



Zambia: Solar PV and Hydro Mini-Grids

Developer Guide

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A NOTE TO THE READER

This Developer Guide is meant to be a 'reference document' to inform early market exploration. It is a relatively long document which summarises a wealth of details. It should best be read to obtain specific facts or information. The Guide is supplemented with Case Studies and Model Business Cases accessible at www.get-invest.eu.

ABOUT GET.INVEST MARKET INSIGHTS

The first series of GET.invest Market Insights are published in early 2019 covering four renewable energy market segments in three countries, namely: renewable energy applications in the agricultural value-chain (Senegal), captive power (behind the meter) generation (Uganda), mini-grids (Zambia) and stand-alone solar systems (Zambia).

Each Market Insight package includes **a)** a 'how to' Developer Guide, **b)** Model Business Cases and **c)** Case Studies. The Developer Guide enables the reader to navigate the market and its actors, to understand the current regulatory framework and lays down the step-by-step process of starting a new project/business. The Model Business Case analyses project economics and presents hypothetical, yet realistic, investment scenarios. It hence indicates the criteria for a viable project/business to enable the reader to identify the most cost-effective project/business opportunities. The Case Study analyses the viability of operational or high-potential projects/businesses to highlight lessons learnt and industry trends.

GET.invest Market Insights therefore summarise a considerable amount of data that may inform early market exploration and pre-feasibility studies. It is recommended to cross-read all three products to gain a comprehensive overview. The products are accessible at www.get-invest.eu.

ABOUT GET.INVEST

GET.invest is a European programme which supports investment in decentralised renewable energy projects. The programme targets private sector business and project developers, financiers and regulators to build sustainable energy markets.

Services include project and business development support, information and matchmaking, and assistance in implementing regulatory processes. They are delivered globally and across different market segments.

GET.invest is supported by the European Union, Germany, Sweden, the Netherlands, and Austria, and works closely with initiatives and industry associations in the energy sector.

FOREWORD

For meeting the challenges but also realising the opportunities of Sustainable Development Goals and climate change, a transformation of energy systems is paramount. As a key element, private sector needs to be mobilised, and scarce public resources need to be channelled into enabling and leveraging private sector investment. Through innovation, further reducing costs, a focus on low-carbon and resource-efficient solutions, the private sector will have a major role to play in the transformation towards an inclusive green economy and energy access for all.

One of the key barriers remains the access to capital, and how more projects and business ventures can successfully tap into the many existing financing options. Tackling this challenge has been the focus of the efforts of the European Union and its Member States.

In this context, the EU, Germany, the Netherlands, Sweden, and Austria jointly contribute to GET.invest, in a collaborative European effort to accelerate private investment in decentralised renewable energy projects.

Information about market opportunities as well as the country- and market-segment-specific “how to do business” is an important complementary tool to more tangible support provided by GET.invest to project and business development to access financing. We therefore expect that the Market Insights publication series will be useful to both national as well as international stakeholders in developing sustainable markets for decentralised renewable energy projects.

The Sustainable Development Goals show us what challenges still lie ahead. They also show us, however, that the current moment can be an opportunity. With everyone’s commitment, bringing both public and private actors to the table, we can make a difference towards the transformation to an inclusive green economy.

**Signed collectively,
the supporters of GET.invest**



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ABBREVIATIONS

AEEP	Africa-EU Energy Partnership	GDP	Gross Domestic Product
AECF	Africa Enterprise Challenge Fund	GEF	Global Environment Facility
AfDB	African Development Bank	GIS	Geographic Information System
AC	Alternating Current	GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
ARPU	Average Revenue Per User	GNI	Gross National Income
ASYCUDA	Automated System for Customs Data and Management	GOGLA	Global Off-Grid Lighting Association
ATP	Ability to Pay	GWh	Gigawatt hour
CEEEZ	Centre for Energy, Environment, and Engineering	HEP	Hydro Electric Power (Limited)
CoC	Certificate of Conformity	IAAZ	Impact Assessment Association of Zambia
COMESA	Common Market for Eastern and Southern Africa	IAEREP	Increase Access to Electricity and Renewable Energy Production
CIF	Cost, Insurance and Freight	ICT	Information and Communications Technology
CPI	Consumer Price Index	IDC	Industrial Development Corporation
DBZ	Development Bank of Zambia	IEA	International Energy Agency
DC	Direct Current	IEC	International Electrotechnical Commission
DFID	Department for International Development	IFC	International Finance Corporation
DFS	Digital Financial Services	IMF	International Monetary Fund
EASP	Electricity Services Access Project	IPPs	Independent Power Producers
EEP S&EA	Energy and Environment Partnership Southern and Eastern Africa	JICA	Japan International Cooperation Agency
EERG	Energy and Environmental Research Group	kV	Kilovolt
ERB	Energy Regulation Board	kWh	Kilowatt hour
ESCO	Energy Services Company	LCMS	Living Conditions Monitoring Survey
EU	European Union	MoU	Memorandum of Understanding
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility	MW	Megawatt
EUR	Euro	MWh	Megawatt hour
FDI	Foreign Direct Investment	NAPSA	National Pension Scheme Authority
FEWS	Famine Early Warning Systems	NES	National Electrification Strategy
FiT	Feed-in Tariff	NHCC	National Heritage Conservation Commission

OPEC	Organization of the Petroleum Exporting Countries	W	Watt
OPPI	Office for Promoting Private Power Investment	WHO	World Health Organization
PACRA	Patents and Companies Registration Agency	Wp	Watt-peak
PAYG/ PAYGO	Pay-As-You-Go	WTP	Willingness to Pay
PAYE	Pay as You Earn	ZABS	Zambia Bureau of Standards
PPA	Power Purchase Agreement	ZAMSIF	Zambia Social Investment Fund
PV	Photovoltaic	ZANACO	Zambia National Commercial Bank
PVOC	Pre-export Verification of Conformity	ZARENA	Zambian Renewable Energy Agency
RE	Renewable Energy	ZDA	Zambia Development Agency
REA	Rural Electrification Authority	ZEMA	Zambia Environmental Management Agency
REF	Rural Electrification Fund	ZMW	Zambian Kwacha
REFIT	Renewable Energy Feed-in Tariff	ZPC	Zengamina Power Company
REMP	Rural Electrification Master Plan	ZPPA	Zambia Public Procurement Authority
RGC	Rural Growth Centre	ZRA	Zambia Revenue Authority
SADC	Southern African Development Community		
SAPP	Southern African Power Pool		
SHS	Solar Home System		
Sida	Swedish International Development Cooperation Agency		
SNV	Netherlands Development Organization		
UHF	Ultra High Frequency		
UK	United Kingdom		
UNCTAD	United Nations Commission on Trade and Development		
UNHCR	United Nations High Commissioner for Refugees		
UNZA	University of Zambia		
USAID	United States Agency for International Development		
USD	United States Dollar		
VAT	Value Added Tax		
VHF	Very High Frequency		

EXECUTIVE SUMMARY

This Developer Guide describes the opportunity for, and steps to implement, renewable energy mini-grids in Zambia, with a focus on the private sector. The Guide is for potential international and national micro- and mini-grid developers and investors interested in the generation, distribution and supply of electricity in unserved or underserved areas of Zambia with projects in the range of 5 kW to 10 MW. Solar PV and hydropower options are considered.

The Guide is part of a package of products under the first series of the Market Insights of GET.invest. Each package covers a certain renewable energy market segment and includes **a)** a 'how to' Developer Guide, **b)** Model Business Cases and **c)** Case Studies – all accessible online at www.get-invest.eu

Mini-grids involve small-scale electricity generation, which serve a limited number of consumers via a distribution grid that can operate in isolation from national electricity transmission networks and supply relatively concentrated settlements with electricity at grid quality level. The Guide focuses on autonomous, isolated mini-grid implementation in a nascent market. While the possibility of grid interconnection is considered, what would happen to a mini-grid at that time is not covered in the Guide due to uncertainties and a lack of precedent.

Information and data used in the preparation of the Guide was gathered from a number of sources: project site visits, in-country interviews with more than 20 key stakeholders and a careful review of available reports and legislation.

The key takeaways are as follows:

somewhere between 500 and 2,000 sites.¹ An off-grid market assessment in 2018 and a new geo-spatial National Electrification Strategy that will be ready in 2019 will help identify and assess the actual number of potential mini-grid sites. Solar PV (battery/diesel hybrid) is the likely technology for many mini-grids, while there may be 5–15 sites suitable for electrification with hydropower.

- While a large market opportunity at first glance, private mini-grid deployment in Zambia may be limited by low population densities in rural areas, lower-than-expected-demand, a subsidised national grid tariff and an underdeveloped mobile money ecosystem. In addition, given the early stage of the market, there are a number of regulatory uncertainties and procedural gaps including lack of accessible information on available sites and grid extension planning and some tariff setting requirements. Even so, Zambia does have existing private mini-grid projects and developers are already establishing themselves in the country.
- There are currently: **a)** two public diesel mini-grids, **b)** at least four operational small hydro mini-grids (one private, one public, two not-for-profit) and one public small hydro mini-grid under construction and **c)** five operational solar PV mini-grids (four private, one public but run by a cooperative) and two public solar PV mini-grids under construction. The two diesel mini-grids are 1,000 kW and 2,600 kW, the hydro mini-grids range from 17 kW to 1,000 kW and the solar mini-grids from 10 kW to 300 kW. The first hydro mini-grid was installed before 2008 and the first solar PV mini-grid in 2013.

MARKET OVERVIEW

- With a national electrification rate of 33.1% and more than 2 million off-grid households, there is a potential role for renewable energy mini-grids to help deliver energy access. Based on preliminary rough estimates by the World Bank and other assumptions, up to 216,000 household and business customers may be best served by mini-grids across

1) 500 sites if a typical larger site of 440 customer connections is assumed as per the 2008 Rural Electrification Master Plan and rural electrification planning information up to 2012. 2,000 sites if an average of 110 connections is assumed, as per information provided by the Rural Electrification Authority in 2018, based on experience from 2013 to 2017. Note that the potential number of sites is a very rough estimate to provide indicative information - it is not based on actual data

- Prospective mini-grid developers are able to identify sites and initiate projects on an unsolicited basis. At the time of writing there was no competitive procurement process in place for mini-grids in Zambia. In the near future, the government intends to tender out the operation of three of the public mini-grids to the private sector – two solar PV and one small hydro. As part of the new National Electrification Strategy, public and private sector roles and responsibilities may be clarified, which could include establishing procedures for site allocation to private developers under a procurement programme. Incoming developers and investors should be prepared to adapt business models to accommodate such market changes. The competitive landscape is also rapidly evolving as there were at least five new mini-grid market entrants in 2017 and 2018.

ELECTRICITY TARIFFS

- The national grid retail energy tariffs range from Zambian Kwacha (ZMW) 0.15/kWh to 0.89/kWh (EUR 0.013/kWh to 0.075/kWh) for residential customers and from ZMW 0.49/kWh to 0.54/kWh (EUR 0.041/kWh to 0.045/kWh) for public institutions and small businesses. Monthly fixed charges are ZMW 18.23 (EUR 1.53), ZMW 83.84 (EUR 7.04) and ZMW 96.41 (EUR 8.09), respectively. These prices are exclusive of 3% excise duty and 16% Value Added Tax. Zambia does not have a national uniform tariff – private mini-grids may charge different tariffs subject to regulatory approval. For example:²

- a) A 750 kW private hydro mini-grid in 2017 charged a connection fee of between EUR 76 and EUR 109 (ZMW 900 and ZMW 1,300), a fixed tariff of EUR 5.89 (ZMW 70) per month up to 1.5 amps and a stepped tariff of EUR 7.57 (90) per month for the first 150 kWh plus ZMW 0.71–1.31/kWh (EUR 0.06–11/kWh) above that for other users.

- b) A 30 kW private solar PV mini-grid commissioned in 2017 has an approved connection fee of ZMW 100 (EUR 8.40). Some customers may be on time based tariffs ranging from ZMW 5 to 8 (EUR 0.42–0.67) per day while others may be billed a lower fixed monthly amount.
- c) A 60 kW public solar PV mini-grid commissioned in 2013 has an approved monthly charge of ZMW 40 (EUR 3.36).
- d) Two new public solar PV mini-grids (200 kW and 300 kW) under construction have proposed tariffs of ZMW 21/kWh (EUR 1.98/kWh) and ZMW 18/kWh (EUR 1.51/kWh), respectively.

These tariffs compare with an estimated willingness to pay of between ZMW 70–125 (EUR 5.89–10.60) per month for households in rural/off-grid areas and ZMW 200–460 (EUR 16.83–38.45) per month for institutions and businesses. Based on older data from 2009 from electrified rural – but potential high growth – centres, actual monthly expenditure on electricity was ZMW 52.29 (EUR 4.39) for households and ZMW 201.60 (EUR 16.93) for businesses.³ For connection charges, one report estimates that rural customers will be able and willing to pay ZMW 250 (EUR 21) for households and ZMW 768 (EUR 64) for small businesses. Updated data on ability and willingness to pay for energy services by households and businesses in rural areas is being gathered in 2018.

- Mini-grid retail tariffs must be approved by the Energy Regulation Board (ERB), which uses the revenue requirement or rate of return methodology. In principle, cost-reflective tariffs may be proposed by developers. However, the current tariff guidelines present some grey areas. Most important of these is that there is a benchmark rate of 6% return on assets and it is not clear if this is fixed or may be negotiated by private developers. In addition, any subsidised assets cannot be included in the rate of return calculation. Apart from the tariff, ERB also approves customer connection charges.

2) Note: All projects received capital grants or subsidies and the tariffs are not necessarily indicative of cost-reflectiveness for commercial viability. Tariff levels for the 750 kW hydro mini-grid and 30 kW solar mini-grid are uncertain – various figures were obtained from different sources

3) Note: 2009 figures are based on the then even lower subsidized national tariff and have not been adjusted for inflation

MINI-GRID LICENSING

- All mini-grid developers in Zambia that intend to supply electricity to third parties (i.e. customers) must apply for an electricity license. There are no mini-grid specific regulations and the standard licensing process is followed — while it is relatively straightforward there are a number of steps and requirements that may be burdensome for smaller developers. However, ERB does apply a “light handed” approach to some procedures for mini-grids. For example, a mini-grid is issued with one combined generation, distribution and supply licence rather than three separate licences. In addition, the retail tariff determination process is shortened for mini-grids as compared to the national utility — rather than advertising publicly and consulting widely on proposed tariffs, a developer only needs to show that it has adequately consulted in the community targeted for a mini-grid.

One major risk in the process is that the mini-grid licence is only granted after project construction. Although a preliminary approval (including the indicative tariff) can be provided by ERB early on in the licensing process in the form of an “investment endorsement”, the terms of approval could be modified when the licence is issued, i.e., after construction. Furthermore, due to procedural constraints a provisional licence is usually granted before the standard licence is finally issued. The official timeline for license issuance is 60 days from receipt of application but it could take longer to obtain especially if information provided to ERB is incomplete or insufficient. There is a processing fee for each license of 0.1% of the planned investment cost and, once a license has been issued, a fee of 0.7% of the monthly gross turnover of the licensed business.

One pre-requisite for an electricity licence is environmental approval of the project by the Zambia Environmental Management Agency (ZEMA). Whether a full environmental impact assessment (Environmental Impact Statement) or a simplified assessment (Environmental Project Brief) is required is determined on a case-by-case basis by ZEMA. A new environmental law may be adopted in 2018–2019, which would provide more clarity on requirements for developers.

RISKS FOR DEVELOPERS

- The top risks that a mini-grid developer entering the Zambian market is likely to face are:
 - a) Identification of a sufficient number of viable sites for a portfolio that enables economies of scale, which may be mitigated with local market knowledge and by working with government agencies and other partners.
 - b) Securing a tariff that allows for an adequate return on investment and is within the customer ability to pay. A focus on commercial customers could help but viability gap financing may still be necessary in the initial years.
 - c) Other risks emerge in the medium term, such as the extension of the national grid and for developers with assets bought with and financing in hard currency, exchange rate fluctuations.
- While such risks are similar to those found in other countries, it should be noted that the Zambian government has indicated both its commitment to increasing electrification via off-grid options and its interest in private sector participation. As specific examples, ERB appears to not have the intention of overregulating the mini-grid sector and the National Electrification Strategy and associated efforts should not only provide site level data but also provide guidelines for national grid extension.

FINANCING AND SUPPORT

- Different financing options exist or are being put into place in Zambia for mini-grids to help ensure viability. These include a) the EU-funded Increase Access to Electricity and Renewable Energy Production (IAEREP) that will support demonstration projects and feasibility studies, b) Electrifi, which is a EU-based facility with a range of financing instruments and c) the World Bank Electricity Services Access Project (ESAP), which will pilot a partial subsidy programme for and offer local currency loans to private sector mini-grids. In addition, there are fiscal incentives in Zambia such as zero VAT on solar equipment imports, zero customs duty on hydropower and solar imports and income tax holidays for the first 3–5 years of operations for small enterprises.

- Encouragingly, the enabling environment may soon be strengthened thanks to different support mechanisms. For example, the EU is funding technical assistance⁴ to adjust policies and the legal and regulatory framework for energy access and provide capacity building for government agencies, including a review of tariff setting for mini-grids and of environmental processes and requirements. A World Bank programme⁵ is planning to support activities to clarify and document requirements and procedures for licences and permits. At the same time, the IFC is working with the government on an off-grid Public Private Partnership project that may lead to a procurement programme for mini-grids. Specific activities are **a)** an off-grid market assessment with geospatial and site-specific data including on ability and willingness to pay, **b)** a review of the legal and regulatory framework for smaller-scale solar PV systems (below 100 kW), **c)** harmonisation of mini-grid standards and **d)** the establishment of an off-grid information portal.

4) Link: https://eeas.europa.eu/sites/eeas/files/factsheet_2018_finalpdf_2.pdf – accessed February 2019

5) Link: <http://projects.worldbank.org/P162760/?lang=en&tab=documents&subTab=projectDocuments> – accessed February 2019

SECTION 1

Introduction



In Zambia, where electricity access was recorded at 33.1% in 2016 and population densities are among the lowest on the continent, decentralised off-grid electricity supply projects can complement on-going electrification efforts to reduce the country's energy access deficit.

This Developer Guide describes the opportunity for, and steps to implement, renewable energy mini-grids in Zambia, with a focus on the private sector. The Guide is for potential international and national micro- and mini-grid developers and investors interested in the generation, distribution and supply of electricity in un-served (i.e. off-grid) or underserved (i.e. grid proximate but unconnected) areas of Zambia with projects in the 5 kW to 10 MW range. Solar PV and hydropower options are considered.

The Developer Guide is meant to provide a consolidated resource of key information for early stage market exploration. The Guide is not intended to substitute for on-the-ground market research activities. Indicative information is provided based on document reviews and interviews undertaken with more than 20 stakeholders in Zambia in late 2017 and early 2018. Due to the absence of some data, the nascent status of the market and the sector's pace of development, readers are encouraged to review the material referenced, consult with relevant authorities and seek insights from their business network to obtain further details and confirm the latest market information in Zambia.

The Guide is organized across six different sections. Besides the Introduction, **Section 2** provides a country background and **Section 3** describes the electricity sector. **Section 4** provides

an overview of the market potential and describes mini-grid implementation models. A discussion on “how to” develop a private mini-grid (or a portfolio of projects) and key regulatory requirements follows in **Section 5**. **Section 6** concludes with information on some financing options in Zambia. Six annexes provide additional information, including a list of relevant Zambian government institutions and contact details that is found in **Annex A**.

The Developer Guide is part of a package of products under the first series of the Market Insights of GET.invest. Each package covers a certain renewable energy market segment and includes **a)** a 'how to' Developer Guide, **b)** Model Business Cases and **c)** Case Studies. It is recommended to cross-read all three products to gain a comprehensive overview. The products are accessible online at www.get-invest.eu.

Exchange rates used in this Guide are from mid-May 2018:

ZMW – USD	0.10005
ZMW – EUR	0.08396
EUR – USD	1.18850

Note: On 1 January 2013 the old Zambian Kwacha (ZMK) was rebased to the ZMW (1000 ZMK = 1 ZMW)

SECTION 2

Country Profile



The Republic of Zambia is landlocked in southern Africa, east of Angola, south of the Democratic Republic of the Congo, west of Tanzania and Malawi and north of Zimbabwe, Mozambique, Namibia and Botswana (Figure 1). Zambia gained independence from the United Kingdom in 1964.

FIGURE 1. Political map of Zambia⁶



6) United Nations (2004) Map of Zambia, UN Department of Peacekeeping Operations, Cartographic Department.
Link: <http://www.un.org/Depts/Cartographic/map/profile/zambia.pdf> – February 2019

2.1 GEOGRAPHY, TOPOGRAPHY AND CLIMATE

Zambia has a surface area of 752,618 km² with a perimeter of 6,043.15 km. The Zambezi River, the fourth longest river in Africa, forms a natural riverine boundary with Zimbabwe while Lake Kariba on the Zambia-Zimbabwe border forms the largest reservoir by volume in the world. Most of the landmass in the country consists of a wide and high plateau lying 910–1,370 meters above sea level. Elevations below 600 meters are encountered in the valleys of the major river systems. In the northeast, the Muchinga Mountains exceed 1,800 meters. Plateaus in the north eastern and eastern regions of the country are interrupted by the low-lying Luangwa River, and in the western half by the Kafue River.

Although Zambia lies in the tropics, it enjoys a pleasant climate due to its average altitude of 1,200 meters. As indicated in **Figure 2**, the country experiences three seasons: **a)** cool and dry from May to August, **b)** hot and dry from September to November and **c)** warm and wet from December to April. The valleys of the Zambezi and Luangwa exhibit the highest temperatures.

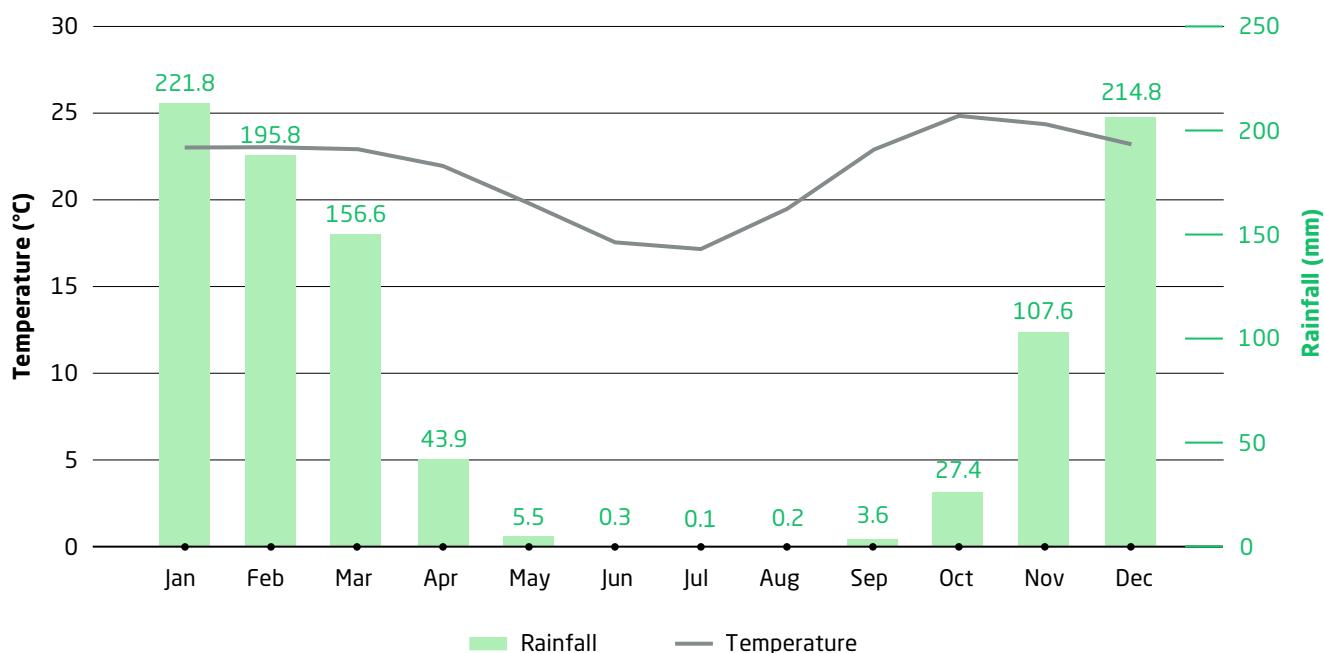
2.2 DEMOGRAPHICS

Zambia is home to over 18 different ethnic groups and over 70 languages and dialects, many of which are members of the Bantu family. English is the official language.

Zambia's population is estimated to be between 15.5 million and 16.2 million people and has been growing at approximately 3% per year since 2010. It is projected that the total population will reach 27 million by 2035. Over half of the country's inhabitants are less than 19 years old and 42% of the Zambian population currently lives in urban areas. The capital Lusaka is the most populated city, with more than 1.7 million residents, and is followed by Kitwe (500,000), Ndola (450,000) and Kabwe (200,000).

Compared to countries in East Africa, Zambia has significantly lower population densities. In 2015, the average population density was 22 people per km² against an average of 80/km² in Kenya, 60/km² in Tanzania, 207/km² in Uganda and 483/km² in Rwanda. However, Zambia's population density is similar to some of its neighbours in southern Africa — i.e. Mozambique,

FIGURE 2. Average monthly temperature and rainfall for Zambia 1901-2015⁷⁾



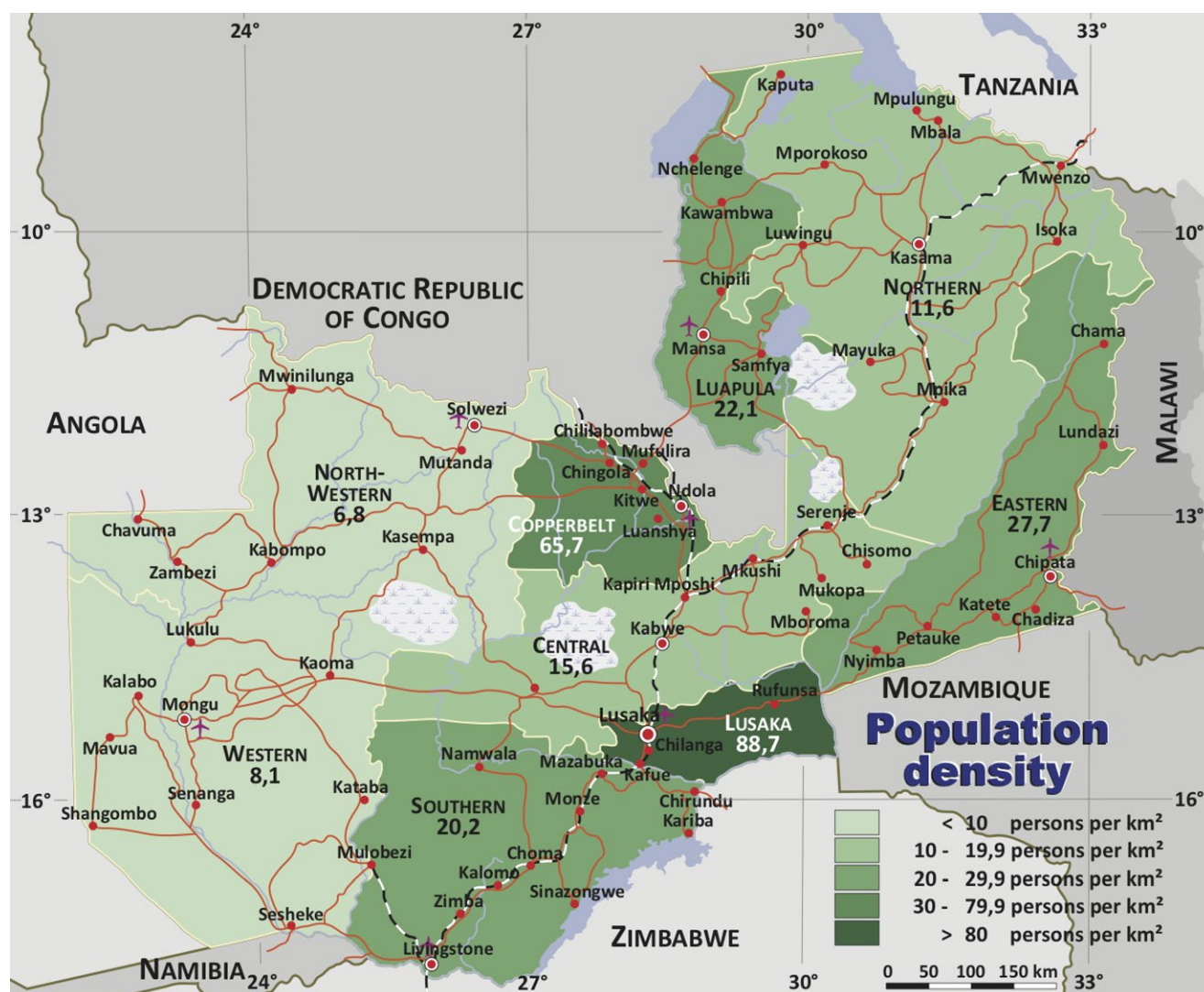
7) Derived from World Bank (2016) Average monthly temperature and rainfall for Zambia 1901–2015. Climate Change Knowledge Portal, World Bank website: Link: <https://tinyurl.com/y9pybjek> – accessed February 2019

Angola, Namibia and Zimbabwe. According to the 2010 Census of Population and Housing, population densities reach a high of 100 people per km² in Lusaka province, and a low of 5.6 people per km² in North-Western Province. **Figure 3** shows the estimated population distribution by province in Zambia in 2012.

Extreme poverty continues to be a predominantly rural rather than urban occurrence. **Figure 4** illustrates a time series depicting percentages of the population living below the poverty line, per

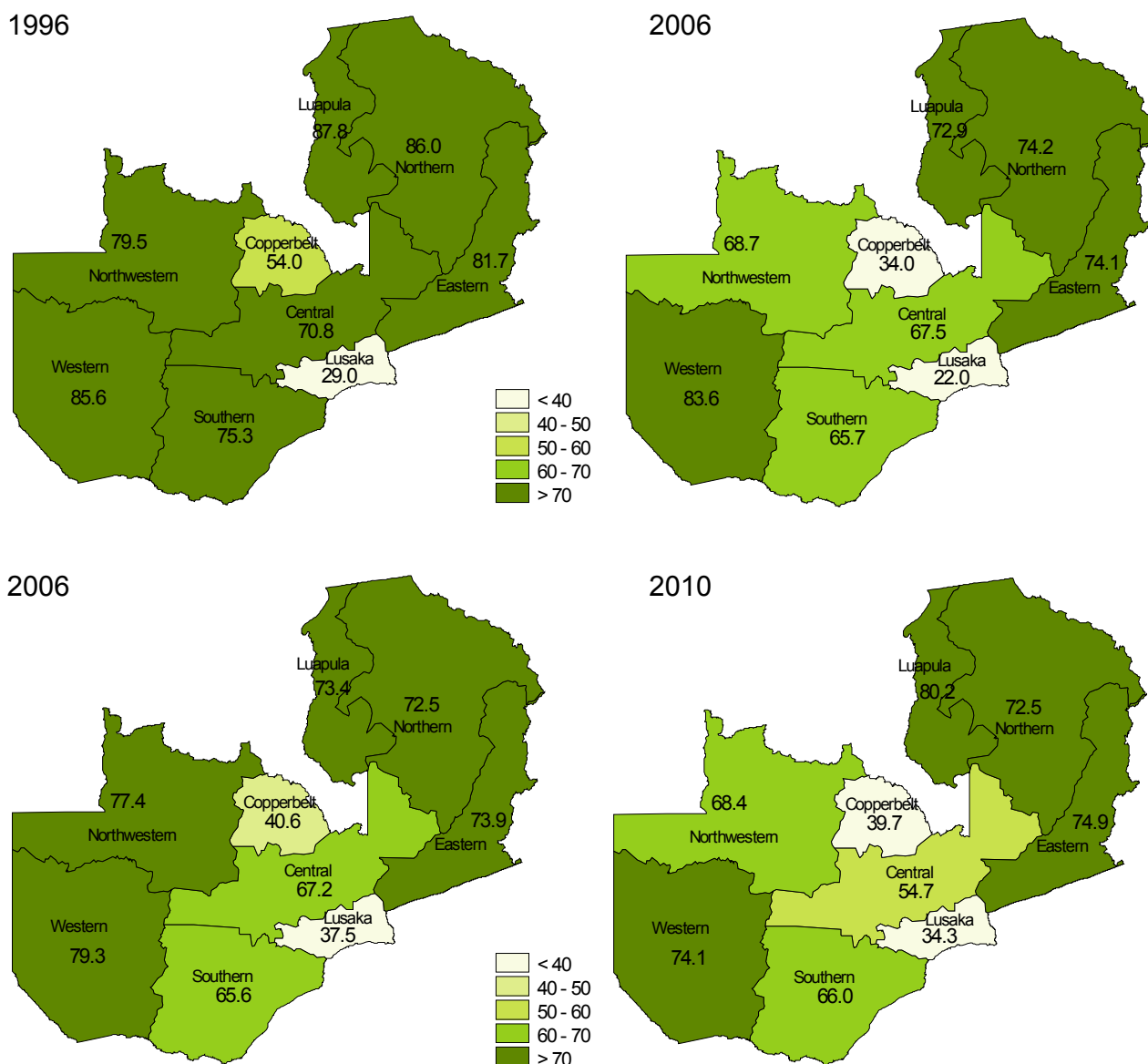
province, over the years 1996 to 2010. Particularly notable are the implications that increased economic activities and urban development have had throughout the Copperbelt and Central provinces over the last 20 years. The percentage of population below the poverty line fell from 54% to 39.7% in the Copperbelt region and from 70.8% to 54.7% in Central Province over the period. This compares with a decrease of about 10% in six other provinces and an increase in poverty levels in Lusaka Province.

FIGURE 3. Estimated population density by province in Zambia in 2012⁸



8) Geo-Ref.net (2018) Geo-Ref.net, Republic of Zambia population density map.
Link: <http://www.geo-ref.net/ph/zmb.htm> – accessed February 2019

FIGURE 4. Percentage of population living below the poverty line by province, 1996–2010⁹



Increases in income have been concentrated among a relatively small segment of the urban workforce; however, an urban unemployment rate of (11.4%) somewhat impedes the rural workforce from participating in the country's more dynamic economic sectors. In 2014, 84% of those in employment were

in the informal sector and the majority were self-employed or working for family members. In terms of employment by sector, agriculture leads (49%), followed by household activities (17.4%) and trade, wholesale and distribution (11.8%).

9) World Bank (2012) Zambia poverty assessment: stagnant poverty and inequality in a natural resource-based economy. World Bank Africa region, Poverty reduction and economic management, p. 123. Link: <https://openknowledge.worldbank.org/handle/10986/16792> – accessed February 2019

2.3 POLITICAL AND ECONOMIC SITUATION

Zambia consists of ten provinces and is governed as a presidential republic. There are five main political parties including the Patriotic Front, which is headed by President Edgar Changwa Lungu, who became the sixth President in 2014 and was re-elected for a five-year term in August 2016.

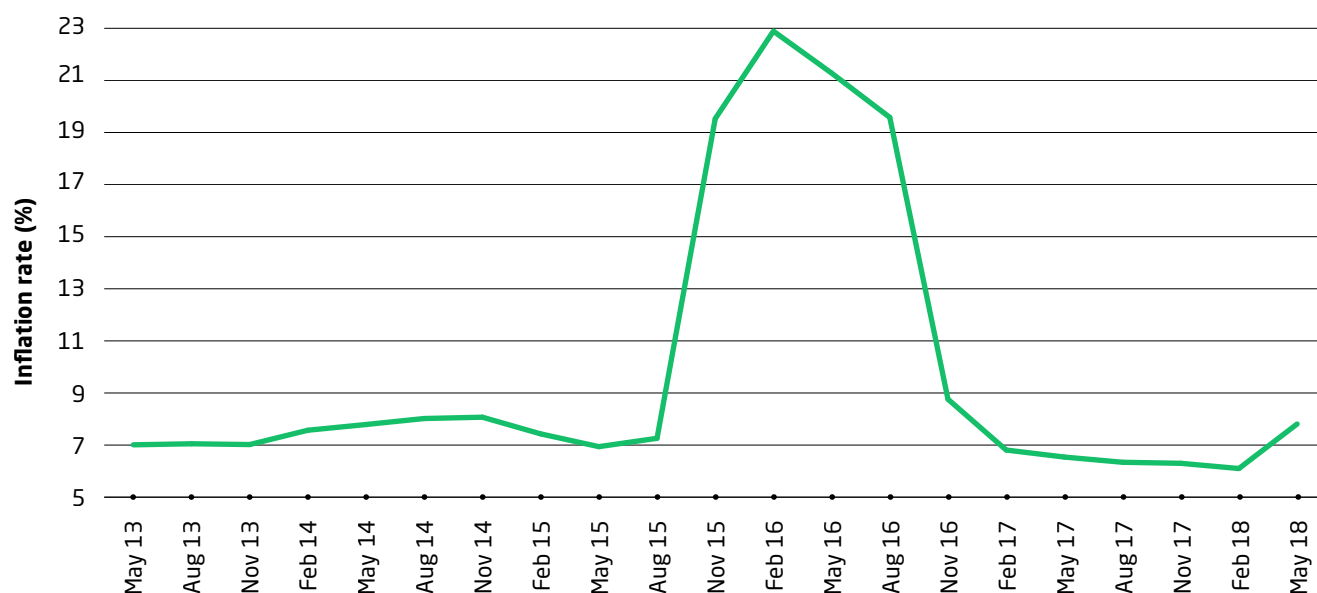
The government exercises executive power, while legislative power is vested in both the government and parliament. The legal system in Zambia is mixed, comprised of the English Common Law and customary Law. All disputes having to do with commercial transactions are dealt with within the Commercial Court, a division of the High Court.

Zambia's economy is strongly dependent on its most important sector – copper mining – which alone accounts for around 70% of export revenue and contributes approximately 10% of GDP, with the bulk of the remainder coming from non-mining industries and the services sector. Zambia has experienced rapid economic growth over the last few decades and, despite recent challenges,

performance has been generally strong since 2010, with the World Bank recognizing Zambia as a lower middle-income country in 2011. Zambia's GDP in 2016 was USD 21 billion – down from a high of USD 28 billion in 2013 but still placing the country among the twenty major economies in Africa. GDP growth has rebounded from a decade low of 2.9% in 2015 to 4.1% in 2017 and is expected to grow by 4.5% in 2018, boosted by rising global demand for copper and increased agricultural production. Nevertheless, Zambia's limited economic diversity leaves the country vulnerable to internal and international dynamics as experienced in 2015: fast rising expenditures, a fiscal deficit, low copper prices, poor agricultural output and an electricity supply crisis. National data shows that inflation in mid-2018 was at about 7.5% having fallen from a high of close to 23% in February 2016. **Figure 5** presents the inflation rate by month from May 2013 to May 2018.

Foreign Direct Investment (FDI) inflows have increased from approximately USD 300 million (EUR 252 million) in 2005 to approximately USD 1.5 billion (EUR 1.3 billion) in 2015, down from a high of USD 2.1 billion (EUR 1.8 billion) in 2013.

FIGURE 5. Monthly inflation rate (%), 2013-2018¹⁰



10) Central Statistical Office (2018) Overall Inflation by Month, Price Statistics, Zambia Data Portal website.
Link: <http://zambia.opendataforafrica.org/ukxlqoc/prices-statistics> – accessed February 2019

The Zambian currency was re-based from the old Zambian Kwacha (ZMK) to the current Zambian Kwacha (ZMW) on 1 January 2013. The USD reached an all-time high of 13.90 against the Zambian Kwacha in November 2015 while the EUR appreciated by half against the currency in the same year, reaching 14.77.

The volatility in the Kwacha, which has more or less subsided, was linked to lower export earnings and government revenues during the 2015/2016 dry season. In mid-May 2018, the USD traded at 9.87 to the ZMW and the EUR at about 11.86. The ZMW

is projected to depreciate slightly by the end of 2018. **Figure 6** presents the EUR – ZMW rate since 2013.

The Gross National Income (GNI) per capita has quadrupled over the past two decades, from a level of USD 330 (EUR 277) in 2000 to USD 1,360 (EUR 1,144) in 2016. **Figure 7** provides a comparison of national population distributions across nine household income strata, as defined in the Central Statistics Office Living Conditions Monitoring Survey (LCMS) Reports for the years

FIGURE 6. EUR to ZMW 5-year exchange rate, 2013-2018¹¹

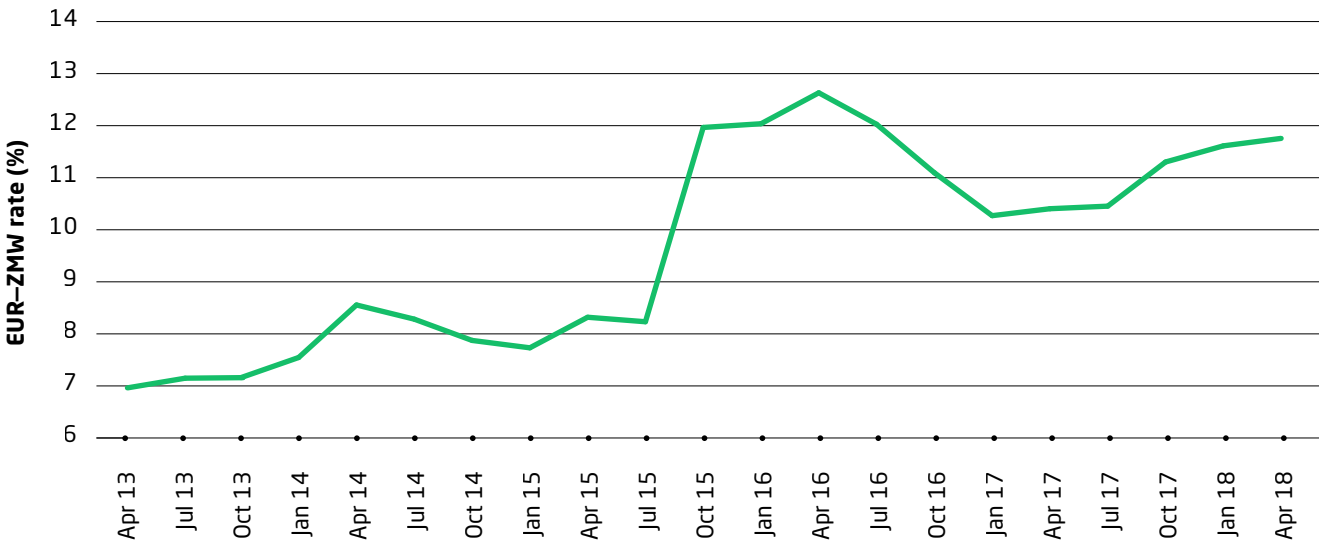
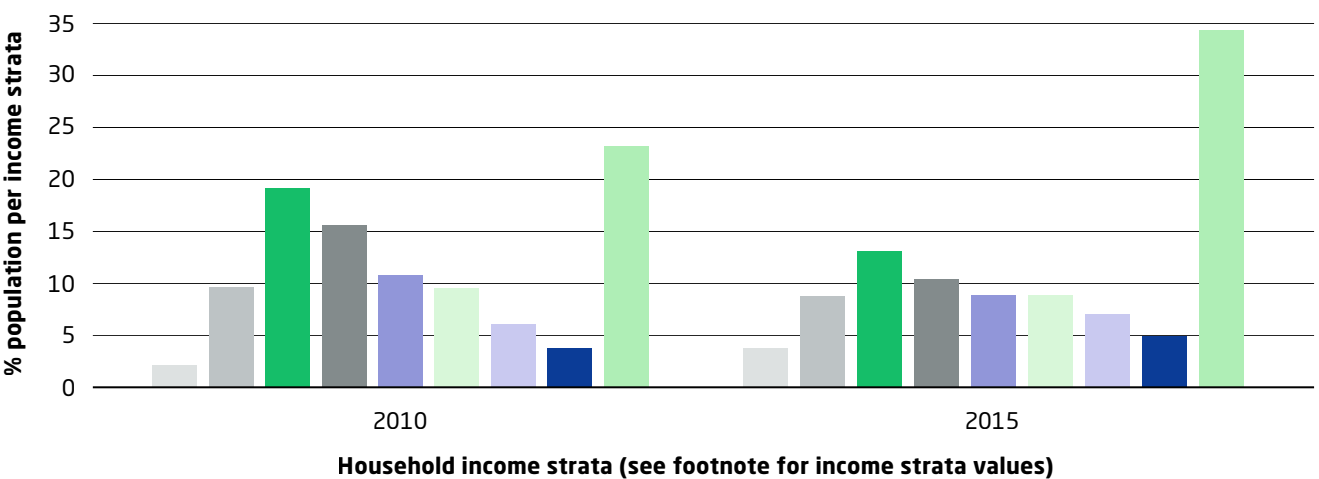


FIGURE 7. Distribution of population (%) by household income strata in 2010 and 2015¹²



2010 and 2015. While the proportions of population occupying both the lowest and highest income strata have increased over the period, there is also an indication of an expanding “middle class”. Whereas only 53.4% of all households occupied the top five income strata in 2010, corresponding to an average monthly household income of approximately ZMW 442 (EUR 37) or greater, this proportion of the population expanded to approximately 64.1% in 2015.

2.4 TELECOMMUNICATIONS AND MOBILE MONEY

There are approximately 13 million active mobile phone users and 7 million mobile broadband users as shown in **Table 1**. The Average Revenue Per User (ARPU) is estimated at ZMW 400 (EUR 33.61) per year.

TABLE 1. Mobile phone and mobile Internet penetration in 2017¹³

INDICATOR	NUMBER	PENETRATION RATE
Mobile subscribers	13,438,539	81.92%
Mobile internet users	7,723,855	47.08%

The national network geographic coverage was at 78% in Q3 2017, which represents 93% coverage by population, with about 2,430 telecommunication towers across the country. The majority of site coverage was through 2G network (2,987), followed by 2G/3G network (2,141) and about 235 4G sites.

The key telecommunications actors in the country include Airtel Zambia, MTN, Vodafone and Zamtel. MTN Zambia has the largest coverage at 44.1%, followed by Airtel Zambia and Zamtel at 42.7% and 27.0%, respectively.

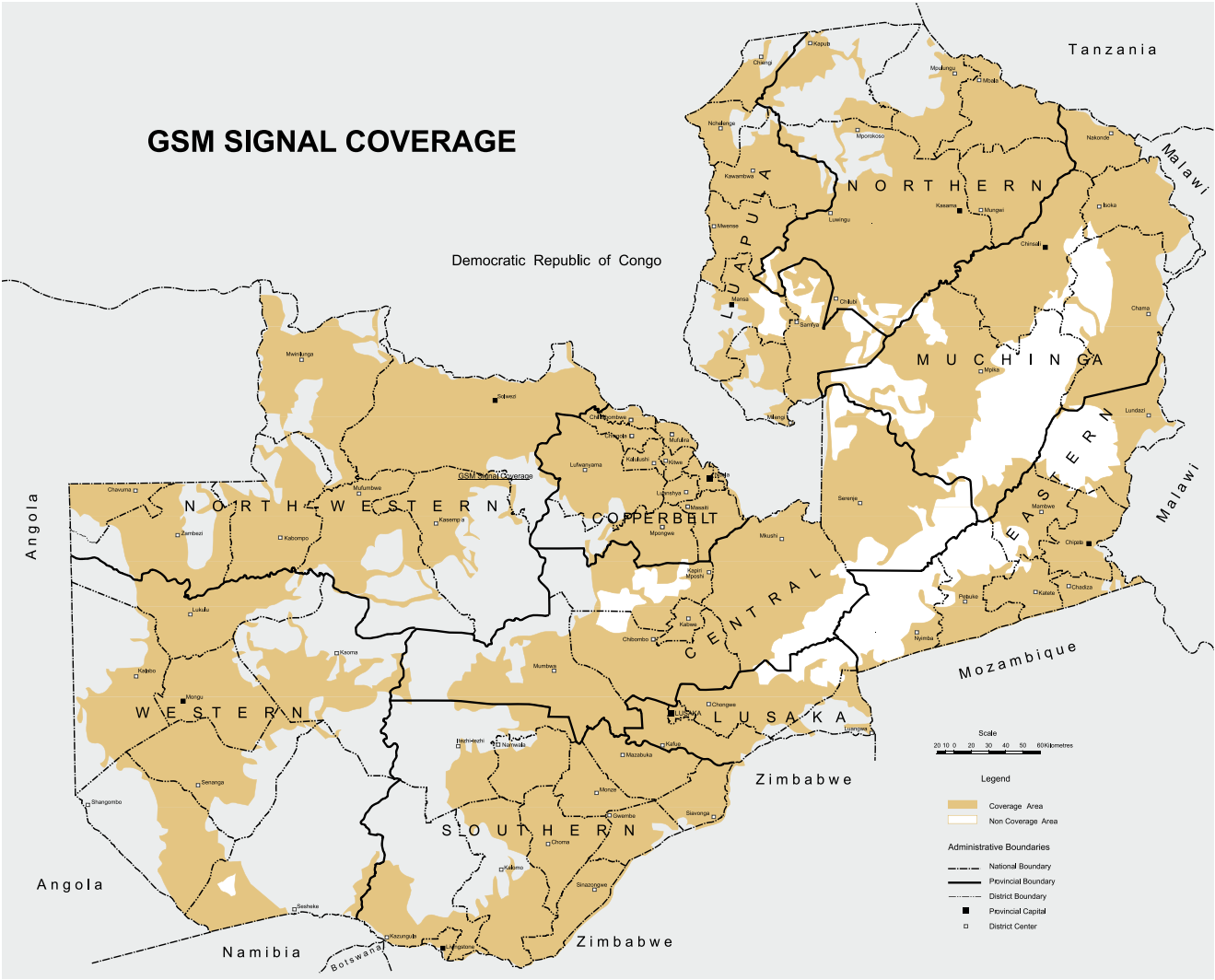
A Times of Zambia (national newspaper) media article from 2015 on the state of the country’s mobile network suggested a severe urban-rural disparity in geographical network coverage. A national ICT survey in 2015 affirms greater coverage in urban than rural areas, as shown in **Figure 8**, although it should be noted that some of the un-served areas are national parks, forest reserves and game management areas.

Mobile money usage in Zambia remains limited, despite a seemingly welcome environment. Eighty-six per cent of adults do not have a bank account, yet are willing to learn new technologies, and 47% of Zambians prefer not to carry cash, according to a FinScope report from 2015. Furthermore, almost 70% of Zambian adults who are aware of mobile money would like to use their phone to pay for goods, services and utility bills. There are a number of money transfer services and mobile money providers — including Airtel, MTN, Zoon, Kazang, Shoprite and ZANACO — however approximately half of adults in Zambia are not aware of the existence of digital financial services and less than 20% of the population has used digital financial services. For those that are aware of digital finance, there appears to be a limited understanding of how various platforms work as well as a general scepticism towards the integrity of mobile-to-mobile transactions. According to the Helix Institute of Digital Finance, Zambia could become an “Over the Counter-led” mobile money market, whereby agents support customers to make transactions due to an apparent consumer preference for working with agents as opposed to the person-to-person (“wallet”-type) mobile banking that is prevalent in much of East Africa.

As of December 2016, the existing base of users of digital finance services was approximately 7 million registered accounts, of which 1.3 million were considered active. This represented an annual 24% increase in both the number of registered accounts and of active accounts. Over the same period, the number of active agents increased by 69%: from 7,304 active agents (83 active agents per 100,000 adults) to 12,376 active agents (136 active agents per 100,000 adults). Some highlighted indicators from the sector are shown in **Figure 9**.

- 11) European Commission (2018) InforEuro monthly accounting rate of the euro, Zambian Kwacha, EC website. Link: http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/index_en.cfm – accessed February 2019
- 12) Analysis based on 2010 LCMS and 2015 LCMS data. The LCMS reports have nine strata of monthly household income. Adjusted for the 2013 currency re-basement these are from left to right (in ZMW): <50; 50–150; 150–300; 300–450; 450–600; 600–800; 800–1,000; 1,000–1,200; and >1,200
- 13) Zambia Information and Communications Technology Authority (2018) ICT Statistics Portal, ZICTA website. Link: <http://onlinesystems.zicta.zm:8585/statsfinal/index.html> – accessed February 2019

FIGURE 8. GSM coverage map of Zambia, 2015¹⁴



14) Zambia Information and Communications Technology Authority (2015) Information and Communications Technology & Postal Services Investment Profile, p. 16. Link: <https://tinyurl.com/yamtnffy> – accessed February 2019

FIGURE 9. Some digital finance market indicators for Zambia, 2016¹⁵



15) UN Capital Development Fund (2017) State of the Digital Financial Services Market in Zambia, 2016, p. 15.
Link: <http://www.uncdf.org/article/2776/state-digital-financial-services-market-zambia-2016> – accessed February 2019

SECTION 3

Electricity Sector Profile



Zambia's power sector is largely dependent on hydropower, which accounted for 85% of total installed generation capacity in 2016 followed by coal at 11%, diesel at 3% and Heavy Fuel Oil at 2% (Figure 10). The country has been facing an electricity supply deficit occasioned by increasing demand and low water levels at the main hydro dams. Poor rainfall was experienced from 2014 to 2016 resulting in load management measures that included load shedding, which affected many small businesses. In April 2018, Zambia's first grid-connected solar PV plant (1 MW) was commissioned, and 76 MW of solar IPP power is expected to come online in late 2018 or early 2019.

FIGURE 10. Installed generation capacity in Zambia, 2016¹⁶

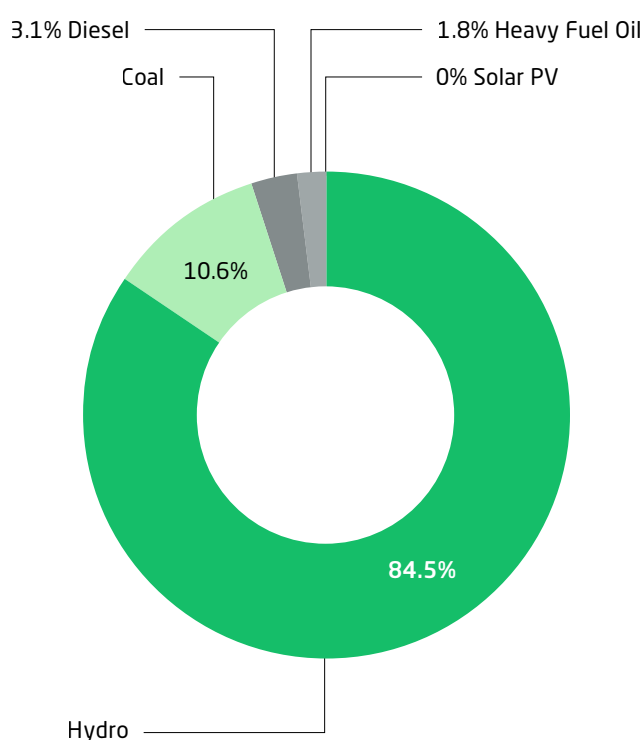


Table 2 presents some key figures for Zambia's electricity sector.

TABLE 2. Key electricity sector indicators in Zambia¹⁷

Installed generation capacity (2017), MW	2,886
Installed fossil fuel capacity (2016), % of total installed capacity	15
Hydro capacity (2016), % of total installed capacity	85
Other RE capacity (2016), % of total installed capacity	<1
Renewable electricity output as % of total electricity output excl. hydro (2014)	<1
Average distribution and transmission losses as % of output (2014)	15
Net electricity imports (2016), GWh	1,391
Electrification rate, total (2016) %	33
Electrification rate, urban (2015) %	67
Electrification rate, rural (2015) %	4
Peak demand (2016), MW	2,287
Per capita electricity consumption (2014), kWh	707

3.1 ELECTRICITY POLICIES, PLANS AND LEGISLATION

The Zambian government views renewable energy as a critical element of the country's future energy mix. The country's Vision 2030, the 2017 Seventh National Development Plan and the National Energy Policy each acknowledge a need to diversify generation and increase electricity access.

The most relevant policies, plans and legislation for mini-grids are as follows:

16) Derived from ERB (2017) Energy Sector Report 2016, p. 4.
Link: <http://www.erb.org.zm/downloads/esr2016.pdf> – accessed February 2019

17) Data sources in Table 21 in references

- The National Energy Policy¹⁸ (1994, revised 2008) set the scene for the liberalisation of the electricity sector and specifies measures to improve electricity access through:
 - a) Enacting legislation for public and private sector investment and participation
 - b) Applying viability gap funding mechanisms
 - c) Enabling isolated grid systems with cost-reflective tariffs
- The Electricity Act¹⁹ (1995, amended 2003) provides the overarching legal framework for the generation, transmission, distribution and supply of electricity in Zambia and opened the sector to private actors. The Act includes the Electricity (Licensing) Regulations and the Electricity (Supply) Regulations.
- The Energy Regulation Act²⁰ (1995, amended 2003) formally established the Energy Regulation Board (ERB) and defined its functions and powers. Both the Electricity Act and the Energy Regulation Act may be revised in 2018.
- The Rural Electrification Act²¹ (2003) established the Rural Electrification Authority (REA), specified its functions and equipped it with a Rural Electrification Fund.
- The Zambia Distribution Grid Code²² (2016) provides the basic rules, procedures, requirements and standards for the operation, maintenance, and development of electricity distribution systems in Zambia.
- The Renewable Energy Feed in Tariff Strategy²³ (2017) published by the Ministry of Energy aims to increase national generation output through private sector investment in small and medium size renewable energy plants of up to 20 MW.
- In 2008 REA developed the Rural Electrification Master Plan²⁴ (REMP) for the term 2009 – 2030. The plan identifies 1,217 un-electrified Rural Growth Centres (RGCs) to be electrified through grid extension, standalone solar systems and mini-grids by 2030 to achieve 51% rural electricity access.
- The Power System Development Master Plan²⁵ (2010) is a comprehensive sector planning document for the period up to 2030.

Section 5.5 provides detailed information on the regulatory requirements for mini-grids in Zambia.

3.2 INSTITUTIONAL ARRANGEMENTS

With the electricity sector reforms of 1995, the Zambian government ended the monopoly of the state power company and established an independent regulatory body. Eight years later a dedicated public agency for rural electrification was created. The main electricity sector actors are listed here. For further information on each, please see the GET.invest Zambia market brief²⁶:

- The Ministry of Energy (MoE) is responsible for the development and management of energy resources in a sustainable manner through the preparation and monitoring of energy policies, strategies, plans and programmes and the coordination of stakeholders in the sector.

18) Link: <https://tinyurl.com/y9o49ers> – accessed February 2019

19) Link: <http://www.parliament.gov.zm/sites/default/files/documents/acts/Electricity%20Act.pdf> – accessed February 2019

20) Link: <http://www.parliament.gov.zm/sites/default/files/documents/acts/Energy Regulation Act.pdf> – accessed February 2019

21) Link: http://www.erb.org.zm/downloads/legislation/Rural_Electrification_Act.pdf – accessed February 2019

22) Link: <http://www.erb.org.zm/downloads/gridcode/ZambiaDistribution-GridCode.pdf> – accessed February 2019

23) Link: <https://tinyurl.com/ybt982tr> – accessed February 2019

24) Link: <http://www.rea.org.zm/about-us/remf/page.html> – accessed February 2019

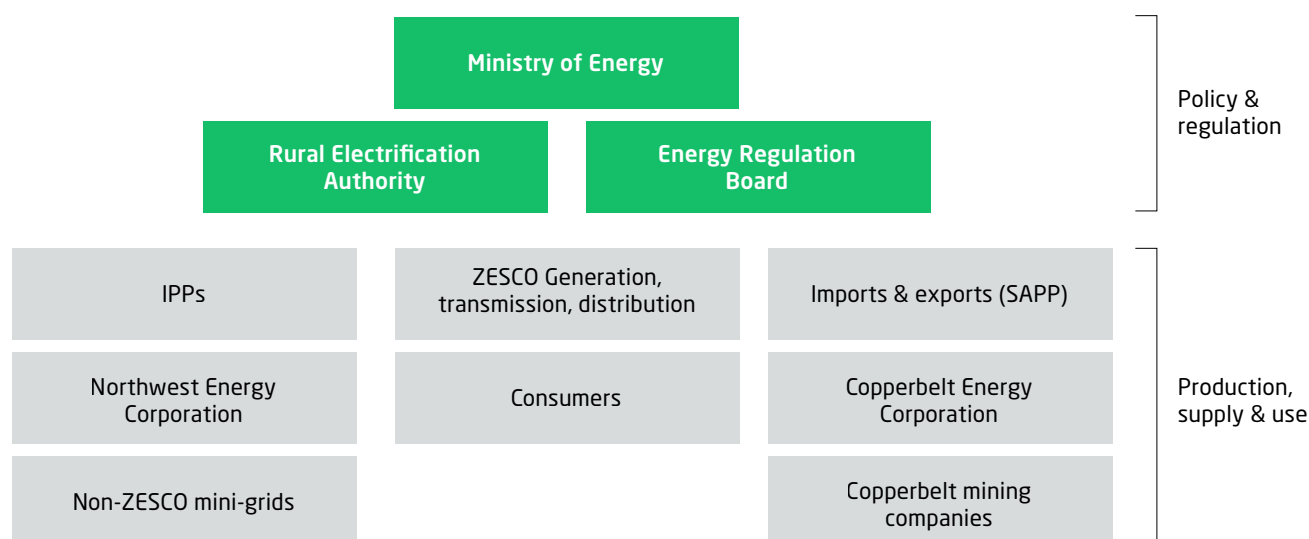
25) Link: http://open_jicareport.jica.go.jp/640/640/640_533_11989118.html – accessed February 2019

26) Link: <http://www.get-invest.eu> – accessed February 2019

- The Energy Regulation Board²⁷ (ERB) is responsible for, among others: electricity licensing, determination of electricity tariffs, development of standards (in collaboration with the Zambian Bureau of Standards), investigation of customer complaints and arbitration of conflicts among sector stakeholders.
- The Office for Promoting Private Power Investment²⁸ (OPPI), under the Ministry of Energy, is mandated to promote private investment in the generation and transmission of electricity.
- The Rural Electrification Authority²⁹ (REA) carries out public activities in connection with rural electrification, including management of the Rural Electrification Fund and development and implementation of the Rural Electrification Master Plan (REMP).
- ZESCO Limited³⁰ (ZESCO) is fully owned by the Industrial Development Corporation, a state-owned investment holding company. ZESCO operates the electricity grid, is responsible for much of the country's power generation.
- As of mid-2018, there were five IPPs, one private transmission and distribution company (Copperbelt Energy Corporation) and one private distribution company (Northwest Energy Corporation) buying power in bulk from ZESCO and approximately 10 private and community-owned solar and hydro mini-grids in Zambia.

The institutional set-up of the power sector is presented in **Figure 11**. There are other relevant entities for the development of mini-grids in Zambia. These are presented in **Section 5**.

FIGURE 11. Institutional structure of Zambia's power sector³¹



27) Link: <http://www.erb.org.zm> – accessed February 2019

28) Link: <http://www.opppi.gov.zm> – accessed February 2019

29) Link: <http://www.rea.org.zm> – accessed February 2019

30) Link: <http://www.zesco.co.zm> – accessed February 2019

31) Adapted from Kapika and Eberhard (2013) Power Sector Reform and Regulation in Africa, p. 128. Link: <https://tinyurl.com/ybe4973j> – accessed February 2019. Note: ZESCO is also the single buyer and main, but not sole, system operator. SAPP = Southern African Power Pool

3.3 ELECTRICITY DEMAND AND ELECTRIFICATION RATES

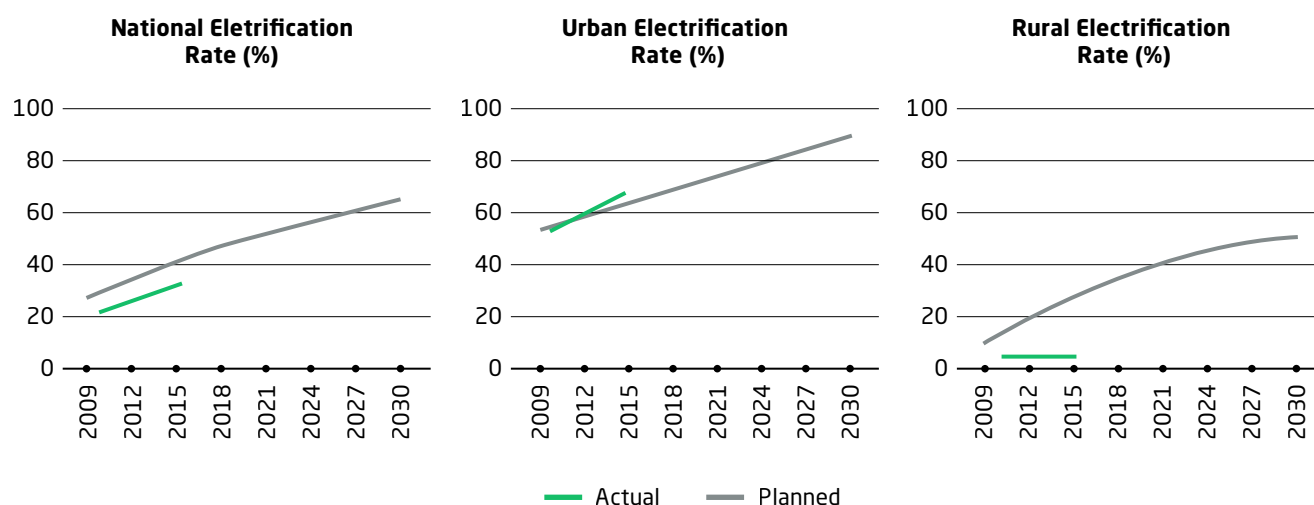
According to the Seventh National Development Plan, 33.1% of Zambian households were electrified in 2016, with 67.3% and 4.4% of households electrified in urban and rural areas, respectively,³² in 2015 as per the Living Conditions Monitoring Survey (Figure 12).

The most recent sub-national data on electricity access is found in the 2015 Living Conditions Monitoring Survey Report, which indicates that approximately 419,000 urban households and 1.64 million rural households did not have access to electricity. The breakdown of access by province is shown in Table 3.

Zambia's per capita electricity consumption of 707 kWh/year in 2014 was comparatively high relative to the sub-Saharan African average (excluding South Africa) of 153 kWh/year. Annual per capita consumption in Zambia was significantly higher than that of East African countries such as Kenya (167 kWh), Tanzania (99 kWh) and Uganda (89 kWh) and more in line with that of its neighbours such as Angola (312 kWh), Botswana (1,749 kWh), Mozambique (463 kWh), Namibia (1,585 kWh) and Zimbabwe (537 kWh).³³

The mining sector consumes the bulk of electricity in Zambia, almost twice that of the residential sector, as shown in Table 4. The table also indicates a 5% reduction in electricity consumption from 2015 to 2016 due to ZESCO load management as a result of poor rainfall.

FIGURE 12. Electrification rates in Zambia – planned versus actual 2009–2015³⁴



32) Another 7.4% of rural households were reported to have access to electricity when solar PV systems are considered

33) Estimated electricity consumption by typical mini-grid customers is found in the GET.invest Model Business Cases. Link: <http://www.get-invest.eu/> – accessed February 2019

34) Derived from World Bank (2017) Electricity Service Access Project (P162760), Project Appraisal Document, Zambia, p. 16. Link: <http://projects.worldbank.org/P162760/?lang=en&tab=documents&subTab=projectDocuments> – accessed February 2019

TABLE 3. Electricity access by province, 2015³⁵

PROVINCE	# OF HOUSEHOLDS	ELECTRICITY ACCESS RATE (%)	# OF OFF-GRID HOUSEHOLDS
Central	292,049	19.6	234,807
Copperbelt	450,843	58.0	189,354
Eastern	342,161	7.8	315,472
Luapula	207,612	6.5	194,117
Lusaka	592,073	70.6	174,069
Muchinga	174,832	17.1	144,936
Northern	253,779	8.9	231,193
North-western	164,141	13.9	141,325
Southern	338,259	24.7	254,709
Western	199,215	6.0	187,262
Total	3,014,964	—	2,067,244

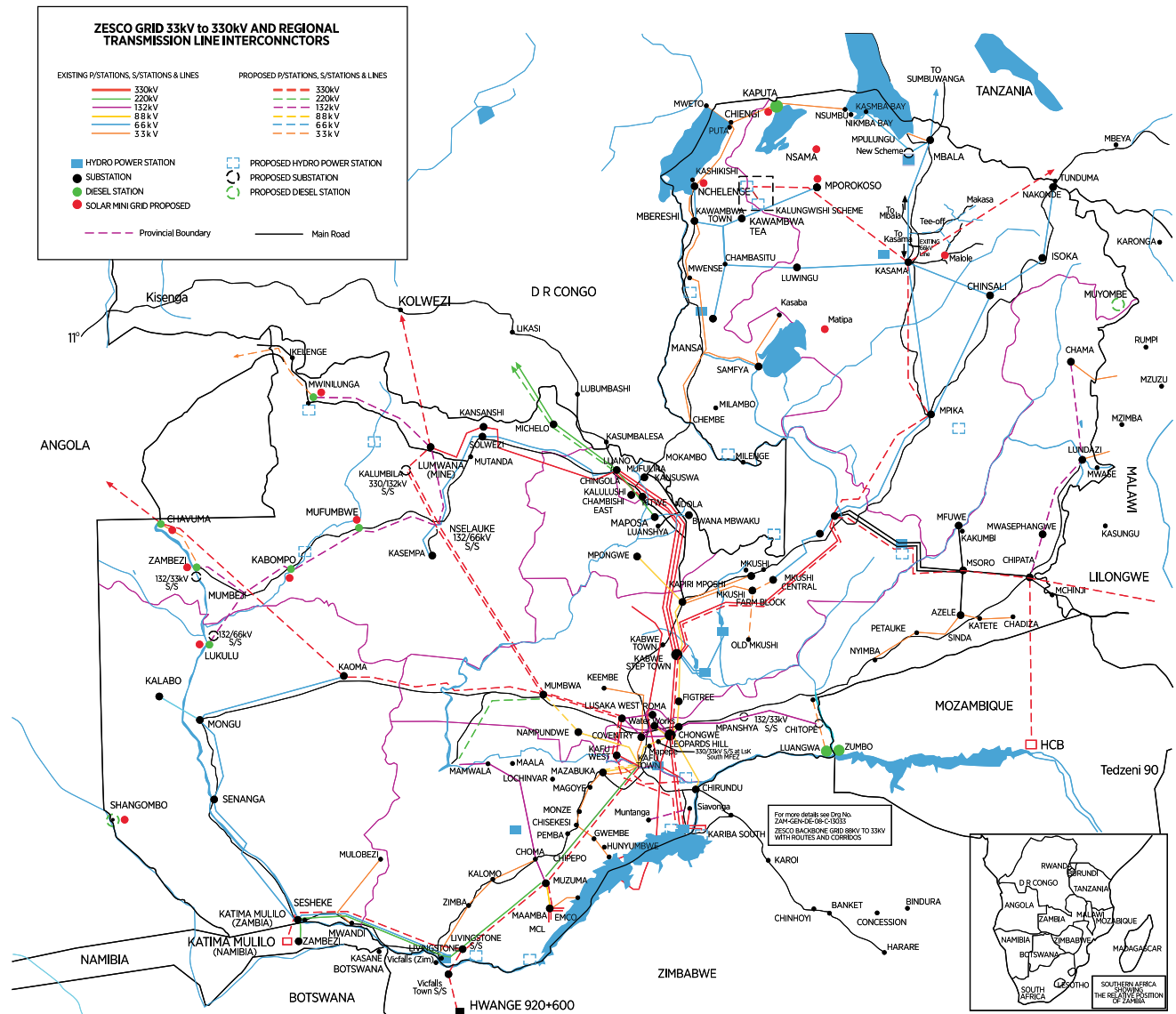
TABLE 4. Electricity consumption by economic sector, 2015 and 2016³⁶

SECTOR	GWh		SHARE (%)	
	2015	2016	2015	2016
Mining	6,246	5,918	54.5	54.5
Domestic	3,482	3,383	30.4	31.2
Finance and property	517	499	4.5	4.6
Manufacturing	531	470	4.6	4.3
Agriculture	260	228	2.3	2.1
Trade	110	97	1.0	0.9
Energy and water	89	88	0.8	0.8
Others	99	80	0.9	0.7
Quarries	68	60	0.6	0.5
Transport	33	28	0.3	0.3
Construction	15	7	0.1	0.1
Total	11,450	10,858	100	100

35) Central Statistical Office (2016) 2015 Living Conditions Monitoring Survey Report, p. 130. Link: <https://tinyurl.com/y9g8jdao> – accessed February 2019.
Note: the 2015 LCMS provides a wealth of country data with provincial granularity and is a recommended resource for mini-grid developers

36) Energy Regulation Board (2017) Energy Sector Report, 2016, p. 9. Link: <http://www.erb.org.zm/downloads/esr2016.pdf> – accessed February 2019

FIGURE 13. Transmission and distribution network in Zambia³⁷



37) International Renewable Energy Agency (2013) Zambia Renewables Readiness Assessment, p. 12.
Link: http://www.irena.org/documentdownloads/publications/rra_zambia.pdf – accessed February 2019

Despite an abundance of domestic energy sources, with the potential for hydro and solar power being particularly strong, Zambia imported 2,185 GWh of electricity in 2016. The economic progress over the past decades has increased national demand for electricity. Peak demand was recorded at 2,287 in 2016, while annual growth in electricity demand has been estimated at approximately 3%, requiring between 150 MW and 200 MW of new capacity per year.

Transmission and distribution infrastructure in Zambia is mostly owned by the vertically integrated ZESCO, which operates and maintains a high and low voltage distribution system. As shown in Figure 13, many areas of the country remain off-grid. The transmission grid operated by ZESCO is based on five voltage levels: 330 kV (2,241 km), 220 kV (571 km), 132 kV (202 km), 88 kV (734 km) and 66 kV (1,037 km) and the distribution network at two voltage levels: 33 kV (2,100) and 11 kV (1,037). ZESCO uses 400 V supply lines, with direct supply to final consumers typically at 240 V except for higher consumers at 400 V.

Several initiatives meant to improve transmission and distribution in the country are currently underway, the details of which can be found on the [Transmission Projects](#)⁴⁰ and [Distribution Projects](#)⁴¹ pages of the ZESCO website.

3.4 ELECTRICITY TARIFFS

Electricity tariffs in Zambia have historically been heavily subsidized, leading to a challenging commercial environment for private developers, as well as for ZESCO. For private mini-grid developers, the low ZESCO retail tariffs can provide customers with the expectation of electricity services at a price that is often untenable on a per kWh basis with cost-reflectivity.

TABLE 5. ZESCO tariff schedule (current from September 2017)³⁸

TARIFF CATEGORY	CUSTOMER DESCRIPTION	TYPE OF CHARGE	TARIFF FROM 1 SEP 2017	
			ZMW	EUR
1. Metered residential (prepaid, capacity 15 kVA)	R1 – Consumption up to 200 kWh/month	Energy charge/kWh	0.15	0.013
	R2 – Consumption above 200 kWh/month	Energy charge/kWh	0.89	0.075
		Monthly fixed	18.23	1.53
2. Commercial (capacity 15 kVA)	Commercial	Energy charge/kWh	0.54	0.045
		Monthly fixed	96.41	8.09
3. Social services	Schools, hospitals, orphanages, churches, water pumping, street lighting	Energy charge/kWh	0.49	0.041
		Monthly fixed	83.84	7.04
4. Maximum demand	For maximum demand tariffs (16 kVA and above) see ZESCO tariffs webpage ³⁹	—	—	—

Note: Above tariffs are exclusive of 3% excise duty and 16% Value Added Tax

38) Adapted from Energy Regulation Board (2017) Revision of Electricity Tariffs May 2017. Link: <https://tinyurl.com/y76734ss> – accessed February 2019

39) Link: <http://www.zesco.co.zm/customerCare/tariffs> accessed February 2019

40) Link: <http://www.zesco.co.zm/projects/transmission> – accessed February 2019

41) Link: <http://www.zesco.co.zm/projects/distribution> – accessed February 2019

Efforts to adjust tariffs are on-going, in line with the objective of SADC to achieve cost reflective electricity prices by 2019. In early 2017, a ZESCO tariff application was approved, with a 50% increase from May 2017 and a 25% increase from September 2017. In the same tariff determination, residential tariff bands were revised. [Table 5](#) shows the ZESCO tariff schedule from September 2017 that was still valid as at the time of writing.

An electricity cost of service study for the determination of economic cost-based tariffs is near completion and may lead to another retail tariff increase in 2018 or 2019.

The ZESCO tariffs are not a national uniform end-user tariff. Other electricity suppliers may seek ERB approval for different tariffs. For example, the North Western Energy Corporation that buys in bulk from ZESCO for onward distribution and the private Zengamina hydro and Sinda solar mini-grids, owned and operated respectively by Zengamina Power Company Limited and Muhanya Solar Limited, each has their own approved retail tariffs.

3.5 RURAL ELECTRIFICATION

The Government of Zambia maintains its official target of achieving 51% rural electricity access by 2030. Various initiatives are being undertaken – by the government, development agencies, the private sector and non-profit organisations – to address the low rates of electrification in rural areas.

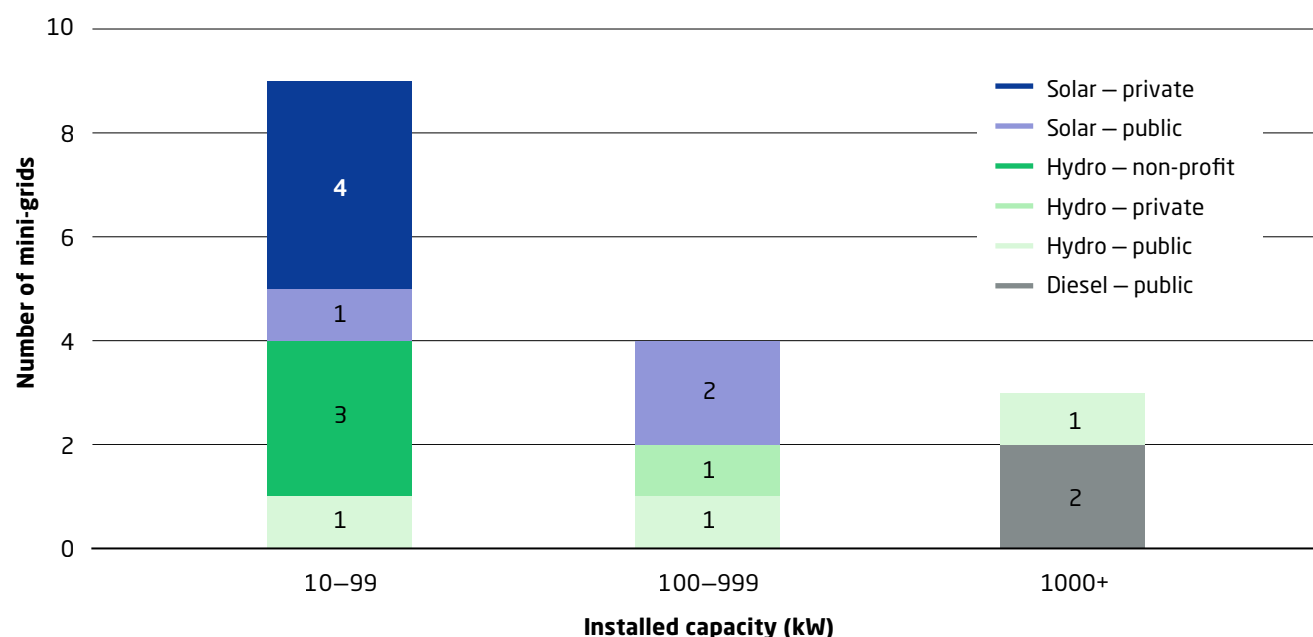
Grid extension and connections

Since 2006, REA has implemented almost 160 grid extension projects in rural areas in all 10 provinces of Zambia. Initially the extension projects were focused on off-grid schools and rural health centres but later household connections were also targeted. As part of a World Bank-financed electricity access project, REA through ZESCO is expected to connect an additional 22,000 low-income households and 1,000 small and medium businesses in rural areas by 2022.

Mini-grids

There were 16 public, private and non-profit diesel, hydro and solar PV mini-grids installed or under construction in Zambia at the end of 2017. The breakdown of installed capacity by energy and ownership type is shown in [Figure 14](#).

FIGURE 14. Number of mini-grids in Zambia by energy and ownership type as of end 2017⁴²



⁴²) Derived from data compiled for this Guide. Includes projects under construction and small hydro mini-grids where the operations status is not known. Excludes recently decommissioned diesel mini-grids

Until recently ZESCO operated seven isolated diesel-based mini-grids (Table 6) but only two remained operational at the end of 2017. The two mini-grids are run from 06:00–24:00. Older diesel stations have been decommissioned as the national grid is extended while newer isolated diesel systems may still be installed in off-grid load centres. ZESCO has undertaken two pre-feasibility studies for hybridisation of the diesel stations with solar PV.

While Zambia has more than 10 years of experience with hydro-based mini-grids, only one is a private enterprise. A list of seven existing and one planned project is found in Table 7, with a total existing capacity of about 2.5 MW and less than 10,000 connections.

Solar PV-based mini-grids currently make only a small contribution to rural electrification in Zambia, as per Table 8.

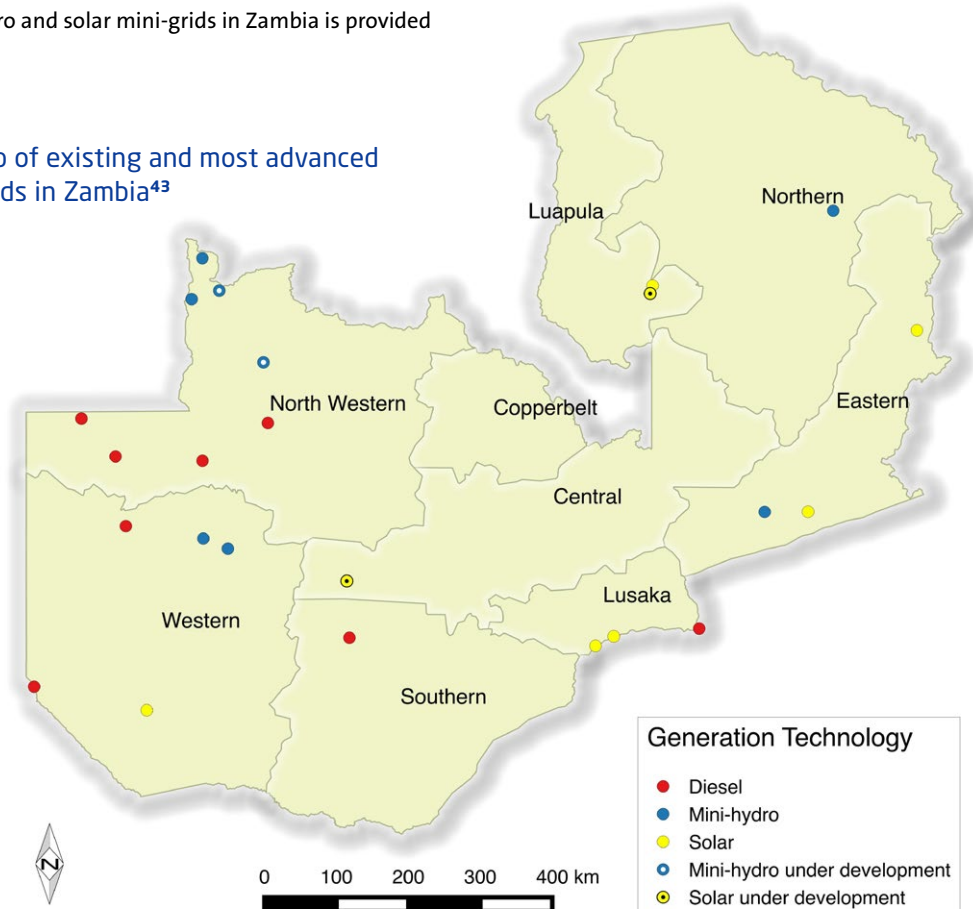
The approximate location of the existing and most advanced planned diesel, hydro and solar mini-grids in Zambia is provided in Figure 15.

Stand-alone solar systems

Recent years have seen a proliferation of solar portable lighting products and an emerging pico-SHS sector, with system sizes largely below 10 W. Solar lanterns are widely available throughout the country. Market sales figures compiled by the Global Off-Grid Lighting Association estimate that approximately 21,250 solar home system kits and solar lanterns were sold in Zambia between July and December 2017, representing approximately USD 700,000 (EUR 589,000) in cash sales revenues. Further information is available in the [GET.invest Zambia stand-alone solar business developer Guide](#).⁴⁴

There are also at least two larger stand-alone captive PV systems – one of 86 kWp with a 160 kWh battery at the AKTC demonstration farm and training centre and another system of at least 120 kWp capacity at the off-grid Chitokoloki Mission Station.

FIGURE 15. Map of existing and most advanced planned mini-grids in Zambia⁴³



43) Derived from data compiled for this Guide

44) Link: <http://www.get-invest.eu/> – accessed February 2019

TABLE 6. ZESCO isolated diesel mini-grids as at end 2017⁴⁵

SITE	SIZE MW	MWh	STATUS
Luangwa	2.6	3,300	Operational
Shang'ombo	1.0	900	Operational
Kabompo	2.0	–	Recently decommissioned due to grid arrival
Zambezi	1.8	–	Recently decommissioned due to grid arrival
Lukulu	0.5	–	Recently decommissioned due to grid arrival
Mufumbwe	0.8	–	Recently decommissioned due to grid arrival
Chavuma	0.8	–	Recently decommissioned due to grid arrival

TABLE 7. Public and private hydro mini-grids⁴⁶

SITE	OWNER	STATUS	SIZE kW	DETAILS
Zengamina	ZPC	Operational since 2007	750	<ul style="list-style-type: none"> Supplies two RGCs in North-western Province Hospital, clinics, schools, telecom towers, farm, small businesses and 600 households 35 km of 33 kV and 10 km of 400 V network
Nyangombe	Church mission	Operational	73	<ul style="list-style-type: none"> Cooperative building, hammer mill and main residences
Lwawu	Church mission	Unknown	50	<ul style="list-style-type: none"> Mission building, hammer mill and household customers
Luena	UNHCR	Not functional as of 2015	24	<ul style="list-style-type: none"> Refugee camp, 64 household customers
Mangongo	Church mission	Operational	17	<ul style="list-style-type: none"> Church, clinic and 54 household customers
Shiwangandu	ZESCO	Operational since 2012	1,000	<ul style="list-style-type: none"> Targeted to supply 25,000 people in Chinsali 1,600 MWh generation in 2016
Kasanjiku	REA	Construction	640	<ul style="list-style-type: none"> Targeted to supply 12,000 people in Ntambu
Multiple	HEP Ltd	Planning	5,000	<ul style="list-style-type: none"> Development of a cluster of sites is planned

Note: ZPC = Zengamina Power Company, HEP = Hydro Electric Power

45) ERB (2017) Energy Sector Report 2016, p. 7 and ERB (2016) Energy Sector Report 2015, p. 6, personal communication REA 12/07/2018

46) Compiled from various sources. Non-uniformity of details is due to the lack of readily accessible information

TABLE 8. Public and private solar PV mini-grids⁴⁷

SITE	OWNER	STATUS	SIZE kW	DETAILS
Mpanta	Kafita Cooperative Society (developed by REA and managed by the cooperative)	Operational since 2013	60	<ul style="list-style-type: none"> — Located in Samfya District — 450 households, 1 school, 1 health centre, a market, churches and fish refrigeration depots
Sinda	Muhanya Solar	Operational since 2017	30	<ul style="list-style-type: none"> — Located in Sinda District in an area already electrified by ZESCO — 60 households and 5 businesses. 50 more household and 2 institutional connections planned — Provides SHS to peripheral customers — 50 more household and 2 institutional connections planned
Multiple	Standard MicroGrid	3 micro-grids operational	10, 10 and 24	<ul style="list-style-type: none"> — One 10 kW grid with 32 customers is located in Mugurameno — Existing systems are containerised — Partnership with Empowered by Light NGO — Plans to build 150 micro-grids across the country
Chunga	REA	Construction	200	<ul style="list-style-type: none"> — Located in Kafue National Park — Targeting 570 households, public institutions and businesses
Lunga	REA	Construction	300	<ul style="list-style-type: none"> — Located on Kasoma Lunga Island — Targeting 1,600 households, public institutions and businesses
Multiple	Entiba Energy	Planning	100	<ul style="list-style-type: none"> — One pilot site under development — Has identified 40 additional sites
Luangwa	Green Knowledge Institute	Planning	48	<ul style="list-style-type: none"> — Located in Lundazi — One pilot project solar PV/wind hybrid
Multiple	ENGIE / Power Corner	Scoping	n/a	<ul style="list-style-type: none"> — One pilot site under assessment
Kanja area	Sigora Zambia	Scoping	n/a	<ul style="list-style-type: none"> — Sioma District, Western Province — Targeting 215 households, 15 businesses, health centre, veterinary office and a school

47) Compiled from various sources

3.6 RENEWABLE ENERGY RESOURCE POTENTIAL

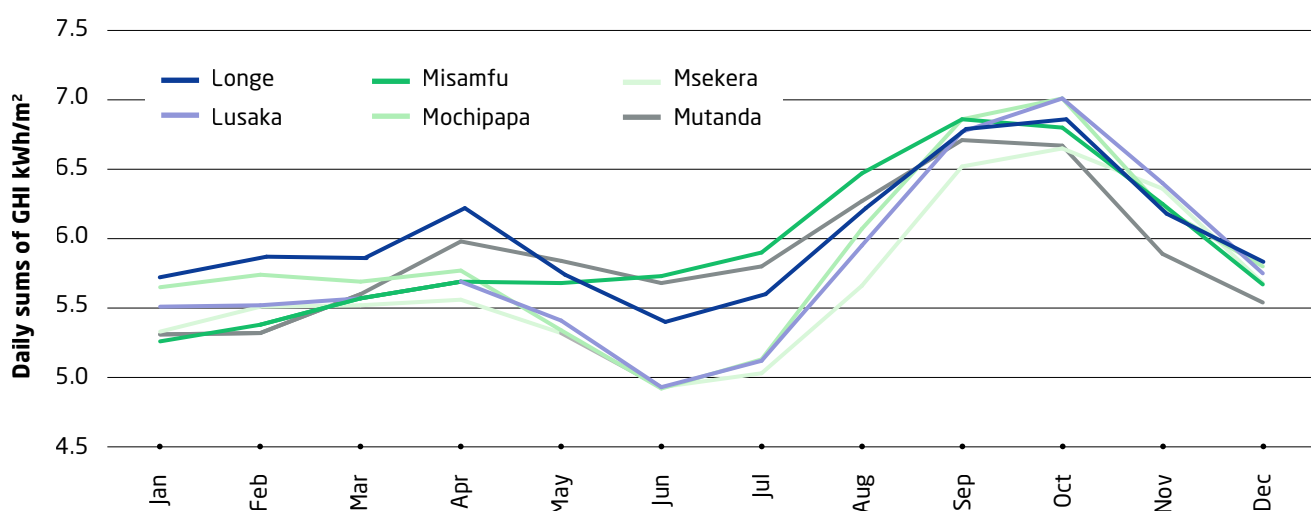
This section provides an introduction to the solar and hydro energy resources of Zambia. Information on the wind, biomass and geothermal potential can be found in the [GET.invest Zambia market brief](#).⁴⁸

Solar

High solar irradiation values provide strong potential for the development of solar PV-based generation. Zambia enjoys an average of 2,000 to 3,000 hours of sunshine per year. Average global horizontal irradiation (GHI) is 5.5 kWh/m²/day, with southern and part of the northern areas recording the highest global solar irradiation, up to 2,300 kWh/m²/year, as shown in [Figure 16](#). Such characteristics indicate strong potential for photovoltaic applications.

The World Bank Energy Sector Management Assistance Program (ESMAP) is undertaking a 5-year renewable energy resource mapping project in Zambia. Solar radiation measurement data, maps, and a modelling report are available [here](#).⁴⁹

FIGURE 17. Monthly average daily solar GHI (kWh/m²) at six locations in Zambia⁵⁰



Average daily solar irradiation is not consistent throughout the year, with a noticeable decrease during the rainy season in June and July as shown for six towns in [Figure 17](#). This affects the amount of electricity that a solar system can generate in a given month.

Small hydro

As reported by IRENA, Zambia's small hydropower potential is estimated at 63 MW across a number of sites. Approximately 60 potential small hydro sites ranging from 30 kW to 3 MW have been assessed by REA in North-western, Northern and Luapula provinces, of which 7–8 sites were considered to be potentially viable and sufficiently close to population centres. Of these, two have since been developed by REA and ZESCO and others underwent detailed studies.

OPPPI, ZESCO and REA all have hydropower site databases. The information, however, needs to be requested and was not readily available at the time of writing. The [Water Resources Management Authority](#)⁵¹ (WARMA) can provide hydrological data, where available. As of 2009, there were only 19 river gauging stations in the country. [Figure 18](#) provides a map of the main rivers of Zambia, while the location of the gauging stations can be found in the mini-hydro chapter of the REMP.

48) Link: <http://www.get-invest.eu/> – accessed February 2019

49) Link: http://www.esmap.org/re_mapping_zambia – accessed February 2019

50) Derived from World Bank (2018) ESMAP Renewable Energy Resource Mapping in Zambia.
Link: http://www.esmap.org/re_mapping_zambia – accessed February 2019

51) Link: <http://www.warma.org.zm> – accessed February 2019

52) SolarGIS (2018) Solar Resource Map Global Horizontal Irradiation Zambia. Link: <https://solargis.com/maps-and-gis-data/download/zambia> – accessed February 2019

53) Ezilon Maps (2018) Zambia Map – Physical Map of Zambia.
Link: <https://tinyurl.com/yd7wca8y> – accessed February 2019

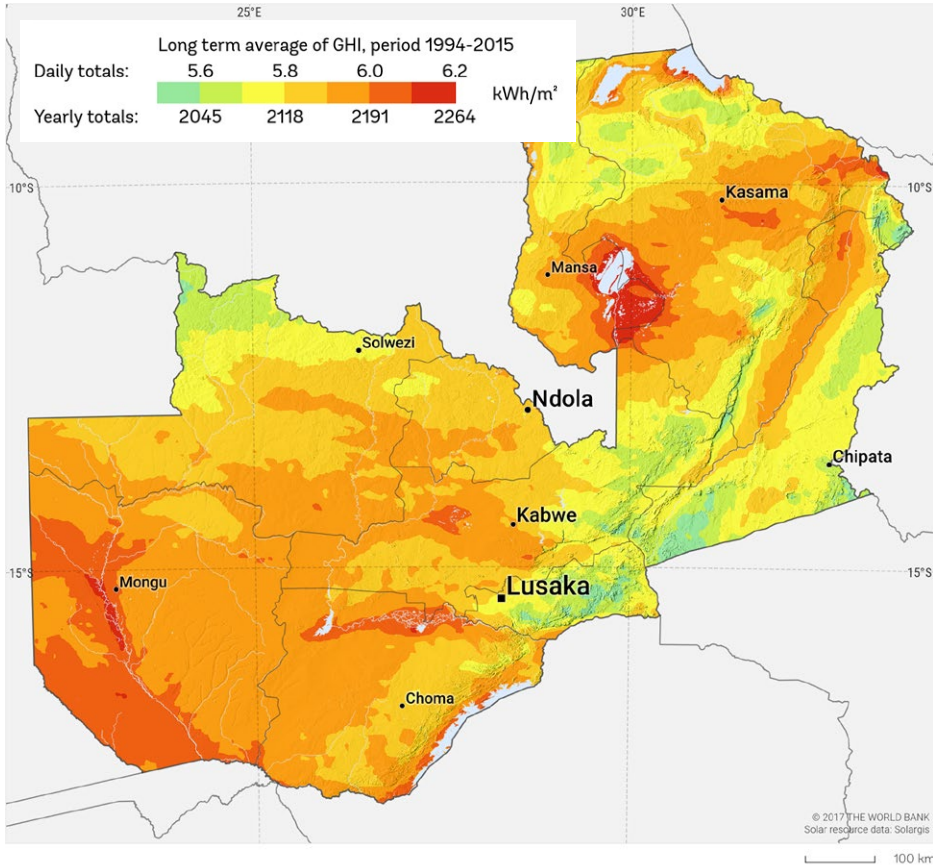


FIGURE 16. Average solar global horizontal irradiation (kWh/m²) in Zambia⁵²



FIGURE 18. Physical map of Zambia with main rivers⁵³

SECTION 4

The Market Potential and Implementation Models for Mini-Grids in Zambia



Given Zambia's electricity access gap and an increasingly welcoming environment for private companies in the energy sector, the market seems well suited for the development of mini-grid projects. At the same time, low population density and setting tariffs that are both affordable and cost reflective are challenging. The following section reviews some considerations for solar PV and hydro mini-grid developers aiming to enter the Zambian market.

4.1 OVERVIEW OF MINI-GRID SYSTEMS

WHAT IS A MINI-GRID?

Mini-grids “involve small-scale electricity generation which serves a limited number of consumers via a distribution grid that can operate in isolation from national electricity transmission networks and supply relatively concentrated settlements with electricity at grid quality level.”⁵⁴ Mini-grids may also be called pico- or micro-grids depending on their size. For the purposes of this Guide, the term mini-grid encompasses:

- Micro-grids (5–20 kW) — for up to about 100 customers
- Mini-grids (20–10,000 kW) — for 100+ customers

Mini-grids in Africa are usually established in remote, often rural, or isolated regions to provide electricity where the practicalities or cost of extending the national grid are prohibitive but there is a main load centre or sufficient loads in a cluster to favour an inter-connected grid over individual stand-alone systems. In some cases, mini-grids may be built close to the main grid to provide greater connectivity and/or improved reliability for some consumers.

Mini-grids may be designed to be permanent and expand over time to meet demand while other systems are temporary and either integrated with or decommissioned when the main grid arrives. Depending on size and intended level of service a mini-grid can supply different types of consumers (household, business, institution, industry) and can have grid networks of a few hundred metres in length to 10's of kilometres, usually at a voltage level of 33 kV or less. A schematic of an alternating current (AC) mini-grid with energy storage is shown in [Figure 19](#).

TECHNOLOGY PREVIEW

While conventional mini-grids have used fossil fuel, renewable energy and hybrid (mixed energy source) mini-grids can reduce costs, simplify maintenance and logistics and lower greenhouse gas emissions while providing reliable and high quality power.

Solar PV mini-grids

Solar PV mini-grids are attractive because solar resources are readily available and systems are modular and can be installed in many locations. However, due to the effects of cloud cover and nightfall, solar PV mini-grids usually have energy storage or hybrid systems to ensure availability of supply. The three most common configurations are **a)** solar PV-battery, **b)** solar PV-diesel hybrid and **c)** solar PV-battery with diesel back-up.

Hydro mini-grids

Hydropower-based mini-grids are very site specific as they must be located where there is both an exploitable hydropower resource and a cluster of consumers. Where the hydro resource is sufficient, or the system is designed to operate during periods of low flow, hydropower can provide continuous output and therefore energy storage or hybrid systems are less common. The hydro resource will usually be tapped with a run-of-river system without a large storage dam.

[Figure 20](#) and [Figure 21](#) are images from a solar PV and a hydro mini-grid in Zambia.

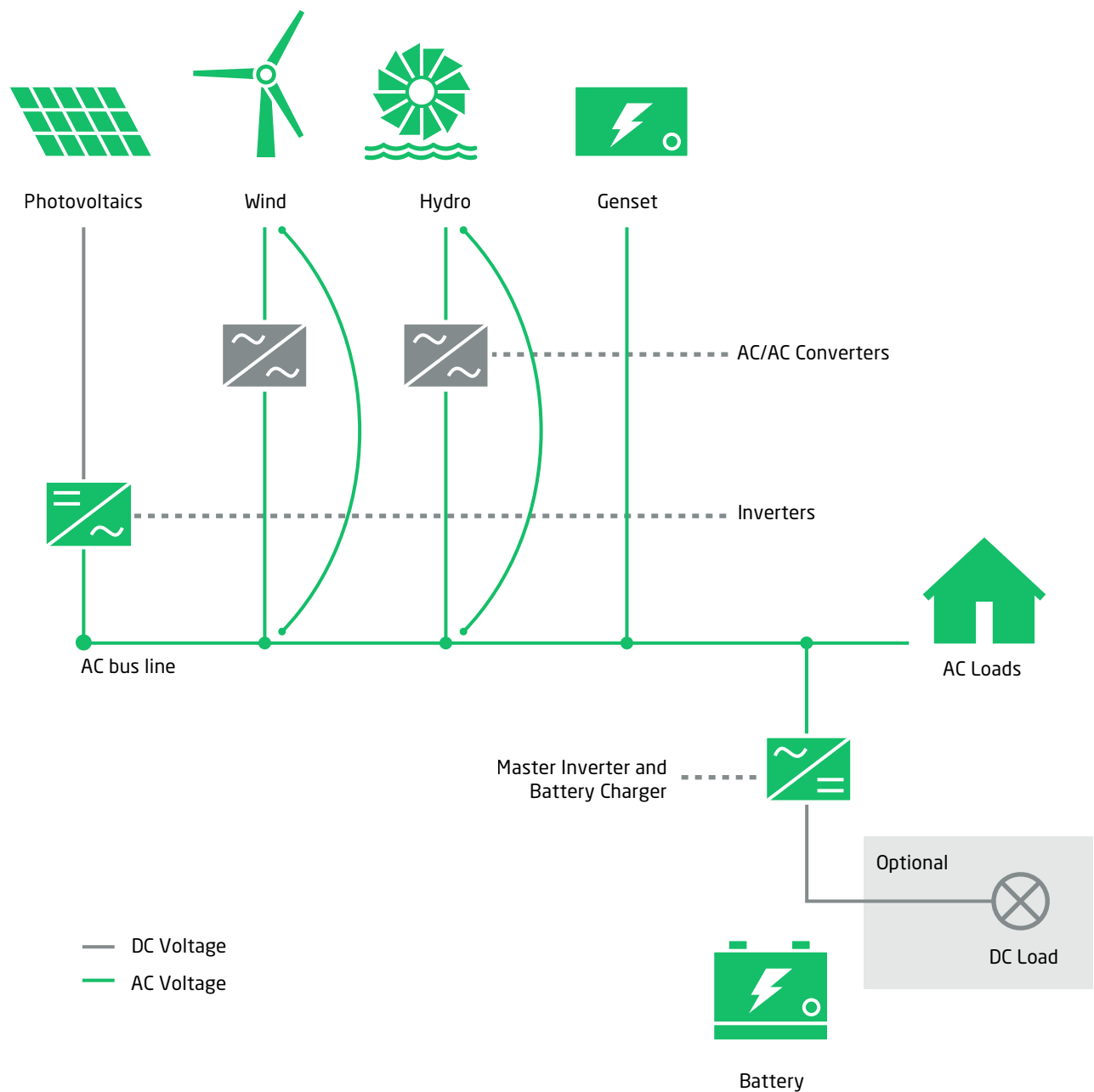
The [GET.invest Model Business Cases](#)⁵⁵ and [GET.invest Project Case Studies](#)⁵⁶ have information on technical and financial considerations for solar PV and small hydro mini-grids.

54) European Union Energy Initiative Partnership Dialogue Facility (2014) Mini-grid Policy Toolkit: Policy and Business Frameworks for Successful Mini-grid Roll-outs, p. 12. Link: <http://www.euei-pdf.org/en/recp/mini-grid-policy-toolkit> – accessed February 2019

55) Link: <http://www.get-invest.eu> – accessed February 2019

56) Link: <http://www.get-invest.eu> – accessed February 2019

FIGURE 19. Schematic of a mini-grid with storage⁵⁷



57) European Union Energy Initiative Partnership Dialogue Facility (2014) Mini-grid Policy Toolkit: Policy and Business Frameworks for Successful Mini-grid Roll-outs, p. 123. Link: <http://www.euei-pdf.org/en/recp/mini-grid-policy-toolkit> – accessed February 2019

FIGURE 20. Sinda 30 kW solar PV mini-grid⁵⁸



FIGURE 21. Zengamina 750 kW hydro mini-grid⁵⁹



58) © GIZ

59) https://en.wikipedia.org/wiki/Zengamina#/media/File:Zengamina_Mini-hydro_Power_Station_via_DJI_P3P.jpg,
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4.2 MARKET OPPORTUNITY

As noted in [Section 3.3](#), the national electrification rate in 2016 was 33.1% and 4.4% in rural areas, with more than 2 million households being off the grid. Electricity access rates were lowest in Western, Luapula, Eastern, Northern and North-western provinces.

Mini-grid potential is always site specific. In Zambia, although there are many un-electrified users, the potential is somewhat limited by the low population density in rural areas — for example, there may be 500 m between households in a village, increasing distribution costs. At the same time, as in some other countries, actual electricity demand can often be lower than is initially estimated.

The latest publicly available rural electrification planning document — the Rural Electrification Master Plan (REMP)⁶⁰ — is from 2008 (with some data from 2006). The plan clusters 1,217 un-electrified Rural Growth Centres (RGCs) — areas that exhibit the potential for increased economic activity with electricity access — into 180 project packages, estimating that over USD 1.1 billion (or USD 50 million per year) (EUR 920 million or EUR 42 million per year) is required to electrify all packages by 2030. In 2017, REA reported that under its updated 5-year rolling plan (2017–2021) 413 RGCs are being prioritised for electrification by various means from 2017 to 2021. This number may include the 163–167 high priority RGCs that will be targeted for grid extension and densification under a World Bank-funded electricity access programme.

The REMF estimated the least cost option for electrification of the 1,217 RGCs to be 79.9% grid extension, 19.8% solar systems and less than 1% mini-hydro. However, the RGCs cover only about 40% of the rural population, meaning that there are currently no electrification plans (via grid extension, mini-grid or SHS) for 60% of the country's rural inhabitants.

At the time of writing, Zambia did not have a policy establishing how the electrification of a site may be allocated between ZESCO, REA and the private sector. This means that it is necessary to conduct field research on the ground and consult closely with MoE, ZESCO, REA and ERB to identify and collate site-specific opportunities. The World Bank is funding a geo-referenced

National Electrification Strategy (NES) that should address these issues, which will be informed in part by site identification and analysis being led by the International Finance Corporation (IFC) (see [Section 4.6](#)). Overall, the north, north west and west of the country have the highest potential for solar or hydro mini-grids as these areas are furthest from the national grid and diesel fuel costs are high. However, these regions also have the lowest population densities.

As a very indicative figure of potential market size,⁶¹ in 2017 the World Bank preliminarily estimated that for 50% of the population off-grid solutions are the least cost option, 40% SHS and 10% mini-grid (mostly solar PV in the north). This implies that about 206,000 households — and by extension approximately 10,000 small and medium enterprises — may be best served by mini-grids. Assuming that a typical micro-grid supplies 25–100 customers and a larger mini-grid 500–2,000 customers, something between 100 and 8,000 mini-grids might be needed. Using World Bank assumptions (2017) for a typical solar PV mini-grid of 60 kW serving 440 customers in Zambia for analytical purposes leads to a rough estimate of 500 solar PV mini-grid sites. Based on recent information from REA (2018) indicating that a typical village to be electrified has an average of 110 customer connections,⁶² the number of potential mini-grid sites would be approximately 2,000. With regards to small hydro mini-grids, a very rough estimate is that 5–15 sites may have potential based on a review of available information as summarised in [Section 3.6](#).

4.3 IMPLEMENTATION MODEL OPTIONS

There are four main implementation models for mini-grid deployment: **a)** utility-based, **b)** public/community-based, **c)** private sector and **d)** public-private partnership. Zambia already has experience with the first three and has intentions to test the fourth ([Table 9](#)).

Each implementation model has advantages and disadvantages. For a private mini-grid developer in Zambia, the private implementation model is currently the most straightforward and potentially allows for the greatest market access and flexibility but entails business risks such as lack of certainty regarding grid extension plans.

60) Link: <http://www.rea.org.zm/about-us/remf.html> — accessed February 2019

61) Indicative figures are estimated to give a very rough idea of potential market size — they are not based on actual data

62) Personal communication REA 12/07/2018

TABLE 9. Mini-grid implementation models in Zambia⁶³

MINI-GRID MODEL	MODEL DESCRIPTION	EXAMPLES IN ZAMBIA
Utility	The state-owned or national level private utility company is responsible for the construction and operation of the grid. The utility company will normally only implement a mini-grid where there is a large demand centre far from the national grid and – given that mini-grids are often a non-core business – only if directed by the government. Such mini-grids may initially prioritise the electrification of public institutions and will usually charge the same tariff as for customers connected to the national grid, even if these tariffs are not cost-reflective, thus requiring viability gap financing.	ZESCO is the only utility and runs three mini-grids: — Shiwangandu hydro — 2 diesel mini-grids
Community	In the community model, a group of local residents, who may form a cooperative society or similar organisation, will build, own and operate a mini-grid. The community may receive support from a public agency or an NGO and may contribute in-kind resources. The mini-grid may be run on non-profit principles and charge minimal fees to ensure greater access.	REA developed one site operated by a community cooperative. Other mini-grids have been initiated by church missions: — Mpanta solar — Nyangombe hydro
Private sector	Under the private mini-grid model, a company will usually seek out sites that have the highest potential for a return on investment. Both remote sites (to avoid the risk of grid extension) and grid proximate sites (for easier access and higher ability to pay) may be targeted. Some developers will plan the mini-grid around one or more anchor load customers. The business will often look to build a portfolio of sites in “packages” for economies of scale. Private mini-grids will aim to charge cost-reflective tariffs and entice customers with low connection fees. Private developers will usually seek a combination of viability gap financing, equity and debt financing. The private sector may often be better suited to manage smaller mini-grids than utilities.	A number of private mini-grids are in operation: — Zengamina hydro — Sinda solar — Standard Microgrid
Public private partnership	Public-private partnerships entail the different actors taking on well-defined roles and responsibilities for the efficient implementation of a mini-grid. Often responsibility is broken down and allocated along the lines of development, financing, construction, operations and ownership. In some cases a public actor may grant a full concession to a company to build, own and operate in a geographic area	REA intends to seek a private partner for O&M and tariff collection for these projects: — Kasanjiku hydro — Lunga solar — Chunga solar

63) Expanded and adapted from EUEI-PDF (2014) Mini-grid Policy Toolkit: Policy and Business Frameworks for Successful Mini-grid Roll-outs and World Bank (2017) Electricity Service Access Project Appraisal Document

4.4 MARKET SEGMENTATION

The potential mini-grid market in Zambia can first be segmented by general location and then by typical customer types (Table 10). Ability and willingness to pay is another important consideration closely linked to customer type (see Box 1: “Ability and willingness to pay for electricity”).

TABLE 10. Zambia mini-grid market segment overview⁶⁴

General location	<ul style="list-style-type: none"> — Larger Rural Growth Centre (RCG) > 400 households — Smaller RGC < 400 households — Other rural areas — Peri-urban areas
Customer types	<ul style="list-style-type: none"> — Public institutions: schools, hospitals or health centres, markets, religious centre, community centre, post office, local government administration, water pump, etc. — Larger businesses: hammer mill, other agro-processor or small factory, telecom towers, welder, water pump), etc. — Smaller businesses: grocery shop, kiosks, carpenter, hair salon, phone and battery charging, tire repair shop, video hall, bars and cafes, etc. — Households.

GENERAL LOCATION

Rural Growth Centres and their environs

Rural Growth Centres (RGCs) are “rural localities with a high concentration of residential settlements and the centre of rural economic activities.” All RGCs are expected to have public institutions, markets and business enterprises. REA assumed one hammer mill for every 174 households. An annual demand growth rate of 2.9% is expected. An RGC provides services not only to its residents but also to inhabitants in the surrounding area. A map of RGCs is shown in Figure 22.

Countrywide, out of 1,217 RGCs, approximately 39% or 474 have more than 400 households and can be considered as larger load centres as compared to the 61% or 743 that are on the smaller size. According to information from REA based on experience in 2013–2017, the average off-grid site is assumed to require 110 household connections.⁶⁵ Where mini-grids are the most suitable rural electrification option, this general distinction can help guide potential segmentation by customer numbers.

Other rural areas

Other rural areas are more dispersed, have less centralised economic activity and are typically more remotely located. Except where there are potential anchor loads present (e.g. remote tourist lodges, agro-processors, hospitals and missions), smaller micro-grids (up to 15–20 kW) may be more suited to such areas.

Peri-urban areas

There may be potential for mini-grids in some peri-urban areas either where the ZESCO network is absent or where connectivity is low.

NON-RESIDENTIAL CUSTOMER TYPE EXAMPLES

Three examples of non-residential customer types are presented. Typical customer demand and consumption profiles are not provided in the Guide but can be found in the [GET.invest Model Business Cases](#).⁶⁶

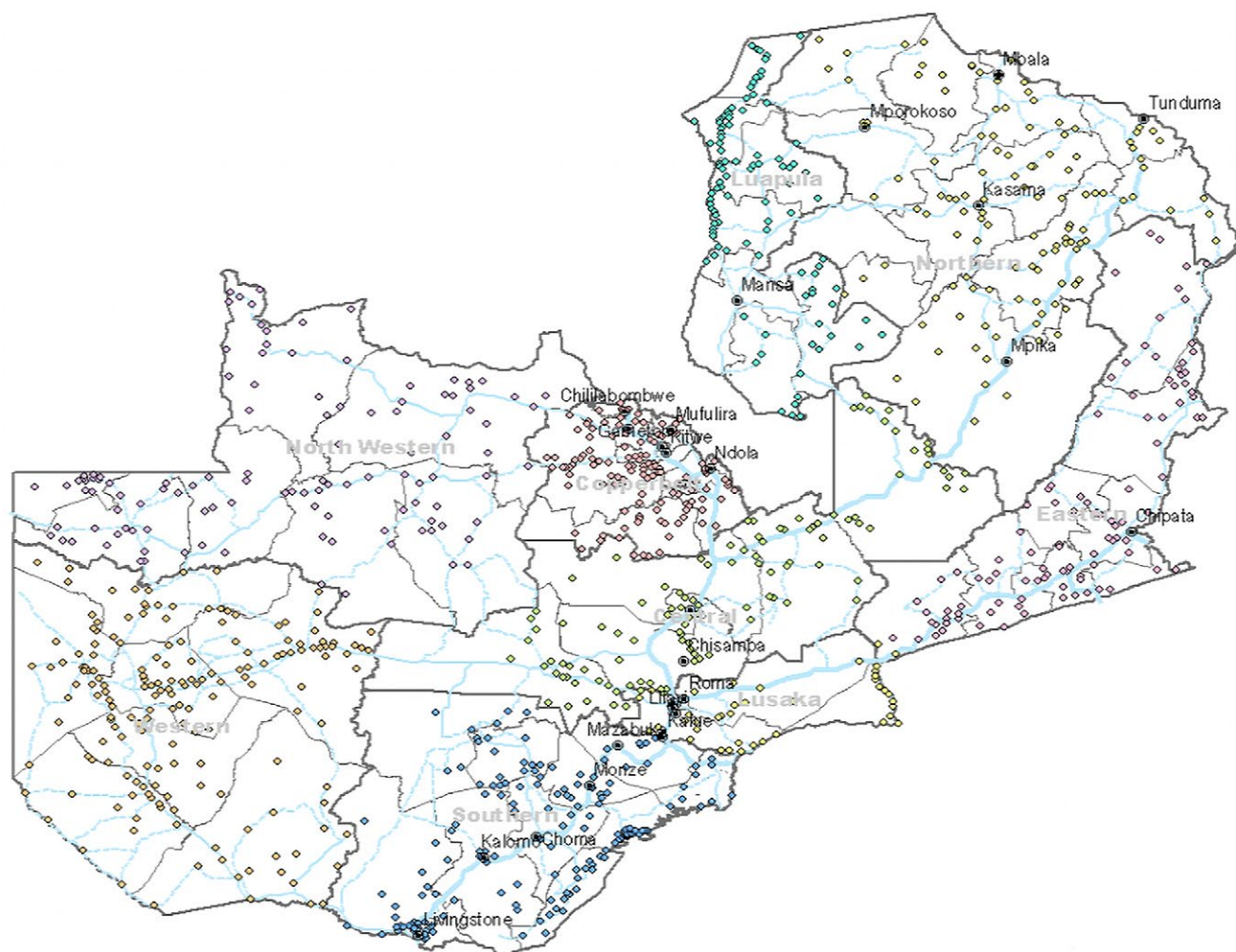
It should be noted that while the 2008 Rural Electrification Master Plan (REMP) has demand estimates for typical Rural Growth Centres, there are no estimates for other rural areas. Demand estimates in the REMP are based on a number of assumptions and due to site specific characteristics, developers should expect to do their own studies to assess customers and potential demand. As a case in point, at least one mini-grid in Zambia was reported to be significantly oversized and one developer has downscaled the generation capacity of its planned projects due to low demand projections. Where low demand is expected, mini-grid developers may consider providing access to reliable appliances or finding ways to stimulate productive use in addition to supplying electricity.

64) Based on a review of the Rural Electrification Master Plan and other information.

65) Personal communication REA 12/07/2018

66) Link: www.get-invest.eu – accessed February 2019

FIGURE 22. Map of Rural Growth Centres in Zambia, colour-coded by province, 2009⁶⁷



67) Rural Electrification Authority (2008) Rural Electrification Master Plan: 2009–2030, Chapter 13 GIS Database Development, p. 13–5.
Link: http://open_jicareport.jica.go.jp/pdf/11871027_05.pdf – accessed February 2019

BOX 1. Ability and Willingness to Pay for Electricity

Understanding the customer ability and willingness to pay for electricity services is key for a mini-grid developer in Zambia. These parameters will vary by location depending on factors such as economic activities, electricity service options availability, remoteness of the site, etc. Developers should therefore carry out their own site-specific surveys in order to collect customer data and design and size each mini-grid. Nevertheless, national level information on ability and willingness to pay for rural households can provide useful guidance.

Ability to pay

According to the 2015 Living Conditions Monitoring Survey, the average monthly income for households is ZMW 810 (EUR 68) in rural areas and ZMW 3,152 (EUR 265) in urban areas. Average expenditure in rural areas is ZMW 763 or EUR 64/month (ZMW 430 or EUR 36 on food and ZMW 333 or EUR 28 on non-food items). Using a benchmark of 10% of income for estimated ability to pay (ATP) for electricity, rural households might be expected to afford EUR 6.80/month. Rural households practicing larger-scale agriculture have the highest income.

Separately, Bloomberg New Energy Finance in their Off-Grid Solar Market Trends Report 2016 (p. 8) estimated that off-grid households in Zambia were spending USD 108 per year (approximately EUR 8.50/month) on lighting alone.

It should be noted that some agricultural households may face a lean period at the end of the “warm and wet” season (Nov-Apr), with tightened cash flows, which could affect ability to pay for electricity bills or upfront connection fees

Willingness to pay

The World Bank Electricity Service Access Project document in 2017 reported the results of two recent studies — ERB International 2015 Feasibility Study for the Project “Sustainable Electricity Supply Southern Division” and a second one not referenced — as follows:

STUDY AREA	HOUSEHOLD WTP PER MONTH	INSTITUTION / COMMERCIAL WTP PER MONTH
Southern Zambia	*USD 12.60 / EUR 10.60	USD 45.70 / EUR 38.45
Off-grid areas	USD 7.00 / EUR 5.89	USD 20.00 / EUR 16.83

* Household estimated WTP was for basic lighting, radio, communication and television

For connection charges, the World Bank in the same document assumes that last-mile customers will be able and willing to pay ZMW 250 (EUR 21) for households and ZMW 768 (EUR 64) for small businesses.

The World Bank also expects that a new ZESCO household customer will consume about 91.03 kWh per month (which might be high for some rural households). At current ZESCO tariffs, this works out to a monthly electricity bill of EUR 2.75 before VAT (16%) and Excise Duty (3%).

Actual payments for electricity

The 2008 Rural Electrification Master Plan has information on ATP and WTP. However, this is based on older data and may no longer be representative especially given the effects of inflation. At the time, actual monthly expenditure on electricity in electrified RGCs (ZESCO tariff) was ZMW 52.29 (EUR 4.39) for households and ZMW 201.60 (EUR 16.93) for businesses.

For the electricity tariffs being paid by existing mini-grid customers see [Section 5.5](#).

Schools

According to the 2015 Education Statistics Bulletin, there are approximately 9,636 schools offering grades 1–12. Of these, 8,800 schools are primary schools, while 830 are secondary schools. Approximately 70% of primary and 18% of secondary schools lack access to electricity. This suggests some potential for mini-grids to electrify schools. The REMP notes average monthly energy consumption for primary schools at 331 kWh, and that for secondary schools at 54 kWh. The disparity in average demand between primary and secondary schools is unknown. This adds up to a potential unmet school electricity services demand of over 2 million kWh per month. However, it should be noted that public electrification efforts — including with standalone systems — are also likely to target education institutions.

Health clinics

According to the 2012 “List of Health Facilities in Zambia”, there are approximately 2,000 health facilities in the country. 1,100 health facilities are described as “Rural Health Facilities”, which serve catchment areas of up to 10,000 residents and 307 health facilities are described as “Health Posts”, which serve

remote areas of up to 3,500 residents, providing only the most basic first aid services. Approximately 10% of all health facilities rely on diesel-based generation (which may include ZESCO isolated grids), 37% rely on solar PV, and approximately 13% are off-grid. The remaining 40% have grid electricity. However, a 2009 USAID study of electrification opportunities for health facilities indicated that as much as 66% of health centres and rural health posts were off-grid, or underserved — i.e. did not have access to electricity services beyond basic lighting and communications.

Per a recent study on electrifying rural health clinics, Health Posts and Rural Health Facilities in Zambia may be approximated to facilities requiring basic and intermediate access to electricity services, respectively, Tier 2 and Tier 3 as per [Table 11](#). The REMP similarly notes average monthly consumption for a rural health clinic at 337 kWh, which falls within Tier 3 service delivery.

As with schools, health centres are also being prioritised by public electrification efforts. However, where a health centre is located at an available mini-grid site and does not already have a standalone solar system, the above indicative demand figures would be useful.

TABLE 11. Proposed multi-tier measurement of electricity supply in health facilities⁶⁸

	TIER 1 MINIMAL ACCESS	TIER 2 BASIC ACCESS	TIER 3 INTERMEDIATE ACCESS	TIER 4 ADVANCED ACCESS	TIER 5 FULL ACCESS
Peak power capacity Watts (W)	5–69	70–199	200–1,999	2,000–9,999	> 10,000
Daily energy capacity Watt hours (Wh) per day	20–279	280–1,199	1,200–31,999	32–220 kWh per day	> 220 kWh per day
Duration of supply Hours per day	> 4	> 4	> 8	> 16	> 23
Evening peak hours supply Hours per day	—	> 2	> 2	4	4

68) Adapted from World Health Organization (2015) Access to Modern Energy Services for Health Facilities in Resource-Constrained Settings: A Review of Status, Significance, Challenges and Measurement, p. 55. Link: <https://tinyurl.com/y7dq2rrd> — accessed February 2019

Telecommunication towers

Telecommunication towers are potential anchor clients for mini-grids. Telecommunication base transceiver stations and repeater sites (VHF, UHF and cellular) for data, video and voice communication typically have a demand of between 5–15 kW per site. As of 2016, the largest tower company in Zambia (IHS Africa) had 10% of its masts off-grid (approximately 170 towers out of 1,714) in rural areas. Although IHS Africa has already been installing solar battery and solar hybrid systems to reduce reliance on diesel generators, it may also welcome electricity services provided by renewable mini-grids.

4.5 COMPETITIVE LANDSCAPE

The mini-grid landscape in Zambia is nascent but rapidly evolving. In 2017 and 2018, five new solar PV mini-grid market entrants came on the scene.

The main established private players on the solar side are Muhanya Solar, who have one operational mini-grid and Standard Microgrid in partnership with the NGO Empowered by Light, with three operational micro-grids. Supported by the Beyond the Grid Fund for Zambia, Standard Microgrid is now planning to install 150 microgrids by 2021. More recent entrants include Sigora Zambia who have selected their first site and Entiba Energy who have one pilot site under development and have identified 40 more. AMPS Zambia and ENGIE / PowerCorner are planning pilot projects as is the Green Knowledge Institute. FuturaSun and ePower Holdings have also explored the market. PowerGen built their first mini-grid in Zambia but have since shifted focus to East Africa.

In addition to solar mini-grid developers, there are more than 50 standalone solar system installation companies and solar lantern distributors licensed in Zambia. There is at least one operational provider of mobile money-enabled Pay-As-You-Go (PAYGO) SHS solutions, with several new market entrants launching operations in 2016 and 2017 thanks in part to results based financing from Sida (see [Section 6.3](#)). These companies could become either competitors to or potential partners for developers, especially in more remote areas that may be targeted with smaller scale mini-grids.

There is only one private hydropower mini-grid developer, who is also interested in the small IPP business: Hydro Electric Power Limited set up by the team behind the Zengamina project.

4.6 OUTLOOK ON MARKET DEVELOPMENT

Given the challenges being faced by public electrification efforts and the amount of funding required to reach the government's targets, it is likely that private sector investment in renewable energy mini-grids will find an increasingly warm welcome in Zambia. Two examples of this are [a](#)) the government's intention to establish public private partnerships (PPPs) for the operation of three renewable energy mini-grids built by REA and [b](#)) the country's willingness to attract and enable international funding programmes in support of private mini-grids (see [Section 6.3](#)) and other means of off-grid electrification. However, it should be noted that a formal PPP may take time to establish because although there is a regulatory framework (the PPP Act of 2009) there is not much experience in Zambia and no subsidiary regulations have been implemented to provide details and clarifications.

At the same time, the Government of Zambia in addition to the EU, Sida, the World Bank and the IFC — among others — all plan to help improve the enabling environment:

- The Ministry of Energy has launched the *Zambian Off-Grid Energy Taskforce*, a government-led body convening representatives of relevant government ministries, the private sector and the international donor community to coordinate initiatives and activities in the off-grid electrification sector. The Taskforce met for the first time in April 2018 and constituted a sub-committee to redraft the Statutory Instrument that defines tariff exemptions for the importation of solar equipment and to address inconsistencies in customs procedures to facilitate the importation of solar equipment.
- The EU is supporting the adjustment of policies and the legal and regulatory framework to streamline procedures for investors for energy access and will help enhance the capacities of the government agencies that play a role in facilitating market entry. This will include a review of environmental processes and requirements
- The EU and the IFC are assisting ERB to define a mini-grid tariff framework taking into account best practice, which may include a light-handed approach for tariff setting
- Sida is working with partners to build a market platform intended to convene the government, donors, entrepreneurs, academia, financial institutions and investors to create a deeper understanding of the off-grid market.

- The World Bank plans on **a)** reviewing the legal and regulatory framework and providing recommendations, **b)** clarifying and documenting requirements and procedures for licenses and permits and **c)** supporting authorities to streamline processes and develop light-handed regulations, where appropriate, for off-grid and mini-grid systems. In addition, the Zambia Renewable Energy Agency (ZARENA) has formed an association to promote and support all renewable energy enterprises.
- One major development is the preparation of a National Electrification Strategy (NES) that will include updated geo-spatial planning, identification and scoping of sites, support for private participation and clarification of roles and responsibilities for ZESCO, REA and the private sector. As part of this work, efforts led by the IFC are underway to identify sites most suitable for mini-grid development, using GIS analysis and site-level data. This off-grid market assessment will include data on willingness and ability to pay for energy services for both rural households and businesses. One intended outcome of the NES is that it will be used to guide national grid extension planning. The NES is expected to be ready in 2019.
- The IFC is developing a mini-grid information portal (similar to what is available for Tanzania⁶⁹). The portal will provide GIS and site information and will contain key documents and guidelines (policies, laws, procedures) available for the sector.

69) See: www.minigrids.go.tz – accessed February 2019

SECTION 5

How to Develop Solar and Hydro Mini-Grids in Zambia



This section provides information on important steps and regulatory considerations to develop a solar PV or hydro mini-grid in Zambia, starting with some general insights.

Market entry and partnerships

For an international developer, establishing a partnership in Zambia is highly recommended to make use of local skills, knowledge and networks. Solar suppliers, water pump distributors, ICT companies or logistics companies with presence in rural areas are possible options. Partnerships between solar home system and mini-grid businesses may also be worthwhile.

Local supply and know-how

Depending on the type and size of the mini-grid, most components may need to be imported for reasons of packaged EPC economies of scale, specifications and warranty. There exist developers from Zambia with the capacity to perform technical and financial feasibility assessments. Installation can also be done locally. Project owners should plan to invest in training staff to be responsible for operations and maintenance.

Timeframe

For companies who do not already have a presence in Zambia, it should be recognized that it might take 6–18 months before a first site is identified and project approved.

5.1 INVESTOR PROTECTION AND PROCEDURES

In 2017, Zambia was ranked at 85 out of 190 countries in terms of overall ease of doing business and 118 out of 137 countries in 2016 based on key indicators for global competitiveness.

The Zambian Development Agency Act⁷⁰ of 2006 provides several investment promotion measures and protections afforded to investors in Zambia. For example, the Act stipulates that an investor's property shall not be compulsorily acquired except for public purposes under an Act of Parliament and that investors will be compensated for any such acquisitions. The Act also enables foreign investors to transfer funds out of Zambia, in foreign currency, after the payment of relevant taxes.

These funds may be in the form of dividends or after-tax income, the principal and interest of any foreign loan, management fees, royalties, and other charges in respect of any agreements or the net proceeds of the sale or liquidation of a business enterprise. The Zambian Development Agency (ZDA) established under the Act can play a facilitation role for investors (see [Section 5.3](#)).

5.2 BUSINESS REGISTRATION AND TAXATION

BUSINESS REGISTRATION

All potential companies in Zambia are required to be registered with the Patents and Companies Registration Agency⁷¹ (PACRA). PACRA administers and attends to matters incidental to the Companies Act.⁷² The Companies Act provides for the incorporation, management, administration and winding up of companies, including registration of names. The Act also provides for the registration of foreign companies doing business in Zambia. Currently there are no local ownership requirements for registering a business in Zambia. However, as per section 208 of the Act, more than half of the directors of a company must be resident in the country. PACRA applies a registration fee of 2.5% to increases and reductions in the share capital of a company incorporated in Zambia. PACRA also administers a number of laws relating to patents, trademarks, registered designs and the creation of security interests in movable property.

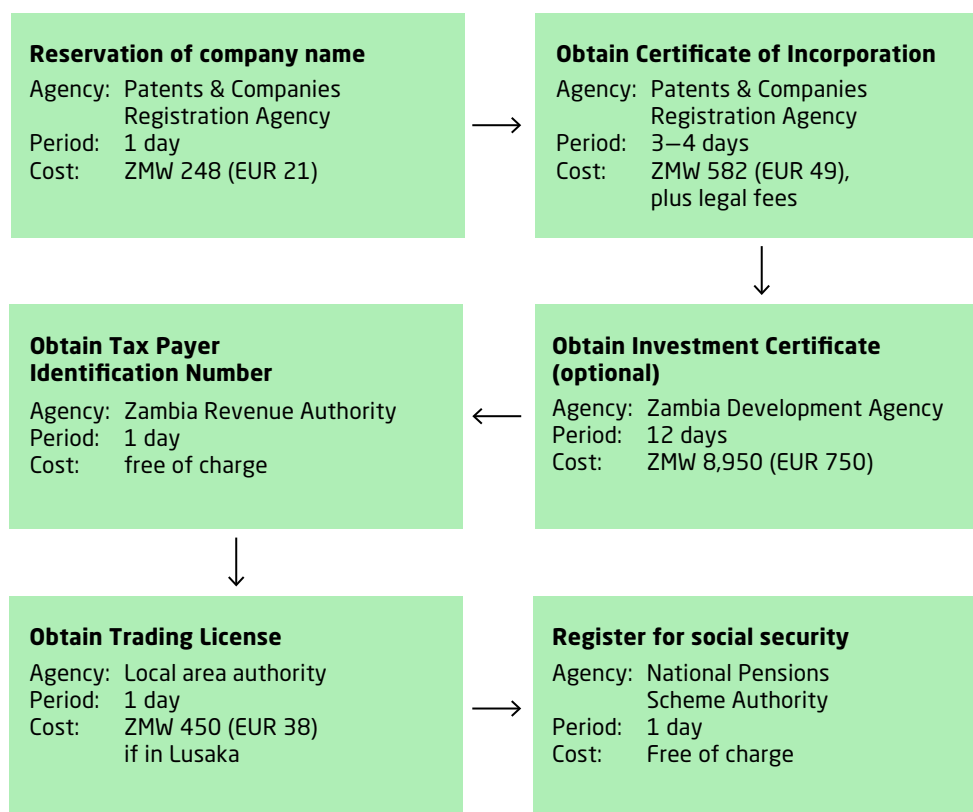
The process of starting a business (private company limited by shares) is as follows:

70) Link: http://ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=90114&p_country=ZMB&p_count=182 – accessed February 2019

71) Link: <https://www.pacra.org.zm> – accessed February 2019

72) Link: <http://www.parliament.gov.zm/sites/default/files/documents/acts/Companies%20Act.pdf> – accessed February 2019

FIGURE 23. Process of starting a business in Zambia



Full information on registering a business and complying with annual filing requirements with PACRA can be found on the [PACRA website](https://www.pacra.org.zm).⁷³

Under the [Trades Licensing Act](#),⁷⁴ a company operating within the jurisdiction of any municipality (e.g. Lusaka, Kitwe, Chipata, etc.) needs an annual business permit from relevant local authority (e.g. Council). In addition, as much of the rural areas are administered under customary law and are overseen by area chiefs, it is advisable to consult with all local authorities prior to beginning commercial activities.

BUSINESS TAXATION

In addition to being registered with PACRA, all companies, local or foreign, must register with Zambia Revenue Authority (ZRA) for corporate income tax, Pay as You Earn (PAYE) income tax on employment earnings and possibly Value Added Tax (VAT), depending on the scope and scale of the business.

The main national tax laws that are relevant are:

- Income Tax Act
- Value Added Tax Act
- Customs and Excise Act
- Property Transfer Tax Act

73) Link: <https://www.pacra.org.zm> – accessed February 2019

74) Link: <http://www.parliament.gov.zm/sites/default/files/documents/acts/Trades%20Licensing%20Act.pdf> – accessed February 2019

Income tax

The [Income Tax Act](#)⁷⁵ requires limited companies, partnerships, and self-employed individuals to pay a tax on profits made. The corporate income tax rate is generally 35%, although for companies with an annual turnover of not more than ZMW 800,000 (EUR 67,165) a monthly turnover tax is applied instead. There are six different turnover tax bands with a fixed base amount and a monthly rate of 3% on the balance.

Withholding Tax (WHT) is tax withheld on income at source. WHT obligations vary depending on the nature of the payment and residency status. Relevant WHT rates are 15% on dividends and interest, 15% on local management and consultancy fees and 20% on foreign management and consultancy fees, except if stipulated otherwise in a double taxation treaty.

As of early 2018, Zambia had signed tax treaties with Botswana, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, Kenya, Mauritius, Netherlands, Norway, Romania, South Africa, Sweden, Switzerland, Tanzania, Uganda and the United Kingdom. Further information can be found at the [ZRA website](#).⁷⁶

For income tax on employment earnings, Pay as You Earn (PAYE) tax is levied at 37.5% on amounts above a lower taxed tiered monthly threshold of ZMW 2,100 (EUR 176). An example of the PAYE tax calculation can be found on the [ZRA website](#).⁷⁷ Monthly filings to ZRA are required.

Information on the taxation of business profits, tax computation, provisional tax, declaration reporting requirements and taxpayer rights can be found via the ZRA website.

Value Added Tax

Value Added Tax (VAT) is a consumption-based tax that is currently set at 16% for standard rated supplies. It is levied in the supply chain at each point where value is added to a good or service. When importing products that are not zero rated or exempted from VAT, it is paid at the point of entry. VAT on imports is charged on the taxable value, which includes the customs duty.

The Value-Added Tax (Zero Rating) (Amendment) (No.2) Order, 2008 to the Value-Added Tax (Zero Rating) Order 1996 stipulates zero rating for the solar products found in [Table 12](#).

TABLE 12. Zero-rated energy saving appliances, machinery and equipment⁷⁸

ITEM	TYPE
Photovoltaic panels	—
Solar batteries	— lead acid, of kind used for starting piston engines; — other lead acid accumulators; — nickel cadmium; — nickel iron; — other accumulators
Static converters	Inverters for solar power
Electric generating sets	— generators with compression ignition internal combustion piston engine (diesel or semi diesel generators); — generators with spark ignition internal combustion piston engines (petrol generators)

Plant and equipment for hydro mini-grids may be subject to VAT. In such a case, VAT deferment on imports of eligible capital goods can be available.

Mini-grid operators will be required to add VAT to electricity sales. The annual income threshold for VAT registration is ZMW 800,000 (EUR 66,165). Further information regarding VAT in Zambia is found via the [ZRA website](#).⁷⁹

Customs duty and excise tax

Customs duty collected at the point of entry to Zambia is calculated on a Cost Insurance and Freight (CIF) basis. Most goods fall into one of three tariff bands: **a)** capital equipment and raw materials — 0–5%, **b)** intermediate goods — 15% or **c)** finished goods — 25%.

75) Link: <http://www.parliament.gov.zm/node/1292> – accessed February 2019

76) Link: <https://www.zra.org.zm/> – accessed February 2019

77) Link: <https://www.zra.org.zm/commonHomePage.htm?viewName=PAYE> – accessed February 2019

78) World Bank (2017) Electricity Service Access Project, p. 112

79) Link: <https://www.zra.org.zm/commonHomePage.htm?viewName=ValueAddedTax> – accessed February 2019

The following goods had a customs duty of 0% as of January 2015:

- Hydro turbines, generators and transformers
- Photovoltaic panels, inverters and solar batteries (e.g. lead-acid and lithium-ion)

Imported steel piping and electric cables had a customs duty of 15% and 25%, respectively. However, imports from COMESA or SADC countries may be duty free under the common single market.

For mini-grids, there are two excise taxes⁸⁰ to consider:

- Electrical energy — 3% as of April 2018. A private mini-grid will likely need to add this excise tax to their customers' electricity bills, which is used for the Rural Electrification Fund.
- Cement — ZMW 40 (EUR 3.32) per tonne as of April 2018

In reality, companies have experienced difficulties in the application of VAT and customs duty. This is largely due to lack of specificity in some areas, e.g. lithium-ion batteries are explicitly excluded from customs duty but are left out of the list of battery types that are zero-rated for VAT. Developers should confirm the most up to date processes for zero rating and VAT exemptions with ZDA, which offers to facilitate communications with ZRA on this issue as a service to investors. Developers that have been wrongfully charged are able to appeal with ZRA, or, if needed, with the Tax Appeals Tribunal.

Property tax

The Property Tax Act⁸¹ provides for a tax of 5% of the value of a transfer of land, including any improvements on it, shares issued by a privately held Zambian company and intellectual property. The tax is payable by the vendor. See ZRA website.⁸²

Tax regulation is subject to change, therefore it is advisable to obtain the latest information from ZRA and consult with a professional tax advisor to ensure full compliance.

5.3 BUSINESS INCENTIVES AND TAX EXEMPTIONS

Companies considering setting up in Zambia should consult the Zambian Development Agency⁸³ (ZDA) first, which can help access both fiscal and non-fiscal investment incentives, in addition to providing investors with a range of coordination services. In the energy sector, the ZDA can assist developers to liaise with institutions including ERB, OPPPI, ZRA, ZEMA and the Ministry of Lands and Natural Resources for the necessary approvals and licenses required for a private mini-grid. ZDA has a One-Stop-Shop⁸⁴ for business registration and can provide both an investment licence and an Investment Promotion and Protection Agreement.⁸⁵ While it is not mandatory to involve ZDA in investment and project development procedures, its support may be beneficial. Full information about the services offered via ZDA can be found at the ZDA website.⁸⁶

Investors of eligible projects that invest more than USD 500,000 (EUR 420,000) or its equivalent in a multi-facility economic zone, an industrial park or a priority sector (including energy), or invest in a rural enterprise as defined under the ZDA Act can receive favourable tax and import duty incentives. Per the Zambia Development Act: "rural business enterprise" means a business enterprise located in a rural area." Per the 2015 LCMS, the Central Statistical Office defines an urban area as **a)** one having a minimum population size of 5,000 people, **b)** a main economic activity that is non-agricultural, **c)** and basic modern facilities such as piped water, tarred roads, post office, police post/station, and health centre. An area without these characteristics could therefore be considered rural.

80) Link: <https://www.zra.org.zm/commonHomePage.htm?viewName=Excise> – accessed February 2019

81) Link: <http://www.parliament.gov.zm/node/1302> – accessed February 2019

82) Link: <https://www.zra.org.zm/commonHomePage.htm?viewName=PropertyTransferTax> – accessed February 2019

83) Link: <http://www.zda.org.zm> – accessed February 2019

84) Link: <http://www.zda.org.zm/?q=content/one-stop-shop> – accessed February 2019

85) Link: <https://tinyurl.com/ybdp9xfa> – accessed February 2019

86) Link: <http://www.zda.org.zm/> – accessed February 2019

Fiscal incentives that mini-grid developers may be entitled to are:⁸⁷

- Accelerated depreciation of capital expenditure.
- Zero per cent import duty on capital goods, machinery, and specialized motor vehicles for five years.

Non-fiscal incentives, that are also available to projects with a smaller investment size of between USD 250,000 and USD 500,000 (EUR 210,000 and EUR 420,000), include investment guarantees, protections against nationalization and facilitation of an investor work permit.

In addition, tax losses can be carried forward for up to 10 years for electricity generation projects. Furthermore, micro and small enterprises in urban areas may be exempt from income tax for the first three years of operation, while those in rural areas may be exempt for the first five years.

The ZDA has created a general 2016 [investor guide](#)⁸⁸ and a specific guide for the [energy sector](#)⁸⁹ — however, they do not incorporate changes to the law made in 2017 and 2018.

5.4 IMPORTATION PROCESS

The majority of imports are delivered through the port at Dar es Salaam; however, ports at Beira and Durban are also used. From the time of reaching port, it can take about 15 days to assign a truck, while crossing the port of entry can take up to 10 days. In total, a period of two or three months could be expected. For example, one report noted that importing a container from Durban takes about 53 days due to the distance, documentation, handling and clearance time. And for each day that a container is delayed at the point of entry, demurrage may be incurred. For one entrepreneur, storage fees at one border entry were EUR 375 per day per 20-foot container.

Zambia uses the UNCTAD Automated System for Customs Data and Management (ASYCUDA). Typical documentation such as a billing of lading and invoice are needed to clear goods with customs. An Import Declaration Form must be completed but there is no fee charged. For certain products as stipulated by the Zambia Bureau of Standards⁹⁰ (ZABS), a pre-export verification of conformity (PVOC) is needed in the country of origin. A Certificate of Conformity (CoC) is issued by a PVOC agent and is required for customs clearance to avoid denial of entry. A list of the applicable products is available [here](#).⁹¹ Currently some mini-grid equipment — such as power supply generators — are excluded, although ZABS may still request confirmation of quality certification by the standards body in the country of origin, which can be provided by the manufacturer.

5.5 ENERGY SECTOR REGULATIONS AND LICENSING

The renewable energy mini grid sector in Zambia is still evolving and some regulatory gaps are being addressed at the time of writing this Guide. Therefore, project developers are advised to confirm the latest status of licensing and regulations with the concerned authorities.

This section details the required steps to comply with electricity sector regulations and licensing by autonomous solar and hydro mini-grids supplying multiple customers. It is worth noting that there are currently no specific regulations for mini-grids and that while some of the steps and requirements may have been intended for large projects they are also applicable to smaller mini-grids. Nevertheless, the Energy Regulation Board (ERB) does seem to be open to applying light-handed regulation for the sector, in particular for smaller mini-grids.

Procedures for environmental licencing, water permitting and land rights acquisition are found in [Section 5.6](#). An overview table of all the main development and licensing steps is provided in [Annex D](#), which also has considerations for site identification and the possibilities for exclusivity.

87) Note: A five-year income tax holiday for new eligible businesses and exemption of withholding tax on dividends for the first five years were revoked as of 1 January 2018. PwC (2018) Zambia corporate tax, significant developments: Link: <http://taxsummaries.pwc.com/ID/Zambia-Corporate-Significant-developments> — accessed February 2019

88) Link: <http://www.zda.org.zm/?q=content/investment-Guide-zambia> — accessed February 2019

89) Link: <http://www.zda.org.zm/?q=content/energy> — accessed February 2019

90) Link: <https://www.zabs.org.zm> — accessed February 2019

91) Link: https://www.cma-cgm.com/static/eCommerce/Attachments/Zambia_111115.pdf — accessed February 2019

ELECTRICITY LICENSING

Electricity generation, transmission, distribution and supply licenses are issued by ERB under the Electricity Act⁹² of 1995 and its amendments, subsidiary legislation and related guidelines including:

- The Energy Regulation Act of 1995⁹³ (and 2003 amendment)
- The Electricity (Licensing) Regulations of 1998 (currently only available in hard copy from the Government Printer)
- The Electricity (Supply) Regulations of 1995 (embedded in the Act)
- The 2014 Power Quality Management Framework for the Electricity Supply Industry in Zambia⁹⁴

The 2011 Licensing and Investment Endorsement guidelines for Projects in the Electricity Sub-Sector and the Procedure for Approval of Projects in the Electricity Sub-Sector (both available here⁹⁵) provide further guidance for developers. Lastly, the developer may need to adhere to the Electricity (Grid Code) Regulations of 2013⁹⁶, the Distribution Grid Code of 2016⁹⁷ and relevant standards (see next), especially where a mini-grid may become grid-connected in the future.⁹⁸

Requirement for an electricity licence

All autonomous mini-grids of all sizes and technologies that supply electricity to third parties require a generation, distribu-

tion and supply licence.⁹⁹ ERB issues licences with the following periods of validity:

- Generation (30 year validity)
- Transmission (30 year validity)
- Distribution (15 year validity)
- Supply (5 year validity)
- For mini-grids only, combined generation, distribution and supply (20 year validity)

The combined generation, distribution and supply licence is issued to mini-grids as part of light handed regulation in the off-grid sector.¹⁰⁰

The combined license is only issued by ERB once the mini-grid has been built and before commissioning. For the development and construction period, developers should apply for an ERB Investment Endorsement (see next).

It should be noted that two potential licence exemptions exist that are not applicable to mini-grids that supply electricity to customers:

- In accordance with the Electricity Act, a mini-grid with an installed capacity of less than 100 kW is exempted from obtaining an electricity license if it is solely for own use.
- As per section 2.7 of the Distribution Grid Code, a “micro/mini-embedded generation installation” — defined as a generator connected at the distribution voltage level with a name plate capacity of up to 10 kVA single phase and 30 kVA three phase — is exempt from a generation licence. This exemption is intended for potential net metering customers.

There is also a 5-year license issued by ERB for Manufacturing, Wholesale Importation, and Installation of Solar Energy

92) Link: <http://www.parliament.gov.zm/node/1456> – accessed February 2019

93) Link: <http://www.erb.org.zm/downloads/legislation/Energy%20Regulation%20Act.pdf> – accessed February 2019

94) Link: <https://tinyurl.com/yc2qmhzz> – accessed February 2019

95) Link: <http://www.erb.org.zm/content.php?viewpage=gjee> – accessed February 2019

96) Link: <http://www.erb.org.zm/press/ZambianGridCodePublicNotice.pdf> – accessed February 2019

97) Link: <https://tinyurl.com/y9jt98sd> – accessed February 2019

98) Distribution is defined in the Electricity Act as “the transportation of electricity on high voltage, medium voltage and low voltage systems for delivery to the final consumers but does not include supply.” This means that a micro-grid with a low voltage network may need to adhere to the Distribution Grid Code, even though the Distribution Grid Code considers typical distribution networks to be at voltage levels of between 11 kV and 66 kV

99) There are older, smaller, non-commercial hydro mini-grids supply multiple users (e.g. Nyangombe, Lwawu, Luene and Mangongo as found in [Table 7](#)) that are not on ERB’s record and are not licensed

100) Personal communication ERB 06/07/2018, see also: http://www.iec.ch/affiliates/pdf/workshops/2015_zambia.pdf – accessed February 2019

Systems¹⁰¹ that is not applicable to the importation of solar energy products for own use (i.e. not meant for sale), such as for a mini-grid project. However, developers must apply to ERB for a formal grant of a waiver so as to avoid issues with ZABS and ZRA at the border when importing solar equipment.

Electricity licensing procedure

Up to when this Guide was published, there was no competitive procurement process in place for mini-grids. Developers could apply for a license on an unsolicited basis.¹⁰²

Investment Endorsement

Once a potential solar PV or hydropower mini-grid site has been identified and assessed (see [Annex D](#)), a developer should apply to ERB for an Investment Endorsement. While an Investment Endorsement is not a legal requirement in the process, it is highly recommended as it gives a good degree of certainty that **a)** ERB will later issue the license, **b)** provides for pre-approval of the project and the mini-grid tariff, and **c)** can be used in support of obtaining funding for the project.

Investment Endorsements are specific to a site and are usually valid for a period of one year, which is renewable upon sufficient grounds and evidence of progress or any justified cause. There is no fee for the endorsement. A template Investment Endorsement for a generation project is available [here](#).¹⁰³

Project construction (but not commissioning) is allowed with an Investment Endorsement. However, one mini-grid developer in Zambia was allowed to build and commission a recent project without an ERB Investment Endorsement or a (provisional) license, with the tariff approval and licensing coming after the fact. This may have been due to the specific circumstances of the project and not to be expected in most cases.

Upon approval, the developer must report periodically on progress towards agreed project milestones¹⁰⁴ and inform ERB in case of any material changes to the project. In case of a material change (capacity expansion, network or customer increase by

more than 5%) then ERB must review and determine if a new endorsement is needed. ERB may also amend the endorsement conditions to take into account new information that may become available.

Risks for developers remain as ERB has the discretion to decide whether the terms of the Investment Endorsement, including the tariff, will be included in the electricity licence or varied.

The steps to apply for an Investment Endorsement are as follows:

- The developer completes the application form available on the [ERB website](#).¹⁰⁵ The application must include and be accompanied by information and documentation such as:
 - a)** The location and technical description of the project
 - b)** Company shareholders
 - c)** Estimated costs and financing agreements
 - d)** Technical and economic justification of the validity of the costs
 - e)** The proposed tariff(s) and the costs included in its calculation
 - f)** Documentation such as a certificate of incorporation, 5-year business plan, proof of available funds and audited financial statements (if available)
 - g)** A decision letter from the Zambia Environmental Management Agency (ZEMA) granting the project a no objection or environmental approval (see [Section 5.6](#))
 - h)** Evidence of formal access to land under customary or state tenure (see [Section 5.6](#)). A consent letter or lease agreement is sufficient, a title deed is not necessary
 - i)** Evidence of local authority consent. Where the project is on state land, a “zoning approval” that demonstrates that the project is within the development plans of the local council is required. For customary land, the consent of the local chief (traditional leader) is required.

101) Link: <http://www.erb.org.zm/downloads/licensingProcedureForSolar-ImportersDealers.pdf> – accessed February 2019

102) A future off-grid Public Private Partnership procurement programme for mini-grid developers may be a possible component of the National Electricity Strategy and updated rural electrification planning

103) Link: <https://tinyurl.com/ycq79ox5> – accessed February 2019

104) The specific milestones and timing of the reporting are agreed between ERB and the developer

105) Link: <http://www.erb.org.zm/content.php?viewpage=gjee> – accessed February 2019

- The ERB Board will review and consider the application. Particular attention is paid to the suitability of the project and the costs that are allowed for the tariff calculation. ERB will perform an economic evaluation for the purpose of tariff determination. At any time during the review ERB may request further information or undertake a site visit. Sometimes ERB only conducts site visits at the licensing phase.
- Next, ERB will provide the developer with a draft Investment Endorsement that stipulates the permissibility of costs, the tariff indication and various conditions that require adherence. ERB and the developer will meet to discuss the draft endorsement.
- The final Investment Endorsement will be issued – or the application rejected – by ERB taking into account the information made available. The endorsement will state the approved technical specifications for the project, the applicable tariff, the geographical area and the implementation timeframe. The record of an endorsement, less confidential information, will be made publicly available.

Combined generation, distribution and supply mini-grid license

Once all other approvals are in place and the project has been built, the developer should apply for the combined generation, distribution and supply **mini-grid license**. The license is valid for a specific geographical area.¹⁰⁶ Usually a **provisional license** is first provided, and may even be made available during the public notice period (see next). Commissioning of the project is allowed with the provisional licence, which is valid until the **standard license** can be issued. The standard license is issued later because ERB Board approval is required and the Board only meets about once per quarter. Licenses cannot be issued before the project is built, which, even with the assurances of an Investment Endorsement, still implies some risk for investors.

The procedure for the mini-grid licence application is as per the Electricity (Licensing) Regulations, which stipulate the form¹⁰⁷ that a license application must take, information to be provided¹⁰⁸ and the fees to be paid. The application steps and the

fees are described next (see [Annex C](#) for a schematic overview of the steps):

- For each mini-grid license the developer must submit an application to ERB with similar information to that required for an Investment Endorsement, as updated if needed (e.g. if any of the project parameters have since changed). In addition, the application should include:
 - a) A copy of the Investment Endorsement, if any
 - b) Additional documentation including latest PACRA annual return (if available), latest Tax Clearance Certificate from ZRA, which is issued biannually as of 1 January 2017 upon request from ZRA,¹⁰⁹ residence permits for foreign directors or shareholders and proof of residence of directors (e.g. utility bill or tenancy agreement)
 - c) For hydropower mini-grids, the source and quantity of water supply and a water rights or abstraction permit from the Water Resources Management Authority (WARMA – see [Section 5.6](#))
 - d) For hydropower mini-grids in particular, consent from the National Heritage Conservation Commission (NHCC) confirming that a site is not classified as a national or cultural heritage site (see [Annex D](#))
- The application form should be submitted in triplicate to ERB.
- ERB will acknowledge receipt of the duly lodged application and conduct technical and economic assessments. At this stage, ERB will likely conduct a physical inspection of the project to ensure compliance with technical standards. ERB will also confirm the financial capability of the applicant. Once the developer has passed both the technical and the economic assessment, a non-refundable, one-off processing fee must be paid to ERB, being 0.1% of the cost of the planned investment.

¹⁰⁶) But may not provide exclusivity for supply (see [Annex D](#))

¹⁰⁷) Link: <http://www.erb.org.zm/downloads/legal/erbLicenceAppForm.pdf> – accessed February 2019

¹⁰⁸) Link: <https://tinyurl.com/ybumkw3t> – accessed February 2019

¹⁰⁹) The length of time required for issuance of the Tax Clearance Certificate is highly variable

- If the outcome is positive, the application will be advertised by ERB in the government Gazette.¹¹⁰
- If after a prescribed 30-day notice period from the date of advertisement, no adverse reports or objections are received, ERB will ordinarily proceed to issue the license.

The official timeline for license issuance is 60 days from receipt of application. This consists of 30 calendar days for ERB administrative processes and the 30 days statutory gazetting period. In some cases a licence could take longer to obtain, for example if the Gazette delays in publishing the notice. The expedience with which the license will be processed also depends in large part on the completeness of information provided.

The license will be issued with terms and conditions, one being that the developer will pay the requisite fees, being a monthly fee of 0.7% of monthly gross turnover of the business (this may be increased to the maximum 0.8% allowed in the Energy Regulation Act amendment of 2003). A sample generation license (for an IPP) is available here.¹¹¹ If the developer moves the project to a new site, the license can be amended.¹¹² A license can also be transferred to another developer with ERB's consent, which cannot be unreasonably withheld.

Renewal of a mini-grid license is permitted. The applicant must apply to ERB in writing at least six months before the expiry of the existing license otherwise ERB will assume that the developer does not intend to renew.

MINI-GRID RETAIL TARIFF SETTING

The Electricity Tariff Determination Guidelines for Retail Customers¹¹³ is the main policy document that guides retail tariff setting for electricity supply in Zambia. The main principles and considerations are that:

- There is no uniform national retail tariff in Zambia. Mini-grid operators are allowed to propose cost-reflective tariffs that can be higher than the ZESCO tariff. However, the tariff must be approved by ERB based on the methodology in the guidelines, which may limit the rate of return on investment.
- ERB uses the revenue requirement also known as rate of return method to determine tariffs. This can be burdensome for smaller developers as all expected costs need to be presented and justified.
- Only certain assets can be included in the calculation of revenue requirements. Subsidised assets can be included for depreciation purposes but a developer is not allowed to make a return on such assets. This has important implications given that many mini-grids in Zambia might need to receive viability gap financing to be commercially viable.
- The guidelines make reference to ZESCO key performance indicators, which impact expenses that may be claimed in revenue requirements. For mini-grids, there are different specific key performance indicators. However, these have not been applied or implemented to date for mini-grid regulation.¹¹⁴
- The benchmarked rate of return as per the guidelines is fixed at 6% real on assets. It is not clear if this is pre or post tax and if there is any flexibility, i.e. if the 6% return is a cap that is intended for all electricity retailers or if it was intended for ZESCO and can be negotiated for private mini-grids.

The tariff application and review procedure as found in the guidelines is intended to apply to the national utility. For mini-grids, where a tariff application is complete, ERB has in practice allowed for a simplified and shortened procedure, although this is not explicitly documented in writing.¹¹⁵ Therefore, rather than requiring advertisement of public notice in print and electronic media and wide consultation for a tariff application, ERB will instead request for a record of community engagement meetings in the area to be serviced by the mini-grid. This information is usually verified by ERB during licensing inspections through a random sample of community interviews.

110) The requirement as relating to tariff setting (see next) that the application needs to also be advertised in a newspaper circulating in the area of supply does not apply to mini-grids but only to the national utility

111) Link: <https://tinyurl.com/y7gpbl7s> – accessed February 2019

112) ERB has also indicated that it may be possible to include new mini-grids under an already issued, existing licence, where the mini-grid is in the same geographical area

113) Link: <http://www.erb.org.zm/downloads/eregulation/Guidelines/electricityTariffDeterminationGuidelines.pdf> – accessed February 2019

114) Communication ERB 06/07/2018

115) Personal communication ERB 06/07/2018

BOX 2. Mini-grid retail tariff and connection fees experience in Zambia

While it is permitted to sell electricity at a higher price than the ZESCO tariff, it may be difficult to find customers who are willing and able to pay. Some might prefer to wait until ZESCO or REA extend the national grid. Willingness and ability to pay is described in [Section 4.4](#).

The cost of generation at the ZESCO diesel mini-grids was between USD 0.35/kWh to USD 0.40/kWh (EUR 0.29/kWh to EUR 0.34/kWh) in 2013. Those mini-grids receive an operating subsidy of about 70% from the government.

The private Zengamina hydro mini-grid (750 kW, 600+ customers) in North-western Province charged a connection fee of between USD 90 and 130 (EUR 76 and EUR 109). In its initial period of operations from 2007, tariffs ranged from USD 0.08/kWh to USD 0.11/kWh (EUR 0.07/kWh to EUR 0.09/kWh) with a bulk user tariff for larger consumers (telecom tower and commercial farm) of USD 0.30/kWh (EUR 0.25/kWh) based on the avoided cost of diesel generation. In 2017, it was reported that the tariff had been varied to a fixed tariff of USD 7/month (EUR 5.89/month) (up to 1.5 amps) and a stepped tariff of USD 9/month (EUR 7.57/month) for the first 150 kWh plus USD 0.06-0.13/kWh (EUR 0.05–0.11/kWh) for other users. In mid-2017, the project owner indicated that the actual average tariff based on consumption was USD 0.04/kWh (EUR 0.03/kWh), below what is needed for commercial viability. The project was funded with international donations and only achieved break even on OPEX (not CAPEX) after seven years according to the World Bank.

The private 30 kW solar PV mini-grid (in Sinda, 60+ households) that was commissioned in 2017 received 50–70% international grants. The approved connection fee is ZMW 100 (EUR 8.40) and time-based tariffs range from ZMW 5 to 8 per day (EUR 0.42–0.67). Affordability is not known as most people in the project area are subsistence farmers. The load per household is limited to 300 W.

The 60 kW Mpanta solar mini-grid was developed by REA with a concessional loan and is operated by the Kafita Cooperative (local community) in Samfya District approximately 800 km north of Lusaka. In 2013, ERB approved a monthly charge of ZMW 40 (EUR 3.36) per customer but the rate along with payment collection challenges means that O&M costs are not covered. For REA's new solar mini-grids (Chunga 200 kW and Lunga 300 kW) it was reported in 2017 that an indicative tariff of USD 2.35/kWh (EUR 1.98/kWh) and USD 1.79/kWh (EUR 1.51/kWh) was proposed.

The World Bank in its 2017 Project Appraisal Document for an Electricity Service Access Project for Zambia estimates that a CAPEX subsidy of 75% on a typical mini-grid would allow for affordable tariffs while delivering a 15% return in investment. It remains to be seen how public funding and return expectations will be aligned with the parameters stipulated in the Electricity

For a green field mini-grid the tariff will be determined as part of the Investment Endorsement or at the time of electricity license application if the developer opts to forego an Investment Endorsement.

Section 8 of the Electricity Act (as amended) allows a mini-grid operator to vary tariff charges after a 30-day notice period as long as no consumer objects and ERB does not proactively intervene. Nevertheless, given its mandate to set tariffs and protect consumers, in practice ERB approval should always be sought for any tariff adjustments.

In addition to the tariff, mini-grid operators may charge their customers a connection fee. The retail tariff guidelines are silent on how the connection charge is established but it is also subject to ERB approval at the time of tariff application. The 2016 [Grid Connection Guidelines](#)¹¹⁶ report prepared for the Renewable Energy Feed-in-Tariff (REFIT) program and the [Zambian Distribution Grid Code](#)¹¹⁷ of 2016 both indicate principles for connection fees, e.g. that they should reflect underlying costs and that a distinction may be made between “shallow” and “deep” costs

116) Link: <https://tinyurl.com/y8jjvert> – accessed February 2019

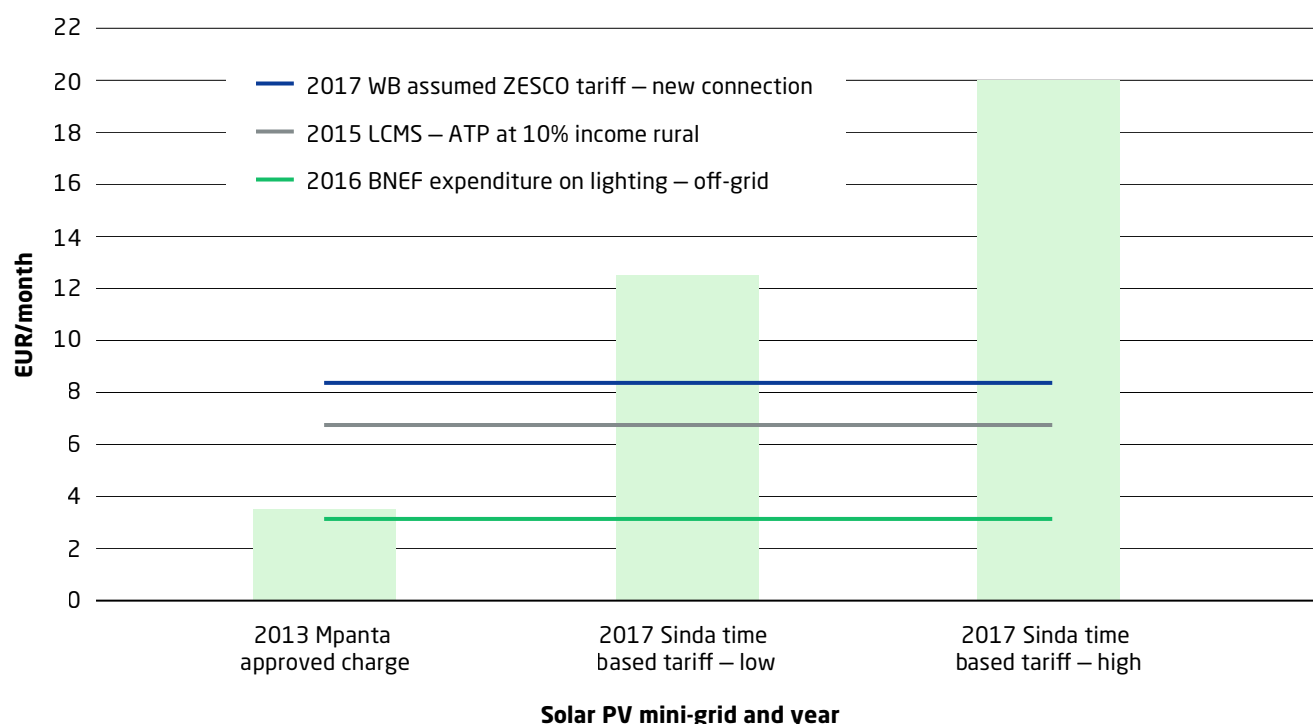
117) Link: <https://tinyurl.com/y9jt98sd> – accessed February 2019

(i.e. those costs directly associated with a customer connection and those for the shared network further from the point of customer connection). ERB will take such principles as well as other considerations such as ability to pay into account when approving connection fees.

The [GET.invest Zambia Mini-Grid Model Business Cases¹¹⁸](#) and [Project Case Studies¹¹⁹](#) provide indications of the retail tariffs calculated for example mini-grid projects.

Figure 24 provides a basic comparison of the approved and actual monthly charges in EUR for households for the two larger operational solar PV mini-grids (60 kW Mpanta and 30 kW Sinda) in Zambia against benchmarks for (a) assumed monthly charges for a new ZESCO household electricity customer, assumed monthly ability to pay at 10% of income in rural areas and estimated monthly expenditure on lighting in off-grid areas.

FIGURE 24. Household monthly ATP and actual expenditure on electricity at solar mini-grids¹²⁰



118) Link: www.get-invest.eu/ – accessed February 2019

119) Link: www.get-invest.eu/ – accessed February 2019

120) Various sources. Note: WB = World Bank, LCMS = Living Conditions Monitoring Survey, ATP = Ability to Pay, BNEF = Bloomberg New Energy Finance

– Mpanta and Sinda are, respectively, 60 kW and 30 kW public and private solar PV mini-grids

– Assumed ZESCO customer monthly expenditure used as a benchmark is based on 2017 World Bank (Electricity Access Service Project document) estimates of 91.03 kWh/month consumption for a new household customer and the ZESCO tariff. Household customer type is not specified but assumed to be “last-mile” and peri-urban or rural

– Taxes on electricity (16% VAT And 3% Excise Duty) have not been taken into account

TECHNICAL STANDARDS

A solar or hydro mini-grid project will need to adhere to various technical standards for the electricity sector developed by the Zambian Bureau of Standards (ZABS), which generally mirror those of the International Electro-Technical Commission (IEC) or are based on those of South Africa. Zambia has existing or draft standards for some electrical, solar and hydropower equipment, power quality, service quality and safety. Where there are no standards (e.g. for solar PV inverters), the relevant IEC standard or internationally recognized equivalent should be used.

Most Zambian standards are not available online – copies may be purchased from ZABS. Examples of the [standards](#)¹²¹ are:

- **Zambian Standard ZS387 Power Quality and Reliability** to regulate the quality and reliability of electricity in Zambia with requirements for voltage parameters and interruptions
- **Zambian Standard ZS397 Quality of Consumer Service** that provides minimum levels for various consumer service parameters such as response times to requests for service
- **Zambian Standard ZS403 Batteries for Use in Photovoltaic Systems** specifies minimum requirements for different types of batteries
- **Zambian Standard ZS647 Code of Practice for Electricity Metering** provides minimum requirements for metering equipment, installation and data access
- **Zambian Standard ZS746 Off-Grid and Rural Grid Extension Systems Construction and Safety** for distribution and supply equipment and practices in off-grid and rural areas

In addition to the standards, the [Electricity \(Grid Code\) Regulations](#)¹²² of 2013, the [Zambian Distribution Grid Code](#) of 2016, the [Electricity \(Supply\) Regulations](#) of 1995 and the [Power Quality Management Framework for the Electricity Supply Industry in Zambia](#) of 2014 all have technical requirements to which a mini-grid project should adhere.

121) Link: <http://www.erb.org.zm/content.php?viewpage=dstd> – accessed February 2019

122) Link: <http://www.erb.org.zm/press/ZambianGridCodePublicNotice.pdf> – accessed February 2019

As part of its off-grid support project, the IFC intends to work with ERB and ZABS to undertake a review and streamlining of technical standards and specifications with a focus on solar PV systems under 100 kW in size and deployed under a Public Private Partnership business model.

MINI-GRID INTERCONNECTION UPON NATIONAL GRID ARRIVAL

Zambia does not have any policy or regulation in place to address the situation where the national grid arrives at a private mini-grid site. There is thus a regulatory gap regarding the procedure for grid interconnection (if required or so desired) and the application of any compensation mechanism if ZESCO were to take over the mini-grid network. Nevertheless, it should be noted that:

- For mini-grid integration into the national grid, the mini-grid would need to have been designed, built and continue to operate in adherence with the aforementioned technical standards and technical requirements of the applicable regulations and codes.
- If a mini-grid operator wishes to become a bulk electricity buyer from ZESCO for onward distribution, ZESCO would first need to agree and then an ERB-approved PPA would be needed.
- Where the mini-grid operator would instead become a power generator and sell all or most of its production to ZESCO, it would likely do so either as an IPP (with a PPA, perhaps under the REFIT) or as an embedded generator under a net metering framework as envisioned in the [Distribution Grid Code](#).

In addition, while not intended for the grid interconnection of a mini-grid, the 2016 [Zambia Distribution Grid Code](#) (intended for individual customers and embedded generators), the 2016 [Grid Connection Guidelines](#) (intended for individual customers and IPPs) and the 2016 [Model Grid Connection Agreement](#)¹²³ (intended for IPPs) each provide some information that would likely apply to mini-grid interconnection or integration. For example, that the mini-grid may need to pay for the interconnection facilities and that a load flow study would first be required.

123) Link: <https://tinyurl.com/yaw9ey5c> – accessed February 2019

5.6 ENVIRONMENTAL, WATER AND LAND APPROVALS

Environmental licence

The Environment Management Act¹²⁴ of 2011 is the principal law on the environment in Zambia and establishes the Zambia Environmental Management Agency¹²⁵ (ZEMA) as the independent environmental regulator and coordinating agency. The 2011 Act repealed and replaced the Environmental Protection and Pollution Control Act of 1990 and its amendments.

There are two subsidiary regulations to the Act:

- The Environmental Protection and Control (Environmental Impact Assessment) Regulations¹²⁶ of 1997. The regulations were developed under the old Act but are still in force. The regulations therefore still refer to the former Environmental Council, which is now ZEMA.
- The Environmental Management (Licensing) Regulations¹²⁷ of 2013. The licensing regulations cover project emissions, waste management and pesticides and toxic substances, which would not usually be applicable to a solar PV or hydro mini-grid project.

Under the Environmental Impact Assessment (EIA) regulations, a developer shall not implement a project for which an Environmental Project Brief (EPB) or an Environmental Impact Statement (EIS) is required without ZEMA approval. ZEMA approval is furthermore a pre-requisite for other permits such as the energy license or (if applicable) the water use permit. The requirement for an EPB (simplified EIA) or EIS (full EIA) depends on the project type and its impacts:

- **Environmental Project Brief (EPB)** – for projects listed in the First Schedule of the regulation. “Hydropower schemes and electrification” fall under the First Schedule

- **Environmental Impact Statement (EIS)** – for projects listed in the Second Schedule of the regulation. “Electricity generation station” falls under the Second Schedule

Regardless of the project type and the schedule under which it is listed, ZEMA in practice can use its discretion to determine whether an EPB or an EIS is needed. A solar PV mini-grid may not necessarily be subject to a full EIA (EIS) nor will larger hydropower schemes always be allowed to undergo a simplified assessment (EPB). Indeed, there are examples of mini-grids in Zambia, both solar PV and mini-hydro, which did not undergo the full EIS process while at the same time a detailed EIS was required for at least two mini-hydro projects. A mini-grid developer should therefore start the impact assessment process by submitting an EPB and ZEMA will advise if an EIS is required. The two routes are described next.

Environmental Project Brief – simplified EIA

- An EPB is prepared. This can be done by the mini-grid developer in the prescribed format. There is no requirement for accredited environmental experts to be involved.
- The EPB is sent to ZEMA for screening. ZEMA must respond within 14 days with any comments.
- In case of comments, the developer sends a revised EPB to ZEMA with the comments addressed. Once ZEMA confirms acceptance the developer is requested to send six copies of the final EPB.
- ZEMA is expected to take about 40 days before giving the final decision. During these 40 days, ZEMA allows stakeholders to give comments and can decide to conduct site visits and inspections.
- After 40 days ZEMA gets back with a decision letter – rejection, approval or full EIS required. In case nothing is communicated after 40 days, the developer has consent to proceed.

It should be noted that the process can take longer than the official timeline. For one mini-grid developer EPB approval took eight months.

124) Link: <http://www.zema.org.zm/index.php/publications/environmental-legislation/environmental-management-acts/> – accessed February 2019

125) Link: <http://www.zema.org.zm> – accessed February 2019

126) Link: <http://www.zema.org.zm/index.php/publications/environmental-legislation/environmental-regulations/> – accessed February 2019

127) Link: <http://www.zema.org.zm/index.php/publications/environmental-legislation/environmental-regulations/> – accessed February 2019

Environmental Impact Statement – full EIA

- Where an EIS is required, the developer must first prepare a Terms of Reference (ToR) as guided by the regulation. As part of drafting the ToR, public consultations must be held to help determine the scope of work for the EIA and a Scoping Report also prepared. Experts involved in the ToR drafting and scoping do not need to be approved by ZEMA.
- The ToR and Scoping Report are submitted to ZEMA. There is likely to be a round of comments from ZEMA. Once all comments are addressed and documents approved, the developer submits the names and qualifications of the persons that will prepare the EIS.
- When the names are accepted, the team of experts can carry out environmental studies and begin to prepare the EIS, as guided by the regulations and the EIS report format.
- As part of the process, communities that may be affected by the project must be consulted. This is done by first **a)** publicizing a description of the project in the mass media for at least 15 days and subsequently at regular intervals and then **b)** holding meetings with the affected communities after the first 15 day period.
- Once ready, the EIS is submitted for review to ZEMA, which is expected to get back to developers with comments within 14 days. Once comments are addressed and the report approved, a final report is submitted in 12 copies.
- ZEMA will then distribute copies of the EIS to relevant parties, publish notices in national newspapers for two weeks and make a radio broadcast requesting for written comments. In some instances, a local public consultations and/or a site inspection is also organised. Any written comments must be received within 20 days of the last public notice. This can be extended by 15 days in case of a remote project or if contentious issues have arisen.
- ZEMA has 65 days to make a decision. In case ZEMA deems necessary after the consultation period, a public hearing may also be held, at the developer's cost. The public hearing has specific requirements and can add about 45 days to the process.
- ZEMA's final decision is communicated through a letter – unconditional approval, conditional approval, deferral or rejection.

As part of the review for both an EPB and EIS, ZEMA will specifically seek comments from relevant government agencies – e.g. ERB, WARMA for hydro mini-grids or the Department of National Parks and Wildlife on biodiversity impacts. For projects in customary land areas, ZEMA may also request a letter from the traditional authority indicating support for the project.

Once the project is commissioned, the developer must undertake an environmental audit within a period of not less than 12 months and not more than 36 months. ZEMA may also carry out monitoring in case of conditional approval.

The ZEMA environmental study report formats (EPB, Scoping Report, ToR, EIS) can be downloaded [here](#).¹²⁸ While a ZEMA regional office will be involved in the assessment, the EIA process is centralised in Lusaka where all paperwork and payments should be presented.

The environment license fees are as per the Fifth Schedule of the EIA regulations ([Table 13](#)).

At the time of writing, a new draft environmental law was under preparation. The proposed law is expected to be approved before the end of 2018 and may provide better clarity on the requirements for developers. It should also be noted that as part of its support for energy access in Zambia, the EU will be reviewing environmental processes and requirements.

Water use permit – for hydropower mini-grids

Water resource use and management in Zambia is governed by the [Water Resources Management Act](#)¹²⁹ of 2011, which sets out provisions to regulate water use including through the issuance of water permits. The Act establishes the [Water Resources Management Authority](#)¹³⁰ (WARMA) as the autonomous regulatory body. Management of water resources is decentralized and WARMA works with Water Catchment Councils, developed around the six catchment areas of Zambia – Zambezi, Kafue, Luangwa, Chabeshi, Luapula, Tanganyika – with each having a WARMA regional office. Management is further devolved to sub-catchment areas, under Sub-Catchment Councils and down further to Water Users Associations.

128) Link: <http://www.zema.org.zm/index.php/services/procedures/environmental-assessment-formats/> – accessed February 2019

129) Link: <https://tinyurl.com/y9g8qzoe> – accessed February 2019

130) Link: <http://www.warma.org.zm> – accessed February 2019

A hydro mini-grid project will need to apply for a water use permit for hydroelectric purposes.

Application for a water permit, accompanied by the application fee, can be made through any level of the decentralised water use management institutions. In customary land areas (see next) the applicant must first obtain a letter of consent from the traditional authority (e.g. the local chief) and the developer should also contact the Land Survey Department to demarcate the land. WARMA will then subject the application to public comments by notice in a daily newspaper.

Any objection to the application must be received within 30 days. If there is no objection the application is reviewed first by the Sub-Catchment Council and then the Catchment Council. The Catchment Council should consider the decision of the Sub-Catchment Council within 30 days before submitting its decision to WARMA. At the same time, WARMA will conduct a hydrological study at the site that is evaluated by a technical committee. In customary land areas, the traditional authority will also be consulted. If there is an objection, it is first reviewed at the Water User Association level before being fed in to the rest of the hierarchy for consideration. The WARMA Board takes the final decision. In total, the permit is supposed to be issued within 60 days. An overview of the water permitting process is available [here](#).¹³¹

For hydropower, a 25 or 30-year water use permit may be granted. The permit is issued with conditions such as the payment of prescribed charges (see next) and use of water resources in accordance with the Act (including environmental or reserve flow).

In addition to the permit, hydro engineers and builders of water works are required to be licensed by WARMA and therefore a developer should involve a licensed practitioner. WARMA furthermore has the power to take an application to ZEMA and request that the project be subjected to the environmental impact assessment process if not already underway or completed – the EIA and WARMA applications can proceed in parallel. In many cases, however, the developer would first meet ZEMA's requirements before applying for a water use permit.

The fees and charges for hydropower projects are found in the Water Resource Management (Charges and Fees) Regulations¹³² of 2018 as shown in [Table 14](#). The water usage tariff regime for a hydro project is currently based on the amount of electricity generated. However, this may change in the future to base it on the amount of water used. This is in part to ensure the financial sustainability of WARMA, even though for a run-of-river project no water is actually consumed.

In addition, a water works dam construction permit and diversion canal fees may apply. Hydropower projects are, however, exempt from dam storage fees. Furthermore, a hydro project of less than 500 kW that exports to the national grid is exempted from the water permit requirement and all the prescribed fees in [Table 14](#). Similarly, a project that has been classified as a community project¹³³ by WARMA, as approved by the Minister responsible for water, pays only fifty percent of the prescribed fees.

Land approvals

There are two categories of land in Zambia as per the Lands Act of 1995¹³⁴: state lands and customary lands, which comprise, respectively, 46% and 54% of the national land area. There are also two systems of land tenure: leasehold (99 years renewable) and customary tenure. Zambia does not have a freehold system of tenure. A non-Zambian may only acquire land in specific circumstances stipulated in the Lands Act, including if the person is a permanent resident, an investor under the Zambia Development Agency Act or a Zambian company with at least 75% Zambian shareholding.

For state land, whether acquired from the state or another current owner, the consent of the Commissioner of Lands (in Lusaka) and the relevant local authority (e.g. district council) is required. For customary land, which can but does not need to be converted to state land, the area chief's written consent is first also needed. Approval for land acquisition requires a land survey (if not already surveyed) — which is a separate process with associated costs — and the payment of various charges: the consideration fee, a preparation fee, a registration fee and the property transfer tax (which is not payable on land acquired from the state).

131) Link: <http://www.warma.org.zm/permits-and-applications/water-permits/> – accessed February 2019

132) Link: https://www.zambiaii.org/zm/legislation/statutory-instrument/2018/18/si_2018_18.pdf – accessed February 2019

133) Developers should confirm with WARMA how a community project is defined

134) Link: <http://www.parliament.gov.zm/node/945> – accessed February 2019

Leasehold tenure is considered by many investors to be more secure than customary tenure and although this may not be justified, local banks will often not finance projects on customary land. Regardless, it is important to note that the conversion process from customary to state land can take at least a year if not more. Mini-grid developers should therefore be prepared in many instances to build and operate on customary land. A land agent or ZDA may be able to help with land procedures and issues that may arise.

A mini-grid developer may acquire, (sub) lease or obtain an easement on the land for a project. For acquisition of state land,

the official timeline is 45 days for consent and another 60 days for issuance of the title deed. However, the latter can take three months or more where the land is not already surveyed. Once acquired, an annual ground rent is charged by the Ministry of Lands and Natural Resources.

It may also be possible to come to other arrangements for rights of use — e.g. one mini-grid developer received area chief consent for use of customary land without acquiring, leasing or having a formal easement on the land, although this might not provide enough certainty for some investors. In either case, it is recommended to obtain local authority approval and area chief

TABLE 13. Environmental license fees¹³⁵

TYPE	PROJECT COST USD	FEE UNITS*	ZMW	EUR
Environmental Project Brief (EPB)	—	43,333	12,999.90	1,090
Environmental Impact Statement (EIS)	Less than 100,000	43,333	12,999.90	1,090
	100,000–500,000	216,665	64,999.50	5,460
	500,000–1,000,000	541,662	162,498.60	13,640
	1,000,000–10,000,000	1,083,324	324,997.20	27,290
	10,000,000–50,000,000	2,166,650	649,995.00	54,570
	Greater than 50,000,000	3,249,975	974,992.50	81,860

*Note: 1 fee unit is equivalent to ZMW 0.30

TABLE 14. Hydropower project water permit prescribed fees¹³⁶

ITEM	FEE UNIT*	ZMW	EUR
Application for permit for usage up to 10 MW	16,666.67	5,000	420
Application for permit for additional usage from 10 MW up to 250 MW	3,333.33	999.99	84
Annual access charge per kW of installed capacity	2.529976	0.75899	0.06372
Use per kWh generated	0.003069	0.00092	0.00008
In a cascade of any installed capacity per kWh generated	0.002534	0.00076	0.00006

135) Government of Zambia (1997) Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, Fifth Schedule.

Link: <https://tinyurl.com/y8au3gxw> – accessed February 2019

136) Government of Zambia (2018) Water Resource Management (Charges and Fees) Regulations, 2018 https://www.zambiaii.org/zm/legislation/statutory-instrument/2018/18/si_2018_18.pdf – accessed February 2019

consent (where applicable) and secure land access early in the project development cycle.

A new draft lands policy paper was announced in March 2018 that may bring changes to the land tenure regime and developers should keep a close eye on the latest developments.

Where land is zoned for a particular land use (e.g. residential, commercial, industrial) and change to another land use is necessary, the provisions of the Town and Country Planning Act¹³⁷ will apply. It is not normally required in customary land areas.

The Factories Act, Public Health Act and Local Government Act may also be applicable to mini-grid projects.

5.7 WORK PERMITS AND SOCIAL SECURITY CONTRIBUTIONS

An employment or investor permit is required for foreign nationals intending to work in Zambia. Work permits are managed by the Department of Immigration.¹³⁸ There are two types of work permit in Zambia: a short-term, temporary employment permit and a longer-term employment or investor permit.

The temporary employment permit is typically issued for business visitors in Zambia for longer than 30 days. The applicant can arrive in Zambia on a business visa and apply for a temporary employment permit in country, depending on their country of origin. The estimated processing time is one to two weeks. The permit is valid for a maximum of six months in any 12-month period.

Employment permits are issued to foreigners who enter the country to take up employment for longer than six months and meet the eligibility rules of the Immigration and Deportation Act¹³⁹ of 2010, First Schedule and the Guidelines¹⁴⁰ for employment permit issuance of May 2017. The processing time is

approximately four to six weeks. They can be extended for up to ten years, subject to the guidelines. The period is the same for an investor permit, which has different requirements,¹⁴¹ e.g.: proof of investment of at least USD 150,000 or 250,000 (EUR 125,000 or EUR 21,000) in a company in Zambia.

A foreign national must be a holder of either an employment or investor permit for over 10 and 3 years respectively, to apply for a residency permit. Full information regarding work permits is available from the Department of Immigration. Professional immigration consultants recognised by the Department can be contacted for assistance with applying for work permits. In addition, ZDA can help facilitate the process for investor permits if the investor is registered with ZDA. The work permit fees for 2018 are listed in [Table 15](#).

TABLE 15. Zambia work permit fees 2018¹⁴²

WORK PERMIT TYPE	APPLICATION		RENEWAL	
	ZMW	EUR	ZMW	EUR
Temporary employment permit	4,500	378	5,250	441
Employment permit	6,000	504	7,000	588
Investors permit	4,000	336	5,000	420

On-arrival visas are eligible for select nationalities, with additional information available [here](#).¹⁴³

Any company employing staff must register and file monthly contributions with the National Pension Scheme Authority (NAPSA). The contribution rate is set at 10% of gross income up to a ceiling, half of which is payable by the employee and half payable by the employer. Full information can be found at the [NAPSA website](#).¹⁴⁴

137) Link: <http://www.parliament.gov.zm/node/1239> – accessed February 2019

138) Link: <https://www.zambiaimmigration.gov.zm> – accessed February 2019

139) Link: <http://ilo.org/dyn/natlex/docs/ELECTRONIC/86259/97228/F1200888520/ZMB86259.pdf> – accessed February 2019

140) Link: <https://tinyurl.com/ybkzyjpl> – accessed February 2019

141) Link: https://www.zambiaimmigration.gov.zm/index.php?option=com_content&view=article&id=50&Itemid=57 – accessed February 2019

142) KPMG (2017) 2018 Budget Highlights Zambia, p. 30. Link: <https://home.kpmg.com/content/dam/kpmg/xx/pdf/2017/11/tnf-zambia-nov29-2017.pdf> – accessed February 2019

143) Link: https://www.zambiaimmigration.gov.zm/index.php?option=com_content&view=article&id=93&Itemid=118 – accessed February 2019

144) Link: <http://www.napsa.co.zm/> – accessed February 2019

SECTION 6

Financing Mini-Grids in Zambia



While domestic financing options remain limited for private mini-grid developers in Zambia, international and donor-backed national funding opportunities are increasing.

6.1 TYPICAL FINANCING MODALITIES

Mini-grid businesses are typically initially financed with a mix of subsidies, results-based finance and equity over a several year development cycle. In the initial 2 to 4 years, activities may predominantly be financed through founder investments and grants. Once the business has demonstrated market and operational traction, it may raise a first equity round, typically on the order of EUR 1–5 million. This round allows the business to grow its team and put the appropriate systems in place for scalable operations. Once the mini-grid business is ready to scale, it will likely access larger equity rounds and – once the model is proven and cash flows are sufficient – eventually debt, more often from a private placement rather than a bank loan.

Foreign exchange exposure is a critical business risk for mini-grid operators who typically purchase capital assets in hard currency (due to both to the need to procure most equipment internationally and the sources of funding being in USD or EUR) and have most or all revenue in local currency. This risk is magnified for larger mini-grid projects that may have 5–15 year payback periods. As such, mini-grid developers may seek out funding facilities denominated in local currencies. At the time of writing, no country-specific facility existed in Zambia, although one is being planned under a World Bank support programme (see [Section 6.3](#)). Developers are also encouraged to explore currency-hedging options, such as those provided by [TCX](#)¹⁴⁵ and [MFX Solutions](#).¹⁴⁶

6.2 DOMESTIC FINANCING OPPORTUNITIES

The opportunity for domestic financing of private mini-grids is limited. The market, technology, and business models of mini-grid companies are rather unknown to local commercial banks, who may also consider other, more conventional investment opportunities as demonstrating both higher return and lower risk profiles. In addition, interest rates for loans in local currency

are high, averaging 25% in December 2017 and significant collateral may be required. Bank loans also typically have short tenures but financing for mini-grid projects might require a 10-year credit line. Furthermore, if a mini-grid is to be built on customary land, a local bank may not even consider financing the project due to the perceived lack of security. This reflects the situation in much of East and Southern Africa, where there are few if any examples of commercial bank lending to mini-grids. Through the GCF-supported Zambia Renewable Energy Financing Framework project, the African Development Bank will be building the capacity of local commercial banks in Zambia to invest in off-grid and mini-grid renewable energy projects.

The Development Bank of Zambia (DBZ) may provide slightly better possibilities. DBZ has a private sector project finance facility that allows for loans up to 10 years in ZMW or foreign currency. A two-year grace period may be available. The minimum loan size is USD 200,000 (EUR 170,000) or its equivalent. Foreign currency interest rates are the base rate plus up to 5% and ZMW interest rates are offered at the Bank of Zambia base rate (9.75% in April 2018) plus a margin of up to 9%. The security requirements are, however, quite substantial. DBZ also has separate lines of credit available to small and medium enterprises (SME) for up to 100,000 (EUR 85,000) or ZMW 1 million and is receiving support from the African Development Bank for SME on-lending and business development. Further information is available [here](#)¹⁴⁷ and [here](#).¹⁴⁸

DBZ has experience with mini-grids, having provided soft loans with funding from UNEP/GEF for the ZESCO Shiwangandu 1 MW hydro mini-grid and the REA 60 kW solar PV mini-grid. New World Bank funding for the off-grid sector may also be made available via DBZ (see [Section 6.3](#)).

The Rural Electrification Fund (REF) managed by REA is in theory also able to support private sector rural electrification projects including mini-grids. The REF is funded by the 3% excise levy on electricity bills, transfers from the government treasury and donor contributions. Privately driven rural electrification projects may be subsidized by up to 50% of the capital costs, with remaining funds to be secured by the developer with a minimum level

145) Link: <https://www.tcxfund.com/> – accessed February 2019

146) Link: <http://mfxsolutions.com/> – accessed February 2019

147) Link: <http://www.dbz.co.zm/products/> – last accessed May 2017, link no longer available

148) Link: <http://www.dbz.co.zm/wp-content/uploads/2016/11/New-Lending-Facilities-for-Business-Entities1.pdf> – last accessed May 2017, link no longer available

of 20% of equity, and a minimum internal rate of return of 10% before subsidies. However, only one private mini-grid project has successfully obtained support from REA, presumably under the REF: USD 25,000 (EUR 21,000) in 2007 for the Zengamina 750 kW hydro mini-grid. Information on how to access the Fund is not publicly available and little is known by developers in Zambia.

6.3 INTERNATIONAL FINANCING OPPORTUNITIES

In addition to international private capital, which as of early 2018 already included equity investment in three mini-grid companies active in Zambia, and crowd-funded or peer-to-peer lending to mini-grid projects in East Africa, there are a number of public funding opportunities listed next.

Developers are encouraged to review the [GET.invest Funding Database](#)¹⁴⁹ for an overview of financing opportunities that may be applicable to mini-grids. The [GET.invest Finance Catalyst](#)¹⁵⁰ service may also be useful for developers that need transaction preparation support.

Increased Access to Electricity and Renewable Energy Production

Increased Access to Electricity and Renewable Energy Production (IAEREP) is a EUR 40 million EU-funded programme set to run up to 2022 to help improve the enabling environment for and encourage private sector participation in delivering energy access and clean energy services in Zambia. The latter through demonstration projects and support for feasibility studies. The first call for proposals is expected in 2018 for Public Private Partnership business models. Information is available from the [EU Delegation in Lusaka](#).¹⁵¹

ElectriFI

ElectriFI is a specialist debt and equity financing partner for small-scale private companies focusing on new or improved electricity connections as well as on generation capacity from sustainable energy sources in emerging countries. ElectriFI is a 215-million-euro impact investment facility for renewable energy companies active on- and off-grid in emerging markets. Partnering with the European Development Finance institutions, the European Commission launched ElectriFI in December 2015

during the COP21 in Paris. ElectriFI is also funded by contributions from the US Power Africa and Sweden.¹⁵²

Beyond the Grid Fund Zambia

The Beyond the Grid Fund is a Sida funded EUR 20 million, four-year project aiming to help electrify 1,000,000 Zambians. The first round has awarded five companies with co-financed grants, including two companies already active in Zambia, and three new market entrants. BGFZ has been reported to focus more on companies providing Tier 1 and 2 level of energy services. The BGFZ website is [here](#).¹⁵³

Energy and Environment Partnership Southern and East Africa

The Energy and Environment Partnership for Southern and East Africa (EEP-S&EA) is a programme that promotes renewable energy, energy efficiency, and clean technology investments, at pilot and scale-up stage. EEP phase III recently launched under a new host, the Nordic Development Fund. A first call for proposals for grant and repayable grant funding between EUR 200,000 and 1 million for early stage projects was available in 2018. Zambia is an eligible country. More information is available on the [EEP website](#).¹⁵⁴

World Bank Electricity Service Access Project

As part of its wider support for electrification in Zambia, the World Bank is planning two pilot financing facilities for private sector investment in energy access: an Off-Grid Smart Subsidy Program (OGESSP) for partial subsidies for private sector mini-grids and SHS in locations selected under yet-to-be developed National Electrification Strategy and an Off-Grid Loan Facility. The OGESSP will target energy access Tiers 3–4. The Loan Facility will likely be made available via the Development Bank of Zambia, and offer loans to certain types of solar equipment suppliers (in USD or ZMW) and to mini-grid developers and PAYG companies (in ZMW). The World Bank project appraisal document is [here](#).¹⁵⁵

The Africa Enterprise Challenge Fund

The Africa Enterprise Challenge Fund (AECF) is an Africa-based challenge fund that supports businesses in agriculture, agribusiness, rural financial services and communications systems, renewable energy and climate resilience. AECF provides catalytic funding in the form of repayable and non-repayable grants to

149) Link: <https://www.get-invest.eu> – accessed February 2019

150) Link: <http://www.get-invest.eu> – accessed February 2019

151) Link: https://eeas.europa.eu/delegations/zambia_en – accessed February 2019

152) Link: <http://electrifi.eu> – accessed February 2019

153) Link: <https://www.reep.org/bgfz> – accessed February 2019

154) Link: <https://eepafrica.org> – accessed February 2019

155) Link: <http://projects.worldbank.org/P162760/?lang=en&tab=documents&subTab=projectDocuments> – accessed February 2019

businesses that would otherwise not be able to secure early stage and growth financing, as well as business growth support. The AECF has previously provided financing to three projects in Zambia within the agribusiness sector. In 2017, AECF Renewable Energy and Adaptation to Climate Change Technologies (REACT) also had a Household Solar challenge fund window focused on off-grid electrification solutions including in Zambia. More information can be found [here](#).¹⁵⁶

156) Link: https://www.aecfafrica.org/portfolio/renewable_energy/react_ssa – accessed February 2019

ANNEX A

Contact Information for Government Institutions

INSTITUTION	CONTACT DETAILS
Ministry of Energy	New Government Complex P.O. Box 31696, Lusaka
Office for Promoting Private Power Investment (OPPPi)	Stand 4529, Corner of Pandit Nehru and United Nations Avenue, Longacres P.O. Box 36079, Lusaka Phone: +260 211 253970 Email: oppipi@zamnet.zm Web: www.oppipi.gov.zm
Energy Regulation Board (ERB)	Plot No 9330, Off Alick Nkhata Road P.O. Box 37631, Lusaka Phone: +260 211 258844-49 Email: erb@erb.org.zm Web: www.erb.org.zm
Rural Electrification Authority (REA)	Longolongo Road, Lusaka Phone: +260 211 241298
ZESCO Limited	Great East Road, Stand No. 6949 P.O. Box 33304, Lusaka Phone: +260 211 361111 Email: zesco@zesco.co.zm Web: www.zesco.co.zm
Zambia Development Agency (ZDA)	Nasser Road P.O. Box 30819, Lusaka Phone: +260 211 229240 / 220177 Email: info@zda.org.zm Web: www.zda.org.zm
Zambia Environmental Management Agency (ZEMA)	Corner Church and Suez Roads Plot No. 6975 P.O. Box 35131, Lusaka Phone: +260 211 253140 / 254023 / 254059 Email: zema@zema.org.zm Web: www.zema.org.zm

Water Resource Management Authority (WARMA)	Counting Square House Block 3, Thabo Mbeki Road P.O. Box 51059, Lusaka Phone: +260 211 251934 Email: info@warma.org.zm Web: www.warma.org.zm
Zambia Revenue Authority (ZRA)	Kalambo Road P.O. Box 35710, Lusaka Phone: +260 211 380111 / 971 281111 / 962 251111 Email: advice@zra.org.zm Web: www.zra.org.zm
Zambia Bureau of Standards (ZABS)	Lechwe House, Freedom Way Lusaka Phone: +260 211 231385 Email: info@zabs.org.zm Web: www.zabs.org.zm
Department of Immigration	Kent Building, Haile Selassie Road P.O. Box 50300, Lusaka Phone: +260 211 252622 Email: pro@zambiaimmigration.gov.zm Web: www.zambiaimmigration.gov.zm

ANNEX B

Relevant Stakeholders

This Annex compiles a non-exhaustive list of stakeholders selected according to their relevance to the subject of this guide.

DEVELOPMENT PARTNERS ACTIVE IN RENEWABLE ENERGY

African Development Bank (AfDB)

The African Development Bank has two on-going projects in Zambia's energy sector, including support for the development, construction, operation and maintenance of a 120 MW base load hydro power plant at the site of the Itzhi-Tezhi dam on the Kafue River in Zambia, and the construction of associated transmission and distribution infrastructure. AfDB also funded the latest electricity cost of service study, intends to set up a financing facility for renewable energy IPPs and is providing capacity building to local banks.

Department for International Development (DFID)

In February 2017, the UK's Department for International Development signed a partnership agreement with Zambia, including Zambia in the UK's Energy Africa program focused on accelerated household solar solutions across sub-Saharan Africa.

European Union (EU)

The EU is an active development cooperation partner in Zambia's energy sector. In November 2016, the EU signed a EUR 40 million grant providing support for reforms in the energy sector promoting renewable energy and energy efficiency technologies. The EU is additionally supporting the rehabilitation of the Kariba Dam as well as the Lusaka Transmission and Distribution Rehabilitation Project; the latter of which a EUR 65 million financing agreement was announced in January 2017. The EU will be providing technical assistance to the ERB, MoE and REA for the next four years.

Innovation Norway

In March 2017, Innovation Norway provided a grant of USD 700,000 (EUR 590,000) to finance the installation of solar

PV systems at rural health clinics throughout the country. The systems will be installed through a consortium of four Norwegian companies, including Bright Products AS, W. Giertsen Energy Solutions AS, Eltek AS and Differ AS.

International Finance Corporation (IFC)

The IFC is supporting the government to implement an off-grid Public Private Partnerships project that aims to inform decision making related to and the structuring of a potential off-grid procurement programme, including for renewable energy mini-grids. Project components include **a)** an off-grid market assessment, **b)** legal and regulatory review, **c)** harmonisation of mini-grid standards and **d)** the establishment of an off-grid online portal.

Japan International Cooperation Agency (JICA)

JICA has provided substantial support to the development of rural electrification and renewable energy initiatives in Zambia, primarily through its historical support for the formulation of the REMP.

OPEC Fund for International Development

The OPEC Fund for International Development has provided over USD 150 million (EUR 125 million) in financing to public sector projects in Zambia, however none in the energy sector. In 2016, the Fund signed a USD 20 million (EUR 17 million) debt agreement with ZESCO to support capital expenditure plans meant to increase generation and transmission capacity.

Power Africa and USAID

Power Africa and USAID Zambia have provided USD 2 million (EUR 1.7 million) supporting the IFC's Scaling Solar programme (Power Africa, 2017). Through the Scaling Off-Grid Energy Grand Challenge, USAID provided Fenix International and VITALITE USD 750,000 (EUR 635,000) and USD 300,000 (EUR 252,000) of financing respectively to scale solar home solutions in the country. Power Africa has supported the development of a Renewable Energy Feed in Tariff (REFIT) and standardized Power Purchase

Agreement (PPA), and is currently providing technical assistance to the ERB. KfW is managing the GET-FIT Zambia programme to support government implementation of the REFIT.

Renewable Energy and Energy Efficiency Partnership (REEEP)

REEEP is implementing the Sida-funded Beyond the Grid Fund for Zambia, as well as a programme on increasing financing flows to rural energy solutions, which is funded by the German Government and scheduled to start in September 2018.

Swedish International Development Cooperation Agency (Sida)

Sida is funding the 'Beyond the Grid Fund for Zambia' that aims to bring clean energy access to one million Zambians and accelerate private-sector growth in energy generation and distribution in the country (REEEP, 2017). The fund will operate from 2016–2018, with a maximum funding level of EUR 20 million. The fund intends to provide 1 million Zambians with access to clean electricity.

The World Bank

The World Bank is implementing a number of projects for electricity access in Zambia. The "Electricity Service Access Project" is designed to provide up to USD 26.5 million (EUR 22.3 million) for last-mile connections, private sector support and national electrification planning. Through the "Lusaka Transmission and Distribution Rehabilitation Project" the World Bank is providing up to USD 105 million (EUR 88 million) to support ZESCO in the rehabilitation of networks within Lusaka Division. The World Bank is currently implementing a national multi-tier household energy access survey in Zambia and is the agency funding the development of the National Electricity Strategy.

RESEARCH, CAPACITY DEVELOPMENT, AND TRAINING

Centre for Energy, Environment and Engineering Zambia (CEEZ)

The CEEZ is a non-governmental research organization whose activities involve analysis, policy recommendations, and the provision of training in energy and environment (IRENA, 2013).

Impact Assessment Association of Zambia (IAAZ)

The Impact Assessment Association of Zambia (IAAZ) is an association formed in Zambia to provide a forum for advancing innovation and communication of best practices in all forms of Environmental Impact Assessment (EIA). The association maintains a database of impact assessment practitioners in Zambia and meets regularly as a community of practice (IAAZ, 2017).

University of Zambia (UNZA)

The majority of scientific renewable energy expertise at the University of Zambia is within the Energy and Environment Research Group (EERG) in the Department of Physics of the School of Natural Sciences. It focuses on energy and environment related to high quality and targeted consultancy, capacity-building and research in energy and the environment (IRENA, 2013).

Zambia Solar Association

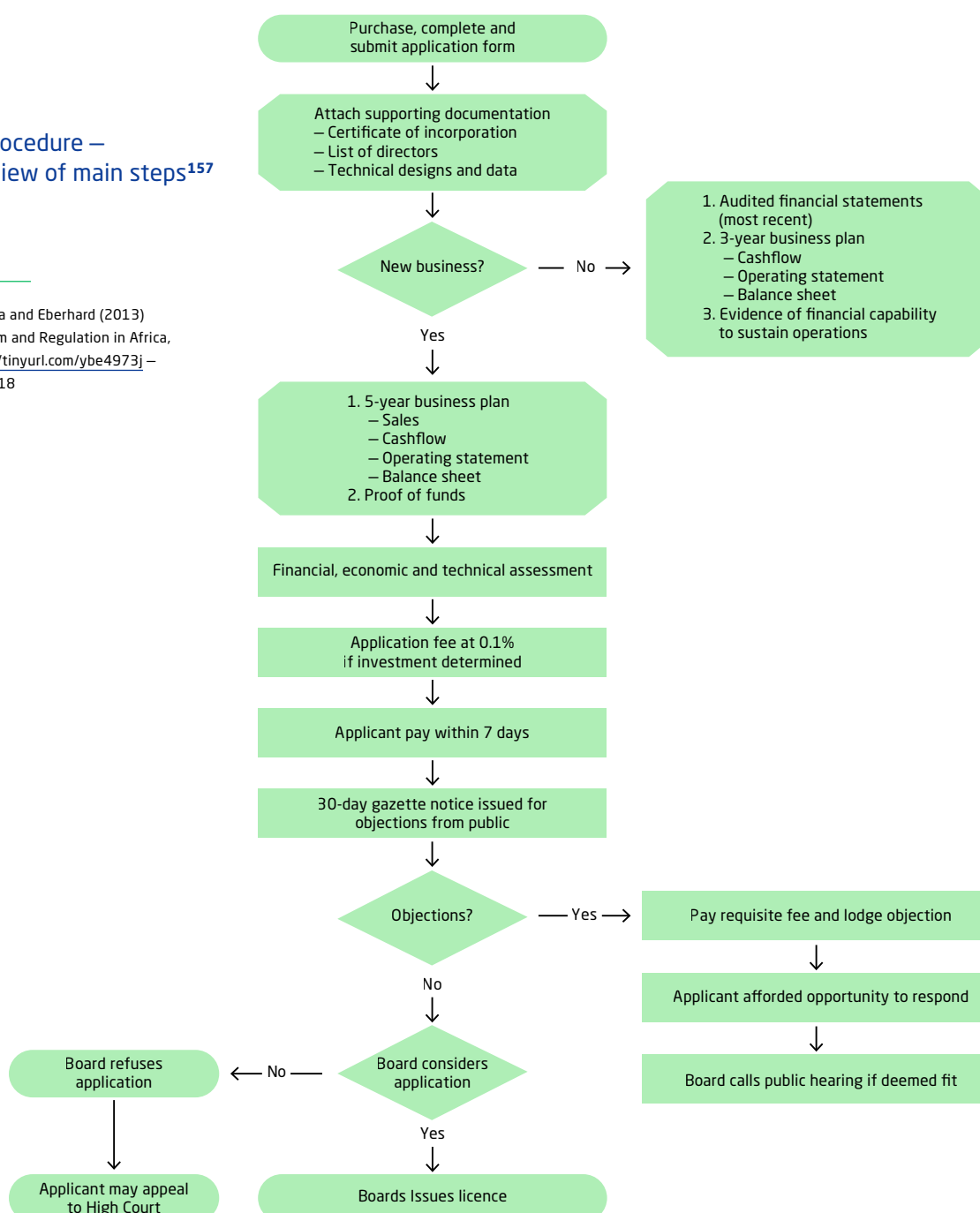
In March 2017, the licensed solar companies agreed to establish a dedicated solar association to promote solar energy and Zambia and advocate for a conducive enabling environment. All licensed solar companies in Zambia are eligible to join.

ANNEX C

ERB Electricity License Procedure

FIGURE 25.
ERB licensing procedure –
schematic overview of main steps¹⁵⁷

157) Adapted from Kapika and Eberhard (2013)
Power Sector Reform and Regulation in Africa,
p. 100. Link: <https://tinyurl.com/ybe4973j> –
accessed 28/04/2018



ANNEX D

Additional Information for Developers

Table 16 provides an overview of the main development steps for solar and hydro mini-grids in Zambia. Ancillary requirements (e.g. health and safety) are not shown. Electricity sector licensing and compliance and environmental, water and land approvals are described in [Section 5.5](#) and [Section 5.6](#).

It should be noted that there is a lack of clarity regarding the applicability of the steps with an asterisk (*) in **Table 16** to mini-grids because the steps are originally intended for projects above 10 MW and generation IPPs, in particular hydropower.

TABLE 16. Main development and licensing steps for solar and hydro mini-grids¹⁵⁸

REGULATORY OR DEVELOPMENT STEP IN SEQUENCE	INSTITUTION	APPLICABILITY	
		Solar	Hydro
Site assessment/pre-feasibility study	—	—	—
Concept note to OPPPI*	MoE/OPPPPI	Optional	Maybe
Exclusivity discussion**	REA	Maybe	Maybe
Exclusivity feasibility study rights to site via MoU*	MoE	Optional	Maybe
Feasibility study	—	—	—
National monument, cultural and heritage site approval ¹⁵⁹	NHCC	If required	Yes
Project environmental assessment determination ¹⁶⁰	ZEMA	Recommended	Recommended
Environmental Project Brief (EPB)	ZEMA	Yes	Yes
Environmental Impact Statement (EIS)	ZEMA	If required	If required
ERB environmental assessment site visit ¹⁶¹	ERB	Recommended	Recommended
Investment Endorsement application	ERB	Recommended	Recommended
ERB technical design review	ERB	Yes	Yes
ERB tariff negotiation	ERB	Yes	Yes

¹⁵⁸) Understanding from stakeholder interviews and comments and review of various regulations, guidelines and reports

¹⁵⁹) Some potential sites – especially those for hydropower – may be protected under the National Heritage Conservation Commission (NHCC) Act as preserved national monuments or cultural heritage sites

¹⁶⁰) ZEMA may require an applicant to submit an Environmental Impact Statement (EIS) in addition to an Environmental Project Brief (EPB)

¹⁶¹) Where ZEMA has transmitted project environmental documentation (EPB or EIS) for comments, ERB will make a site visit as part of the EIA approval process

ERB review of project timelines and milestones	ERB	Yes	Yes
Investment Endorsement Approval	ERB	Yes	Yes
Implementation Agreement*	MoE	Optional	Maybe
Application for waiver of solar product licence ¹⁶²	ERB	Yes	No
Water use rights ¹⁶³	WARMA	No	Yes
Project construction	—	—	—
Investment Endorsement progress reports and audits	ERB	Recommended	Recommended
ERB pre-commissioning and licensing inspection	ERB	Yes	Yes
Provisional license for generation, distribution and supply	ERB	Yes	Yes
Project commissioning	—	—	—
Standard license	ERB	Yes	Yes

* May only apply to projects above 10 MW and be primarily for generation IPPs, however somewhat subjective

** Not a requirement, unclear if it is an option

Note: MoU = Memorandum of Understanding, NHCC = National Heritage Conservation Commission

SOLAR AND HYDRO MINI-GRID SITE IDENTIFICATION AND EXCLUSIVITY

Site identification

As mentioned in [Section 5.5](#), as at the time of writing there was no tender or competitive bidding process for mini-grids in Zambia. Private developers may identify potential sites on their own and initiate mini-grid projects. However, it is advisable to consult early on with the Ministry of Energy (including OPPPI, especially for hydro mini-grids), ZESCO (in particular the offices for decentralisation and distribution), REA and ERB. These agencies have the latest information on rural electrification project and grid extension plans.

- For hydropower mini-grids, OPPPI has a list of potential sites that can be reviewed and ZDA and WARMA may have additional information on planned hydropower projects.

- For solar it is most important to confirm site availability with REA and ZESCO, rather than resource potential. OPPPI can still be a useful entry point for solar mini-grid developers, given the former's mandate to promote and facilitate investment in the electricity sector.

In addition, for hydropower mini-grids in particular the National Heritage Conservation Commission (NHCC) should be approached to confirm whether or not a potential site is not a national or cultural heritage site. This should be done in the early planning stages because such a site may not be explored without NHCC consent.

It is also recommended to approach traditional leaders for projects in customary land areas at an early stage. Not only may area chiefs be able to help identify and assess sites, the traditional authority's consent will later be needed for project permits and use of land.

There are some important areas of uncertainty in the site identification and selection process. For example, there is no confirmation that if a developer identifies a site and undertakes a pre-feasibility study that it will have access to the site. It could be that REA or ZESCO could take over or the government might decide to tender out the site. If the latter were to occur, the Zambia Public Procurement Authority (ZPPA) might need to become involved (especially with hydro sites).

162) Waiver is only granted once the applicant has procured the solar energy equipment, because shipping documentation forms part of the information required when applying for a waiver

163) Water use rights may be made a condition of the Investment Endorsement to be met when applying for a license

Possibilities for site exclusivity

Exclusivity for electricity generation for hydropower

Once a hydropower site is identified for electricity generation, a concept note is usually submitted to OPPPI, describing the potential project. If OPPPI approves the **concept note**, OPPPI (who collaborate with WARMA) and the developer then sign a Memorandum of Understanding¹⁶⁴ that provides exclusivity for assessments and feasibility studies.

However, the concept note, MoU and exclusivity are intended for larger projects of 10 MW and above, with a focus on generation IPPs. It is unclear if OPPPI would be willing or required to provide exclusivity for a small hydro generator for a mini-grid (OPPPI does not normally get involved in distribution and supply). OPPPI does have a mandate to ensure optimal use of hydropower resources, so even without exclusivity it may need to approve the feasibility study project design.

If electricity generation site assessment exclusivity (MoU) is sought and obtained for a hydro mini-grid, it is for an initial period of up to two years depending on the level of complexity. The MoU may be extended by requesting in writing to OPPPI with justifications and presenting evidence of costs incurred in actively assessing the site. Quarterly progress reports to OPPPI, containing the information stipulated in the MoU, are required. No fee is payable for the MoU or MoU extension.

Once the final feasibility study is submitted to OPPPI, and the project design is approved (OPPPI has three months to review), the developer and Ministry of Energy may sign an **Implementation Agreement** (for which there is no fixed template), which grants further exclusivity for 25 years to develop, build and operate the project. This again is usually for generation projects only. The developer can use the Implementation Agreement, which is usually signed after the ERB Investment Endorsement but before the electricity generation license is issued, to seek ZDA, ZESCO, ZEMA, WARMA, Ministry of Land and ERB support and licenses, as applicable.¹⁶⁵

Exclusivity for electricity generation for solar PV

The aforementioned steps are unlikely to apply to solar PV mini-grids given their small project size and the abundance of solar

energy resources. It is not known whether solar PV mini-grid developers could optionally seek to obtain such exclusivity for site assessment and generation.¹⁶⁶

Exclusivity for distribution and supply for hydro and solar mini-grids

It is not clear if it may be possible, or what the process might be, to obtain a distribution and supply concession¹⁶⁷ or other form of exclusivity for supply for a mini-grid (from the Ministry of Energy or ERB, in consultation with REA) or if developers have to bear the risk of grid extension. The base scenario is that a concession is not provided by default because:

- a) A formal approval from REA is not needed to implement a mini-grid
- b) While the electricity license does specify a geographic area of supply, it does not discuss exclusivity
- c) At least one private mini-grid was built in an area where the national grid was present but customers were not connected.

However, there are indications that a form of concession can be secured on a case-by-case basis:

- a) One private hydro mini-grid has reportedly secured a concession for its distribution and supply area, as provided for by ERB. This may have been due to the extreme remoteness and specific circumstances of the project.
- b) The North Western Energy Corporation and the Copperbelt Energy Corporation, both large-scale private companies, have distribution and supply licences (including for residential supply) in and around specific mining areas.
- c) One private solar mini-grid developer has obtained prior approval (the form of which was not confirmed) from REA to supply a number of sites.

164) Link: <https://tinyurl.com/y8caa8fk> – accessed February 2019

165) It should be noted that the stated requirements for an electricity license do not mention an OPPPI concept note, MoU or an Implementation Agreement

166) The private developers with operational solar mini-grids interviewed for this Guide did not indicate that they had sought or obtained exclusivity from OPPPI

167) As per page 92 of the EUEI-PDF RECP Mini-grid Policy Toolkit, a concession is “a contract between a public and private entity granting exclusive rights to invest, operate and maintain the distribution assets and sell electricity to end-users for a give number of years in specified geographic services areas”

ANNEX E

Selected Data Disaggregated by Province

Energy source used for lighting

In 2015, and although it varied by province, flashlights remained the main energy source of lighting for almost 71% of rural households, followed by solar PV at 7.4% and candles at 6.2% as indicated in [Table 17](#). This is a significant change from 2010 when kerosene and candles were the predominant energy source for lighting. Interestingly, the use of electricity as the main source of lighting declined between 2010 and 2015 in rural areas, from 4.3% to 3.7% even the percentage of households with an electricity connection remained roughly the same (4.5% in 2010, 4.4% in 2015).¹⁶⁸

Household income by province

[Table 18](#) provides an overview of household income by province, which shows a strong concentration of economic activity in the North-South, Lusaka-Copperbelt corridor and comparatively lower incomes away from this central region. Additional income data is provided in the 2015 LCMS.

Agricultural productivity and sales by province

A review of crop productivity ([Table 19](#)) reveals that agricultural yields are generally depressed in the Southern, Eastern, and Western provinces. While this may be attributed to lower soil fertility and climactic conditions, it could also suggest limited agricultural extension services and less access to agricultural inputs. Farmers may be located in highly remote areas of low population density, for which distribution channels may be difficult to create. The percentages of households engaged in selling own agricultural production is comparatively lower in these regions ([Table 20](#)). This could be due to decreased yields, or potentially market access constraints given limited physical infrastructure or high dispersion. Developers are encouraged to review systemic as well as supply- and demand-side dynamics that may result in reduced rural economic activity in certain provinces.

168) Central Statistical Office (2012) Living Conditions Monitoring Survey Report 2006 and 2010, p. 231. Link: <https://tinyurl.com/y7f2gfok> – accessed February 2019

169) Central Statistical Office (2016) 2015 Living Conditions Monitoring Survey Report, p. 131. Link: <https://tinyurl.com/y9g8jdao> – accessed February 2019

170) Indaba Agricultural Policy Research Institute (2015) Zambia Rural Agricultural Livelihoods Survey Report, 2015. Link: <https://tinyurl.com/y85rk6ju> – accessed February 2019

TABLE 17. Main sources of lighting by province (%) 2015¹⁶⁹

		KER	ELEC*	SOLAR PV	CANDLE	DIESEL	OPEN FIRE	TORCH	NONE	OTHER
Setting	Rural	1.6	3.7	7.4	6.2	0.3	4.3	70.6	2.4	3.4
	Urban	0.8	67.6	0.8	16.3	0.1	0.2	12.8	0.4	0.9
Province	Central	2.5	18.4	6.2	8.4	1.0	1.9	58.9	1.1	1.7
	Copperbelt	0.8	58.1	1.0	18.8	0.1	0.2	19.5	0.4	1.1
	Eastern	0.6	6.9	9.6	3.8	0.0	2.7	73.1	2.8	0.5
	Luapula	3.3	6.3	4.2	9.4	0.0	2.8	61.8	1.9	10.3
	Lusaka	1.1	70.9	1.2	14.7	0.2	0.0	10.5	0.6	0.8
	Muchinga	0.4	16.4	7.9	8.2	0.2	2.9	60.2	0.6	3.2
	Northern	3.9	8.3	5.5	8.5	0.2	2.6	68.3	0.4	2.2
	North-western	0.4	14.4	4.1	7.3	0.2	6.7	53.6	4.4	9.1
	Southern	0.1	24.6	5.9	6.9	0.2	1.6	59.3	0.8	0.5
	Western	0.5	6.0	6.2	9.3	0.0	13.0	56.3	6.5	2.1
Zambia	—	1.3	31.2	4.6	10.6	0.2	2.5	45.7	1.6	2.3

Note: Ker = kerosene/paraffin, Elec = electricity

TABLE 18. Gross annual household income (off-farm) per household member by province (EUR, 2012)¹⁷⁰

	MEAN	PERCENTILE 25	MEDIAN	PERCENTILE 75
Central	397.57	88.94	177.10	405.97
Copperbelt	377.64	88.11	189.67	373.07
Eastern	235.72	66.80	125.36	230.93
Luapula	341.20	68.07	140.10	284.39
Lusaka	663.53	132.42	264.04	679.81
Muchinga	242.38	44.30	92.91	209.61
Northern	303.11	67.18	129.21	262.96
North-western	349.81	74.49	155.27	336.36
Southern	318.94	77.19	155.84	326.13
Western	219.93	50.66	106.87	210.41
National	318.30	68.19	140.32	293.18

TABLE 19. Average yield per household by crop, mT/ha¹⁷¹

CROP	AVERAGE	CENTRAL	COPPERBELT	EASTERN	LUAPULA	LUSAKA	MUCHINGA	NORTHERN	NORTHWESTERN	SOUTHERN	WESTERN
Maize	2.13	2.37	2.3	2.12	2.51	2.19	2.7	2.69	2.24	1.6	1.06
Sorghum	0.68	0.84	0.82	0.53	0.8	1.42	1.02	0.88	1.44	0.4	0.46
Rice	1.3	—	—	1.71	1.38	—	1.36	1.25	1.58	—	1.14
Millet	0.86	0.97	1.41	0.45	0.85	1.13	1.03	1	1.76	0.46	0.31
Groundnuts	0.67	0.76	0.71	0.58	0.77	0.79	0.75	0.61	0.73	0.63	0.61
Soya beans	0.85	1.06	0.84	0.77	0.48	1.18	0.57	0.82	0.73	0.64	0.2
Seed cotton	0.98	0.76	3.52	1.02	—	0.78	1.33	—	—	0.83	—
Mixed beans	0.51	0.57	0.52	0.46	0.47	0.45	0.47	0.5	0.64	0.49	0.45
Cowpeas	0.56	0.94	0.39	0.39	0.52	0.31	3.64	0.49	0.23	0.5	0.44
Sweet potato — white or yellow	4.03	4.85	4.8	4.8	3.87	9.55	2.83	3.69	3.76	3.42	3.02
Cassava	1.61	1.04	2.21	2.21	1.93	1.41	0.87	1.35	2.69	1.49	1.22
Sweet potato — orange	3.75	2.97	4.55	4.55	3.87	4.45	1.51	3.53	2.72	7.12	6.45

171) Indaba Agricultural Policy Research Institute (2015) Zambia Rural Agricultural Livelihoods Survey Report, 2015.

Link: https://images.agri-profocus.nl/upload/post/RALS_2015_Survey_Report_Finalv-_edited1456827249.pdf – accessed February 2019

TABLE 20. Percentage of households selling crops from own production¹⁷²

CROP	AVERAGE	CENTRAL	COPPERBELT	EASTERN	LUAPULA	LUSAKA	MUCHINGA	NORTHERN	NORTHWESTERN	SOUTHERN	WESTERN
Maize	52.5	68.6	63.8	40.8	59.8	42.4	59.2	70.3	64.4	48.8	21.3
Sorghum	14.6	33.8	46.6	30.4	—	70.9	16.2	14.9	36.7	8.5	1.2
Rice	67.2	—	—	50.6	72.3	—	58.4	76.5	72.5	—	68.1
Millet	43.5	50.6	62.5	32.4	65.9	45.5	52	53.9	54.3	22.6	2.6
Groundnuts	56.1	63.4	67.1	50.9	66.4	36.1	53.9	64.2	68.8	43.2	45.3
Soya beans	83.6	95.4	79.3	90.1	30.3	81.6	60.5	65.5	82.2	92.2	—
Seed cotton	99.1	99.3	100	99.7	—	100	93.3	—	—	100	—
Mixed beans	67.3	73.6	41.3	51.1	63.3	21.9	62.2	74.3	84.1	41	44.6
Cowpeas	35	62.9	21.8	38.4	9.1	20.3	11	—	56.6	43.2	18.4
Sweet potato — white or yellow	60.8	66.6	84.2	61.8	61	47.6	54.5	43.9	66.9	56.2	29.7
Cassava	22.3	10.5	39.8	70.7	36.2	16.2	5.8	19.4	13.5	11.5	19.8
Sweet potato — orange	46.8	36.7	100	15.5	34.3	—	—	49.5	20.7	94.8	100

172) IARPI 2015

DOCUMENT REFERENCES

TABLE 21. Reference Table for **Table 2** – Electricity sector in figures

Installed generation capacity (MW, 2016)	http://www.erb.org.zm/downloads/eregulation/statisticalbulletin/statBulet2017.pdf
Installed fossil fuel capacity (2016), % of total installed capacity	ERB (2017) Energy Sector Report 2016
Hydro capacity (2016), % of total installed capacity	ERB (2017) Energy Sector Report 2016
Other RE capacity (2016), % of total installed capacity	ERB (2017) Energy Sector Report 2016
Renewable electricity output as % of total electricity output excl. hydro (2014)	https://data.worldbank.org/indicator/EG.ELC.RNWX.ZS?locations=ZM
Avg. distribution and transmission losses as % of output (2014)	https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=ZM
Net electricity imports (2016), kWh	ERB (2017) Energy Sector Report 2016, p. 9
Electrification rate, total (2016) %	Government of Zambia (2017) Seventh National Development Plan 2017–2022, p. 45
Electrification rate, urban (2015) %	Government of Zambia (2017) Seventh National Development Plan 2017–2022, p. 21
Electrification rate, rural (2015) %	Government of Zambia (2017) Seventh National Development Plan 2017–2022, p. 21
Peak demand (2016), MW	ERB (2017) Energy Sector Report 2016, p. 24
Per capita electricity consumption (kWh, 2014)	https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?locations=ZM

Africa Enterprise Challenge Fund (2018) AECF website. Link: www.aecfafrica.org — accessed April 2018

African Development Bank (2017) Zambia — African Development Bank, 2017. Link: <https://www.afdb.org/en/countries/southern-africa/zambia/> — accessed March 2017

African Development Bank (2018) Africa Economic Outlook 2018, Zambia Country Notes. Link: <https://www.afdb.org/en/countries/southern-africa/zambia/zambia-economic-outlook/> — accessed April 2018

Aidun and Muench (2015) Financing DESCOs — A Framework. Link: https://docs.wixstatic.com/ugd/4c83e3_6de2aea07130463f8c7746640807aa5c.pdf — accessed July 2017

allAfrica.com (2014) Zambia: Chinese FDI in Zambia Hits \$2.6 Billion, Times of Zambia. Link: <http://allafrica.com/stories/201404030446.html> — accessed March 2017

allAfrica.com (2015) Zambia: Network Coverage, Times of Zambia. Link: <http://allafrica.com/stories/201510271533.html> — accessed March 2017

Bank of Zambia (2015) FinScope 2015 Top Line Findings Report, Financial Sector Deepening Zambia programme. Link: <http://www.fsdzambia.org/finscope-2015/> — accessed October 2017

Bank of Zambia (2018) Currency History webpage, Bank of Zambia website. Link: <http://www.boz.zm/currency-history.htm> — accessed April 2018

Bank of Zambia (2018) Monetary Policy Committee Statement for Fourth Quarter 2017, Governor's Presentation to the Media, 21 February 2018. Link: <http://www.boz.zm/MPCPresentation-Feb2018.pdf> — accessed April 2018

BBC (2017) Zambia Country Profile. Link: <http://www.bbc.com/news/world-africa-14112449> — accessed March 2017

BDO (2017) Zambia National Budget 2018. Link: <https://www.bdo.co.zm/en-gb/insights/publications/zambia-budget-for-2018> — accessed April 2018

Bloomberg (2015) Zambia's Electricity Shortfall Widens to Half of Peak Demand. Link: <https://www.bloomberg.com/news/articles/2015-09-22/zambia-s-electricity-shortfall-widens-to-half-of-peak-demand> — accessed March 2017

Bloomberg New Energy Finance (2017) Off-Grid Solar Market Trends Report 2016. Link: <https://about.bnef.com/blog/off-grid-solar-market-trends-report-2016/> — accessed April 2018

Bloomberg New Energy Finance (2017a) Q1 2017 Off-Grid and Mini-Grid Market Outlook. Link: <https://data.bloomberglp.com/bnef/sites/14/2017/01/BNEF-2017-01-05-Q1-2017-Off-grid-and-Mini-grid-Market-Outlook.pdf> — accessed July 2017

Bloomberg New Energy Finance (2017b) Q2 2017 Off-Grid and Mini-Grid Market Outlook. Link: <http://global-climatescope.org/en/blog/2017/04/24/2QFPM/> — accessed July 2017

Central Intelligence Agency (2017) The World Factbook, 2017. Link: <https://www.cia.gov/library/publications/resources/the-world-factbook/geos/za.html> — accessed April 2018

Central Statistical Office (2011) Zambia 2010 Census of Population and Housing, February 2011. Link: <https://unstats.un.org/unsd/demographic/sources/census/wphc/Zambia/PreliminaryReport.pdf> — accessed March 2017

Central Statistical Office (2012) Living Conditions Monitoring Survey Report 2006 and 2010. Link: https://www.zamstats.gov.zm/phocadownload/Living_Conditions/2006-2010%20LCMS%20Final%20Report.pdf — accessed April 2018

Central Statistical Office (2015) 2013–14 ZDHS Key Findings, March 2015. Rockville, Maryland, USA: Central Statistical Office (CSO), Ministry of Health (MOH) and ICF International. Link: <https://www.dhsprogram.com/pubs/pdf/SR219/SR219.pdf> — accessed April 2018

Central Statistical Office (2016) 2015 Living Conditions Monitoring Survey Report. Link: https://www.zamstats.gov.zm/phocadownload/Living_Conditions/2015%20Living%20Conditions%20Monitoring%20Survey%20Report.pdf — accessed April 2018

Central Statistical Office (2017) Zambia Labour Force Survey of 2014, The Statistician, July 2017. Link: http://www.zamstats.gov.zm/phocadownload/Dissemination/The_Statistician_2017.pdf — accessed April 2018

Central Statistical Office (2018) Overall Inflation by Month, Price Statistics, Zambia Data Portal website. Link: <http://zambia.opendataforafrica.org/ukxlqoc/prices-statistics> — accessed June 2018

Chanda, Linus (2017) Power Sector in Zambia – Opportunities for Private Companies, Presentation of the Information Workshop on Decentralised Energy Supply and Load Management in Zambia, Berlin, Germany, December 2017. Link: <https://tinyurl.com/ybyqe6x9> — accessed April 2018

Chulu, Kabanda (2017) State Reviewing Electricity Act, Zambia Daily Mail Limited online, 23 October 2017. Link: <https://www.daily-mail.co.zm/state-reviewing-electricity-act/> — accessed April 2018

City Population (2018) Zambia: Provinces, Major Cities, and Urban Centres, Citypopulation.de. Link: <https://www.citypopulation.de/Zambia-Cities.html> — accessed April 2018

Climatescope (2017) Climatescope – Zambia. Link: <http://global-climatescope.org/en/country/zambia/#/details> — accessed March 2017

Copperbelt Energy Corporation (2018) Commissioning of Zambia's Maiden Grid Connection Solar PV Power Plant, CEC website. Link: <https://cecinvestor.com/the-commissioning-of-zambia-as-maiden-grid-connected-solar-pv-power-plant/> — accessed April 2018

Danish Energy Management & Esbensen (2017) Renewable Energy Market Landscape Study covering 15 countries in Southern and East Africa, Volume III, Donor Mapping. Link: http://www.entwicklung.at/fileadmin/user_upload/Dokumente/Regionen/Volume_III_Market_Landscape_Study_EEP-SEA_Donor_Mapping.pdf — accessed April 2018

Enel (2017) Enel Signs 25-Year PPA With Zambian National Utility ZESCO, 2017. <https://www.enelgreenpower.com/en/media/press/d201704-enel-signs-25-year-ppa-with-zambian-national-utility-zesco.html> — accessed April 2017

Energy Environment Partnership Africa (2018) The Energy Environment Partnership Southern and Eastern Africa. Link: <http://www.eepafrica.org> — accessed April 2018

Energy Regulation Board (2014) ERB Statistical Bulletin 2013–2014. Link: http://www.erb.org.zm/downloads/eregulation/statisticalbulletin/statBullet2013_2014.pdf — accessed April 2018

Energy Regulation Board (2014) Power Quality Management Framework for the Electricity Supply Industry in Zambia. Link: <https://static1.squarespace.com/static/58c95e0c5016e18d705d710a/t/59b1465b3e00bed6f7a8f013/1504790109990/Final+ERB+Power+Quality+Management+Framework.pdf> — accessed April 2018

Energy Regulation Board (2015) Energy Sector Report, 2014. Link: <http://www.erb.org.zm/reports/EnergySectorReport2014.pdf> — accessed April 2018

Energy Regulation Board (2015) The Electricity Tariff Determination Guidelines for Retail Customers. Link: <http://www.erb.org.zm/downloads/eregulation/Guidelines/electricityTariffDeterminationGuidelines.pdf> — accessed April 2018

Energy Regulation Board (2016) Energy Sector Report, 2015. Link: <http://www.erb.org.zm/reports/ESR2015.pdf> — accessed April 2018

Energy Regulation Board (2016) The Zambian Distribution Grid Code. Link: <https://static1.squarespace.com/static/58c95e0c5016e18d705d710a/t/59dcd4e19f8dcedaf33c6b5/1507646188564/Zambia+Distribution+Code+%2800457395xB0385%29.pdf> — accessed April 2018

Energy Regulation Board (2017) Energy Sector Report, 2016. Link: <http://www.erb.org.zm/downloads/esr2016.pdf> — accessed April 2018

Energy Regulation Board (2017) Invitation to Submit Written Comments on NWECC's Application to Revise Electricity Tariffs for the Year 2017. Link: <http://www.erb.org.zm/downloads/notices/nwecPCP.pdf> — accessed April 2018

Energy Regulation Board (2017) Revision of Electricity Tariffs May 2017. Link: <http://www.erb.org.zm/downloads/eregulation/zescotariffs/erbApprovedTariffScheduleMay2017.pdf> — accessed April 2018

Energy Regulation Board (2017) Personal communication, May 2017

Energy Regulation Board (2017a) ERB website. Link: <http://www.erb.org.zm> — accessed March 2017

Energy Regulation Board (2017b) Speech by the ERB Board acting chairman Prof. Francis Yamba on the ZESCO application to vary electricity tariffs – 2017. Link: <http://www.erb.org.zm/press/statements/tariffDecisionSpeech10.05.2017.pdf> — accessed April 2018

Energy Regulation Board (2018) ERB website, ERB Statistical Reports 2013–2016. Link: <http://www.erb.org.zm/content.php?viewpage=stbn> — accessed April 2018

Energy Regulation Board (2018) Personal communication, July 2018

European Commission (2018) Construction of Two-Grid Extension Projects in Kaoma and Mumbwa Districts in Zambia, EC website. Link: https://ec.europa.eu/europeaid/projects/construction-two-grid-extension-projects-kaoma-and-mumbwa-districts-zambia_en — accessed April 2018

European Commission (2018) InforEuro monthly accounting rate of the euro, Zambian Kwacha, EC website. Link: http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/index_en.cfm — accessed May 2018

European External Action Service (2016) The Government of Zambia and the European Union signed a Financing Agreement for the Support to the Zambia Energy Sector. Link: https://eeas.europa.eu/headquarters/headquarters-homepage/16118/government-zambia-and-european-union-signed-financing-agreement-support-zambia-energy-sector_ro — accessed March 2017

European External Action Service (2017) European Union Signs €65 million grant with Zambia to improve access to energy. Link: https://eeas.europa.eu/headquarters/headquarters-homepage/18954/european-union-signs-eu65-million-grant-zambia-improve-access-energy_en — accessed March 2017

European External Action Service (2018) European Union Delegation Zambia Development Partnership Fact Sheet 2017/2018. Link: https://eeas.europa.eu/sites/eeas/files/fact-sheet_2018_finalpdf_2.pdf — accessed April 2018

European Union Energy Initiative Partnership Dialogue Facility (2014) Mini-grid Policy Toolkit: Policy and Business Frameworks for Successful Mini-grid Roll-outs. Link: <http://www.euei-pdf.org/en/recp/mini-grid-policy-toolkit> — accessed June 2018

Ezilon Maps (2018) Zambia Map – Physical Map of Zambia. Link: <https://www.ezilon.com/maps/africa/zambia-physical-maps.html> — accessed April 2018

Focus Economics. (2017) Focus Economics website. Link: <http://www.focus-economics.com/country-indicator/zambia/gdp> — accessed March 2017

Geo-Ref.net (2018) Geo-Ref.net, Republic of Zambia population density map. Link: <http://www.geo-ref.net/ph/zmb.htm> — accessed April 2018

GOGLA Lighting Global (2018) Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data, July – December 2017, Public Report,. Link: https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf — accessed April 2018

Government of Zambia (1995) The Electricity Act. Link: <http://www.parliament.gov.zm/node/1456> — accessed April 2018

Government of Zambia (1995) The Energy Regulation Act. Link: <http://www.erb.org.zm/downloads/legislation/Energy%20Regulation%20Act.pdf> — accessed April 2018

Government of Zambia (1997) Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations. Link: <http://www.zema.org.zm/index.php/publications/environmental-legislation/environmental-regulations/> — accessed April 2018

Government of Zambia (2003) The Rural Electrification Act. Link: [http://www.erb.org.zm/downloads/legislation/Rural Electrification Act.pdf](http://www.erb.org.zm/downloads/legislation/Rural_Electrification_Act.pdf) — accessed April 2018

Government of Zambia (2017) Seventh National Development Plan 2017-2022. Link: <http://extwprlegs1.fao.org/docs/pdf/zam170109.pdf> — accessed April 2018

Government of Zambia (2018) Water Resource Management (Charges and Fees) Regulations, 2018. https://www.zambialii.org/zm/legislation/statutory-instrument/2018/18/si_2018_18.pdf — accessed April 2018

Gov.uk (2017) UK and Zambia sign Energy Africa Partnership Agreement. Link: <https://www.gov.uk/government/world-location-news/uk-and-zambia-sign-energy-africa-partnership-agreement> — accessed March 2017

Helix Institute of Digital Finance (2016) Agent Network Accelerator Survey - Zambia Country Report 2015. Link: <http://www.helix-institute.com/data-and-insights/agent-network-accelerator-survey-zambia-country-report-2015> — accessed October 2017

Hydro4Africa (2012) Zambian Shiwangandu small hydro-power plant inaugurated, Hydro4Africa website. Link: <http://hydro4africa.net/news/viewnews.php?ID=732> — accessed April 2018

Imelda K. Moise, Ezekiel Kalipeni & Leo C. Zulu (2011) Analysing Geographical Access to HIV Sentinel Clinics in Relation to Other Health Clinics in Zambia, Journal of Map & Geography Libraries: Advances in Geospatial Information, Collections & Archives, 7:3, 254–281, DOI: 10.1080/15420353.2011.599756

Impact Assessment Association of Zambia (2017) IAAZ website. Link: <http://www.zema.org.zm/iaaz/> — accessed March 2017

Indaba Agricultural Policy Research Institute (2015) Zambia Rural Agricultural Livelihoods Survey Report, 2015. Link: https://images.agri-profocus.nl/upload/post/RALS_2015_Survey_Report_Finalv_edited1456827249.pdf — accessed April 2018

Industrial Development Corporation (2017) IDC website. Link: <http://www.idc.co.zm/> — accessed March 2017

Innovation Norway (2017) News on the Solar4Health-project. Link: <http://www.innovasjon Norge.no/en/start-page/noreps/recentactivities/norway-funds-zambias-solar-energy-supply-in-health-facilities/> — accessed March 2017

International Energy Agency (2014) Zambia: Electricity and Heat for 2014. Link: <http://www.iea.org/statistics/statisticssearch/report/?year=2014&country=Zambia&product=Electricityand-Heat> — last accessed March 2017, link no longer available

International Energy Agency (2017) World Energy Outlook — Energy Access Database. Link: <http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/> — accessed March 2017

International Finance Corporation (2018) Scaling off-grid energy solutions in Zambia through Public-Private Partnerships, project overview, IFC Energy and Water Advisory Services, April 2018

International Growth Centre (2016) Lights out: Zambia's Electricity Crisis. Link: <http://www.theigc.org/blog/lights-out-zambia-as-electricity-crisis/> — accessed March 2017

International Monetary Fund (2018) IMF Office in Zambia, IMF website. Link: <http://www.imf.org/en/Countries/ResRep/ZMB#country> — accessed April 2018

International Renewable Energy Agency (2013) Zambia Renewables Readiness Assessment. Link: http://www.irena.org/documentdownloads/publications/rra_zambia.pdf — accessed July 2017

International Renewable Energy Agency (2017) Global Atlas. Link: <http://irena.masdar.ac.ae/> — accessed March 2017

International Rivers (2012) A Risk Climate for Southern African Hydro. Available: https://www.internationalrivers.org/sites/default/files/attached-files/zambezi_climate_report_final.pdf — accessed March 2017

Internet World Status (2017) Zambia Internet Stats and Telecommunications Reports. Link: <http://internetworldstats.com/af/zm.htm> — accessed March 2017

Japan International Cooperation Agency (2017) JICA Zambia website. Link: <https://www.jica.go.jp/zambia/english/index.html> — accessed: March 2017

Johnson, O and C. Muhoza (2016) Renewable energy mini-grids: An alternative approach to energy access in southern Africa. Nairobi. Stockholm Environment Institute - Africa World Agroforestry Centre. Link: <http://www.iapri.org.zm/news/item/396-2015-rual> — accessed March 2017

Kapika and Eberhard (2013) Power Sector Reform and Regulation in Africa. Link:

https://www.researchgate.net/publication/290439901_Power_Sector_Reform_and_Regulation_in_Africa_Lessons_from_Kenya_Tanzania_Uganda_Zambia_Namibia_and_Ghana — accessed April 2018

KMPG (2017) 2018 Budget Highlights Zambia. Link: <https://home.kpmg.com/content/dam/kpmg/xx/pdf/2017/11/tnf-zambia-nov29-2017.pdf> — accessed April 2018

Knoema (2017) World Bank Education Statistics, 2015. Link: <https://knoema.com/WBEDS2017/world-bank-education-statistics> — accessed March 2017

Kumar and Winiecki (2014) Access to Energy via Digital Finance: Overview of models and prospects for innovation. Link: https://www.cgap.org/sites/default/files/researches/documents/DigitallyFinancedEnergy_FINAL.pdf — accessed March 2017

Loenen, Bastiaan van (1999) Land Tenure in Zambia. Link: https://www.researchgate.net/publication/242672704_Land_tenure_in_Zambia — accessed April 2018

Lusaka Times (2017) ZESCO applies to raise tariffs by 75%. Link: <https://www.lusakatimes.com/2017/03/27/zesco-applies-raise-tariffs-75/> — accessed March 2017

Lusaka Times (2017) US company to light up 215 rural homes in Sioma district using solar, 31 May 2017. Link: <https://www.lusakatimes.com/2017/05/31/us-ngo-light-1-200-rural-homes-sioma-district-using-solar/> — accessed April 2018

Lusaka Times (2017a) Mining firms could face \$276 million bill in power dispute-CEC. Link: <https://www.lusakatimes.com/2017/03/21/mining-firms-face-276-million-bill-power-dispute-cec/> — accessed March 2017

Lusaka Times (2018) Zambia to Ban Foreigners from Owning Land, 2 March 2018. Link: <https://www.lusakatimes.com/2018/03/02/zambia-ban-foreigners-owning-land/> — accessed April 2018

Michigan State University (2009) Identifying Regions of Staple Food Net Consumption and Supply, April 2009. Link: https://msu.edu/~longabau/gis_project/ — accessed March 2017

Ministry of Education (2015) 2015 Educational Statistical Bulletin. Link: <http://www.moe.gov.zm/index.php/documentation-a-information-center/planning-a-information/finish/8-planning-a-information/14248-2015-education-statistical-bulletin/0> — accessed March 2017

Ministry of Energy and Water Development (2008) National Energy Policy. Link: <https://static1.squarespace.com/static/58c95e0c5016e18d705d710a/t/58ee21f0ebbd1a-718d26a06d/1492001282630/National+Energy+Policy+2008.pdf> — accessed May 2018

Ministry of Energy and Water Development (2015) Energy Policy in Zambia. Link: http://www.grips.ac.jp/teacher/oono/hp/course/student_slides/2015/lufunda_energy.pdf — accessed July 2017

Ministry of Energy and Water Development (2017) MEWD website. Link: <http://www.mewd.gov.zm/> — accessed March 2017

Ministry of Health (2012) The 2012 List of Health Facilities in Zambia. Link: <http://www.moh.gov.zm/docs/facilities.pdf> — accessed March 2017

Muench (2015) Currency Risk and Mitigation Strategies for the Off-Grid Energy Sector. Link: https://docs.wixstatic.com/ugd/4c83e3_242d019d9d904df3b6e7caf69447acf0.pdf — accessed July 2017

Musonda, Geoffrey (2017) Status of Rural Electrification in Zambia, presentation 11 April 2017. Link: <https://eepafrica.org/wp-content/uploads/Presentation-Status-of-Rural-Electrification-In-Zambia-KEF.pdf> — accessed April 2018

Nations Encyclopaedia (2017) Zambia. Link: <http://www.nationsencyclopedia.com/Africa/Zambia.html>. — accessed March 2017

Neoen (2017) PPA Signature in Zambia, Neoen website. Link: <https://www.neoen.com/en/ppa-signature-zambia/> — accessed March 2017

Nkumbula, Paul (2017) Personal communication, February 2017

Observatory of Economic Complexity (2017) Zambia, 2017. Link: <http://atlas.media.mit.edu/en/profile/country/zmb/> — accessed March 2017

Odendaal, Natasha (2016) IHS eyes offgrid solutions to power up its towers, 2 June 2016, Engineering News, Creamer Media. Link: http://www.engineeringnews.co.za/article/ihs-eyes-off-grid-solutions-to-power-up-its-towers-2016-06-02/rep_id:4136 — accessed April 2018

Office for Promoting Private Power Investment (2017) OPPPI website. Link: <http://www.oppqi.gov.zm/> — accessed March 2017

Power Africa (2017) Power Africa – Zambia. Link: <https://www.usaid.gov/powerafrica/zambia> — accessed March 2017

PwC (2018) Worldwide Tax Summaries, Zambia, Corporate – Other Taxes, PwC website: <http://taxsummaries.pwc.com/ID/Zambia-Corporate-Other-taxes> — accessed April 2018

PwC (2018) Zambia corporate tax, significant developments: Link: <http://taxsummaries.pwc.com/ID/Zambia-Corporate-Significant-developments> — accessed April 2018

Renewable Energy Cooperation Programme (2016) RECP Zambia Scoping Mission Visit Report

Renewable Energy and Energy Efficiency Partnership (2018) Power Africa: Beyond the Grid Fund for Zambia Website. Link: <https://www.reeep.org/bgfz> — accessed April 2018

Rural Electrification Authority (2008) Rural Electrification Master Plan: 2009 – 2030. Link: <http://www.rea.org.zm/index.php/2013-08-24-13-50-58/remap> — accessed March 2017

Rural Electrification Authority (2017) REA website. Link: <http://www.rea.org.zm/> — accessed April 2018

Rural Electrification Authority (2017) Personal communication, May 2017

Rural Electrification Authority (2018) Mini Hydro Development, REA website. Link: <http://www.rea.org.zm/our-projects/mini-hydro.html> — accessed April 2018

Rural Electrification Authority (2018) Grid Extension Projects, REA website. Link: <http://www.rea.org.zm/our-projects/grid-extension.html> — accessed April 2018

Rural Electrification Authority (2018) Personal communication, July 2018

Scaling Solar (2017) Link: <https://www.scalingsolar.org/> — accessed March 2017

Scott, A, Diecker, J, Harrison, K, Miller, C and S. Wheeldon (2016) Accelerating access to electricity in Africa with off-grid solar – Off-grid solar country briefing: Zambia. Overseas Development Institute. Link: https://www.energynetwork.co.uk/webfm_send/1688 — accessed April 2018

Sustainable Energy for All (2017) SE4All Hub website. Link: <https://www.se4all-africa.org/se4all-in-africa/country-data/zambia> — accessed 13 March 2017

Sikwanda, Cletus (2016) Migration of Electricity Tariffs to Cost Reflectivity In the SADC Region - A Case Study of Zambia. Link: <https://tinyurl.com/y8qmhku8> — accessed April 2018

SolarGIS (2018) Solar Resource Map Global Horizontal Irradiation Zambia. Link: <https://solargis.com/maps-and-gis-data/download/zambia> — accessed April 2018

Stiko, N J, Chamberlin, J and M Hichaambwa (2015) The Geography of Customary Land in Zambia: is Development Strategy Engaging with the Facts? Link: <https://ageconsearch.umn.edu/bitstream/211222/2/wp98.pdf> — accessed April 2018

Trading Economics (2017) Zambia. Link: <https://tradingeconomics.com/zambia/indicators> — accessed April 2017

Trading Economics (2018) Zambia – Economic Indicators. Link: <https://tradingeconomics.com/zambia/indicators> — accessed April 2018

UN Capital Development Fund (2016) Consumer Behaviours in Zambia. Link: <http://www.unCDF.org/article/871/consumer-behaviors-in-zambia> — accessed March 2017

UN Capital Development Fund (2017) State of the Digital Financial Services Market in Zambia, 2016. Link: <http://www.unCDF.org/article/2776/state-digital-financial-services-market-zambia-2016> — accessed May 2017

UN Children's Fund (2017) Zambia Nutrition, UNICEF website. Link: https://www.unicef.org/zambia/5109_8461.html — accessed March 2017

UN Economic Commission for Africa (2015) Zambia Country Profile. Link: <http://www.uneca.org/sites/default/files/images/ORIA/CP/zambia.pdf> accessed March 2017

UN Industrial Development Organization (2017) UNIDO website. Link: <http://www.unido.org/africa/selected-projects/zambia-mini-grids.html> — accessed March 2017

United Nations (2004) Map of Zambia, UN Department of Peacekeeping Operations, Cartographic Department. Link: <http://www.un.org/Depts/Cartographic/map/profile/zambia.pdf> — accessed June 2018

US Africa Development Foundation (2017) US Africa Development Foundation Cofunds Zambia's First Public-Private Solar Mini-Grid, 21 April 2017, USADF website. Link: <http://www.usadf.gov/pressreleases/2017/4/11/zambias-first-public-private-solar-mini-grid?platform=hootsuite> — accessed April 2018

USAID (2009) Powering Health: Options for Improving Energy Services at Health Facilities in Zambia. Link: http://www.poweringhealth.org/Pubs/zambia_assessment_report.pdf — accessed March 2017

USAID (2017) USAID Announces \$4 Million to Solar Start-Ups for African Off-Grid Energy, 2016. Link: <https://www.usaid.gov/news-information/press-releases/oct-14-2016-usaid-announces-4-million-solar-start-ups-african-grid-energy> — accessed March 2017

USAID (2018) Famine Early Warning System Network, Southern Africa, Zambia webpage. Link: <http://fews.net/southern-africa/zambia> — accessed April 2018

US Department of State (2017) Zambia, 2017. Link: <https://travel.state.gov/content/passports/en/country/zambia.html> — accessed March 2017

US International Trade Administration (2018) Zambia – Import Tariffs, Zambia Country Commercial Guide, export.gov website. Link: <https://www.export.gov/article?id=Zambia-Import-Tariffs> — accessed April 2018

Various mini-grid developers and entrepreneurs in Zambia (2017), Personal communication, March – October 2017

Water Resources Management Authority (2017) Personal communication, May 2017

Water Resources Management Authority (2018) WARMA website. Link: <http://www.warma.org.zm> — accessed April 2018

Wikipedia (2018) Zengamina webpage. Link: <https://en.wikipedia.org/wiki/Zengamina> — accessed April 2018

World Atlas (2017) The World Atlas Official Website. Link: <http://www.worldatlas.com/articles/top-copper-producing-countries-in-the-world.html> — accessed March 2017

World Bank (2010) Zambia's Infrastructure: A Continental Perspective, 2010. Link: http://siteresources.worldbank.org/INTAFRICA/Resources/Zambia-Country_Report_03.2011.pdf — accessed March 2017

World Bank (2012) Zambia poverty assessment: stagnant poverty and inequality in a natural resource-based economy. World Bank Africa region, Poverty reduction and economic management. Link: <https://openknowledge.worldbank.org/handle/10986/16792> — accessed April 2018

World Bank (2014) ESMAP Solar Resource Mapping for Zambia (P145271) Interim Solar Modelling Report. Link: <http://documents.worldbank.org/curated/en/259231467986245030/pdf/98030-ESMAP-P145271-Box391499B-PUBLIC-WBG-ESMAP-Zambia-Solar-Modeling-Report-2014-11-26.pdf> — accessed April 2018

World Bank (2016) Average monthly temperature & rainfall for Zambia 1901–2015, Climate Change Knowledge Portal, World Bank website. Link: http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCCode=ZMB — accessed April 2018

World Bank (2016a) Zambia Economic Brief, June 2016, WB website. Link: <http://documents.worldbank.org/curated/en/804591467989562427/pdf/106508-WP-P157243-PUBLIC.pdf> — accessed March 2017

World Bank (2016b) Zambia Overview, WB website. Link: <http://www.worldbank.org/en/country/zambia/overview#1> — accessed March 2017

World Bank (2016c) Zambia Economic Brief: Raising Revenue for Economic Recovery, December 2016. Link: <http://documents.worldbank.org/curated/en/166021480932290112/pdf/110728-WP-P157243-PUBLIC-ZambiaEBRaisingRevenue-forEconomicRecoveryDecember.pdf> — accessed March 2017

World Bank (2016d) World Bank SSA Electricity Tariff Database, October 2016. Link: <http://databank.worldbank.org/data/download/avpfa/avpfa-tariff.xlsx> — accessed March 2017

World Bank (2017) Data – World Bank website. Link: <http://data.worldbank.org> — accessed March 2017

World Bank (2017) Doing Business 2018: Reforming to Create Jobs. Link: <http://www.doingbusiness.org/~media/WBG/DoingBusiness/Documents/Annual-Reports/English/DB2018-Full-Report.pdf> — accessed April 2018

World Bank (2017) Electricity Service Access Project (P162760), Project Appraisal Document, Zambia. Link: <http://projects.worldbank.org/P162760/?lang=en&tab=documents&subTab=projectDocuments> — accessed April 2018

World Bank (2017a) GINI Index estimate – WB website. Link: <http://data.worldbank.org/indicator/SI.POV.GINI?locations=ZM/> — accessed March 2017

World Bank (2017b) World Bank website. Link: <http://www.worldbank.org/en/news/loans-credits/2017/02/16/zambia-west-lunga-scaling-solar-energy-project> — accessed March 2017

World Bank (2017c) Zambia Poverty Assessment – WB website. Link: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20204786~menuPK:435735~pagePK:148956~piPK:216618~theSitePK:430367,00.html> — accessed March 2017

World Bank (2018) Ease of Doing Business in Zambia, World Bank website. Link: <http://www.doingbusiness.org/data/exploreconomies/zambia#starting-a-business> — accessed June 2018

World Bank (2018) Electric power consumption (kWh per capita), 2014, Zambia. Link: <https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?locations=ZM> — accessed April 2018

World Bank (2018) Electric power transmission and distribution losses (% of output), 2014, Zambia. Link: <https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=ZM> — accessed April 2018

World Bank (2018) Electricity production from renewable sources, excluding hydroelectric (% of total), 2014, Zambia. Link: <https://data.worldbank.org/indicator/EG.ELC.RNWX.ZS?locations=ZM> — accessed April 2018

World Economic Forum (2018) Global Competitiveness Index 2017-2018. Link: <http://reports.weforum.org/global-competitiveness-index-2017-2018/countryeconomy-profiles/#economy=ZMB> — accessed April 2018

World Food Programme (2017) World Food Programme Official Website. Link: www.wfp.org/countries/zambia — accessed March 2017

World Health Organization (2015) Access to Modern Energy Services for Health Facilities in Resource-Constrained Settings: A Review of Status, Significance, Challenges and Measurement, p. 55. Link: http://apps.who.int/iris/bitstream/handle/10665/156847/9789241507646_eng.pdf;jsessionid=F-3D616EECFE93FE4FE9469D8485CBF40?sequence=1 — accessed May 2017

World Intellectual Property Organization (2016) The Global Innovation Index 2016. Link: http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2016.pdf — accessed March 2017

Zambia Bureau of Standards (2017) ZABS website. Link: <http://www.zabs.org.zm/> — accessed April 2018

Zambia Business Times (2017) Top 10 companies in Zambia. Link: <http://zambiabusinesstimes.com/2017/02/12/top-10-companies-in-zambia/> — accessed March 2017

Zambia Business Times (2018) Zambia to implement cost-reflective energy tariffs by year end – Ministry of Energy. Link: <https://zambiabusinesstimes.com/2018/06/22/zambia-to-implement-cost-reflective-energy-tariffs-by-year-end-energy-ministry/> — accessed June 2018

Zambia Development Agency (2017) ZDA website. Link: <http://www.zda.org.zm/?q=content/energy> — accessed March 2017

Zambia Development Agency (2017) Personal communication, May 2017

Zambia Development Agency (2018) Land Considerations, ZDA website. Link: <https://tinyurl.com/y92ssarr> — accessed April 2018

Zambia Development Agency (2018) Import and Export Considerations, Doing Business in Zambia, ZDA website. Link: <http://www.zda.org.zm/cost/en/Investment/Doing%20Business%20IN%20Zambia/Import%20and%20Export%20Considerations> — accessed April 2018

Zambia Electricity Supply Corporation (2017) ZESCO website. Link: <http://www.zesco.co.zm/home> — accessed April 2017

Zambia Electricity Supply Corporation (2018) Personal communication – May 2018

Zambia Electricity Supply Corporation (2018) Transmission, ZESCO website. Link: <http://www.zesco.co.zm/ourBusiness/transmission> — accessed April 2018

Zambia Environmental Management Authority (2017) Personal communication, May 2017

Zambia Environmental Management Authority (2018) ZEMA website. Link: <http://www.zema.org.zm/> — accessed April 2018

Zambia Information and Communications Technology Authority (2015) Information and Communications Technology & Postal Services Investment Profile. Link: <https://www.zicta.zm/Views/Publications/ICTandPostalServicesInvestmentProfile.pdf> — accessed March 2017

Zambia Information and Communications Technology Authority (2018) ICT Statistics Portal, ZICTA website. Link: <http://onlinesystems.zicta.zm:8585/statsfinal/index.html> — accessed May 2018

Zambia Institute for Policy Analysis (2013) The Distribution of Household Income in the Middle Class in Zambia, December 2013. Link: http://www.zipar.org.zm/index.php?option=com_docman&view=download&alias=38-the-distribution-of-household-income&category_slug=working-papers&Itemid=120 — accessed March 2017

ZambiaInvest (2015) Zambia Electrification Authority to Spend USD 770,000 on Rural Solar Projects, 31 January 2015, ZambiaInvest website. Link: <http://www.zambiainvest.com/energy/zambia-electrification-authority-to-spend-usd-770000-on-rural-solar-projects> — accessed April 2018

ZambiaInvest (2016) ZambiaInvest website. Link: <http://www.zambiainvest.com/economy/investment-opportunities-zda> — accessed March 2017

Zambia Revenue Authority (2015) Customs and Excise Tariff. Link: <https://www.zra.org.zm/pages/documents/consolidated-TariffGuide.pdf> — accessed May 2018

Zambia Revenue Authority (2017) ZRA website. Link: <https://www.zra.org.zm/> — accessed April 2018

Zambia Revenue Authority (2018) ZRA website, Excise Duty webpage. Link: <https://www.zra.org.zm/commonHomePage.htm?viewName=Excise> — accessed April 2018

Zambia Tourism (2017) Zambia Distance Chart. Link: <http://www.zambiatourism.com/map> — accessed March 2017

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