Mini-Grid Market Opportunity Assessment: Zimbabwe

Green Mini-Grid Market Development Programme:
SE4ALL Africa Hub & African Development Bank

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SUSTAINABLE ENERGY FOR ALL
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The Carbon Trust wrote this report based on an impartial analysis of primary and secondary sources. The Carbon Trust's mission is to accelerate the move to a sustainable, low carbon economy. It is a world leading expert on carbon reduction and clean technology. As a not-for-dividend group, it advises governments and companies around the world, reinvesting profits into its low carbon mission.

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The Carbon Trust would like to thank the following actors that made this report possible: The Ministry of Energy and Power Development, the Ministry of Environment, Climate Change, Tourism, and Hospitality Industry., Zimbabwe Energy Regulatory Authority (ZERA), Zimbabwe Electricity Transmission and Distribution Company (ZETDC), the Rural Electrification Agency (REA), Renewable Energy Association of Zimbabwe (REAZ), ZimStats, Practical Action, ZB Bank, Hivos, C&J Accounting, Meeco, Honorary Consulate of Ireland to Zimbabwe.

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PREFACE

This paper, part of the Green Mini-Grid Market Development Programme (GMG MDP) document series, assesses the green mini-grid market in country. Green-mini grids include 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 often results in significant financial losses for the utility, required to sell power at prices significantly below the cost of production and delivery. Moreover, it leaves the most remote towns and villages unelectrified. The latest Sustainable Energy for All (SEforALL) Global Tracking Framework estimates that the urban-to-rural divide in access to electricity in Africa is as high as 450 percent, with 69 percent of the population in urban areas electrified compared to only 15 percent in rural areas.

There are three principal options for providing new connections to currently unserved populations in Africa, namely: extension of the national grid; installation of separate "mini" grids to operate independently from the main grid; and 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.

The development of GMGs is not without its challenges however. In addition to unfriendly policy and regulatory frameworks, barriers to growth of the private mini-grids sector in Africa include the lack of proven business models, market data and linkages, key stakeholder capacity, and access to finance.

In response to these challenges, the SEforALL Africa Hub at the African Development Bank (AfDB) designed and launched Phase 1 of the GMG MDP in 2015, with grant funding from the AfDB's Sustainable Energy Fund for Africa (SEFA).[1] 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 Department for International Development (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 implemented by the World Bank's Energy Sector Management Assistance Program (ESMAP). Phase 2 of the GMG MDP, greater in scope and scale as compared to Phase 1, was launched in November 2017.

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

The goals of the GMG programme are central to AfDB's mission of spurring sustainable economic development, social progress and poverty reduction in its regional member countries. 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, a transformative, partnership-driven effort, aspires to achieve universal access to energy in Africa by 2025.

This report was prepared by the Carbon Trust and SNV Netherlands Development Organization at the request of the AfDB. It was written by Antoinette Gous and William Hudson of Carbon Trust, Chandirekera Sarah Mutubuki-Makuyana and Nqabayezwe Moffat Moyo from SNV. Carbon Trust is a mission-driven organization helping businesses, governments and the public sector accelerate the move to a low carbon economy. SNV is a not-for-profit international development organisation, working in Agriculture, Energy, and Water, Sanitation & Hygiene.

The content of this report was reviewed by Bornface Mutangadura on behalf of the AfDB's GMG team and cleared by Brendan Coleman, Energy Specialist & Project Manager at the AfDB. It was edited by Ruth Lumley.

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1 The SEforALL 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

Contents

List of Figures

List of Tables

LIST OF ACRONYMS

AECF	Africa Enterprise Challenge Fund
EIA	Environmental Impact Assessment
EMA	Environmental Management Agency
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMG MDP	Green Mini-Grid Market Development Programme
HV	High Voltage
IPP	Independent Power Producer
km	Kilometre
kV	Kilovolt
kWh	Kilowatt-hour
LV	Low Voltage
MEPD	Ministry of Energy and Power Development
MV	Medium Voltage
MW	Megawatt
NDC	Nationally Determined Contribution
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
REF	Rural Electrification Agency
RECP	EU Renewable Energy Cooperation Programme
RE-FIT	Renewable Energy Feed-in Tariff
REMP	Rural Electrification Master Plan
SSA	Sub-Saharan Africa
ZANU-PF	Zimbabwe African National Union – Patriotic Front
ZENT	ZESA Enterprises
ZESA	Zimbabwe Electricity Supply Authority
ZERA	Zimbabwe Energy Regulatory Authority
ZETDA	Zimbabwe Electricity Transmission and Distribution Company
ZINWA	Zimbabwe National Water Authority
ZPC	Zimbabwe Power Company

EXECUTIVE SUMMARY

This country report is one of a series of country reports under the Market Intelligence business line of the African Development Bank's Green Mini-Grid Market Development Programme (GMG MDP). The MDP has the ultimate objective of fostering access to electricity across Africa by promoting the development of green mini-grids where they represent a technically and economically better option than the extension of the main grid. The Market Intelligence business line aims to provide comparable, actionable data on the potential for GMGs across countries in Sub-Saharan Africa (SSA). This report provides an analysis for Zimbabwe. Previous country reports can be downloaded from the GMG Help Desk (http://greenminigrid.se4all-africa.org).

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. Assessing the potential for mini-grids is challenging as such analysis requires plenty 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 available data and highlight general assessments that would be relevant to most mini-grid stakeholders. Raw data is provided with this report, so stakeholders may further conduct their own specific analysis.

The Republic of Zimbabwe is a landlocked country situated in Southern Africa between the Zambezi and Limpopo Rivers, with a total land area of 390,757km^2. The country is divided into 10 administrative provinces including two metropolitan cities, the capital Harare and Bulawayo, with provincial status. The other eight provinces are Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo, Matabeleland North, Matabeleland South, Midlands. These provinces are further divided into 62 districts.

Zimbabwe has a population of circa. 13.5 – 16.5 million with a population density of 42.7 people per km^2. Outside of the major urban agglomerations in the capital Harare, and Bulawayo, the population distribution of Zimbabwe is relatively even spread, with the eastern half of the country having slightly higher population density. 32.2% of the population reside in urban areas, and the rate of urbanisation is expected to average 2.19% annually between 2015-2020. Population growth was at 2.3% annually in 2017, and though down slightly from the previous year, has been on the rise from since a low of 1% in 2003.

Zimbabwe gained independence from British colonial rule in 1980 and the ZANU-PF, led by Mr Robert Mugabe, ruled the country almost exclusively until 2017. Mr Mugabe was then ousted in 2017, replacing him with one of his then vice presidents and now current president, President Emmerson Dambudzo Mnangagwa.

Zimbabwe's economy is recovering from decades of economic contraction, the sharpest of which occurred between 2000 and 2008, almost halving GDP. In 2008, Zimbabwe experienced the peak of hyperinflation. The Reserve Bank of Zimbabwe acted upon by printing money in excess to fund the country's budget deficit. A multicurrency regime was adopted to stabilise inflation. This contributed to a period between 2009 and 2012 that was marked by economic growth, with mining and agriculture also underpinning the strengthening of the economy. The country experienced real annual growth of around 10% following dollarization in 2009.

Economic crisis, hyperinflation and ensuing political crisis have had significant effects on the Zimbabwean society; however, since the election of the new president, there is an expectation of economic reform. Zimbabwe has experienced mass migration, leading to a significant brain drain, pushing highly skilled workers abroad due to unemployment, low wages, and few opportunities. Zimbabwe's economy continues to face challenges; weak domestic demand and high informality, a challenging political environment, high public debt and a crisis in liquidity. Investor confidence is further eroded by perceptions of weak governance and poor accountability (Zimbabwe is ranked 155th out of 190 countries in Ease of Doing Business). However, strong performance in key sectors such as mining have contributed to improvements in economic growth in recent years, and the country has seen improvements in the business climate

generally. Zimbabwe has significant natural resources, existing public infrastructure and strong human capital. There is much potential for further strengthening of the economic situation with further political and economic reforms, including re-stabilisation of the monetary system and a resolution regarding the accessibility of development financing.

The key institutions in the energy sector are the Ministry of Energy and Power Development, the Rural Electrification Fund (REF) and the Zimbabwe Energy Regulatory Authority (ZERA). The ministry is responsible for policy formulation, performance monitoring, promotion of new and renewable sources of energy and overseeing the performance of state-owned utility company, ZESA Holdings. REF's mandate and responsibility is to facilitate, plan and implement rural electrification projects, together with administering the 6% rural electrification fee. ZERA is responsible for regulating and monitoring public and private enterprises involved with energy production, transportation, distribution and supply as well as issuing licences and setting tariffs.

The power utility has been unbundled into a holding company with four subsidiaries underneath it. ZESA Holdings (Pvt) Ltd was formed as the holding company with Zimbabwe Power Company (ZPC), Zimbabwe Electricity Transmission and Distribution Company (ZETDC), ZESA Enterprises (ZENT) and Powertel Communications as subsidiaries. It has been announced that government has approved the re-bundling of ZESA. This is expected to be completed by 2020.

Zimbabwe has previously had a poor regulatory environment for renewable energy, IPPs and off-grid energy. However, government has recently started to put policies and frameworks in place to create a regulatory environment that is more investor friendly. This includes the amendment of the Energy Act, development of the National Energy Policy, Mini-grids Framework and Renewable Energy Policy and the amendment of the Indigenous Act to relax the requirement of 51% local shares in companies. The IPP framework and the Rural Electrification Master Plan (REMP) is under development.

Zimbabwe has an installed capacity of approximately 2,470MW which is mainly derived from hydro and coal. IPPs are contributing about 5% towards generation power, with the remainder being produced by ZPC. Zimbabwe has a net deficit in power supply as the actual capacity available is much lower than the installed capacity. This is due to droughts, a shortage of coal, and power stations operating below capacity due to aging equipment. The deficit is met through electricity imports from neighbouring countries or otherwise leads to power cuts. There are however both ZPC and IPP generation plants in the pipeline.

Just over half of the population is unelectrified, with national electricity access estimated at 38%-40%. Rural electrification rates are estimated at 19% and urban electrification rates at 78%-80%. The REMP was identified as a strategic priority to fulfil REF's mandate of rural electrification. The REMP has however remained in a draft format for a number of years and the delay in publishing the REMP has negatively affected the implementation of rural electrification.

Mini-grids below 100kW are regulated by light-handed regulations and do not require a license. Mini-grids above 100kW require a licence, although the recently published Renewable Energy Policy increased the threshold of when a licence fee is payable to 1MW. All mini-grids in Zimbabwe are below 100kW in size and tend to be developed by NGOs with donor funding. A number of barriers have restrained the development of the commercial mini-grid market in Zimbabwe. The country is endowed with uncertainty and has low investor confidence due to its historic political and economic climate. Zimbabwe also does not have a proven commercial business model for mini-grids. It is therefore lacking private sector investment in the mini-grid market.

Our analysis estimates that 1.1million people, or 6% of the unelectrified population would be best served by mini-grid solutions. A further 2.2mil people (13% of unelectrified population) will be best served by SHS and 7.6 mill (44% of unelectrified population) people live within 15 km of the grid which therefore has a higher likely hood of being electrified through grid extension. This calculation has been based on the current grid coverage, with any planned grid extensions likely resulting in a contraction of the estimated physical market size. 80% of the determined mini-grid market is in the Manicaland, Masvingo and Matabeleland North and South provinces due to their low electrification rates and more limited grid coverage, but where populations are not so sparse that they are better served by SHS**.** The highest-potential for mini-grid solutions is the Manicaland and Masvingo provinces, with 250,687 and 246,182 people being most economically served through mini-grids, respectively. **This translates to 10.7% of** each provinces' population.

We have estimated a current market size of US$54.4million, based on an average mini-grid tariff of USD $0.28/kWh, and average household demand per day of 2.2kWh. This tariff was derived from averaging a number of existing mini-grids in Zimbabwe, and the rate of demand is between a Tier 3 and Tier 4 level of electricity access per the SEforAll MultiTier Framework, allowing for some limited productive use.

Overall, the government is supportive of IPPs and mini-grid developers. They also acknowledge the importance that off-grid electrification will play to increase electricity access and the role that IPPs have to increase the installed capacity of the country. With this in mind, government have started to take steps which will create a conducive environment for private investors, such as the development of policies and frameworks which will aid in attracting private sector investment into the power sector.

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

The African Development Bank's (AfDB) Green Mini-Grids Market Development Programme (GMG MDP) aims to foster access to electricity across Africa. The MDP provides assistance to a range of stakeholders in overcoming the challenges for widespread and sustainable implementation of Green Mini-Grid (GMG) projects, by:

- Establishing a comparable, actionable understanding of the GMG market opportunity in Sub-Saharan Africa (SSA);
- Promoting the 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 a series of country reports of the MDP's Market Intelligence business line, each of which provides an analysis of the GMG potential per country. These reports provide comparable, actionable data on the GMG potential across countries in SSA. GMG Opportunity Assessments for other countries can be downloaded from the GMG Help Desk *(http://greenminigrid.se4all-africa.org).*

The Market Development Programme is implemented by the Sustainable Energy for All (SEforALL) Africa Hub, through a grant of the Sustainable Energy Fund for Africa (SEFA). The SEforALL Africa Hub, hosted by the AfDB, is a partnership of African institutions dedicated to support the continent's progress towards the SEforALL initiative's three main objectives on energy access, renewable energies and energy efficiency.

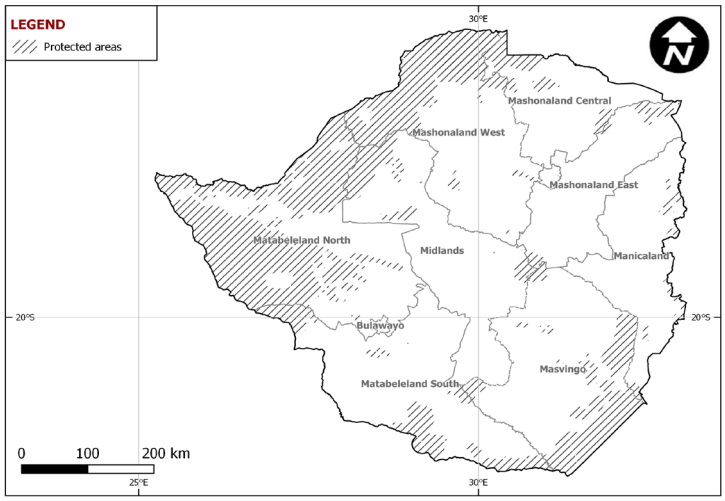
The development of clean energy mini-grids is also the primary objective of the Mini-Grid Partnership for which the Bank is playing a lead role for Africa. The Partnership will galvanize action on the barriers facing the sector, with the engagement of public, private and civil society expertise and resources. The Mini-Grid Partnership (formerly the Clean Mini-Grids HIO), including the co-ordination 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 was designed from the beginning to be integrated and closely coordinated with the activities carried out in the framework of the Partnership.

2. COUNTRY AND SECTOR OVERVIEW

2.1 COUNTRY OVERVIEW

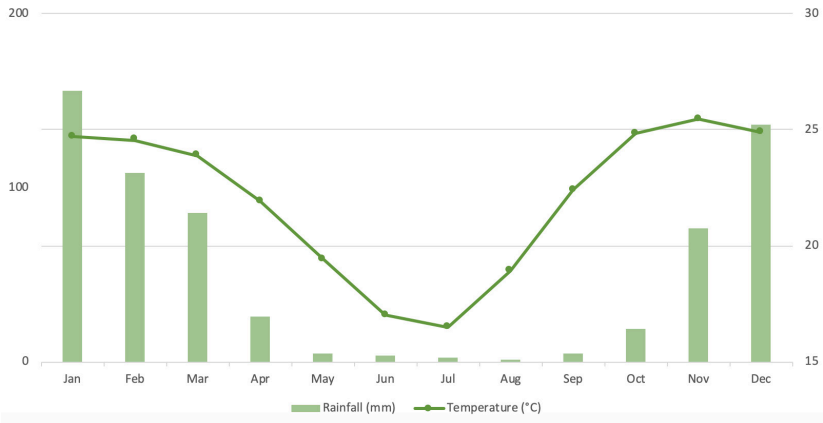
The Republic of Zimbabwe is a landlocked country situated in Southern Africa between the Zambezi and Limpopo Rivers, with a total land area of 390,757km². Zimbabwe is bordered by Mozambique to the east, South Africa to the south, Botswana to the west, and Zambia to the northwest. The country is divided into 10 administrative provinces including two metropolitan cities, the capital Harare and Bulawayo, with provincial status (Figure 1). The other eight provinces are Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo, Matabeleland North, Matabeleland South, Midlands. These provinces are further divided into 62 districts (CIA , 2018).

Figure 1: Administrative Map of Zimbabwe



Zimbabwe's climate is sub-tropical, though this is moderated by altitude; the terrain is mostly high plateau with a higher central plateau and mountains to the east. The Zambezi river forms a natural boundary with neighbouring Zambia, on which the Victoria Falls is located; the world's largest curtain of falling water. On the Zambia-Zimbabwe border is Lake Kariba, the world's largest reservoir by volume at 180 cubic kilometres (CIA , 2018). The rainy season is from November to March, with highest rainfall occurring in January at 161mm on average (World Bank, 2018). Annual rainfall ranges from 550mm to 900mm across the country. Zimbabwe is a sunny country which enjoys about 3,000 hours of sunshine a year. Temperature variations correspond closely to altitude, with the low-lying areas in the south and north west experiencing warmer temperatures than the high lying areas in the east. The mountainous eastern highlands also support numerous rivers and streams (World Weather & Climate Information, 2018).

Figure 2: Average Monthly Temperature and Rainfall for Zimbabwe 1991-2015

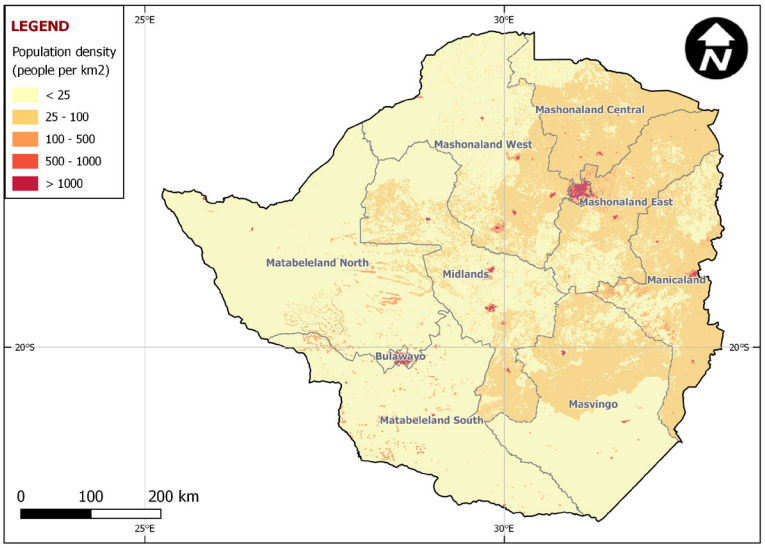


Source: World Bank Climate Change Knowledge Portal

Zimbabwe is particularly vulnerable to a changing climate. Two-thirds of Zimbabwe is classified as being arid, or semi-arid, and Zimbabwe is facing growing exposure to drought, floods and extreme temperatures associated with climate change. The effects of climate variability and shocks are felt in both urban and rural areas. Droughts have effected rural areas where rain fed agriculture is the primary source of livelihood, as well as water supply in urban areas, as important water sources have run dry. The inherent dryness of much of the land, coupled with increasing demand on water from a growing population, is placing significant pressure on water supplies (Brown et al. , 2012). Droughts have also negatively affected electricity supply. Water levels of the Kariba Dam, the location of one of Zimbabwe's largest hydropower plants, has in recent times reached one of the lowest dam capacity levels of 27%, where a minimum level of 37% is required for power generation.

Population estimates of Zimbabwe vary between different sources. According to the 2017 Inter-Censal Demographic Survey, the estimated population in Zimbabwe is 13.6 million (ZimStats, 2017). World Bank Data gives a 2017 population as being 16.5 million (World Bank, 2018), and the CIA World Factbook data, which estimated in July 2018 the population as being a little over 14 million (its estimates explicitly taking into account the effects of excess mortality due to AIDS) (CIA , 2018).

Figure 3: Population Density in Zimbabwe



Source: Carbon Trust analysis

Population density in Zimbabwe is 42.7 people per km², slightly below the Sub-Saharan African average of 45 (World Bank, 2018). Outside of the major urban agglomerations in the capital Harare, and the second city of Bulawayo, the population distribution of Zimbabwe is relatively evenly spread, with the eastern half of the country having slightly higher population density (Figure 3). 32.2% of the population reside in urban areas, and the rate of urbanisation is expected to average 2.2% annually between 2015-2020 (CIA , 2018). Population growth was at 2.3% annually in 2017, and though down slightly from the previous year, has been on the rise from since a low of 1% in 2003 (World Bank, 2018). Population growth in rural areas in Zimbabwe is higher than the Sub-Saharan average (2.4% compared with 1.9%), and in urban areas is lower than the Sub-Saharan average (2.1% compared with 4.1%) (World Bank, 2018).

Zimbabwe gained independence from British colonial rule in 1980 and the ZANU-PF, led by Mr Robert Mugabe ruled the country almost exclusively until 2017. Mr Mugabe was then ousted in 2017, replacing him with one of the then vice president, and now current president President Emmerson Dambudzo Mnangagwa.

Zimbabwe's institutional structure is comprised of three branches; the Executive, Legislative and Judiciary. The Executive branch is made up of the Chief of State, the President, and the Cabinet, appointed by the president. The legislative branch is a bicameral Parliament, and the judicial branch is made up of the Supreme Court, Constitutional Court, and other subordinate courts including the High Court, and customary law courts. The legal system is a mixture of English common law, Roman-Dutch civil law and customary law. (CIA , 2018).

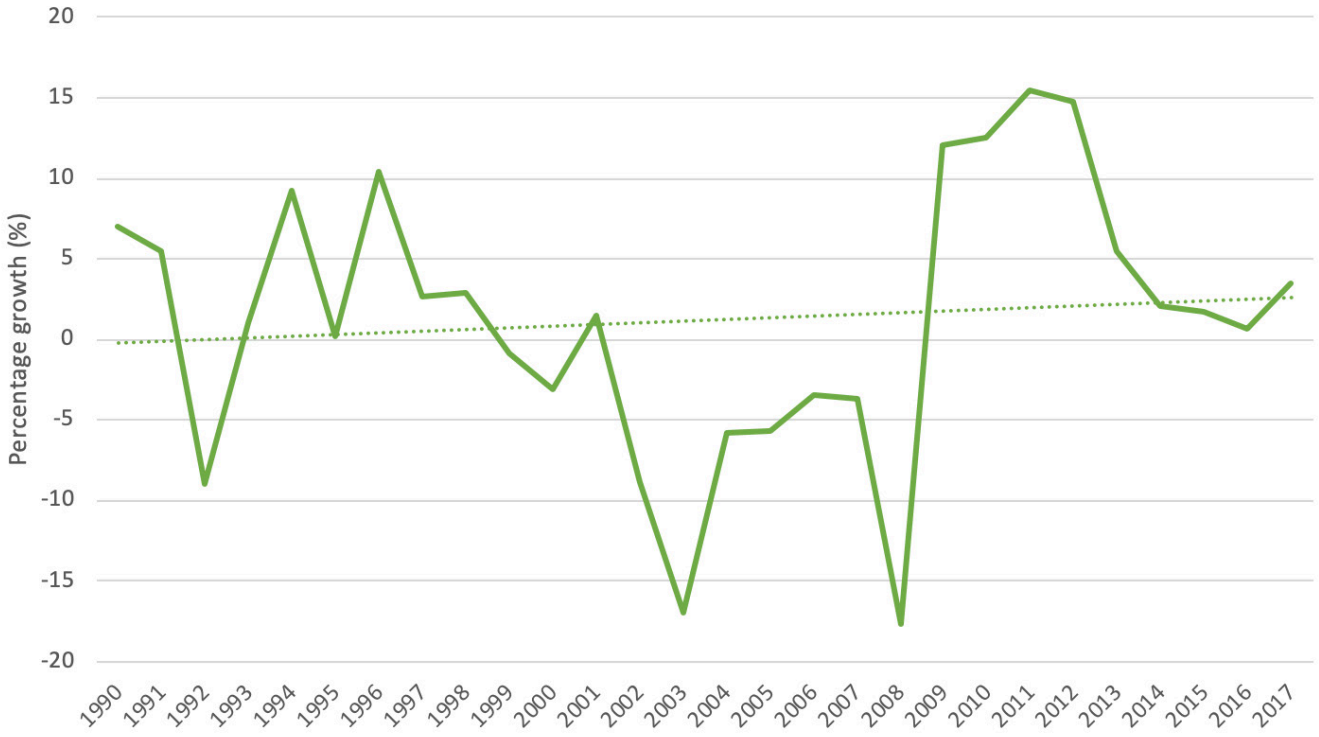
Road infrastructure in Zimbabwe is aging, with limited maintenance and improvements made in recent decades due to a lack of financial resources. This has seen significant deterioration in urban and unsealed rural roads. The country has 88,100 km of classified roads of which, 17,400 km are sealed or paved. Primary roads, including significant route linking neighbouring countries account for about 5% of the network. This also includes a part of the Pan-Africa Highway which passes through Zimbabwe, contributing significantly to the country's imports and exports. Secondary roads account for 14%, and together with the primary roads, link the major economic centres of the country. Tertiary and access roads link rural areas to the secondary road network. The government has recently set aside over US$ 232 million for emergency road rehabilitation.

Zimbabwe has widespread mobile coverage with three mobile service providers namely Econet, NetOne and Telecel. Econet is the market leader and is continuously increasing its mobile coverage. Econet erected 613 additional mobile base stations between November 2016 and June 2018 and currently has approx. 82% population coverage. Recent improvements in telecommunications infrastructure include the expansion of 3G and 4G mobile broadband services and in rolling out national fibre backbone networks. More than half of the population have access to the internet; 98% of all connections are mobile internet (TechZim, 2018).

Zimbabwe's economy is recovering from decades of economic contraction, the sharpest of which occurred between 2000 and 2008, almost halving GDP. In 2008, Zimbabwe experienced the peak of hyperinflation. The Reserve Bank of Zimbabwe acted upon by printing money in excess to fund the country's budget deficit. A multicurrency regime was adopted to stabilise inflation. This contributed to a period between 2009 and 2012 that was marked by economic growth, with mining and agriculture underpinning the strengthening of the economy. The country experienced real annual growth of around 10% following dollarization in 2009. In 2012, GDP growth fell, attributed to a number of factors, including poor harvests, low levels of revenues from minerals (the economy of Zimbabwe is dominated by mining and agriculture), decreased activity in the manufacturing sector, and 80% of the workforce remaining in the informal sector. In 2016, the government adopted an expansionary fiscal policy, resulting in a fiscal deficit which widened to 11.1% in 2017, from 8.5% in 2016 (World Bank, 2018). 2017 saw higher economic growth of 3.4% (up from 0.6% in 2016), though this was still around 2% below the Sub-Saharan average, and is predicted to slow in 2018 to around 2.7% due to lack of liquidity (World Bank, 2018). Zimbabwe's GDP as of 2017 was US $17.9billion, with a GDP per capita of US$927. Real GDP growth is projected at only 1.2% in 2019 (AfDB, 2018). With GDP unable to keep up with population growth in the county, this slow growth is contributing to increases in poverty (World Bank, 2018).

Economic crisis, hyperinflation and ensuing political crisis have had significant effects on the Zimbabwean society. Zimbabwe has experienced mass migration, leading to a significant brain drain, pushing highly skilled workers abroad due to unemployment, low wages, and few opportunities. (CIA , 2018). Zimbabwe had seen progress in a number of health indicators which have stalled since the mid-2000s. The fertility rate has been fairly stable, and the prevalence of HIV has dropped from 29% to 15% since 1997, but this rate is still among the highest in the world, supressing the life expectancy rate. Life expectancy in 2018 was estimated at 61.1 years (59 for males and 63.2 for females). In 2003, life expectancy was 43.1 years (World Bank, 2018). (CIA , 2018). In 2017, Zimbabwe was ranked 156th (155th in 2016) of 189 countries on the UN's Human Development Index. Although low, in 2011, Zimbabwe ranked 173 out of 187 countries, when health, education and other basic services largely collapsed as a result of the economic and political crisis (UNDP, 2018)

Figure 4: Annual GDP Growth in Zimbabwe between 1990 and 2017



Source: World Bank data

Zimbabwe was ranked 155th out of 190 countries in Ease of Doing Business ranks in 2018, down from 159 in 2017 (World Bank, 2018). Investment, both foreign and domestic is stifled by land tenure and titling issues, as well as the inability for dividends to be repatriated overseas, and the ambiguity of the government's Indigenisation and Economic Empowerment Act. (CIA , 2018). Economic growth is hampered by poor infrastructure, a poor investment climate including a deficient regulatory environment, large public debt and high government wage expenditures (CIA , 2018).

Zimbabwe's economy continues to face challenges; weak domestic demand and high informality, a challenging political environment, high public debt and a crisis in liquidity. Investor confidence is further eroded by perceptions of weak governance and poor accountability. However, strong performance in key sectors such as mining have contributed to improvements in economic growth in recent years, and the country has seen improvements in the business climate generally (AfDB, 2018). Zimbabwe has significant natural resources, existing public infrastructure and strong human capital. There is much potential for further strengthening of the economic situation with further political and economic reforms, including re-stabilisation of the monetary system and a resolution regarding the accessibility of development financing.

2.2 OVERVIEW OF THE ENERGY SECTOR

2.2.1. ENERGY MIX, EMISSIONS AND TRENDS

The main sources of energy in Zimbabwe are coal, wood fuel, electricity and petroleum fuels, of which wood fuel comprises the majority. According to the latest (2009) national energy balance, wood fuel comprises the bulk (61%) of the total energy supply, followed by liquid fuels (18%), electricity (13%), and then coal (8%). Rural communities meet 94% of their cooking energy requirements with firewood, whereas 20% of urban households use wood as the main cooking fuel. Coal, charcoal and liquefied petroleum gas (LPG) are used by very few households for cooking (less than 1%). Most urban households use electricity for cooking (80%), in contrast, only 6% of rural households use electricity for this purpose. The use of LPG and charcoal for cooking is strongly related to the quality of electricity supply. In times of prolonged electricity shortages, the share of LPG and charcoal usage tend to increase.

The total share of renewable energy in the energy mix is 5%, with total clean energy generation at 194.1 GWh/ year. The country has significant renewable energy resources, but the development of the sector has been hampered by a poor regulatory environment, including a lack of incentives, and the prevailing economic challenges (Climatescope, 2017).

Zimbabwe's contribution to global greenhouse gases are insignificant, and coupled with the high carbon sequestration potential of the country's forests, it makes Zimbabwe a net carbon sink. Zimbabwe's GHG emissions in the year 2000 were 26,996Gg CO2e which translates to 0.002Gg CO2e per capita. This translates into a global contribution of less than 0.05% to global emissions. Due to the country's low emissions, the main challenges remain adaptation and building resilience. Nevertheless, mitigation actions are still considered important and the government recognises the benefits of tapping into the renewable energy sources that the country has to offer (NDC Zimbabwe, 2015).

National government's focus is mainly to increase the installed capacity of on-grid generation, whereas the Rural Electrification Agency is tasked with rural electrification through both on-grid and off-grid technologies.

2.2.2. KEY ENERGY AND ELECTRICITY SECTOR STAKEHOLDERS

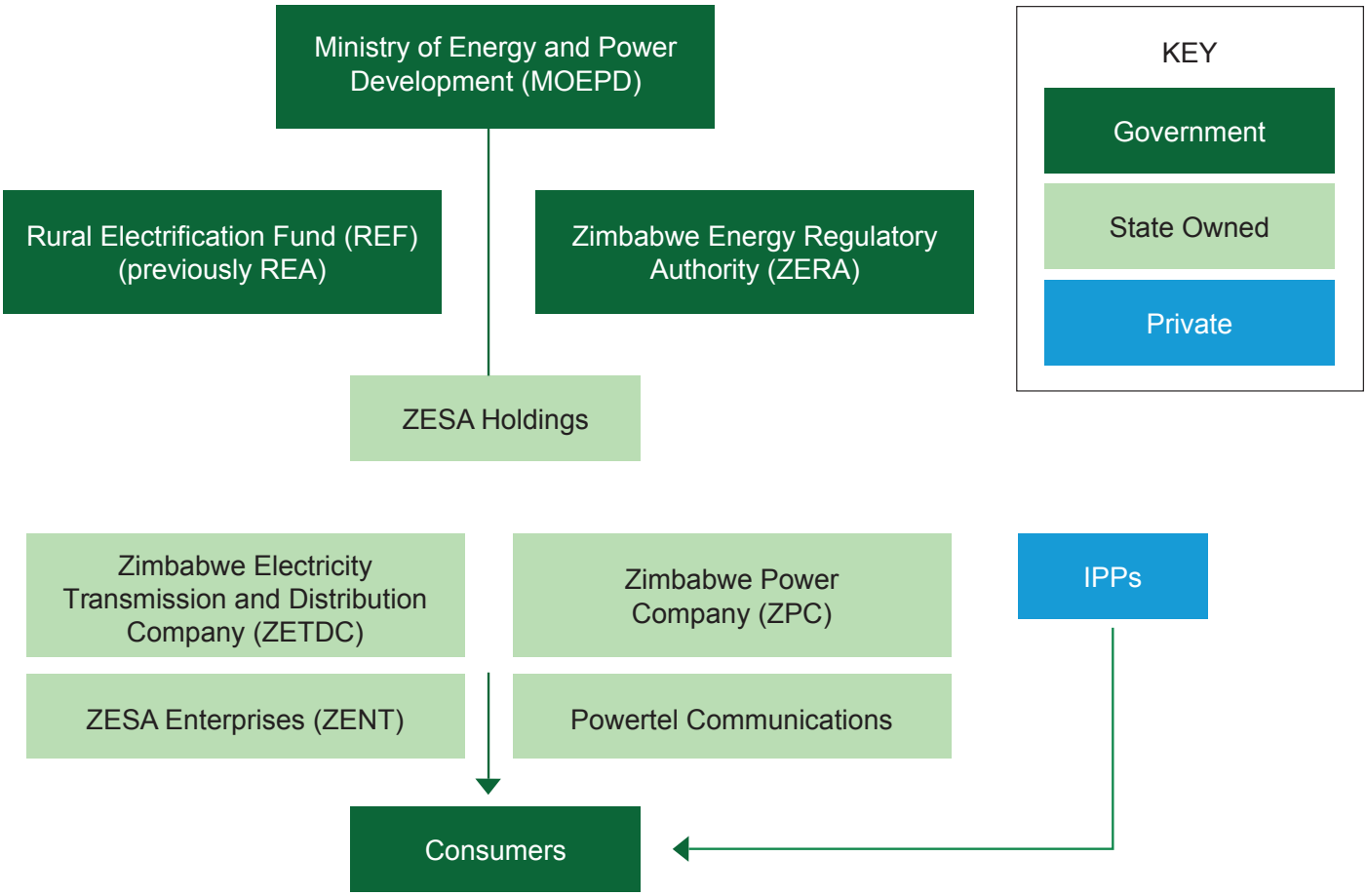
The Ministry of Energy and Power Development is the overarching regulatory authority, and is supported by the Rural Electrification Fund (REF) and Zimbabwe Energy Regulatory Authority (ZERA). The ministry is responsible for policy formulation, performance monitoring, promotion of new and renewable sources of energy and overseeing the performance of state-owned utility company, ZESA Holdings. The REF (previously the Rural Electrification Agency) was established by the Rural Electrification Act that was promulgated in 2002. REF's mandate is to facilitate electrification of rural areas, is responsible for planning and implementing rural electrification projects, and to administer the funds for rural electrification . ZERA was established in 2012 by the Energy Regulatory Authority Act (Chapter 13:23) of 2011. ZERA is responsible for regulating and monitoring public and private enterprises involved with energy production, transportation, distribution and supply as well as issuing licences and setting tariffs. ZERA regulates all energy sources which includes petroleum, gas, renewable energy and electricity derived from conventional thermal power.

The power sector underwent comprehensive reforms after parliament passed the Electricity Act (Chapter 13:19) in 2002. This brought about the restructuring and unbundling of the vertically integrated Zimbabwe Electricity Supply Authority (ZESA). The restructuring led to the formation of ZESA Holdings (Pvt) Ltd as the holding company under which four subsidiaries were formed. The subsidiaries include an interesting and unusually diverse portfolio of services and products that is usually not associated with a utility company. The subsidiaries are as follows:

- Zimbabwean Power Company (ZPC): responsible for on-grid power generation and supply to the grid;
- Zimbabwe Electricity Transmission and Distribution Company (ZETDC): responsible for the transmission and distribution of electricity, balancing supply and demand, and performing services such as grid impact assessments;
- ZESA Enterprises (ZENT): A flexible investment arm of ZESA Holdings that provides a diverse range of products and services such as manufacturing of equipment used in the power sector and fleet hiring; and
- Powertel Communications: A public data network operator fully licensed by the Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) that provides data communications services. It was originally primarily responsible for providing communication services to the power companies (ZESA Holdings, 2018).

However, it was announced at end of August 2018 that Cabinet had approved the re-bundling of ZESA. The decision was made to reduce costs, as it is too costly to run each subsidiary separately, each with their own executives. The process of re-bundling is in process and is expected to be completed by 2020 (ESI Africa, 2018).

Figure 5: Institutional Structure of the Electricity Sector



2.2.3. GOVERNMENT ENERGY POLICIES, STRATEGIES, TARGETS, ROADMAPS, PLANS AND PROGRAMMES

The Government is very supportive of both renewable energy technologies and independent power producers (IPPs) and have recently put measures in place to support the development thereof. The Electricity Act of 2002 and National Energy Policy (NEP) of 2012 makes provision for Independent Power Producers (IPPs) to be active in electricity generation. To realise this, the Electricity Act was amended in 2007 to allow for IPPs to be active. The objective of the NEP is to increase the access of IPPs and public-private partnerships to the power generation sector, in order to create more local power generation that is diverse in supply. To promote private investment, government amended the Indigenous and Economic Empowerment Act (Chapter 14:33) effective from 2018, to relax the requirement that foreign companies had to previously have a 51% local share (Finance Act GN158A of 2018).

The National Energy Policy is supportive of renewable energy technologies including biomass, hydro, solar and wind power, and acknowledges the potential of renewable energy for rural electrification. The NEP specifically aims to increase hydropower capacity with an additional 1,100MW of large hydro-power and 150MW of in-land small hydro schemes by 2020. Large hydropower will be derived from the Kariba South hydro extension (already commissioned) and construction of Batoka Gorge hydro power plant (in feasibility study phase). These targets have been revised in the Renewable Energy Policy to be maintained by 2030 instead of 2020.

Zimbabwe's Nationally Determined Contribution (NDC) sets a target of reducing energy emissions per capita by 33% in comparison to its projected business-as-usual trajectory. The energy sector has been identified as the major greenhouse gas contributor and therefore majority of emissions reduction will come from renewable energy deployment. Actions to achieve this reduction include increasing hydro in the energy mix together with the deployment of solar-powered off-grid systems (NDC Zimbabwe, 2015).

In order to transform the policy intentions into reality, a Renewable Energy Policy together with an implementation strategy was developed to achieve the goals set in the NEP and NDC. The Renewable Energy Policy was approved by Cabinet in 2019. The policy specifies targets for renewable energy and energy efficiency and also articulates an implementation strategy with specific deliverables and timeframes. To meet the NDC's 33% emission reduction target, it sets a target of 1,100MW (or 16.5% of total demand) of electricity from renewable energy sources by 2025, and 2,100MW (or 26.6% of total demand) by 2030, excluding large hydro such as from Lake Kariba. The policy also brought about the following key changes that are relevant to GMGs:

- The payable licencing fee threshold was increased from 100kW to 1 MW;
- EIA requirements have been relaxed for mini-grids up to 5MW;
- Awarding National Project Status and Tax Incentives to RE projects;
- A Green Energy Fund is being set up to extend financial assistance for setting up renewable energy projects (including mini-grids) and will initially be housed with REF, then subsequently with the Infrastructure Development Bank of Zimbabwe (IDBZ);
- Setting up of a Nodal Agency to facilitate admirative approvals and assist with complex processes such as land acquisitions, transmission connectivity and signing of a PPA.

The Government is in the process of developing an Independent Power Producers Policy Framework. This is to promote investment into the energy sector and to introduce the concept of competitive bidding when procuring renewable energy. The IPP Policy Framework will aim to simplify the process for IPPs to implement their projects.

REF has developed a Rural Electrification Master Plan (REMP), that is yet to be published. The REMP provides a master plan for universal energy access through both on-grid and off-grid technologies. The REMP is discussed in detail in section 2.4.1.

Zimbabwe is one of the target countries which is eligible to receive funding from the Renewable Energy and Adaptation and Climate Technologies Program for Sub-Saharan Africa (REACT SSA) by the Africa Enterprise Challenge Fund (AECF). The AECF is a development institution which supports businesses to create resilience and sustainable incomes in rural and marginalized communities in Africa. The programme will provide funding to promote the implementation of renewable energy projects by the private sector. The fund will match funding on a 1:2 bases to a minimum of US$250,000 and a maximum of US$1.5mill e.g. private funding of US$125,000 will be matched with US$250,000 from the fund (AECF Africa, 2018). Under the AECF REACT programme, SIDA committed US$6.5million to Zimbabwe for two years, from 2020 to 2021. In a second round of funding, which included mini-grids, 14 companies in Zimbabwe were shortlisted of which 9 were targeted to be funded.

The Swedish Embassy in Harare signed an agreement to the amount of US$773,000 in 2017, to support UNICEF in the second phase expansion of its Green Innovations Hub (GiHub) programme. The programme began in 2015 and serves as an incubation space for young people. Young entrepreneurs have been invited to come up with ideas for products and services that promote renewable energy and sustainability. Feasible projects will receive funding for testing and technical support to be scaled up. Overall the programme aims to build capacity in the renewable energy and sustainability sectors, provide space for incubation and innovation, and cultivate a culture of environmental stewardship (United Nations Zimbabwe, 2017). 29 projects were funded and supported with mentorship and business coaching. The project closed in October 2019 and linked some of the promising projects to organisations like PFAN, ILO's Green EnterPrize project and others. Several other projects like ILO GreenEnterPrize projects have since been funded by the Swedish Embassy in Zimbabwe to run similar green innovation funding challenges and they are currently being implemented. Another project which is also funded by Swedish Embassy and SDC called Opportunities for Youth Employment (OYE) is a USD2.5 million project from SIDA which serves as a sequel of other projects implemented by SNV.

2.3 OVERVIEW OF THE POWER SECTOR

2.3.1. CONTEXT

ZPC and ZETDC are the main actors involved in the power sector, responsible for power generation and transmission and distribution, respectively. The generation sector has been liberalised with ZPC responsible for approx. 95% of power production. ZETDC is theoretically not a monopoly as other players can obtain transmission and distribution licences, however, in practice there are no other significant companies responsible for transmission and distribution.

Just over half of the population is unelectrified, with national electricity access estimated at 38%-40%. As with most sub-Saharan African countries, there is a big difference between rural and urban electrification rates. Access to electricity in urban areas are estimated at 78-80% and rural electricity access is estimated at 19%. 68% of the population live in rural areas which therefore translates into approx. 7.8mill people that have no access to electricity (ZimStats, 2017). Electrification rates have only increased slightly in the last 25 years.

2.3.2. GENERATION

Zimbabwe's electricity is mainly derived from coal and hydropower. Zimbabwe has an installed capacity of approx. 2,470MW, comprised of large hydro (approx. 45%) and fossil fuel powered stations (approx. 50%). The remaining 5% is derived from IPPs. Licensed IPP projects have the capacity to approximately generate a combined 130 MW of power, of which the bulk is derived from 3 independent power producers using biomass, and to a lesser extend from mini hydro projects. In recent times, various solar PV systems ranging in size from 400kW to 1MW has been installed mainly for self-consumption, especially in response to the extended power cut being experienced. The IPPs generating power from bagasse are mostly for own consumption but can feed excess power into the grid. Generation projects follows a least cost plan for meeting demand and priorities for generation is resource driven. In recognition of least cost development, the government is also fully supportive of IPPs (AECF Africa, 2018).

Table 1: Zimbabwe Power Sources

Name of power plant	Owner	Capacity (MW)
Kariba Dam Hydroelectric Power Station	ZPC	750
Kariba South Extension (Hydro)	ZPC	300
Hwange Thermal Power Station	ZPC	920
DEMA diesel peaking plant	ZPC	100
Munyati (Coal)	ZPC	100
Bulawayo (Coal)	ZPC	90
Harare (Coal)	ZPC	80
Triangle (Bagasse)	Triangle Ltd	45
Hippo Valley Estates (Bagasse)	Hippo Valley Estates	33
Green Fuel (Bagasse)	Green Fuel	18
Small and Mini-hydro IPPs	Various IPPs	30

Source: ZPC, 2018; PGI Group, 2018 and Netherlands Enterprise Agency, 2017

Zimbabwe has a net deficit in power supply as the actual capacity available is much lower than the installed capacity. Actual capacity sits around 1,300MW-1,500MW compared to an installed capacity of approx. 2,470MW. This is due to a combination of droughts causing low water levels in the Kariba dam, a shortage of coal, cost of fuel and power stations operating under capacity due to a lack of maintenance. As a result, supply has not been able to meet the power demand of approx. 1,600MW (Zimbabwe Situation, 2018). Besides the commissioning of the Kariba South extension (300MW hydro) in 2018, limited other additional power generation capacity has been added to the grid in the last three decades.

Zimbabwe's peak demand has actually decreased, down from 2,200MW in 1999, due to deindustrialisation and economic downturn. Supply has only marginally increased from 1,050 MW in 2009 to 1,200 MW in 2015 (Ministry of Energy and Power Development, 2016). The deficit resulted in power cuts which was met through electricity imports from South Africa, Mozambique and DRC of approximately 400MW-450MW. In recent times the deficit has increased and extended power cuts (of up to 18 hours per day) has been experienced (ZESA Holdings, 2018).

There are, however, projects in the pipeline to increase generation capacity. These include Hwange Power Station Expansion (600 MW coal), Mutare peaking plant (120 MW), the Batoka Gorge Hydro Power station (2,400MW to be equally split between Zimbabwe and Zambia) and approx. 700MW from IPPs. Hwanga Power Station is expected to come online between 2021-2022. After experiencing initial delays in project commencement for the Mutare peaking plant, government gave approval in 2017 for the project to commence and construction is expected to take 18-24 months. The Batoka Gorge power station is still in the process of finalising feasibility studies and is expected to take 6 years to complete from the start of construction. ZPC is also undertaking repowering of some of its existing plants which is expected to add an additional supply of around 200-250 MW to the grid in the next 5-10 years. As mentioned above, the Kariba South Extension came online in March 2018, which adds an additional 300MW capacity to the grid. This increases the total installed generation capacity of Kariba hydropower plant to 1,050MW. However, due to low water levels, the plant is not running at maximum capacity and will in effect produce between 650MW and 850MW (ZPC, 2018).

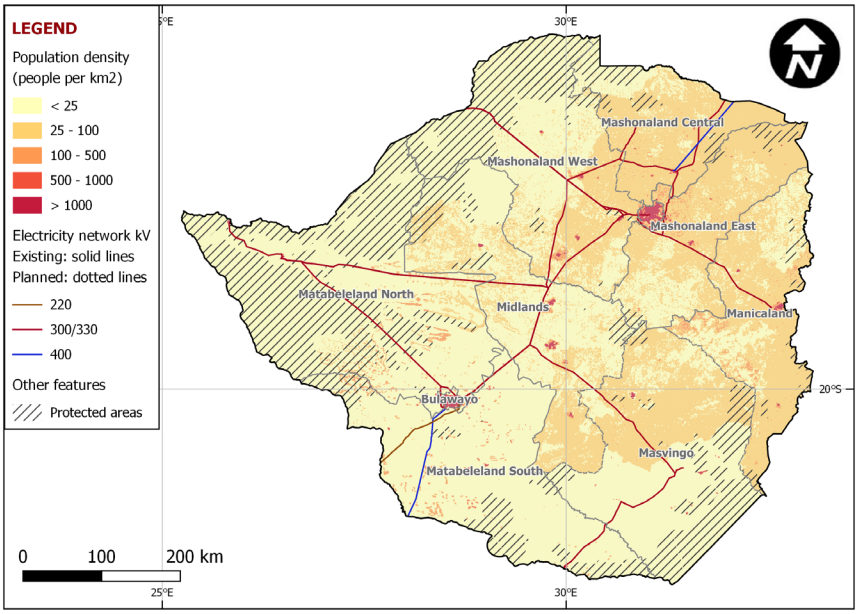
There are approx. 25 IPPs who have been licenced, but whose projects have not reached implementation stage and are at various stages of project preparation. These stages include completing EIAs and detailed feasibility studies, finalising PPAs and reaching financial closure. The combined capacity of these licenced IPP that have not reached implementation are approx. 700MW, made up of 660 MW (17 solar projects) and 50 MW (9 mini hydro projects) (AECF Africa, 2018). Most PPA have been negotiated on a case by case basis, however government is recently moving towards a tender process.

IPPs have faced significant barriers to participate in the power sector due to lack of clarity over regulation and a lack of incentives, together with a high offtake risk for independent generators. In view of the anticipated surge in demand for electricity, consistent with the growth trajectory expected under the new economic dispensation, investment in power generation projects such as small hydro and solar plants has been recognised by Government as critical. Recent government interventions such as new policies (e.g. Renewable Energy Policy) and frameworks may aid in overcoming challenges previously faced by IPPs. (Climatescope, 2017)

In addition to the above-mentioned future projects to be implemented through ZPC and IPPs, REF is planning to electrify rural areas through both on- and off-grid technologies. Additional detail regarding REF's plans are discussed in detail section 2.4.1.

2.3.3. TRANSMISSION AND DISTRIBUTION

Figure 6: Zimbabwe Transmission and Distribution Network



Source: Carbon Trust analysis

Zimbabwe has a transmission system that is relatively well spread geographically with sufficient line and transformer capacity to avoid overloading the grid. The backbone of the grid network runs through the centre of the country from Bulawayo to Harare, with transmission lines extending to the east of the country. High voltage lines run from the two main generation plants, Kariba and Hwange, located in the west of the country (Figure 6). ZETDC is responsible for transmission lines of 66kV and above of which is in total 7,274km in length. Most of the transmission lines are 330kV (3,232km), 132kV (2,012km) and 88kV (1,690km) lines, with one 440kV (161km) transmission line running from South Africa and Botswana (African Development Bank).

Although the grid has sufficient capacity, the infrastructure is quite old and rundown and is in need of upgrades and rehabilitation. 70% of electricity is used in productive sectors with the remaining supply being used for domestic purposes. Most of the domestic demand is from Harare and surrounding areas. ZETDC has several future projects to reinforce and extend the transmission grid network. The implementation of these projects will be dependent on whether ZETDC has the necessary funds available.

Although historically low, electricity tariffs have become increasingly expensive after significant tariff increases were approved by ZERA in 2019. A tariff increase of 320% was approved in 2019 in two stages and is currently being implemented. ZERA firstly approved a tariff increase to USD 38.61c/kWh after the US dollar tariff of USD 9.86c/kWh was eroded to USD 1.01c/kWh following currency changes in February 2019. A second tariff increase to USD 162.16c/kWh, effective 3 October 2019, was approved to assist in increasing the utility's revenue and cover operating costs and outstanding debt. It is expected that the tariffs may continue to be further reviewed monthly. ZESA has been struggling to cover costs related to operations, maintenance, electricity imports and fuel and announced a loss of ZWL320 million in August 2019. Domestic and agricultural customers will continue to be cushioned through a lifeline band covering 50 units at a price of ZWL41c/kWh for domestic customers and a special tariff structure for agricultural customers (ZESA, 2019).

Pay-as-you-go meters were introduced in 2014 as a solution for the lack of payment received from users for electricity usage. Between 60-70% of people have converted to the new pre-paid systems (ZERA, 2014).

Net metering and Renewable Energy Feed-in Tariffs (REFiT) were introduced by government for renewable energy producers in 2014. Net metering is regulated by the Net Metering Regulations which stipulates a cap of 100kW generating capacity. Above 100kW, Renewable Energy Feed-in-tariffs are applicable. ZERA developed Renewable Energy Feed-in-tariffs in 2013 which are summarised in the table below.

Table 3: ZERA Feed-in-tariffs

Technology	Tariff (US$)/kWh
Hydro 100kW ≤≥ 1MW	0.142
Hydro 1 < ≥ 5MW	0.125
Hydro 5< ≥ 10MW	0.111
Biomass 100kW ≤≥ 10MW	0.115
Bagasse 100kW ≤≥ 10MW	0.096
Biogas 100kW ≤≥ 10MW	0.106
Solar PV 100kW ≤ ≥1 MW	0.138
Solar PV 1 MW < ≥ 5 MW	0.131
Solar PV 5 MW < ≥ 50 MW	0.118
Wind 100kW < ≥ 5 MW	0.103

Source: ZERA, 2013

2.4 OVERVIEW OF THE OFF-GRID SECTOR

2.4.1 ENERGY ACCESS POLICY AND PLANNING

REF (previously REA) is the main actor responsible for energy access planning and off-grid electrification. REF's mandate is to promote the provision of electricity and other modern energy services to rural areas using renewable energy technologies where possible together with administering funds for rural electrification. The vision and mission of the agency is to achieve universal access to modern energy service by 2040 for rural communities in Zimbabwe.

To fulfil REF's mandate and vision, the development of a Rural Electrification Master Plan (REMP) was identified as a strategic priority. In brief, the REMP process comprises of three main steps: (1) quantifying the demand for energy services; (2) developing a suite of least-cost options to meet the projected demand over time using both on- and off-grid technologies as and where relevant; and (3) formulating an implementation plan. On-grid technologies comprise the extension of the grid, and off-grid technologies includes solar micro- and mini-off-grid systems as well as solar home systems (SHS). The REMP only considers solar technologies and does not include other renewables such as hydro and biogas.

The most suited technology for an area was determined by ranking technologies according to their economic internal rate of return. This was determined using financial and technical analyses. The technology with the best ranking were selected to be implemented in a specific area; where a ranking of 8 or higher is required for a technology to be considered feasible. Electrification planning also took the quality of electrification needed into consideration. A 5-tier system was used to rank the quality of electricity required in an area (5 = grid quality electricity and 1 = most basic application of electricity i.e. lighting and phone charging only). The results of the assessments identified that an application of approx. a 50/50 split between on- and off-grid technologies would be most suited to achieve the goals of the REMP.

The REMP has remained in a draft format for a number of years and the release date is uncertain. The delay in publishing the REMP has negatively affected the implementation of rural electrification. As the REMP has not been published yet, the REF has up until now identified institutions for electrification with assistance from the Ministry of Energy. During the years 2002-2008, a donor funded programme was implemented by REF, where solar panels of about 1kW in size where installed at 400 clinics and schools that were more than 10km from the grid (ECA & Practical Action, 2013).

Rural electrification is funded through and administered by REF. REF is funded through allocating 6% of consumers' electricity bills towards the fund. The fund has not been sufficient to electrify all areas, and therefore electrification of selected areas/institutions have been prioritised. Priorities have been given to schools and clinics as well as important community leaders.

Overall, government is supportive of privately developed mini-grids and acknowledge the importance that off-grid electrification will play to increase electricity access.

2.4.2 LICENSING AND EXISTING MINI-GRIDS

Mini-grids with a size of <100kW are governed by light-handed regulations and are exempted from requiring a licence. All existing mini-grids in Zimbabwe are below the threshold of 100kW. This has mainly been due to avoiding the burden of regulatory compliance and to reduce cost by avoiding to pay a licence fee. This may leave uncertainty as to how the licencing and regulating process will work in practice, specifically relating to mini-grids. The Renewable Energy Policy has since increased the installed capacity threshold for when a licence fee is payable from 100kW to 1MW. It was suggested in country by ZERA that developers of mini-grids with a size of <100kW should notify ZERA and REF in order for the authorities to possibly incorporate the planned or existing mini-gird into their electrification strategies. This also ensures transparency between the developer and regulator.

Mini-grids above 100kW and IPPs require a generation license, although projects of less than 1MW are exempted from paying a licence fee. Apart from generation licences, private sector can also receive a transmission and distribution license, should the project be large enough to require such infrastructure. From an IPP point of view, it has taken much longer than the stated 90 days to receive a licence due to the multiple point of contacts involved in the licensing process.

The requirements for all types of licenses can be found in the Electricity Act , the ZERA Electricity Licencing Guideline and Requirements 2017 document and in the Renewable Energy Policy. A list of required documentation for a generation, transmission and distribution license is specified in Appendix A.

The above thresholds can be summarised as follows:

Installed capacity	Licensing requirement	Licence fee
Less than 100kW	No license	No fee payable
100kW – 1MW	Licence required	No fee payable
More than 1MW	Licence required	Licence fee payable

A non-refundable application fee of US$2,500 plus 15% VAT is payable upon submission of your application form together with the relevant supporting documents. Licence fees are based on the requirements contained within SI 55 of 2015 and is dependent on the size of the operation. The cost for generation, transmission and distribution licences are as follows:

- **Generation licence:**

  Greenfields operation:

Size of operation:	Cost of licence (US$)
1-10MW	$10,000 fixed
11MW and above	$20,000 fixed plus $10,000 per 25 MW of part thereof

  Brownfields operation: For brownfield projects, 50% of the licence fee for greenfield projects are payable.
- **Transmission licence:** Fixed licence fee of $US120,000
- **Distribution licence:** The licence fee for electricity distribution is $US20,000 fixed cost, plus $US10,000 per 1,000 GWh.

The duration of a licence is dependent on the life span of the equipment, and is valid up to a maximum duration of 30 years, with the exception of an Electricity Supply licence, which is only valid for 5 years.

Case Study: Mashaba Solar mini-grid

The Mashaba project is a unique 99kW solar mini-grid system in the Gwanda district and was developed by a consortium of NGOs (Practical Action, SNV Netherlands Development Organisation and Dabane Trust). It was funded by several donors, with the EU contributing 75% of the funding. The mini-grid was commissioned in 2016.

The mini-grid has more productive use customers than consumptive and social customers. It powers three irrigation schemes, two business centres, a clinic, a primary school and teachers and nurses' households.

The mini-grid uses a three-tier tariff structure with a pre-paid metering system for all customers.

The Mashaba mini-grid offers opportunities for private investors as funders for expansion, as managers for a fee and as end users of the electricity generated.

The mini-grid was constructed to be expanded as the demand for electricity increases.

Mashaba Solar Mini-grid

Renewable energy projects must undergo an Environmental Impact Assessment; relaxed approval processes apply to projects with an installed capacity of <5MW. To obtain an environmental authorisation, one must follow the provisions in the Environmental Management Act, 2002 and Statutory Instrument 7 of 2007 (Environmental Impact Assessment and Ecosystems Protection) Regulations. A fee is payable to the Environmental Management Agency (EMA). Projects that are small scale with minimal impact are required to pay a fee of USD210. Fees for projects that have moderate to high negative impact is based on a percentage of the total cost of the project, ranging from 0.8% to 1.2%.

Hydro-powered mini-grids will require a water permit and will also have to pay a non-consumptive water use tariff. The tariffs are dependent on the type of water source that the hydro station will be built on, and is based upon the installed capacity and energy output generated. The fees are payable to the Zimbabwe National Water Authority (ZINWA). Table 4 below summarises the non-consumptive water use tariffs for fixed and variable charges:

Table 4: ZINWA non-consumptive water use charges

Charges	Project on ZINWA dams	Run-of-river Project	Project on self-built dam
Fixed charge per installed Capacity ($/kW per annum)	Nil	1	0.5
Variable charge for generated energy output ($/kWh)	10% of revenue generated	0.001	0.001

Existing off-grid mini-grids are mainly developed by NGOs and tend to be donor funded. SNV Netherlands Development Organisation and Practical Action are notable development organisations involved in the mini-grid sector in Zimbabwe (Holsteijn, 2016). Two notable mini-grid projects of SNV and Practical Action are the Mashaba solar PV mini-grid project and the Himalaya mini hydro mini-grid project. The Himalaya mini-grid project is an 80kW community-based micro-hydro scheme in the Mutare district, implemented by Practical Action and Oxfam within the RuSED project and was commissioned in 2015 (Practical Action & ENEA, 2016).

The pilot micro-hydro mini-grids listed in Table 5 were installed in Zimbabwe as part of a 5-year ACP-EU Energy Facility funded programme, developed and implemented by Practical Action (Economic Consulting Associates & Practical Action, 2013).

Table 5: Mini-grids developed as part of the ACP-EU Energy Facility programme

Micro-Grid	District	Technology	Size (kW)	Date commissioned	Owner
Chipendeke	Mutare Rural	Hydro	25	2012	Community Cooperative
Nyafaru	Nyanga	Hydro	20	Originally in 1990, being rehabilitated in recent times	N/A (Manager: School Development Committee)
Dazi	Nyanga	Hydro	20	2011	Community Trust Fund
Nyamwanga	Mutasa	Hydro	30	2013	Community Cooperative
Hlabiso	Chimanima	Hydro	30	2013	Community Cooperative
Ngarura	Mutasa	Hydro	30	2013	Community Cooperative

Source: Economic Consulting Associates & Practical Action, 2013

2.4.3. MINI-GRID TARIFFS

ZERA has limited interference with tariff models for mini-grids that are <100kW in size, as the regulator is aware and supportive of cost reflective tariffs that cover operation and maintenance costs. Mini-grid developers can therefore determine their own tariff and tariff model. Tariffs are still subjected to the ability and willingness of customers to pay and although not mandatory, it is good practise to consult the community on tariffs (Practical Action & ENEA, 2016). Most mini-grids in Zimbabwe use a 3-tier tariff system, where business, households and social services (schools and clinics) each have their own tariff. The tariffs can be charged per kWh or it can be in the form of a monthly flat rate. A tariff model can also be based on the number of bulbs a user has. An example of this is where the user pays US$10 per month for the first bulb and US$3 per month for every additional bulb.

For mini-grids above the size of 100kW, tariffs have to be approved by ZERA. ZERA has published a tariff code which provides guidance to developers on how to determine tariffs that are fair to both the consumer and licensee. The tariff code is applicable to holders of generation, transmission and distribution licenses. The tariff code outlines the rate of return (RoR) methodology that is used in the calculation of annual revenue requirements of electricity utilities in the electricity supply industry. The rate of return (RoR) methodology allows providers of the electricity services to recover their efficiently incurred costs as well as realise a reasonable return as calculated through a weighted average cost of capital.

2.4.4. SUBSIDIES AND INCENTIVES

Government has extended a number of fiscal concessions towards power generation projects in recognition of the energy deficit within the country, and the importance of investing in power generation projects such as small hydro and solar plants to decrease this deficit. These concessions are designed to assist in minimising construction cost and includes suspending import duty and providing tax holidays for renewable energy developers.

Statutory Instrument 147 of 2010 suspends importation duty on solar PV products. When importing equipment, about 40-50% of the cost is attributable to importation costs, in addition to the 15% VAT that is payable. Importing products duty free therefore aids in reducing capital costs, however, the application thereof has been inconsistent and low. Solar PV products have been poorly defined, and as a result, many products that form part of a solar PV system that are not solar panels e.g. batteries, have not been exempted from importation tax. The SI has since been updated to include lithium ion batteries; however, as of the time of writing the report, this amendment is still dependent on obtaining approval from the Ministry of Finance. Exemption from import tax is also not applied consistently between the various customs offices. There have been cases of people taking advantage of a lack in knowledge by claiming car batteries are solar batteries, and thus importing the car batteries duty free. A solution to this could be to develop a Bill of Quantities with all products relating to the solar PV system and get it signed off when obtaining National Project Status.

Renewable energy developers can receive a 5-year tax holiday from paying corporate tax. The 2018 Zimbabwe National Budget Statement proposed to exempt power generation projects from Corporate Income Tax for the first 5 years of operation, with effect from 1 January 2018. Thereafter, a corporate tax rate of 15% will apply. Developers need to apply for National Project Status to be eligible for this exemption.

The Renewable Energy Policy provides other incentives to promote investment in renewable energies such as giving RE projects Prescribed Asset Status and providing Viability Gap Funding. Prescribed Asset Status will enable and encourage developers to have access to sufficient capital funds. It will attract capital from pension funds as pension funds are required to invest a certain percentage into prescribed assets. To increase electricity access and develop off-grid community solutions, projects in rural areas will be eligible for Viability Gap Funding from REF for the development of a distribution network in the area. The quantum of Viability Gap Funding will be as determined by REF (Renewable Energy Policy, 2019).

2.4.5. POWER PURCHASE AGREEMENTS

Zimbabwe has a standard Power Purchase Agreement (PPA) in place for renewable energy generation projects. There are about 13 licensed IPPs who are operating with PPAs, which appears to be honoured by the off-taker. There are no grid-tied mini-grids in Zimbabwe currently and therefore none are eligible for a PPA. Recently, government has made the decision to move toward tenders rather than direct negotiations for PPAs. The IPP Framework will aid in implementing this process.

2.4.6. ARRIVAL OF THE GRID

According to ZERA, mini-grids should be developed to be grid-ready to avoid becoming grid stranded off-grid assets. Once the grid arrives in an area, a mini-grid can be incorporated into the grid, should it suffice to the relevant technical and safety standards. A grid impact assessment will also first have to be performed and passed for a mini-grid to be integrated with the grid. Mini-grid operators may then have the opportunity to integrate and sell surplus electricity to the grid. Mini-grid operators have the following options for integration as detailed in the Zimbabwe Mini-grid Framework:

1. **Utility takes over distribution, mini-grid continues with power generation:** Mini-grid interconnects with the main grid and becomes another power plant on the grid. The utility takes over electricity distribution to retail customers (small power producer-SPP). In summary, the mini-grid becomes a small IPP and sell electricity to the utility.
2. **Utility takes over power generation, mini-grid continues to manage distribution:** Mini-grid ceases to generate power, but continues to operate the local distribution mini-grid system, obtaining bulk electricity supply from the main distribution utility (small power distributor-SPD). In summary, the mini-grid developer buys power from the grid and sells it to users. The mini-grid generation source becomes absolute.
3. **Mini-grid interconnects with the main grid, becoming another power plant on the grid and continues to manage distribution.** Mini-grid continues to sell electricity to utility as an IPP and can also buy bulk electricity from the utility and sell it to users (Combination of option 1 and 2).
4. **Mini-grid distribution system continues to operate and is managed by mini-grid operator, but only use mini-grid power source as a backup when the utility grid goes down.** Mini-grid buys power from grid and sell to users, use mini-grid generation as back-up when grid is down. Mini-grid generation source does not become absolute (Zimbabwe Mini-grid Framework, 2018).

The different options should be discussed and agreed with ZERA and ZETDC as a PPA and the appropriate licence may be required. The regulator is aware of four mini-grids that have become grid stranded due to not being grid ready. No evidence of compensation mechanisms are in place.

2.4.7. TECHNICAL RULES

To avoid mini-grids becoming grid stranded assets, the mini-grid needs to be constructed to be grid ready and comply with the relevant technical and safety requirements. These requirements can be found within the distribution code (SI 147 of 2017) and the grid code (SI 91 of 2017). It is recommended to work with REF and ZETDC to install the grid network to ensure that it is grid ready. Under normal operating conditions, a deviation of voltage of ±6% from the nominal value of 230V single phase or 380V 3 phase is permitted. Nominal operating frequency shall be 50Hz, with a deviation in frequency of ±0.5% permitted.

The Zimbabwe Mini-grid Framework, published September 2018, provides simple guidelines to enable uniform application of technical and financial requirements of mini-grids in the country. This framework is intended to be used by mini-grid designers and contractors. It sets common operation, reporting and financial practices to reduce high-risk market perceptions of individual projects, and in doing so, encourage private investment and increase funding opportunities. The framework covers options and requirements for the different technical components of a mini-grid such as distribution options for different customers, types of distribution network schemes, requirements for voltage quality, protection requirements, meters options, customer installation requirements, mini-grid equipment standards requirements and the required levels of service – power quality, reliability and availability (Zimbabwe Mini-grid Framework, 2018).

2.4.8. MOBILE SERVICES

Zimbabwe has wide spread mobile coverage and excellent access to mobile payment services. Zimbabwe has three mobile service providers namely Econet, NetOne and Telecel. Between the three service providers, Econet is the market leader. Econet has widespread 2G and 3G coverage and LTE and 4G coverage mainly in urban areas, covering a total of 82% of the population. Due to the shortage of cash in Zimbabwe, mobile payment services are very popular and works effective. Each mobile service provider has a mobile payment service, of which the most popular is Econet's EcoCash mobile payment service. Reports indicate that EcoCash has 97% of the market share (TechZim, 2018).

2.4.9. BARRIERS TO MINI-GRID DEPLOYMENT AND OPPORTUNITIES

A number of barriers have restrained the development of the commercial mini-grid market in Zimbabwe. The country is endowed with uncertainty and has low investor confidence due to its historic political and economic climate. It is therefore lacking private sector investment in the mini-grid market. Existing mini-grids tend to be non-commercial pilot projects developed by NGOs and are donor funded.

One of the largest barriers to developing mini-grids is the long-standing currency issue faced in Zimbabwe. 'Bond' notes were recently introduced into the economy. The official rate of exchange for the Bond note is 1:1 against the US$. However, due to market forces, it does not allow the Bond note to be 1:1 against a strong currency such as the US dollar, and subsequently an informal exchange rate was created. This informal exchange rate is subjected to extreme and regular fluctuations. This becomes a problem when local customers pay for electricity using Bonds, however, the mini-grid developer has to pay for infrastructure and loan repayments in US$. Due to the weak strength and high volatility of the Bond note, there is a large currency risk when developing a mini-grid. The currency must first stabilise before the private sector will gain confidence to invest into the country and allow the commercial mini-grid sector to grow. The currency situation is believed to only be a medium-term problem and that government is going to implement reforms to stabilise the currency, however, as with many other aspects in Zimbabwe, there is a lot of uncertainty about what will play out in future.

ZIMSWAP financial model

The Zimbabwe Schools Water and Agriculture Project (ZIMSWAP) is an example of how innovative thinking overcame financial barriers for schools. ZIMSWAP is a project that gives schools and communities access to clean water which is also used to irrigate crops, and in doing so, allow the schools to generate an income from selling the produce. The project drills boreholes for schools, installs solar powered pumps, a water tank and drip irrigation systems.

The projects are funded through loans from local banks. ZIMSWAP assists schools to obtain funding by using a record of school fees as proof of income to pay back the loan. In this way, the schools are able to build a credit rating.

The ZIMSWAP programme has thus far been successfully implemented at 120 schools.

Until the currency stabilises, innovative ways to obtain financing is required to overcome the currency barrier. Blended financing, both local and foreign funding together with grants and loans will decrease the risk of currency fluctuations. Local commercial banks such as ZB Bank and Old Mutual Zimbabwe are examples of local banks that lend money for renewable energy projects.

The ability and willingness of customers to pay is hampered due to high unemployment rates, a shortage of cash and a lack of sustainable economic activities, particularly in agriculture. To overcome this, mini-grid business models should include energy for productive use to stimulate economic activities and generate income. Through electrifying productive uses, it aids in generating income for community members which will increase the willingness and ability of people to pay for electricity services. It is essential for the success of mini-grid roll out to be accompanied by economic activities. Mini-grid models that incorporate PAYG or mobile payment systems will offer the best payment solutions to customers.

There is also a lack of appropriate financial structures to provide development funding to undertake EIA and feasibility studies, as there is no market for this type of funding. Grant funding would work well to cover these costs.

Zimbabwe has a challenging settlement pattern for mini-grids as the rural population is quite dispersed with low densities. The very linear and dispersed settlement patterns of communities are not conducive for mini-grid development and will require long distribution infrastructure. However, stakeholder interviews revealed a Zimbabwe specific opportunity may be to focus on electrifying what is known as growth centres, business centres and rural centres (in order of largest to smallest size). These centres are small economic hubs in rural areas that provide goods and services to the local community and were created to promote socio-economic development. They typically consist of a hospital, clinic or health centre (dependant on size) together with other businesses and shops. These centres may also aid in securing an anchor load that has a productive use such as a grinding mill, butchery or irrigation scheme. By constructing the mini-grid with a modular structure, the mini-grid may be expanded as businesses grow and will allow more households to be included over time.

Administrative procedures are generally complex, with multiple point of contacts, and mini-grids usually fall in a grey area regarding regulatory frameworks. There are a lot of regulatory red tape when developing a mini-grid in Zimbabwe, especially for mini-grids above 100kW in size. Various government departments are involved in the process of obtaining authorisation to construct a mini-grid, and each has their own unique set of requirements that need to be adhered to. Examples include obtaining environmental authorisation, land use authorisations, water use authorisations (for hydro only), company registration and licensing and tariff approval (>100kW only). This may result in long delays in the development process. An authority that serves as a one-stop shop may be beneficial to streamline the approval process.

Land acquisition is a challenge as projects face competition from other land uses and due to the political sensitivity around land reform in Zimbabwe. Most land parcels within the growth, business and rural centres have already been allocated for a specific land use. These uses are most commonly for housing, commercial and industrial uses. It's

difficult to change the land use of an area in Zimbabwe. This may especially be a problem for solar powered mini-grids that require a large area to erect solar panels. The Renewable Energy Policy has identified land acquisition as a barrier to RE development and aims to address the issue by simplifying the acquisition process, making it more transparent and ensuring fair prices to all to avoid future disputes.

Although Zimbabwe is one of the most literate countries in Africa and has a successful schooling system, they have a lack of skills that specifically relate to renewable energy. Renewable energy is a fairly new sector in Zimbabwe with few institutions offering training and a limited number of job opportunities in renewable energy, as compared to mature industries such as agriculture and mining. In addition, most people who do have skills in renewable energy only stay in the country for a few years where after they pursue work in other countries which offer better job opportunities. As a result, there is limited in-country knowledge and capacity to performed work in the renewable technology field. Proposals for funding and other renewable energy related opportunities may also lack a deeper understanding and insight into the subject and may hinder acceptance of the proposals by funders.

Poor quality solar products being imported led to a lack of confidence in solar products. There is limited quality control over what people are bringing into the country. Recently, efforts have been made to lift the standard of products imported. The Standards Association of Zimbabwe developed 15 solar PV system standards comprising of Codes of Practice and Specifications. These have been developed at national level but are still to be harmonised regionally. They are still to be integrated into practise. There is need for awareness of the standards, capacity development of stakeholders on the standards, and enforcement and monitoring. Bureau Veritas pre-shipment inspections for imports are also now in place (and co-ordinated by Ministry of Industry and Commerce) to minimise importation of substandard goods. However, there is still no standard for solar PV lanterns and products.

Although there are many barriers, many opportunities exist that will aid in overcoming the barriers faced to mini-grid development. These opportunities include obtaining National Project Status to be eligible for tax holidays; targeting growth, business and rural centres with customers that have productive uses; remain below the 100kW license threshold, implementing mobile payment systems and obtaining blended financing.

Overall, the government is supportive of mini-grid developers as they acknowledge the importance of private mini-grids to increase electrification rates and have started to take steps which will create a conducive and attractive environment for private investors.

3. GREEN MINI-GRID POTENTIAL

Estimating the potential for mini-grids is a challenging task that requires robust data and/or assumptions. Some physical factors, such as resource availability and geographic features, can be collected remotely through satellite data, but other factors require availability of local datasets and surveys. Certain non-physical factors, such as demand and consumption patterns, require precise settlement-level data to be collected. This data is often unavailable, out of date, or highly resource intensive to obtain. In addition, opportunity assessments rely upon criteria that differ depending on the approach of the implementing agency. For example, a private developer might consider purely financial metrics, whereas a community scheme might focus on quality of services provided. Given these constraints, the opportunity assessment in this report is designed to be of relevance to all mini-grid stakeholders, but will not address the individual needs of all.

This chapter aims to give mini-grid stakeholders an understanding of the size of the opportunity for green mini-grids in Zimbabwe. Market size estimates are calculated based on a number of considerations: (1) **physical opportunity size** according to GIS datasets (population density, load centres, existing grid, etc.), (2) **existing electricity expenditure** by rural households, (3) maximum **customer affordability** and willingness to pay, and (4) **tariffs** currently allowed in-country. Comparisons will be made between an existing market size, based on affordability and in-country tariff limitations, and the theoretical market size based on cost-reflective tariffs.[2] The difference between current and theoretical market size will allow an approximation of any subsidy requirement for opening the market (in percentage terms).

3.1 DATA AVAILABILITY

In Zimbabwe, population density data can be sourced from WorldPop[3] or from Zimbabwe National Statistics (ZimStat). WorldPop data estimates numbers of people per grid square, with national totals adjusted to match UN population division estimates. ZimStat data also allows for the creation of population density maps on a national or sub-national level (by ward, district or province), although this data is typically made available only on request and may be unavailable online.

GIS maps that show locations of potential load centres (e.g. business centres, schools and clinics), mobile phone coverage and poverty atlas maps, can also be provided by ZimStat. Again, this data is typically made available only on request and may be unavailable online. Similarly, the University of Zimbabwe's Geography Department can provide GIS mapping services in their private capacity for a fee, although it is unclear whether they leverage ZimStat's data, their own data, or both.

The Rural Electrification Agency (REA) has GIS data indicating electrified and non-electrified areas in Zimbabwe, as well as both areas theREF intends to extend the grid to, and areas prioritised for off-grid technologies. However, this data was not publicly available at the time of writing, and may only be accessed after publication of the Rural Electrification Master Plan (REMP).

Similarly, a GIS map of the planned grid network was not unavailable from the Zimbabwe Electricity Transmission and Distribution Company (ZETDC). As such, market sizing estimates have been made using the current grid network. Grid extension populations within the 15km buffer of the current grid were inferred based on a combination of high voltage (HV) line data (obtained from IFC GIS data: electricity transmission and distribution grid maps) and satellite mapping of night-lights. Off-grid populations are those outside of these areas.

2 Cost-reflective tariffs are assumed to be $0.4/kWh across SSA, based on cash flow modelling for typical mini-grids seen across SSA and elsewhere in the world. It should be noted that $0.4/kWh may be conservative in some markets, particularly those that face supply chain challenges.

3 www.worldpop.org.uk

Existing electricity expenditure was taken from data on five existing SNV mini-grids across Zimbabwe. Households attached to these grids pay between US $0.09 – 0.11 / kWh, with annual household consumption levels of 2,128 kWh; this is sufficient to constitute a modern energy service (extremely high by typical consumption levels across SSA). World Bank data was not available to corroborate this.

Data on willingness and ability to pay of rural households was inferred from a number of sources, mostly focused on existing tariffs. Small scale diesel tariffs range from $0.165/kWh to $0.72/kWh, so with an average around $0.25/kWh. Green mini-grid case studies SNV show tariffs between $0.09 - 0.11/kWh, matching on-grid tariffs which currently average around $0.10 / kWh (December 2014), indicating a significant range in both tariffs charged and customer affordability.

3.2 ASSESSING MINI-GRID POTENTIAL: METHODOLOGY

The first step in understanding mini-grid potential in Zimbabwe is to identify numbers of potential mini-grid customers, based on population (or household) density and proximity to the grid. To do this, the country's land area is segmented into three area categories — grid extension, mini-grid and standalone system (SHS) — based on distance between the existing transmission and distribution network and the population.

- Grid extension areas: defined as areas within 15km of the grid
- Mini-grid areas: defined as areas further than 15km from the grid[4], with household density greater than 50 households per km^2
- Standalone system (SHS) areas: defined as areas further than 15km from the grid, with household density less than 50 households per km^2

To understand where these different areas lie, the national grid is inferred using a combination of high voltage (HV) line GIS data and satellite mapping of night-lights, buffered by 15km to produce the grid-extension area[5]**.** Potential off-grid populations are outside of this grid extension area, with mini-grid populations identified based on population density greater than 50 households per km^2.

Once mini-grid population sizes are established, mini-grid market sizes can be estimated by multiplying the number of potential mini-grid customers by likely electricity expenditure (either per capita or by household). This report uses four different electricity expenditure scenarios:

1. Existing rural household expenditure on electricity based on the World Bank Global Consumption Database (World Bank, n.d.). This approach assumes that 60% of rural household energy expenditure is on electricity, and that household revenue comprises 60% of the total revenue of a mini-grid (when including revenue from businesses, public sector buildings and industrial users).
2. Existing rural household expenditure on electricity based on other literature and sources. This may be based on international or local studies, or local stakeholder interviews (in theory, this should yield similar results to scenario (1) above, although this may not be the case in practice).
3. Potential rural household expenditure on electricity, estimated based on a bottom-up calculation of what would be required to deliver SE4ALL Tier 2/3 energy access nationwide, and an average allowable tariff currently used in-country. This approach assumes that the average rural household's electricity use would be approximately 2.2

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4 While we have assumed GMG populations are those beyond 15km of the grid, some 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. 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.

5 Using this combination of night-lights and HV line datasets provides a more comprehensive picture of current electrification than using HV lines alone. Although HV grid line data is commonly available for countries in Sub-Saharan Africa, these lines provide a limited view of electrified areas, since medium voltage (MV) lines are often used to reach towns at distances exceeding 15km. This analysis therefore infers the position of the MV lines from satellite data of night-time light emissions, pre-processed to provide yearly-average datasets from which noise and cloud cover have been removed.

kWh/day; according to the SE4ALL Multi-Tier Framework, this represents a supply level between Tier 3 (1kWh per day) and Tier 4 (3.4kWh per day), which allows for electrical lighting, air circulation, television and phone charging (tier 2 level), plus additional appliances that can allow for productive uses.

4. Potential rural household expenditure on electricity, estimated based on a bottom-up calculation of what would be required to deliver SE4ALL Tier 2/3 energy access nationwide, and a flat tariff of $0.4 / kWh. This tariff has been chosen as the minimum tariff needed for private developers to recover their costs. Such a rate is assumed to be one which in many contexts in Sub-Saharan Africa, and in other developing countries, is cost-reflective. It has been used to allow comparisons across countries in terms of market size, but also to highlight the shortfall between feasible tariffs, and often-cost-reflective tariffs.

Results from these four scenarios are discussed in the results section that follows.

3.3 ASSESSING MINI-GRID POTENTIAL: RESULTS

While Zimbabwe has a transmission system that is relatively well spread geographically, there remain large areas across the country with no grid coverage. The backbone of the grid network runs through the centre of the country from Bulawayo to Harare, with transmission lines extending to the east of the country. High voltage lines run from the two main generation plants, Kariba and Hwange, located in the west of the country. Transmission lines above 220kV are illustrated in figure 7. By inferring the presence of MV and LV transmission lines using night lights, and overlaying population density (figure 8) onto the resultant map, we can identify those areas best served by mini-grids (figure 9).

Figure 7: Zimbabwe transmission and distribution network (excluding MV/LV coverage inferred from nightlights)

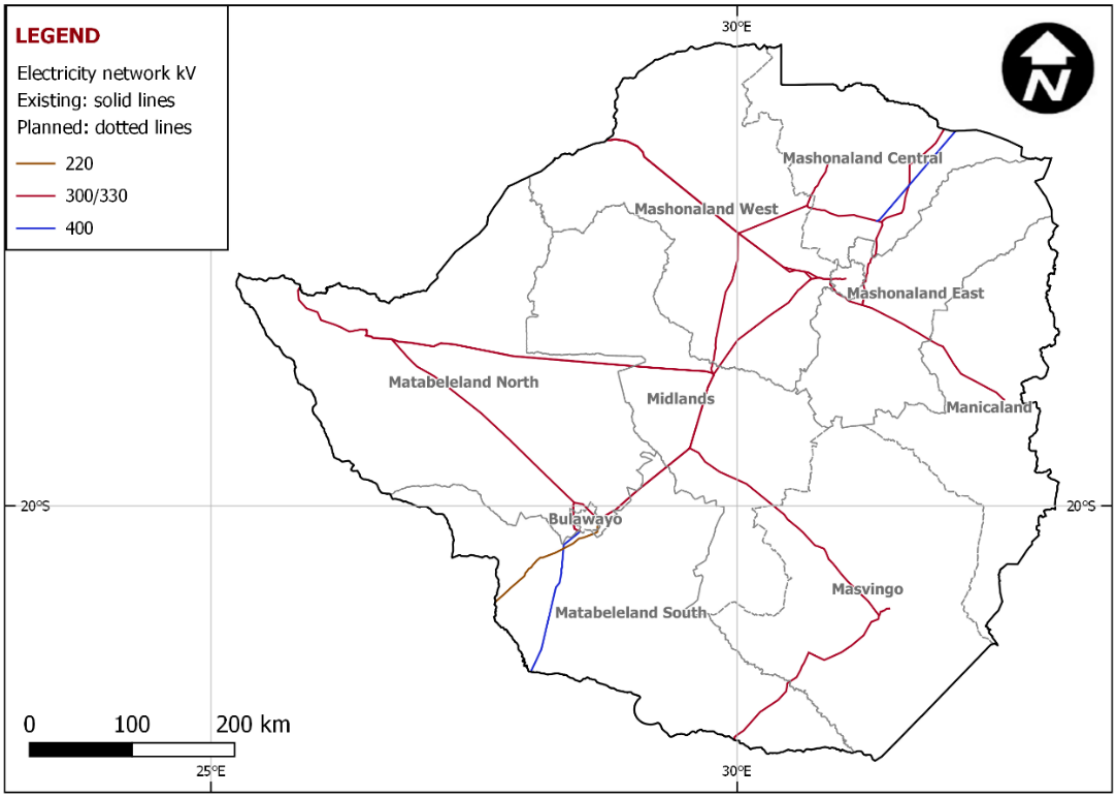


Figure 8: Population density in Zimbabwe

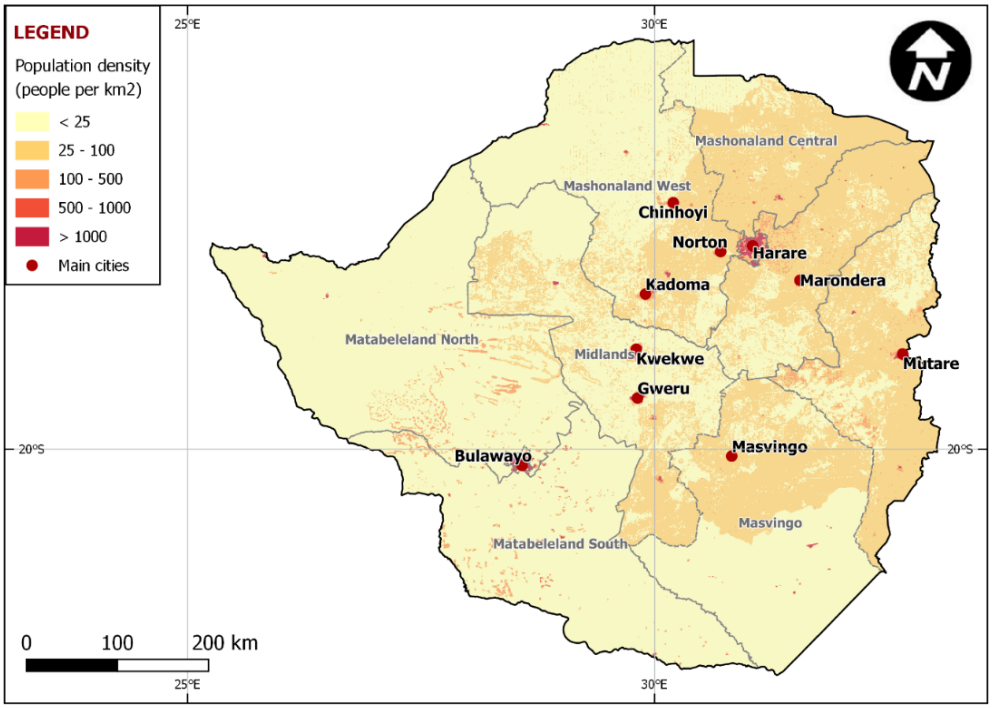
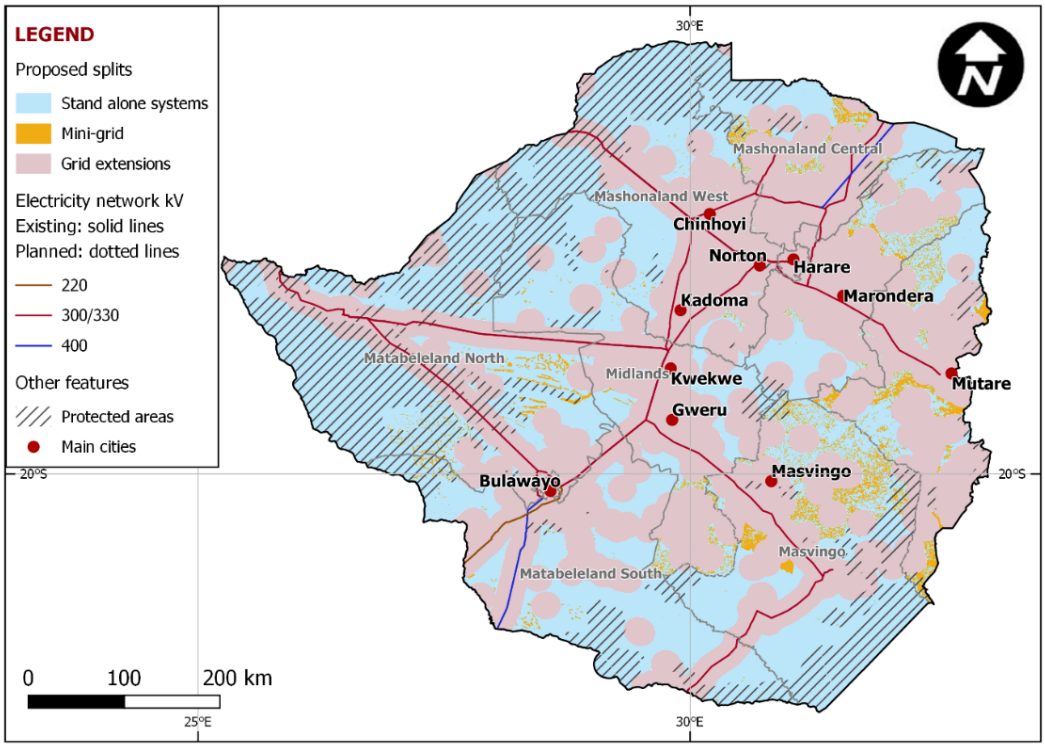


Figure 9: Regions best served by grid extension, mini-grid and standalone systems, shown with major and minor population centres. (Carbon Trust analysis)



Our analysis estimates that 1.1 million people (6% of the non-electrified population) will be best served by mini-grid solutions in Zimbabwe. A further 2.2 million people (13% of the non-electrified population) will be best served by solar home systems (SHS) and 7.6 million people (44% of the non-electrified population) will be best served by grid extension, based on proximity to the existing grid. This calculation is based on the current grid coverage only[6]; any planned grid extensions will reduce the estimated market size.

80% of the Zimbabwean mini-grid market is in the Manicaland, Masvingo and Matabeleland North and South provinces, due to their low electrification rates, limited grid coverage, and population densities high enough to support mini-grids. 251,000 and 246,000 people will be most economically served through mini-grids in Manicaland and Masvingo respectively, corresponding to around 11% of the population in each province. The provinces with the largest percentage of the population best served by SHS technologies are Mashonaland West and Masvingo, at 21% and 20% respectively.

Population sizes best served by either grid extension, mini-grid or SHS are shown by province in table 6:

Table 6: Suitable electrification solutions by province in Zimbabwe (Carbon Trust analysis)

Province	Current grid network				
	Electrification rate	Population (thousands)			Mini-Grid Market ($m)
		< 15km of grid	Mini-Grid	SHS	
Bulawayo	96%	737,808	-	-	-
Harare	81%	2,277,552	-	-	-
Manicaland	32%	1,901,158	250,687	196,673	12.52
Mashonaland Central	25%	1,230,439	87,036	218,222	4.34
Mashonaland East	38%	1,453,538	73,293	260,053	3.66
Mashonaland West	45%	1,584,469	9,802	435,485	0.49
Masvingo	40%	1,584,816	246,182	461,782	12.29
Matabeleland North	37%	774,852	202,716	204,251	10.12
Matabeleland South	32%	730,206	170,372	142,316	8.51
Midlands	49%	49,709.27	49,709	321,435	2.48
Total		**14,050,743**	**1,089,796**	**2,240,217**	**54.4**

In terms of potential revenue, the size of the market based on 1.1 million potential customers varies according to the four electricity expenditure scenarios described in section 3.2:

1. **E**xisting rural household expenditure on electricity from the World Bank Global Consumption Database: this is unavailable for Zimbabwe

2. Existing rural household expenditure on electricity based on other reports / literature: in Zimbabwe, this is available from a research report published by SNV Netherlands Development Organisation (SNV) in 2016, based on five existing mini-grids. The report suggests that households are willing to pay US$ 0.09-0.11 per kWh, with annual

6 High voltage lines plus lights seen from satellite, which are used to infer the presence of medium and low voltage lines (**note:** this method may camouflage a significant existing off-grid contribution from diesel gensets, meaning that this mini-grid market size result is likely to be conservative; further studies in-country are required)

household electricity consumption levels of 2,128 kWh or per capita electricity consumption of 519 kWh (4.1 persons per household based on UN estimates (UN, 2017)). This equates to 5.8 kWh per day per household, significantly exceeding SE4ALL Tier 3 electricity access.

Overall annual expenditure on electricity is around $57.11 per person in this scenario: an overall annual mini-grid market size of $62.1m given a mini-grid population of 1.1 million.

3. Potential rural household expenditure on electricity, estimated based on a bottom-up calculation of what would be required to deliver SE4ALL Tier 2/3 energy access nationwide, and an average allowable tariff currently used in-country: annual cost of electricity from a mini-grid was estimated based on forward-looking household electricity consumption of 2.2 kWh per day, represents annual per capita electricity demand of 197 kWh (4.1 persons per household). The average tariff for on-grid renewable energy installations (<50MW) in Zimbabwe is around $0.11 / kWh. Small scale off-grid diesel generator tariffs ranges from $0.17 – $0.72/kWh; an average across all tariffs was estimated around $0.25 / kWh.

   Based on annual electricity demand of 197kWh per capita, a tariff of $0.25 / kWh gives an average annual electricity expenditure of USD $49.94 per person: an overall annual mini-grid market size of $54.4m given a mini-grid population of 1.1 million.

4. **Potential rural household expenditure on electricity, estimated based on a bottom-up calculation of what would be required to deliver SE4ALL Tier 2/3 energy access nationwide, and a flat tariff of $0.4 / kWh:** this tariff is assumed to be cost reflective.

   Based on annual electricity demand of 197kWh per capita, a tariff of $0.4 / kWh gives an average annual electricity expenditure of USD $78.80 per capita: an overall annual mini-grid market size of $85.9m given a mini-grid population of 1.1 million.

A summary of these four market size estimates is shown in table 7.

Table 7: Market Size Estimates for the Four Scenarios

Scenario	Estimated per capita annual costs for GMG ($)	Market Size given current GMG population ($m)	Market Size of GMG population (given planned grid extension)
1 World Bank Database	Data not available	Data not available	Data not available
2 Other Donor Reports	$57.11	$62.1m	
3 'Bottom-up' + existing tariff	$49.94	$54.4m	
4 'Bottom-up' + theoretical tariff	$78.80	$85.9m	

While scenarios (2) and (3) yield similar results, the results are driven by very different tariffs and reported levels of electricity demand. Scenario (2) is based on a very low tariff and very high per household electricity consumption, which is unrealistic. Scenario (3) is based on tariffs and demand levels observed elsewhere in SSA, with a 'bottom-up' calculation being the more likely (and more conservative) estimate of the likely mini-grid market size in Zimbabwe. By coincidence, these two scenarios yield similar results.

In summary, this report estimates an annual mini-grid market size of USD $54.4 million in Zimbabwe, based on an average mini-grid tariff of USD $0.28/kWh, and average household demand per day of 2.2kWh. This implies per capita annual electricity expenditure of $49.94 within the population best served by mini-grids. Based on an estimated cost-

reflective tariff of $0.4/kWh across SSA, it is therefore estimated that **43% of project costs would be need to be covered by subsidy (approximately $30m annually)** to open up the mini-grid market to developers (lifetime project costs – with subsidy covering both CAPEX and OPEX).

3.4 RENEWABLE ENERGY POTENTIAL FOR MINI-GRIDS

3.4.1 HYDRO

Zimbabwe has a high potential for both large and small hydro power plants, with an estimated 17,500GWh/year hydroelectric potential. As at 2016, less than 20% of this had been exploited (RECP, 2018). The large hydropower potential of the Zambezi River is estimated at 7,200MW. The total small and mini hydro potential is estimated to be 120MW, based on 20MW from existing dams, 60MW from proposed dams and 43MW from run-of-river sites (Klunne, 2013). The Eastern Highlands are particularly promising for small hydro development as it has a wet climate with perennial streams and rivers flowing throughout the year. Droughts and variable rainfall have limited the viability of micro-hydro systems in Zimbabwe in recent years, with hybrid systems proposed to mitigate some of the risks from future droughts (Practical Action, 2017).

Several mini-hydro sites have been assessed for their feasibility as community-scale projects. Table 7 below summarises the sites and sizes that have been assessed for its feasibility (Practical Action, 2017):

Table 8: Mini-hydro feasibility assessment locations and sizes

Mini-Grid Project	District	Size (MW)
Manyuchi	Mwenzi	5.5
Mutirikwi	Masvingo	40
Osborne	Mustasa	23.6
Siya	Bikita	5.6
Duru	Mutasa	6.0
Gairezi	Nyanga	70
Tsanga	Nyanga	8.8

Along with several mini and micro hydro mini-grids that have been installed, 8 small-hydro plants have been installed by IPPs in Zimbabwe, ranging from 30kW to 15MW in capacity (Table 10). Nyangani Renewable Energy manages most of the hydroelectric plants that deliver electricity to the grid. Nyangani Renewable Energy is partly owned by the UK based PGI Group. The Kupinga hydropower station was financed by financial services group, Old Mutual Zimbabwe and is operated by Kupinga Renewable Energy.

Table 9: Mini- and small hydro IPPs in Zimbabwe

Name of plant	Capacity	Commissioning Date	Owner/operator
Rusito Hydropower	0.75MW	Unknown	Rusito Power Company
Nyamingura Power Station	1.1 MW	2010	Nyangani Renewable Energy
Kupinga Hydropower station	1.6MW	2017	Kupinga Renewable Energy
Duru Power Station	2.2 MW	2013	Nyangani Renewable Energy
Pungwe A Power Station	2.7 MW	2013	Nyangani Renewable Energy
Pungwe B Power Station	15 MW	2015	Nyangani Renewable Energy
Pungwe C Power Station	3.8 MW	2016	Nyangani Renewable Energy
Hauna Hydro Power station	2.3MW	2017	Nyangani Renewable Energy

Source: PGI Group, 2018 and Klunne, 2013

3.4.2 BIOMASS

Biomass occupies the largest share of the total energy mix, though it is predominantly used for cooking and heating by the general population, rather than for electricity generation. Biomass used by commercial companies for electricity generation currently has an installed capacity of almost 100MW (Table 11). This tends to be limited to sugar cane producers and saw mills, and is generally for self-consumption (though in some instances, excess power is fed back into the grid) (Practical Action, 2017). Biomass mini-grids are most likely to be viable near industrial sites producing biomass waste such as forestry and sugar. Surplus power could be used for nearby communities.

Table 10: Biomass power generation plants in Zimbabwe

Licensee	Plant	Fuel	Capacity
Tongaat Hullet (Pvt) Ltd	Triangle Sugar Mill	Bagasse	45 MW
Tongaat Hullet (Pvt) Ltd	Chiredzi Sugar Mill	Bagasse	33 MW
Green Fuel (Pvt) Ltd	Chisumbanje Ethanol Plant	Bagasse	18 MW
Border Timbers (Pvt) Ltd	Charter Sawmill	Wood waste	0.5 MW

Source: Practical Action, 2017

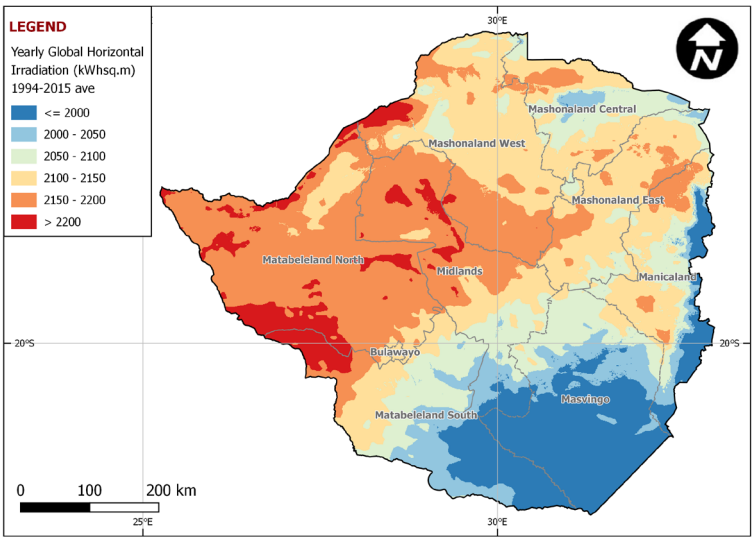
3.4.3 SOLAR

Zimbabwe is abundant in solar resources, with annual irradiation values ranging from 1,950 to 2,200 kWh/m^2. Radiation values are overall high across the whole country, with the north and west regions of the country having the highest potential for solar energy generation. Only a limited potion of this solar energy potential has been utilised. Solar energy has traditionally been used for applications for solar water heating for domestic and commercial purposes, refrigeration in rural clinics and hospitals and solar-water pumping to a limited degree. Solar home systems are becoming increasingly more common in rural and peri-urban areas, although the quality of the products available on the market has tended to be poor (Practical Action, 2017). As a result, installed solar power is mostly in rural areas, concentrated in social institutions such as schools and clinics (RECP, 2018).

Nyangani Renewable energy is the first IPP to commission a solar PV plant – Riverside Solar Power Station, with a capacity of 2.5MW in the Mutoko district in south-eastern Zimbabwe. This is the first of four phases. Once completed, the project will generate 10MW (African Energy, 2018). There are about 660MW solar power in the pipeline from IPPs who have not reached implementation stages yet.

In recent times, various solar PV systems ranging in size from 400kW to 1MW has been installed for self-consumption, especially in response to the extended power cut being experienced (Distributed Power Africa, 2019).

Figure 10: Annual Global Horizontal Irradiation in Zimbabwe (1994 - 2015 averages)



3.4.4 WIND

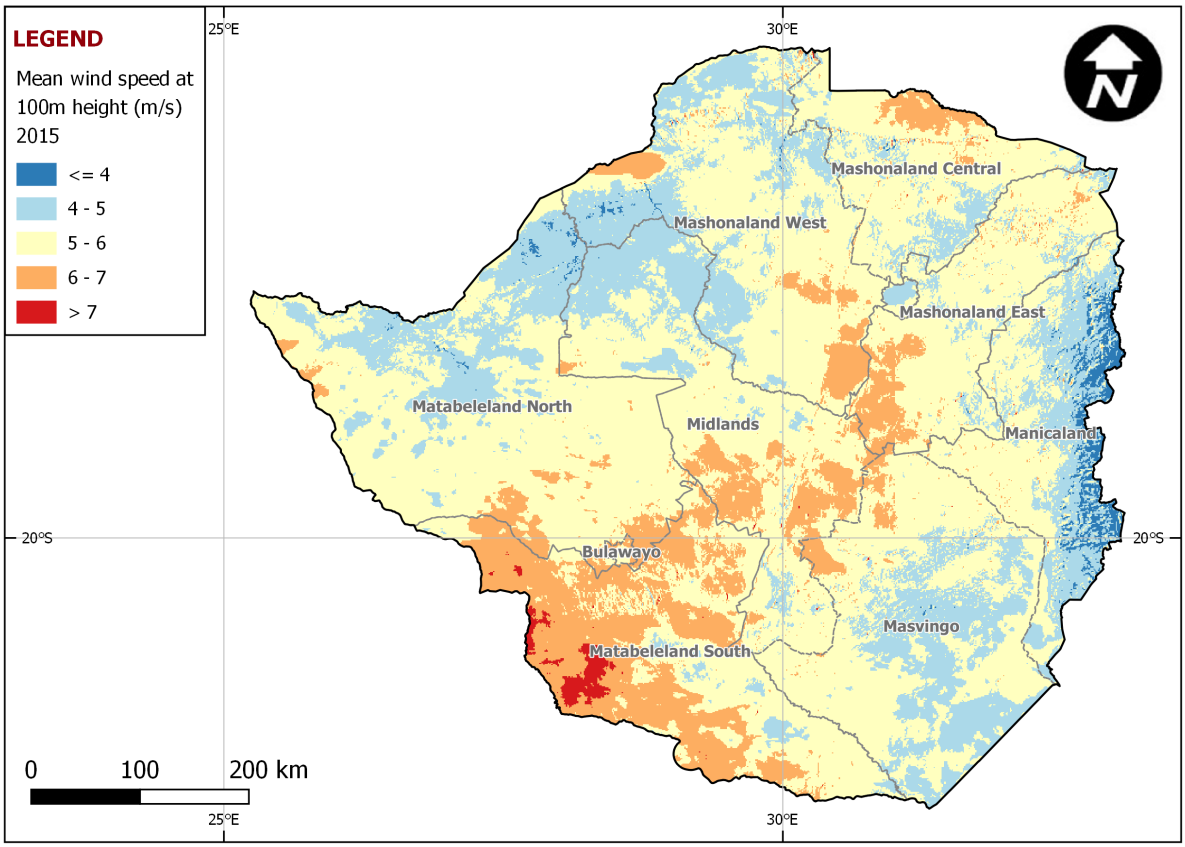
Average windspeeds are estimated at 3.5 m/s, with wind power potential the highest in the central Midlands, Bulawayo and Matabeleland South provinces, where windspeeds range from 4 to 6m/s (RECP, 2018). At 50 m, wind potential ranges from 10W/m^2 to 120W/m^2. (Hove & Madiya, 2013). Wind speeds ranging from 2-4m/s is suitable for water pumping and windspeeds of >5m/s may be suitable for electricity generation. Zimbabwe's average windspeeds are therefore slightly low for large-scale generation, however small-scale projects may still be viable in some sites, and is particularly suitable for water pumping (Hove & Madiya, 2013).

Besides wind-powered water pumping systems, there are no existing wind farms in Zimbabwe. A pilot project, which was implemented in 3 phases between 1990-2008, ran as part of the Power from Wind project and was implemented by the Zimbabwe Environmental Research Organisation (ZERO). This project resulted in the production of 1kW and 4 KW wind turbines by a local manufacturer: Power Vision, and the installation of wind turbines in the Temaruru and Dumbanwe areas. However, the project was ceased in 2008 due to vandalism of the turbines by local people and a lack of responsibility and ownership for the projects (Chikoto, et al., 2015).

A proposed feasibility study to determine the wind potential of three sites was put on hold by ZERA in early 2018, due to a lack of available funding. The purpose of the feasibility study was to create an accurate knowledge base of the wind resource potential to inform future renewable energy projects (The Herald, 2018).

ATC/Centragrid is exploring wind potential in Zimbabwe and plans to install wind masts by early 2020. They will concurrently run geotechnical investigations and expect to generate the first wind power in 2024.

Figure 11: Mean wind speeds in Zimbabwe at 100m height



4. DIRECTORY

4.1 ENERGY SECTOR POLICIES AND REGULATORY FRAMEWORKS DIRECTORY

Electricity Act (Chapter 13:19) of 2002 and Amendment Act

http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1808.pdf

https://www.zera.co.zw/images/legislation/electricity%20ammendment%20act.pdf

The Act established the Zimbabwe Electricity Regulatory Commission (ZERC) and details its functions and management. The ZERC was later dissolved following the establishment of ZERA in 2012, which took over the responsibilities of ZERC. The electricity act provides requirements for the licensing and regulation of the generation, transmission, distribution and supply of electricity.

National Energy Policy, 2012

http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1804.pdf

The National Energy Policy (NEP) seeks to promote the optimal supply and utilisation of energy, for socio-economic development in a safe, sustainable and environmentally friendly manner. The NEP brings out Government's objective to ensure that the energy sector's potential to drive economic growth and reduce poverty is fully harnessed through exploitation of these renewable energy resources. The NEP spells out an intention to create and promote a conducive environment for energy-sector players (including IPPs and public-private partnerships) to be able to identify and develop opportunities for energy supply that promote sustainable development.

Energy Regulatory Act (Chapter 13:23) of 2011

http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/laws/1806.pdf

The Energy Regulatory Act created ZERA (Zimbabwe Energy Regulatory Authority) to ensure that energy supply is reliable, adequate and sustainable, whilst the prices charged are fair, the environment is protected, and energy is supplied safely through effective regulation. ZERA initiatives also opened up the energy supply market to include IPPs and other private players.

Renewable Energy Policy

Not yet published at time of writing report

The Renewable Energy Policy aims to specify targets for Renewable Energy and Energy Efficiency as well as articulate an implementation strategy. It also seeks to specify deliverables and timeframes.

Electricity (Licensing) Regulations (SI 103 of 2008) and amendment (SI 55 of 2015)

https://www.zera.co.zw/images/images/SI%20103%20Electricity.pdf

https://www.zera.co.zw/images/SI_55_of_2015_Electricity_Licensing_Regulations_Amendment_opt.pdf

Provides the requirements and process to be followed to obtain a generation, transmission and distribution license.

Electricity Licensing Guidelines and Requirements 2017

https://www.powerutilityleadership.com/wp-content/uploads/2018/03/Zimbabwe_Electricity_Regulation.pdf

To provide a framework for the licensing of electricity undertaking intending to invest into the regulated activities of generation, transmission, distribution and supply of electricity in excess of 100kW.

Electricity distribution code (SI 147 of 2017)
https://www.zera.co.zw/images/Electricity%20Distribution%20Code%20Regulations.pdf
The distribution code establishes the basic rules, procedures, requirements and standards that govern the operation, maintenance and development of the electricity distribution system to ensure the safe, reliable and efficient operation of the distribution system in Zimbabwe.

Electricity grid code (SI 91 of 2017)
https://www.zera.co.zw/images/Electricity%20Grid%20Code%20Regulations.pdf
The grid code establishes the obligations of industry participants around the use of the national transmission system and operation of the interconnected power system. It provides the minimum technical requirements to be connected to the national transmission system to ensure the safe and efficient operation thereof.

Zimbabwe Mini-grid Framework, 2018
Not available online at the time of writing the report
Provides simple guidelines to enable uniform application of technical and financial requirements of mini-grids in the country.

ZERA tariff code
https://www.zera.co.zw/images/ZERA_Tariff_Code_Final.pdf
The purpose of the tariff code is to set out information requirements and the procedures for calculation of the appropriate tariff level in accordance with section 51 of the Electricity Act (13:19) of 2002. The tariff code shall apply to holders of licenses which are provided for in the Electricity Act from section 42 to 44 being generation license, transmission and bulk supply license and distribution and retail license.

4.2 INVESTMENT INCENTIVES DIRECTORY

Statutory Instrument 147 of 2010
Suspends importation duty on solar PV products and LED lighting.

4.3 DATA SOURCES DIRECTORY

This methodology was developed during the 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, the results of which are provided in Section 3, considers the potential for mini-grids by segmenting the countries into two areas: grid and off-grid areas. This split is based on the distance of 15km from the power network. The GIS sources used in this analysis are detailed below.

1. **Electricity transmission network (medium and high voltage)**
File Name: transmissiongridecowas2017.geojson
Source Age: 2017
File type: Geojson, line
Description: A shapefile of the electricity transmission network of Zimbabwe
Projected coordinate system: WGS_1984 (EPSG: 4326)
Source: World Bank dataset combined with OpenStreetMap data
Link: https://energydata.info/dataset/zimbabwe-electricity-transmission-network-2017

2. **Woldpop Population Density**

File Name: ZWE15adjv5.tif

Source Age: 2013

File type: Raster

Description: 2015 estimates of numbers of people per grid square, with national totals adjusted to match UN population division estimates (http://esa.un.org/wpp/).

Projected coordinate system: WGS_1984 (EPSG: 4326)
Data Source: World Pop data portal

Spatial Resolution: 100m

Link: http://www.worldpop.org.uk/data/data_sources/

3. **Administrative Layers (National and Region Boundaries; Main Cities)**
File Name: zwe_polbnda_adm1_250k_cso; zwe_settlements_250k_cso.shp
Source Age: 2011

File type: ESRI Shapefile, polygons and points

Description: Shapefiles of State and Local Government Area boundaries

Projected coordinate system: WGS_1984 (EPSG: 4326)
Source: Humanitarian Data Exchange
Link: https://data.humdata.org/dataset/zimbabwe-admin-level-1-boundaries and https://data.humdata.org/dataset/zimbabwe-settlements

4. **Wind**

File Name: gwa__gwa_ws_100m_mean.tif

Source Age: 2015

File type: Raster

Description: Mean wind speed at 100m height

Coordinate system: WGS_1984 (EPSG: 4326)
Source: DTU, IRENA
Link: https://irena.masdar.ac.ae/gallery/#gallery

5. **Solar**

File Name: GHI.tif

Source Age: 2015

File type: Raster

Description: Annual total Global Horizontal Irradiation (GHI) (kWh/sqm) averaged over 1994-2015

Coordinate system: WGS_1984 (EPSG: 4326)

Source: DTU, IRENA
Link: http://globalsolaratlas.info/downloads/zimbabwe

4.4 STAKEHOLDER DIRECTORY

GOVERNMENT AND AGENCIES

Ministry of Energy and Power Development

Email: energy@energy.gov.zw or power@energy.gov.zw

Telephone: +263 4 733095-9 or +263 4 799194

Link: www.energy.gov.zw

Brief description: The Zimbabwe Ministry of Energy and Power Development commissioned the Department of Conservation and Renewable Energy to develop and promote increased use of new and renewable sources of energy and ensure efficient production and utilisation of energy. The department is responsible for policy making and performance monitoring in renewable energy and energy efficient sectors.

Rural Electrification Agency (REA)

Email: rea@zesa.co.zw

Telephone: +2 63 470 8110 or +2 63 470 8119

Link: www.rea.co.zw

Brief description: The Rural Electrification Agency (REA) is a statutory body formed in 2002 in terms of the Rural Electrification Fund Board Act (13:20) to facilitate rapid and equitable electrification of the rural areas of Zimbabwe. REF was set up as an organization that is responsible for planning and implementing rural electrification projects through compact construction teams stationed at the eight provincial offices of the country with centralised logistical support planning, business development, accounting and administration at Head Office.

Zimbabwe Energy Regulatory Authority (ZERA)

Email: admin@zera.co.zw

Telephone: +263 4 780010 or +263 4 253416

Link: www.zera.co.zw

Brief description: The Zimbabwe Energy Regulatory Authority (ZERA) is a body corporate established in terms of the Energy Regulatory Authority Act [Chapter 13:23] of 2011. It is mandated to regulate the entire energy sector in Zimbabwe in a fair, transparent, efficient and cost-effective manner for the benefit of the consumers and energy suppliers. ZERA derives its mandate from the Energy Regulatory Authority Act [Chapter 13:23] of 2011 read together with the Electricity Act no 4 of 2002 [Chapter 13:19], the Petroleum Act [Chapter 13:22] of 2006 and subsequent amendments

Zimbabwe Transmission and Distribution Company (ZETDC)

Email: pr@zedc.co.zw

Telephone: +263 774508-35 or +263-773300-30

Link: https://zetdc.co.zw/

Brief description: The Zimbabwe Electricity Distribution Company's (ZETDC) business is the distribution and retail of electricity to the end user and performing gird impact assessments.

Zimbabwe Power Company (ZPC)

Email: pr@zpc.co.zw

Telephone: + 263 4 250407-9

Link: www.zpc.cp.zw

Brief description: Zimbabwe Power Company (ZPC) became operational in 1999. The organisation has been authorised to construct, own, operate and maintain power generation stations for the supply of electricity.

Zimbabwe Investment Authority (ZIA)

Email: info@zia.co.zw

Telephone: +263 4 757931/6

Link: www.invetzim.com

Brief description: The Zimbabwe Investment Authority (ZIA) is the country's investment promotion body set up to promote and facilitate both foreign direct investment and local investment. ZIA is an institution born out of the merger of the Export Processing Zones Authority (EPZA) and the Zimbabwe Investment Centre (ZIC).

MINI-GRID PRACTITIONERS AND PRODUCT DEVELOPERS

Hivos

Contact: **Email**: sa-hub@hivos.org
Telephone: + 263 (2)4 2250463 or +263 (2)4 2706125

Link: https://southern-africa.hivos.org/

Brief description: Hivos is a development aid organisation, headquartered in the Netherlands. Hivos and its partner organisations campaign at national and international level to reduce climate change and alleviate poverty by opting for 100% renewable energy.

SNV

Contact: **Email**: zimbabwe@snv.org
Telephone: +263 4 707750/56/65/69

Link: www.snv.org

Brief description: SNV is a non-profit organisation, headquartered in the Netherlands, that specialise Agriculture, Energy and Sanitation & Hygiene. They promote energy access through supporting site selection, design, construction, management and operation of different min-grids across Africa, including Zimbabwe. SNV has developed 5 mini-grids in Zimbabwe.

Practical Action

Contact: **Email**: info@practicalaction.org.zw
Telephone: +263 4 776 107 or +263 4 776 631

Link: www.practicalaction.org/southern-africa

Brief description: Practical Action is a development charity that is headquartered in the UK, with a mandate to increase people's access to renewable energy through off-grid electricity supply. Zimbabwe is one of Practical Action's focus countries. They implemented the ACP-EU Energy Facility funded programme, together with the development of other mini-grids in Zimbabwe.

OneSun Solar (Pvt) Limited

Brief description: OneSun Solar is a JV between the Meeco Group and C&J Group, who aims to bring new clean energy services for Zimbabwe by combining the two founding companies' expertise. Previously, Meeco was already engaged in Zimbabwe since late 2013 and has installed clean energy projects country-wide to promote sustainable development. The new joint venture will open new opportunities and builds on the wealth of experience the two companies have and further speed up the adoption of new clean energy services in the region.

BILATERAL AND MULTILATERAL DONOR ORGANISATIONS

European Union

Contact: **Email**: Delegation-Zimbabwe-hod@eeas.europa.eu
Telephone: +263 4 338158-164 or +263 772 568 980

Link: https://eeas.europa.eu/delegations/zimbabwe/1866/about-eu-delegation-zimbabwe_en

Brief description: The Delegation represents the European Union in all matters, informing on all activities of the Union and keeping its headquarters in Brussels abreast of significant local developments. It works closely with the EU Member States in Zimbabwe, and in particular, the country representing the EU Presidency. It also co-operates and co-ordinates activities with representatives of non-EU Member States and multilateral organisations. One of the Delegation's main activities is to ensure the effective implementation of EU development assistance to Zimbabwe. Most programmes are financed under the European Development Fund (EDF), the main instrument for providing EU assistance to countries in Africa, Caribbean and Pacific (ACP), under the Cotonou Agreement.

UNDP

Contact: **Email**: registry.zw@undp.org
Telephone: +263 4 338 836-44

Link: http://www.zw.undp.org/

Brief description: UNDP has supported the Government in developing a costed action plan on mitigation and adaptation through the national climate change response strategy. Evidence from the assessment of development results shows that UNDP has a track record for this work, and donors and government are interested in seeing UNDP continue to lead in climate change work. UNDP will support the Government in implementing the Sustainable Energy for All initiative (known as 'SE4All') and the renewable energy policy.

SIDA

Contact: **Email**: sida@sida.se
Telephone: +46 (0)8 – 698 50 00

Link: https://www.sida.se/English/where-we-work/Africa/Zimbabwe/

Brief description: Sida is a government agency working on behalf of the Swedish parliament and government, with the mission to reduce poverty in the world. Through our work and in cooperation with others, we contribute to implementing Sweden's Policy for Global Development (PGU). In 2001, it has not been possible for Sida to provide funds to the Zimbabwean government, and therefore channels funds through civil society organisations or multilaterals such as the UN and WorldBank.

OTHER RELEVANT ORGANISATIONS AND INITIATIVES

ZB Bank

Contact: **Email:** info@zb.co.zw
Telephone: +263 8677002001 or +263 4 304044/45/46/49

Link: www.zb.co.zw

Brief description: ZB financial holding is a commercial bank in Zimbabwe which has an investment banking department and are fully supportive of renewable energy deployment in Zimbabwe. ZB Bank has implemented renewable energy project in Zimbabwe of there own.

Renewable Energy Association of Zimbabwe (REAZ)

Contact: **Telephone**: +263 4 764112

Link: www.reaz.co.zw

Brief description: REAZ is an independent, non- governmental and non-profit making organisation. The mandate of REAZ is to facilitate the sustainable development and uptake of Renewable Energy Technologies in Zimbabwe to the benefit of its members, stakeholders and consumers.

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APPENDIX A

Generation, Transmission and Distribution license requirements

General documentation and information required to be submitted with your licence application, regardless of the type of licence:

a) ZERA Application Form
b) Business Plan
c) Certificate of Incorporation/Articles of Association
d) Company registration documents – CR2, CR14
e) Particulars of Shareholders and Directors of the company
f) Board Profile and Shareholding Structure/Shareholders Agreement
g) Proof of Financial capability (Equity, Debt Financing/loan/grant/etc)
h) Audited Financial Statements for past 3 years (if any)
i) Investment Authority license
j) Tax Clearance Certificate
k) Technical capacity to carry out the project

Generation license requirements:
a) Generation Capacity
b) Buyer/Off-taker arrangements
c) Electricity Generation Cost
d) Grid Impact Assessment
e) Fuel Supply Arrangement(s)/Agreement(s)
f) Proposed Power Purchase Agreement
g) Proposed interconnection point to the transmission system
h) Prefeasibility/Feasibility Study report
i) Maps indicating the location of the generating plant
j) Land Use Permit
k) Water Extraction Perm
l) Environmental Impact Assessment prospectus/Certificate
m) Project Time Line /Gantt Chart/Implementation

Transmission Licence Requirements

a) Map indicating route of the transmission lines;

b) Information relating to the transmission system:

i. Line specifications– capacity, voltage, length, conductor type, configuration, etc.
ii. Points of supply
iii. Contractual arrangements (where applicant intends to operate transmission facilities not owned by the Applicant)
iv. Single line Diagram
v. Methodology for fees and tariffs for Distribution use and Connection charges.
vi. Guidelines on non-discriminatory open access by third parties to transmission facilities (in case of primary licensee)
vii. Environmental impact assessment prospectus/Certificate

Distribution Licence Requirements

a) Map indicating location of the distribution lines;

b) Information relating to the distribution system:

i. Line specifications – (Capacity, voltage, length, conductor type, configuration, etc.
ii. Points of supply
iii. Contractual arrangements – O & M
iv. Metering arrangements, billing arrangements
v. Connection charges/agreements
vi. Client services standards
vii. Applicable tariffs
viii. Single line Diagram
ix. Transformers and transformer sizes
x. Proposed agreements for distribution network connections and use of system
xi. Environmental Social Impact Assessment and Environmental Management Agency approval
xii. Number and types of customers per voltage level.

Retail/Supply Licence Requirements

a) Maps indicating the proposed area for supply of electricity
b) Proposed tariff model
c) Power purchase agreements
d) Commercial agreements (Supply/customer side)
e) Metering and billing systems
f) Proposed customer categories for the supply of electricity; and
g) Transmission/Network access agreements

Green Mini-Grids
Market Development Programme
Document Series

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