERSHIPS

**Contact:** David Taylor, Senior Strategist, [david.taylor.jr@accenture.com](mailto:david.taylor.jr@accenture.com)

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A consultancy involved in strategic development, assessment and analysis of mini grids in select developing countries. The Energy Access for Development Impact (EADI) provides technical assistance across all technology types.

### AFRICAN ASSOCIATION FOR RURAL ELECTRIFICATION (CLUB-ER)

**Contact:** Silvia Puddu, Secretariat, [secretariat@club-er.org](mailto:secretariat@club-er.org)

[www.club-er.org](http://www.club-er.org)

CLUB-ER is a network of over thirty public sector organisations responsible for rural electrification in Africa. This network focuses on capacity building for rural electrification through sharing expertise, including training and disseminating support tools.

### ENERGIAS DE PORTUGAL (EDP)

**Contact:** Guilherme Collares Pereira, [collares.pereira@edp.pt](mailto:collares.pereira@edp.pt)

[www.edp.pt](http://www.edp.pt)

EDP is one of the major European electricity operators, based in Portugal, with a relatively strong focus on renewable generation. The Access to Energy (A2E) programme plays a facilitation role in energy access: Identifying project opportunities, supporting fundraising managing solar and biomass projects and ensuring financial self-sustainability of projects. This includes the Titimane Village project (Niassa), in partnership with UNEP, which looks to demonstrate the need for private sector involvement in mini grids and the policies needed to support this involvement.

## EUROPEAN INVESTMENT BANK (EIB)

**Contact:** Secretariat, [eu-africa-itf@eib.org](mailto:eu-africa-itf@eib.org)

[www.eib.org/projects/loans/regions/acp/mz.htm](http://www.eib.org/projects/loans/regions/acp/mz.htm)

The EU-Africa Infrastructure Trust Fund (EU-AITF) is an instrument of the wider EU-Africa Infrastructure Partnership. EIB acts as financial manager and hosts the Secretariat of the EU-AITF. Its role is to mobilise additional finance for key infrastructure projects in sub-Saharan Africa, thereby increasing access to energy, transport, water and sanitation, as well as communication services. This includes technical and financial assistance for renewable energy sources in projects targeting SE4ALL objectives. EIB also has experience from an Energy Access and Development Project, which ran for five years from 2010-2014. The project aimed mainly at reinforcing primary networks, grid extension and the increase in new connections in peri-urban and rural areas.

## EU ENERGY INITIATIVE PARTNERSHIP DIALOGUE FACILITY (EU-EI PDF)

**Contact:** Michael Franz, GIZ, [michael.franz@euei-pdf.org](mailto:michael.franz@euei-pdf.org)

[www.euei-pdf.org](http://www.euei-pdf.org)

The EUEI PDF is a multi-donor facility focused particularly on energy and the Sustainable Development Goals. ToRs have recently been prepared for a EUEI PDF project to address clean energy policy issues in Mozambique (this concept was originally drawn up by UNEP together with EDP). Previously, EUEI PDF has supported the development of a Biomass Energy Strategy (BEST) for Mozambique, as well as a country mapping for “higher education for renewable energy”.

## ENERGY ACCESS VENTURES FUND

**Contact:** Thomas Andre, Schneider Electric, [thomas.andre@schneider-electric.com](mailto:thomas.andre@schneider-electric.com)

[www2.schneider-electric.com/documents/press-releases/en/shared/2015/03/20150302\\_PRF\\_AfricaEnergyAccessFund\\_EN.pdf](http://www2.schneider-electric.com/documents/press-releases/en/shared/2015/03/20150302_PRF_AfricaEnergyAccessFund_EN.pdf)

The Energy Access Ventures Fund delivers technical and financial assistance targeting small energy access businesses. The fund will be managed by Aster Capital (Energy Access Venture jointly backed by Schneider Electric and the CDC Group), the UK Department for International Development (DFID), European Investment Bank, FISEA (PROPARCO, OFID, and AFD) and FFEM. The Fund has secured commitments of EUR 54.5 million to invest in Africa.

## EDUARDO MONDLANE UNIVERSITY

**Contact:** Boaventura Chongo Cuamba, Associate Professor of Renewable Energy Physics, [boaventura.cuamba@gmail.com](mailto:boaventura.cuamba@gmail.com)

<http://www.uem.mz>

Based in Maputo. The university has several schools and departments involved in renewable energies and rural electrification, such as the Engineering School and the School of Rural Development.

## POLYTECHNIC UNIVERSITY

**Contact:** Prof. Dr. Rosania Pereira da Silva, Director of the Unit for Extension and University Cooperation, [esa@apolitecnica.ac.mz](mailto:esa@apolitecnica.ac.mz), +258 (21) 352 750

<http://estudante.sapo.mz/artigos/artigo/universidade-politecnica-354681.html>



Based in Maputo. Polytechnic University's Electrical Engineering course delivers training in the development, consulting, maintenance and management of energy and other related systems.

#### **TECHNOLOGICAL UNIVERSITY OF MOZAMBIQUE**

**Contact:** Professor Severino Elias Ngoenha, Rector, [info@udm.ac.mz](mailto:info@udm.ac.mz), [+258 82 123 4567](tel:+258821234567)

**Link:** <http://www.udm.ac.mz/index.php>

Based in Maputo. The Technological University of Mozambique has a number of courses relating to rural electrification and renewable engineering under its Faculty of Technological Sciences, including its Degree in Alternative Energy Engineering and Management and Petroleum Resources.

# 7. ANNEX. OBJECTIVES, SCOPE AND METHODOLOGY OF THE MARKET ASSESSMENT

## 7.1 OBJECTIVES OF THE MARKET ASSESSMENT

The objective of the Green Mini Grids Africa Market Development Programme is to support the scale-up of investments in commercially viable GMG projects through a broad range of interventions to improve the enabling environment. The project seeks to remove or reduce market barriers at regional scale and strengthen the ecosystem for the emergence of a thriving GMG sector in Sub-Saharan Africa – contributing significantly to the objectives of the SEforALL.

The Market Intelligence business line supports activities that foster the ability of project developers, investors and public entities in identifying market opportunities for GMGs, facilitating a coherent national approach and supporting the linkages between central authorities, local/national businesses, investors and communities with demand for power.

## 7.2 SCOPE OF THE MARKET ASSESSMENT

This report is one of the five country reports as part of the third deliverable for this project. All published deliverables are to be available through the African Development Bank and other dissemination channels. As written in the original terms of reference, the project had three main deliverables:

**D1 – An evaluation of the methodologies and best practices available for assessing GMG potential;** D1 will analyse the methodologies currently utilised to assess the GMG potential with top-down approaches. The assessment will include data requirements, software requirement, robustness, handling of data paucity, quality of outputs, facility of use, openness of the system, interoperability with other planning tools, cost and any other specific strength or weakness. The output of the D1 will be a report accompanied by an executive summary and a presentation or infographics.

**D2 – Creation or choice of an opportunity assessment methodology in order to generate comparable data across countries, to the extent that is possible;** On the basis of the methodological analysis made in D1, the consultant will present a methodology able to generate comparable data across countries. The methodology shall generate quality outputs, be robust, scalable, preferably based on open source or commonly used software and need only limited training. The output of the D2 will be a methodological paper or report and a presentation. If any new software tool will be developed to implement this methodology, it will have to be disseminated as open source.

**D3 – The publication of country-level analysis** on mini grid market opportunities, initially focussing on at least 5 countries in SSA that are prioritising GMGs, generated with the above methodology. AfDB will provide the country list and will support the consultant to get access to country institutions, notably the SEforALL focal points, and national sources of data to apply the methodology. The D3 Output will be a report with the assessment for the five countries.

## 7.3 METHODOLOGY

This methodology was developed in second phase of this project, the Green Mini Grids Market Development Program - Market Intelligence business line, which is also available via the African Development Bank.

This analysis, whose results are given in Section 2, considers the potential for mini grids by segmenting the countries into three areas, grid, mini grid and standalone areas. This split is based on the distance from the power network and population. We have used the planned power network for up to 2020, and the geospatial data provided in this annex. Mini grid regions are defined based on a distance of greater than 15km from the grid, as well as a household density greater than 50 household/km<sup>2</sup>. Grid regions are defined as within 15km of the grid, and standalone systems make up the remaining area. Protected and wetland areas are excluded.

The GIS sources used in this analysis are detailed below.

#### **POPULATION DENSITY GRID**

**Source:** World Pop data portal

#### **EXISTING AND PLANNED POWER GRID**

**Source:** Elaborated by the Carbon Trust using data from the AICD - Africa Development Bank, 2009 and the report “USAID – The Electricity Sector in Mozambique: An Analysis of the Power Crisis and its Impact on the Business Environment”, 2015.

#### **PROTECTED AREAS**

**Source:** The World Database on Protected Areas, 2014

#### **LAKES AND WETLANDS**

**Source:** Global Lakes and Wetlands Database, 2004

#### **IDENTIFIED RENEWABLE SOURCES AND PROJECTS**

**Source:** Renewable Energy Atlas, FUNAE, 2014

#### **MEAN AVERAGE WIND SPEED**

**Source:** DTU/IRENA, 2005

#### **ANNUAL GLOBAL HORIZONTAL IRRADIATION**

**Source:** DTU/IRENA, 2015

#### **OTHER – MAP OF ELECTRIFICATION OF ADMINISTRATIVE POSTS AS OF 2015**

**Source:** Translated and used with the permission of the Director of Planning, EDM, 2016

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