WORLD BANK GROUP

ECREEE

TOWARDS SUSTAINABLE ENERGY

REGIONAL OFF-GRID ELECTRIFICATION PROJECT

Off-Grid Solar Market Assessment & Private Sector Support Facility Design

TOGO REPORT

JULY 2019

GreenMax Capital Advisors

Energio Verda
Renewable Energy for Development

ASD

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS & ACRONYMS

AFD	Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
ARSE	Autorité de Règlementation du Secteur de l'Electricité (Electricity Sector Regulatory Authority)
ASD	African Solar Designs
AT2ER	Rural Electrification and Renewable Energy Agency
ATN	Agence Togolaise de Normalisation (Togolese Standards Agency)
BCEAO	Banque Centrale des États de l'Afrique de l'Ouest (Central Bank of West African States)
BIC	Bureaux d'Information sur le Crédit (Credit Information Bureaus)
BOAD	Banque Ouest Africaine de Développement (West African Development Bank)
BoP	Bottom of the Pyramid
C&I	Commercial and Industrial
CAPEX	Capital Expenditure
CCIT	La Chambre de Commerce et de l'Industrie du Togo (Chamber of Commerce and Industry of Togo)
CEB	Communauté Electrique du Benin (Electricity Community of Benin)
CEET	Compagnie Energie Electrique du Togo (Electricity Company of Togo)
CEMAC	Communauté Economique et Monétaire de l'Afrique Centrale (Economic and Monetary Community of Central Africa)
CFA	Communauté Financière Africaine (African Financial Community)
CIZO	National Rural Electrification Program
COD	Cash-on-Delivery
DFI	Development Finance Institution
DfID	Department for International Development
EBID	ECOWAS Bank for Investment and Development
ECA	Export Credit Agency
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
ECOWREX	ECOWAS Observatory for Renewable Energy and Energy Efficiency
ECREEE	ECOWAS Center for Renewable Energy and Energy Efficiency
EDF	Électricité de France
EDM	Entrepreneurs du Monde
EIB	European Investment Bank
EMPER	Entrepreneurs de Micro-Projets d'Energie Renouvelables (Entrepreneurs of Micro-Projects of Renewable Energy)
ESMAP	Energy Sector Management Assistance Program
EU	European Union
EUR	Euro
EVA	Energio Verda Africa
FAO	Food and Agriculture Organization of the United Nations
FEI	Facility for Energy Inclusion
FGD	Focus Group Discussion
FI	Financial Institution
FNFI	Fonds National de la Finance Inclusive (National Fund for Inclusive Finance)
FX	Foreign Exchange
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information Systems

GNI	Gross National Income
GOGLA	Global Off-Grid Lighting Association
GoT	Government of Togo
GSMA	Groupe Spéciale Mobile Association (Global System for Mobile Communications)
HC	Health Center
HDI	Human Development Index
HH	Household
ICT	Information and Communications Technology
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IMF	International Monetary Fund
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
kW	Kilowatt
kWh	Kilowatt-hour
JVE	Jeunes Volontaires pour l'Environnement (Young Volunteers for the Environment)
LPG	Liquefied Petroleum Gas
LTO	Lease-to-Own
MCC	Millennium Challenge Corporation
MFI	Microfinance Institution
MME	Ministry of Mines and Energy
MTF	Multi-Tier Energy Access Framework
MW	Megawatt
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-Governmental Organization
NPL	Non-Performing Loan
O&M	Operation and Maintenance
OGS	Off-Grid Solar
OHADA	L'Organisation pour l'Harmonisation en Afrique du Droit des Affaires (Organization for the Harmonization of Business Law in Africa)
OTR	Office Togolais des Recettes (Togolese Revenue Authority)
PANER	Plan d'Action National pour les Énergies Renouvelables (National Renewable Energy Action Plan)
PAYG	Pay-As-You-Go
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PRODERE	Programme Régional de Développement des Énergies Renouvelables et de l'Efficacité Énergétique (evelopment Programme for Renewable Energy and Energy Efficiency)
PUE	Productive Use of Energy
PV	Photovoltaic
RE	Renewable Energy
RISE	Regulatory Indicators for Sustainable Energy
ROA	Return on Assets
ROE	Return on Equity
ROGEP	Regional Off-Grid Electrification Project
SEFA	Sustainable Energy Fund for Africa
SEforALL	Sustainable Energy for All
SHS	Solar Home System
SME	Small and Medium Enterprise

SPV	Special Purpose Vehicle
SSA	Sub-Saharan Africa
SUNREF	Sustainable Use of Natural Resources and Energy Finance
TA	Technical Assistance
UEMOA/WAEMU	Union Économique et Monétaire Ouest Africaine / West African Economic and Monetary Union
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USD	United States Dollar
VAT	Value Added Tax
WAPP	West African Power Pool
WB	World Bank
WEP	Women Environmental Programme
Wh	Watt-hour
Wp	Watt peak

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NOTE: The findings, analysis, conclusions and recommendations expressed in this report are those of the authors – they do not necessarily represent the views of ECREEE, the World Bank, or any of the individuals and organizations that contributed to this study.

KEY DEFINITIONS

ELECTRICITY ACCESS

For the purpose of this analysis, figures on national, urban and rural electrification rates are from the International Energy Agency (IEA) Energy Access Outlook Report, 2017.[1] Although local government authorities (energy ministries, rural electrification agencies, utilities etc.) may have different or more up-to-date electrification data, one single, uniformly-accepted source was necessary as a baseline to assess electricity access figures across all 19 of the countries analyzed under this regional market assessment.

There is no single internationally-accepted and internationally-adopted definition of modern energy access. The IEA defines energy access as "a household having reliable and affordable access to both clean cooking facilities and to electricity, which is enough to supply a basic bundle of energy services initially, and then an increasing level of electricity over time to reach the regional average."[2] A "basic bundle of energy services" means, at a minimum, several lightbulbs, task lighting (such as a flashlight or lantern), phone charging and a radio. This definition of energy access serves as a benchmark to measure progress towards UN Sustainable Development Goal 7.[3] The IEA electricity access statistics presented in this report include household connections, either from a grid connection or from a renewable energy-based off-grid source; the approach excludes illegal connections. The data is sourced wherever possible from governments, supplemented by data from multilateral development banks, various international organizations and other publicly available statistics.

The Multi-Tier Energy Access Framework (MTF) is also used as a key reference throughout this report. Rather than measuring electricity access as a household connection to an electricity grid, the MTF views electricity access along a continuum of service levels (tiers) and according to a series of indicators, including capacity, availability/duration of supply, reliability, quality, affordability, legality and health/safety.[4]

OFF-GRID / STAND-ALONE SOLAR

The term "off-grid" as it is widely used throughout this report (e.g. "off-grid sector") refers to both mini-grids and stand-alone systems. When "off-grid solar" or its acronym "OGS" are used, this refers *only* to stand-alone solar systems and does not include mini-grids. The main focus of this market assessment is the stand-alone solar sector. While micro/mini-grids typically provide a small community with electricity, stand-alone solar systems are not connected to an electricity distribution system and typically include a battery, but may also be used in conjunction with a diesel generator, wind turbine etc. Stand-alone solar technology broadly includes the following:

- Pico solar/solar lanterns[5]
- Single module solar systems (DC)[6]
- Multiple module solar systems (AC)[7]
- Large solar systems (AC)[8]

In addition to providing electricity access, stand-alone solar products/systems also support a wide range of productive applications (e.g. solar water pumping, agricultural processing, milling equipment, refrigeration etc.).

[1] https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf
[2] https://www.iea.org/energyaccess/methodology/
[3] https://sustainabledevelopment.un.org/sdg7
[4] "Multi-Tier Framework for Measuring Energy Access," World Bank ESMAP: https://www.esmap.org/node/55526
[5] Typically less than 10 Wp; all-in-one lighting and/or phone charging; enables partial or full Tier 1 electricity access
[6] Typically 11-100 Wp; capable of powering a few appliances (lights, mobile phone charging, TV, radio, fan etc.); often referred to as a "plug-and-play" solar home system when components are sold as a set; enables full Tier 1 or higher electricity access
[7] Typically 101-500 Wp; capable of powering multiple appliances; requires small inverter
[8] Typically greater than 500 Wp; most often used to power a large home; requires large inverter

Multi-tier Matrix for Measuring Access to Household Electricity Supply

ATTRIBUTES			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak Capacity	Power capacity ratings[28] (in W or daily Wh)		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
				Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
		OR Services		Lighting of 1,000 lmhr/ day	Electrical lighting, air circulation, television, and phone charging are possible			
	2. Availability (Duration)	Hours per day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
		Hours per evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
	3. Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs
	4. Quality						Voltage problems do not affect the use of desired appliances	
	5. Afford-ability					Cost of a standard consumption package of 365 kWh/year < 5% of household income		
	6. Legality						Bill is paid to the utility, pre-paid card seller, or authorized representative	
	7. Health & Safety						Absence of past accidents and perception of high risk in the future	

Source: World Bank Energy Sector Management Assistance Program (ESMAP)

WEST AFRICA AND THE SAHEL

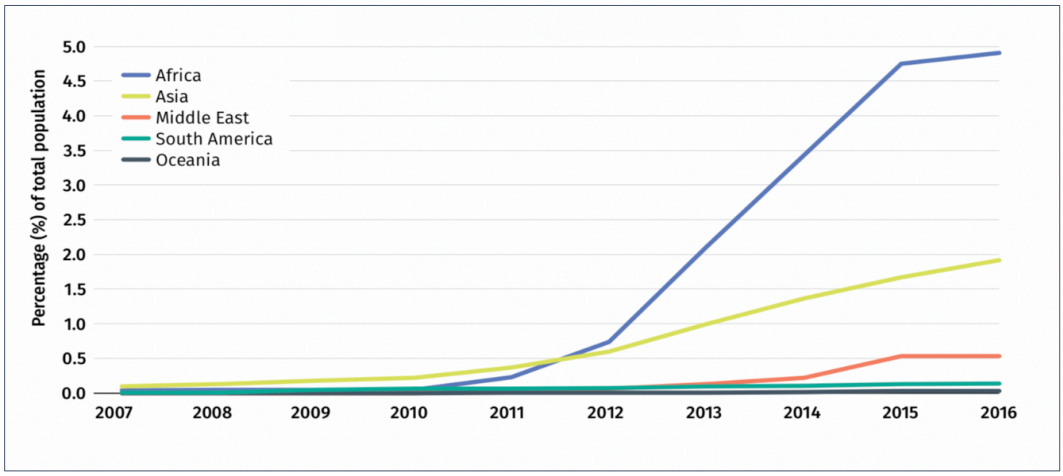
The term "West Africa and the Sahel" as it is used to throughout this report refers to the 19 countries covered by the first phase of the Regional Off-Grid Electrification Project (ROGEP). The countries include the 15 member states of the Economic Community of West African States (ECOWAS) – Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo – plus Cameroon, Central African Republic, Chad and Mauritania.

EXECUTIVE SUMMARY

I. INTRODUCTION

Access to electricity in Sub-Saharan Africa has improved significantly over the past decade. The number of people without access to electricity in the region stopped increasing for the first time in 2013 and has since declined.[9] Although grid connections continue to be the primary method of electrification, access to electricity through off-grid renewable energy systems has grown considerably. The use of off-grid solar (OGS) power is notably on the rise, with African countries accounting for most of the sector's growth over the last decade (**Figure ES-1**). The pace of solar electrification has accelerated more rapidly in Sub-Saharan Africa than anywhere in the world.[10] In order to achieve universal electrification by 2030, the International Energy Agency (IEA) estimates that Sub-Saharan Africa will need more than half of new electricity access connections between 2017 and 2030 to be made through decentralized systems (mini-grids and stand-alone systems), with solar technologies representing nearly 60% of these connections.[11]

Figure ES-1: Off-Grid Solar Access Rate by Region



Tier 1 access and above

Source: International Renewable Energy Agency

Despite this progress, government efforts to increase electricity access in Africa have struggled to keep pace with rapid population growth and increasing demand. Many countries across the region must navigate the interrelated challenges of energy poverty, energy security and climate change (among other sociopolitical, economic and development challenges), which collectively slow the adoption of renewable energy and the pace of off-grid market growth. Rates of energy access remain particularly low in rural areas, where the electrification rate is less than 25% across Sub-Saharan Africa.[12] In part, this is due to the gap between the power sector's infrastructure needs and the availability of necessary resources to expand grid electrification. Extending the grid to rural areas can be challenging due to significant transmission distances and low population densities.

[9] "Energy Access Outlook, 2017: From Poverty to Prosperity," International Energy Agency, (2017): https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf
[10] "Tracking SDG7 – The Energy Access Report 2018," The World Bank, IEA, IRENA, UN Statistics Division and the WHO, (2018): https://openknowledge.worldbank.org/handle/10986/29812
[11] Tracking SDG7 – The Energy Access Report, 2018.
[12] IEA Energy Access Outlook, 2017.

As of 2016, over 200 million people in West Africa and the Sahel – more than half of the region's population – lacked access to electricity. This figure represents nearly one-third of Africa's total unelectrified population. Rates of urban and rural electrification vary widely across the region, with the average rate of access nearly three times higher in urban areas.[13]

Despite these access deficits, the region is generously endowed with renewable energy resources – including hydropower, solar, wind and bioenergy. These resources are largely untapped, however, as investments in the power sector remain high-risk due to market instability, as well as a variety of political and regulatory risks. Other energy sector challenges include *inter alia* limited institutional capacity, poor utility financial performance, a shortage of local technical expertise and a lack of support from local financial institutions (FIs).

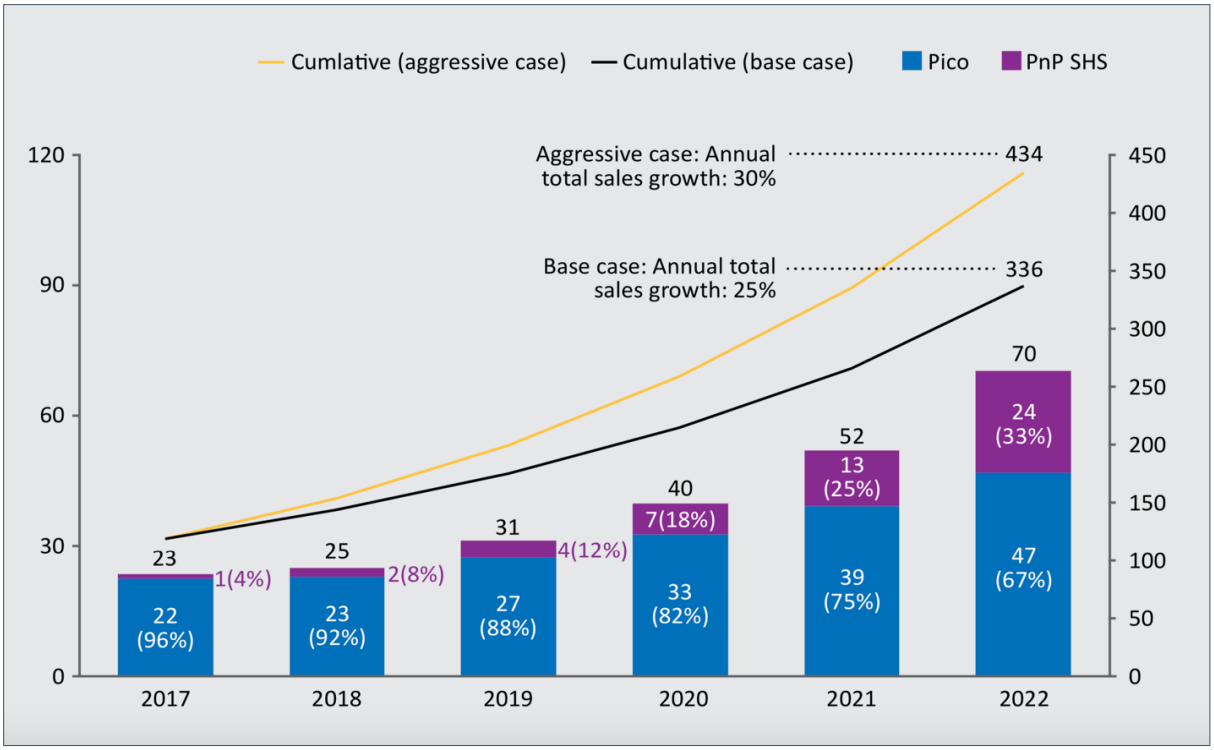
Until recently, diesel generators largely served as the expensive alternative both for rural electrification and for urban and peri-urban "bad grid" areas, where electricity was unreliable or only available for part of the day. However, the advent of decentralized renewable energy technologies, particularly stand-alone solar and mini-grid systems, offers opportunities to deliver clean and cost-effective off-grid solutions. Accordingly, policymakers are increasingly utilizing these options in electrification planning as they offer a reliable, flexible and relatively affordable complement to grid extension initiatives.

Solar energy is the most promising technology in the off-grid space, with three key trends converging to drive the industry's growth: first, continued reductions in hardware and balance of system costs (solar modules, batteries, inverters, appliances etc.); second, a digital revolution, with mobile communication technology facilitating payments and monitoring; and third, innovation in private sector business models, such as pay-as-you go (PAYG) and third-party ownership of solar home systems (SHS), which offer energy as a service and remove previously prohibitive up-front costs for households.[14] As a result of these developments, the off-grid solar market is rapidly evolving and expanding.

In 2016, the OGS market reported global revenues of approximately USD 1 billion. This figure is expected to increase to USD 8 billion by 2022, with SHS representing the majority of this revenue growth and an increasing share of unit sales **(Figure ES-2)**. Investments in the off-grid solar sector doubled annually between 2012 and 2016, increasing by 98% over this period. Between 2013 and 2017, East Africa represented 86% of the global PAYG market in terms of cumulative unit sales, followed by West Africa at 12% and Asia at 2%.[15] As the East African market becomes more crowded and solar companies expand their operations into West Africa, the region will account for a larger geographic share of the burgeoning global OGS market. Although the sector's investment trends remain volatile, there is some preliminary evidence to suggest that this transition is already underway: in 2016, West Africa accounted for 34% of total funds raised, up from 9% in 2015, while East Africa's share of funding decreased from 77% to 47% over the same period.[16]

[13] IEA Energy Access Outlook, 2017.
[14] "Derisking Renewable Energy Investment: Off-Grid Electrification," United Nations Development Programme (UNDP) and ETH Zurich, (December 2018): https://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Strategies/DREI%20Off-Grid%20Electrification%20-%20Full%20Report%20(20181210).pdf
[15] "Off-Grid Solar Market Trends Report 2018," Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018): https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf
[16] Ibid.

Figure ES-2: Global Off-Grid Solar Market Forecast (million units sold)



NOTE: Left axis = annual sales volume; Right axis = cumulative sales volume; PnP SHS = Plug-and-Play Solar Home System

Source: Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP

Many international off-grid solar companies, including most of the industry's leading players – BBOXX, Greenlight Planet, Azuri, d.light, Off-Grid Electric, M-KOPA Solar, Fenix International, and French utilities EDF and Engie among others – have recently entered markets in West Africa, joining international pioneers such as PEG and Lumos, which launched originally in Ghana and Nigeria, respectively, and both expanded into Côte d'Ivoire and Togo.[17] While these large international companies are well capitalized, there is a dearth of financing for smaller, early-stage companies that operate in nascent markets across West Africa and the Sahel. In fact, the top 10 global off-grid solar companies have received nearly 90% of investment capital since 2012, while early-stage companies often struggle to raise the necessary capital to accelerate growth.[18]

In order to scale off-grid electrification, OGS companies will need to access large volumes of commercial debt financing. In the longer term, partnerships with local commercial banks and microfinance institutions (MFIs) will also be necessary in order to develop domestic, local-currency sources of financing and reduce foreign exchange risk.[19] Partnerships with local FIs, whose understanding of the credit risk of local populations, may also reduce financing costs more rapidly compared to other methods (e.g. using debt from securitized receivables).[20] Although most financing currently comes from non-commercial sources (i.e. the

[17] Bavier, J., "Off-grid power pioneers pour into West Africa," Reuters, (February 20, 2018): https://www.reuters.com/article/us-africa-power-insight/off-grid-power-pioneers-pour-into-west-africa-idUSKCN1G41PE
[18] "Accelerating Energy Access: The Role of Patient Capital," Acumen, (2018): https://acumen.org/wp-content/uploads/Accelerating-Access-Role-of-Patient-Capital-Report.pdf
[19] UNDP and ETH Zurich, 2018.
[20] "How can Pay-As-You-Go Solar Be Financed?" Bloomberg New Energy Finance, (7 October 2016): https://www.bbhub.io/bnef/sites/4/2016/10/BNEF_WP_2016_10_07-Pay-as-you-go-solar.pdf

international development community), global capital markets have the size and depth necessary to meet this investment challenge. Nevertheless, small investment sizes and other early-stage market investment risks are currently holding back abundant and low-cost private capital flows to the off-grid sector.[21]

In order to mitigate risks and spur investment, the OGS sector requires substantial policy and regulatory support. It is therefore important that governments send a clear signal to the private sector by integrating off-grid technologies into national development programs, electrification plans and electricity access targets. Governments should also adopt favorable policies, laws and regulations to boost private sector participation, including procurement and tax incentives, grants and subsidies, concession schemes, streamlined licensing and permitting procedures, and quality standards for equipment. Additional measures include public awareness raising, encouraging inclusive gender participation, and building local capacity at all levels (e.g. solar PV vocational training and technical certification programs, training for FIs to address unfamiliarity of lenders with off-grid solar sector, corporate and consumer financing needs etc.).

In addition, solar companies increasingly rely on mobile money platforms to scale their business, as mobile payments allow them to offer low-income customers new ways to access and pay for electricity through innovative business models such as PAYG. Mobile money services, however, are only just beginning to be deployed in West Africa and the Sahel. Solar companies are therefore limited by low levels of penetration and in some cases by country-specific regulatory restrictions.[22] Governments can take action to foster linkages between the off-grid solar, telecommunications and mobile money sectors to expedite the uptake of market-transforming technology platforms and business models.

Governments across West Africa and the Sahel have implemented a range of policies and approaches to support off-grid market development, including private concessions, Public Private Partnerships (PPPs), Rural Electrification Agencies (REAs) and Rural Electrification Funds (REFs), among other measures. Some countries like Senegal and Mali have adopted private concessions to scale up mini-grids in rural areas, while others, such as Nigeria and Ghana, have improved rural electrification largely through public investment.

To support these initiatives, the Economic Community of West African States (ECOWAS) adopted the ECOWAS Renewable Energy Policy (EREP) in 2013, which intends to achieve universal electricity access in the region by 2030. The EREP also aims to increase the share of the region's rural population served by decentralized renewable energy services (mini-grids and stand-alone systems) to 25% by 2030. The ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE) is working with member states to develop and implement national policies and strategies with electrification targets through 2030 in line with the EREP, including Sustainable Energy for All (SEforALL) Action Agendas and National Renewable Energy Action Plans (NREAP), among other programs in support of renewable energy and off-grid market development.[23]

[21] UNDP and ETH Zurich, 2018.
[22] "Scaling Access to Energy in Africa: 20 Million Off-Grid Connections by 2030," Scaling Off-Grid Energy: A Grand Challenge for Development, USAID, UK DFID, Shell Foundation, (2018): https://static.globalinnovationexchange.org/s3fs-public/asset/document/SOGE%20YIR_FINAL.pdf?uwUDTyB3ghxOrV2gqvsO_r0L5OhWPZZb
[23] ECOWAS Renewable Energy Policy, 2013: http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf

II. BACKGROUND AND CONTEXT OF THE ASSIGNMENT

In this context, with funding from the World Bank, ECREEE launched the Regional Off-Grid Electrification Project (ROGEP) in 19 countries in West Africa and the Sahel. The project aims to enhance shared capacity, institutions and knowledge in order to increase electricity access of households, businesses and public institutions using modern stand-alone solar systems through a harmonized regional approach. ROGEP has two main components/objectives:

- ✓ **Component 1: Accelerate development of a regional off-grid solar market:**

  (1A) Foster regional collaboration and promote a supportive enabling environment for the OGS sector;
  (1B) Provide entrepreneurship technical support to OGS companies at various stages of development (training to accelerate business growth and/or facilitate market entry);
  (1C) Provide entrepreneurship financial support to OGS companies at various stages of development (matching grants);
  (1D) Provide financing to remove barriers in challenging markets (market entry grants and performance grants to OGS companies operating in challenging markets)

- ✓ **Component 2: Facilitate access to financing for off-grid solar businesses:**

  (2A) Provide line of credit for OGS businesses via the West African Development Bank (Banque Ouest Africaine de Développement, BOAD) to be extended to local FIs for on-lending to local entrepreneurs (working capital for companies to finance equipment imports, receivables from PAYG schemes etc.)
  (**2B**) Implement contingent grant facility via BOAD to share risks with local FIs and encourage lending to OGS businesses.

In addition, the project intends to support a range of capacity building activities targeting public and private sector stakeholders to address existing policy, regulatory, institutional, financial, economic, business, technology and capacity related barriers. ECREEE will also assist each country with development and implementation of national programs and initiatives in the areas of renewable energy, rural electrification and energy access in line with the regional focus of the assignment.

Under the first phase of the project, an initial assessment of the off-grid solar market was undertaken in each of the 19 countries. The study focused exclusively on the stand-alone solar PV market and did not assess mini-grids (see **Key Definitions**). The scope of work was broadly divided into the following tasks:

(1) Review the current enabling policy and market environment for the off-grid solar sector
(2) Analyze the market for off-grid solar products and systems, including an estimate of demand from the household, institutional and productive use market segments and analysis of the supply chain;
(3) Assess the willingness and capacity of national and regional financial institutions to provide commercial and/or consumer financing to the off-grid solar sector; and
(4) Propose models to incentivize the private sector and financial institutions to support off-grid solar market development and to harmonize a regional market to achieve universal access.

Available geographic information system (GIS) data for each country supported the Task 1 and Task 2 analyses. A least-cost electrification analysis was undertaken utilizing geospatial mapping to assess the potential development of electricity access and grid coverage in each country through 2023 and 2030. The study estimated the total number of potential settlements, people and households electrified by on-grid, mini-grid or off-grid stand-alone solutions under each timeframe based on a series of indicators, including national electricity grid proximity, population density and nodes of economic growth. The assessment was

also performed for health facilities and education centers (although the analysis was limited by the availability and/or quality of GIS data for these market segments). The results of the analysis were used to estimate the share of the population suitable for off-grid stand-alone solar solutions over the analyzed periods and to assess corresponding potential demand from the household sector under the Task 2 market sizing.

Within the context of this assignment, a gender-focused analysis was also implemented in order to assess the level of female participation in each country's off-grid energy sector. Each stage of the market study therefore analyzed inclusive participation and gender implications. A comprehensive gender profile is presented in **Annex 4**, including a summary of findings, as well as recommendations to improve gender equality and enhance women's engagement in development of the off-grid sector.

To carry out these tasks, the project team utilized a combination of desk research, input from local country experts and feedback from engagement with a wide range of stakeholders at the country and regional levels. Interviews were conducted with policymakers, industry experts, and representatives from solar companies and financial institutions. Focus group discussions were also held in each country with key stakeholders from the four market segments analyzed under Task 2 (household, institutional, productive use and supplier). Focus group participants included representatives from government, the donor community, NGOs, solar companies, business and industry associations, academia, community groups, and women's groups. In addition to the focus group meetings, surveys were administered in order to collect additional Task 2 market data, including (i) a survey of international solar companies to gauge their level of interest in the region; (ii) a survey of local solar companies and retail suppliers in each country to inform the supply chain analysis; and (iii) an assessment of an off-grid village in each country to better understand how solar is being utilized for productive uses. Under Task 3, a survey was administered to local and regional FIs to determine their level of capacity and interest in lending to the off-grid solar sector. A detailed description of the methodology used to carry out these tasks is presented in **Annexes 1-3**.

This report is organized into three sections that correspond to Tasks 1-3 described in the scope of work above (Task 4 was prepared in a separate report). **Section 1** covers the enabling policy and market environment for the OGS sector. This includes an overview of the status of the on-grid and off-grid markets, an analysis of off-grid energy policy and regulation and gaps in the existing framework, and a summary of off-grid development initiatives. The results of the least-cost electrification analysis are also included in this section.

Section 2 estimates the potential market for off-grid solar products and systems by assessing potential demand from the household, institutional and productive use market segments (**Figure ES-3**), followed by an analysis of the supply chain. The household market sizing utilizes results from the least-cost electrification analysis, along with data on household income and energy expenditure, in order to estimate potential demand based on the number of households able to afford various OGS systems. Both the cash and financed market potential were estimated for 2018, 2023 and 2030.

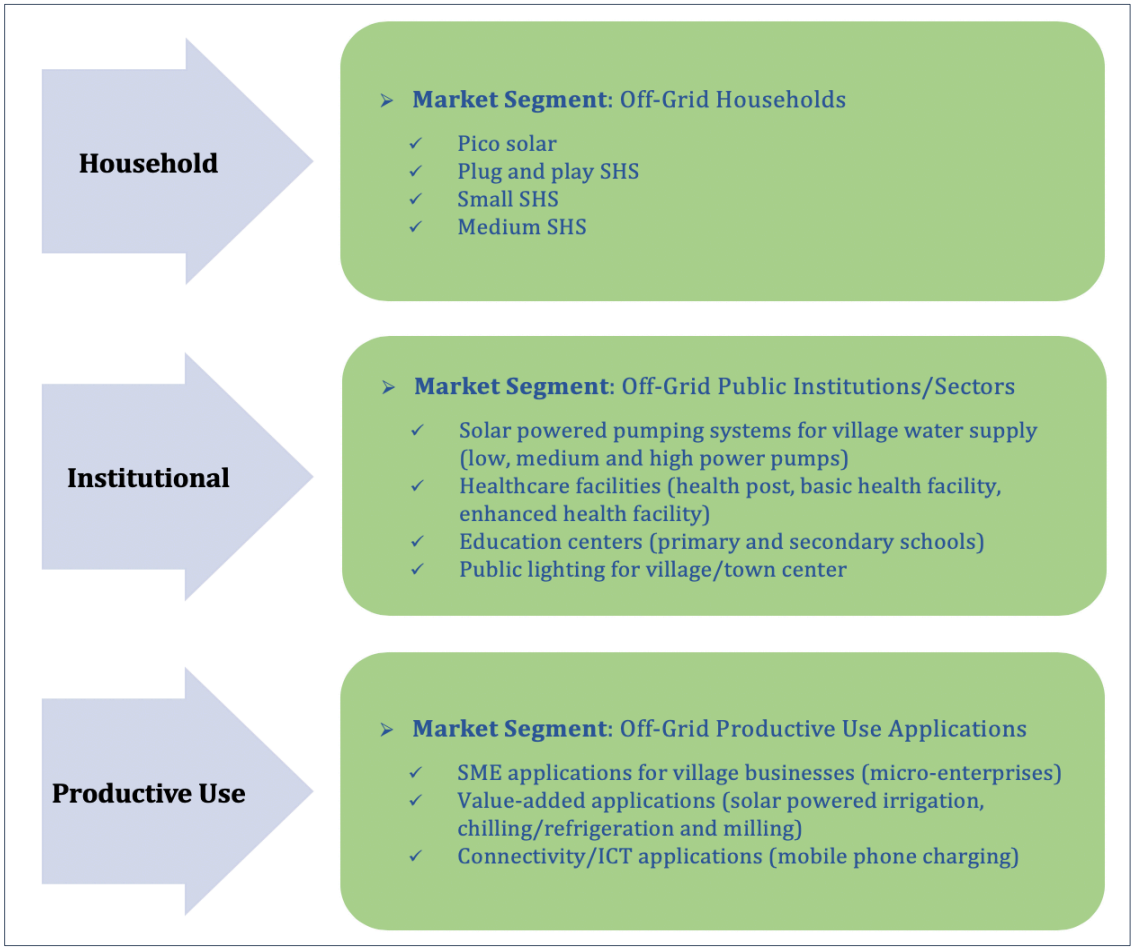
The institutional sector analysis combines available GIS data with secondary research to estimate potential demand based on assumptions about the electricity needs, usage patterns and associated costs of solar electrification of four public/institutional markets – water supply for off-grid communities, healthcare facilities, education centers (primary and secondary schools) and public lighting. Where GIS data was unavailable, per capita comparisons were made using data from similar countries to estimate off-grid solar demand by market segment (see **Annex 2** for country categorization). The productive use of energy (PUE) market sizing estimates potential off-grid solar demand for SME, value-added and connectivity applications. Feedback from stakeholder interviews and focus group discussions informed the analysis and

helped characterize each market segment's consumer perceptions, interest, awareness, ability to pay and access to finance.

The Task 2 supply chain analysis presents an overview of key market actors, solar products and services, sales figures and business models, and includes a discussion of the role of informal market players and the impact of uncertified products. The analysis also addresses the capacity needs of the supply chain and describes specific areas of support where technical assistance is needed to accelerate market growth.

Section 3 assesses the willingness and capability of national and regional financial institutions (FIs) to provide commercial and/or consumer financing to the off-grid solar sector in each country. This section includes a summary of financial products for the off-grid sector, a comprehensive overview of each country's financial market and commercial lending environment (including analysis of commercial banks, microfinance institutions and other non-bank financial institutions) and any programs supporting off-grid solar lending. This section also examines the scope of financial inclusion in each country and the impact of digital financial services and mobile money on access to finance. It concludes with the results of surveys that were administered to financial institutions in each country across the region.

Figure ES-3: Analyzed Off-Grid Market Segments



NOTE: SHS = Solar Home System; ICT = Information Communication Technology

III. EXECUTIVE SUMMARY

Togo is a low-income country in West Africa whose economy relies heavily on the agricultural sector, which employs about two-thirds of the labor force. Poverty is widespread, particularly in rural areas, where a significant share of the population relies on subsistence farming. Economic growth is driven mainly by agricultural exports. Togo is also one of the world's largest producers of phosphates, which contribute to a significant share of the country's export earnings. The country's relative political stability and recent efforts by the Government of Togo (GoT) to modernize the country's commercial infrastructure have enabled it to enjoy a period of prolonged growth.[24]

Access to electricity remains an ongoing challenge. In 2016, approximately two-thirds of Togo's population – an estimated 5 million people – lacked access to electricity, with a significant disparity between rates of access in urban (74%) and rural (5%) areas.[25] Even where grid connections exist, power supply is often unreliable, with fewer than one-fifth of firms and about half of households reporting reliable access to electricity when surveyed.[26] Off-grid electrification is a policy priority for the Government, which is committed to achieving universal access by 2030. In 2015, with support from ECREEE, the Government has outlined its commitments and initiatives to develop renewable energy and meet its electrification targets in its SEforALL National Renewable Energy Action Plan (Plan d'Action National pour les Énergies Renouvelables, PANER).

Currently, the Government's efforts to establish a supportive policy and regulatory framework for the off-grid sector are progressing well, as evidenced by the country's 34-points improvement in its World Bank Regulatory Indicators for Sustainable Energy (RISE) energy access score between 2015 and 2017.[27] In the 2017 RISE evaluation, Togo ranked fourth in West Africa and the Sahel behind Côte d'Ivoire, Ghana and Cameroon, and was among the highest scoring countries in Africa.

In 2018, the Government adopted the Togo Electrification Strategy, which relies heavily on renewable energy to increase electrification in the country. The strategy is to be rolled out in three phases over 12 years and will cost an estimated CFA 100 billion (USD 1.8 billion) of which half is expected to come from private investment. The strategy envisions a combination of grid extensions, mini-grids and off-grid stand-alone solar systems to achieve its electrification objectives. The GoT analysis found that the stand-alone sector will play a significant role in electrifying rural households. The Government has adopted a specific platform to lead implementation of the off-grid stand-alone solar component of the strategy – the 'CIZO' program – under which private sector solar firms will distribute solar kits to rural households. In 2017, UK-based BBOXX won a tender to distribute 300,000 solar home systems (SHS) over a five-year period under the program. BBOXX has partnered with France's EDF Group and is also collaborating with La Poste – Togo's postal company – to take advantage of its extensive network in rural areas of the country to distribute its solar products. In 2019, BBOXX piloted *Tomorrow's Connected Community* in Togo – a conceptual business model that provides solar electricity to an entire village (streetlights, households, schools, businesses etc.) through a micro-grid and solar home systems, fully managed and maintained by the company's digital platform.[28]

[24] "Togo Economic Outlook," African Development Bank, (2018): https://www.afdb.org/en/countries/west-africa/togo/togo-economic-outlook/
[25] IEA Energy Access Outlook, 2017.
[26] Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact," AFD and World Bank, Africa Development Forum, (2019): https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y
[27] "Policy Matters: Regulatory Indicators for Sustainable Energy," World Bank ESMAP, (2018): http://documents.worldbank.org/curated/en/553071544206394642/pdf/132782-replacement-PUBLIC-RiseReport-HighRes.pdf
[28] "BBOXX Launches 'Tomorrow's Connected Community," Alternative Energy Africa, (April 25, 2019): https://ae-africa.com/read_article.php?NID=9968

The Government also awarded licenses to another supplier – Soleva, a consortium of Aphelion Energy and Wawa Energy Solutions – to distribute Greenlight Planet's Sun King solar lighting kits. The Government's subsidy to households is meant to cover the price of the solar equipment, leaving customers to pay only the cost of their energy consumption on a Pay-As-You-Go (PAYG) basis. Around 10,000 solar kits were installed in rural Togo in 2018; another 100,000 households are due to be connected by 2020, and a total of 555,000 by 2030.[29]

This report assesses the market opportunity for off-grid solar products and systems by estimating demand from the household, institutional, and productive use sectors in Togo (**Figure ES-4**). According to the assessment, there is a significant OGS market opportunity, with the annualized cash market potential in 2018 estimated to be USD 27 million. The productive use sector (USD 22.4M) makes up the majority of estimated demand, followed by the household (USD 2.8M) and institutional (USD 1.7M) sectors.

Figure ES-4: Indicative Total Cash Market Potential for Off-Grid Solar Products in Togo, 2018

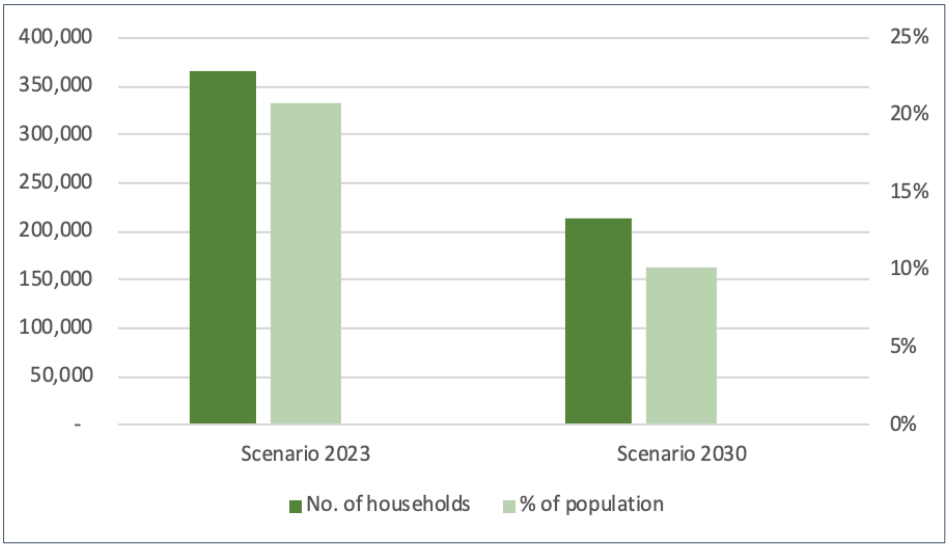
Source: African Solar Designs analysis

[29] "Togo subsidizes off-grid solar to extend electricity access to all," Reuters, (March 2, 2019): https://af.reuters.com/article/topNews/idAFKCN1QJ09L-OZATP?platform=hootsuite

The least-cost electrification analysis found that by 2023, 816 settlements across Togo (1,194,348 households) will be connected to the main grid, representing 67.8% of the population. By 2030, this figure will increase to 1,462 settlements (1,829,921 households), equivalent to 87.4% of the population. These estimates are based on the assumption that all planned grid extensions will be completed by 2030.

In the off-grid sector, the analysis identified 666 settlements (366,354 households), representing 20.8% of the population in 2023, as suitable for stand-alone systems, decreasing to 277 settlements (213,086 households) and 10.2% of the population in 2030 (**Figure ES-5**). While the total size of the OGS market for households will decrease over time, it will also become more concentrated in the remote Plateau region of the country. The Plateau region remains the most important market for OGS products in terms of number and concentration of off-grid households through 2030. This consistency should support development of OGS distribution networks in this region over time.

Figure ES-5: Estimated Number of Households and Share of Population Suitable for OGS Systems in Togo, 2023 and 2030

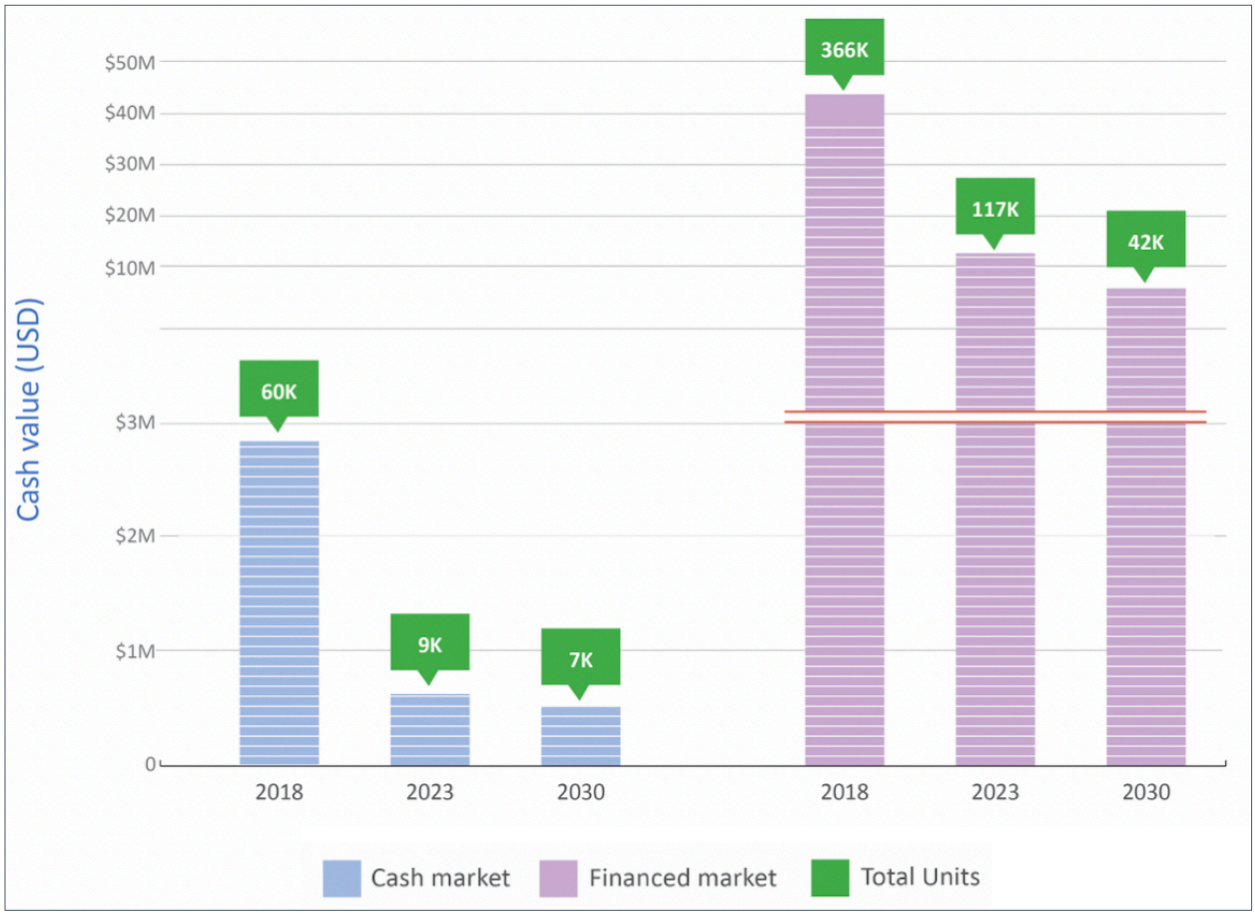


Source: Energio Verda Africa GIS analysis

According to the analysis, the annualized off-grid solar cash market potential for the household sector in 2018 is USD 2.8 million, increasing sharply to USD 43.2 million with the addition of consumer financing (**Figure ES-6**). Consumer financing allows the poorest households to enter the market and those already in the market to afford larger systems.

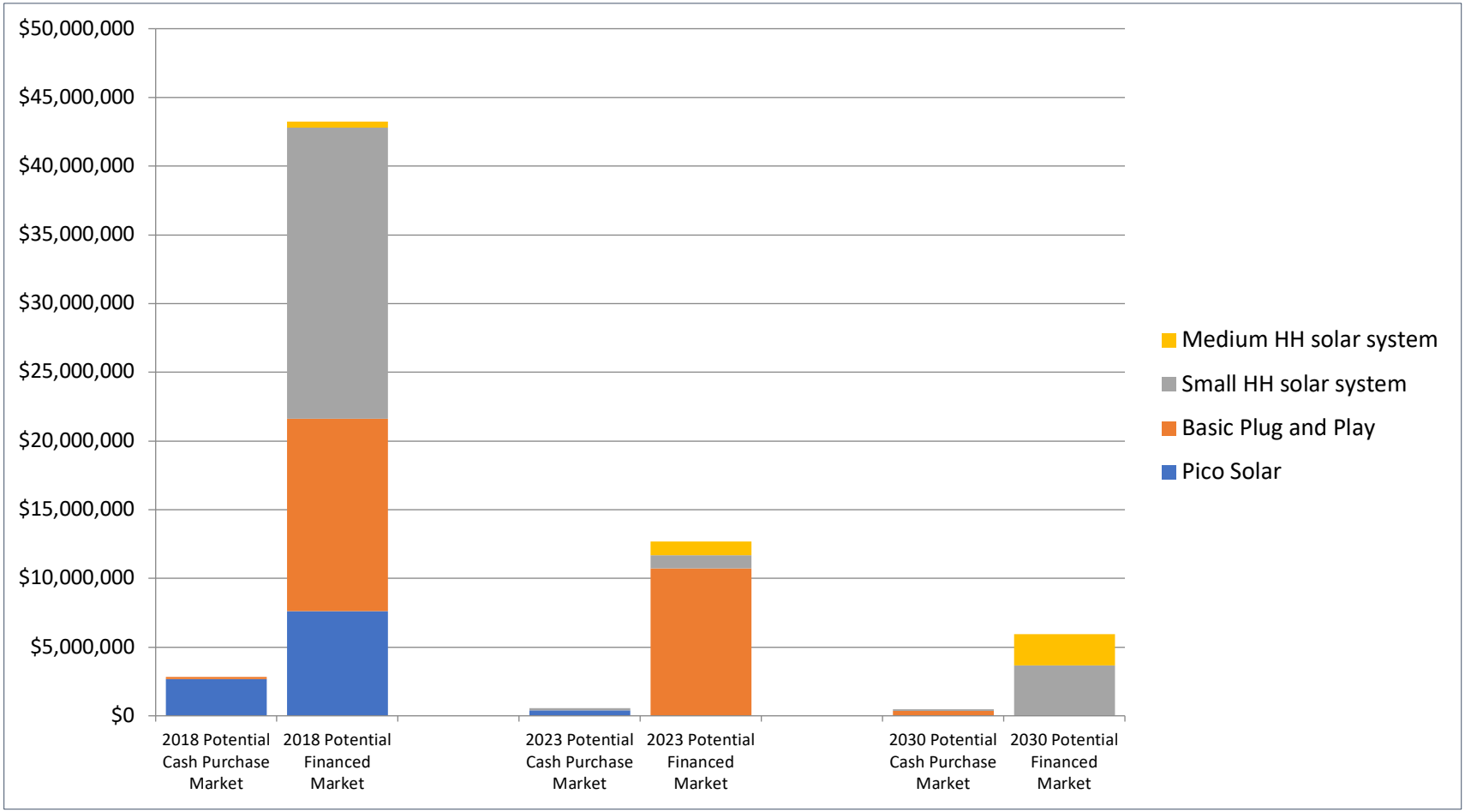
According to the assessment, the most common types of systems the market can afford on a cash basis are pico solar and small plug and play systems; however, this changes significantly with the introduction of financing (**Figure ES-7**). While affordability improves over time, households in the lowest income quintiles cannot afford any off-grid solar products without financing. Consumer financing will therefore prove critical for accelerating off-grid solar market growth and meeting electrification targets through 2030.

Figure ES-6: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector



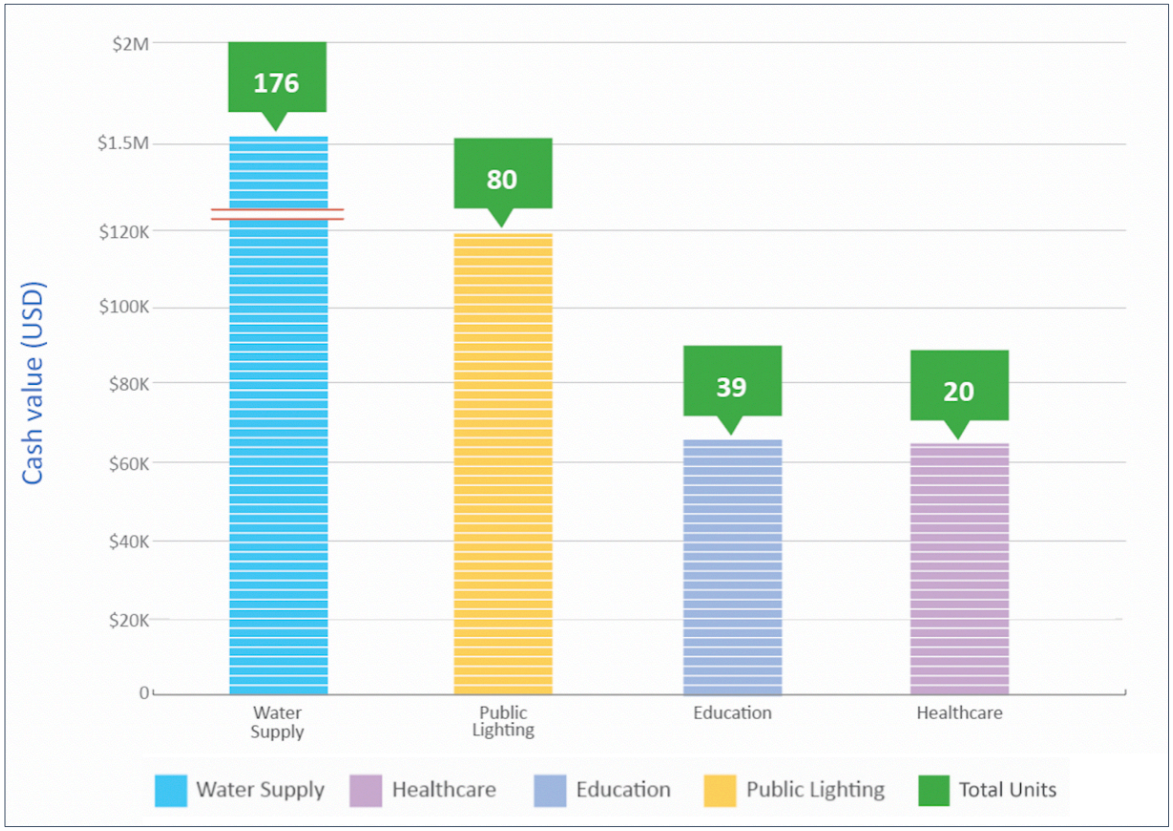
Source: African Solar Designs analysis

Figure ES-7: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type



Source: African Solar Designs analysis

Figure ES-8: Estimated Off-Grid Solar Cash Market Potential for Institutional Sector

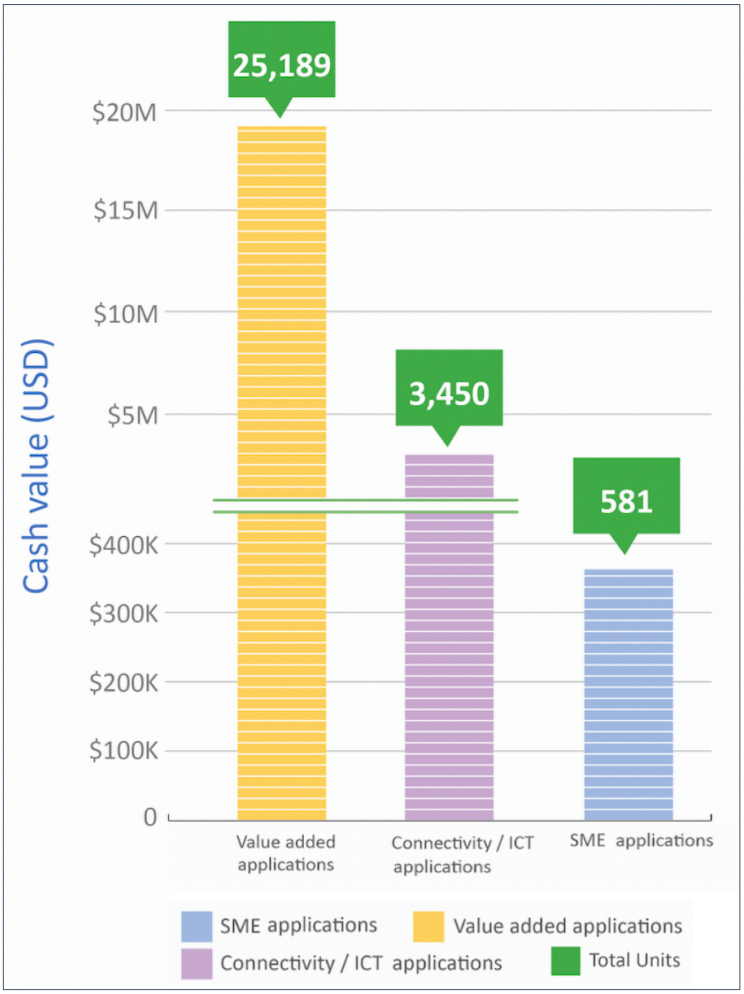


Source: African Solar Designs analysis

The estimated annualized cash market potential for Togo's public/institutional sector in 2018 is USD 1.7 million (**Figure ES-8**). The institutional market segment with the largest potential is water supply (USD 1.5M), followed by public lighting (USD 119K), education (USD 66K) and healthcare (USD 65K). The water supply sector analysis identified off-grid water points such as boreholes and wells that could benefit from solar technology for water pumping. The healthcare sector analysis identified off-grid health facilities categorized by their size (from basic clinics to enhanced health facilities) that could be electrified by stand-alone systems. The education sector analysis identified primary and secondary schools that could be electrified by stand-alone systems. The public lighting analysis assessed the lighting needs for off-grid villages and market centers (excluding street lighting).

According to the analysis, the annualized off-grid solar cash market potential for the productive use sector in 2018 is USD 22.4 million (**Figure ES-9**). The estimated demand from value-added applications represents most of the PUE market potential (USD 19.1M), followed by applications for connectivity (USD 2.9M) and SMEs (USD 363K).

Figure ES-9: Estimated Off-Grid Solar Cash Market Potential for Productive Use Sector



Source: African Solar Designs analysis

The value-added applications that were analyzed include solar pumping for agricultural irrigation, solar powered milling and solar powered refrigeration. The assessment utilized a series of inputs, including data from the UN's Food and Agriculture Organization on national agricultural production, as well as applicable solar technologies to support income generation for small shareholder farmers (i.e. solar pumps, mills, and refrigeration systems). Access to energy for agriculture is critical for the country's economic development, particularly given the sector's importance to GDP.

Off-grid solar power supports a wide range of connectivity applications, including mobile phone charging, wi-fi servers, banks, mobile money kiosks, and telecommunications towers. Mobile phone and internet connectivity are also necessary pre-cursors to mobile money and PAYG solutions in the off-grid solar sector. The market sizing examined mobile phone network coverage as well as rates of mobile phone

ownership and mobile internet penetration to estimate the market potential for mobile phone charging enterprises (stations/kiosks).

The calculation of the estimated off-grid solar market for SMEs focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit significantly from extended working hours and the use of modern appliances/machinery. The estimated demand for this market segment is therefore intended to provide a baseline for future research, as a more robust analysis would be necessary to assess realistic demand from all SMEs.

It should be noted that the Task 2 market sizing assesses the total *potential* demand for off-grid solar, as well as variables that affect demand, such as changes in population density, household income, expansion of national grids and access to finance, among other factors. This data will support policymakers and practitioners as they assess market potential over time. However, the quantitative demand estimate has not been revised to reflect *realistic* market potential. Many other factors and market failures will prevent the full realization of this total market potential, and these will vary by market segment.

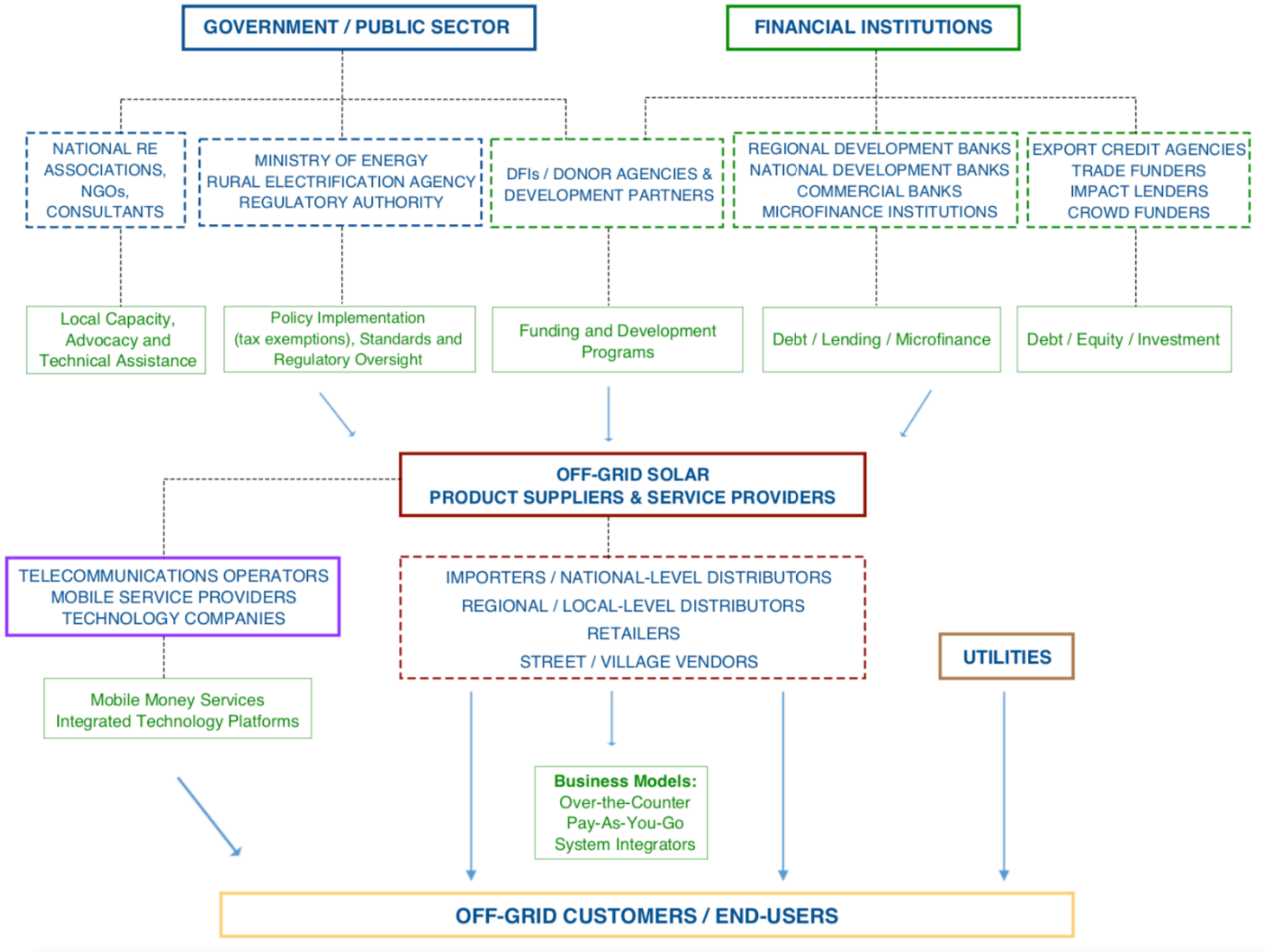
For household demand, the off-grid solar market is already tangible. Still, many factors will affect household demand for solar products, such as distribution realties, consumer education, competing economic priorities for households, financial shocks, etc. The institutional market will be affected largely by government and donor budget allocations along with the potential for community-based finance. The productive use market is perhaps the least concrete. Considered a relatively new market segment for the off-grid solar industry, productive use market dynamics are not yet well understood. The ability to realize potential productive use market demand will also be affected by many of the factors that commonly determine enterprise prospects in the country, including infrastructure, rural distribution, marketing, access to finance, insecurity, regulation, etc. The data presented in this report is intended to provide a baseline for future research.

Following the estimates of market demand, this report analyzes the supply chain for off-grid solar products and services in Togo, which includes a wide range of stakeholders, including importers, distributors, wholesalers, retailers and end-users (**Figure ES-10**). The country has a small but quickly growing solar market, which is currently dominated by the larger companies that are distributing OGS products under the Government's CIZO program. The supply chain is made up of both formal and informal companies that offer a variety of solar products and systems and deploy several business models. Rural households make up the main market for OGS products in the country, as the demand for lighting products and household electrical appliances is growing. Nevertheless, urban households, both electrified and non-electrified, are also a key consumer market, as they may have greater ability to afford solar products and systems.

The off-grid solar supply chain faces several barriers, including competition from the informal market. The widespread sale of low-quality, uncertified products undermines consumer confidence in solar equipment, undercuts the prices of sellers of quality-verified products and hinders overall OGS market growth. There are also a number of interrelated challenges and capacity building needs of the supply chain, including financial, capacity, awareness and regulatory challenges.

Togo's nascent solar market is poised to grow if requisite technical assistance is provided to the supply chain. To operate effectively, companies need a significant amount of both local and international technical and financial expertise, as well as an ability to make practical decisions about their operations. Companies must manage a number of technical competency requirements, including the selection of business models, importation and distribution channels, solar PV technologies, as well as the design and implementation of associated marketing instruments and related initiatives.

Figure ES-10: Off-Grid Solar Market and Supply Chain Overview



Source: GreenMax Capital Advisors

Local industry and supply-chain stakeholders who participated in the Task 2 focus group discussions and surveys identified the following key barriers to and drivers of OGS market growth in Togo:

Key Barriers to Off-Grid Solar Market Growth
• Low consumer purchasing power and lack of consumer financing options
• Low levels of consumer awareness of solar solutions, particularly in rural areas
• Lack of financing for solar companies
• Informal sector competition and market spoilage
• Lack of local capacity/qualified technicians to maintain systems
• High transaction costs associated with equipment inventory, distribution, importation, taxation etc.
• Insufficient or fragmented market data on consumer electricity needs, usage or experience
Key Drivers of Off-Grid Solar Market Growth
• Strong off-grid electricity demand
• Government policy and action is supportive of the industry, which helps attract substantial/sustained investment to the market
• Growing penetration of mobile money services allows OGS companies to increasingly utilize integrated technology platforms and innovative business models to offer PAYG consumer financing solutions to the market
• Extensive private sector engagement in development of the off-grid sector, with companies adopting new business models and strategies to attract external investment and expand their operations
• Strong donor presence and support from the international development community provides confidence that the market will continue to receive financial, policy and technical support necessary to develop

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

Access to financing is critical for off-grid solar market growth. Solar companies need financing for working capital needs, while off-grid solar consumers need financing for the purchase of systems. This report analyzes the willingness and capacity of national and regional financial institutions to provide financing to businesses and consumers in Togo and throughout the region to support development of the OGS sector. In addition to commercial banks and microfinance institutions, impact investors and crowd funders are also active in several markets across the region.

With 13 commercial banks in the country, the number of institutions relative to the population is extremely low. Moreover, commercial banks operate mainly in urban areas, leaving many rural and low-income people and businesses with limited access to financial services. Microfinance institutions have been able to fill this void, with about 200 of these institutions serving roughly 40% of the adult population.

Although access to banking and financial services through formal institutions remains limited, Togo is experiencing a rapid increase in the availability and usage of digital financial services and mobile banking, driven by widespread mobile phone ownership, rapidly growing mobile internet usage and network coverage. This dynamic is driving greater financial inclusion; in 2017, 45% of the country's adult population had an account at a financial institution or with a mobile money service provider, up from 10% in 2011 and second behind Ghana (58%) for the highest rate of inclusion in the region. Despite the country's overall improvement, there is still a significant gender gap in rates of access to financial services, as women in Togo are 15% less likely than men to have an account at a financial institution or with a mobile money service provider.[30]

Expanding digital financial services, especially mobile money, can create new opportunities to better serve women, the lower-income population, and other groups that are traditionally excluded from the formal financial system. Moreover, mobile money technology also plays a critical role in the application of off-

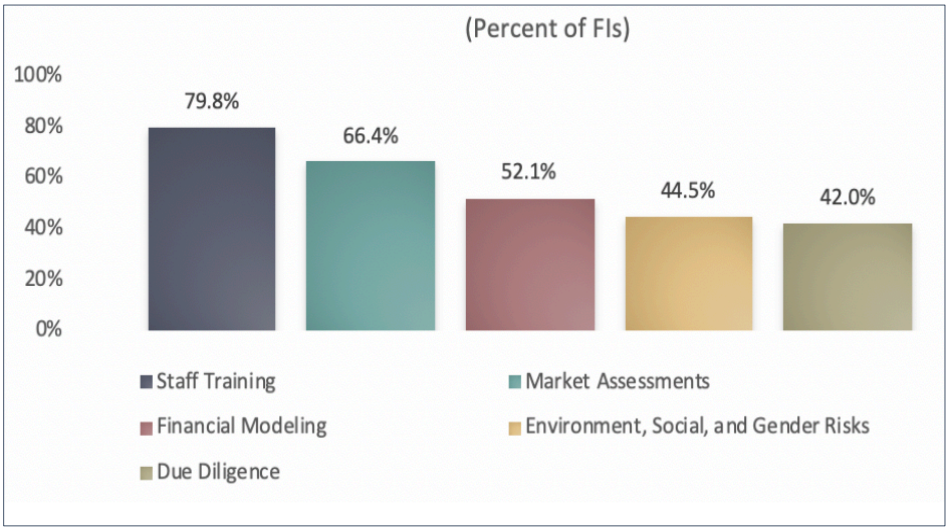
[30] Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution," World Bank, (2017): http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf

grid solar solutions, particularly for PAYG systems that rely on the interoperability between digital financial services and stand-alone solar devices.

While there are several Government and donor-funded programs that provide financing to support development of Togo's off-grid solar market, these funds have not been channeled through local commercial banks or MFIs. ROGEP is therefore a pioneering initiative in the country, as it endeavors to boost OGS lending via engagement with local financial partners. Local FIs are increasingly becoming more aware of the opportunities in the off-grid sector due to the Government's Electrification Strategy, as well as initiatives such as AFD's Sustainable Use of Natural Resources and Energy Finance (SUNREF) program.

According to the Task 3 survey of financial institutions in Togo and across the region,[31] there is strong interest to provide financing to the off-grid solar sector. Respondents identified loan guarantees and credit lines as the most important measures to reduce market entry risks for lenders and stimulate FI engagement in the sector. Surveyed FIs also identified several areas of internal capacity that require improvement in order to lend (or increase lending) to the OGS sector (**Figure ES-11**). The most common need among FIs was training for bank staff, which includes *inter alia* assistance to originate deals and appropriately assess the credit risk of off-grid solar firms and projects, due diligence support to qualify products and approve vendors, and targeted support for new lenders to the sector with product structuring and development as well as building deal-flow. Technical assistance for solar enterprises (as is envisioned under Component 1B of ROGEP) will also be necessary, as entrepreneurs often do not have proper financial management and accounting systems in place, are unable to present quality financial models and lack the expertise required to structure their companies to take on debt obligations.

Figure ES-11: Financial Institution Needs to Increase Off-Grid Solar Lending



Source: Financial Institution survey; Stakeholder interviews; GreenMax Capital Advisors analysis

[31] The results are based on feedback from a total of 121 FIs (including commercial banks, microfinance institutions and other non-bank FIs) that were interviewed across the 19 countries.

Gender inclusiveness is also a key component of this market assessment, and the key findings of the gender analysis are presented throughout this report. Given that the off-grid market is only beginning to emerge in Togo, women are not yet highly engaged in the sector. The overall lack of inclusive participation in the off-grid space is attributable to a wide range of factors. A 2018 survey conducted by IRENA found that nearly three-quarters of respondents cited cultural and social norms as the most common barrier to women's participation in expanding energy access, which reflects the need for gender mainstreaming (**Figure ES-12**). More than half of the women surveyed in Africa identified a lack of skills and training as the most critical barrier, compared to just one-third of respondents globally.[32]

The same survey found that access to necessary technical, business or leadership skills development programs was the single most important measure that could be taken to improve women's engagement in energy access. Over half of survey respondents also highlighted the need to integrate gender perspectives in energy access programs, mainstream gender in energy policies and to enhance access to financing for women (**Figure ES-13**).[33]

[32] "Renewable Energy: A Gender Perspective," International Renewable Energy Agency, (2019): https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf
[33] Ibid.

Figure ES-12: Key Barriers to Women's Participation in Energy Access

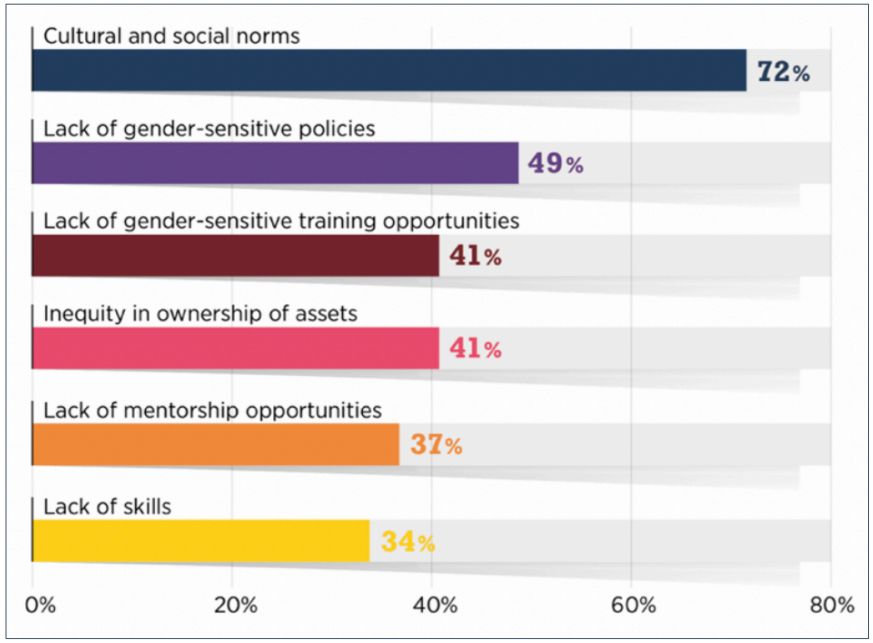
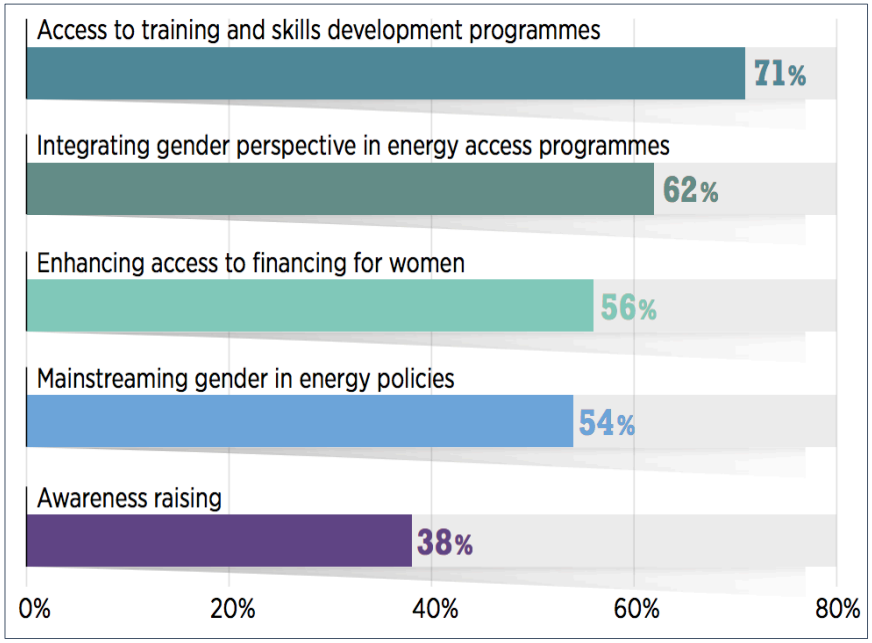


Figure ES-13: Measures to Improve Women's Engagement in Energy Access



Source: International Renewable Energy Agency

The gender analysis undertaken in Togo corroborated many of these findings and revealed several interrelated challenges that women face in the off-grid sector, including lack of access to skills development, technical capacity building, and education/training; lack of access to capital, asset ownership, collateral and credit (e.g. to start a business); and low rates of financial literacy due to a lack of education and information available to women on access to financial resources.

A number of initiatives exist that seek to address some of these challenges and help improve gender inclusion in the country's energy and off-grid sectors. For example, in 2018, ECREEE partnered with AfDB to launch a regional workshop to advance the participation of women in the renewable energy sector. The program intends to address the lack of female inclusion in the energy value chain, as women represent only 2% of energy sector entrepreneurs in West Africa. The joint initiative ultimately seeks to develop a pipeline of investment-ready, women-owned energy businesses across the region, including in Togo.[34]

[34] "Feasibility study promotes women's participation in energy transition," ESI Africa, (7 May 2018): https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/

I. STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT

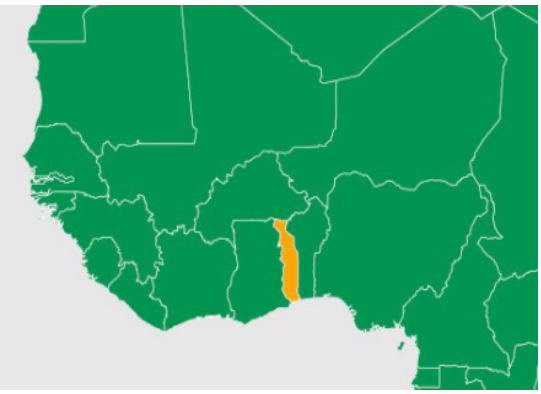
This section begins with a brief introduction of key macroeconomic and social indicators in Togo (**Section 1.1**). This is followed by an overview of the country's existing energy sector (**Section 1.2**), with a focus on the status of energy access, including an assessment of both the on-grid and off-grid markets, a least-cost electrification analysis and a review of gender policies. **Section 1.3** examines national energy policy and regulation vis-à-vis the off-grid solar market, including detailed analysis of the existing framework for off-grid stand-alone systems[35] in Togo as well as gaps in the framework. **Section 1.4** is a summary of all relevant national and donor-funded development initiatives in the off-grid sector. **Annex 1** provides an overview of the Task 1 methodology.

1.1 Country Overview

Togo is a low-income country in West Africa whose economy relies heavily on the agricultural sector, which employs about two-thirds of the labor force. Poverty is widespread, particularly in rural areas, where a significant share of the population survives on subsistence farming. Economic growth was estimated at 4.5% in 2017 and is projected to gradually increase to 5% in 2018 and 5.3% in 2019, driven mainly by agricultural exports.[36] Togo is also one of the world's largest producers of phosphates, which contribute to a significant share of the country's export earnings. The country's relative political stability and recent efforts by the Government of Togo (GoT, or "the Government") to modernize the country's commercial infrastructure have enabled it to enjoy a period of prolonged growth.

Table 1: Macroeconomic and Social Indicators

Population	7.8 million[37]
Urban Population	40.4% of total
GDP	USD 4.75 billion
GDP growth rate	4.5%
GNI per capita*	USD 610
Unemployment rate	6.2%
Poverty rate	55.1% (2015)
Urban	35.9%
Rural	68.7%
Currency	West African franc (FCFA)
Official language	French
Natural resources	Agricultural (cocoa, coffee, cotton); ores (phosphates, limestone)



* World Bank Atlas method (current USD)[38]

All figures from 2017 unless otherwise indicated
Source: African Development Bank and World Bank

[35] NOTE: The term "off-grid" as it is widely used throughout this report (e.g. "off-grid sector") refers to both mini-grids and stand-alone systems. When "off-grid solar" or its acronym "OGS" are used, this refers *only* to stand-alone systems and does not include mini-grids
[36] "Togo Economic Outlook," African Development Bank, (2018): https://www.afdb.org/en/countries/west-africa/Togo/Togo-economic-outlook/
[37] 50.2% male/49.8% female
[38] "World Bank Open Data: Togo," World Bank, (2017): https://data.worldbank.org/country/Togo

1.2 Energy Market

1.2.1 Energy Sector Overview

Togo's energy sector is governed by the Ministry of Mines and Energy (MME), which develops and implements energy policies and programs. The Electricity Company of Togo (Compagnie d'Energie Electrique du Togo, CEET) is the country's public utility with control over power importation, transmission and distribution. The Electricity Community of Benin (Communauté Electrique du Bénin, CEB) is co-owned by the governments of Benin and Togo and is charged with developing electricity infrastructure for both countries. The Agency of Rural Electrification and Renewable Energy (Agence Togolaise d'Electrification Rurale et des Energies Renouvelables, AT2ER), was established to manage the country's rural electrification programs and initiatives and promote development of renewable energy.

Table 2: Institutional and Market Actors in the Energy Sector

Institution / Company	Role in the Energy Sector
Ministry of Mines and Energy (Ministre des Mines et des Energies, MME)	Ministry responsible for (i) planning, organizing, and coordination of all mining and energy sector policies and activities; (ii) ensuring the satisfaction of the national demand as well as the self-sufficiency and security of the supply of electricity; and (iii) ensuring quality of products and energy infrastructure.
Electricity Company of Togo (Compagnie d'Energie Electrique du Togo CEET)	Public company responsible for importation, transmission and distribution of electricity at the lowest cost in accordance with commonly accepted commercial principles, the quality and continuity of service, the effective pricing of electricity based at least on the supply cost criteria, technical viability and operational efficiency, financial profitability and financial equilibrium.
Electricity Community of Benin (Communauté Electrique du Bénin, CEB)	Binational public utility under the ARSE that was established under the Benin-Togo Electricity Code and is co-owned by both governments and responsible for power generation, transmission and development of electricity infrastructure for both countries. Owns and operates the Nangbeto hydroelectric dam in Togo with an installed capacity of 65 MW.
Authority of Regulation of the Electricity Sector (Autorité de Règlementation du Secteur de l'Electricité, ARSE)	Public authority that is responsible for (i) the evaluation of projects and supervision of national and international tenders for the conclusion of concession agreements; (ii) proposals to the Minister of Energy draft standards and formulas intended to regulate sector activities; (iii) sets tariffs charged by concessionaires and operators; (iv) ensures the quality of energy supplied, and (v) oversees specifications and safety standards.
Agency of Rural Electrification and Renewable Energy (Agence Togolaise d'Electrification Rurale et des Energies Renouvelables, AT2ER)	Agency under the arm of the MME that is responsible for overseeing programming and realization of rural electrification works and mobilizes institutions to finance rural electrification and development of RE.

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

1.2.2 Electricity Access: *Grid and Off-Grid*

Energy access in Togo represents a significant challenge. In 2016, an estimated 65% of the population – about 5 million people – did not have access to electricity, with a significant disparity in rates of access between urban (74%) and rural (5%) areas.[39] The Government has set a target of achieving universal access by 2030.

[39] "Energy Access Outlook, 2017: From Poverty to Prosperity," International Energy Agency, (2017): https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf

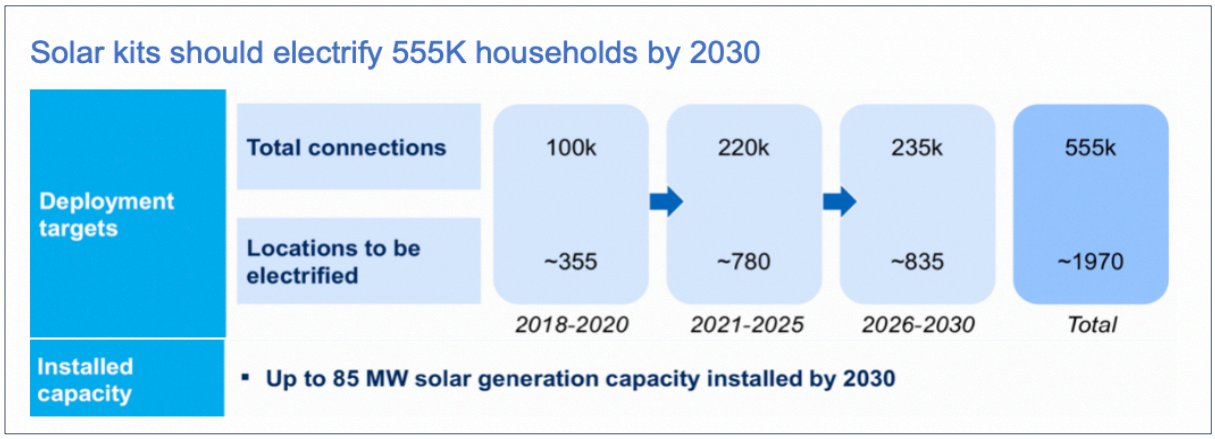
1.2.2.1 Off-Grid Market Overview

Although electricity access in rural areas remains limited, progress has recently been made in the development of Togo's off-grid sector. In 2018, the Government, through the MME, adopted the Togo Electrification Strategy, which relies heavily on renewable energy to increase electrification in the country. The strategy is to be rolled out in three phases over 12 years and will cost an estimated CFA 100 billion (USD 1.8 billion) – equivalent to approximately one-third of the country's annual GDP – of which half is expected to come from private investment. The overall target of this program is for electricity to reach 50% of Togo's 7.5 million-population by 2020, 75% by 2025 and to achieve universal access by 2030.

The strategy envisions a combination of grid extensions, mini-grids and off-grid stand-alone solar systems to achieve its electrification objectives. The GoT analysis found that the stand-alone sector will play a significant role in electrifying rural households – with an estimated 555,000 solar kits to be distributed to 1,970 locations through 2030 (**Figure 1**). The off-grid solar component of the electrification program is estimated cost of CFA 435 billion (USD 737 million), which would cover subsidies and tax incentives to offset the cost of the solar kits, credit lines to finance deployment to specific market segments, guarantees for operators to cover default risk, technical assistance and other indirect support (**Figure 2**). The private sector is expected to cover about two-thirds of this total financing requirement.[40]

The Government has adopted a specific platform to lead implementation of the off-grid stand-alone solar component of the strategy – the 'CIZO' program. Under this initiative, with support from private sector solar firms to distribute solar kits to rural households, it is estimated that the country's rural electrification rate will increase to 40% over the next five years.

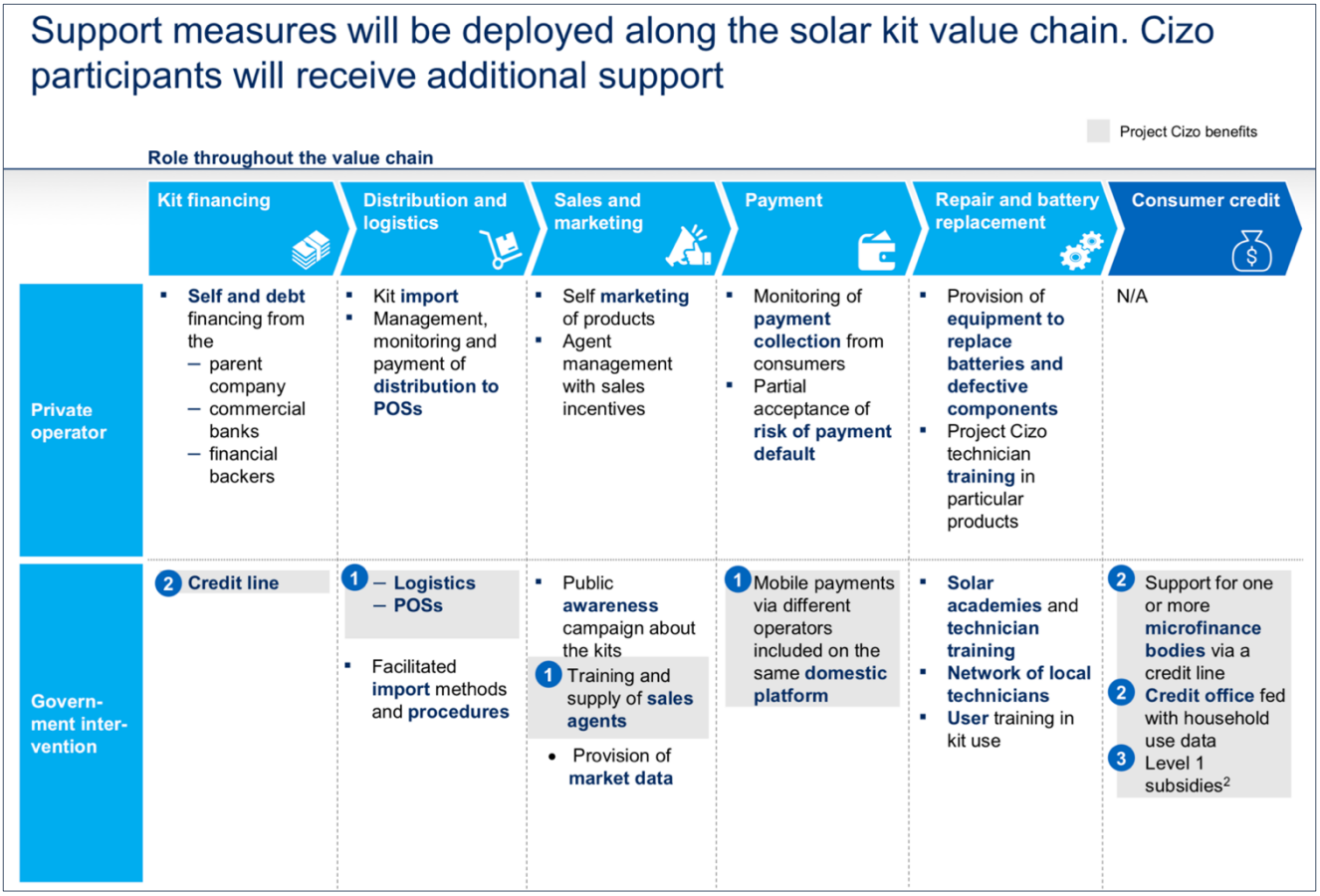
Figure 1: CIZO Program – Stand-alone Solar Kit Deployment Targets, 2018-2030



Source: National Electrification Strategy

[40] Togo electrification strategy, 2018: https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Electrification-Strategy-Short-EN-Final.pdf

Figure 2: CIZO Program – Government Interventions in Support of Stand-alone Solar Market Growth



Source: National Electrification Strategy

Two private sector solar companies have already been granted licenses to operate in the country's market. Under the program, the Government provides subsidies to households to offset the purchase of solar home systems sold by participating companies. As part of the CIZO initiative, the GoT also plans to connect around 800,000 households to the grid through planned extensions of its network.[41]

In 2017, UK-based BBOXX won a tender to distribute 300,000 solar home systems (SHS) over a five-year period under the program. BBOXX has partnered with France's EDF Group and is also collaborating with La Poste – Togo's postal company – to take advantage of its extensive network in rural areas of the country to distribute its solar products. BBOXX received USD 4 million in debt financing from Union Togolaise de Banque as well as a 50% pro-rata credit enhancement from the African Guarantee Fund.[42] In 2019, BBOXX launched *Tomorrow's Connected Community* – a conceptual business model that provides solar electricity to an entire village (streetlights, households, schools, businesses etc.) through a micro-grid and solar home systems, fully managed and maintained by the company's digital platform.[43]

[41] "Togo electrification scheme gets boost from solar rollout," Republic of Togo, (2017): http://www.republicofTogo.com/Toutes-les-rubriques/In-English/Togo-electrification-scheme-gets-boost-from-solar-rollout
[42] "BBOXX receives invitation to meet President of Togo to roll out 300,000 solar home systems," BBOXX, (July 2017): http://www.bboxx.co.uk/bboxx-receives-invitation-meet-president-Togo-roll-300000-solar-home-systems/
[43] "BBOXX Launches 'Tomorrow's Connected Community,'" Alternative Energy Africa, (April 25, 2019): https://ae-africa.com/read_article.php?NID=9968

The Government also awarded licenses to another supplier – Soleva, a consortium of Aphelion Energy and Wawa Energy Solutions – to distribute Greenlight Planet's Sun King solar lighting kits. The Government's subsidy to households is meant to cover the price of the solar equipment, leaving customers to pay only the cost of their energy consumption on a Pay-As-You-Go (PAYG) basis. Around 10,000 solar kits were installed in rural Togo in 2018; another 100,000 households are due to be connected by 2020, and a total of 555,000 by 2030.[44]

1.2.2.2 Demand and Supply/Generation Mix

Table 3: Electricity Sector Indicators, 2017[45]

Installed Capacity	230 MW
Thermal	163 MW
Hydropower	67 MW
Renewable (non-hydro)	-
National electrification rate (2016) Urban electrification rate Rural electrification rate	35% 74% 5%
Population without access	5.1 million
Households without access	1.1 million
Electrification target	Universal access by 2030

Source: ARSE, IEA, USAID Power Africa and World Bank

Togo's installed capacity is operated by CEB and ContourGlobal, a private operator, and runs mainly on thermal generation, with a significant share of the total imported from neighboring Côte d'Ivoire, Nigeria, and Ghana. CEB also operates an additional 65 MW of large hydropower capacity at the Nangbeto dam. The actual availability of electricity is impacted by inadequate fuel supplies, dynamic hydrological conditions, and poor infrastructure. While the country relies heavily on fossil fuels for power generation, it boasts significant potential for solar, wind and hydropower technologies. The GoT aims to take advantage of this potential and add RE capacity to its generation mix (**Table 4**).[46]

[44] "Togo subsidizes off-grid solar to extend electricity access to all," Reuters, (March 2, 2019): https://af.reuters.com/article/topNews/idAFKCN1QJ09L-OZATP?platform=hootsuite
[45] See **Section 2.1** for more details on households/population without access to electricity.
[46] "Togo Power Africa Fact Sheet," USAID, (2018): https://www.usaid.gov/powerafrica/Togo

Under the Toto Electrification Strategy, an estimated 108 MW of additional power will need to be generated by the grid through 2030 for the country to achieve 100% electrification. In addition to the abovementioned 550,000 solar kits, the country will need to deploy 315 mini-grids, extend the grid to connect 960 new localities, and provide 400,000 households under the grid with electricity (grid densification).[47]

Table 4: Current and Planned Installed Capacity[48]

Installed Capacity (MW)	2017	2020 (planned)	2030 (planned)
Thermal	163	no data	no data
Large hydro	65	65	115
Small hydro	2	22	70
Solar	-	45	68
Wind	-	no data	24
Total Installed Capacity (MW)	**230**	**-**	**-**
Total thermal	163	no data	no data
Total renewable energy	67	132	276

Source: ARSE; SEforALL National Renewable Energy Action Plan

Electricity tariffs are set by the GoT based on the advice of ARSE. In 2018, the average retail electricity tariff for all end users in Togo was USD 0.22/kWh.[49] The rate is slightly lower for low-income customers who receive a social tariff subsidy. Tariffs are not cost-reflective and do not generate adequate revenue for CEET to cover the cost of supply.

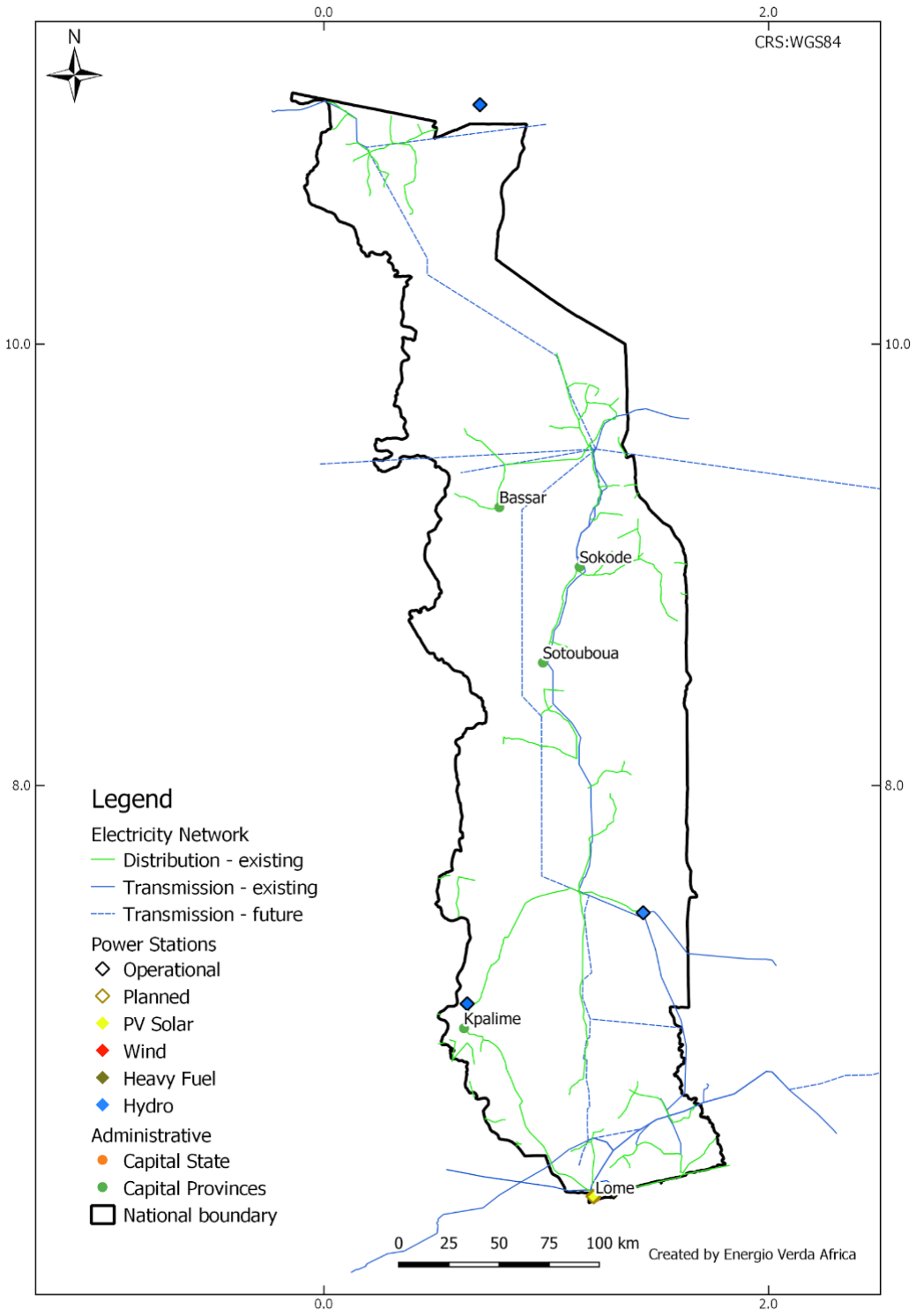
1.2.2.3 Transmission and Distribution Network

CEET is responsible for the distribution of electricity within the country (**Figure 3**). CEET purchases approximately half of its electricity from CEB, a binational entity that is co-owned by Togo and Benin. Overall, a significant gap exists between the infrastructure needs of the power sector and the availability of resources to invest in grid maintenance and extension to rural areas. Consequently, the existing network is often unreliable (**Figure 4**).

The GoT is working with a number of development partners to secure funding for improvements to the network. As a member of the West African Power Pool (WAPP), Togo has made regulatory commitments regarding opening access to transmission networks, fair pricing, and transparency.[50]

[47] Togo electrification strategy, 2018: https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Electrification-Strategy-Short-EN-Final.pdf
[48] "Plan d'Actions National des Énergies Renouvelables (PANER)," SEforALL / ECREEE, (2015): http://se4all.ecreee.org/sites/default/files/plan_dactions_national_des_energies_renouvelables_paner_-_Togo.pdf
[49] "Regulatory Indicators for Sustainable Energy: Togo," World Bank, (2018): http://rise.worldbank.org/country/Togo
[50] "Togo Energy Sector Support and Investment Project," World Bank, (2017): http://documents.banquemondiale.org/curated/fr/944651513998136523/pdf/TOGO-PAD-ENERGY-NEW-12012017.pdf

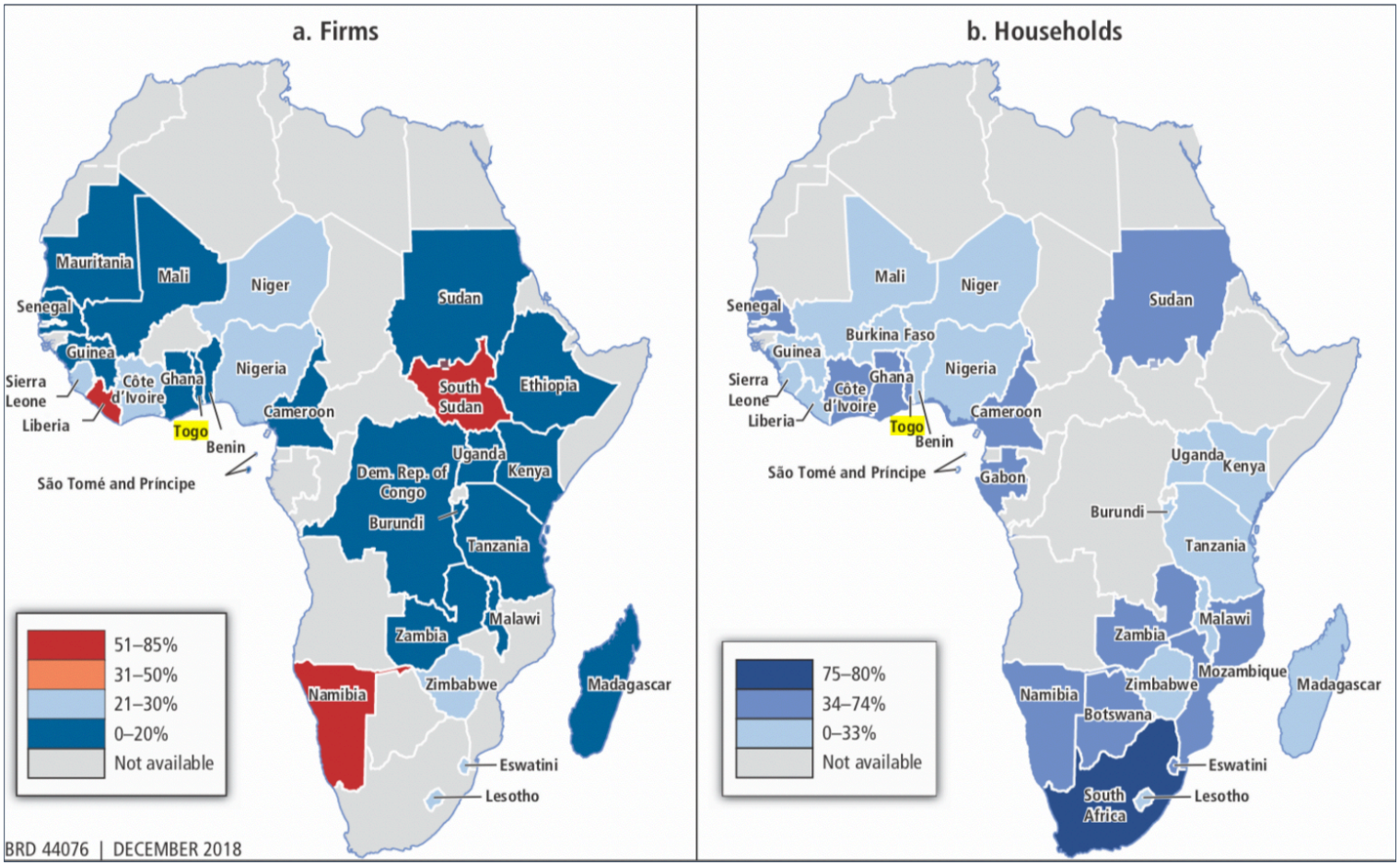
Figure 3: Electricity Transmission and Distribution Network[51]



Source: Energio Verda Africa GIS analysis

[51] See **Annex 1** for more details, including data sources.

Figure 4: Access to Reliable Electricity by Firms and Households in Africa[52]



Source: World Bank Enterprise Surveys, 2013-2017 and Afrobarometer Household Surveys, 2014-2015

The maps in **Figure 2** illustrate the share of firms (Panel a) and households (Panel b) reporting access to a reliable supply of electricity. In Togo, fewer than one-fifth of surveyed firms and about half of surveyed households reported having reliable access to electricity.

[52] Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact," AFD and World Bank, Africa Development Forum, (2019): https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y

1.2.2.4 Least-Cost Electrification Analysis

A least-cost electrification analysis has been performed to assess the potential development of electricity access in Togo through 2023 and through 2030 ("Scenario 2023" and "Scenario 2030").[53] The analysis identifies the scale of market opportunities for off-grid stand-alone solar electrification. A brief summary of the approach and methods used, main assumptions and key results of the analysis in Togo are outlined below. Additional geographic information system (GIS) information, including categorizations, key definitions, and datasets are included in **Annex 1**.

- **Methodology**

This analysis used geospatial techniques to determine the least-cost electrification options for settlements across Togo based on their proximity to electrical infrastructure, population density or nodes of economic growth.

For the scenario 2023 analysis, it is assumed that widespread densification of the existing electrical grid will enable settlements within 5 km of existing grid lines to connect to the grid (according to WAPP densification plans).[54] Beyond this area, the likely candidates for electrification by mini-grid systems are settlements that are relatively dense (above 350 people/km^2) and have active local economies, evidenced by the presence of social facilities and by their proximity to other settlements already with electricity access (i.e. within 15 km of night-lights areas). All remaining settlements – those in areas of lower population density (below 350 people/km^2) or far from the national grid – are defined as candidates for off-grid stand-alone systems.

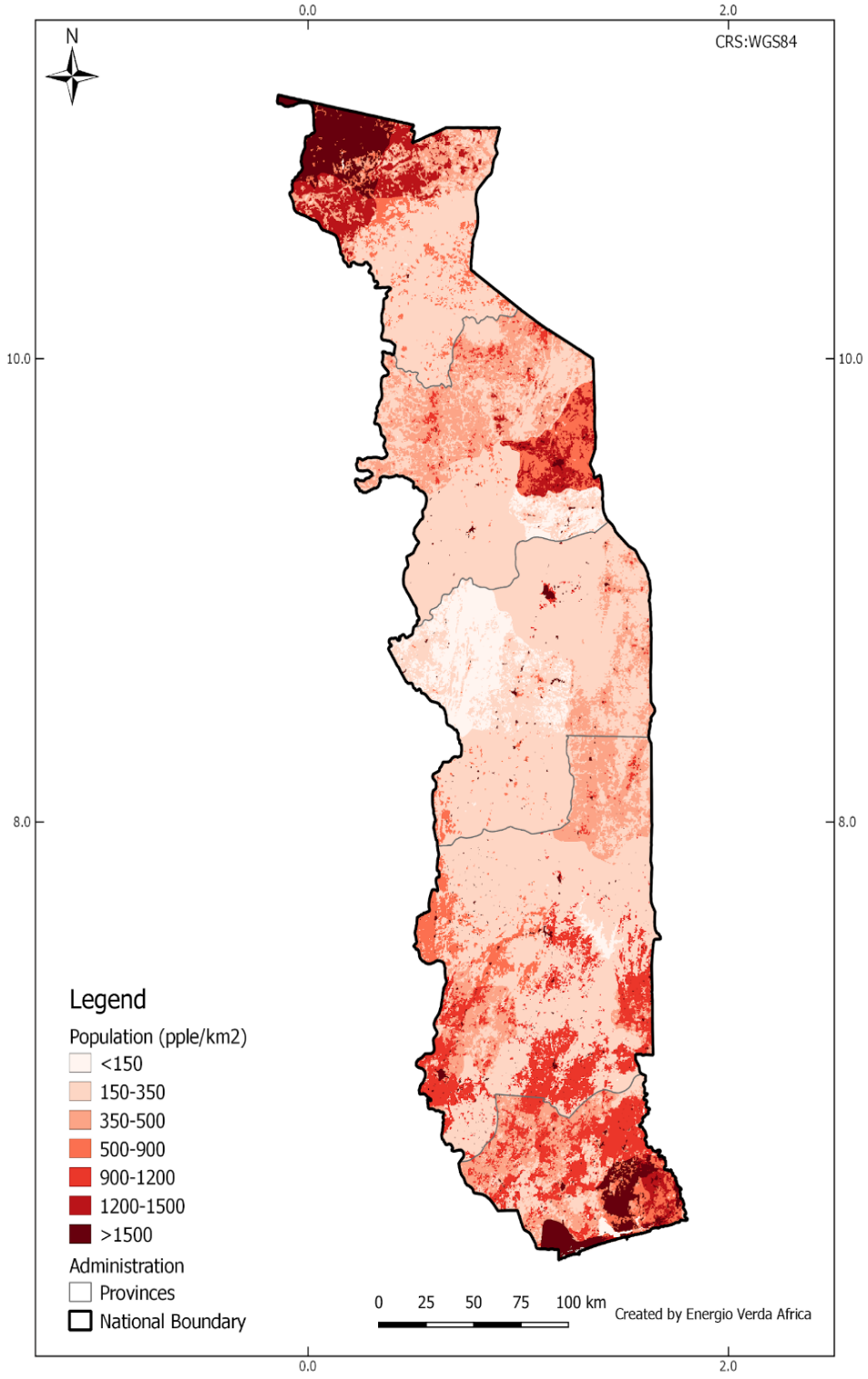
For the scenario 2030 analysis, it is assumed that the grid and the reach of grid densification efforts will extend far beyond the existing network. Hence, settlements that are within 15 km of current lines (average densification distance announced by utilities across West Africa in a 10-year timeline in personal interviews) and 5 km of future planned line extensions are assumed to be connected. For mini-grids, future economic development – which will allow new settlements to grow sufficiently to become candidates for mini-grids – is assumed to occur in settlements within 1 km of mini-grid settlements (average distance of mini-grid coverage of different developers) identified in the scenario 2023 analysis, as well as within 15 km of economic growth centers – airports, mines and urban areas. All other settlements are defined as candidates for off-grid stand-alone systems.

Given the lack of low voltage distribution line data, it is necessary to approximate areas where un-electrified settlements in close proximity to the grid exist. The analysis therefore focuses on settlements that are within 5 km of the high and medium voltage network, but that are located beyond 15 km of areas with night-time light emissions (indicative of electrification). Settlements in areas of low population density (below 350 people/km^2) that met the above criteria are identified as both being currently un-electrified and unlikely to be electrified within scenario 2023.[55]

Additional analysis was undertaken to estimate the population within each settlement. The current annual national population growth rate of 2.5%[56] was applied to the geospatial analysis to project population figures for the scenario 2023 and 2030 analyses.[57] **Figure 5** shows population density across the country, which served as the basis for this analysis.

[53] NOTE: Rather than presenting a 10-year projection through 2028, the analysis conforms to GoT electrification targets for 2030
[54] NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)
[55] Note that this analysis was performed for scenario 2023 but not for scenario 2030 due to uncertainties regarding population densities being too high over such a long timeframe
[56] https://data.worldbank.org/indicator/SP.POP.GROW?locations=TG
[57] See **Annex 1** for the results of this analysis as well as more details on the approach and methods used

Figure 5: Population Density, 2015[58]



Source: Energio Verda Africa analysis

[58] See **Annex 1** for more details, including data sources.

- **Results**

Table 5 summarizes the results of the least cost electrification analysis. **Figure 6** and **Figure 7** illustrate the distribution of settlements according to least-cost electrification options under scenarios 2023 and 2030, respectively. The number of households was estimated by using the average household size for the country (4.6 persons/household).[59]

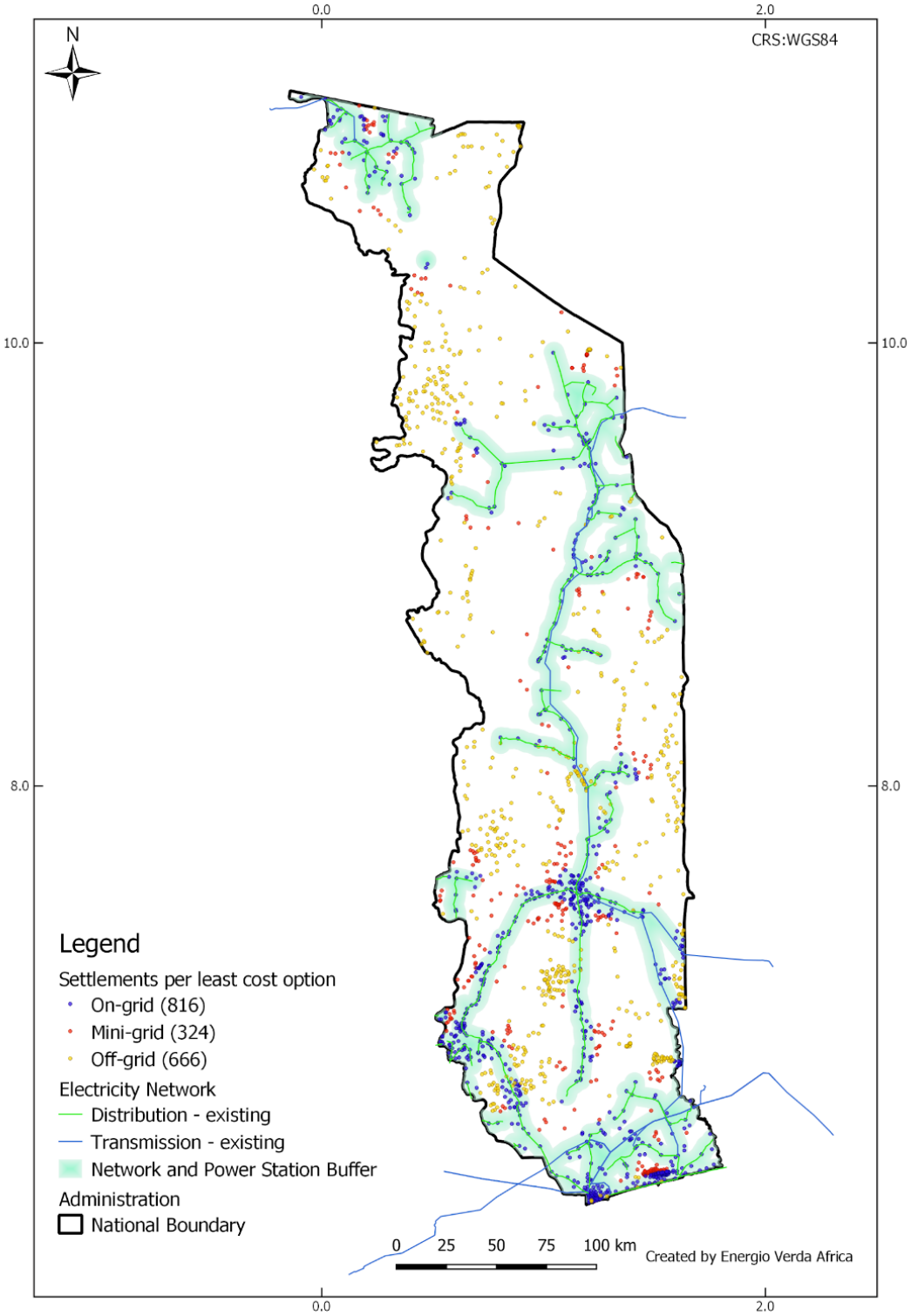
Table 5: Results of Least-Cost Electrification Analysis

Scenario	Indicator	Least-Cost Electrification Option			Grid Vicinity		
		Grid extension	Mini-grid	Off-grid stand-alone systems	Under-grid un-served	Total under-grid	Total outside grid vicinity
Scenario 2023	Number of settlements	816	324	666	61	877	929
	% of settlements	45.2%	17.9%	36.9%	7.0%	48.6%	51.4%
	Total population	5,494,002	920,758	1,685,228	94,256	5,588,259	2,511,729
	% of population	67.8%	11.4%	20.8%	1.7%	69.0%	31.0%
	Number of households	1,194,348	200,165	366,354	20,491	1,214,839	546,028
Scenario 2030	Number of settlements	1,462	67	277	Not calculated	1,462	344
	% of settlements	81.0%	3.7%	15.3%	Not calculated	81.0%	19.0%
	Total population	8,417,635	230,509	980,196	Not calculated	8,417,635	1,210,705
	% of population	87.4%	2.4%	10.2%	Not calculated	87.4%	12.6%
	Number of households	1,829,921	50,111	213,086	Not calculated	1,829,921	263,197

Source: Energio Verda Africa GIS analysis

[59] "Household Size and Composition Around the World," United Nations, (2017): http://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf

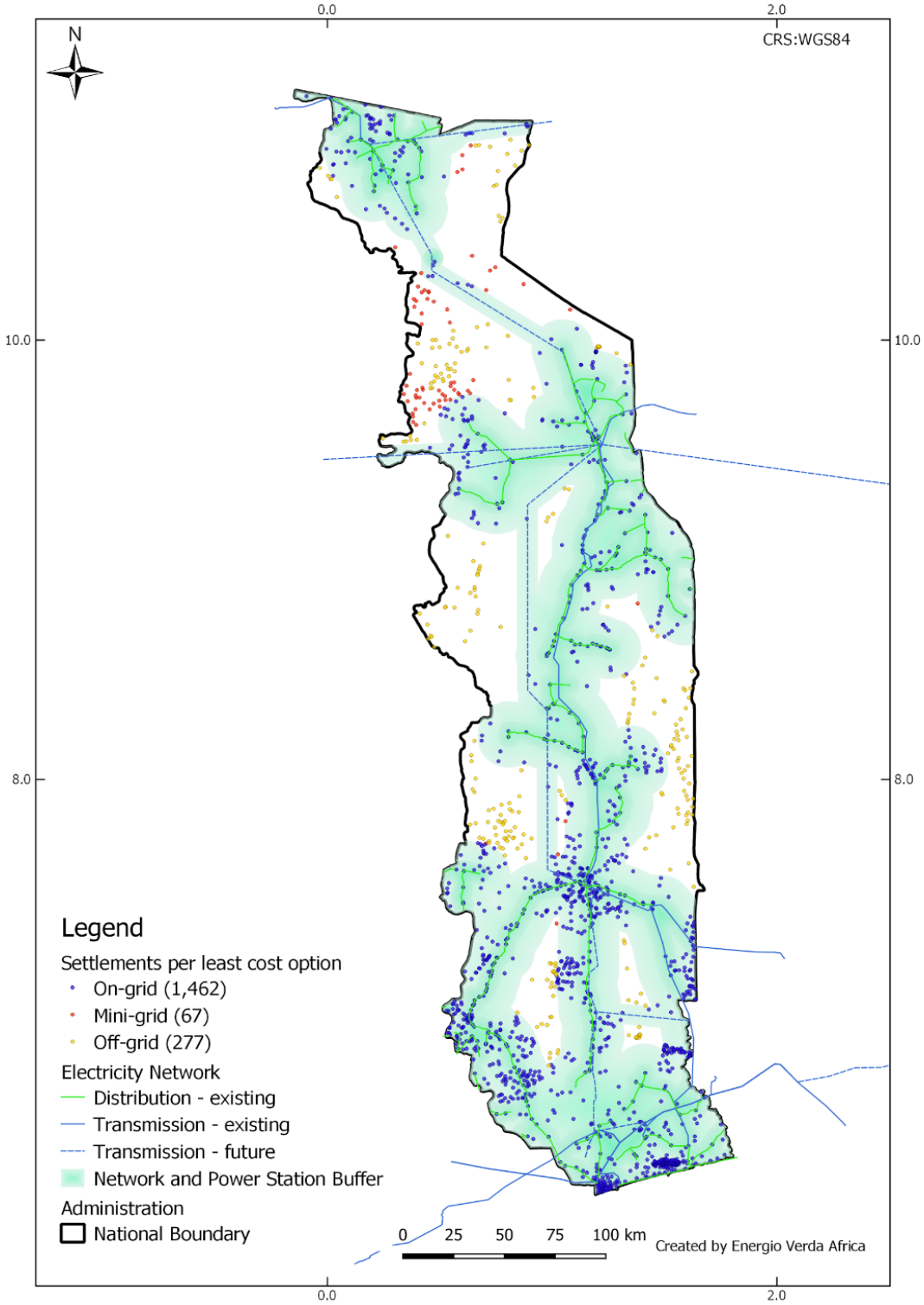
Figure 6: Distribution of Settlements by Least-Cost Electrification Option, 2023[60]



Source: Energio Verda Africa GIS analysis

[60] Displaying identified settlements with known location (given coordinates) only; see **Annex 1** for more details, including data sources.

Figure 7: Distribution of Settlements by Least-Cost Electrification Option, 2030[61]



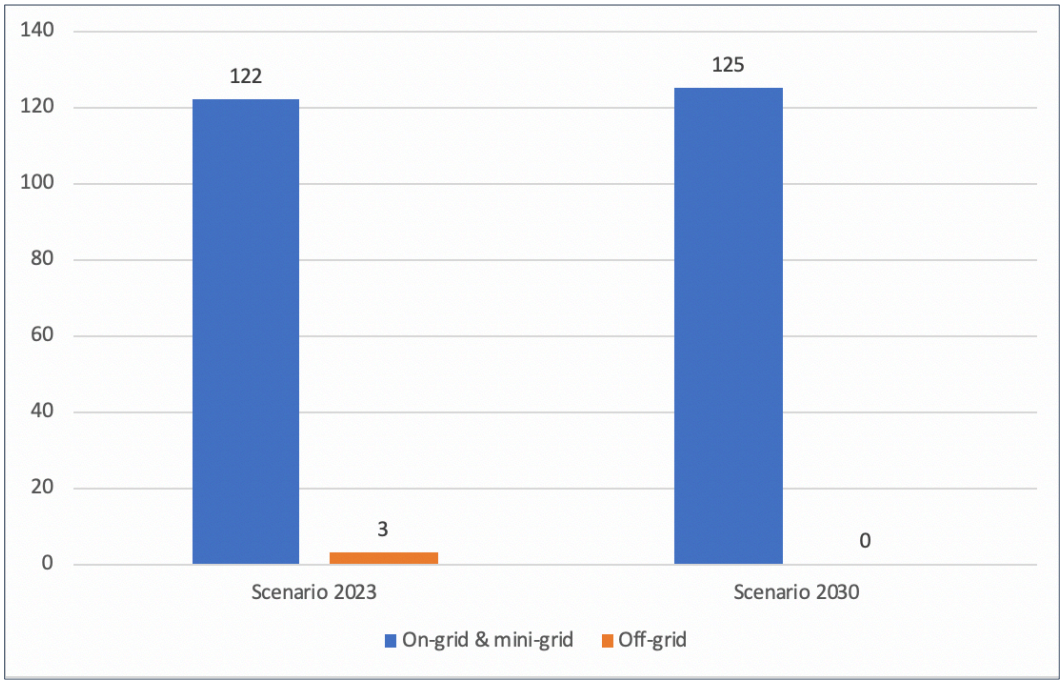
Source: Energio Verda Africa GIS analysis

[61] Displaying identified settlements with known location (given coordinates) only; see **Annex 1** for more details, including data sources.

The analysis also covered the education centers and health facilities that will remain off-grid during the analyzed timeframes. Unfortunately, no schools with known coordinates were identified for analysis.

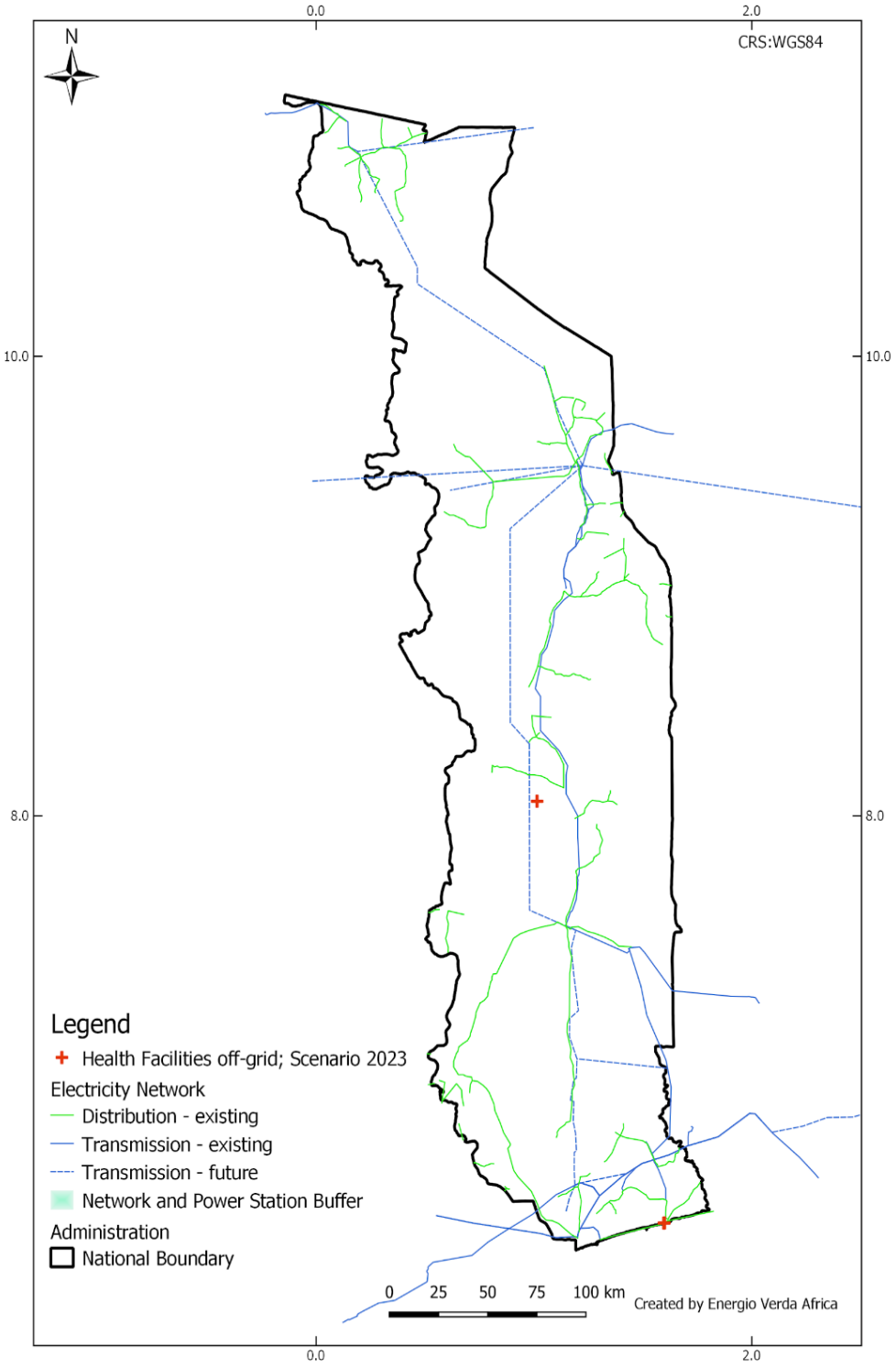
Figure 8 summarizes the number of health facilities that may be electrified by on-grid, mini-grid or stand-alone solutions in scenarios 2023 and 2030. Of the 125 identified health facilities (hospitals and clinics), one hospital and two clinics remained in off-grid areas in scenario 2023, while all of the identified health facilities were connected to the grid in scenario 2030. **Figure 9** illustrates the distribution of potential off-grid health facilities across the country in scenario 2023.

Figure 8: Identified Health Facilities for On-Grid, Mini-Grid and Stand-alone Solutions, 2023 and 2030



Source: Energio Verda Africa GIS analysis

Figure 9: Distribution of Potential Off-Grid Healthcare Facilities, 2023[62]



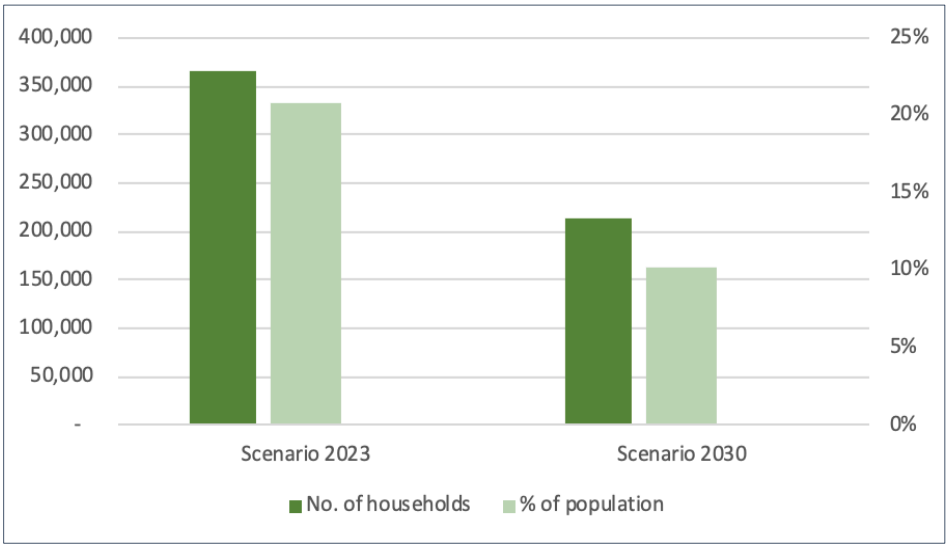
Source: Energio Verda Africa GIS analysis

[62] Displaying identified facilities with known location (given coordinates) only; see **Annex 1** for more details, including data sources.

According to the geospatial analysis (**Table 5**), by 2023, 816 settlements across Togo (1,194,348 households) will be connected to the main grid, representing 67.8% of the population. By 2030, this figure will increase to 1,462 settlements (1,829,921 households), equivalent to 87.4% of the population. These estimates are based on the assumption that all planned grid extensions will be completed by 2030. Not all settlements in close proximity to electricity lines will connect to the main grid, largely due to the low density of these areas (dispersed settlements with a density below 350 people/km^2). By 2023, an estimated 61 settlements located under the grid will meet these criteria (or 7.0% of the settlements located within 5 km of the grid).

Outside of the main grid areas, settlements with higher economic growth potential and higher population density can optimally be electrified by mini-grids. By 2023, this represents an estimated 324 settlements (200,165 households), or 11.4% of the population, decreasing to 67 settlements (50,111 households), or 2.4% of the population by 2030. The remaining more dispersed settlements (further from centers of economic activity) can optimally be served by off-grid stand-alone systems. This comprises 666 settlements (366,354 households) and 20.8% of the population in 2023, decreasing to 277 settlements (213,086 households) and 10.2% of the population in 2030 (**Figure 10**).

Figure 10: Estimated Number of Households and Share of Population Suitable for OGS Systems, 2023 and 2030



Source: Energio Verda Africa GIS analysis

The analysis indicates that the off-grid stand-alone market has the potential to grow significantly. According to figures published by the Global Off-Grid Lighting Association (GOGLA),[63] an estimated 4,588 off-grid stand-alone solar PV products (pico solar and SHS) have been sold in Togo as of the end of 2017 (see **Table**

[63] "Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2017): https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf; and
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2017): https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth12017_def.pdf; and
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2016): https://www.gogla.org/sites/default/files/recource_docs/final_sales-and-impact-report_h22016_full_public.pdf; and
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2016): https://www.gogla.org/sites/default/files/recource_docs/global_off-grid_solar_market_report_jan-june_2016_public.pdf

41 in **Section 2.4.3**). The least-cost analysis estimates that more than 365,000 households in 2023 are suitable for off-grid stand-alone systems.

In its SEforALL National Renewable Energy Action Plan (PANER), the GoT envisions a relatively limited share of the population will gain electricity access through off-grid systems (**Table 6**). The findings of the least-cost analysis suggest that the Government may need to consider increasing the utilization of off-grid solutions (a combination of mini-grids and stand-alone systems) in its electrification planning in order to achieve its energy access targets, particularly in the near-term until planned grid extensions are realized.

Table 6: Estimated Share of Population Served by Off-Grid Systems[64]

Share of population with access to off-grid systems powered by renewable energy (%) *	2020 (target)	2030 (target)
	2.2%	8.9%

* Estimate includes both mini-grids and stand-alone systems

Source: SEforALL National Renewable Energy Action Plan (PANER)

Since publication of the PANER in 2015, the Government adopted the Togo Electrification Strategy in 2018 and its corresponding CIZO program.[65] The GoT / CEET team that prepared the strategy also carried out GIS analysis, which concluded that for the country to reach 100% electrification by 2030, a total of about 555,000 new households will need to be electrified by solar kits and about 55,000 new households by mini-grids (excluding existing households electrified by off-grid solutions in 2018). These numbers differ from the findings of the GIS analysis undertaken for this report, in which about 213,000 households are suitable for solar kits (i.e. stand-alone solutions) and about 50,000 households for mini-grids in 2030.[66] The GoT / CEET analysis concludes that more households could be electrified by grid extension and densification than previous estimates. The data will need to be adjusted over time to estimate the number of households that could be connected to the main grid by densification. This study assumes that all households in close proximity to the grid (5 and 15 km) will be electrified by the grid, since the uncertainties regarding population densities (and therefore the extension of MV lines) are too high over such a long timeframe.

1.2.2.5 Inclusive Participation[67]

Inclusive participation in the off-grid energy sector in Togo remains an ongoing challenge. Gender inequality persists, as women are under-educated and generally have a lower socio-economic status, with inadequate access to basic social services and reduced economic opportunities compared to men. Gender discrimination is widespread, as women are almost entirely excluded from decision-making positions at all levels of society. Togo ranks poorly in the United Nations Development Programme (UNDP) Gender Inequality Index, which measures several indicators to assess levels of gender inequality in the areas of health, access to education, economic status and empowerment. Female participation in education, particularly higher education, remains disproportionately low (**Figure 11**).[68]

[64] "Plan d'Actions National des Énergies Renouvelables (PANER)," SEforALL / ECREEE, (2015): http://se4all.ecreee.org/sites/default/files/plan_dactions_national_des_energies_renouvelables_paner_-_Togo.pdf

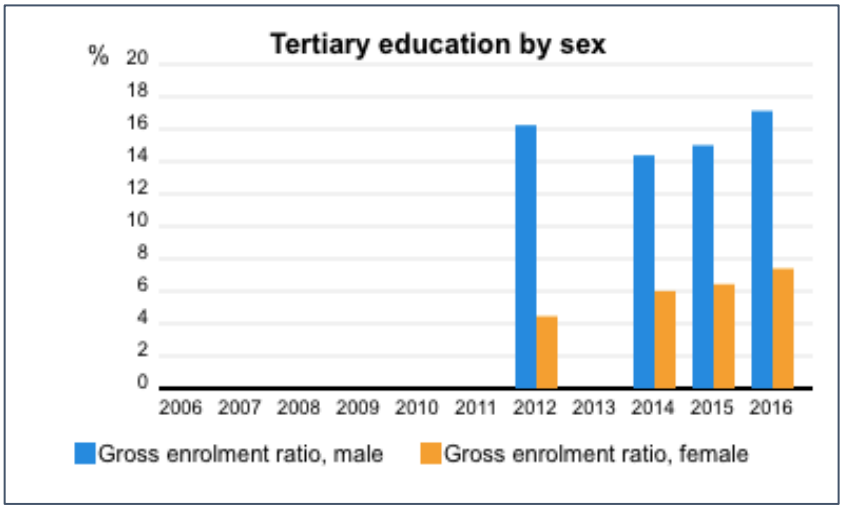
[65] Togo electrification strategy, 2018: https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Electrification-Strategy-Short-EN-Final.pdf

[66] The discrepancy in the findings of the two analyses can be attributed to differences in settlement and household data. The GoT strategy identified 3,248 localities and 1,280,000 households; Energio Verda Africa identified 1,806 settlements and 2,093,117 households. Furthermore, while the GoT study assessed the % of the newly-electrified households, the Energio Verda Africa analysis examined the % of the total number of households.

[67] Please refer to **Annex 4** for more details

[68] "Gender Inequality Index," UNDP, (2015): http://hdr.undp.org/en/composite/GII

Figure 11: Rates of Enrollment in Tertiary Education



Source: UNESCO Institute for Statistics

Togo has adopted several policies and action plans to promote gender equality and has signed on to key international and regional framework agreements protecting women's rights. These include ratification of the Convention on the Elimination of All forms of Discrimination against Women and the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa. A General Directorate for the Advancement of Women has existed since 1977, a Ministry for the Promotion of Women was established in 2010, and a National Policy on Gender Equality and its corresponding Action Plan were adopted in 2011. Despite these policy initiatives, the level of participation among women remains very low, especially in rural areas where customary and religious practices tend to supersede state policies and laws.[69]

In the energy sector, efforts have been made to implement measures under the regional framework, ECOWAS Policy for Gender Mainstreaming in Energy Access, and at the national level. Gender mainstreaming in the country's energy policy requires capacity building of staff and the implementation of gender management systems at the institutional level to provide guidance on gender responsive leadership and decision making. As part of this process, the Government has undertaken a Gender Audit of its energy policy and established energy linkages in its gender policy. The GoT has also established a gender focal point at the Ministry of Energy to promote inclusive participation for women in the energy sector.

1.2.3 Key Challenges

Some of the key energy sector challenges facing Togo include (but are not limited to) the following:

- **Investment in Grid Extension and Maintenance**: Increasing electricity demand is putting pressure on power supply – a mismatch that will continue to burden the electricity transmission and distribution network that needs maintenance and investment to reduce losses and expand access.

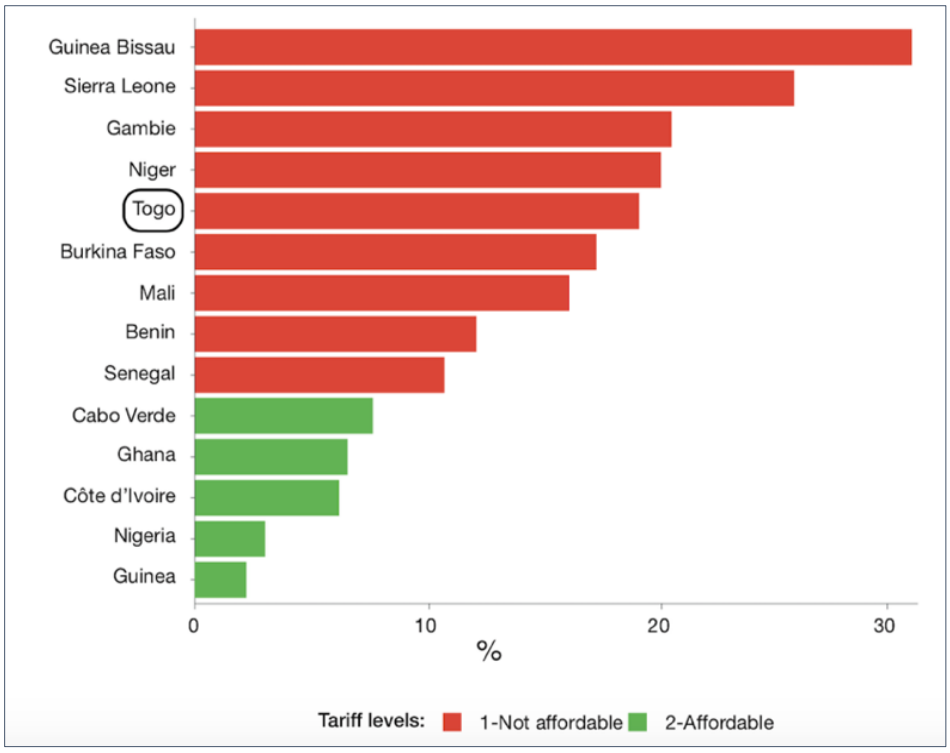
- **Electricity Tariffs**: Average electricity tariffs in Togo (USD 0.22/kWh) are slightly above the ECOWAS region's average tariff of USD 0.20/kWh.[70] Togo subsidizes electricity tariffs for low-

[69] "Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa," ACHPR, (2018): http://www.achpr.org/instruments/women-protocol/

[70] "Electricity Tariffs in ECOWAS Region," African Development Bank Group, Energy Policy, Regulation and Statistics Division, (September 2018): http://www.ecowrex.org/sites/default/files/pesr1_-_energy_statistics_bulletin_september_2018.pdf

income consumers, providing electricity to poorer households below the cost of supply with funds from the GoT and the utility (CEET) through a range of residential and commercial consumers who pay higher electricity rates. Despite this cross-subsidization scheme, average households in the country still spend a disproportionate amount of their income on electricity (**Figure 12**).

Figure 12: Share of Income Spent on Household Electricity in ECOWAS Countries, 2018



NOTE: Liberia is excluded from the analysis; the threshold for what is considered an affordable tariff is 10% of income spent on electricity – a household is considered energy poor if more than 10% of income is spent on energy/fuel to maintain adequate level of comfort; On average, households in the ECOWAS region spend 17% of their income on electricity.

Source: ECOWAS Regional Electricity Regulatory Authority

- **Utility Financial Performance:** Without cost-reflective tariffs in place, CEET does not generate adequate revenue to invest in grid extensions and maintenance. The utility also has poor billing collection procedures, which further hamper its cash flows.[71] CEET has not been able to honor its payments to CEB, accumulating arrears of US 58 million at year end 2016.[72] As a result, Togo's power sector remains largely dependent upon foreign assistance.

- **Imbalanced Energy Mix:** A reliance on imported fossil fuels leaves the power sector susceptible to price volatility and favors a more carbon intensive energy source despite the strong potential for cleaner renewable alternatives. When international oil prices are high, and/or the exchange rate fluctuates, the operation of Togo's power stations is constrained, leading to frequent load shedding and outages.

[71] "Togo's Efforts to Improve Power Sector's Performance Gets World Bank Support," World Bank, (20 December 2017): https://www.worldbank.org/en/news/press-release/2017/12/20/Togos-efforts-to-improve-power-sectors-performance-gets-world-bank-support

[72] "Togo Energy Sector Support and Investment Project," World Bank, (2017): http://documents.banquemondiale.org/curated/fr/944651513998136523/pdf/TOGO-PAD-ENERGY-NEW-12012017.pdf

Moreover, Togo still receives half of its power from countries like Nigeria and Ghana, which leaves it susceptible to external risks; in July 2018 Nigeria threatened to cut the power supply to Togo.[73]

- **Local Financial Institutions**:[74] Local financial institutions (FIs) and microfinance institutions (MFIs) lack sufficient internal capacity and credit appetite to invest in the renewable energy/off-grid sectors. This challenge is complicated as it arises mainly from the risk perceptions of FIs, which influence whether efforts should be made to develop strategies and customize financial products to target a nascent market, where there is often limited knowledge of technologies, market characteristics and historical data on portfolio credit performance. There are also likely misperceptions about the potential size of these markets as well as doubts about the profitability of offering financial products in rural off-grid areas, where the creditworthiness of potential clients may be an issue.[75]

- **Other Challenges**: Successful development of the off-grid sector will require more than just a financial support mechanism – the Government and its supporting agencies will also need to develop and implement a range of measures to expedite growth of the market, including a robust technical assistance (TA) platform to supplement ROGEP's objectives. This platform should address *inter alia* (i) awareness raising, education and training for consumers, including organization of appropriate community management structures; (ii) solar PV system supply chain and operations and maintenance (O&M) services, including training of local technicians to ensure that the cost of maintenance is affordable and sustainable; and (iii) standards for equipment and service providers (i.e. installers, technicians) to guide customers to companies providing the best value for their money. These measures should be part of a national rural electrification sector strategy to inform decision-making of key stakeholders surrounding development and regulation of the country's stand-alone solar PV market.

[73] "Electricity: Nigeria Threatens to Cut Supply to Togo," Togo First, 2018

[74] The role of FIs is examined in further detail in **Section 3.**

[75] One notable exception to this is the commercial and industrial (C&I) market segment, where systems are larger and off-takers are often companies with large enough balance sheets to borrow. This has been one of the stand-alone market segments where there has been some lending to date in Africa (e.g. AFD's Sunref program)

1.3 National Policy and Regulation

1.3.1 National Electricity/Electrification Policy

In 2012, the Government of Togo drafted an Energy Policy and Strategy, which included the following policy priorities: (i) diversification of the country's energy mix, (ii) a focus on increasing RE in the energy mix and for rural electrification, (iii) the involvement of the private sector to mobilize investment, (iv) an update of the regulatory framework and implementing measures, (v) increasing stakeholder coordination and (vi) establishing a national GIS database.[76]

In 2017, the GoT established a new agency, AT2ER, to lead development of rural electrification and renewable energy at the national level. In 2018, the MME updated the country's electrification strategy to present a coherent long-term vision for universal electrification and to mobilize the resources necessary to achieve this goal by 2030 (**Figure 13**).

Figure 13: Togo Electrification Strategy, 2018[77]

Source: National Electrification Strategy

[76] "Togo Energy Profile," UNEP, (2015): https://wedocs.unep.org/bitstream/handle/20.500.11822/20593/Energy_profile_Togo.pdf?sequence=1&isAllowed=y
[77] Togo electrification strategy, 2018: https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Electrification-Strategy-Short-EN-Final.pdf

As a member state of ECOWAS, the GoT is also committed to the ECOWAS Regional Renewable Energy Policy[78] for the period 2015-2030, which seeks to: (i) set national RE targets, (ii) create a harmonized regulatory framework as well as common tax and duties policies and standards, (iii) develop technology knowledge and capacity building, and (iv) promote a regional RE market. For the electricity sector, the objective is to increase the share of RE in total generation and ensure that RE is used to serve the population without access through mini-grid and stand-alone systems by 2030. Under the leadership of ECREEE, Togo developed a National Renewable Energy Action Plan (PANER).[79]

For the off-grid sector, SEforALL recommends: (i) the establishment of RE tax incentives measures, (ii) consider solar in electricity public procurement, (iii) Tax, VAT and custom duty exemption on solar equipment (PV and thermal: pumping kits, solar lamps, solar panels, solar water-heater, batteries, converters and inverters). It also suggests the development of a RE Master Plan with a dedicated fund and the establishment of a quality standards and quality control unit for solar PV components within the National Standard Agency.

1.3.2 Integrated National Electrification Plan

In 2018, the Government adopted an integrated national electrification strategy, with a specific focus on off-grid sector development in the short and medium-term (through 2030).[80]

1.3.3 Energy and Electricity Law

As part of its national strategy to achieve universal electrification by 2030, the GoT has introduced more supportive regulations for renewable energy technologies; a new Renewable Energy Law (law No. 2018-10) that passed in July 2018 includes provisions for off-grid energy and fiscal incentives applied to solar products for approved companies, including exemptions and reductions of import duties, company tax, minimum flat tax, property tax and VAT.[81] In addition, a key component of the CIZO program is to reduce taxes and import duties on solar products and to facilitate the importation and logistics process among other supportive measures.[82] Solar products also have to comply with international performance standards, i.e. Lighting Global standards, maintenance and after-sales service, and connectivity.

In addition to the newly adopted RE law, the following laws govern the electricity sector in Togo:

- Benin-Togo Electricity Code (2005-2006) is based on an energy agreement concluded between the two countries in 1968 and was later revised in 2003 and again in 2016, in order to promote IPPs and to end the monopoly that CEB has over the market
- Electricity Law (2000-12) liberalized the production segment and promotes the liberalization of transport and distribution segments and created the regulatory agency ARSE.

In addition, a separate legal provision established AT2ER in 2016 to support RE and rural electrification planning and policy, with the agency responsible for (i) implementing rural electrification projects, (ii)

[78] "ECOWAS Renewable Energy Policy," ECOWAS, (2015): http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf
[79] "Plan d'Actions National des Énergies Renouvelables (PANER)," SEforALL / ECREEE, (2015): http://se4all.ecreee.org/sites/default/files/plan_dactions_national_des_energies_renouvelables_paner_-_Togo.pdf
[80] Togo electrification strategy, 2018: https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Electrification-Strategy-Short-EN-Final.pdf
[81] "Loi Relative à la Promotion de l'Électricité à base des Sources d'Énergies Renouvelables au Togo," Government of Togo, (2018): http://www.arse.tg/wp-content/uploads/2018/09/Loi_Energie_Renouvelable_082018.pdf
[82] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf

developing national RE potential and raising national awareness, and in (iii) mobilizing financing and investment for RE and rural electrification.

1.3.4 Framework for Stand-alone Systems

Figure 14 is an overview of the key national policies, programs, laws, and regulations pertaining to Togo's framework for stand-alone systems. The gaps in this framework are addressed in **Section 1.3.5**.

To date, the Government's efforts to establish a supportive policy and regulatory framework for the off-grid sector have been largely successful, as the country more than doubled its World Bank Regulatory Indicators for Sustainable Energy (RISE) energy access score between 2015 and 2017. In the 2017 RISE evaluation, Togo ranked fourth in West Africa and the Sahel behind Côte d'Ivoire, Ghana and Cameroon, and was among the highest scoring countries in Africa (**Figure 15**).

Figure 14: Policy and Regulatory Framework for Stand-alone Systems[83]

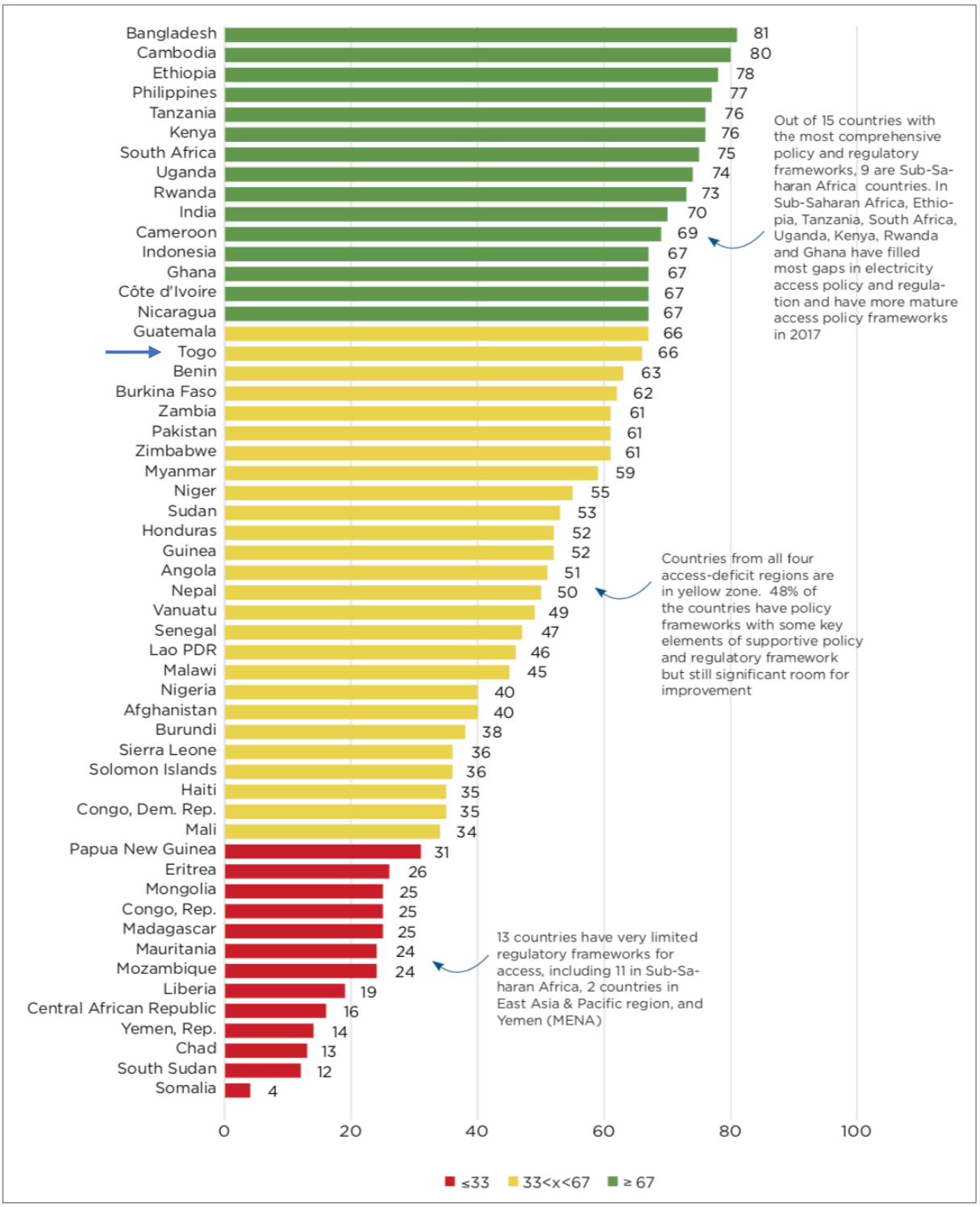
	TOGO		
	World Bank RISE 2017 Energy Access Score: 66 World Bank RISE 2015 Energy Access Score: 32	2017 ranking among West Africa and the Sahel (ROGEP) countries: 4th	
Policy/Regulatory Support and Financial Incentives	**Specific national policies, laws and programs**[84]		
	National electrification policy with off-grid provisions	√	Togo Electrification Strategy
	Integrated national electrification plan	√	Togo Electrification Strategy
	Energy/electricity law with off-grid provisions	x	
	National programs promoting off-grid market development	√	CIZO program
	Specific target for rural electrification	√	Universal access by 2030
	Financial incentives		
	Subsidies, tax exemptions or related incentives for solar equipment/stand-alone systems	√	30% import tax exemption for SHS
	Standards and quality		
	Government-adopted international quality standards for stand-alone systems	√	ISO & IEC equipment standards
	Government-certified program for solar equipment installers	x	
	Consumer awareness/education programs	√	Togo Electrification Strategy
	Concession Contracts and Schemes	x	
	Business Model Regulation	√	Togo Electrification Strategy

√ = existing/implemented provisions in the current regulatory framework
X = no existing provisions

Source: World Bank RISE; Stakeholder interviews; GreenMax Capital Advisors analysis

[83] "RISE Togo," Regulatory Indicators for Renewable Energy RISE, (2015): http://rise.worldbank.org/country/Togo
[84] Under this analysis, national electrification policies, laws and regulations were only considered if they include detailed provisions and corresponding action plans to support development of the off-grid sector (through the utilization of mini-grid and stand-alone systems)

Figure 15: Distribution of RISE Electricity Access Scores in Access-Deficit Countries, 2017[85]



Source: World Bank Regulatory Indicators for Sustainable Energy

[85] "Policy Matters: Regulatory Indicators for Sustainable Energy," World Bank ESMAP, (2018): http://documents.worldbank.org/curated/en/553071544206394642/pdf/132782-replacement-PUBLIC-RiseReport-HighRes.pdf

1.3.4.1 Existence of Specific National Programs

In 2017, AfDB's Sustainable Energy Fund for Africa (SEFA) approved a grant to sponsor a national program (CIZO) promoting rural electrification through off-grid solar PAYG kits.[86] The program aims to provide three million people in Togo with access to electricity for the first time and is aligned with the government's strategy to improve energy access rates in rural Togo from 6% in 2017 to 35% before 2022.[87] The National Electrification Strategy will see 300 new solar mini-grids built in various parts of rural Togo, as well as the distribution of more than 500,000 solar kits throughout the country (under the CIZO program). UK-based company BBOXX and US-based GreenLight Planet (through its local affiliate, Soleva), have already been awarded licenses to begin solar product distribution in the country. The CIZO Program is estimated to cost the GoT USD 1.8 billion, of which the government has committed to raising USD 318 million to date.[88]

1.3.4.2 Financial Incentives

In line with the Government's goals as defined under the Togo Electrification Strategy and CIZO program, the usual 30% import duty requirement has been lifted for solar kits for participating companies. In order to promote growth of the solar sector, the GoT has also put in place a range of regulatory, logistic and fiscal framework reforms to attract more investments in the clean energy sector. These measures will help spur growth of the market and contribute to increased solar development in Togo.[89]

1.3.4.3 Standards and Quality

Under the Government's electrification program, Lighting Global equipment standards and quality requirements are in place. The solar companies that have been awarded licenses to participate in the CIZO program already utilize quality-certified solar products and equipment that meets international standards.

1.3.4.4 Concession Contracts and Schemes

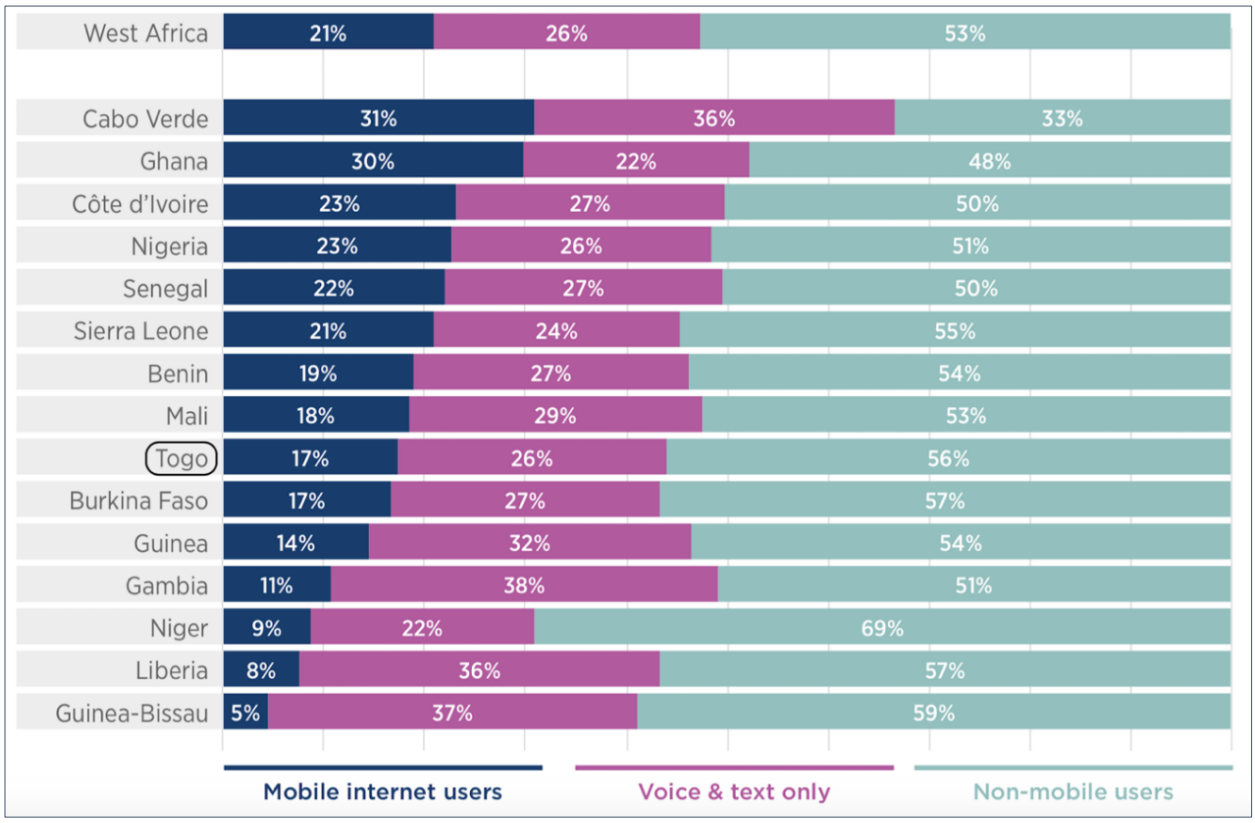
The GoT has pursued an innovative approach to achieve its electrification objectives, as it has granted licenses to private solar companies to deliver a pre-specified volume of solar kits / SHS to the market within a fixed time period. Given its unique size, Togo does not have any geographic concession areas assigned to market participants – they are allowed to operate country-wide.

1.3.4.5 Specific Business Model Regulation

The incorporation of IT infrastructure is a key pillar of the CIZO rural electrification program, as the Government will set up a national network of mobile money agents to enable PAYGO for the solar kits in even the most remote areas. BBOXX is also partnering with La Poste, Togo's postal company, to take advantage of its extensive network in rural areas of the country to distribute its solar products. As was demonstrated in East Africa in recent years, the proliferation of mobile money platforms can rapidly facilitate energy access. Recent data suggests that there is an opportunity for the Government to build on the CIZO program and continue to take advantage of the country's rapidly growing mobile internet usage (**Figure 16**) and high rates of mobile phone ownership in rural areas (**Figure 17**).

[86] "Togo's rural electrification programme obtains funding," ESI-Togo, (2017): https://www.esi-africa.com/Togos-rural-electrification-programme/
[87] Ibid.
[88] Ibid.
[89] "Togo: Greenlight Planet," TogoFirst, (2018): https://www.Togofirst.com/en/energy/2906-1139-Togo-greenlight-planet-to-provide-populations-300-000-solar-kits-by-2022

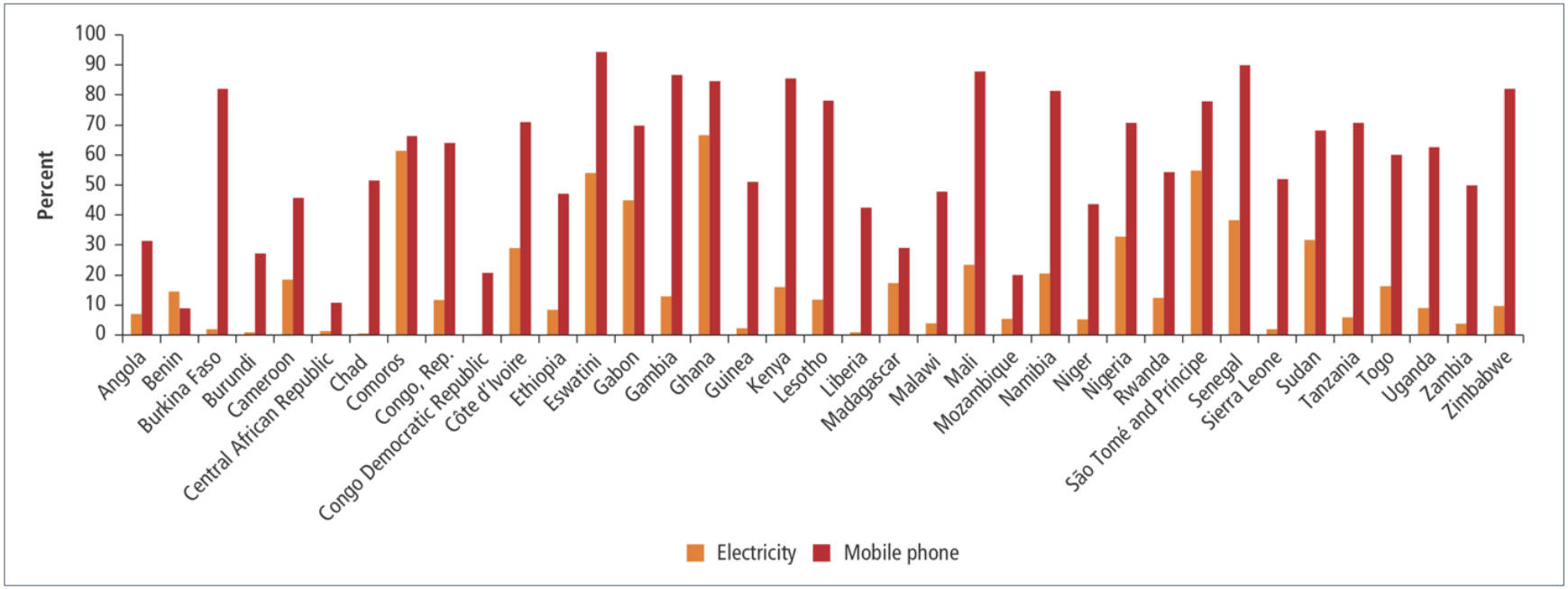
Figure 16: West Africa Mobile Internet Penetration Rates, 2017[90]



Source: GSMA Intelligence

[90] "The Mobile Economy: West Africa 2018," GSMA Intelligence, (2018): https://www.gsmaintelligence.com/research/?file=e568fe9e710ec776d82c04e9f6760adb&download

Figure 17: Electricity Access and Mobile Phone Ownership in Sub-Saharan Africa, 2016 (% of rural households)[91]



Source: World Bank

[91] Blimpo, M., and Cosgrove-Davies, M., "Electricity Access in Sub-Saharan Africa: Uptake Reliability and Complementary Factors for Economic Impact," AFD and World Bank, (2019): https://openknowledge.worldbank.org/bitstream/handle/10986/31333/9781464813610.pdf?sequence=6&isAllowed=y

1.3.5 Capacity Building and Technical Assistance

At the institutional level, the Togo Electrification Strategy has established a clear roadmap for the country's development of the off-grid sector and has successfully encouraged private sector participation. Yet, there are still a range of technical and financial challenges that need to be overcome to ensure the GoT meets its rural electrification targets. Local FIs and MFIs will need incentives and support to develop and implement new financial products and administrative procedures to lend to the off-grid sector. Local technical capacity of the solar sector will need to be developed to ensure long-term O&M services are available and sustainable. Above all, financing and TA will be critical for all market actors – government, financial institutions, end-users, suppliers and service providers – in order to accelerate growth. **Table 7** identifies some of the policy/regulatory challenges facing off-grid market development in Togo and the proposed mitigation measures/TA interventions to overcome these gaps.

Table 7: Gaps in the Off-Grid Policy and Regulatory Framework[92]

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
1. Specific National Policies, Laws and Programs	A. Renewable Energy and Electricity Law	a. Help Government implement legal framework that is flexible and helps create appropriate incentives for private sector participation in off-grid market development (e.g. to expedite electricity market liberalization)[93]
2. Financial Incentives (import duties, taxes, etc.)	A. Insufficiently supportive financial incentives / tax regime	a. Help Government expand existing financial incentives[94] to cover the entire off-grid stand-alone solar product supply chain, including batteries, inverters or other system components to provide necessary support to the industry b. Help Government establish a Special Task Force (within AT2ER) to (i) mitigate potential difficulties in customs clearance and import logistics, and (ii) oversee implementation of tax exemptions by coordinating with all relevant agencies and regulatory bodies involved (i.e. Agence Togolaise de Normalisation, ATN) c. Help Government introduce appropriate grant and subsidy schemes which require private funding matches and are predictable and not overly bureaucratic d. Help Government create PPP schemes to share high project development and market entry costs particularly with developers in remote areas e. Help Government analyze where fossil fuel subsidies serve as an impediment to development of clean energy solutions

[92] "Government" as it is used throughout this table refers to the main public institutions, officials and policymakers responsible for planning, management and regulation of the energy sector in Togo (**Table 2**), including the Ministry of Energy and Mines (MME), the Electricity Sector Regulatory Agency (ARSE), the Togolese Rural Electrification and Renewable Energy Agency (AT2ER), and the national utilities, CEET and CEB (also of Benin), among other national and local authorities.
[93] The GoT adopted a new Renewable Energy Law in 2018.
[94] The GoT has implemented a 30% import tax exemption for solar equipment

3. Standards and Quality	**A. Insufficient Market Data**	a. Help Government establish a Special Task Force (e.g. through the AT2ER) responsible for collaborating with the private sector to compile and regularly update a database of critical off-grid market data (including inter alia solar product imports, costs, sales volumes, resource potential etc., GIS data and other key demographic and socioeconomic indicators) that can be (i) utilized by policymakers to make informed electrification planning decisions based on accurate/updated market information, and (ii) made easily accessible to interested off-grid developers, investors and other key industry stakeholders.
	B. Unclear / lack of quality standards	a. Help Government enforce implementation of international quality standards for off-grid stand-alone solar products, including minimum technical standards (IEC Technical Specifications), warranties, required availability of and cost guidelines for post-sale services/O&M, etc.[95] b. Help Government integrate standards with appropriate oversight agencies to ensure quality-verification procedures are in place c. Help Government implement a legal framework that enables companies or public authorities to prosecute those caught distributing counterfeit or poor-quality products that are not up to promulgated standards
	C. Lack of capacity of local technical sector (solar PV technicians, installers, services providers etc.)	a. Support establishment of technical certification and vocational training programs through government, private sector, and/or academia for installation and maintenance of stand-alone solar systems (through AT2ER) b. Support development of database of best practices / information sharing to ensure skills transfer from international, local and regional initiatives (through AT2ER)
	D. Insufficient attention of private companies to environmental/social standards and community engagement	a. Assist private sector and/or civil society organizations to ensure environmental/social standards are in place b. Assist in development of strategies encouraging inclusive gender participation c. Support with implementation of a repair and recycling framework for off-grid solar systems and equipment
	E. Insufficient public awareness	a. Support Government trade associations and civic society organizations to develop and implement consumer awareness/marketing/education programs on the benefits of solar products and the existence of related national programs (i.e. CIZO program) b. Support development and implementation of programs to educate consumers, retailers and distributors on the benefits of quality certified solar products vs. counterfeit products

[95] Solar companies participating in the CIZO program are already distributing quality-certified products

4. Concession Contracts and Schemes	**A. Lack of clear and transparent licensing and permitting procedures**	
	a. Insufficient communication and streamlining	a. Help Government develop improved systems for sharing and disseminating information to project developers and key stakeholders, including establishment of a "one-stop-shop" for national level permits and approvals and expediting of local permits
	B. Lack of understanding of emerging concession and energy services schemes for off-grid providers	
	a. Need for understanding of different SHS concession schemes	a. Help Government understand all options and models for possibilities of granting geographic concessions to private operators of SHS[96]
	b. Need for understanding of emerging models for 'Integrated Private Utilities'	b. Help Government understand and develop approaches to facilitate pilots of 'Integrated Private Utility' schemes.[97]
	c. Public procurement or public finance/budget laws that hamper deployment of energy services models for public facilities	c. Help Government develop procurement and public finance laws that will facilitate stand-alone solar system investment for public facilities (schools, health care facilities, etc.)
	d. Lack of standardized contracts for energy services provided by private system operators to public facilities	d. Help Government trade associations or civic society organizations develop model bilateral PPA and Energy Services Contracts for small scale IPPs and ESCOs to sell power or deliver energy services to public facilities (i.e. schools, health care facilities) or deliver solar street lighting services to municipalities (e.g. through private off-grid developers)
	e. Insufficient protection for stranded investments	e. Help Government develop proper procedures and guidelines to protect against stranded investments from competition among all on-grid and off-grid rural electrification approaches[98]

[96] Different models used to grant geographic concessions to SHS providers can yield wide-ranging results. Some observers have lauded approaches being used in Rwanda, Nigeria, and DRC as successful while, there has been criticism of the approach deployed in Senegal.
[97] Innovative models are emerging for entire geographic areas to be concessioned to integrated private energy services operators who may offer an appropriate mix of solutions within their franchised area (i.e. a mix of SHS, rooftop solar, specialized systems for productive use, mini-grids and micro-grids). This is being piloted by the Shell Foundation in several countries.
[98] As the off-grid sector becomes populated by a variety of different approaches, all private operators are subject to potential stranded investments "when the grid arrives" and even SHS providers can have their assets and revenues threatened when the mini-grid arrives.

5.	**Business Model Regulation**	**A. Lack of understanding about different pricing schemes and business models offered by stand-alone solar system developers**	a. Support capacity building of regulators, Government, and non-Government stakeholders about different pricing schemes[99] offered by stand-alone solar system providers to improve understanding and help avoid unnecessary interventions to regulate. b. Support regulators and off-grid enterprises to collaborate specifically on developing pricing schemes for productive use market segment (e.g. through the CIZO program)[100] c. Support off-grid entrepreneurs and telecommunications companies in building the capacity of and fostering linkages between telecommunications companies / mobile money providers and off-grid solar companies to help roll out technology platforms and PAYG business models (e.g. through the CIZO program)

Source: Focus Group Discussions; Stakeholder interviews; GreenMax Capital Advisors analysis

[99] The term "pricing schemes" used in this context refers to pricing options offered by standalone solar system providers for SHS, productive use, rooftop solar for public facilities, solar street lighting, etc. that are new, innovative and may be difficult for stakeholders to initially well understand. Whether these are PAYG, Lease to Own, electricity sales, commodity-based pricing, time of use or block pricing, the lack of understanding can often cause stakeholders to ask Government to intervene to "protect consumers" where such regulation of the market could in fact be misguided and unwarranted.

[100] The productive use segment is brand new with SHS providers, mini-grid operators and vendors specialized on a single type of SME or agricultural productive use (i.e. grain mills, water pumps, cocoa processing etc.) all grappling to arrive at attractive approaches to billing for energy services. This is an area where TA support is much needed to help all stakeholders sort out fair and practical approaches.

1.4 Development Initiatives

1.4.1 National Government Initiatives

An overview of the key Government-led initiatives in Togo's off-grid sector are presented in **Table 8**.

Table 8: National Government Off-Grid Development Programs

Project/Program	Timeline	Market Segments	Description
National electrification strategy of Togo; CEET, AT2ER	2018-2030	Grid extension, mini-grids, off-grid stand-alone solar	• The government of Togo through the support of IFC designed a national electrification strategy which aims at providing 100% electrification rate by 2030 using a combination of isolated energy systems and grid extensions.
CIZO; AT2ER	2017 - 2022	Stand-alone systems.	• The program is a partnership between the GoT and BBOXX and aims to provide electricity access to 300,000 households by 2022 through standalone systems.
AT2ER	Not yet defined	Mini-grids.	• The government plans to install 400 mini-grids to connect off-grid customers. As a start the government secured CFA 6 billion from the regional development bank (BOAD) to install 62 mini-grids.

1.4.2 DFI and Donor Programs

The main Development Finance Institution (DFI) and donor-led programs supporting development of Togo's off-grid sector are summarized in **Table 9**.

Table 9: DFI and Donor-Funded Off-Grid Development Programs

Project/Program	Sponsor	Timeline	Market Segment(s)	Description
SUNREF Afrique de l'Ouest	Agence Française de Développement (AFD)	2015 - ongoing	Energy access	• AFD provided a line-of-credit of EUR 5 million to commercial banks, namely ORABANK and Société Générale, to finance private sector green projects including energy access.
Programme Régional de Développement des Énergies Renouvelables et de l'Efficacité Énergétique (PRODERE)	Union Economique et Monétaire Ouest Africaine	2014 - 2017	Solar lighting, mini-grids, stand-alone solar systems.	• UEMOA through PRODERE implemented by SABER installed 22,000 SHS, 13,000 solar street lights and 4 mini-grids in Togo
European Union	EU	2018	Mini-grids	• EU launched a tender for a feasibility study for 300 mini-grids to support the government.
ProÉNergie	GIZ	2016 - ongoing	Mini-grids, stand-alone solar systems	• GIZ is interested in supporting 400 villages with mini-grid and 300 villages with solar home systems.
ECO-VILLLAGES	UNDP	2016 - 2018	Solar PV, stand-alone solar systems, mini-grids.	• UNPD planned to install 8 Eco-villages which is a concept aiming at bringing electricity access to rural communities and multifunctional platform for agro-processing activities
Electrifi	European Commission and Power Africa		Rural electrification, mini-grids	• ElectriFi co-financed the implementation of the Asrama Microgrid Pilot Project with Benoo Energie (operator), providing EUR 100,000 • The objective is to develop a 24-kW mini-grid, providing electricity access to 370 households and 85 businesses.

1.4.3 Other Initiatives

Outside of the Government and DFI/donor initiatives mentioned above, there are also several non-governmental organization (NGO) programs and other related initiatives in Togo's off-grid sector:

- **Young Volunteers for the Environment (Jeunes Volontaires pour l'Environnement, JVE**): JVE is planning to install a 3-kW hybrid mini-grid combining hydro and solar to electrify a rural community in Togo.
- **Entrepreneurs of Micro-Projects of Renewable Energy (Entrepreneurs de Micro-Projets d'Énergies Renouvelables, EMPER):** EMPER is planning to install 115 solar kiosks in Togo from 2018 to 2020.
- **Solar Energy Enterprises in Africa (SEEA):** SEEA is planning to install 30 mini-grids to support productive use in rural areas of Togo.
- **Mivo Energie:** Mivo supports local producers of stoves, establishes a viable distribution network, develops adapted financial solutions and organizes awareness campaigns.
- **Sun Power:** The association works in education and solar energy, on the one hand by sponsoring individual and collective orphaned children and on the other hand by carrying out solar energy projects. International workshops are organized every summer to promote cultural exchanges and show our solidarity with the poor.

II. OFF-GRID SOLAR PV MARKET ASSESSMENT

This section presents the overall market assessment for stand-alone off-grid solar (OGS) energy systems in Togo. **Section 2.1** provides an overview of the current household off-grid energy situation and estimates potential household market demand for solar energy systems. **Section 2.2** introduces institutional off-grid energy demand and the potential of solar to supply this market. **Section 2.3** evaluates the demand for off-grid solar to serve productive use applications. **Section 2.4** examines the existing off-grid solar product supply chain in the country. **Table 10** summarizes the overall total cash market potential for OGS systems from each of the analyzed market segments. **Annex 2** provides an overview of the Task 2 methodology.

It should be noted that the Task 2 market sizing assesses the total *potential* demand for off-grid solar, as well as variables that affect demand, such as changes in population density, household income, expansion of national grids and access to finance, among other factors. This data will support policymakers and practitioners as they assess market potential over time. However, the quantitative demand estimate has not been revised to reflect *realistic* market potential. Many other factors and market failures will prevent the full realization of this total market potential, and these will vary by market segment.

For household demand, the off-grid solar market is already tangible. Still, many factors will affect household demand for solar products, such as distribution realties, consumer education, competing economic priorities for households, financial shocks, etc. The institutional market will be affected largely by government and donor budget allocations along with the potential for community-based finance. The productive use market is perhaps the least concrete. Considered a relatively new market segment for the off-grid solar industry, productive use market dynamics are not yet well understood. The ability to realize potential productive use market demand will also be affected by many of the factors that commonly determine enterprise prospects in the country, including infrastructure, rural distribution, marketing, access to finance, insecurity, regulation, etc. The data presented in this report is intended to provide a baseline for future research.

Table 10: Indicative Total Cash Market Potential for Off-Grid Solar PV Products in Togo, 2018

Off-Grid Market Segment	Annualized Cash Demand (Units)	Annualized Cash Demand (kW)	Annualized Cash Market Value (USD)	Financed Market Value (USD)
Household				
Pico solar	59,330	178	$2,669,863	$7,628,179
Plug and play	1,130	11	$141,262	$13,984,995
Small SHS	0	0	$0.00	$21,189,386
Medium and Large SHS	0	0	$0.00	$423,788
Household Subtotal	**60,460**	**189**	**$2,811,125**	**$43,226,348**
Institutional				
Water supply	176	614	$1,535,063	-
Healthcare facilities	20	26	$65,025	-
Primary and secondary schools	39	23	$65,955	-
Public lighting	80	40	$119,625	-
Institutional Subtotal	**315**	**703**	**$1,785,668**	**-**
Productive Use				
SME applications for microenterprises	581	145	$363,125	-
Value-added applications	25,189	4,150	$19,123,813	-
Connectivity / ICT (phone charging)	3,450	1,380	$2,973,485	-
Productive Use Subtotal	**29,220**	**5,675**	**$22,460,423**	**-**
TOTAL	**89,995**	**6,567**	**$27,057,216**	

Source: African Solar Designs analysis

2.1 Demand – Households

This section analyzes the main characteristics of the household (HH) OGS demand in Togo. Section 2.1.1 provides an overview of the household market segment, including its geographic components. Section 2.1.2 analyzes current household ability and willingness to pay for electricity services to estimate the total potential household sector demand. From this data, the potential household market for off-grid solar products is then calculated for both cash purchases (Section 2.1.3) and financed (2.1.4) purchases. Section 2.1.5 assesses consumer perceptions, interest, and awareness on OGS.

2.1.1 Overview of Household Market Segment

According to the International Energy Agency (IEA), in 2016 there were 1.1 million households (5.1 million people) in Togo without access to electricity.[101] In that year, an estimated 35% of the population had access to electricity, with the rate of access at 74% in urban areas and 5% in rural areas. As shown in **Table 11**, because the large majority of the population does not have access to electricity, households without access are spread across the bottom three income quintiles, living in both rural and peri-urban areas.

This section gives an introduction to household consumer market segments, their characteristics and size (**Table 11**). It then discusses household sources of income and geographic distribution of off-grid households, both presently and projected over time. This provides context for the next section, 2.1.2, which sizes household segment potential market demand through a series of detailed analyses.

[101] See **Annex 2** for more details.

Table 11: Household Consumer Market Segments[102]

Income Quintile	% w/o Access	# of HHs w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# of HHs w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# of HHs w/o Access	Avg. GDP per HH per year	Energy Tier	Geographic segments	Description
	2018 Scenario				2023 Scenario				2030 Scenario					
Highest 20%	1%	3,390	$6,852	Tier 3	1%	3,522	$8,591	Tier 3	1%	4,186	$9,835	Tier 3	High income rural	• Small portion of rural households using a petrol generator set • Has a demonstrated ability to pay for solar off-grid systems
													Mid to high income urban	• Professionals, business owners and salaried people are likely to be connected to the grid. • Small portion without grid access desire replacement to generator power[103]
Fourth 20%	35%	118,661	$2,855	Tier 2	2%	7,043	$3,579	Tier 2	2%	8,372	$4,098	Tier 2	Low income peri-urban / urban "under-grid"	• Low income urban population engaged in SME work or casual labor • Lives near grid but cannot afford or does not have access to connection
Third 20%	90%	305,127	$1,779	Tier 2	3%	10,565	$2,231	Tier 2	3%	12,559	$2,554	Tier 2		
Second 20%	99%	335,640	$1,155	Tier 1.5	4%	14,087	$1,448	Tier 1.5	4%	16,745	$1,658	Tier 1.5	Low income rural	• Engaged in farming, or SME • Lives more than 15km from the nearest grid connection.
Lowest 20%	100%	339,030	$637	Tier 1	94%	331,137	$799	Tier 1	41%	171,224	$915	Tier 1		
Total Households without access to Electricity		**1,101,848**			**Total**	**366,354**			**Total**	**213,086**				

Source: IEA and World Bank; African Solar Designs analysis

[102] See **Annex 1** and **Annex 2** for more details.

[103] This model does not consider connected on-grid households that would purchase OGS systems as a back-up power system due to poor grid quality and reliability. The "households without electricity access" estimates shown here include households without electricity connections, either from a grid connection or from a renewable energy-based off-grid source. This does include "under-grid" households, largely in the lower income quintiles, that live within grid vicinity but are currently not connected. 2023 and 2030 projections assume that under-grid households will become connected in those years.

- **Off-grid household characteristics**

Togo has a high level of extreme poverty (households living below USD 1.90 a day) compared to some of its neighboring countries in West Africa. As shown in **Table 12**, the vast majority of the country's households have a low income.

Table 12: Poverty Headcount in Togo, 2015

Poverty headcount ratio	% of population
Lives at or below $1.90 a day*	49.2%
Lives at or below $3.20 a day*	73.2%
Lives at or below $5.50 a day*	90.1%

*2011 PPP

Source: World Bank

According to feedback from focus group discussion (FGD) participants, for one major OGS product distributor the bulk of customers who adopt solar kits are farmers, NGOs and state officials. Participants also mentioned agricultural processors and pastoralists. Household incomes are very often seasonal because the populations do not have the control of water to make the crops against seasons.

The poverty index (indicators of household incomes) in Togo decreases when one leaves the maritime region in the South by going to the savannah region in the North. However, according to the experiences of OGS suppliers, the populations of the North are better with payment than the populations of the South. The populations across the country are unanimous that the prices of the solar products are expensive compared to their income.

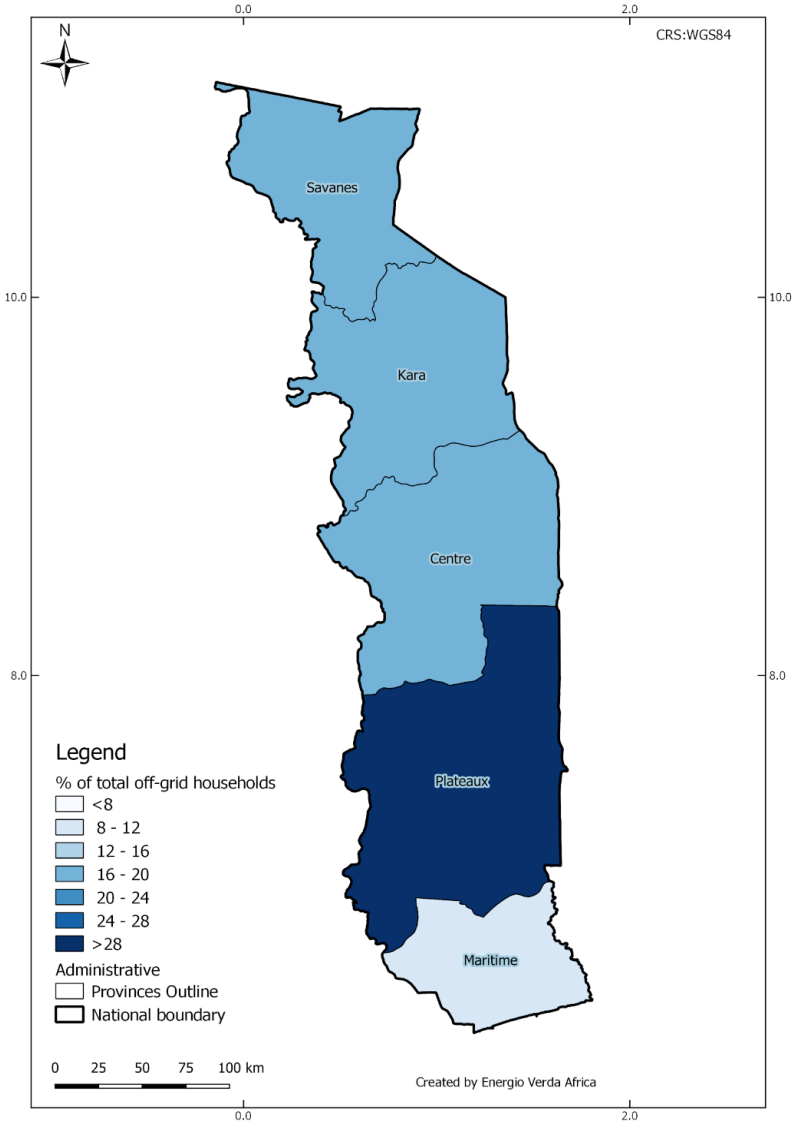
- **Geographic Components of the Solar Market**

The total number of off-grid households and their geographic distribution will change significantly over time. To analyze the potential OGS market over time, GIS maps were prepared from demographic information to present potential market areas for OGS. GIS calculations consider drivers of off-grid household market change including grid extension around current urban and peri-urban centers, mini-grid development for more densely populated rural areas, and population growth. Sources of information for the maps presented below (**Figures 18-21**) can be found in **Annex 1**.

GIS maps shown here are for 2018-2023 and 2030. Data shown for 2018-2023 includes information on existing grid lines only. The data of planned "future lines" is not broken down in enough detail to show in which year future lines will be built, so an assumption was made that all future lines would be built after 2023 but prior to 2030.

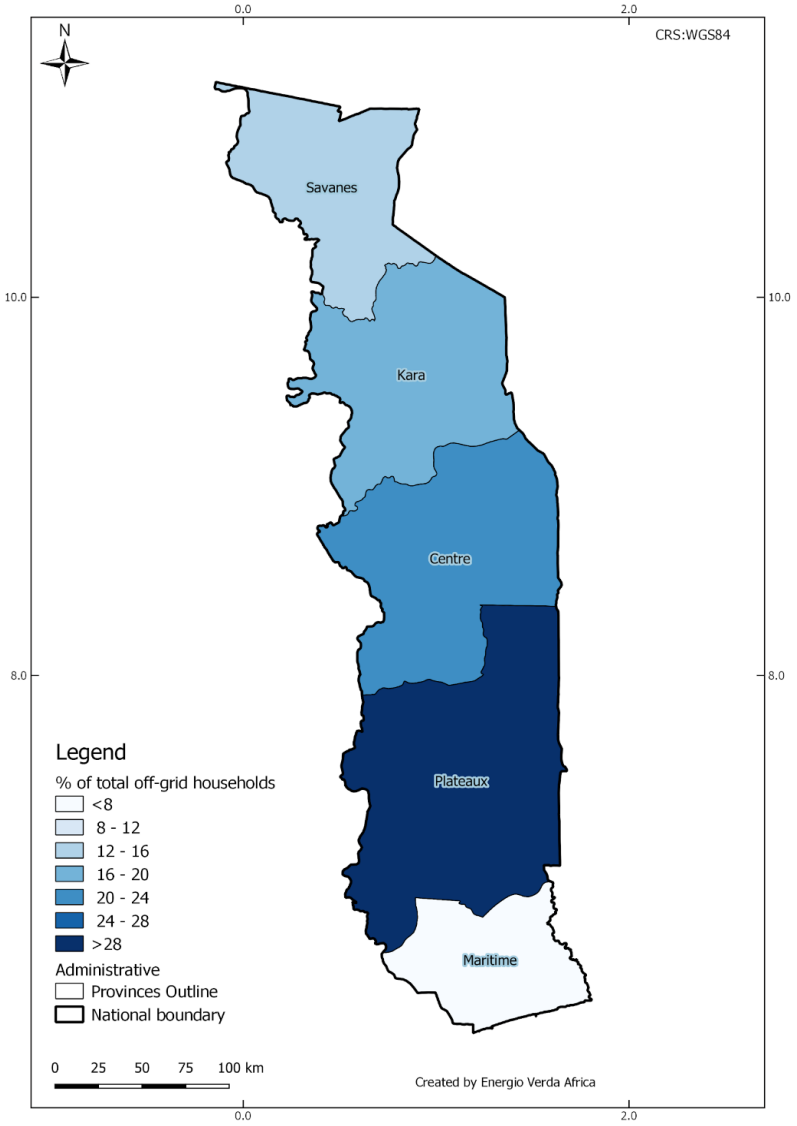
As shown in the maps and chart summaries below (**Figures 18-21**), the total size of the OGS market will decrease over time, while also becoming somewhat more concentrated in remote regions. In all years, the Plateau region remains the most important market for OGS products in terms of number and concentration of off-grid households. This consistency should support development of OGS distribution networks in that district over time.

Figure 18: Distribution of Potential Off-Grid Households by Region, 2023



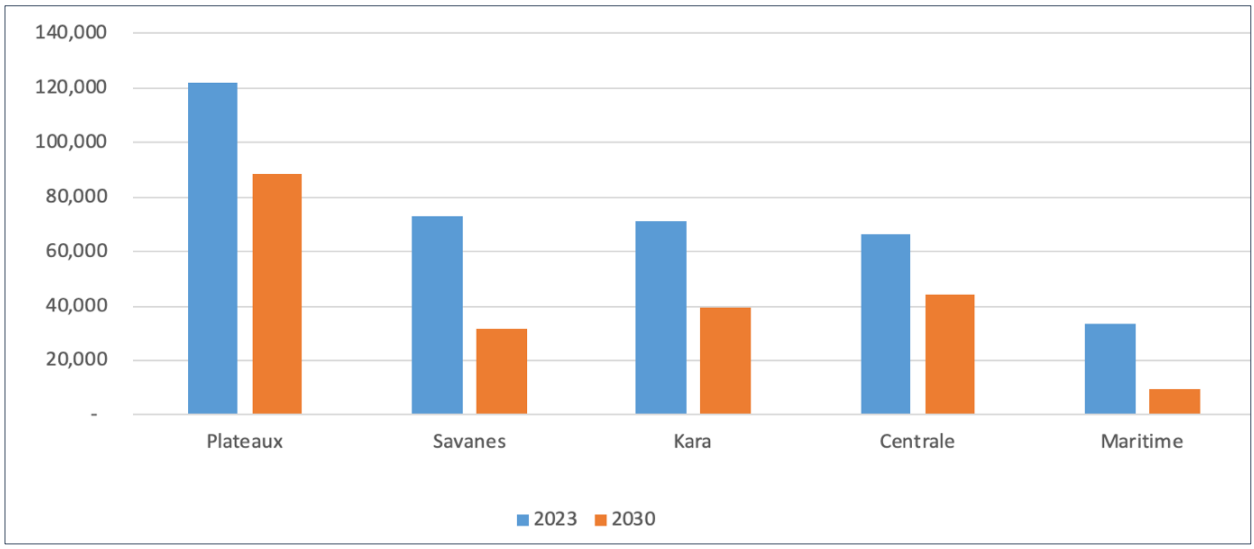
Source: Energio Verda Africa GIS analysis

Figure 19: Distribution of Potential Off-Grid Households by Region, 2030



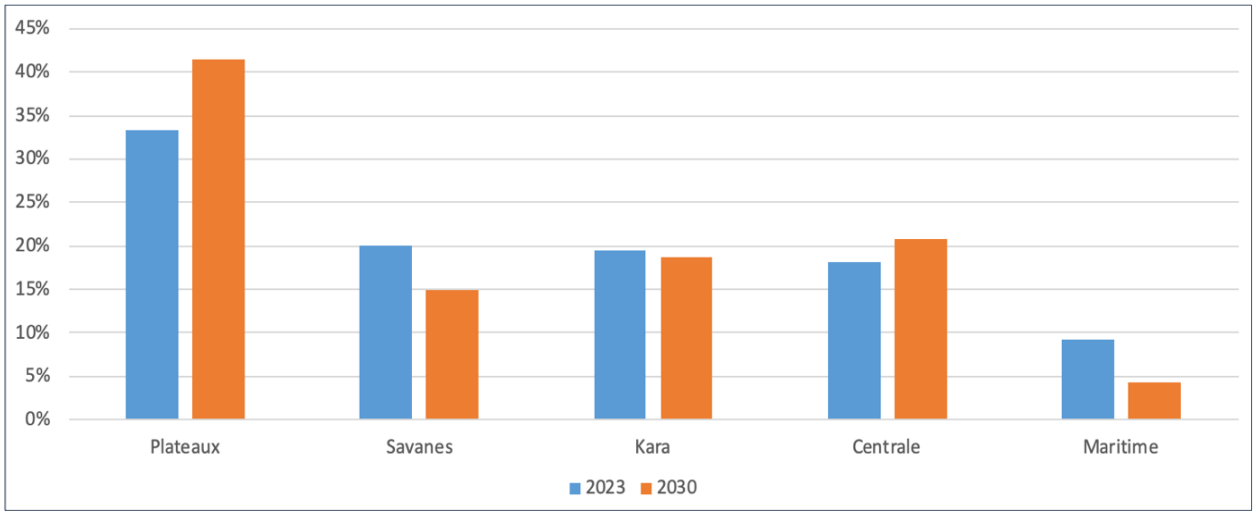
Source: Energio Verda Africa GIS analysis

Figure 20: Estimated Number of Off-Grid Households by Region, 2023 and 2030



Source: Energio Verda Africa GIS analysis

Figure 21: Estimated Percentage of Off-Grid Households by Region, 2023 and 2030



Source: Energio Verda Africa GIS analysis

2.1.2 Analysis of Household Market Segment Demand

In order to calculate total potential household demand for off-grid solar products for the national market, this section analyzes several things:

- Household usage and costs of typical rural energy fuels and devices (non-solar)
- How these rural energy technologies align with typical access to "energy tiers"
- Cost of off-grid solar products alternatives, by energy tier
- Household uptake of solar products thus far
- Potential household demand based on household income quintiles

From this data, the potential household market for off-grid solar products is then calculated at the end of this section for both cash purchases and financed purchases.

➢ **Consumption and expenditures on typical rural energy fuels and devices (non-solar)**

According to FGD feedback, common sources of electricity used in off-grid rural households include lamp-torches, lanterns/storm lamps and candles. Typical household monthly energy expenditure is approximately USD 1.34 / week, or about USD 5.36 / month, according to studies conducted in 250 households in Togo. These amounts take into account all household energy expenditure, namely the lighting and recharging of mobile phones. However, some participants felt that the amount could be reduced to USD 1 / month for poor households that depend only on flashlights for lighting. This data mainly concerns the purchase of batteries for flashlights and recharge of mobile phones.

Focus group participants indicated that most households at the bottom of the pyramid (BoP) use flashlights and lanterns for lighting and mobile phones to communicate. The most affluent households have generators they use on occasion. The average cost of diesel fuel for generator sets is about USD 1 / liter.

Table 13 shows the typical monthly cost of using common rural energy technologies. Household use of different types and amounts of energy technologies is associated with different energy access tiers, as defined in the Multi-Tier Energy Access Framework. For example, a household using one battery powered lantern and one charged cell phone would fall under the Tier 1 level of energy access. A household using two lanterns, one cell phone and a radio would be in Tier 1.5.

These tiers are defined in **Table 14**. Establishing an average monthly household expenditure for each energy tier using common rural technologies shows how household income level aligns with energy tiers. Secondly, it provides a basis to compare these costs to solar products that can offer an equivalent level of service by energy tier. This in turn reveals potential household savings by switching to solar products, as shown in **Figure 22** and **Table 15**.

It should be emphasized that even where households can be categorized into energy tiers by their income, few households actually pay full typical monthly costs because they do not have the available income. In reality, household income is highly variable throughout the year, and they simply do without service for portions of the month and year when cash is not available. This accounts for the difference between "typical monthly costs" (which are real) and "equivalent service costs" (which would be required to maintain the tier-level service). For example, very few households could actually run generators for the number of hours that would enable full tier 3 level services.

Table 13: Rural Energy Technology and Costs[104]

Technology	Details	Average Life (Years)	# of Units/ Month	Unit Operating Cost (USD)	Unit Capital Cost (USD)	Typical Monthly Cost (USD)	Unit Capital Cost (USD)	Typical Monthly Cost (USD)	Unit Capital Cost (USD)	Typical Monthly Cost (USD)
					2018 Scenario		2023 Scenario		2030 Scenario	
Torch lights/Electric Lanterns	Torch lights/electric lanterns powered by D-type, AA-type or AAA-type batteries	0.5	16	$0.16	$2.00	$2.56	$2.19	$2.80	$2.69	$3.44
Cell Phone Charging	Done at a charging station	-	8	$0.17	$0.00	$1.36	$0.00	$1.49	$0.00	$1.83
Smart Phone Charging	Done at a charging station	-	16	$0.17	$0.00	$2.72	$0.00	$2.97	$0.00	$3.66
Battery-powered DC Radio	Radio powered by dry cells replaced two times per month	-	8	$0.16	$0.00	$1.28	$0.00	$1.40	$0.00	$1.72
Small Petrol Generator	The most popular rural generator for basic use is 0.9kW generator (for phone charging, lighting, TV, fan and music system)	2	30	$0.94	$100.00	$28.20	$109.30	$30.81	$134.39	$37.90

Source: African Solar Designs analysis

[104] Data from FGDs, field surveys and various published data sources

Table 14: Typical Tier-Based Energy Costs

Device category and indicative energy supplied	Appliances and level of service	Non-solar devices used to power tier requirement	Typical Monthly Cost (USD) 2018	Typical Monthly Cost (USD) 2023	Typical Monthly Cost (USD) 2030
Tier 0 No electricity	• Characterized by complete lack of electricity services • Many cash-poor consumers are in this situation part of each month when they don't have money to buy dry cells or charge phones	• Rely solely on kerosene, wood and other fuel sources for cooking and lighting	• Subsistence level of energy • Absolute energy poverty	• Subsistence level of energy • Absolute energy poverty	• Subsistence level of energy • Absolute energy poverty
Tier 1 Range: 1 to 20 Wh/day	• Access to one torch powered by dry cell batteries • One cell phone powered by charging service	• One battery-powered light requires dry cell replacement on weekly basis • One cell phone charged 8 times per month	$3.92	$4.28	$5.27
Tier 1.5 Range: 20 to 100 Wh/day	• Access to one torch and one lantern each powered by dry cells • One cell phone powered by charging service • Radio powered by dry cells	• Two battery-powered light points require dry cell replacement on weekly basis • One cell phone charged 8 times per month • Radio dry cells replaced two times per month	$7.76	$8.48	$10.43
Tier 2 Range: 55 to 500 Wh/day	• One torch and two lanterns powered by dry cells • One cell phone and one smart phone powered by charge service • Radio • DC TV	• Three battery light points require dry cell replacement on weekly basis • One cell phone charged 8 times per month and one smart phone charged 16 times per month • TV/Radio powered by lead acid battery recharged once per week	$14.32	$15.65	$19.24
Tier 3 Range: 500 to 2500 Wh/day	• Five lighting points • Multiple cell/smart phones • AC radio and music system • AC TV	• Generator powers a set of appliances	$28.20	$30.81	$37.90

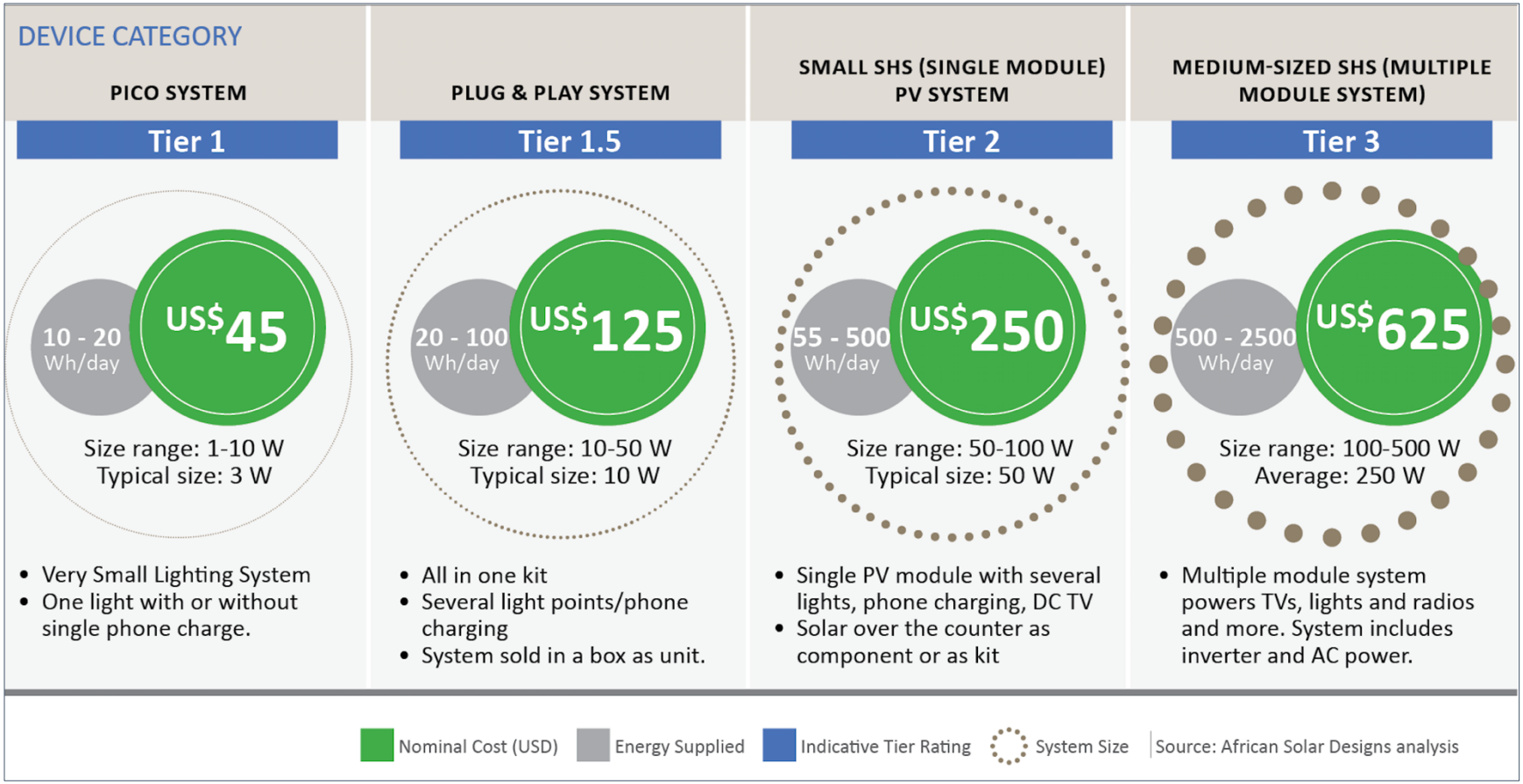
Source: African Solar Designs analysis

Per **Table 14**, it can be seen that, given the purchase price of dry cells and the cost of phone charging, the "ideal" electricity availability is extremely difficult to sustain. This is especially true where there is a high incidence of poverty in rural areas and lack of regular incomes. In reality, households often must reduce their energy consumption when cash is not available. This means that even a Tier 2 level family might drop to Tier 1 for a week each month when cash is not available to pay for phone charging or dry cell purchase.

- **Household Solar PV System Types**

Solar PV systems can provide lower cost and higher levels of service than existing dry cell, phone charging and generator options. In order to model how solar systems can meet existing energy use categories, levels of service and ability to pay, four types of household solar systems are configured to match the tier-based demands of off-grid communities. The system descriptions, energy outputs, prices, tier ratings and target consumer groups are listed in **Figure 22**.

Figure 22: Household PV System Descriptions and Market Segments



Source: African Solar Designs analysis

- **Current usage and procurement process for household solar products**

There are five economic regions in Togo, but none is more favored than the others and all regions are covered by government projects. However, according to private sector actors, the Plateau, Kara and Savanna regions are the most active in the adoption of solar kits by households.

Solar kit suppliers are present throughout the entire territory. For example, BBOXX today has two sales outlets in the five regions of Togo, but this will have to evolve at four points of sale by the end of 2018 and finally have sales outlets in all the prefectures of the country.

There are currently no studies on the distribution of use of solar kits among populations. But according to BBOXX, the regions covered by their facilities are in descending order: Plateau region, Savannah region and Central region.

- **Potential household demand for off-grid solar products**

Looking beyond current use of off-grid solar products by households, this study analyzes potential for OGS market development by estimating potential household demand based on household income. Household income shown in **Table 15** is sourced from World Bank demographic data based on household surveys, which reports income by population quintiles. From household income, potential for energy spending is estimated as 10% of monthly income (see methodology annex). Future scenarios project higher energy budgets as household incomes rise with economic development over time. In all scenarios, the large majority of off-grid households will fall under the lowest income quintile.

Table 15: Energy Expenditure of Different Income Groups

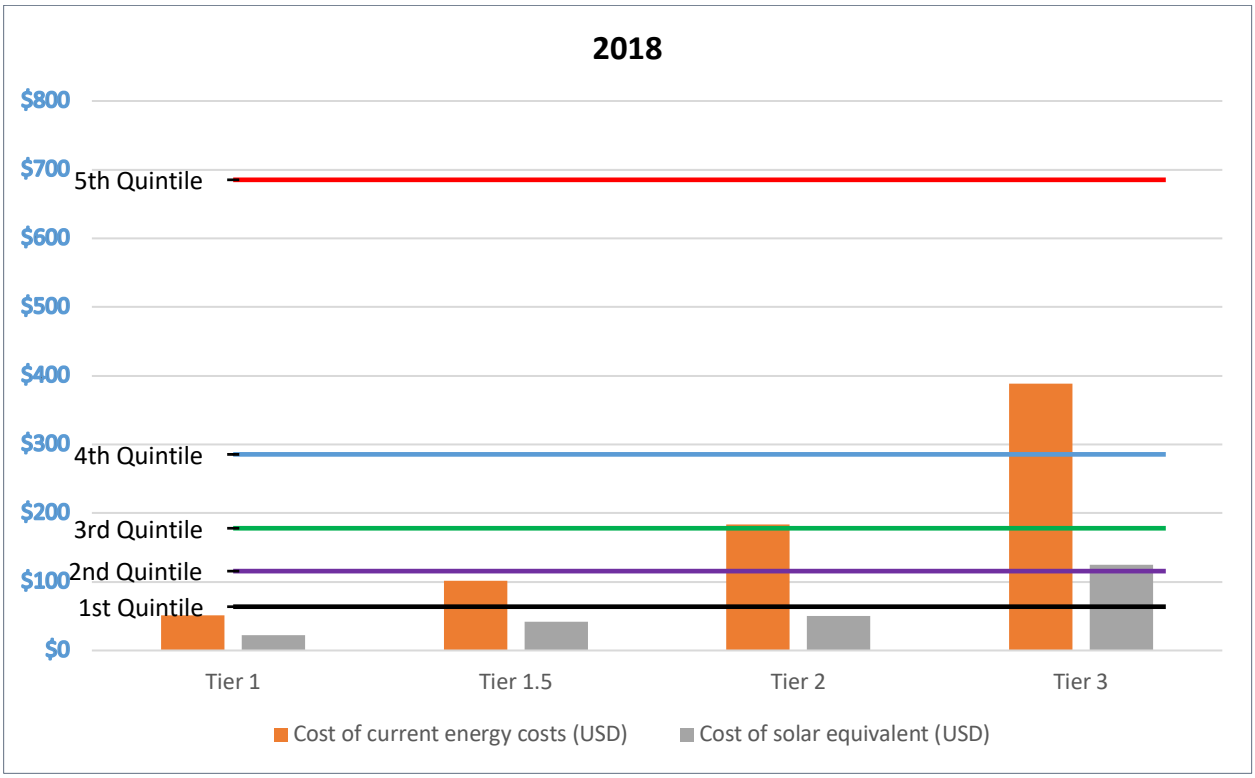
Population Income Quintiles	Per Capita Income (USD per month)	Household Income (USD per month)	Energy as % of Income	Monthly Energy Budget (USD)
2018 Scenario				
Lowest Quintile of Population	$11.55	$53.12	10%	$5.31
2nd Quintile of Population	$20.93	$96.28	10%	$9.63
3rd Quintile of Population	$32.24	$148.29	10%	$14.83
4th Quintile of Population	$51.72	$237.93	10%	$23.79
Highest Quintile of Population	$124.14	$571.03	10%	$57.10
2023 Scenario				
Lowest Quintile of Population	$14.48	$66.59	10%	$6.66
2nd Quintile of Population	$26.24	$120.70	10%	$12.07
3rd Quintile of Population	$40.41	$185.91	10%	$18.59
4th Quintile of Population	$64.84	$298.28	10%	$29.83
Highest Quintile of Population	$155.63	$715.88	10%	$71.59
2030 Scenario				
Lowest Quintile of Population	$16.57	$76.24	10%	$7.62
2nd Quintile of Population	$30.04	$138.18	10%	$13.82
3rd Quintile of Population	$46.27	$212.83	10%	$21.28
4th Quintile of Population	$74.24	$341.49	10%	$34.15
Highest Quintile of Population	$178.17	$819.57	10%	$81.96

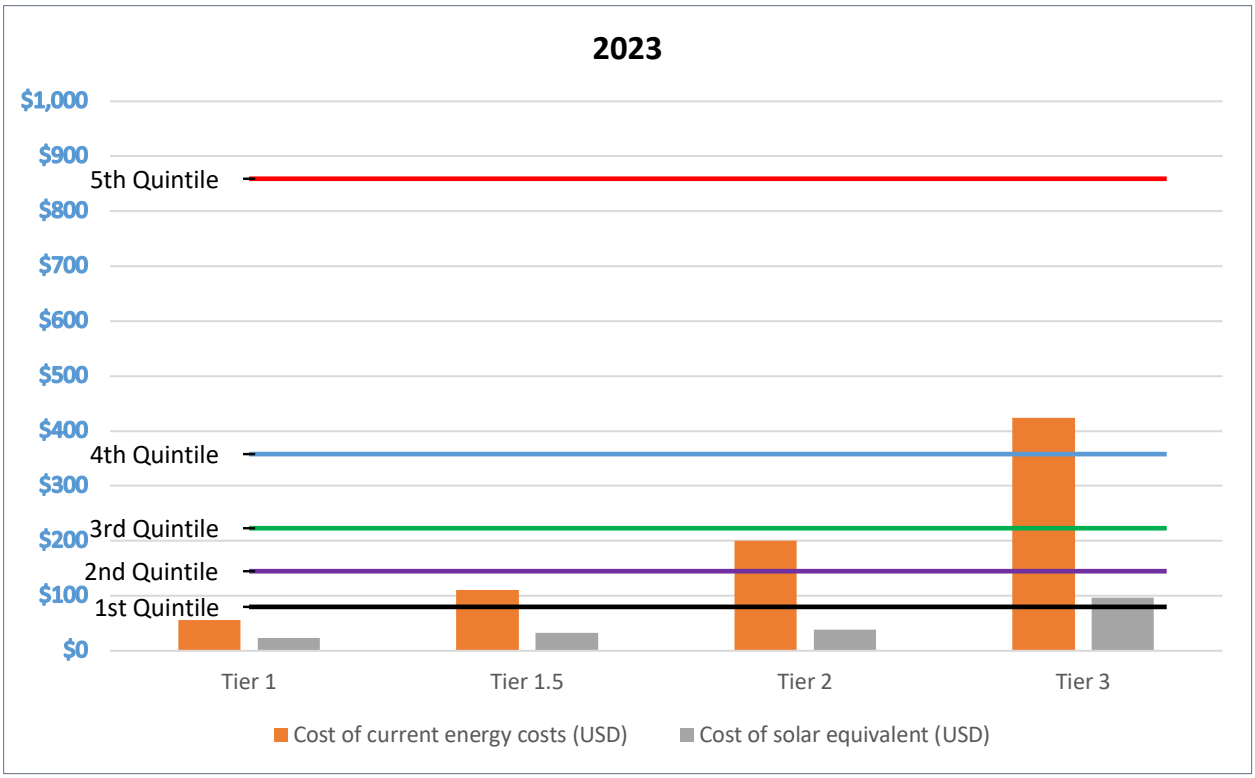
Source: African Solar Designs analysis

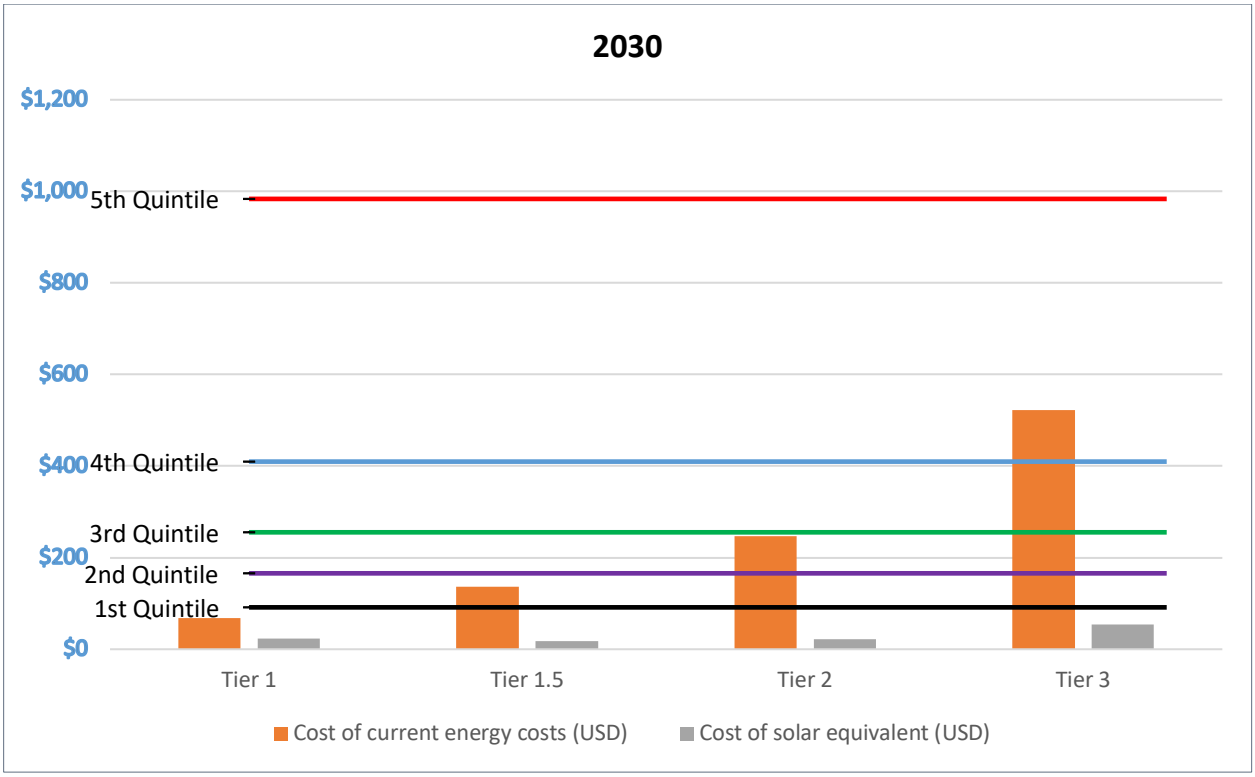
Figure 23 summarizes the preceding data in this section by comparing household energy spending with typical rural energy costs and their solar equivalents. This analysis presents annualized costs (not including financing cost) of current energy technologies for each energy tier, compared with the annual cost of an equivalent solar product. Both the annual costs of current energy technologies and equivalent solar solutions consider the capital costs of the units, and the operating costs considered over the average unit life times.

The data clearly shows strong potential savings for households to switch to solar products. Affordability also increases over time, as the cost of solar technology reduces, while the cost of traditional energy sources increases with inflation, and household income increases. Affordability here is shown by comparing annual income and energy costs over the life of a product. This indicates the need for short term financing, as many households still struggle to pay up front unit capital costs to achieve subsequent savings.

Figure 23: Annual Household Energy Budget by Quintile, Annual Energy Costs and Cost of Solar Equivalents







Source: African Solar Designs analysis

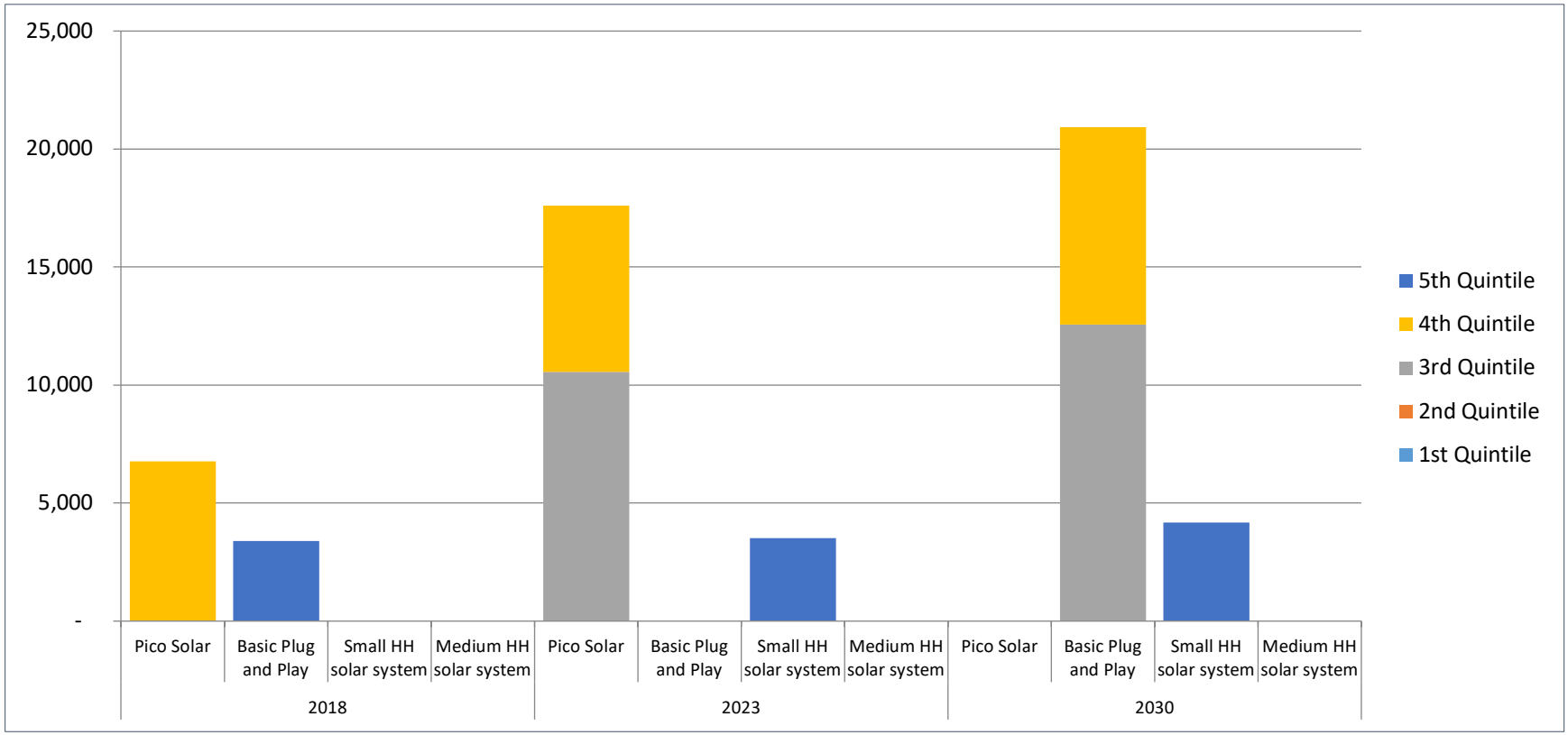
2.1.3 The Market for Household Devices without Consumer Finance

This section analyzes the cash market for various income levels and the corresponding energy services powered by OGS systems they can afford. Modelling of the viable market was based on income quintiles associated with data from the World Bank. The calculations and assumptions made are presented in **Table 15**. It was assumed that for a cash purchase a household is willing to save three months of their current energy expenditure to purchase the OGS system.

Based on the income quintiles and corresponding estimated current energy expenditure, in the 2018 scenario, only households without electricity access in the highest income quintiles – 4, 5 – can afford a solar product unfinanced. This represents a very small number of off-grid households. Affordability increases significantly over time. However, the need for financing solutions for almost all income quintiles is clear.

The model assumes that each household purchases only one system. It also does not consider on-grid households that would purchase OGS systems as a back-up power system due to poor grid quality and reliability. This market has become a key segment of the more mature OGS markets (e.g. in East Africa), but is not the focus of this study, which is based on sizing the current markets in West Africa, alongside a least cost analysis for future access to energy that prioritizes reliable grid connections where possible.

Figure 24: Estimated Number of Households Able to Afford Cash Purchase of OGS Systems by Income Group



Source: African Solar Designs analysis

Table 16 presents the estimated annualized cash market potential for off-grid solar product sales in the country's household sector.

Table 16: Estimated Cash Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
2018 Scenario			
Pico Solar	59,330	178	$2,669,862
Basic Plug and Play	1,130	11	$141,263
Small HH solar system	0	0	$0.00
Medium HH solar system	0	0	$0.00
Total	**60,460**	**189**	**$2,811,125**
2023 Scenario			
Pico Solar	8,804	26	$402,999
Basic Plug and Play	0	0	$0.00
Small HH solar system	704	35	$136,747
Medium HH solar system	0	0	$0.00
Total	**9,508**	**61**	**$539,746**
2030 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	6,977	70	$375,448
Small HH solar system	837	42	$90,108
Medium HH solar system	0	0	$0.00
Total	**7,814**	**112**	**$465,556**

Source: African Solar Designs analysis

The following considerations should also be taken into account when analyzing this data:

- The most common type of systems which the market can afford on a cash basis are pico and small plug and play systems. Based on available income figures Tier 2 and Tier 3 solutions are less viable for the vast majority of the population in the near term. However, this picture changes significantly with the introduction of financing.
- The model does not adequately address highest quintile and actual sales in the market. Note that the analysis does not predict purchases of Tier 3 equipment and it does not reflect what is happening at the extreme high end of the market. Because the analysis divides the population into relatively wide quintiles, it does not adequately address the very small portion of apex rural (and peri-urban) customers that now use generators.

2.1.4 The Financed Market for Off-Grid Solutions

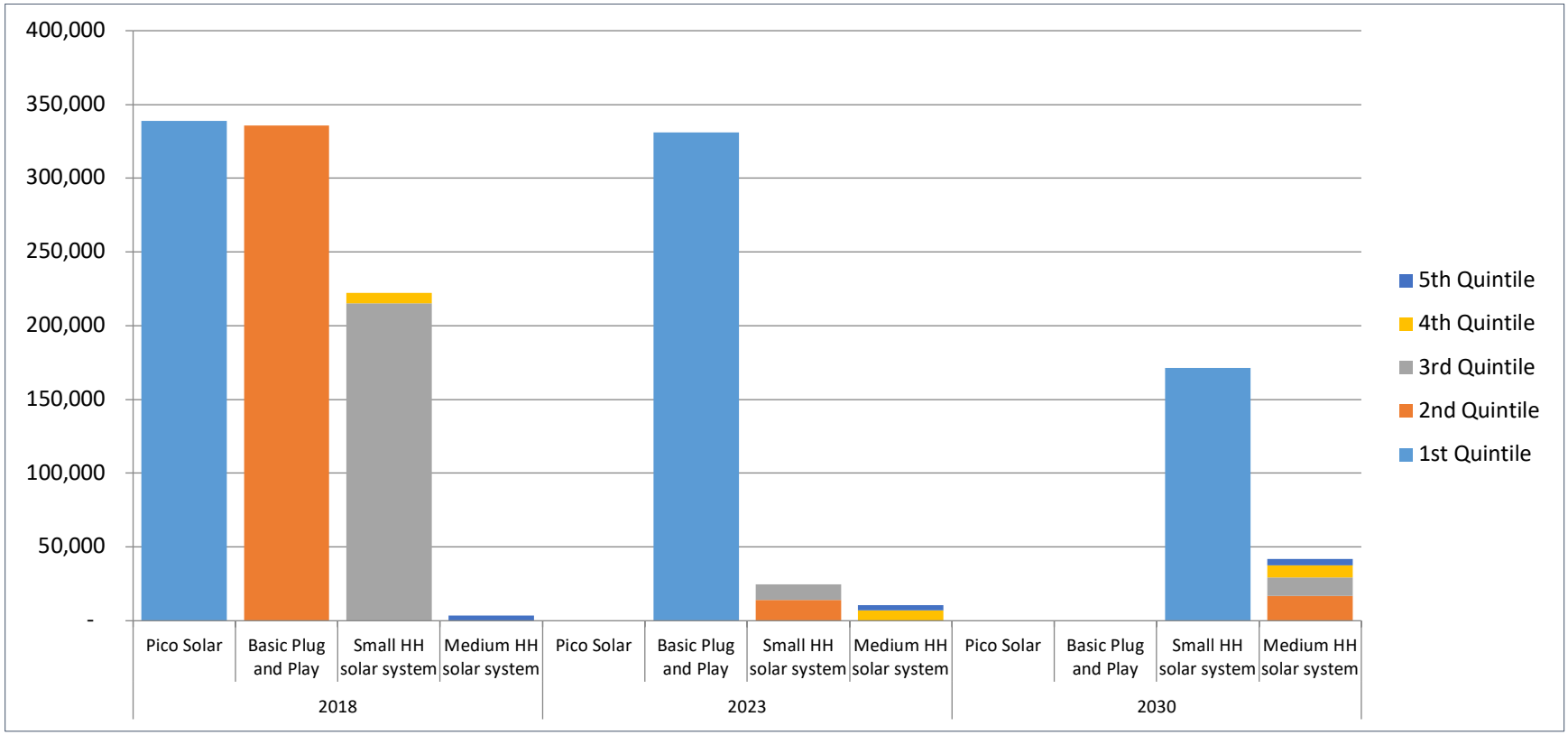
- **Financial Model**

In order to portray the effects of finance, a simple model was prepared that provides OGS system finance with a 24% p.a. interest rate[105] and a 24-month term. The financial model assumes that the households would be willing to save for three months of their current energy expenditure to cover a small upfront deposit of 10% of the system and their current energy expenditure would be used to pay the monthly installments.

This model assumes that each household will purchase the system that offers the highest energy serve level they can afford. As with the cash market model, it assumes that each household purchases one unit each. However, this finance model greatly over-estimates the potential market for credit as both MFIs and PAYG companies would likely be extremely cautious in approving customers. Without concrete data on the loans given to consumers in each income quintile in the country, it is difficult to estimate what the more realistic figures are. Nevertheless, this model does give a clear indication that long loan tenors combined with a low upfront payment would result in significant market transformation. The results of this analysis are presented below.

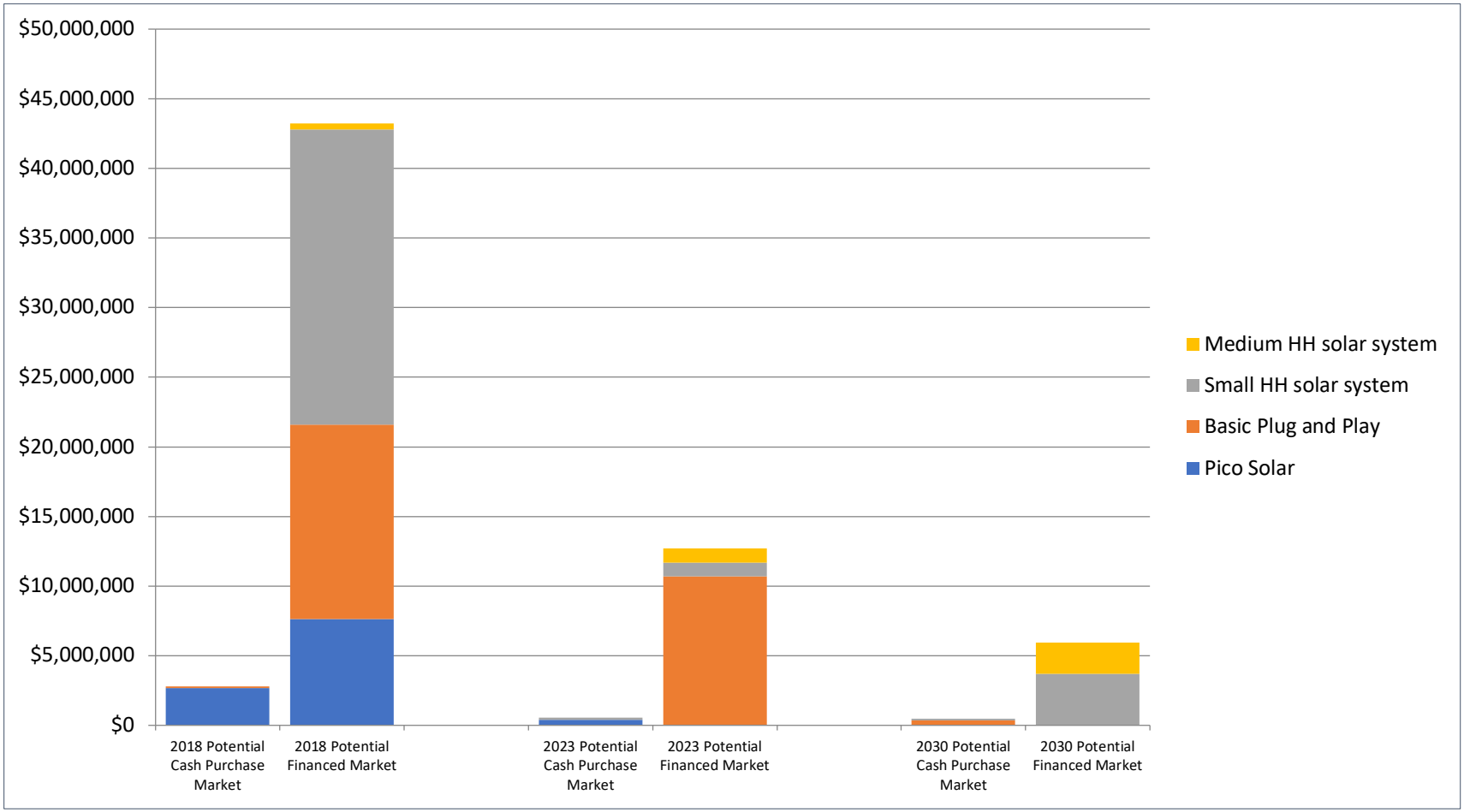
[105] Ferrari, A., Masetti, O., Ren, J., "Interest Rate Caps: The Theory and the Practice," World Bank Policy Research Working Paper, (April 2018): http://documents.worldbank.org/curated/en/244551522770775674/pdf/WPS8398.pdf

Figure 25: Estimated Number of Households Able to Afford Financed OGS Systems by Income Group



Source: African Solar Designs analysis

Figure 26: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type



Source: African Solar Designs analysis

In 2018, without financing, 122,051 households (11.1% of households without electricity access) in the country could afford an OGS system. However, with financing, 1,101,848 households (100% of households without electricity access) could afford an OGS system as the 979,797 households without electricity access in the three lowest income quintiles are enabled to acquire at least one OGS system. Consequently, the annualized potential market size increases from USD 2,811,125 to USD 43,226,347 (**Figure 26**).

The least-cost electrification scenario 2023 calculates that 366,354 households could be electrified by stand-alone systems. Under this scenario, with financing, the number of households with the ability to acquire at least one OGS system increases from 21,130 (5.8% of households without electricity access) to 366,354 (100% of all households without electricity access) as the 345,223 households without electricity access in the two lowest income quintiles are enabled to acquire at least one OGS system. The annualized potential market size increases from USD 539,746 to USD 12,697,680 (**Figure 26**).

The least-cost electrification scenario 2030 calculates that the total number of households that could be electrified by stand-alone systems would drop to 213,086. Under this scenario, with financing, the number of households with the ability to acquire at least one OGS system increases from 25,117 (11.8% of households without electricity access) to 213,086 (100% of all households without electricity access) as the 187,969 households without electricity access in the two lowest income quintiles are enabled to acquire at least one OGS system. The annualized potential market size increases from USD 465,556 to USD 5,938,235 (**Figure 26**).

Table 17 presents the estimated annualized financed market potential for off-grid solar product sales in the country's household sector.

Table 17: Estimated Financed Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
2018 Scenario			
Pico Solar	169,515	509	$7,628,179
Basic Plug and Play	111,880	1,119	$13,984,995
Small HH system	84,758	4,238	$21,189,386
Medium HH system	678	170	$423,788
Total	**366,831**	**6,036**	**$43,226,348**
2023 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	110,379	1,104	$10,714,853
Small HH system	4,930	247	$957,227
Medium HH system	2,113	528	$1,025,600
Total	**117,422**	**1,879**	**$12,697,680**
2030 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH system	34,245	1,712	$3,685,544
Medium HH system	8,372	2,093	$2,252,690
Total	**42,617**	**3,805**	**$5,938,234**

Source: African Solar Designs analysis

2.1.5 Consumer Perceptions, Interest and Awareness

- **Purchasers of solar are "early adopters" who tend to buy from system integrators as well as hardware traders**

  - **Retail purchasers**: Most purchases are made over-the-counter sales in capital and major cities as cash purchases. As with the consumer migration from kerosene to electric lights, there is a gradual migration from low cost dry-cell electric lamps to solar PV systems. Consumers make purchases in the same shops, and sellers are adapting to changes in demand by offering solar equipment.
  - **High-end consumers**: As elaborated in **Section 2.4**, a small number of early adopting consumers buy from specialized solar integrators who offer quality services and components. A large portion of buyers in this segment opt for systems above 200Wp for residential and small business demand.
  - **PAYG**: As the PAYG market segment is still in its nascent stages, detailed data of PAYG customers is still largely unavailable, although recent experience from East Africa suggests that these customers include both rural and peri-urban inhabitants. The PAYG business model / method is still not widely understood; moreover, there are still questions about how to account for the seasonality of incomes as opposed to regular monthly payment plans.

- **Consumers have a general awareness that solar can economically replace generators and batteries, but they are still largely uninformed about solar electric specifics**

  - While knowledge is gradually improving (particularly for small/pico solar lighting systems) most consumers are not yet educated enough to make informed decisions about solar systems.
  - There are often geographic disparities in awareness levels of OGS products, as households in urban or peri-urban areas tend to have better understanding of solar vis-à-vis rural villages.
  - Consumers are hearing "general messages" (i.e. "solar is good," "solar can be cheap," "solar can be more economical"). These messages need to be translated into more specific understanding of the technology (i.e. what are the options, what products are better than others, where to buy solar, what is a best way to pay for solar, what suppliers are more reliable, how to manage O&M, etc.).
  - Consumers often do not get fair information on the product they are buying. Marketing messages are quite mixed and much 'overpromising' occurs for systems. Consumers are largely unaware of standards and quality assurance for solar.

- **Perceptions of households vary according to experience they have had with solar**[106]

  - Although many households recognize the benefits of solar, there is a general perception that solar equipment is very expensive and that products are considered largely un-affordable.
  - Many customers are disappointed with solar technology or mistrust it because:
    - They have bought a substandard/not certified product that broke down quickly;
    - There was no adequate maintenance, aftersales service when the system broke down;
    - There was lack of understanding/experience on how to use the system and it broke down due to over usage or incorrect usage.
    - There is no warranty or fault management system (long-term O&M)
  - Households that have a fuel-powered generator, consider them as a 'sunk cost' and treat solar only as an addition to that cost.
  - Solar is seen as risky by many. Since there are so many options and little information as to what the best solution is, many people think that it is easy to make a costly mistake in choosing what is

[106] Awareness-raising is a key component of the Government's CIZO program, as many customers have had poor previous experiences with low-quality products and are now cautious to embrace new solutions. As part of its awareness raising campaign, the GoT has planned to set up solar academies in the five economic regions of the country to train 3,000 solar technicians – about 600 per region.

best for them. Generators are much better understood.
- Some consumers have 'investment fatigue' from buying multiple solar products of low or unknown quality and are unwilling to make further investments.

- **Willingness to Pay is strongly associated with consumer understanding and perceptions of OGS**
  Although there is demonstrated ability to pay for households in higher income demographics on cash purchase, and for many households through a financed scenario, willingness to pay is strongly associated with consumer understanding and perceptions of OGS. Component-based Plug-and-Play SHS are much more expensive than battery-powered alternatives and are more than what households expect to pay for access to lighting. Consumers who purchase low-priced inferior lighting products for which they have low expectations are less likely to be willing to purchase a relatively high priced OGS system without fully understanding the difference between the products.

  Since most of the retail-shop dry-cell battery-powered lighting products are extremely low cost (and short-lived), conservative rural consumers are wary of expensive new products if they are unable to assess product quality and durability. For this reason, willingness to pay presents a much larger barrier for the development of sales than actual *ability* to pay. East African experience with Global Lighting-certified products has demonstrated that consumer awareness campaigns can grow the demand for quality products.

2.2 Demand – Institutional

2.2.1 Overview of Institutional Market Segment

This section estimates the market potential for off-grid solar products for institutional users in Togo. This market includes the following segments: (i) rural water supply, (ii) healthcare facilities, (iii) primary and secondary schools, and (iv) public town center lighting. The following sub-sections provide an overview of the assumptions used for each market segment along with corresponding analysis. The section concludes with an assessment of institutional ability to pay, looking at funding sources and highest potential market segments. **Annex 2** provides an overview of the methodology, including all calculations.

2.2.2 Analysis of Institutional Market Segment Demand

Table 18 shows the estimated annualized cash market potential for institutional users in Togo. This estimation is calculated using available GIS data, secondary research, and primary source field data. The analysis is based on available information from planned expansion of the sectors and typical usage patterns and costs of existing systems in the country. There was insufficient GIS data available to properly estimate the market size; as a result, per capita comparisons were made with Sierra Leone to analyze certain sectors as described below.[107]

Table 18: Indicative Total Cash Market Potential for Institutional Sector[108]

Institutional Sector		Units	kW Equivalent	Cash Value (USD)
Water supply	Low power pumping system	79	118	$294,563
	Medium power pumping system	79	314	$785,500
	High power pumping system	18	182	$455,000
	Subtotal	176	614	$1,535,063
Healthcare	Health post (HC1)	8	2	$4,875
	Basic healthcare facility (HC2)	10	15	$38,625
	Enhanced healthcare facility (HC3)	2	9	$21,525
	Subtotal	20	26	$65,025
Education	Primary schools	36	18	$53,475
	Secondary schools	3	5	$12,480
	Subtotal	39	23	$65,955
Public lighting	Public lighting (excluding street lighting)	80	40	$119,625
TOTAL		**315**	**703**	**$1,785,668**

Source: African Solar Designs analysis

[107] Sierra Leone was grouped in the same category as Togo; See **Annex 2** for more details

[108] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

- **Water Supply**

Table 19: Key Assumptions for Water Supply Sector Analysis

Sector	System Sizes	Key Assumptions
Water supply	• Low Power (1,500 W) • Medium Power (4,000 W) • High Power (10,000 W)	The type of pump selected is dependent on depth, yield, community need and other factors. System sizes depend on the common pump sizes used for rural applications: • Low power pumps are used for low/medium head applications. They replace hand pumps for shallow wells • Medium power pumps have high volume low head and medium volume medium head applications • High power pumps are used for high volume or high head applications such as deep wells and boreholes

The water supply sector analysis considered the electricity needs for water supply for communities in off-grid areas. Energy is only one component of this sector – a variety of factors (water quality, number of users, yields of well, delivery system etc.) need to be considered when planning for off-grid water supply. The supply of solar powered pumping systems for village water supply requires additional planning and study to identify the most viable sites.

As GIS data was not available to conduct the analysis, a per capita comparison made using data from Sierra Leone[109] identified off-grid potable water points such as boreholes and wells that could be electrified by stand-alone systems. Based on analysis of the identified water points, the estimated annualized cash market potential for the water supply sector is presented in **Table 20**.

Table 20: Estimated Cash Market Potential for Water Supply[110]

Pump Type	Units	kW Equivalent	Cash Value (USD)
Low power	79	118	$294,563
Medium power	79	314	$785,500
High power	18	182	$455,000
Total	**176**	**614**	**$1,535,063**

Source: African Solar Designs analysis

- **Healthcare**

Table 21: Key Assumptions for Healthcare Sector Analysis

Sector	System Sizes	Key Assumptions
Healthcare	• HC1: Dispensary health post (300 W) • HC2: Basic health facility (1,500 W) • HC3: Enhanced health facility (4,200 W)	Available GIS data and a per capita comparison identified 286 off-grid healthcare facilities that could be electrified by stand-alone systems

The healthcare sector analysis considered the electricity needs for off-grid health facilities in the country. Off-grid clinics require power for lighting and various Information and Communications Technology (ICT) needs, including phone charging, maternity, medical examinations, vaccine refrigeration, laboratory, sterilization and staff housing. The size of a facility and number of patients served determines the amount of energy it requires.

[109] Sierra Leone was grouped in the same category as Togo; See **Annex 2** for more details

[110] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

As available GIS data was not sufficient to conduct the analysis, a per capita comparison made using data from Sierra Leone[111] identified off-grid health facilities categorized according to their size (HC1, HC2, and HC3) that could be electrified by stand-alone systems.[112] To establish electricity demand, an assessment of equipment found within each category of healthcare facility was undertaken, with the daily demand of each used to calculate the system size required to cater to the electrical load of the facility (**Table 22**). The assumptions of system size below are based on the services offered at each of these facilities.

Table 22: Healthcare Facility Categorization and Electricity Demand[113]

Type of Facility	Load Category	Wh/day	Total Load (Wh/day)	System Size (W)
Health post (HC1)	Lighting	240		
	Communication	160		
	ICT	800		
			1,200	**250**
Basic healthcare facility (HC2)	Lighting	1,600		
	Maternity	800		
	Vaccine refrigeration	800		
	Communication	400		
	Examination room	400		
	ICT	1,600		
	Staff housing	400		
			6,000	**1,500**
Enhanced healthcare facility (HC3)	Lighting	3,200		
	Communication	1,600		
	Examination room	1,200		
	ICT	2,400		
	Maternity	2,400		
	Laboratory	2,000		
	Sterilization	1,200		
	Vaccine refrigeration	1,200		
	Staff housing	1,600		
			16,800	**4,200**

Source: GIZ; African Solar Designs analysis

Based on these assumptions, the estimated annualized cash market potential for health facilities is presented in **Table 23**.

Table 23: Estimated Cash Market Potential for Healthcare Facilities[114]

Type of Facility	Units	kW Equivalent	Cash value (USD)
Health post (HC1)	8	2	$4,875
Basic healthcare facility (HC2)	10	15	$38,625
Enhanced healthcare facility (HC3)	2	9	$21,525
Total	**20**	**26**	**$65,025**

Source: African Solar Designs analysis

[111] Sierra Leone was grouped in the same category as Togo; See **Annex 2** for more details
[112] NOTE: This represents a small subset of the overall health infrastructure in the country; See **Annex 1** for more details.
[113] "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ__2016__Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf
[114] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

- **Education**

Table 24: Key Assumptions for Education Sector Analysis[115]

Sector	System Sizes	Key Assumptions
Education	• Elementary schools (500 W) • Secondary schools (1,920 W)	A per capita comparison identified 713 off-grid primary schools and 52 off-grid secondary schools that could be electrified by stand-alone systems

The education sector analysis considered the electricity needs of off-grid primary and secondary schools.[116] These include lighting, ICT (computers, tablets etc.), communication (phone charging), laboratories and staff housing. The size of a school and number of students determines the amount of energy it requires.

As GIS data was not available to conduct the analysis, a per capita comparison made using data from Sierra Leone[117] identified off-grid primary and secondary schools that could be electrified by stand-alone systems. To establish electricity demand, an assessment of equipment found within each type of school was undertaken, with the daily demand of each used to calculate the system size required to cater to the electrical load of the school (**Table 25**).

Table 25: Education Center Categorization and Electricity Demand[118]

Type of Facility	Load Category	Wh/day	Total Load (Wh/day)	System Size (W)
Primary School	Communication	160		
	Lighting	640		
	ICT	800		
	Staff house	400		
			2,000	**500**
Secondary School	Communication	160		
	Lighting	1,920		
	ICT	3,200		
	Laboratory use	800		
	Staff house	1,600		
			7,680	**1,920**

Source: GIZ; African Solar Designs analysis

Based on these assumptions, the estimated annualized cash market potential for primary and secondary schools is presented in **Table 26**.

Table 26: Estimated Cash Market Potential for Primary and Secondary Schools[119]

Type of Facility	Units	kW Equivalent	Cash value (USD)
Primary school	36	18	$53,475
Secondary school	3	5	$12,480
Total	**39**	**23**	**$65,955**

Source: African Solar Designs analysis

[115] NOTE: While the GIS analysis in **Section 1.2.2.4** covers all education centers (including nursery, pre-primary, primary, secondary, technical-vocational, universities etc.), this analysis only examines primary and secondary schools (see **Annex 1** and **Annex 2**).
[116] Primary schools encompass both primary and nursery schools. Vocational schools and universities were not considered because they tend to be in cities, which are often grid electrified.
[117] Sierra Leone was grouped in the same category as Togo; See **Annex 2** for more details
[118] "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ__2016__Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf
[119] NOTE: While the GIS analysis in **Section 1.2.2.4** covers all education centers (including nursery, pre-primary, primary, secondary, technical-vocational, universities etc.), this analysis only examines primary and secondary schools (see **Annex 1** and **Annex 2**).

- **Public Lighting**

Table 27: Key Assumptions for Public Lighting Sector Analysis[120]

Sector	System Sizes	Key Assumptions
Public lighting	Standard system (200 W)	• District population figures were used to determine the number of market centers per district, assuming 5,000 people per market center • Each market center was assumed to have two public lighting points

Analysis of the public lighting sector considered the public lighting needs for off-grid villages and market centers. It did not assess public street lighting, which would generally be included in road infrastructure projects. Based on these assumptions, the estimated annualized cash market potential for the public lighting sector is presented in **Table 28**.

Table 28: Estimated Total Potential Market Size for Public Lighting[121]

Public Lighting Network	Units	kW Equivalent	Cash value (USD)
Village lighting (excluding street lighting)	80	40	$119,625

Source: African Solar Designs analysis

2.2.3 Ability to Pay and Access to Finance

Financing for institutional off-grid systems in Togo typically comes from budget allocations made directly by relevant ministries or, more commonly, by donor-funded projects. In recent years, virtually all institutional solar projects in the country have been financed with tender-based procurements and cash-based contracts. Government allocations are typically made ad-hoc, depending on the needs and priorities of the ministry, and whether funds are available. Operation, maintenance and replacement of parts in energy systems (e.g. solar system batteries and inverters) is typically the responsibility of the institution and community. Schools, clinics and other institutions with generators must buy fuel on a regular basis. With the development of the renewable energy sector, NGO/donor funds increasingly design projects that ensure that maintenance of the system is factored into its implementation. However, when there are no funds to maintain the system any further, usage is typically discontinued, and the system falls into disrepair.

Institutional users that rely on government or donor funds for the purchase and O&M of solar systems may be constrained by limited funds and/or competing budget priorities. Thus, local communities benefiting from solar electrification would also have to bear some long-term costs for the maintenance of systems and replacement of parts. In the event that public or donor funding is made available to cover the initial capital expenditure, funds can be raised by local communities through a minimal tariff to customers of the health facilities, water pumping stations etc. for long-term O&M. A market standard of 5-10% of the capital expenditure is accepted as a rate for annual maintenance of systems.[122]

Given budgetary constraints, some institutional sectors may be prioritized for solar electrification over others. Advanced health centers for example, could be prioritized by governments and communities given that electricity is essential to run advanced healthcare equipment. It may be easier in this case to extract maintenance fees from community members receiving health services or budget allocations from local government. In contrast, off-grid schools can be run more easily without access to electricity and may therefore present a lower priority institutional market.

[120] Population figures used in this analysis were obtained from: https://www.citypopulation.de/Togo.html
[121] Population figures used in this analysis were obtained from: https://www.citypopulation.de/Togo.html
[122] Grundfos: https://www.grundfos.com/service-support/encyclopedia-search/maintenance-and-repaircostscm.html

2.3 Demand – Productive Use

2.3.1 Overview of Productive Use Market Segment

The section provides an overview of the main characteristics of productive use of energy (PUE) and how off-grid solar applications have the potential to generate economic activity, increase productivity and transform rural livelihoods in Togo. Focus group participants noted that productive use applications in the agricultural, food processing and informal sectors already exist in the country, including solar powered lighting, mobile phone charging, refrigeration and chilling, water pumping, irrigation and agricultural processing. The PUE market sizing analyzed demand for SME applications for village microenterprises, value-added applications for solar powered irrigation, milling and refrigeration, and connectivity applications for mobile phone charging enterprises.

The calculation of the estimated off-grid solar market for SMEs focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit significantly from extended working hours and the use of modern appliances/machinery. The estimated demand for this market segment is therefore intended to provide a baseline for future research, as a more robust analysis would be necessary to assess realistic demand from all SMEs.

The value-added applications that were analyzed include solar pumping for smallholder agricultural irrigation, solar powered milling and solar refrigeration. Access to energy for agriculture is critical to economic development, particularly given the sector's importance to GDP in the country.

Off-grid solar power supports a wide range of connectivity applications, including mobile phone charging, wi-fi servers, banks, mobile money kiosks, and telecommunications towers. Mobile phone and internet connectivity are also necessary precursors for mobile money and PAYG solutions in the off-grid solar sector. The market sizing examined rates of mobile phone ownership and mobile internet penetration to estimate the market potential for mobile phone charging enterprises (stations/kiosks) in the country.

Information and communication (internet, printing, tv), retail (phone charging, entertainment centers, refrigeration, tailoring) and agriculture sectors (irrigation, agro-processing) are areas with high potential for the productive use of energy in Togo. Solar PV phone charging services and mills are in especially high demand in rural off-grid villages, where there is significant potential for solar to increase revenue.[123]

The agricultural sector in Togo has accounted for nearly 30% of the country's GDP over the past five years, with more than 50% of the population engaged in the sector.[124] Most Togolese farmers practice subsistence farming and use traditional practices, which together with fluctuations in climate, commodity prices, and a shortage of other key inputs results in low productivity. A World Bank survey of local farmers found that improved access to finance, insurance, energy services, mechanized farming and rural road infrastructure could drastically advance the sector's productivity.[125] Moreover, agriculture will remain a key source of

[123] "Energy Access in Rural Togo: The Relevance of the Energy Kiosk Solution," Ines Galichon, Luc Payen, ENEA (2017): http://www.enea-consulting.com/wp-content/uploads/2017/04/ENEA-Consulting-Energy-access-in-rural-Togo-the-Energy-Kiosk1.pdf
[124] Businger, J., "Getting Togo's Agriculture Back on Track and Lifting Rural Families Out of Poverty Along the Way," =World Bank (2017): http://blogs.worldbank.org/nasikiliza/getting-Togos-agriculture-back-on-track-and-lifting-rural-families-out-of-poverty-along-the-way
[125] Ibid.

growth and employment in Togo in the foreseeable future, and thus efforts to sustain growth of this sector will also be beneficial to the country's poverty reduction goals.[126]

Additionally, while energy access is gradually improving in Togo, the country still faces electricity supply, reliability and efficiency issues. More than 50% of firms in Togo identified electricity access as a major business constraint.[127] In order to support Togo's 2030 electricity access goals, the West African Economic and Monetary Union (WAEMU) has calculated monthly revenues of FCFA 5,100 out of a total cost of FCFA 9,300 will have to come from PUE to support connection costs.[128] Thus, productive uses will serve a crucial role in Togo's off-grid electrification plans.

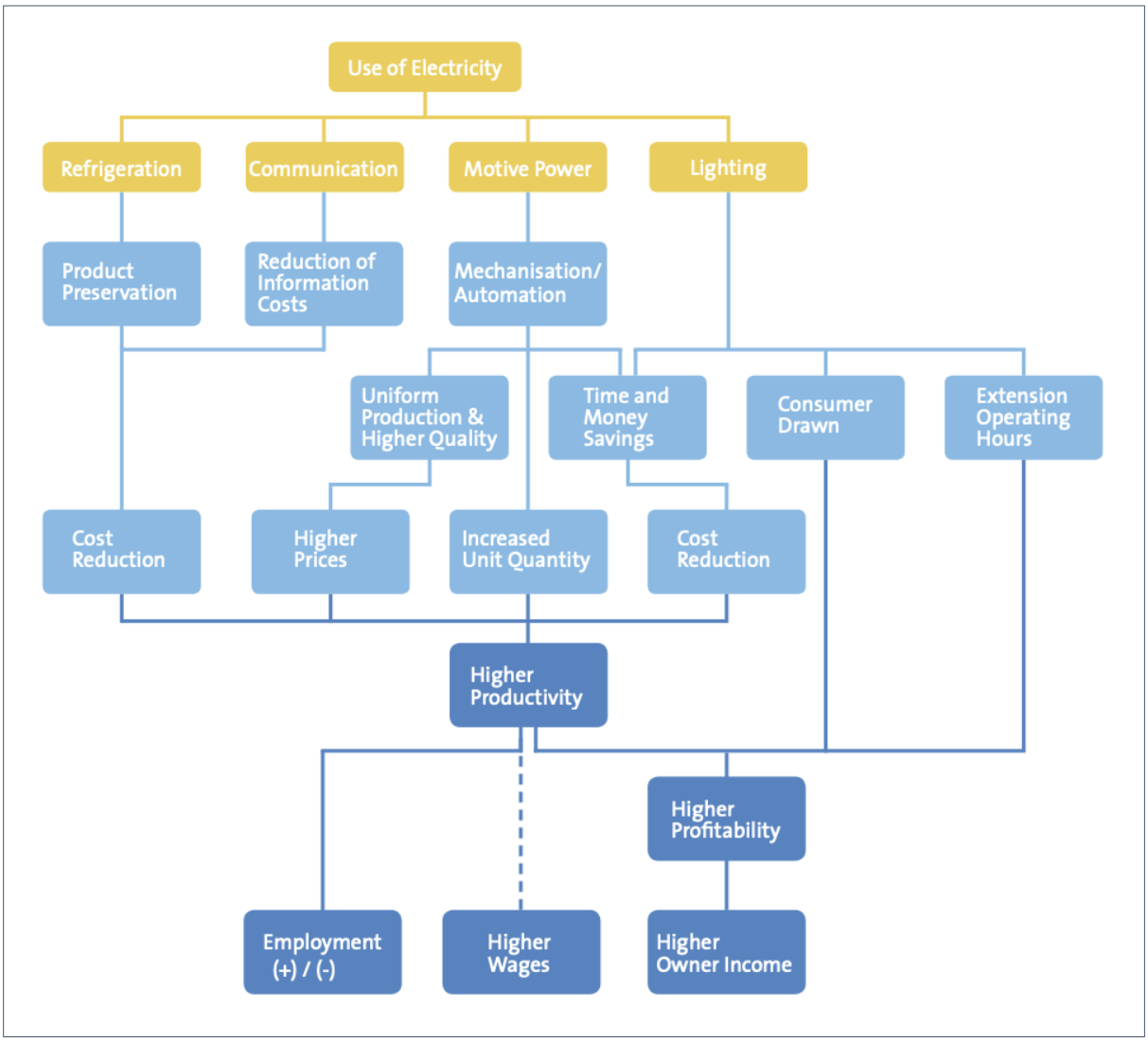
The impact of electricity use on SMEs depends on a variety of external and internal factors, especially access to markets, the location of the firm, supply of inputs and financial capability. Therefore, the extent to which firms can afford to invest in off-grid solar solutions is determined largely by increases in productivity, profitability, and employment/wages from the investment in the off-grid appliance (**Figure 27**).

[126] "International Development Association Project Paper on a Proposed Additional Credit in an Amount Equivalent to Euro 18.7 Million to the Republic of Togo for Agriculture Sector Support Project," World Bank, (March 2017): http://documents.worldbank.org/curated/en/598011492394445446/pdf/TOGO-PP-03282017.pdf

[127] "Enterprise Surveys: Togo," World Bank (2016): http://www.enterprisesurveys.org/data/exploreeconomies/2016/Togo#infrastructure

[128] "Presentation Document: Electrification Strategy of Togo," (2018): http://energyaccess.org/wp-content/uploads/2018/08/Electrification-Strategy-of-Togo-Full.pdf

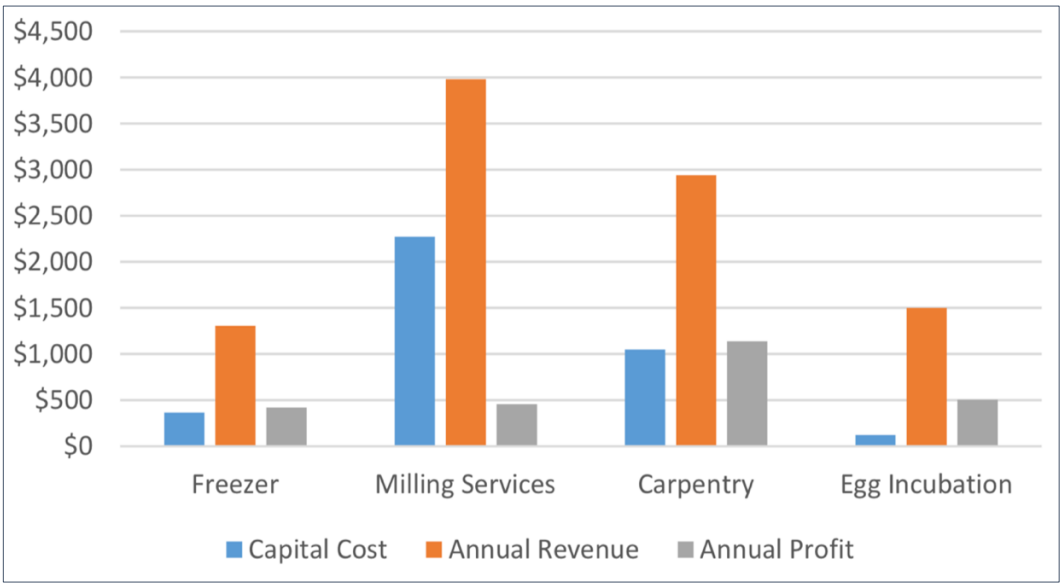
Figure 27: Pathways from Electricity to Income Generation[129]



Source: EUEI PDF and GIZ: Productive Use of Energy – A Manual for Electrification Practitioners

[129] Productive Use of Energy – A Manual for Electrification Practitioners," European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) and GIZ, (2011): https://www.giz.de/fachexpertise/downloads/giz-eueipdf-en-productive-use-manual.pdf

Figure 28: Analysis of Cost, Revenue and Profit for Various Off-Grid Productive Use Applications[130]



NOTE: Annual profit does not include recovery of cost capital

Source: USAID-NREL and Energy 4 Impact: Productive Use of Energy in African Microgrids

In order to organize and simplify this analysis and to deliver meaningful insights on country-level market sizing, productive solar applications have been divided into three main groups (**Table 29**).

Table 29: Overview of Productive Use Applications

Productive Use Application	Description
1) SME applications for village businesses	Barbers and tailors are the two microenterprises that were analyzed. While these businesses employ people and are critical for off-grid towns, they do not create additional income for towns and are not transformative in nature. SME businesses are therefore most at risk during economic downturns because they are at the mercy of the overall economic and political climate.
2) Value-added applications	Solar-powered irrigation, refrigeration/chilling and milling are the three value-added applications that were analyzed. Value added productive use applications enable businesses to add value to products or services and to build new income streams. This can be done by creating a new product or service or by enhancing the value of an existing product (e.g. milling maize). Water pumping tools that support the agricultural, dairy or fishing value chains are included here (water pumps, refrigerators/chillers, and grain mills).
3) Connectivity / ICT applications	Mobile phone charging is the connectivity application that was analyzed. Connectivity applications enable consumers to communicate and access data from the internet. Following the advent of mobile phones and mobile money in East Africa, solar devices that support connectivity applications became the most important income earning applications in East Africa. Mobile phone charging is extremely important for the telecommunications sector. Other connectivity applications include wi-fi servers, mobile money kiosks, banks, and telecommunications towers.

Source: African Solar Designs

[130] "Productive Use of Energy in African Micro-Grids: Technical and Business Considerations," USAID-NREL and Energy 4 Impact, (August 2018): https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive_use_of_energy_in_african_micro-grids.pdf

- **Geographic Locations**

Most PUE sector activities will take place in rural off-grid areas in Togo, particularly in the Plateau region where there is high agricultural potential and favorable climate for crop cultivation, as well as in the savanna region, where there is significant solar potential, low levels of grid connectivity, and rural agricultural livelihoods are the predominant means of income generation.

The Togolese government has in the past pursued the development of agricultural hubs to support the agro-processing of various regional crops. These were centered in the valleys of the Zio, Lili, and Yoto rivers in the Maritime region; the Mono valley and Litimé in the Plateau region, the plains of the Mô, Mono, and the Adélé in the Centrale region; Dankpen, Bassar, and Assoli in the Kara region; and the plains of the Oti, Kpendjal, and the Cuesta area in the Savanes region.[131] Other geographic regions targeted for support include the Avétonou and Kolokopé ranches (Plateau region), the Adélé ranch (Centrale region), Namiélé ranch (Savanes region) and support for the marine fisheries in the Maritime region.[132]

2.3.2 Analysis of Productive Use Market Segment Demand

Data from the World Bank, Food and Agriculture Organization of the UN (FAO) and GSMA was used to conduct the PUE market study. In order to conduct the analysis, several key assumptions were made about PUE applications, which are presented in the sections below and in **Annex 2** in greater detail. **Table 30** presents the estimated annualized cash market potential for off-grid solar productive use applications.

Table 30: Indicative Total Cash Market Potential for Productive Use Sector[133]

Productive Use Sector		Units	kW Equivalent	Cash Value (USD)
SME Applications for Village Businesses	Microenterprises	581	145	$363,125
Value-added Applications	Irrigation	25,000	3,000	$16,250,000
	Milling	109	711	$1,777,250
	Refrigeration	80	439	$1,096,563
	Subtotal	25,189	4,150	$19,123,813
Connectivity Applications	Phone Charging	3,450	1,380	$2,973,485
TOTAL		**29,220**	**5,675**	**$22,460,423**

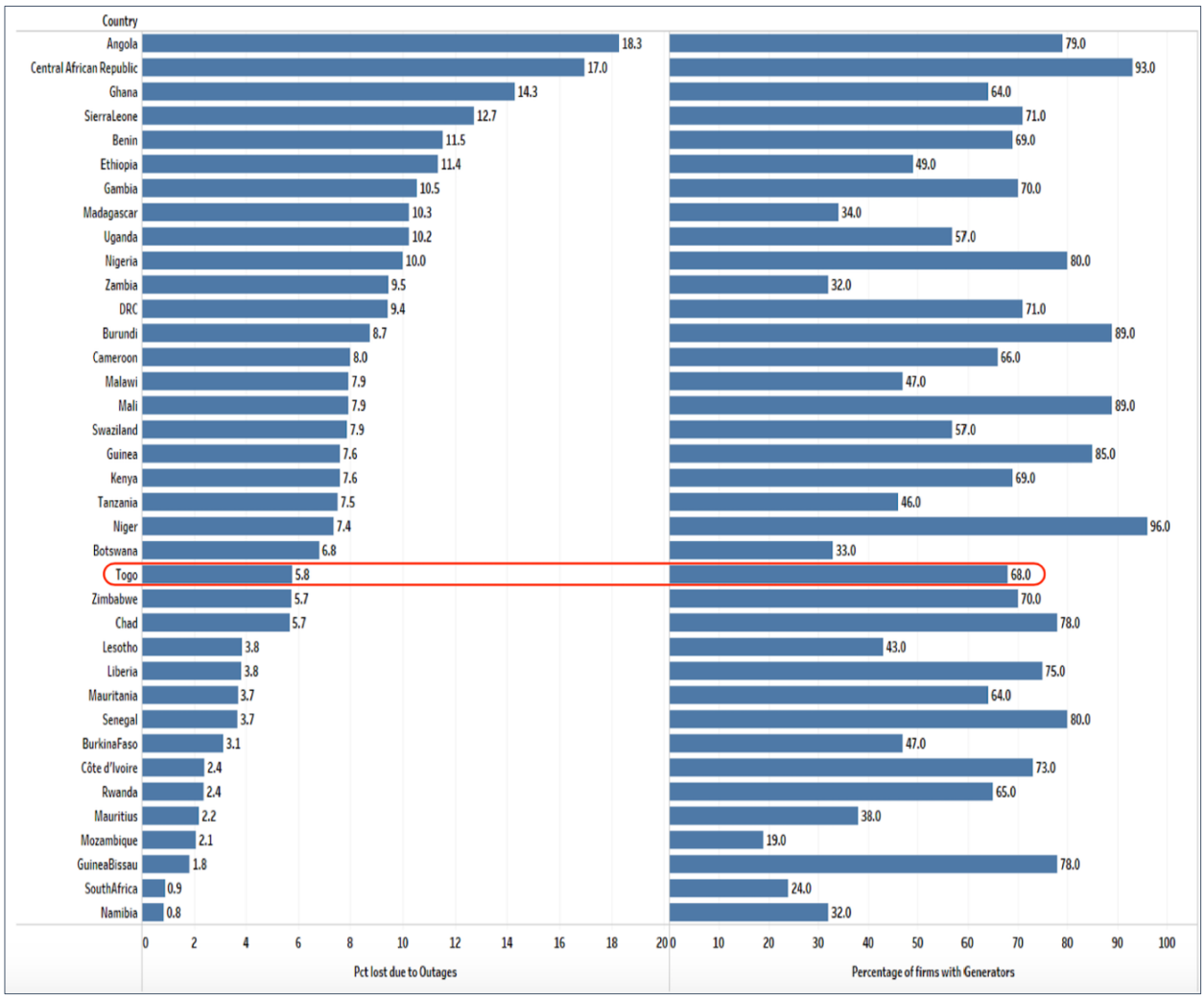
Source: Food and Agriculture Organization, GIZ and GSMA; African Solar Designs analysis

- **SME Applications for Village Businesses**

Access to solar powered appliances can have a wide-ranging impact on SMEs, many of which would otherwise rely on diesel generators to power their enterprises. Close to 33% of SMEs in emerging markets use fossil fuel powered generators in order to address energy insecurity.[134] For ECOWAS countries, independent power generation via fossil fuel powered generators is especially prevalent.[135] This practice is extremely common in Togo, where 68% of firms own generators and power outages account for about 6% of annual sales lost (**Figure 29**). Poor road networks also hinder economic growth in Togo (**Figure 30**).

[131] "Togo: Poverty Reduction Strategy Paper," International Monetary Fund, (2014): https://www.imf.org/external/pubs/ft/scr/2014/cr14224.pdf
[132] Ibid.
[133] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[134] Foster, V., and Steinbuks, J., "Paying the Price for Unreliable Power Supplies: In-House Generation of Electricity by Firms in Africa," World Bank Policy Research Working Paper, (2009): https://openknowledge.worldbank.org/handle/10986/4116
[135] Ibid.

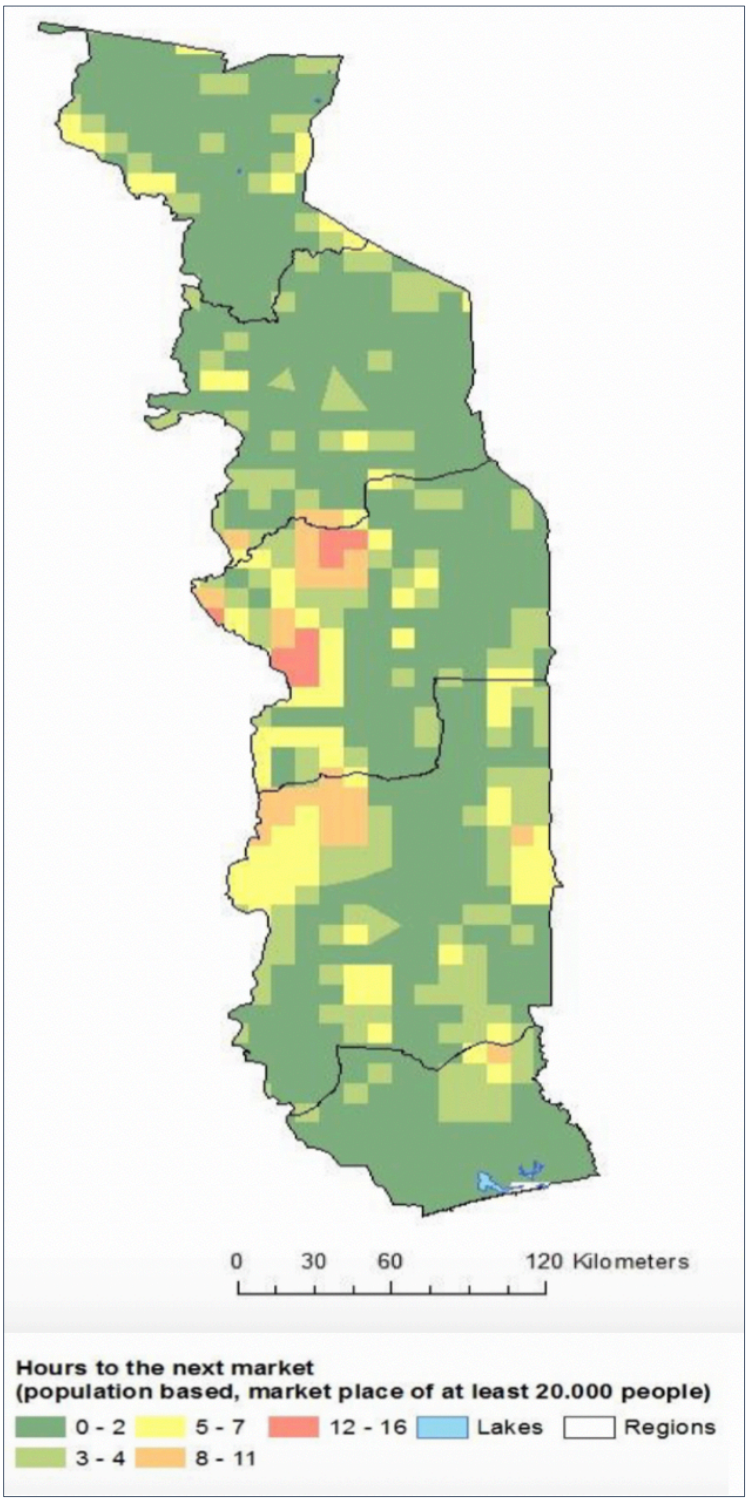
Figure 29: Percentage of Sales Lost due to Power Outages and Percentage of Firms with Generator[136]



Source: Center for Global Development

[136] Ramachandran, V., Shah, M. K., Moss, T., "How Do African Firms Respond to Unreliable Power? Exploring Firm Heterogeneity Using K-Means Clustering," Center for Global Development, (August 2018): https://www.cgdev.org/sites/default/files/how-do-african-firms-respond-unreliable-power-exploring-firm-heterogeneity-using-k-means.pdf

Figure 30: Transportation Distance to Markets in Togo[137]



Source: Forum for Agricultural Research in Africa; Center for Development Research University of Bonn

[137] "Innovation for Sustainable Agricultural Growth in Togo," Program of Accompanying Research for Agricultural Innovation, Forum for Agricultural Research in Africa, Center for Development Research University of Bonn (October 2017): https://research4agrinnovation.org/wp-content/uploads/2016/03/Togo.pdf

While many rural microenterprises would benefit from access to solar power, it may not be a requirement for a commercial enterprise to have access to electrical appliances. Further, while petit trade is facilitated greatly by the availability of electricity (kiosks and retail shops can be open longer hours and sell more and fresher products), electricity is not essential for SMEs because even without lighting, small shops can still sell their merchandise. Additionally, unlike value-added applications, there is not as strong a correlation between the value of the electric appliance and the economic capability of the SME. For example, a refrigerator used to preserve perishable food and chill beverages, irrespective of the value of food and beverages, may be used by either a large hotel or a street side vendor.

With the exception of replacing diesel gensets, the estimation of the available market for off-grid solar appliances for SMEs is not as closely correlated with economic indicators. Nonetheless, some widely marketed solar powered appliances are more centrally related to the revenue generation of SMEs. Investments in such appliances in off-grid and low-income settings are more likely to be sustainable. This study analyzed barbering and tailoring appliances (i.e. hair clippers and sewing machines designed or marketed for off-grid solar powered settings) with respect to microenterprises that face difficulty in accessing outside capital, as the two appliances would provide an economic opportunity for such entrepreneurs that are demographically most likely to be in off-grid communities. A study undertaken in West Africa that found little correlation between electricity access and a firm's profitability did, however, find that tailors do consistently benefit from electricity access.[138]

Focus group participants also highlighted the potential for solar power to support service-based industries, specifically those participating in retail sales of fish, meat, beverages, entertainment and phone charging. The calculation of the estimated OGS market focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit most from extended working hours and the use of modern appliances/machinery. The quantitative demand estimate for this market segment is therefore intended to provide a baseline for future research, as a more robust analysis would be necessary to assess OGS demand from all SMEs.

According to the analysis, estimated annualized off-grid solar cash market potential for barbers and tailors is USD 363K (**Table 31**).

Table 31: Estimated Cash Market Potential for SMEs – Barbers and Tailors[139]

No. of SMEs with Constrained Access to Finance[140]	Units	kW Equivalent	Cash Value (USD)
2,905	581	145	$363,125

Source: World Bank

Published values of the current size of the import market for Togo for relevant off-grid electric machinery and appliances likely under represent what is much stronger latent demand from the SME sector to invest in off-grid solar powered appliances (**Table 32**).

[138] Grimm, M., Harwig, R., Lay, J., "How much does Utility Access matter for the Performance of Micro and Small Enterprises?" World Bank (2012): http://siteresources.worldbank.org/INTLM/Resources/390041-1212776476091/5078455-1398787692813/9552655-1398787856039/Grimm-Hartwig-Lay-How_Much_Does_Utility_Access_Matter_for_the_Performance_of_MSE.pdf

[139] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

[140] "MSME Finance Gap," SME Finance Forum: https://www.smefinanceforum.org/data-sites/msme-finance-gap

- **Value-added Applications**

Agricultural practices, especially for smallholder farmers, can benefit from a wide range of off-grid solar technologies. Cold rooms and ice production are valuable investments for economies engaged in aquaculture. Solar refrigeration, cooling and processing equipment would enable traders and livestock farmers to sell dairy products. Solar drying of cocoa and palm oil processing are productive use applications that would greatly benefit rural farmers in countries where these products contribute to export revenues.

Cotton is an important cash crop for Togo and its smallholder farmers. Therefore, solar powered applications that support its value chain, such as irrigation and ginning equipment, could serve as important inputs for the growth of the sector. Togo's cotton value chain is not directly incorporated into this analysis; rather, cotton production is integrated into the assessment of the size of Togo's irrigation market.

The three value-added applications that were analyzed include solar pumping for agricultural irrigation, solar milling and solar powered refrigeration.

Solar Powered Irrigation:

In most West African countries, the national government is typically responsible for carrying out irrigation initiatives, which vary by the scale of the project and often require the construction of civil works such as dams, canals, embankments, and piping. Donor agencies and development partners provide funding for such projects. This analysis focused instead on a small-scale private sector driven approach and estimated the market potential for off-grid solar pumping systems to support smallholder farmers.

Solar pumping systems vary in their wattage depending on the area of land irrigated, the depth of water abstracted and the quality of the soil and crops among other factors.[141] GIS analysis demonstrated that access to the water table and surface water is not a major determinant of the costing of applicable solar irrigation systems, as most farming settlements in Togo are within close proximity to either surface water or relatively easily extractable sources of water (**Figure 31**).

It is important to note that Togo has recently enacted wide-ranging reforms relating to agriculture and rural land.[142] The implementation of these reforms will, among other things, provide for the establishment of a single land tenure office and thereby simplify the process of registering land. This is a very positive development for the sector, as reduced land uncertainty and tenure security will allow Togolese farmers to increase investment in agricultural production.

In analyzing the available market for solar-powered irrigation, this market scoping exercise focused exclusively on smallholder farmers and solar water pumping irrigation technologies to address their needs. In doing so, this analysis took into consideration the emerging experience with small-scale productive use pumping in East Africa. Small pumps of 80 Wp-150 Wp (e.g. Futurepump and SunCulture) make up the bulk of sales, while larger-sized pumps (e.g., Grundfos) are also frequently marketed to address differing water access and crop conditions.

Table 32 presents the estimated annualized off-grid solar cash market potential for smallholder value-added solar irrigation applications in Togo, which has an estimated cash value of USD 16.2M (see **Annex 2** for more details).

[141] *See* GIZ Powering Agriculture Toolbox on Solar Powered Irrigation Systems: https://energypedia.info/wiki/Toolbox_on_SPIS
[142] "Togo engages land reforms to reduce related conflicts," Togo First, (March 7, 2018): https://www.Togofirst.com/en/economic-governance/0803-419-Togo-engages-land-reforms-to-reduce-related-conflicts

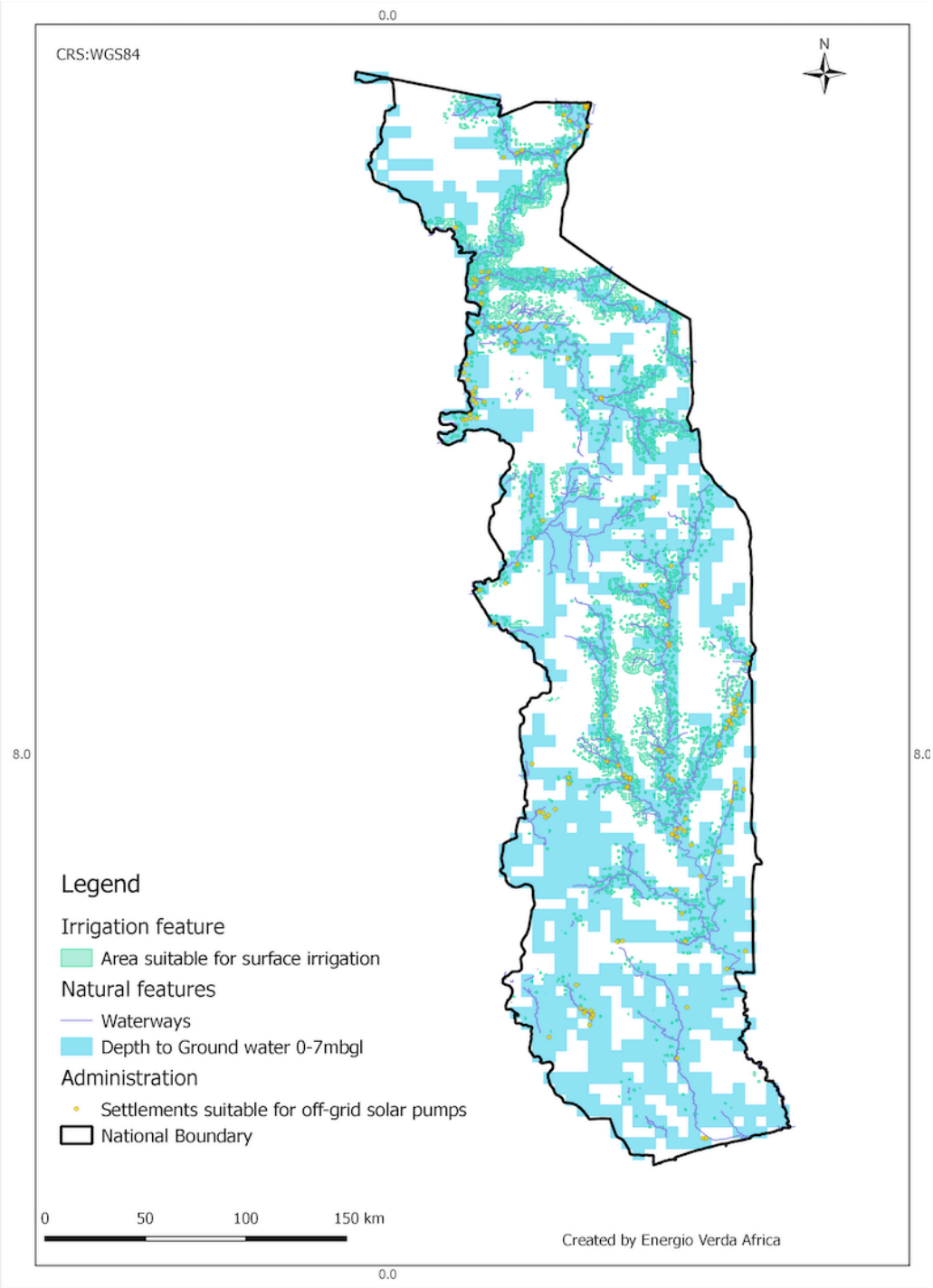
Table 32: Estimated Cash Market Potential for Value-Added Applications – Irrigation[143]

Estimated No. of Smallholder Farms Suitable for OGS Pumping for Irrigation	Units	kW Equivalent	Cash Value (USD)
150,000	25,000	3,000	$16,250,000

Source: Food and Agriculture Organization; World Bank; African Solar Designs analysis

[143] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

Figure 31: Area Suitable for Surface Irrigation and Identified Settlements Suitable for Off-Grid Solar Pumps



Source: British Geological Survey, Bureau of Statistics; ESA Climate Change Initiative; OpenStreetMap; Energio Verda Africa GIS analysis[144]

[144] NOTE: mbgl = meters below ground level
Sources: Mapping provided by British Geological Survey © NERC 2012. All rights reserved; Irrigation area identified from a Land Cover data set through the ESA Climate Change Initiative, Land Cover project 2017. © Modified Copernicus data (2015/2016): https://www.esa-landcover-cci.org/?q=node/187; Settlements provided by OpenStreetMap

Solar Powered Milling:

Cereal crops like maize, sorghum, millet, and rice provide an opportunity for value addition through hulling or milling. Off-grid communities use maize or rice milling equipment that is typically powered by diesel generators. Discussions with off-grid community groups revealed that although many are aware of the long-term cost savings associated with solar powered mills, the up-front cost of purchasing equipment was viewed as too high. **Table 33** presents the estimated annualized off-grid solar market potential for smallholder value-added solar grain milling applications in Togo, which has an estimated cash value of USD 1.7 million (see **Annex 2** for more details).

Table 33: Estimated Cash Market Potential for Value-Added Applications – Milling[145]

Estimated No. of Solar Mills	Units	kW Equivalent	Cash Value (USD)
2,187	109	711	$1,777,250

Source: Food and Agriculture Organization; African Solar Designs analysis

Solar Powered Cooling and Refrigeration:

Solar-powered refrigerators and freezers in rural areas serve multiple purposes, including to store milk, fish, meat and vegetables to extend the life of produce and reduce losses. In addition to storing produce, ice-makers can increase the income of rural SMEs by providing ice to businesses that require cold storage (stores, restaurants etc.). **Table 34** presents the estimated annualized off-grid solar market potential for smallholder value-added solar refrigeration applications in Togo, which has an estimated cash value of USD 1 million (see **Annex 2** for more details).

Table 34: Estimated Cash Market Potential for Value-Added Applications – Refrigeration[146]

Off-Grid Market Centers	Units	kW Equivalent	Cash Value (USD)
1,595	80	439	$1,096,563

Source: Solar-Powered Cold Hubs, Nigeria; African Solar Designs analysis

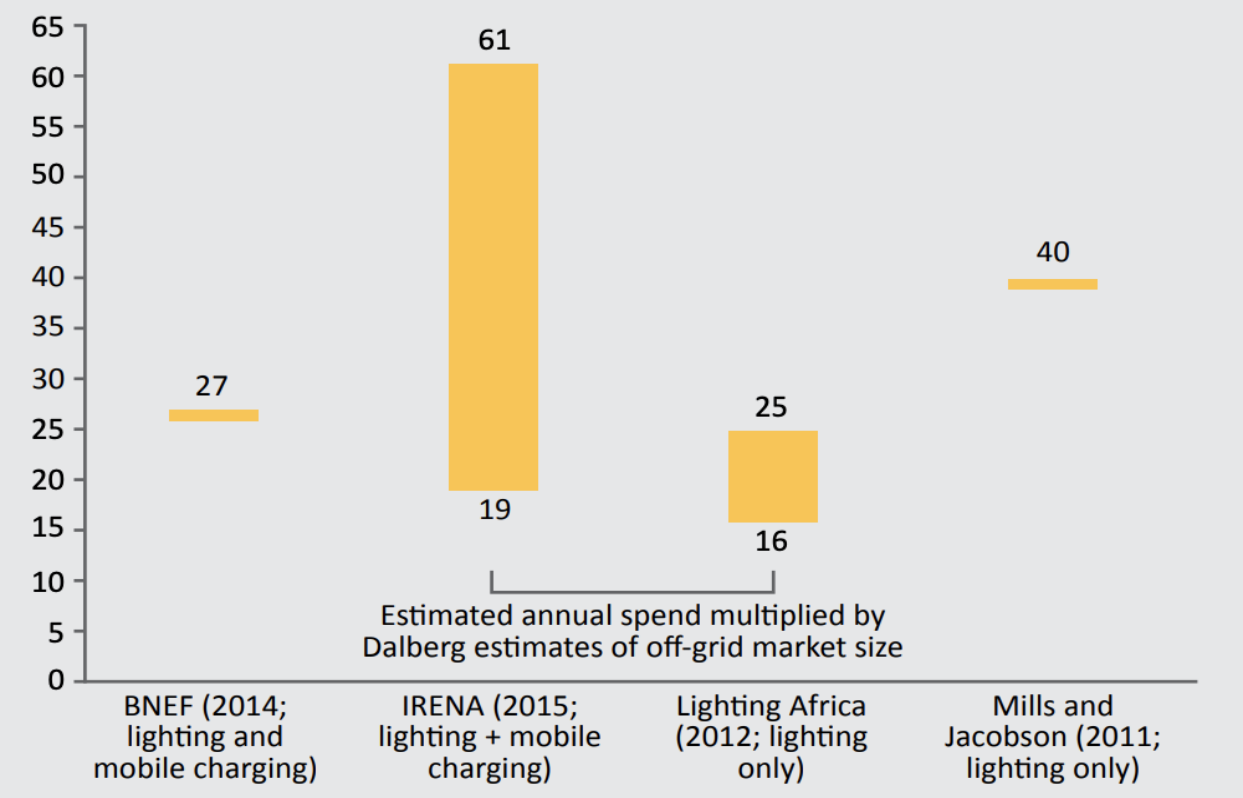
Ultimately, the ability for an agricultural community to benefit from productive use applications has as much to do with access to markets and improved crop inputs, as it has to do with the pricing and availability of financing to purchase the equipment. Hence, the macroeconomic approach used to carry out this market sizing does not account for country-specific cost and supply chain constraints.

- **Connectivity Applications**

Mobile phone charging stations/kiosks make up a critical segment of off-grid solar demand, as the market for solar phone charging is expected to grow significantly in the near-term. Household rates of mobile phone ownership often greatly exceed rates of electricity access (**Figure 17**), while households spend a significant share of income on lighting and phone charging (**Figure 32**). Increasingly, off-grid solar devices, such as lighting devices, also include phone-charging capabilities that enable owners to engage in mobile-phone charging businesses. Moreover, Togolese households spend more than USD 149 per year on lighting and phone charging.[147]

[145] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[146] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[147] "Solar PV in Africa: Costs and Markets," International Renewable Energy Agency, (2016): http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Solar_PV_Costs_Africa_2016.pdf

Figure 32: Estimated Annual Off-Grid Household Expenditure on Lighting and Mobile Phone Charging[148]



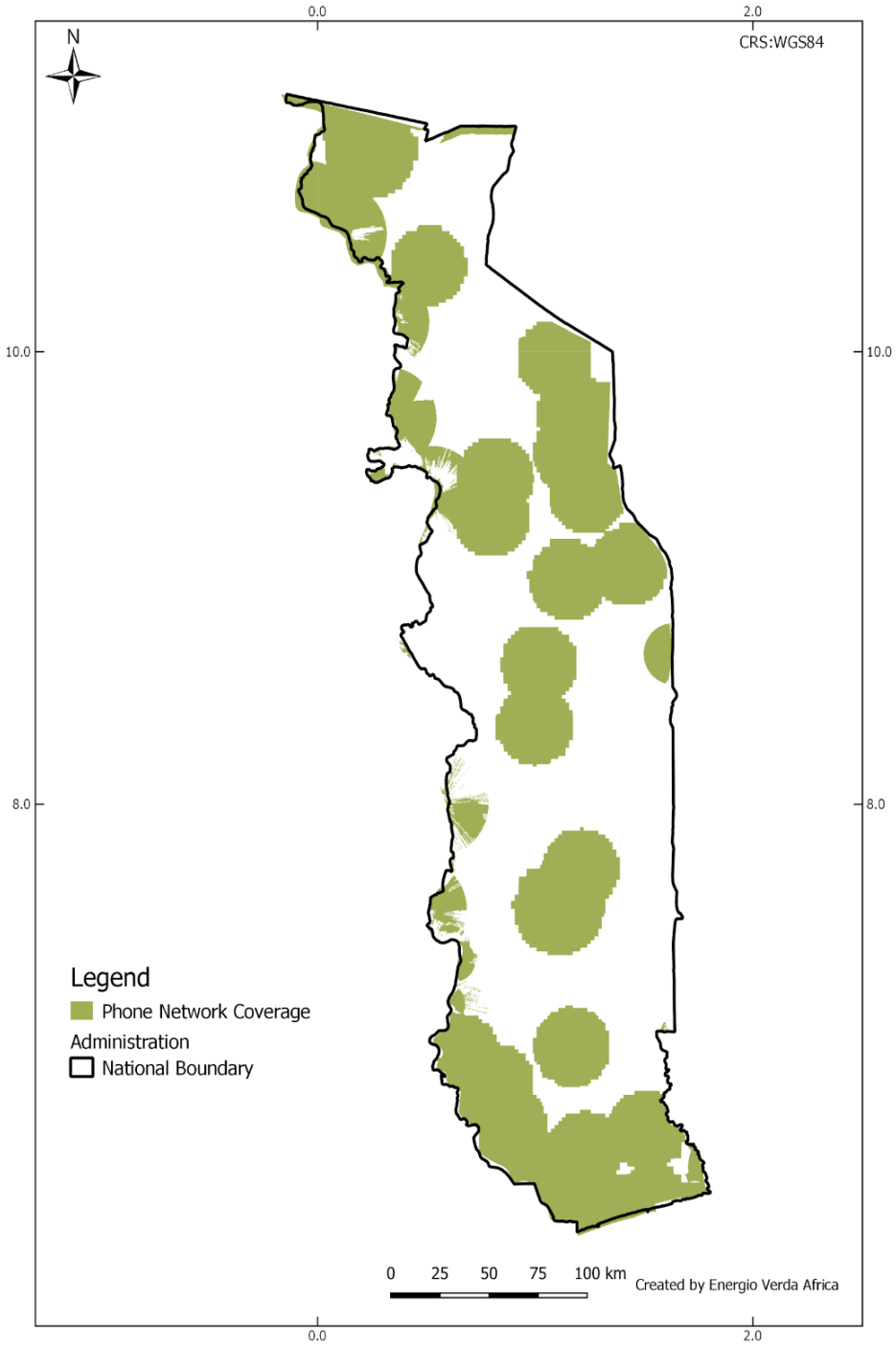
NOTE: Figures in Billion USD

Source: Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP

Figure 33 shows the relatively broad geographic coverage of cellular signals across the region. Cellular connectivity is essential for solar PV markets. In many African countries, mobile phone charging provides a primary productive use application for off-grid solar. Mobile phone access – and more importantly connectivity – helps drive commerce and employment in rural areas. The penetration of mobile money services is also critical, as it drives greater financial inclusion, expands consumer financing options and further increases demand for phone charging enterprises. Above all, mobile phones and connectivity are a necessary precursor to PAYG solutions in the OGS sector. Countries with expanding mobile phone coverage and especially broadband internet users are more attractive to PAYG solar companies **(Figure 16).**

[148] "Off-Grid Solar Market Trends Report 2018," Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018): https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

Figure 33: Mobile Phone Network Geographic Coverage in Togo[149]



Source: GSMA and OpenSignal

[149] See **Annex 2** for more details.

The analysis of the potential solar-powered phone charging market was based on the country's mobile phone penetration rate, rural population rate, and the average costs of OGS phone charging appliances. **Table 35** presents the estimated annualized cash market potential for off-grid solar mobile phone charging enterprises in Togo, which has an estimated cash value of USD 2.9 million (see **Annex 2** for more details).

Table 35: Estimated Cash Market Potential for Mobile Phone Charging Enterprises[150]

Mobile Subscribers[151]	Rural Population (%)[152]	Units	kW Equivalent	Cash Value (USD)
2,900,000	59.50%	3,450	1,380	$2,973,485

Source: GSMA; World Bank; African Solar Designs analysis

2.3.3 Ability to Pay and Access to Finance

The above analysis illustrates that there is a sizeable off-grid solar cash market for productive use applications in Togo. However, more research needs to be done in each segment to better understand affordability of OGS appliances and equipment based on ability and willingness to pay as well as other factors such as access to finance and ultimately whether the expenditure for the equipment is justifiable given increased revenue/productivity in the long-term.

The value-added market for water pumping for irrigation indicates that increased revenues from the use of solar appliances would justify the expenditure for the equipment – although as mentioned, agricultural productivity also depends on other environmental and market factors that are specific to each country. Solar powered irrigation systems may require a financed solution to be profitable investments for farmers, as their cost may exceed benefits depending on how the systems are designed and what components are used.

With regard to microenterprises, further study would be needed to determine the impact of off-grid solar on this sector, especially as it relates to income and affordability of the sectors analyzed (phone charging, barbers and tailoring). Providing solar-kits through subsidized micro-credit schemes can lead to productive uses and boost household income.

The focus group discussion yielded additional insights into the off-grid solar PUE sector from a consumer point of view:

- Many companies cannot afford the up-front cost of solar solutions. A potential solution to this problem would be to implement a third-party ownership system and increased access to financing.
- Despite public and donor-led interventions to lower financial constraints, rural firms still struggle to access financing solutions. This is especially the case for farmers that have invested in solar equipment but have not implemented irrigation schemes that would allow them to harvest crops year-round.
- Solar kiosks can bridge financing gaps by offering financial and credit services to help off-grid customers acquire electric appliances and processing equipment.[153]

[150] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[151] "The Mobile Economy: Sub-Saharan Africa," GSMA, (2017): https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download
[152] World Bank: Rural Population (% of total population) https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS
[153] "Energy Access in Rural Togo: The Relevance of the Energy Kiosk Solution," Ines Galichon, Luc Payen, ENEA (2017): http://www.enea-consulting.com/wp-content/uploads/2017/04/ENEA-Consulting-Energy-access-in-rural-Togo-the-Energy-Kiosk1.pdf

2.4 Supply Chain

This section reviews the off-grid solar supply chain in Togo, including an overview of key actors, solar products and services, business models, and sales volumes. The section also analyzes the role of informal market players and the impact of uncertified products. The section concludes with an assessment of local capacity and the needs of the supplier market segment. The data presented in this section was obtained through desk research, interviews with local officials and industry stakeholders, focus group discussions and surveys of international and local solar companies (see **Annex 2** for more details). The tier system used to classify solar companies throughout this section is described in **Table 36.**

Table 36: Solar Company Tier Classification

	Classification	Description
Tier 1	Startup companies	• Less than 3 full time employees • Less than 300 SHS or Less than 1,500 lanterns sold • Less than USD 100,000 annual revenues • Does not have access to outside finance except personal loans and may have a business account
Tier 2	Early stage companies	• 3 to 25 full time employees • 300 to 30,000 solar home systems or 1,500 to 50,000 lanterns sold
Tier 3	Growth/Mature	• More than 25 full time employees • More than 30,000 solar home systems or 50,000 lanterns sold • More than USD 3 million annual revenues • Has a credit line at a bank and financial statements • Raising equity or other outside financing

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

2.4.1 Overview of Commercial Market for Solar PV Equipment

The off-grid solar supply chain in Togo is made up of a wide range of stakeholders – importers, distributors, wholesalers, retailers, NGOs, and end-users (**Figure 34**). Togo is a small but quickly growing solar market. A 2018 assessment by IFC found that about 3.5% of rural households in Togo utilize solar products, but that the potential size of the commercial market is much larger.[154] Indeed, with the advent of the Togo Electrification Strategy and the Government's CIZO program, the overall environment and commercial opportunity for solar companies in Togo is rapidly improving **(Figure 14**).

A variety of solar products and systems are offered by companies in the market (by both the formal and informal sector) and, as examined in further detail below, there are a number of business models currently being utilized. While rural households make up the main market for off-grid lighting products in the country, urban households, both electrified and non-electrified, are also a key consumer market. Urban households tend to have greater ability to afford OGS products and systems; moreover, despite the high level of grid connectivity in urban areas, power supply is often not sufficient, continuous, or reliable (**Figure 4**), further supporting expanded use of solar PV equipment by this consumer segment.

Recent figures from GOGLA indicate that the sales volume and revenue for companies selling off-grid solar products in Togo have experienced significant volatility but increased over the period 2017-2018 (see **Section 2.4.3**).[155] While formal companies play an important role in the development of Togo's solar

[154] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf
[155] "Off-Grid Solar Market Trends Report, 2018," Dahlberg Advisors and Lighting Africa, (January 2018): https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

industry, IFC estimates that the informal sector accounts for 86% of the overall market.[156] Surveys of local stakeholders and focus group discussions emphasized the urgent need for a comprehensive regulatory framework to address the issue of low-quality, uncertified products flooding the market. Awareness raising was also cited as another key area where additional support was needed for the market to grow.

2.4.2 Overview of OGS Companies in Africa and Level of Interest in the Region

The African off-grid solar market has experienced rapid growth over the last five years. This growth can largely be attributed to the emergence of a progressively diverse, global pool of manufacturers and distributors, decreased system costs and an increase in three major product categories – pico solar, Plug-and-Play SHS, and component-based systems.[157] Leading solar companies such as Greenlight Planet, D.Light, Off-Grid Electric, M-KOPA Solar, Fenix International, and BBOXX represent the largest share of the African off-grid market and are joining other players in West Africa and the Sahel, including Lumos Global, PEG Africa, Barefoot Power, Yandalux, Schneider Electric, Azuri Technologies, Solarama, AD Solar, Enertec, SmarterGrid, GoSolar, Total, Oolu Solar, EnergenWao and SunTech Power to list a few.

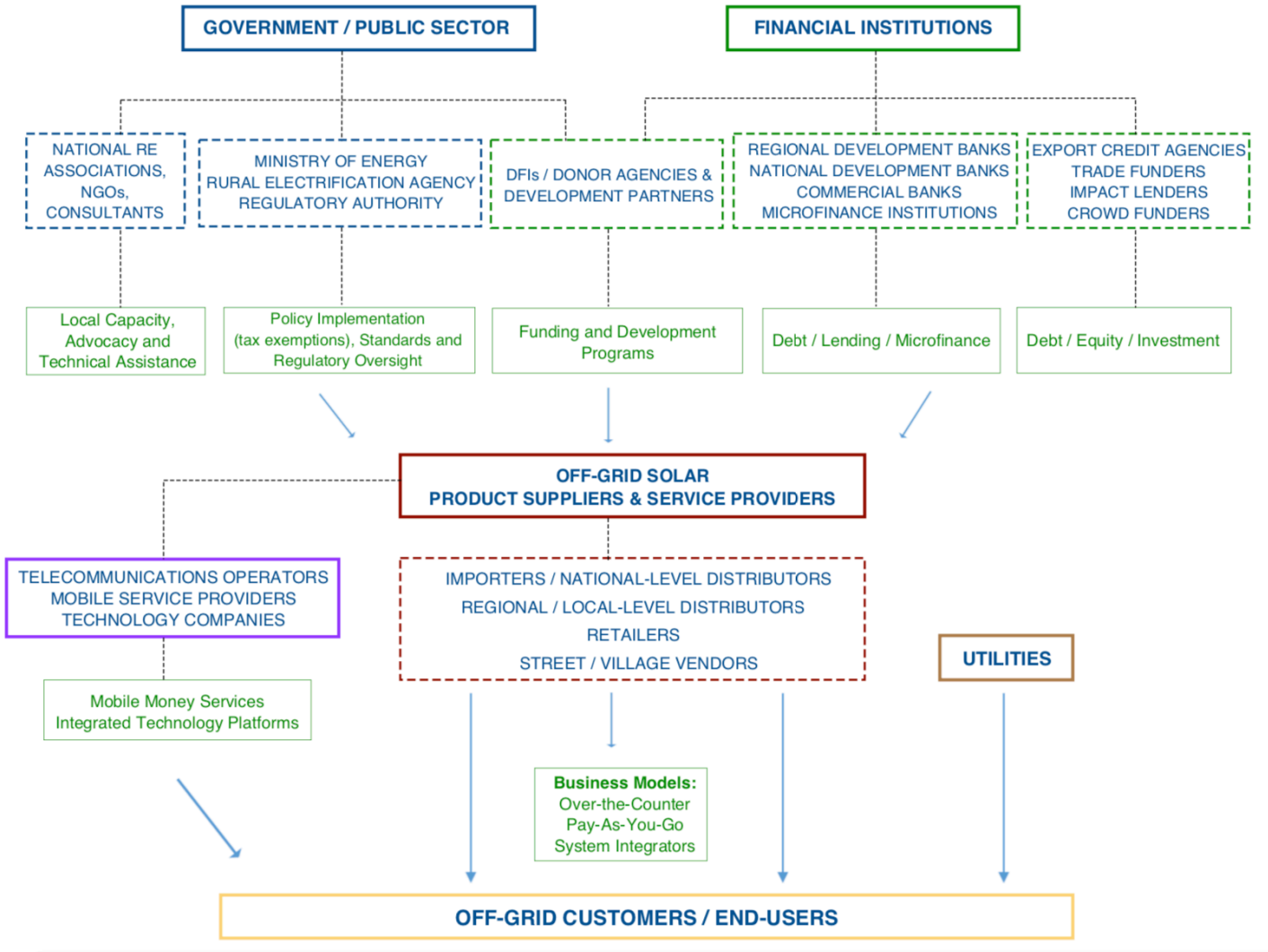
Market entry into Africa began in East Africa for a majority of the leading companies, a trend that can be attributed to advancements in mobile money transfer systems such as M-Pesa that have facilitated the PAYG off-grid business model. As the East African market becomes more crowded and mobile money services spread across the Continent, many international off-grid solar companies have recently entered markets in West Africa and the Sahel. The regional market grew from being nearly non-existent in 2013 to accounting for 9% of worldwide sales (20% of SSA) with over 2 million systems sold in 2017.[158]

Over 500 solar companies have been identified operating across the region, many of which are small local players. These local distributors either operate independently or act as local affiliates of larger international companies operating in this space. The majority of companies in the region are primarily Tier 1 and Tier 2 companies, with relatively few Tier 3 companies. The highest concentration of Tier 3 companies was identified in Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Mali, Nigeria and Senegal.[159]

A survey of large international solar companies that assessed *inter alia* their level of interest in entering the off-grid markets in West Africa and the Sahel is presented in **Figure 35**. The survey found that among respondents, companies expressed the most interest in Nigeria, Sierra Leone, and Côte d'Ivoire, with at least half of respondents indicating a "very high level of interest" in these markets. There was also a relatively high level of interest in Liberia, Senegal, Burkina Faso, Mali and Togo, with at least half of respondents indicating a "very high" or "moderate" level of interest in these markets.

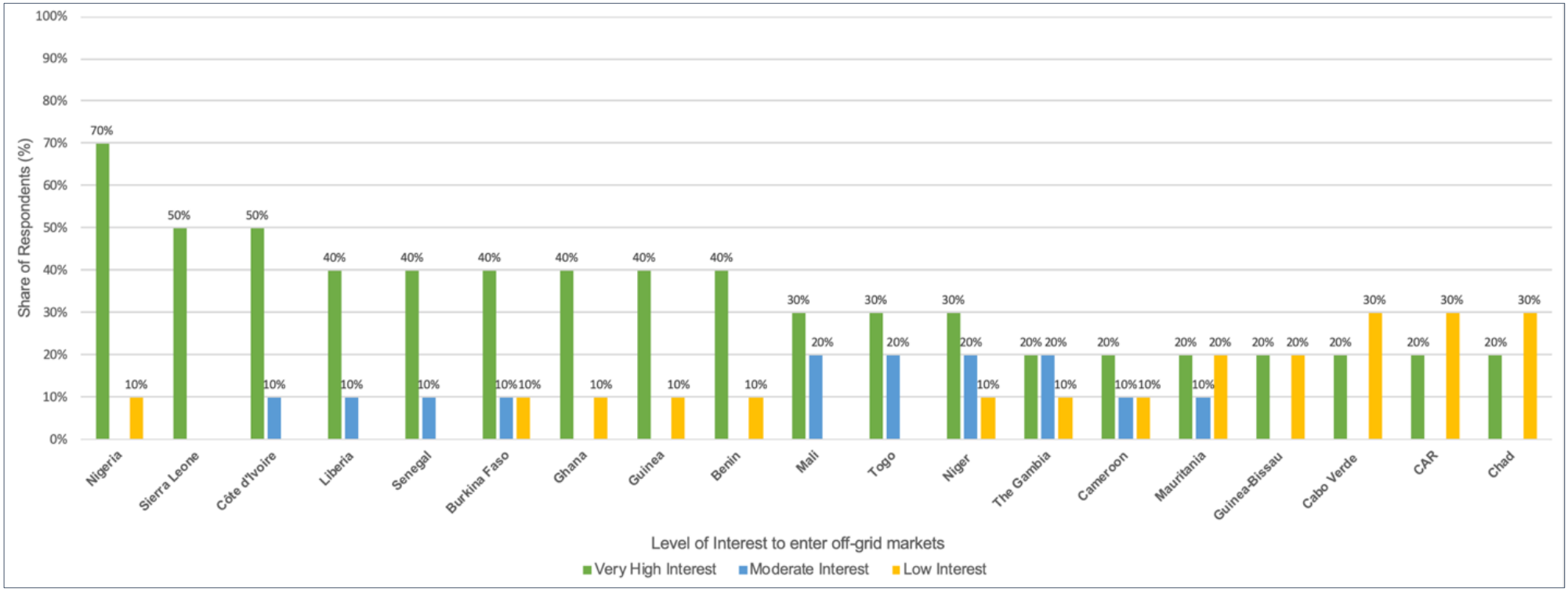
[156] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf
[157] "Off-Grid Solar Market Trends Report, 2018," Dahlberg Advisors and Lighting Africa, (January 2018): https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf
[158] Ibid.
[159] "Insights from Interviews with Off-Grid Energy Companies," ECREEE, (June 2018).

Figure 34: Off-Grid Solar Market and Supply Chain Overview



Source: GreenMax Capital Advisors

Figure 35: Level of Interest in Off-Grid Markets in West Africa and the Sahel among Major Suppliers[160]



Source: Stakeholder interviews; GreenMax Capital Advisors analysis

[160] NOTE: This is not a representative sample of respondents (sample size = 10 respondents). The figure is meant to provide feedback from "major suppliers" of off-grid solar products and services and gauge their level of interest in entering specific ROGEP country off-grid markets. Respondents are all GOGLA members and are either already active in the West Africa and Sahel region or seeking to enter it. The figures presented are the share of respondents (%) who indicated their level of interest in a given country.

2.4.3 Solar Market, Products and Companies in Togo

This section characterizes the current formal market (local and international companies) including recent sales trends, the main solar products, brands and prices.

- **The Formal Market – Local and International Companies**[161]

Focus groups and stakeholder interviews identified nearly 40 companies operating in Togo's solar sector, offering a wide range of products and services to consumers throughout the country (see **Annex 2** for a complete list of identified companies). In addition to local firms, the formal market includes international players that enter the market to install systems for donor-funded projects. As of 2018, most of the solar companies operating in Togo were Tier 1 companies, with the exception of the large international companies working under the CIZO program – BBOXX and Soleva – who distribute stand-alone systems through a PAYG business model with financial support from the GoT (see **Section 1.2.2.1**). To scale up its activities and mobilize additional investment in Togo, BBOXX has partnered with French electricity company EDF. By forming this partnership, the two firms hope to attain a 35% market share in Togo by 2024.[162] Other Tier 3 companies operating in Togo include ACDI, ECM Togo, Otamari, and Projet Production Solaire (PPS) Togo.[163]

Mivo Énergie (EDM), Jeunes Volontaires pour l'Environnement (JVE) and Total Awango are three large distributors of Lighting Global certified products, providing mainly pico solar and/or small solar kits. Mivo Énergie is a Togolese company that was started in 2013 by French NGO EDM that focuses on the distribution of pico solar lanterns and efficient cookstoves in rural areas. The company's operations in Togo are growing quickly; Mivo Énergie sold 4,665 solar lanterns in the first half of 2018, nearly three times as many products as it had sold in all of 2017.[164] Local NGO, JVE, has been operating in Togo's renewable energy sector since 2001, selling pico solar lanterns mainly in the country's southern region of Maritime (Voga).[165] The French petroleum company Total's solar subsidiary, Awango, has formed a partnership with US company d.light to launch its pico solar lantern products in Togo, distributed through its established petrol stations retail network throughout the country.[166]

Outside of the larger market players, most of the local companies surveyed buy their products either directly from manufacturers outside of the country and act as local representatives of their products and brands, or from other local or regional distributors. Most solar companies operating in the market are largely self-financed, with the exception of a few who also have access to bank financing. A few companies offer consumer finance to their customers, while external sources of financing are also available to their customers (e.g. through MFI loans). These companies typically also offer installation and O&M services for the products they sell to customers, including repairs under warrantee.

- **Sales Volumes and Revenue**

Focus group participants indicated that it is challenging to assess the size of the current market due to a lack of standardization in pricing from one company to another and a shortage of sound statistical data.

[161] The data presented in this section was obtained through FGDs, surveys and stakeholder interviews in the country (see **Annex 2**)
[162] "BBOXX and EDF team up to develop off-grid energy solutions in Togo," EDF, (October 2018): https://afrique.edf.com/en/edf-en-afrique/actualites/bboxx-and-edf-team-up-to-develop-off-grid-energy-solutions-in-Togo
[163] "Insights from Interviews with Off-Grid Energy Companies," ECREEE, (June 2018).
[164] "Fiche Programme Mivo Énergie, Accès à l'Énergie au Togo," Entrepreneurs du Monde (EDM), (2017): https://www.entrepreneursdumonde.org/wp-content/uploads/2017/04/TOGO_EDM_MIVO_Fiche-programme-1.pdf
[165] "Présentation JVE au Togo," Jeunes Volontaires pour l'Environnement, (2018): http://jve-international.net/
[166] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf

Moreover, during surveys and FGDs, companies were reluctant to share confidential data on sales volumes and market shares. Local industry stakeholders described the market as having significant volume of sales distributed between hundreds of larger installations (>1 kW) and tens of thousands of consumer product sales along with institutional system market activity.

Using reports published by GOGLA, some basic market information is presented in **Table 37** and **Table 38**. It is important to note that this data only includes figures from GOGLA-affiliated companies and certified product sales and is therefore not fully representative of off-grid solar market activity in Togo.

Table 37: Total Sales Volume and Cash Revenue for Stand-alone Systems in Togo, 2016-2017[167]

Sales Volume / Revenue	2016	2017	Total
Total Volume of Products Sold (Units)			
Total Volume of Products Sold	296	4,588	**4,884**
Pico Solar	252	4,313	**4,565**
SHS	44	275	**319**
Total Cash Sales Revenue (USD)			
Total Cash Sales Revenue	no data	$91,714	**$91,714**
Pico Solar	no data	$78,874	**$78,874**
SHS	no data	$78,874	**$78,874**

Pico solar products categorized as 0-10W
SHS products categorized as >10W

In 2016-2017, about 90% of the overall share of OGS products sold and 92% of total sales revenue in West Africa were pico solar products compared to 10% of products sold and 8% of sales revenue were SHS.

Source: GOGLA, Lighting Global and World Bank; GreenMax Capital Advisors analysis

Table 38: Cash and PAYG Sales Volume and Revenue for Pico Solar Products, H1 2018[168]

Sales Volume / Revenue	Cash	Share (%)	PAYG	Share (%)	Total
Total Sales Volume Togo	**4,505**	**100%**	no data	-	**4,505**
Total Sales Volume West Africa	194,521	65%	104,520	35%	299,041
% of Total Sales Volume in West Africa	2.3%	-	no data	-	1.5%
Total Sales Revenue Togo	no data	-	no data	-	no data
Total Sales Revenue West Africa	$14,972,591	50%	$15,008,999	50%	$29,981,590
% of Total Sales Revenue in West Africa	no data	-	no data	-	no data

NOTE: H1 = First half of year

Source: GOGLA, Lighting Global and World Bank; GreenMax Capital Advisors analysis

[167] "Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2017): https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf; and
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2017): https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth12017_def.pdf; and
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2016): https://www.gogla.org/sites/default/files/recource_docs/final_sales-and-impact-report_h22016_full_public.pdf; and
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2016): https://www.gogla.org/sites/default/files/recource_docs/global_off-grid_solar_market_report_jan-june_2016_public.pdf

[168] "Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2018): https://www.gogla.org/sites/default/files/resource_docs/global_off-grid_solar_market_report_h1_2018-opt.pdf

- **In 2017, 4,588 units were sold in Togo for a total cash sale revenue of USD 91,714:** From the data that is available (only a partial set of data was available), Togo was one of the smallest OGS markets in the region, accounting for less than 1% of total volume sold in West Africa in 2017.

- **Sales figures remain volatile, as Togo is still a nascent off-grid solar market:** Sales volume decreased from 2,668 in H1 2017 to 1,920 in H2 2017 (-28%), reflecting the dynamic nature of the market.

- **While Pico Solar PV products represent the vast majority of products sold in West Africa, the share of sales volume in Togo for these products is comparatively lower**. While regional data from GOGLA for 2016-2017 indicates that pico solar products represented the majority of products sold (about 93% of total sales volume and 86% of sales revenue), the share is smaller in Togo. A study undertaken by IFC suggests that in 2015, 82% of certified products were solar lamps and 18% were SHS.[169]

➢ **Main Solar Products and Components**

Table 39 lists the brands of common solar products and components in Togo. Stakeholder interviews revealed that Sun King Pro and Victron are the two brands with the largest sales volumes. The list does not include non-certified brands that are also common in the country's grey market.[170]

Table 39: Off-Grid Solar Products and Components in Togo

Systems	**Companies**
Distributors of pico solar lanterns	PES-Togo, Youth Volunteers for the Environment (JVE), Total-Togo, Entrepreneurs du Monde (EDM)
Single module distributors	EDM, KYA-Energy-Group, BBOXX, Solartec, PES-Togo, Electrohydrotech, Eco Energy, Veso, Soleva
Multi module system distributors	KYA-Energy-Group, Ezo-Energy, Solartec, Esco-Togo, PES-Togo, Africa Digi Bio Tech (ADBT), Electrohydrotech, Eco Energy, Veso, Soleva, Yandalux, Varta, Steca, Narada, Hoppecke, Yingli, SMA
Very large system supplier	KYA-Energy-Group, Ezo-Energy, Stable Energy, PES-Togo, Africa Digi Bio Tech (ADBT), Eco Energy, Veso
Products/Components	**Brands**
Pico, plug and play system	Sun King, (China), Greenlight Planet (China), Pro (USA), D.light, Barefoot, Niwa (USA), BBOXX, D.light SK, Barefoot Connect Li, Kya Energy Group (Togo)
Solar module	Paris (China), Jinko (China), WinBright (England), Victron
Inverter	Victron (Netherlands)
Lead acid battery	Narada (Netherlands), Victron (Netherlands), Copex (China), WinBright (England)

Source: Stakeholder interviews

[169] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf

[170] In this context, "grey market" refers to products that are not Lighting Global or IEC certified that are typically sold over-the-counter at low prices. Some grey market products are counterfeit or replicas of certified products that undercut the markets of certified products.

➢ Market Prices

Table 40 presents average prices for off-grid systems and components in Togo's solar market.

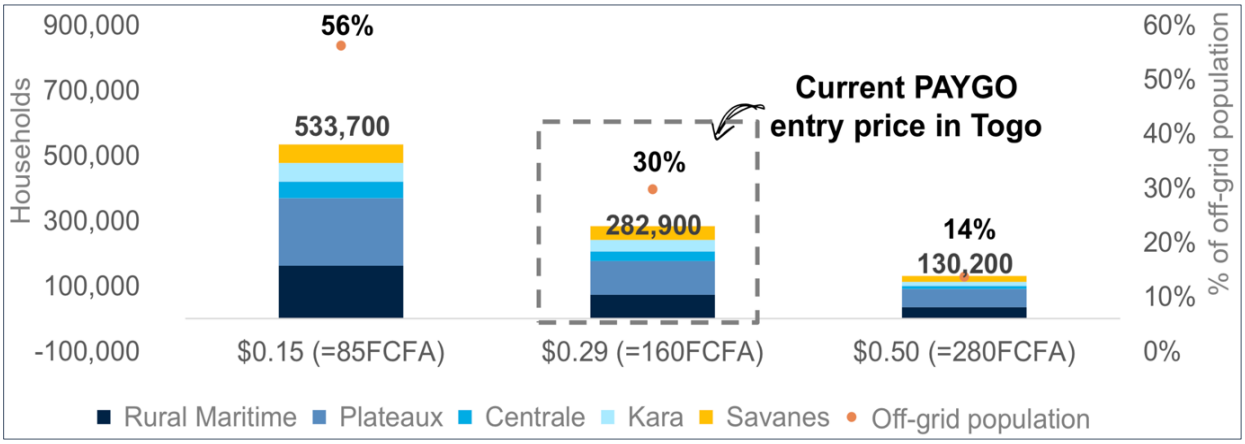
Table 40: Estimated Prices of Solar Systems and Components in Togo

Off-Grid System / Component	Price range (USD / per unit)
Pico solar	$47-$52
SHS (average)	$1,500
Solar Module (500W-5kW)	$70-$4,000
Inverter (3kW-10kW)	$1,600-$8,000
Lead Acid Battery (100Ah-200Ah)	$170-$330

Source: Stakeholder interviews

An affordability analysis undertaken by IFC found that a reduction in prices would significantly expand the share of Togo's market that can be reached by OGS products and services (**Figure 36**).[171] The assessment estimated that reducing the price of OGS products by about half (from FCFA 160 per day to 85 FCFA per day) would drastically increase the affordability of solar products and would grow the market to 500,000 units, or 56% of off-grid households – up from its projection of 280,000 units and 30% of off-grid households under existing price conditions. Geographically, more households would be able to pay in southern regions of Togo (Maritime and Plateau), compared to the rest of the country.[172]

Figure 36: Potential Market for Off-Grid Solar Products by Per-Day Price



Source: International Finance Corporation and Lighting Global

➢ Importation Clearance Processes

The main government body responsible for overseeing the importation of products into the Togolese market is the Togolese Revenue Authority (Office Togolais des Recettes, OTR). The standardization agency in charge of quality and safety standards – Agency Togolaise de Normalisation (ATN) – has authority over renewable energy systems.

[171] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (December 2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf
[172] Ibid.

Solar modules are subject to the WAEMU Common External Tariff, which includes an 18% VAT tax.[173] However, the GoT has introduced more supportive regulations for renewable energy technologies; a new Renewable Energy Law (law No. 2018-10) that passed in July 2018 includes provisions for off-grid energy and fiscal incentives applied to solar products for approved companies, including exemptions and reductions of import duties, company tax, minimum flat tax, property tax and VAT.[174] In addition, a key component of the CIZO program is to reduce taxes and import duties on solar products and to facilitate the importation and logistics process among other supportive measures.[175] Solar products also have to comply with international performance standards, i.e. Lighting Global standards, maintenance and after-sales service, and connectivity.

2.4.4 Overview of Business Models

- **Company Approach to Market**

Historically, solar companies in Togo have developed as vertically integrated companies, many operating across the entire supply chain (as importers, distributors, retailers) and selling a variety of products. About half of the companies surveyed have been in business for more than five years and are well established local players (e.g. Africa Digibiotech, BBOXX, Eco Énergie, Ezo Energie du future, JVE), while most of the remaining surveyed firms have been operating in the solar sector for fewer than three years.

Most companies continue to sell a wide range of products to all market segments; their most important clients are large institutional groups such as government, NGOs, public health facilities or large high-income clients. Some companies have specialized to provide products and services to specific market segments. The main business model is cash/over-the-counter sales, as only a small number of firms have started to utilize PAYG to target low-income households and reach base of the pyramid users in the market.

- **Business Models**

There are five primary business models used in the market (**Table 41),** although in reality PV sector players utilize a number of business models to reach a variety of clients:

- **Over-the-counter cash sales** include both informal and formal components and is the dominant business model in Togo. Many traders simply offer solar products over-the-counter. Formal sector solar companies also stock modules, batteries and balance of system and offer them over-the-counter to do-it-yourselfers and agents. As limited credit is offered along the supply chain, most players have to make up-front payment.
- **System integrators** handle large systems and projects. They design, procure and install systems which range from high-end residential sites, to institutional power to mini-grids. Local integrators represent international solar, inverter and battery brands with whom they partner with on projects. Kya Energy Group designs, assembles, operates and maintains installed solar home systems. The firm specializes in larger systems and assembles systems on site.
- **Plug and play and pico suppliers** cooperate with many of the major off-grid solar brands to distribute products in the country.
- **The PAYG sector** is still in its early stages and represents a minority of companies. Under this model, suppliers build up client bases which number in the tens of thousands and develop credit mechanisms

[173] "Formalités Douanières au Togo," Investir en Zone France (IZF), (2018) : http://www.izf.net/sites/default/files/FORMALITES%20DOUANIERES%20AU%20TOGO.doc

[174] "Loi Relative à la Promotion de l'Électricité à base des Sources d'Énergies Renouvelables au Togo," Government of Togo, (2018): http://www.arse.tg/wp-content/uploads/2018/09/Loi_Energie_Renouvelable_082018.pdf

[175] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf

that fit with local income patterns. Margins are made from subscriptions of thousands of consumers who buy systems through created accounts. The task of installation and after sales services is undertaken by agents. Common products sold include plug and play systems that are fully designed. In Togo, BBOXX is the leading PAYG service provider in the country. More firms will likely start offering PAYG solutions as the country's mobile phone penetration rate continues to increase (**Figure 16**), with the support of two main mobile phone operators – Togocel and Moov – and the increased usage of mobile money services (see **Section 3.2**).

Table 41: Overview of Off-Grid Solar Business Models

Business Model	Strategy and Customer Base	Typical State of Market Development
Over-the-counter solar market	**Formal:** Retailers in Togo are both large-scale (acting as suppliers and distributors) and medium size and are mainly located in large cities and towns around the country. They sell lighting/electrical products, including solar, pico systems and also large panels for urban customers. **Informal:** Kiosks, street vendors form a key pico-product retailer segment (that has not been fully explored). They sell low-priced products which are often short-lived. They have been seen as the entry points for black market low quality solar products to the country.	Mature commercial market Early stage commercial development
System integrator	Integrators operate out of central offices with small specialized staff. They do not typically carry stock for sale over-the-counter. Instead, they deal directly with consumers and institutional clients and provide as per orders. Integrators target the NGO/donor market and participate in procurement tenders for supply and installation of larger systems.	Mature commercial market
Plug and Play system supplier	These suppliers distribute equipment to retailer projects, rural agents, community groups and over-the-counter. Traders of plug and play often sell these devices as part of other businesses.	Early stage commercial development
PAYG Sales	PAYG companies seek to implement the rent-to-own payment-based models used successfully in other countries. The business model is data-driven and relies on mobile money services and a network of agents to meet last-mile customers. Innovative off-grid solar PAYG collaborations between shop-owners, mobile-operators and other larger local businesses are being tested.	Early stage commercial development

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

- **Company Financing**

With overall lack of financial assistance and dedicated financing mechanisms available for the off-grid sector, it can become difficult for companies to finance their operations and grow their business. In addition to financing customer payment options, suppliers also require significant working capital to purchase equipment, conduct marketing campaigns, cover field costs, and high cost of merchandise transportation to rural areas. Distributors of international OGS products receive basic trade finance and marketing support options, though typically limited. Most of the firms surveyed in Togo are self-financed with cash flow covered by on-going business transactions.

As the majority of players are local companies operating in the country, they do not have access to loans, equity and other international funds to finance their growth and development. As a result, most of the solar companies in Togo are unable to raise funds to expand their business. Local financiers have yet to develop an appetite for the solar sector. Focus group participants indicated that local banks tend to be conservative with regard to solar enterprises. Commercial financiers – including banks and MFIs – are not set up to service solar distributor financing requirements. Local SME financing is not available to support businesses in their growth phase. If it was available, companies would make use of cash-flow/credit line financing against the signed contracts with major commercial clients, large NGOs or donors.

When importing, companies are exposed to considerable FOREX risks because they must cover costs of equipment in foreign currency. When projects are delayed, during seasonal low-income periods or when products are delayed in port, dealers must bear FOREX losses. The lack of consumer financing arrangements impedes the growth of the solar market because distributors must take all finance risks and cannot plan with commercial or MFI financing to grow their business.

- **Evolving Business Models**

Togo presents a fertile ground for new business model innovations. Local stakeholders noted that PAYG is the business model with the best growth potential in the market, especially as it is supported under the CIZO initiative. BBOXX has achieved success after piloting a similar initiative in Rwanda prior to entering the Togolese market. New models will require partnerships between developers, solar distributors, telco companies, commercial finance and the retail sector. One of the results of the FGDs was a list of potential partnerships that can be explored to enhance existing and new business models (**Table 42)**.

Table 42: Evolving Off-Grid Solar Business Models

Partnership	Description
Solar Distributors	• Improve efficiency within the supply/distribution chain, positioning them to be able to manage distribution, seek potential for long-term credit lines and capital infusions • Develop better contract terms between large local suppliers in Togo with foreign manufacturers • Test new sales and distribution strategies that increase sales at minimum cost • Prove solar market potential, ultimately attracting a strong group of competing players that scale up solar product access
Commercial financiers	• Commercial financiers are key to unlocking working capital and consumer finance and enabling the market by providing both the funds and means of transferring these funds • Develop financial products for both distributors (financing for working capital needs) and off-grid solar consumers (consumer financing for purchase of systems)
Telecommunications companies and technology providers	• Bring together telecommunications operators, mobile service providers and technology companies and solar supplier/distributor companies to develop Pay-As-You-Go technology platforms • Encourage telecommunications partners to distribute off-grid solar systems through their existing network of agents
Business/Retail Sector	• Comprises networks of retail stores that cover the entire country and provide all types of domestic and agriculture goods for the rural community • Encourage linkages between specialized solar companies and these networks so as to facilitate the increase of the distribution network at a lowest cost possible • Provide promotional tools for local retailers to promote solar products to households/SMEs • Facilitate microfinancing for the domestic market through these networks
Advocacy Bodies	• Capitalize on GoT and donor efforts to (i) facilitate interagency dialogue and oversee policy proposals on new business models and (ii) enhance legislative changes to support the sector

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

2.4.5 The Role of Non-Standard Players in the Market

Stakeholder interviews and FGDs were not able to estimate the size of the over-the-counter informal market. IFC estimates that Lighting Global quality verified products represent an estimated 14% of the market, with the balance (86%) from the informal market and are mostly component based-systems.[176]

Informal traders sell modules, inverters, batteries and pico-products in markets and small shops, typically on a cash basis, with no formal after-sakes services offered. Given that informal sellers are largely unregulated and do not report sales figures, very little data is available on this sector. The sector, however, is very influential as it also controls the delivery of lighting products imported mainly from East Asia. Informal traders understand growing consumer interest in solar solutions and sell competitively-priced low-quality products. Informal traders do not cooperate with the GoT or on formal projects.

Informal traders play an important role in the market because they respond to consumer demand rapidly. Many traders do provide IEC-approved components – this means knowledgeable consumers and technicians can assemble quality systems from over-the-counter selections of components that informal traders sell. It is notable that some informal traders are gaining skills and improving product offerings. The presence of a large informal market, however, leads to issues with equipment quality that hamper development of the country's OGS market.

2.4.6 Equipment Quality and the Impact of Uncertified Equipment

Focus group participants noted that the quality of equipment being distributed under the Government-run electrification programs has been critical to the growth and success of the market. Yet, the prices for this equipment were deemed to be too high given the low purchasing power of most of the rural population. As a result, many consumers still turn to cheaper, over-the-counter informal market products that are sold in electronics shops, hardware stores, kiosks and by street vendors. The sales strategy of this group is to provide low-cost, fast moving products. As a sector, informal retailers provide widely-used lighting products mainly from East Asia to rural customers. However, most of their product range does not meet Lighting Global standards. Moreover, given that the most of their lighting products are low-cost and short-lived, they also ignore and avoid regulations and their products lack warrantees.

Poor-quality and/or counterfeit products negatively impact the entire market by creating a misperception about product quality, which in turn undermines consumer confidence in solar equipment. Moreover, grey-market traders significantly undercut the prices of registered businesses who are still subject to taxes and import duties. Low prices of over-the-counter products make compliant products uncompetitive as many customers opt to buy non-compliant goods that are cheaper.

FGDs and local stakeholder interviews highlighted the concern over the impact of low-quality products on the market. There is a strong desire among licensed suppliers for the GoT to strictly control the influx of solar products at the country's borders and to implement an enforcement mechanism to safeguard product quality.

2.4.7 Local Capacity to Manage Business Development, Installation and Maintenance

Togo's nascent solar market is poised to grow if requisite technical assistance (TA) is provided. While the current market environment is improving under the new Electrification Strategy, CIZO program, and Renewable Energy Law, challenges remain for solar companies. To operate effectively, companies need a

[176] "Off-Grid Solar Market Research for Togo," International Finance Corporation and Lighting Global, (December 2018): https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Off-Grid-Solar-Market-Assessment.pdf

significant amount of both local and international technical and financial expertise, and an ability to make practical decisions about their operations. Companies face a number of technical competency requirements – the selection of approaches and solar PV technologies, the design of their associated marketing instruments and the implementation of related initiatives.

While the CIZO program includes provisions to support development of local solar company capacity, the synergy with formal training institutions has yet to be fully explored and most of the players in the industry are not adequately equipped with the skills needed to design and assess policies, understand and deploy technologies, grasp electricity user needs and ability to pay, and operate and maintain systems. Some of the other areas where TA and capacity building is needed to support growth of the solar market include:

- Provision of TA and training to public and private partners on the development of OGS power projects.
- Support in development of vocational training curricula for solar technicians by working with education institutions to adopt the curricula and implement training programs. This support could include development of community training materials to raise community awareness about the importance of solar PV technologies, the various uses ranging from household use, productive uses and institutional uses of energy, and related safety aspects.
- In order to ensure that interaction with local communities is seamless, the collaborating partners could develop a management training manual for villages addressing the different aspects of solar technologies as well. This could include supporting technicians with troubleshooting posters for on-site display that could help identify and tackle operational issues as they arise.
- Solar technicians were noted to be sparse for some areas and lacking in other areas; as a result, solar businesses send out teams from major cities/towns for any installation and maintenance work. Training people based locally in remote areas to support O&M of solar systems (e.g. battery replacement) could help address this issue and expedite market uptake.

2.4.8 Capacity Building Needs of the Supplier Market Segment

An analysis of the supplier market segment revealed a number of interrelated challenges, including financial, capacity, awareness and regulatory challenges. The focus groups and supplier surveys found that:

- While the industry's largest players have access to various sources of financing, local financing is not widely available (or affordable) to support the sector's development; as a result, many companies are self-financed and do not have the working capital they need to grow and expand their operations.
- Reasons for denied finance by financial institutions included lack of collateral, lack of expertise in finance, the high cost involved in small transactions, and risk aversion.
- Knowledge, technical capacity and expertise is possessed by some professionals in the industry working for large established solar companies; the majority of vendors lack the expertise or knowledge necessary to adequately service the market.
- An improved regulatory framework is necessary to ensure product quality and address issues of low-quality products that compete with certified products sold by formal companies. Tackling this challenge also requires harmonization of pricing in the market.

Table 43 presents various areas of support and associated capacity building for the OGS supply chain in Togo. Attention should be given to the following:

- **Importers/Suppliers**: The July 2018 Renewable Energy Law (No. 2018-10) has granted tax exemption on solar products. This is expected to reduce the cost of financing for importing solar PV and improve the overall quality of products in the market. In addition to supporting suppliers, financing should also be made available to end-users to enable them to purchase OGS systems.

- **Technical Capacity Building**: Focus on growing the number of solar technicians who are adequately skilled to support the supplier network, especially in rural areas. Formalizing this through regulation to require only licensed technicians to design and install solar PV systems is critical. This should be complemented by equally robust efforts to build the capacity of all stakeholders.
- **Financial institutions**: Stakeholders in Togo believe that training should not be limited to technicians and solar players but should extend to local FIs and MFIs to improve their overall knowledge of the solar industry, business models and corresponding financing arrangements and products.
- **Consumers**: Deal with sociotechnical barriers: Although PV technology has advanced tremendously in the last decades, there are still several sociotechnical barriers to adoption, including the local conditions of end-users and the political and financial arrangements of the market. Like most countries in the region, various counterfeit solar PV products have infiltrated the market. Implementation of the regulations and quality/standards to ensure product quality could significantly boost market growth.

Table 43: Capacity Building and Technical Assistance for the OGS Supply Chain in Togo[177]

Area of Support	Description	Rationale
Tax exemptions on solar technology	• Implementation of VAT and import duty exemption on all solar products under new RE law (2018)	• Costs of solar products are inflated by import duties; costs are passed on to customers, making solar less affordable.
Quality control/certification agency	• Ensure that imported products are suitable/relevant to the local context (local standards under ATN) in Togo	• Ensure the quality of products on the market and address the influx of low-quality products • Maintain the trust established between solar industry and customers
Consumer education programs	• Supplier and consumer education and benefit awareness campaigns, targeting both segments, distributors and retailers, with a focus on rural populations	• Overcome negative perceptions and strengthen trust established over the years • Influence purchase decisions, with a focus on rural areas and ease access to distribution channels
Inventory financing facility	• Concessionary credit line so financial institutions can access liquidity for solar market lending; create frameworks that avail loans to solar companies (small household systems, larger PV installations, and mini-grids), pilot with aim of scaling out	• Long inventory financing periods present a key challenge to growth for solar lantern and solar home system distributors • High upfront financing requirements present a key challenge to distributors of larger PV systems (including pumps)
Credit guarantee scheme for inventory financing	• Private sector lending portfolio is de-risked through guarantees and effect loss sharing agreements to cover irrecoverable inventory loans	• De-risking encourages private sector lending to solar sector • Initial security until proof case of economic viability of lending to solar businesses has been established
Market entry and expansion grants	• Combination of upfront grants and results-based financing to invest in infrastructure and working capital	• Significant upfront investment to build distribution network and source inventories to serve household market
Technical assistance	• Help solar companies set up technology platforms for PAYG • Incubation and acceleration of early-stage businesses • Capacity building for solar technicians to enable installation and O&M of equipment • Assess rural communities needs to inform the right business model case by case • Capacity building for local FIs	• Make the business environment more conducive and profitable • Strengthen the overall ecosystem surrounding the solar market • Strengthen capacity across the sector • Ensure knowledge transfer from abroad for faster, more cost-efficient progress

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

[177] Capacity building interventions are proposed for all ROGEP countries at national and regional level under ROGEP Component 1B: Entrepreneurship support, which includes TA and financing for companies in the solar product value chain. Through this component, TA to solar companies can build on existing ECREEE training programs as well as through a new regional business plan competition. Technical assistance can leverage national solar ecosystem stakeholders, and operational national service providers identified and mobilized through this component. The market entry and expansion grants suggested here would also align with Component 1B planned financing interventions for matching grants, repayable grants, co-investment grants, and be connected to the technical assistance interventions.

2.5 Key Market Characteristics

This section reviews the main characteristics of the off-grid solar market in Togo, including a summary of key barriers to and drivers of market growth and an overview of gender considerations. The synopsis presented below is largely based on feedback obtained from interviews with local officials and industry stakeholders, as well as focus group discussions and surveys assessing the demand and supply side of the market (see **Annex 2**).

2.5.1 Barriers to Off-Grid Solar Market Growth

Table 44 examines the key barriers to OGS market growth from the perspective of both the demand and supply side of the market. See **Section 1.3.5** for an overview of the gaps in the country's off-grid policy and regulatory framework.

Table 44: Key Barriers to Off-Grid Solar Market Growth in Togo

Market Barrier	Description
Demand[178]	
Consumers are unable to afford solar systems	• Low-income consumers, particularly in rural areas, lack of access to finance • Purchasing solar products of all varieties among end-consumers remains relatively low.
Lack of initial funding by HHs, businesses and institutions for the initial capital investment	• Relatively high costs of OGS systems (compared to more mature markets in the region) • Consumers rather choose cheaper one-off solutions – like generators and fuel – rather than more expensive up-front solutions that will be cheaper long-term (especially with incremental payments, e.g. PAYG)
A lack of understanding of and trust in solar solutions among consumers impedes development of the market	• There is still lack of general awareness about solar solutions • There is an inability to distinguish between solar products or product quality • Consumers lack information about the most suitable design options, funding options, PAYG benefits and options, points of sales and support, etc. • Products are still not widely available in rural areas, so consumers are unfamiliar with them • Any poor history / track record with OGS will deter consumers from taking expensive risks
Informal sector competition and market spoilage	• The non-standard / unlicensed market still accounts for a majority of OGS product sales • Consumers need to understand the quality and value issues of quality solar products vis-a-vis inferior over-the-counter lighting products and generators. Educated consumers drive markets.
Lack of experience in maintaining the systems and sourcing qualified technicians	• A sustainable approach to O&M is critical for long-term success
Supply	
Technical capacity	• Technical skills lack through the supply chain within the sector, affecting both the upstream, midstream and downstream, thus adversely affecting the ability of the sector to pick up and grow. Majority of the firms decry lack of adequate number of technicians to support the downstream side of the market
Transportation costs	• High transportation costs of inventory deter new entrants; devices and equipment are shipped either from China or from Europe, creating long delivery lead times of up to three months and long inventory holding times once products have arrived in country • Typical supplier payment terms are 30% upon placement of the production order and the remaining 70% upon shipment before any cargo has even left its port of origin. • Transport by container would reduce the costs dramatically; however, this requires purchases in bulk, which local solar distributors aren't able to make without financing

[178] The barriers described here apply to some combination of the Household, Institutional, and SME / Productive Use market segments

Poor sales and performance history of the sector	• A lack of investment into the sector prevents growth; this is due to perceived high risks resulting primarily from lack of track record of sales • Solar distributors have limited alternative financing options. Solar suppliers are unwilling to provide trade financing while commercial financiers in Togo, including banks and MFIs, are currently not positioned to service the financing requirements of solar distributors.
Company finance	• Entrants into the sector require significant working capital, which is not readily available • Equity investments are needed into the local distribution/sales companies. It is quite easy to obtain debt financing and other loans once the solar companies have sufficiently grown and reached the "level of interest" of the larger funds; however, until the number of customers and sales volumes are reached, they need some equity investors to share higher risks with the original founders of the companies
Informal sector competition and market spoilage	• Several informal entrepreneurs have taken advantage of high import duties by illegally importing low-quality solar products ranging from solar lanterns to larger home installations • Black-market traders are able to significantly undercut the prices of registered businesses who are still subject to high taxes and import duties • These products are largely low-grade, failure-prone counterfeits with short lifespans • Damaged perceptions of solar systems durability and reliability hinders market uptake
Lack of data	• No clear figures on the actual needs, actual usage or experience of consumers • The data for the private market players on the available opportunities is very limited and not concise due to fragmented data
High 'transaction costs' for solar installations	• Cash-flow and bureaucratic hurdles for the local suppliers • Sales and O&M services in remote areas can be costly, especially for small businesses

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

2.5.2 Drivers of Off-Grid Solar Market Growth

Table 45 is a summary of the key drivers of OGS market growth in the country.

Table 45: Key Drivers of Off-Grid Solar Market Growth in Togo

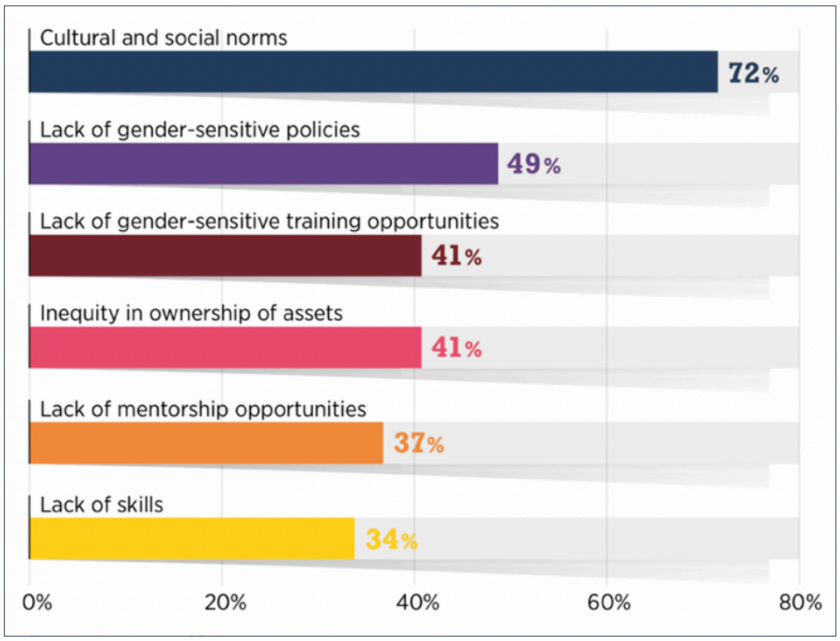
Market Driver	Description
Strong off-grid electricity demand	• Consumers from every market segment are aware of the high costs associated with energy access and consumption and are willing to take on quality, cost-effective alternatives
Willing government to support the industry	• The Government is viewed by sector players as forward-leaning and action-oriented, creating and supporting momentum and positive attention for the solar sector, which helps attract substantial and sustained investment the market (especially with the early success of the CIZO program)
Increased utilization of PAYG	• While Togo's OGS market is only starting to utilize PAYG financing solutions (BBOXX), this model has the ability to grow rapidly by leveraging increasing rates of mobile phone ownership and mobile internet usage in rural areas
Engaged and open-minded private sector	• Local OGS suppliers are actively engaged in efforts to improve / reform the sector, accept new business models and strategies and take measures to attract external investment
Strong donor/NGO presence	• The presence and wide range of donor-funded activities in the country's off-grid sector provides confidence that the market will continue to receive financial and policy support to develop

Source: Focus Group Discussions; Stakeholder interviews; African Solar Designs analysis

2.5.3 Inclusive Participation[179]

Given that the off-grid market is only beginning to emerge in Togo, women are not yet highly engaged in the sector. The overall lack of inclusive participation in the off-grid space is attributable to a wide range of factors. In a 2018 survey that assessed barriers to women's participation in expanding energy access, nearly three-quarters of respondents cited cultural and social norms as the most common barrier, which reflects the need for gender mainstreaming (**Figure 37**). More than half of the women surveyed in Africa identified a lack of skills and training as the most critical barrier, compared to just one-third of respondents globally.[180]

Figure 37: Key Barriers to Women's Participation in Expanding Energy Access



Source: International Renewable Energy Agency

As a starting point, electrification (whether grid-connected or off-grid) increases access to information, which can help challenge gender norms and increase the autonomy of women.[181] Access to electricity can save women time and/or enable them to complete domestic activities in the evening, thus allowing them to participate in paid work during the day. Many opportunities also exist for women in the productive use of energy, including solar-powered machinery that can support productive applications, particularly in the agricultural sector in the areas of irrigation, water pumping, and milling/food processing.[182]

Women, who are often the primary energy users in households, have a strong influence on the energy value chain. Women can take on different roles, including as engaged end-users, community mobilizers,

[179] See **Annex 4** for more details
[180] "Renewable Energy: A Gender Perspective," International Renewable Energy Agency, (2019): https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf
[181] "Productive Use of Energy in African Micro-Grids: Technical and Business Considerations," USAID-NREL and Energy 4 Impact, (August 2018): https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive_use_of_energy_in_african_micro-grids.pdf
[182] "Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Development," UN Women, (2018): http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/sdg-report-fact-sheet-sub-saharan-africa-en.pdf?la=en&vs=3558

technicians, and part time and full-time employees and entrepreneurs.[183] Women also have unique social networks that typically offer greater access to rural households, which can be important to deploying energy access solutions.

Despite these opportunities, women are typically not part of key decision-making processes at nearly all levels of society. Women tend to have limited access to land and capital, as these are often determined by traditional and religious customs that remain deeply rooted in patriarchal traditions. Women also have more difficulty accessing finance due in part to lack of collateral required to guarantee payment and often resort to obtaining loans from money lenders who charge exorbitant interest rates.[184]

The gender analysis undertaken in Togo corroborated many of these trends, and revealed several interrelated challenges that women face in the off-grid sector:

- Women lack access to skills, technical capacity, and education/training
- Women broadly lack access to capital, asset ownership, collateral and credit (e.g. to start a business)[185]
- Extensive household responsibilities reduce their ability to generate income and service credit
- Financial literacy among women remains low and there is a lack of education and information available to women on access to financial resources

A number of initiatives exist that seek to address some of these challenges and help improve the rate of participation among women in Togo's energy and off-grid sectors. The Women Environmental Programme is an NGO that is working to promote gender equality in the country's off-grid sector.[186] Another initiative, the *"Women and Solar Entrepreneurship*" Program, is being implemented by French electricity utility company, Electricity of France (EDF), in partnership with the Togolese institution, Energy Generation. Under the program, EDF will design training modules that will help equip women with skills needed to set up and repair off-grid solar systems as well as teach them more about entrepreneurship in the clean power sector. Energy Generation will leverage its local knowledge of the West African market to support implementation of the training program at various training centers across the region, with initial beneficiaries from Togo, Côte d'Ivoire and Ghana.[187]

In 2018, ECREEE partnered with AfDB to launch a regional workshop to advance the participation of women in the renewable energy sector. The program intends to address the lack of inclusion of women in the energy value chain – only 2% of energy sector entrepreneurs in West Africa today are women. The joint initiative ultimately seeks to develop a pipeline of investment-ready, women-owned energy businesses across the region, including in Togo.[188]

[183] "Renewable Energy: A Gender Perspective," International Renewable Energy Agency, (2019): https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf

[184] See **Section 3.2** for more details.

[185] This is a huge challenge for women in the country, particularly in rural areas, where the population depends on seasonal income from the agricultural sector for their livelihood, which makes loans inaccessible or only available at extremely high interest rates. This issue is examined in further detail in **Section 3.2.**

[186] "WEP Togo," Women Environmental Programme, (2018): http://wepnigeria.net/index.php/wep-Togo/

[187] "EDF Teams Up with Energy Generation in West Africa," Alternative Energy Africa, (6 August 2018): https://www.ae-africa.com/read_article.php?NID=9362

[188] "Feasibility study promotes women's participation in energy transition," ESI Africa, (7 May 2018): https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/

III. ANALYSIS OF THE ROLE OF FINANCIAL INSTITUTIONS

This section begins with an introduction to financial products for the off-grid sector, including for end-users and stand-alone solar companies (**Section 3.1**). This is followed by a comprehensive overview of the country's financial market and commercial lending environment (**Section 3.2**), including an assessment of financial inclusion and a summary any off-grid solar lending activity/programs. **Section 3.3** examines other financial institutions (in addition to commercial banks) that are active in the country. **Section 3.4** presents a summary of key findings from the Task 3 analysis. The data presented in this section was obtained through desk research as well as interviews with/surveys of key officials and representatives from local financial institutions. **Annex 3** provides an overview of the Task 3 methodology.

3.1 Introduction to Financial Products for the Off-Grid Sector

A wide range of financial products can be utilized to support development of the stand-alone solar sector in West Africa and the Sahel. These may include instruments such as matching grants, contingent loans, results-based financing (grants reimbursing cost after completion of work), equity investment (seed capital and later stages), concessional debt (subsidized interest or forgiveness of a portion of principal repayment), short-term commercial credits for inventory purchases and working capital, trade finance solutions (from export credit agencies or private trade funders) and medium-term loans secured on assets or receivables from a portfolio of installed projects. This "financial supply chain" consists of capital delivered at different stages of stand-alone solar enterprise development, by financial sector players that have risk appetites well matched to each specific stage. This section focuses on the roles of commercial financial institutions (FIs) and microfinance institutions (MFIs) in providing debt financing to off-grid solar consumers and enterprises.

3.1.1 Financial Products for End-Users

In order to determine what kinds of debt instruments are available to support stand-alone solar purchases for end-users, it is important to identify the different end-users.

- **Households**

Households represent the majority of end-users in the West Africa and Sahel region and the level of cash flow this market segment has available for energy access depends heavily upon the formal and/or informal economic activity they are engaged in. In general, the ability for households to pay from their own internal resources declines as their distance from urban centers increases and their opportunity to participate in the formal economy with regular cash income declines. Meanwhile, external funding is typically not available for rural households as they remain largely off of the radar of mainstream FIs (with the exception of households where members have regular sources of income from urban centers). MFIs in fact are generally more appropriate sources of household finance. Most of a given country's households can access external funding typically only through microfinance or informal financial services such as local money lenders, cooperative societies and rotating savings and credit associations.

- **Public Institutions**

The main public institutional facilities that require funding for off-grid electrification are directly linked to national, provincial or local administrations and budgets, including schools, health facilities, and other public buildings/lighting systems. Sustainable energy finance for community facilities is typically provided through a ministry, department or agency if the facility falls under the purview of the national or provincial

budget. The challenge is that budget resources are severely limited and constantly face competing priorities; as a result, many public community facilities are left without access to energy.

In order to implement financial products targeting public institutional projects, a few critical questions need to be answered, such as who would be the borrower and whether there are sufficient financial resources available in the budget to pay for the service over a long period of time. This question is also important if these public community facilities end up being included alongside households as part of a local mini-grid.

- **Productive Use**

Financial instruments for SMEs as end-users of sustainable energy represent a very important category of products in that they tend to be commercially viable and are thus important for the long-term sustainability of energy systems. While households and community facilities use energy primarily for consumption, often resulting in other sources of income or budget being allocated to cover the cost of service, SMEs use energy for income-generating activities and can therefore cover electricity costs through the income generated by their business. An enterprise with positive cash flows gives financiers more comfort as well as an opportunity to design financial instruments that are commercial in nature. A loan product with parameters that match the company's ability to service the debt would be a strong and commercially viable option. MFIs often provide short-term loans to microenterprises on this basis while FIs often limit their lending to SMEs with strong balance sheets and available collateral.

- **Commercial and Industrial**

Commercial and industrial (C&I) facilities such as industrial plants, mining operations, shopping malls, logistics and distribution centers or commercial office buildings generally have considerable power consumption requiring energy supply from much larger solar systems that can range from several hundred kW to several MW in capacity. Where there is particularly high cost advantage for stand-alone solar systems over existing energy supply (i.e. vs. diesel generators), some C&I facility owners may find the payback of these investments so attractive that they will seek to purchase the solar power plant outright, often requiring debt financing to complete the transaction. This entails a corporate loan backed by the full faith and credit of the company, a pledge on the installed assets and usually supplemented by additional collateral and personal guarantees posted by the C&I facility owners. Many commercial FIs will offer credits to their existing C&I customers for this purpose but the C&I facility loan applicants are often unable or unwilling to post the required collateral for this specific purpose as their assets may already be encumbered for other business needs.

3.1.2 Financial Products for Suppliers/Service Providers

The stand-alone solar sector remains nascent in most markets across West Africa and the Sahel. The companies offering standalone solar products and energy services are therefore often at start-up or early development stage. Overall by number of players, small indigenous entrepreneurs are well in the majority; however, a few international companies dominate the overall market share. Most equipment is imported with purchases denominated in hard currency, while sales to consumers – whether on a direct purchase, Lease-to-Own (LTO) or Pay-As-You-Go (PAYG) basis – are almost always in local currency. At start-up or early stages of operation, local entrepreneurs, although in need of funding, are usually not ready to take on debt financing and should rely more on seed capital investment and grants until they are able to generate an initial book of business. Once orders begin to materialize, these enterprises have growing funding needs suitable for debt financing instruments which may include the following:

- **Working Capital**

All entrepreneurs need working capital to fuel their business growth and cover basic overheads for operations, marketing and sales. Throughout West Africa and the Sahel, there is a dearth of working capital financing for businesses in all sectors, and the situation is no different for stand-alone solar companies. When available, working capital loans have very short tenors of 3-12 months, must be secured on confirmable cash flows, have difficult-to-meet collateral requirements and carry high interest rates. Since their costs and income are in local currency, local entrepreneurs are best served by working capital loans also denominated in local currency. However, due to high cost of local currency debt, many companies will see advantages in borrowing at much lower interest rates in hard currency as the perceived risk of currency fluctuations across such short tenors is relatively low. Some international companies operating in the West African off-grid solar sector may prefer hard currency financing at the offshore holding company level, depending on how they have structured their local subsidiaries or affiliates in the region.

- **Inventory and Trade Finance**

To fulfill orders, solar system providers need inventory on hand. Equipment suppliers to the off-grid sector in West Africa and the Sahel are usually unwilling or unable to offer generous terms, often requiring down payments with balance due in full at cash-on-delivery (COD). Therefore, these businesses are in dire need of short-term loans of up to 12 months duration to finance inventory purchases. Yet, such loans are hard to come by for developing off-grid enterprises. Since equipment purchase arrangements are usually denominated in hard currency, loans also in hard currency over such short tenors are often acceptable. Trade finance from export credit agencies (ECAs) and private trade funders may also provide good solutions, but these lenders are often unwilling to finance orders under a few million USD or EUR in value.

- **Asset-Based or Receivables Financing**

Once stand-alone solar system providers achieve a portfolio of operating PAYG or LTO installations, the system assets and revenues from customer payments can be used to leverage debt financing to fund business activities and expansion. Typically, a Special Purpose Vehicle (SPV) is established to house the asset portfolio, which is sold by the solar provider to lenders. This form of financing has been widely deployed in East Africa and is also increasingly available in West Africa through a variety of regionally focused specialized debt funds that are focused on portfolio financings in the range of USD 1-10 million.[189]

- **Crowd Funding**

Crowd funding platforms have played an important role in offering working capital, inventory financing and smaller increment asset or receivables-backed loans to off-grid entrepreneurs. Loans of two-five years have been provided to both locally-owned and international solar enterprises with a good number of financings in the USD 150-500K range occurring in Nigeria, Ghana and Côte D'Ivoire.[190]

[189] A total of 11 such specialized debt funds were identified, including those managed by: Sunfunder, responsAbility, Lendable, Sima Funds, Solar Frontier, Neot, Deutsche Bank, Triple Jump, Crossboundary, Lion's Head, Shell and Solar Connect. Only a handful of these have vehicles that are fully funded and deploying capital but as of mid-2018 they reported expectations for financial closings that would make roughly USD 1.5 billion in off-grid focused debt available across Sub Saharan Africa by mid-2019.

[190] The most active crowd funding platforms in the off-grid space have been Kiva, TRINE, Lendahand and Bettervest with the latter two most focused on West Africa.

3.2 Financial Market Overview

3.2.1 Market Structure

As a member of the West African Economic and Monetary Union (WAEMU, or Union Économique et Monétaire Ouest Africaine, UEMOA), Togo shares a currency with seven other countries in the economic community, the West African CFA Franc, which is pegged to the euro. FIs in Togo are regulated by the Central Bank of West African States (Banque Centrale des États de l'Afrique de l'Ouest, BCEAO) and supervised by the WAMU Banking Commission. Within this macroeconomic environment, Togo has experienced relatively low rates of inflation and low interest rates, especially compared to non-WAEMU countries. Between 2009-2014, the average inflation rate for WAMEU countries was approximately 1%, while the average inter-bank interest rate during the same period was about 4%.[191]

The country's financial market is largely made up of three sectors – commercial banks, MFIs and non-bank FIs (**Table 46**). Although stable, Togo's financial sector remains constrained. There are 13 commercial banks, three of which account for about 70% of total commercial banking assets.[192] Compared to other WAEMU countries, Togo possesses a relatively high ratio of non-performing loans (NPLs), while other liquidity and profitability indicators also rank below the monetary union's average (**Table 47** and **Table 48**). The microfinance sector plays a critical role in the overall financial system, as it provides a source of financing to the country's rural population as well as to individuals and businesses that are unable to obtain funding from commercial banks. It is estimated that as many as three-quarters of the nearly 200 MFIs that operate in Togo are unlicensed.[193] Moreover, in 2017, only four of the 16 MFIs that are supervised by the WAMU Banking Commission were fully compliant with regulatory prudential standards.[194]

Table 46: Licensed Financial Institutions in Togo[195]

License Type	Number of FIs
Commercial Bank	13
Micro financial Institution	190
Nonbanking Finance Institutions	18
Three Largest Banks Asset Concentration	69%

Source: World Bank

- **Banking Sector Financial Soundness Indicators**

Asset-Based Indicators: The ratio of NPLs among commercial banks remains above the WAEMU average (**Figure 38** and **Table 47**), while the sector as a whole has also performed below the WAEMU average in measures of liquidity. As of 2017, several Togolese banks were struggling to meet prudential ratios.[196]

[191] "The Landscape for Impact Investing in West Africa: Understanding the current trends, opportunities and challenges," Dalberg and Global Impact Investing Initiative, (December 2015): https://thegiin.org/assets/upload/West%20Africa/RegionalOverview_westafrica.pdf

[192] "Bank Concentration for Togo," World Bank Global Financial Development Database (Federal Reserve Economic Data): https: https://fred.stlouisfed.org/series/DDOI01TGA156NWDB

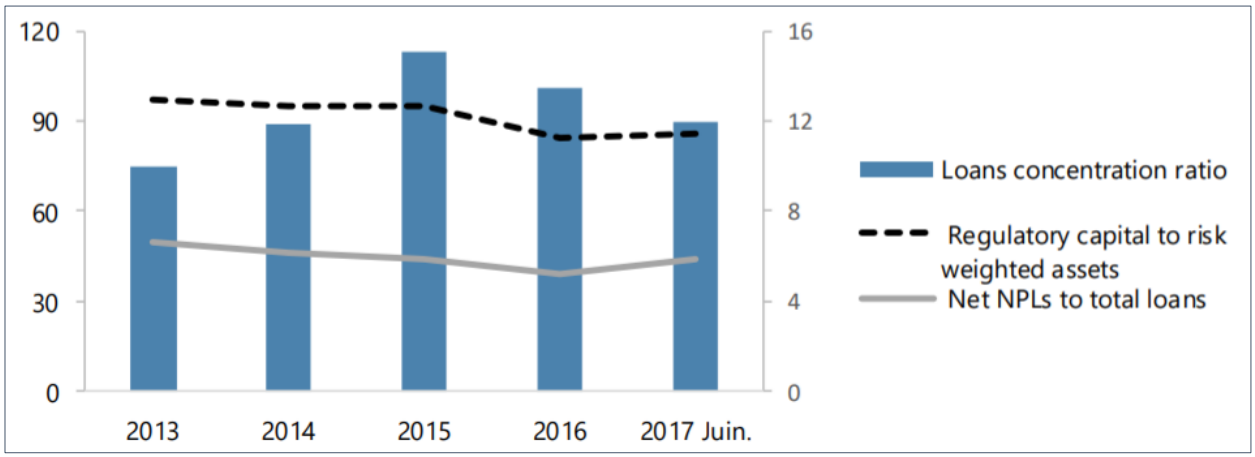
[193] "Housing Finance in Togo," Centre for Affordable Housing in Africa: http://housingfinanceafrica.org/countries/Togo/

[194] "West African Economic and Monetary Union (WAEMU)," International Monetary Fund, (April 2018): https://www.imf.org/en/Publications/CR/Issues/2018/04/25/West-African-Economic-and-Monetary-Union-WAEMU-Common-Policies-for-Member-Countries-Press-45815

[195] "Bank Concentration for Togo," World Bank Global Financial Development Database (Federal Reserve Economic Data): https://fred.stlouisfed.org/series/DDOI01TGA156NWDB

[196] "Implementation Completion and Results Report in The Amount of SDR 8 Million to The Republic Of Togo For a Financial Sector and Governance Project," World Bank, (2017): http://documents.worldbank.org/curated/en/844811491945032256/pdf/ICR00003979-03312017.pdf

Figure 38: Banking Sector Financial Indicators (%)[197]



Source: International Monetary Fund

Table 47: Non-Performing Loans to Total Loans (%)

Indicator	2014	2015	2016	2017
Togo	15.4%	16.6%	15.4%	17%
WAEMU Average	14.9%	14.4%	13.8%	14.6%

Source: International Monetary Fund

Capital-Based Indicators: The banking sector capital adequacy indicators are summarized in **Table 48**. The Togolese banking sector is undercapitalized. In 2017, 20% of the sector's assets exceeded the 8% WAEMU solvency ratio requirement. As a whole, Togolese banking solvency (3.8%) is well behind the WAEMU average of 11%. The sector is also undiversified, as banks are heavily exposed to shocks in the retail and public sectors, which account for 35% and 22% of total loans, respectively. Moreover, there is also a lack of diversification with respect to borrowers; credit to five of the largest borrowers stands at 140% of capital in Togo, compared to 94% in WAEMU.[198]

Table 48: Banking Sector Capital-Adequacy Indicators

Indicator	2014	2015	2016
Regulatory capital to risk-weighted assets (%)	8.5%	6.8%	3.9%
Regulatory tier 1 capital to risk-weighted assets (%)	7.2%	6.1%	3%
Capital to Assets (%)	4.7%	3.7%	1.4%

Source: International Monetary Fund

[197] "West African Economic and Monetary Union (WAEMU)," International Monetary Fund, (April 2018): https://www.imf.org/en/Publications/CR/Issues/2018/04/25/West-African-Economic-and-Monetary-Union-WAEMU-Common-Policies-for-Member-Countries-Press-45815

[198] "Togo," International Monetary Fund, (May 2017): http://commitmentoequity.org/wp-content/uploads/2018/04/cr17128.pdf; and "Togo," International Monetary Fund, (June 2018): https://www.imf.org/~/media/Files/Publications/CR/2018/cr18184.ashx

Income and Performance Indicators: As a result of increasing levels of NPLs, banking profitability has been severely constrained (**Table 49**). As of 2018, Togolese authorities were collaborating with the WAMU Banking Commission to examine a restructuring plan in an effort to address this issue.[199]

Table 49: Banking Sector Profitability Indicators

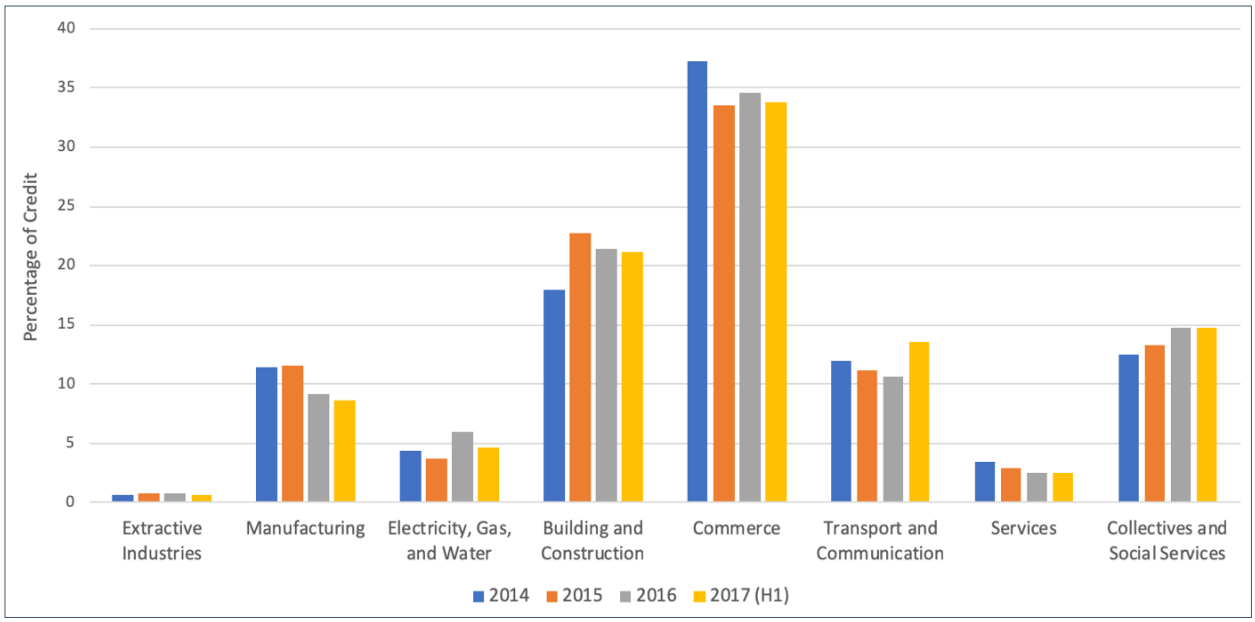
Indicator	2014	2015	2016	2017 (H1)
Return on Assets (ROA)	0.9%	0.7%	2.6%	-2.8%
Return on Equity (ROE)	19.4%	18.7%	181.3%	-57.0%

Source: International Monetary Fund

- **Distribution of Credit by Sector**

Between 2014-2017, the distribution of credit by sector was relatively consistent, with the commercial sector demanding the largest overall share of credit, equal to about one-third of the total (**Figure 39**).[200]

Figure 39: Distribution of Credit by Sector



Source: International Monetary Fund

[199] "Togo: Second Review Under the Extended Credit Facility Arrangement and Request for Modification of Performance Criteria," International Monetary Fund, (2018): https://www.imf.org/en/Publications/CR/Issues/2018/06/22/Togo-Second-Review-Under-the-Extended-Credit-Facility-Arrangement-and-Request-for-46010

[200] Ibid.

3.2.2 Financial Inclusion

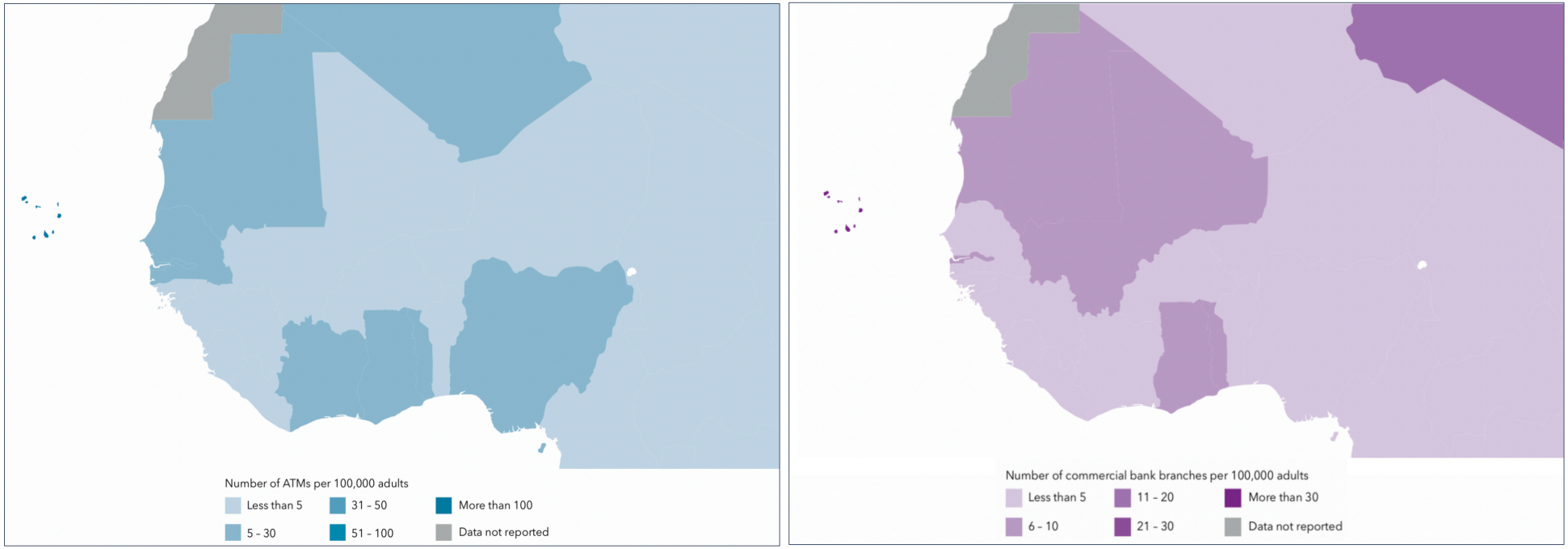
- **Access to Financial Services**

Access to financial services represents an ongoing challenge in West Africa and the Sahel. Overall, about three-quarters of the region's population remains financially excluded, lacking access to banking and financial services through formal institutions (**Figure 40**).[201] There are, however, notable signs of progress. Between 2011 and 2017, the share of the population covered by formal financial institutions increased by nearly 10%.[202] Many countries across the region, including Togo, have also seen a sharp increase in mobile money account ownership (**Figure 41**) and transaction volume (**Figure 42**).

[201] "Le secteur bancaire en Afrique De l'inclusion financière à la stabilité financière," European Investment Bank, (October 2018): https://www.eib.org/attachments/efs/economic_report_banking_africa_2018_fr.pdf

[202] Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution," World Bank, (2017): http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf

Figure 40: ATMs and Branches of Commercial Banks per 100,000 Adults in West Africa and the Sahel, 2017[203]

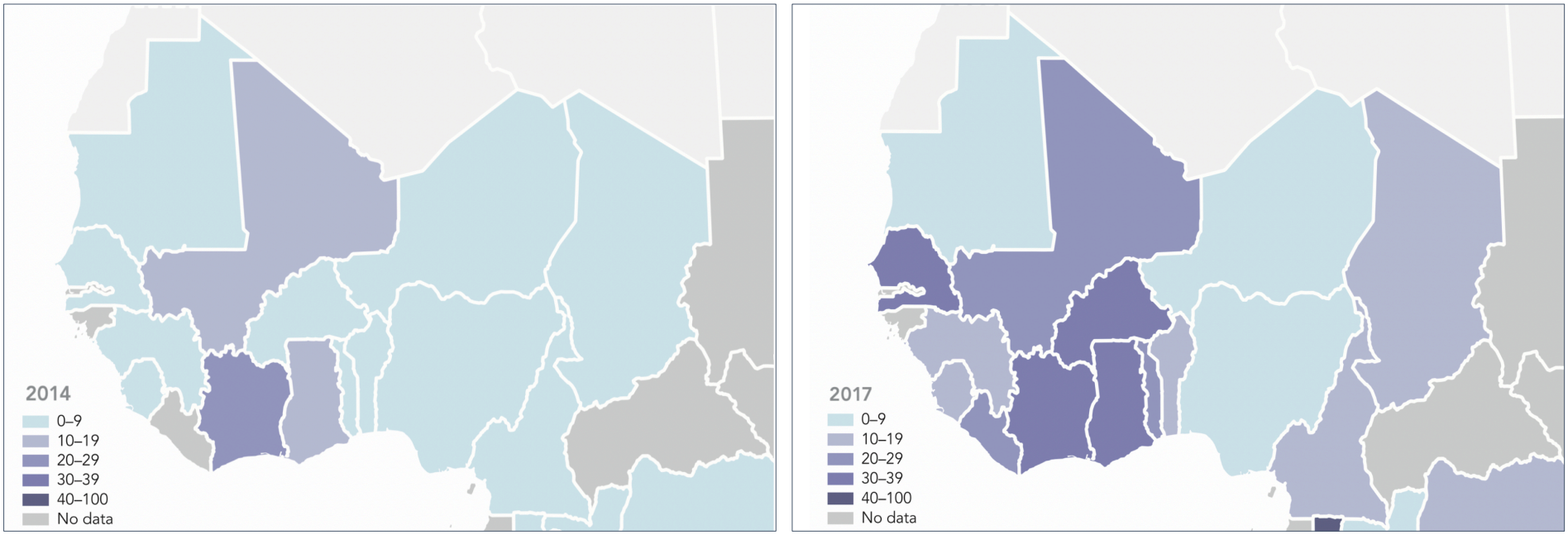


Source: International Monetary Fund

Figure 40 shows the number of ATMs (left) and commercial bank branches (right) per 100,000 adults across West Africa and the Sahel. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. As of 2017, Côte d'Ivoire, Ghana, Mauritania, Nigeria, Senegal and Togo had a relatively higher number of ATMs per 100,000 adults compared to the rest of the region, while The Gambia, Ghana, Mali, Mauritania and **Togo** had a relatively higher number of commercial bank branches per 100,000 adults. Cabo Verde ranked above all countries in the region on both indicators.

[203] International Monetary Fund – Financial Access Survey: http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C&sId=1460054136937

Figure 41: Share of Adults with a Mobile Money Account in West Africa and the Sahel (%), 2014 and 2017[204]



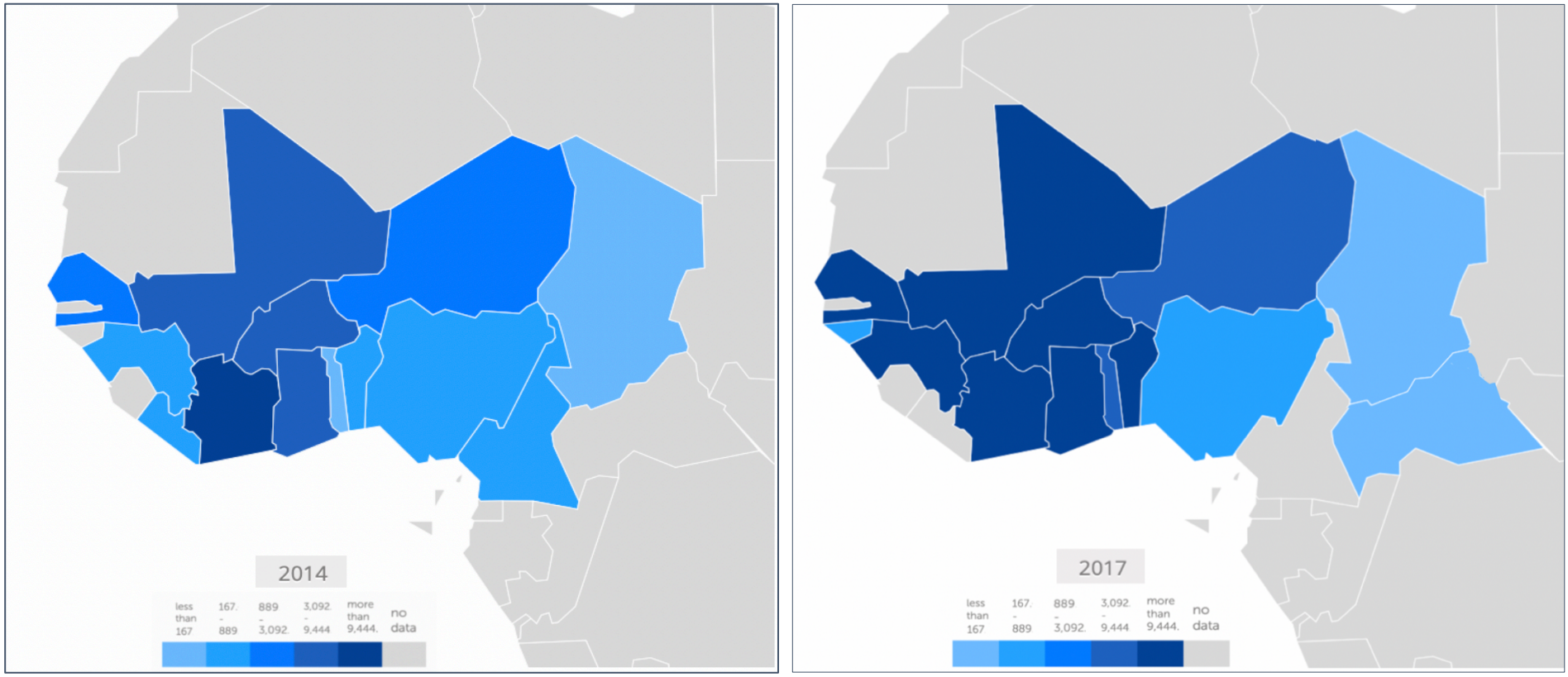
NOTE: Maps exclude Cabo Verde (no data)

Source: World Bank Global Findex Database

Figure 41 shows the increase in the share of adults (%) owning a mobile money account across West Africa and the Sahel between 2014 and 2017. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. As of 2017, the share of adults owning a mobile money account is about 33% in Burkina Faso, Côte d'Ivoire, and Senegal, and 39% in Ghana. Between 2014 and 2017, mobile money account ownership also increased significantly in Benin, Cameroon, Chad, Guinea, Mali, Sierra Leone and **Togo**, while growth in account ownership was slower in Niger, Nigeria and Mauritania. There was either no data or insufficient data available to assess account ownership in Cabo Verde, Central African Republic, The Gambia, Guinea-Bissau, and Liberia.

[204] Demirguc-Kunt et al., 2017.

Figure 42: Mobile Money Transactions per 1,000 Adults in West Africa and the Sahel, 2014 and 2017[205]



NOTE: Maps exclude Cabo Verde (no data)

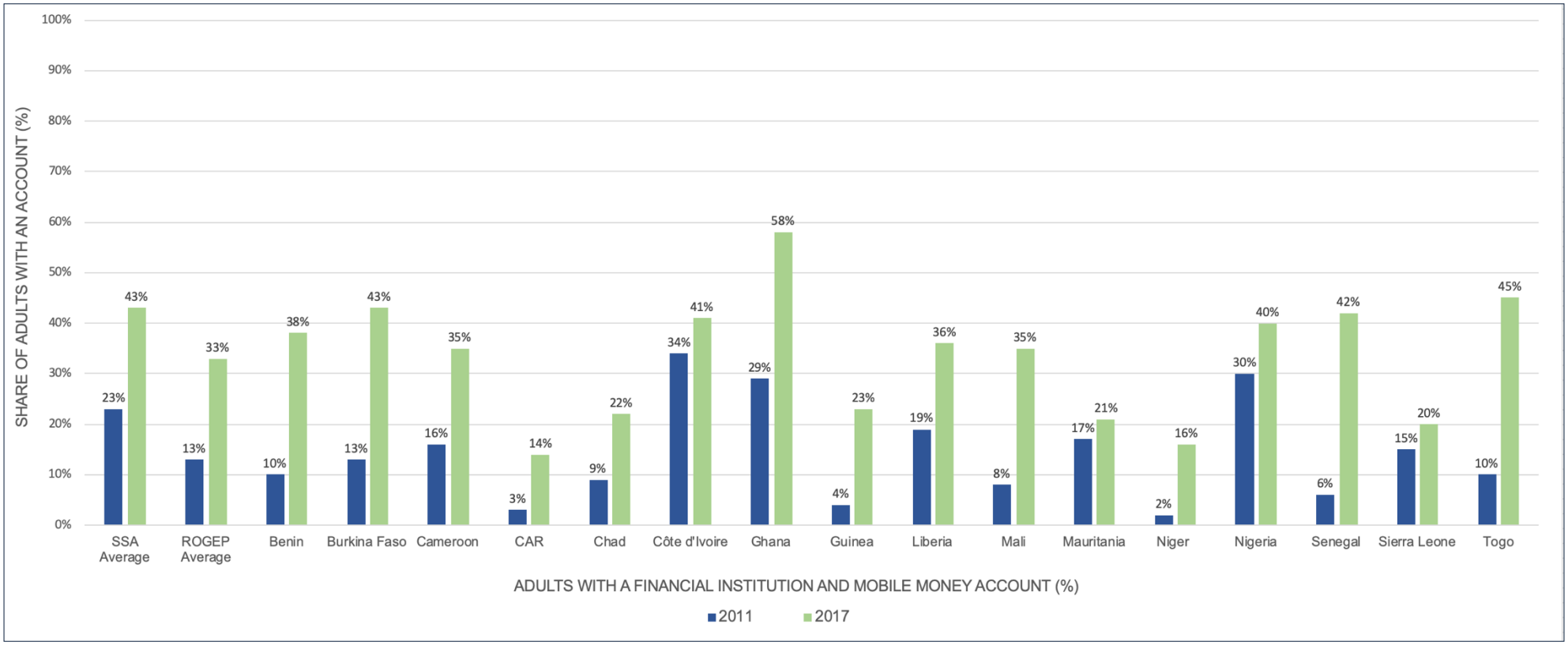
Source: International Monetary Fund

Figure 42 shows the increase in the number of mobile money transactions across West Africa and the Sahel between 2014 and 2017. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. Between 2014 and 2017, mobile money transaction volume increased significantly in Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, Senegal and **Togo**, while growth in transaction volume was slower in Nigeria and Chad. There was either no data or insufficient data available to assess transaction volume in Cabo Verde, Cameroon, Central African Republic, The Gambia, Guinea-Bissau, Liberia, Mauritania and Sierra Leone.

[205] International Monetary Fund – Financial Access Survey: http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C&sId=1460054136937

In 2017, 45% of Togo's adult population had an account at a financial institution or with a mobile money service provider, up from 10% in 2011. In 2017, the country had the second highest rate of financial inclusion in West Africa and the Sahel behind Ghana, 12% above the region's average and slightly above the average for Sub-Saharan Africa (**Figure 43**).

Figure 43: Share of Adults with Access to Financial Services in West Africa and the Sahel (%), 2011 and 2017[206]



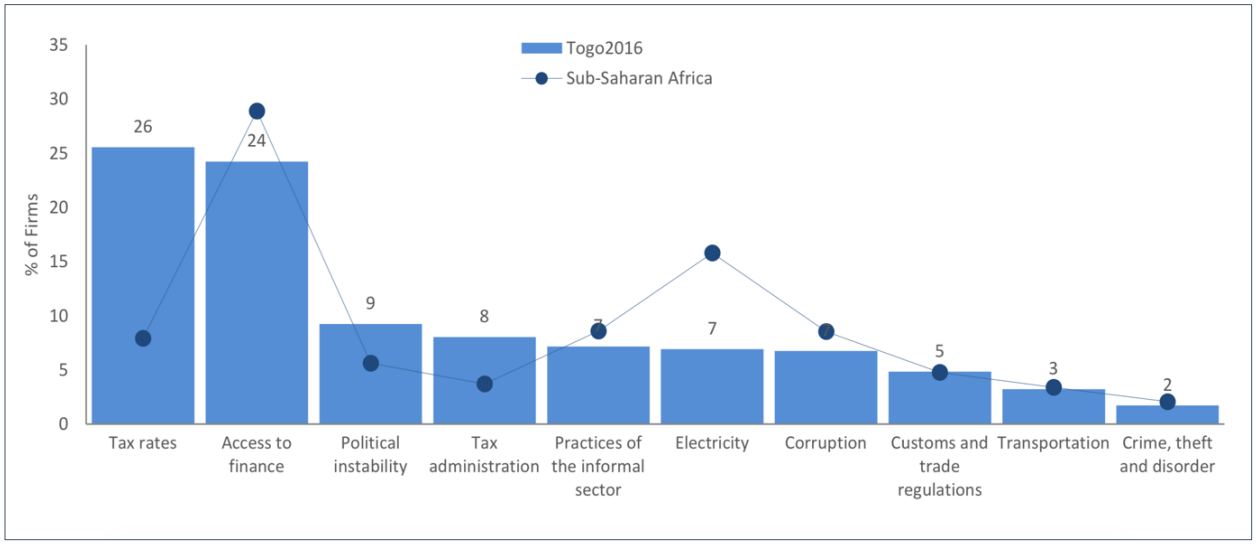
NOTE: Cabo Verde, Guinea-Bissau and The Gambia excluded (no data); data for Côte d'Ivoire is from 2014 and 2017

Source: World Bank Global Findex Database

[206] Demirguc-Kunt et al., 2017.

With 13 commercial banks in the country, the number of institutions relative to the population is extremely low. Moreover, commercial banks operate mainly in urban areas, leaving many rural and low-income people and businesses with limited access to financial services. MFIs have been able to fill this void and provide financing to those in rural areas of Togo. It is estimated that about 200 of these institutions serve roughly 40% of the adult population, a figure that far exceeds the WAEMU average of 16%.[207] Although the number of MFIs has grown significantly over the past decade, access to financing remains a significant barrier for Togolese companies, with 24.2% of surveyed firms identifying this as a major constraint to their business in 2016 (**Figure 44**).[208]

Figure 44: Leading Business Environment Constraints in Togo, 2016

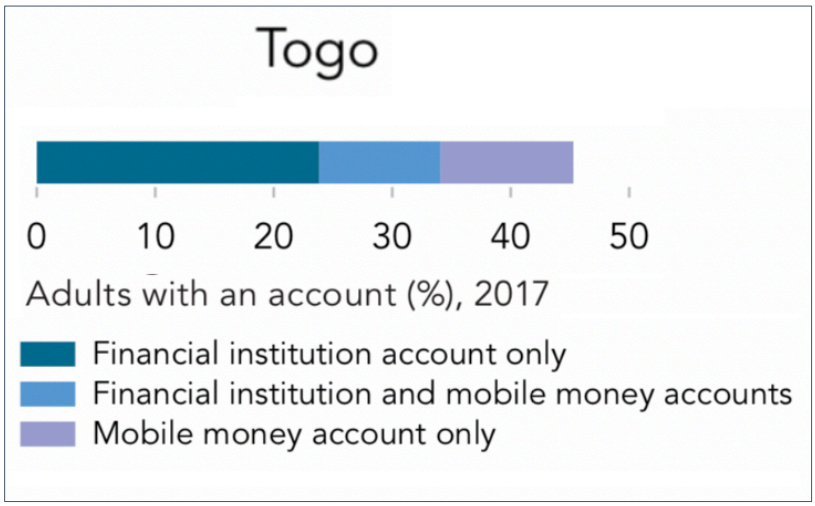


Source: World Bank

Between 2014 to 2017, financial inclusion improved drastically in Togo, increasing by 27%. This represented the second largest increase in the West Africa and Sahel region over this period behind only Burkina Faso. This growth in financial inclusion was driven primarily by the proliferation of mobile money services in the country (**Figure 45**).

[207] "Housing Finance in Togo," Centre for Affordable Housing in Africa: http://housingfinanceafrica.org/countries/Togo/
[208] "Enterprise Surveys: Togo," World Bank, (2016): http://www.enterprisesurveys.org/~/media/GIAWB/EnterpriseSurveys/Documents/Profiles/English/Togo-2016.pdf

Figure 45: Financial Institution Account Ownership[209]



Source: World Bank Global Findex Database

Widespread mobile phone ownership (**Figure 17**), rapidly growing mobile internet usage (**Figure 16**) and extensive network coverage (**Figure 33**), have led to the proliferation of mobile money services and platforms in the country. These dynamics are collectively increasing usage of mobile banking services, expanding overall access to financial services and driving financial inclusion in Togo. Mobile money technology also plays a critical role in the application of off-grid solar solutions, particularly for Pay-As-You-Go systems that rely on the interoperability between digital financial services and stand-alone solar devices.

- **Gender and Women's Financial Inclusion**

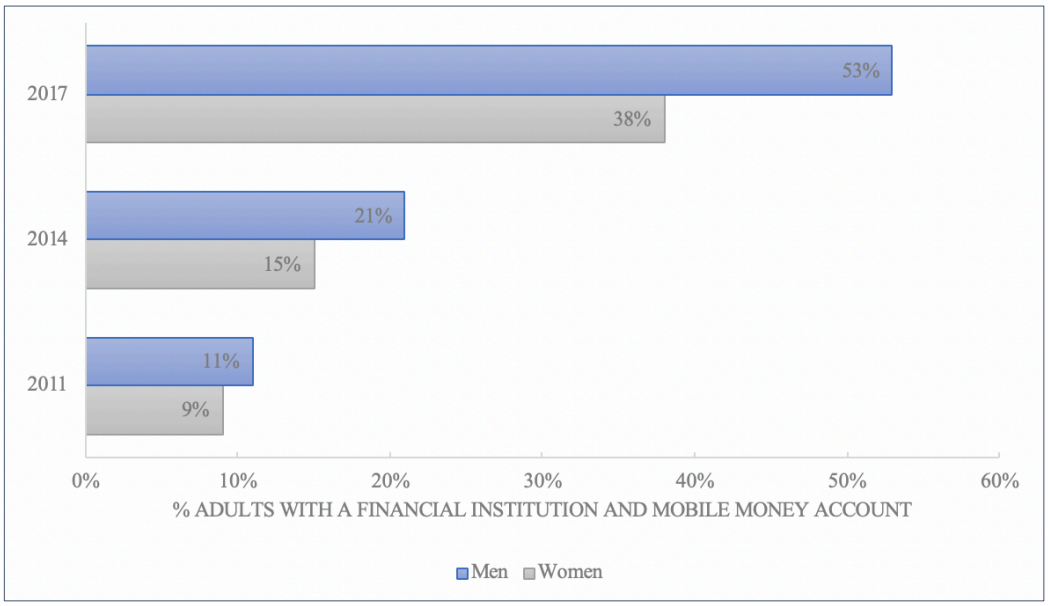
According to data from the World Bank's 2017 Global Findex survey – which examines, among many things, the extent of financial inclusion in Sub-Saharan Africa (SSA) – women in the region are about 10% less likely to have an account at a financial institution or with a mobile money service provider than men. In Togo, the gender gap is slightly higher at 15% (**Figure 46**), as women experience financial exclusion mainly due to low or irregular sources of income and limited access to land and credit. The country's elevated levels of poverty, social and cultural norms, and lower levels of education and rates of literacy make it difficult for women to access and use financial services.

Studies have found that increasing financial inclusion can significantly empower women by increasing savings, reducing levels of inequality, and improving decision-making power in the household. Supportive government policies and regulations are therefore critical to overcoming the barriers that women face and driving overall progress towards financial inclusion.[210]

[209] Demirguc-Kunt et al., 2017.

[210] El-Zoghbi, M., "Measuring Women's Financial Inclusion: The 2017 Findex Story," Consultative Group to Assist the Poor (CGAP), (30 April 2018): https://www.cgap.org/blog/measuring-womens-financial-inclusion-2017-findex-story

Figure 46: Financial Inclusion Gender Gap in Togo[211]



Source: World Bank Global Findex Database

The expansion of digital financial services, especially mobile money, has created new opportunities to better serve women, the lower-income population and other groups that are traditionally excluded from the formal financial system.

Despite the country's overall progress, the gender gap in financial inclusion more than doubled from 6% in 2014 to 15% in 2017, which was among the largest increases in the region over this period. It is worth noting that there are preliminary signs that mobile money might be helping to close the gender gap in financial inclusion, as the gender gap in the share of adults with only a mobile money account is 8%, or about half of the overall gender gap.[212]

In an effort to improve rates of financial inclusion, the Togolese government has implemented several reforms aimed at improving the business climate. In 2012, the National Assembly adopted a new investment code.[213] Subsequently, in 2014, the Government launched the National Inclusive Finance Fund, which provided several customized microfinance products to meet the needs of the country's poorest citizens.[214] The GoT also intends to build upon policies that are being pursued at a regional level. In 2016-2017, the BCEAO, in partnership with the UN Capital Development Fund and the IMF, organized a series of high-level meetings of key West African policymakers to develop a regional policy and strategic framework to improve financial inclusion. Ultimately, the WAMU Council of Ministers adopted an action plan that aimed to expand access to financial services to 75% of the WAEMU adult population over a five-year period. The implementation of this strategy is expected to benefit from financial support from various DFIs as well as technical assistance from the World Bank.[215]

[211] Demirguc-Kunt et al., 2017.
[212] Ibid.
[213] "2013 Investment Climate Statement – Togo," United States Department of State, (2013): https://www.state.gov/e/eb/rls/othr/ics/2013/204747.htm
[214] "Housing Finance in Togo," Centre for Affordable Housing in Africa: http://housingfinanceafrica.org/countries/Togo/
[215] "West African Economic and Monetary Union: Common Policies of Member Countries," International Monetary Fund, (April 2018): https://www.imf.org/en/Publications/CR/Issues/2018/04/25/West-African-Economic-and-Monetary-Union-WAEMU-Common-Policies-for-Member-Countries-Press-45815

3.2.3 Commercial Lending Environment

- **Maturity Structure of Bank Deposits and Credit**

On average, short-term loans are the dominant means of credit in WAEMU countries. On an annual basis, financing provided through short-term loans outweighs that of medium to long-term loans by CFA 386 billion CFA (USD 665 million). This trend does not hold true for Togo, however. In 2012, the maturity structure of bank deposits witnessed a sharp increase in time and savings deposits and a corresponding decrease in demand deposits (**Table 50** and **Figure 47**).[216]

Table 50: Maturity Structure of Bank Deposits

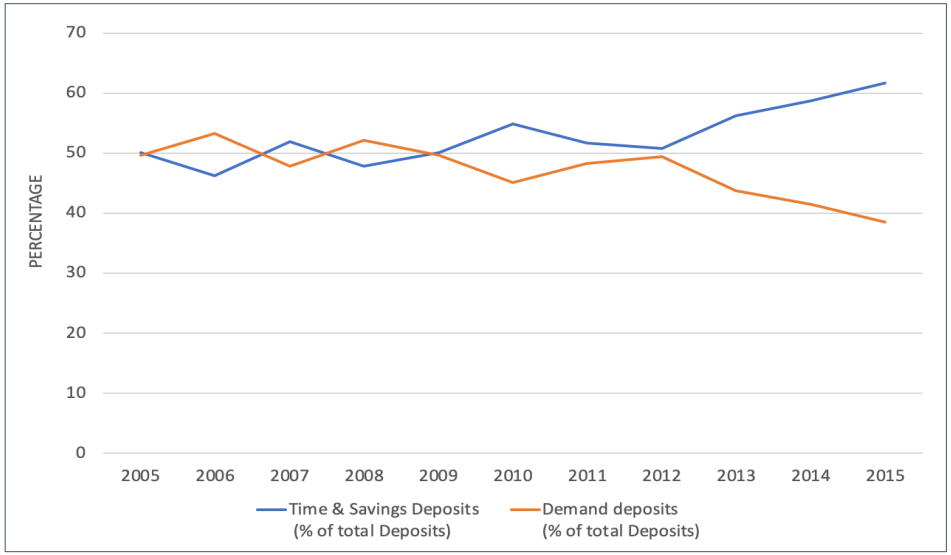
Indicator	2013	2014	2015
Time & Saving Deposits	56.2%	58.7%	61.6%
Demand Deposits	43.8%	41.3%	38.4%

Source: African Developmental Bank

Between 2005-2015, the share of short-term loans steadily decreased as the share of medium and long-term loans increased. Since 2013, the share of medium/long-term loans has exceeded that of short-term loans (**Figure 48**).[217]

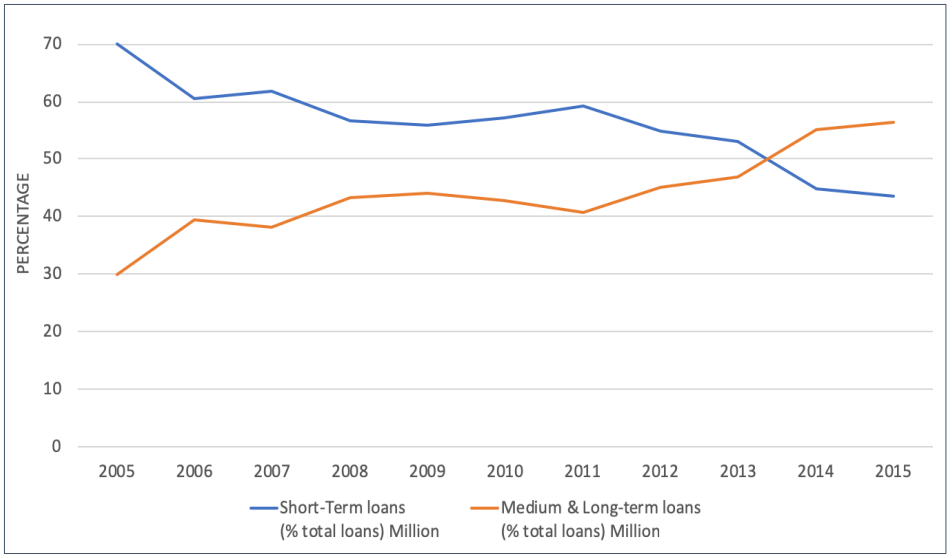
[216] "African Financial Sector Database," African Development Bank, (2016): http://dataportal.opendataforafrica.org/AFDBFP2016/african-financial-sector-database-2016
[217] Ibid.

Figure 47: Maturity Structure of Deposits



Source: African Development Bank

Figure 48: Maturity Structure of Loans



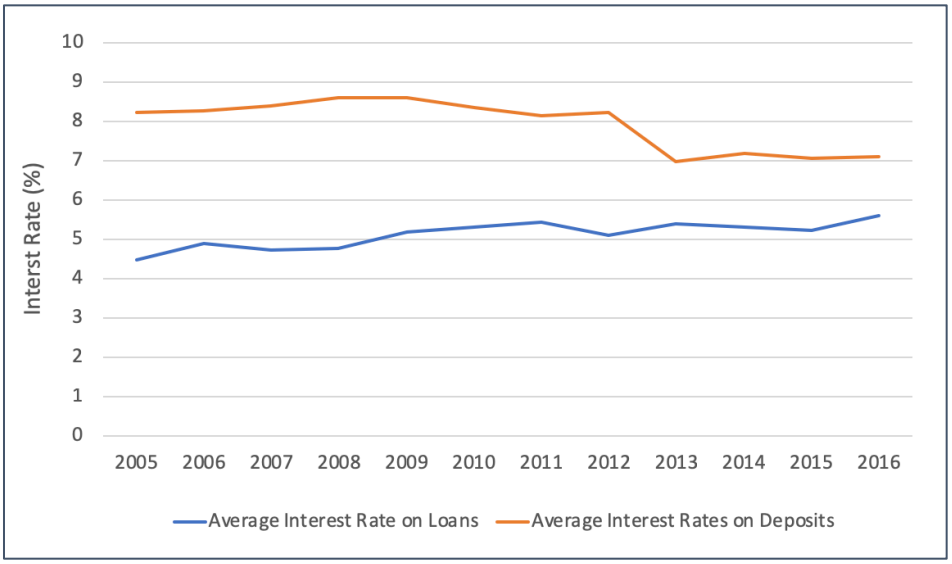
Source: African Development Bank

➢ Interest Rates

As a member state of WAEMU, Togo's monetary policy is decided by the BCEAO. The BCEAO regional monetary policy is heavily dependent on two types of open market operations: (i) refinancing for one week, and (ii) refinancing for one month, allocated at variable rates.[218] In 2017, the weighted average rates for refinancing for one week and one month were around 3.75%. The BCEAO central benchmark rate, or central bank rate, has sustained around 2.5% since 2013, while the marginal lending rate, has hovered around 4.5% in recent years.[219]

Between 2005-2015, Togolese commercial banks have been operating with a negative interest rate spread. The spread has, however, sharply declined in 2012 and leveled off since 2013 to 7% (**Figure 49**).[220]

Figure 49: Interest Rates on Deposits and Loans



Source: African Development Bank

➢ Foreign Exchange Market

As a member state of WAEMU, Togo's currency, the CFA franc, is pegged to the euro. The BCEAO therefore follows the monetary policy of the European Central Bank, which effectively sets interest rates for the CFA franc zone. This pegged exchange rate system limits the ability of member states to quickly respond to shocks. At the same time, CFA zone countries survived the recent collapse of oil prices and commodities without suffering from currency collapse, inflation and fiscal distress like other West African countries.[221] In general, the CFA franc monetary zone consistently outperforms other Sub-Saharan countries in terms of inflation rate and overall macroeconomic stability.

[218] "West African Economic and Monetary Union: Common Policies of Member Countries," International Monetary Fund, (April 2018): https://www.imf.org/en/Publications/CR/Issues/2018/04/25/West-African-Economic-and-Monetary-Union-WAEMU-Common-Policies-for-Member-Countries-Press-45815

[219] "Rapport Annuel de la Commission Bancaire de l'UMOA – 2017," BCEAO, (2018): https://www.bceao.int/sites/default/files/2019-01/Rapport_Annuel_CB_2017.pdf

[220] "African Financial Sector Database," African Development Bank, (2016): http://dataportal.opendataforafrica.org/AFDBFP2016/african-financial-sector-database-2016

[221] Cappola, F., "In Africa: Understanding the CFA Franc and its Foreign Exchange Rate Impact," https://www.americanexpress.com/us/foreign-exchange/articles/cfa-franc-and-its-foreign-exchange-rate-impact/

The CFA franc is backed by a guarantee from the French treasury for the convertibility of the CFA franc into euros at the fixed exchange rate at the Paris Stock Exchange.[222] This provides stability and credibility to the currency. The common currency also expedites trade by removing foreign exchange between the eight member states of WAEMU as well as the six countries in the Economic and Monetary Community of Central Africa (Communauté Economique et Monétaire de l'Afrique Centrale, CEMAC). On a regional level, there are plans to implement a single currency across all of West Africa by 2020, although there are many hurdles to overcome before this degree of macroeconomic convergence can be achieved.[223]

Table 51 presents the official exchange rate of the CFA to USD between 2013 and 2018.

Table 51: Official Exchange Rate (CFA to USD)[224]

Exchange Rate	2013	2014	2015	2016	2017	2018
End of Period	475.64	540.28	602.51	622.29	546.95	572.89
Period Average	494.04	494.41	591.45	593.01	582.09	555.72

Source: International Monetary Fund

- **Collateral Requirements**

A common problem in the West African Economic and Monetary Union is poor judicial processes regarding collateral registry and recovery, as well as a lack of available credit information about the borrower. Hence, most commercial banks require high amounts of collateral in order to mitigate consumer credit risk. In Togo, commercial banks require 265.9% of the required loan; this figure is over 50% above the average for Sub-Saharan Africa and 120% higher than the ECOWAS average (**Table 52**).[225] As a result, a majority of firms in Togo are unable to obtain loans due to high costs of credit, insufficient funds offered, the short maturity of the loans, and/or the amount of required collateral.

[222] Hallet, M., "European Economy: The role of the Euro in Sub-Saharan Africa and in the CFA franc zone," European Commission Directorate-General for Economic and Financial Affairs, (2008): http://ec.europa.eu/economy_finance/publications/pages/publication13478_en.pdf

[223] Liedong, T., "Could West Africa introduce a single currency?" CNN, (August 8, 2017): https://www.cnn.com/2017/08/08/africa/single-currency-west-africa/index.html

[224] International Financial Statistics (IMF): http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B

[225] Quartey, P., Turkson, E., Abor, J., Abdul Iddrisu, A., "Financing the growth of SMEs in Africa: What are the constraints to SME financing within ECOWAS?" Review of Development Finance, (June 2017): https://www.sciencedirect.com/science/article/pii/S1879933717300362?via%3Dihub

Table 52: Collateral Requirements for a Loan

Indicator	Collateral Requirement
Togo	265.9%
Sub-Saharan Africa	213.5%
ECOWAS	147.4%

Source: ECOWAS

- **Banking Supervision**

The corporate financial regulatory framework is determined by legislation issued by WAEMU and the Organization for the Harmonization of Business Law in Africa (L'Organisation pour l'Harmonisation en Afrique du Droit des Affaires, OHADA). In 2016, the WAEMU Council of Ministers adopted measures to implement the Basel II and Basel III rules into the monetary union, designed to further preserve resilience in the banking sector by increasing capital requirements and controlling risk profiles. In addition, BCEAO adopted regulations to establish Credit Information Bureaus (Bureaux d'Information sur le Crédit, BICs) within the monetary union, which were designed to reduce asymmetric information between customers and banks by providing economic and financial information to customers.

The central bank also implemented regulations to improve its ability to enforce existing regulations. The instructions focused on how to set up internal audit systems, compliance audit systems and provisional administration for BICs. The provisions also defined the sanctions applicable to BICs and established the amounts required to set up a special reserve to ensure their long-term viability. Reporting systems and procedures were also put in place to ensure that financial statements of credit institutions were reliable and also prepared in a timely manner.[226] Togo adopted these regulations in 2016.

3.2.4 Lending to the Off-Grid Solar Sector

While there are several government, donor and DFI-funded programs and initiatives that have provided financing to support development of Togo's off-grid solar market, these funds have not been channeled through local commercial banks or MFIs. ROGEP is therefore a pioneering initiative in the country, as it endeavors to boost OGS lending via engagement with local financial partners. Local FIs are increasingly becoming more aware of the opportunities in the off-grid space, and interviews FIs revealed a willingness to participate in providing financing to the sector.

At present, the Government's 'CIZO' program, which aims to achieve universal energy access by 2030, is providing subsidies to households to offset the purchase of solar home systems.[227] BBOXX, one of the private solar companies that has partnered with the GoT under the CIZO project, received USD 4 million in debt financing from Union Togolaise de Banque as well as a 50% pro-rata credit enhancement from the African Guarantee Fund.[228]

[226] "2016 Annual Report," Banque Centrale des Etats de l'Afrique de l'Ouest (BCEAO), https://www.bceao.int/sites/default/files/2017-12/2016_annual_report_2.pdf

[227] See **Section 1.2.2.1** for more details on the CIZO initiative.

[228] "BBOXX receives invitation to meet President of Togo to roll out 300,000 solar home systems," BBOXX, (July 2017): http://www.bboxx.co.uk/bboxx-receives-invitation-meet-president-Togo-roll-300000-solar-home-systems/

3.2.4.1 Programs Supporting Financial Institutions in Off-Grid Solar Lending

- **AFD Sustainable Use of Natural Resources and Energy Finance (SUNREF)**

SUNREF is a credit line provided by AFD for financial institutions and their clients that aim to fund clean energy projects. SUNREF includes TA and credit facilities to provide banks with the necessary long-term financing to overcome financial barriers met by project sponsors. The program is open to companies seeking to obtain easier access to green finance and banks seeking to develop their green finance portfolios. In 2014, Orabank, Société Générale and AFD signed a partnership agreement to launch SUNREF's West Africa program, which makes a EUR 30 million (CFA 19.6 billion) credit line available to banks in the WAEMU (Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo).[229]

SUNREF West Africa recently partnered with Orabank Togo to provide a EUR 400,000 loan to La nouvelle SOTOTOLES, a Togolese steel business, to acquire a new high-efficiency dual-fuel furnace and a device aimed at replacing diesel with liquefied petroleum gas (LPG). The investment helped the firm reduce its energy costs and improve the energy efficiency of its operations.[230]

3.2.4.2 Key Barriers to Off-Grid Solar Lending

- **Unfamiliarity with the Off-Grid Solar Sector**

With the exception of a few local banks engaged with the Government's CIZO program, most FIs in Togo are unfamiliar with lending to off-grid solar projects and companies and have a limited understanding of the nascent sector. During stakeholder interviews, many of the FIs noted a lack of expertise in assessing OGS risks and in structuring/developing customized products for the sector. While programs such as SUNREF have supported participating FIs, there remains a significant gap in overall local capacity. Nearly all of the interviewed FIs stressed that technical assistance would be necessary to facilitate off-grid solar lending.

- **Maturity Structure of Bank's Funding**

The sizable share of short-term deposits limits the ability of banks to offer longer-tenor consumer financing products, which are necessary to accelerate off-grid solar market growth.[231] Lease-to-Own and Pay-As-You-Go (PAYG) payment models reduce entry barriers for consumers by allowing for small, incremental payments for electricity which are more affordable, rather than demanding a high up-front cost for installation and service.[232]

- **Low Private Sector Credit**

Commercial bank credit to the private sector remains weak and continues to constrain development of the OGS sector. As described in **Section 3.2.2**, access to finance remains a key barrier for businesses in the

[229] SUNREF: https://www.sunref.org/en/sunref-elue-meilleure-solution-financiere-pour-lenergie-durable-en-afrique-de-louest/
[230] AFD SUNREF: https://www.sunref.org/en/projet/renouveler-lequipement-et-ameliorer-lefficacite-energetique-dune-usine-de-siderurgie-au-Togo/
[231] The shift from short-term deposits and loans to longer-term deposits and loans (**Figure 47** and **Figure 48**) is noteworthy given the importance of longer-term consumer financing to the OGS sector.
[232] Solar companies participating in the CIZO program are currently deploying these models with financial support from the Government

country. The use of bank loans for working capital and investment is extremely low in Togo. This hinders solar companies from investing in the growth of their business and expansion of their operations.

- **Lack of Credit History/ High Collateral Requirements**

As described in **Section 3.2.3**, consumers in Togo face very strict collateral requirements – significantly higher than other countries in the region (**Table 54**). Many consumers also lack basic financial literacy and knowledge about the terms and conditions of financial products and therefore struggle to obtain loans. The lack of credit history/track record and the weak balance sheet of most off-grid solar enterprises is a critical barrier that often prevents these firms from meeting the collateral requirements of banks. When compared to domestically-owned enterprises, foreign-owned firms are typically more likely to obtain financing.[233] All of the interviewed commercial banks indicated that credit guarantees would be necessary to encourage lending to the off-grid sector.

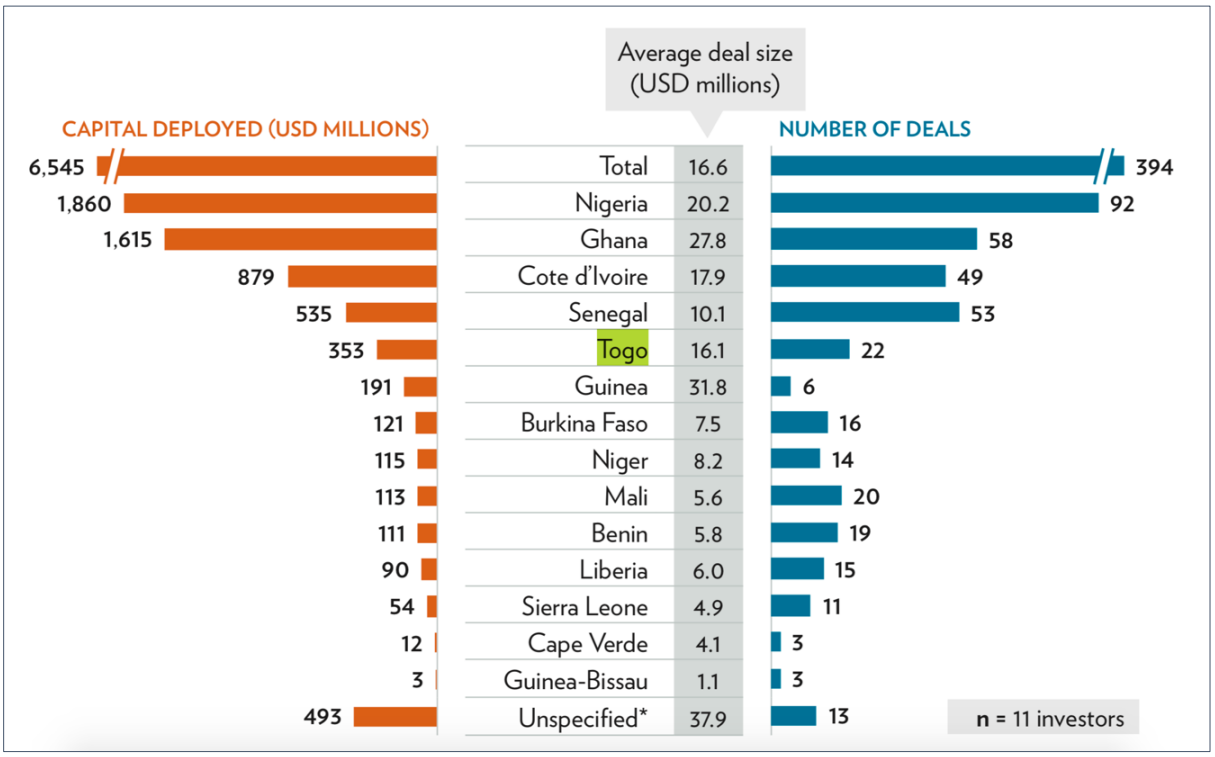
[233] Quartey et. al., 2017.

3.3 Financial Institutions[234]

3.3.1 Development Finance Institutions

Between 2005 and 2015, Togo received a total of USD 353 million in DFI funds with an average deal size of USD 16.1 million; the amount comprised 5.4% of the total DFI investment across West Africa over this period (**Figure 50**).[235]

Figure 50: DFI Investment in West African Countries, 2005-2015



Source: Global Impact Investing Network and Dahlberg

Apart from the above-mentioned AFD/PROPARCO SUNREF program, DFI programs that are relevant to the OGS sector in Togo are described below.

- **African Development Bank Sustainable Energy Fund for Africa / Facility for Energy Inclusion**

The **Sustainable Energy Fund for Africa (SEFA)** is a USD 60 million multi-donor trust fund administered by the African Development Bank with the objective of supporting sustainable private sector led economic growth in African countries through the efficient utilization of clean energy resources and support small- and medium-scale renewable energy project development.[236]

[234] Excluding commercial banks, which are reviewed in detail in **Section 3.2**.
[235] "The Landscape for Impact Investing in West Africa: Understanding the Current Status, Trends, Opportunities and Challenges," Global Impact Investing Network and Dahlberg, (2015): https://thegiin.org/assets/upload/West%20Africa/RegionalOverview_westafrica.pdf
[236] "Sustainable Energy Fund for Africa," African Development Bank, (2018): https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/sustainable-energy-fund-for-africa/

The **Facility for Energy Inclusion (FEI)** is a USD 500 million Pan-African debt facility created by the AfDB to support the achievement of its access to energy goals by providing debt capital to SHS companies, small independent power producers and mini-grid developers. The FEI Off-Grid Energy Access Fund (OGEF), structured by Lion's Head in partnership with the Nordic Development Fund, supports transaction structuring, provides local currency options to reduce risk for borrowers and their customers, and also offers technical assistance to companies to support off-grid market development.[237]

The launch of the FEI in 2016 led to a significant increase in AfDB financing for distributed renewable energy throughout Sub-Saharan Africa.[238] The FEI OGEF, which launched in 2018, will initially focus on East Africa, Côte d'Ivoire, Ghana and Nigeria.[239]

- **International Finance Corporation (IFC)**

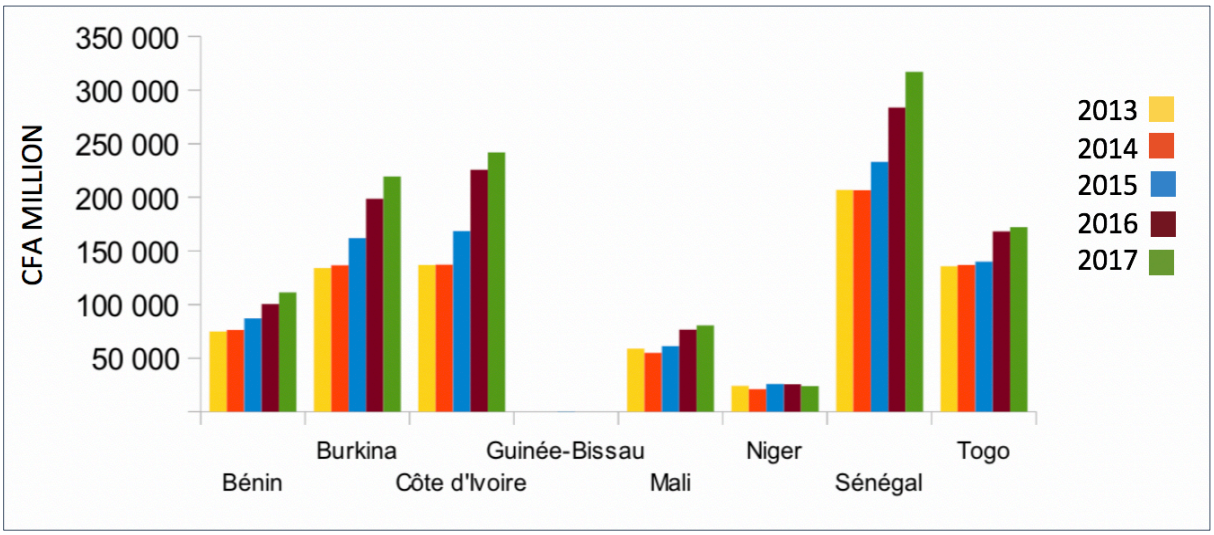
In June 2018, the IFC announced it had invested USD 60 million in a regional risk-sharing facility to support Bank of Africa Group's lending to SMEs in eight African countries, including Togo. Half of the facility is earmarked for women-run businesses, and for climate-related improvements, such as energy efficient equipment upgrades, small solar systems, and climate-smart agricultural supply chains. IFC's investment will cover up to 50% of the risk on these SME loans.[240]

3.3.2 Microfinance Institutions

The microfinance sector in the WAEMU region was formally organized under the Regulatory Program for Mutual Support (Programme d'Appui à la Réglementation des Mutuelles d'Epargne et de Credit, PARMEC), which authorized BCEAO to regulate MFIs through the WAEMU Banking Commission. MFIs with deposits greater than CFA 2 billion (USD 3.4 million) are regulated under PARMEC, while all others are governed through local institutions. As of 2017, there were over 650 MFIs active in WAEMU countries, with 13 million individuals as direct beneficiaries.[241] **Figure 51** and **Figure 52** below illustrate trends in MFI deposits and credits, respectively, in WAEMU between 2013 and 2017. Togo has witnessed a steady increase in both deposits and credits over this period.

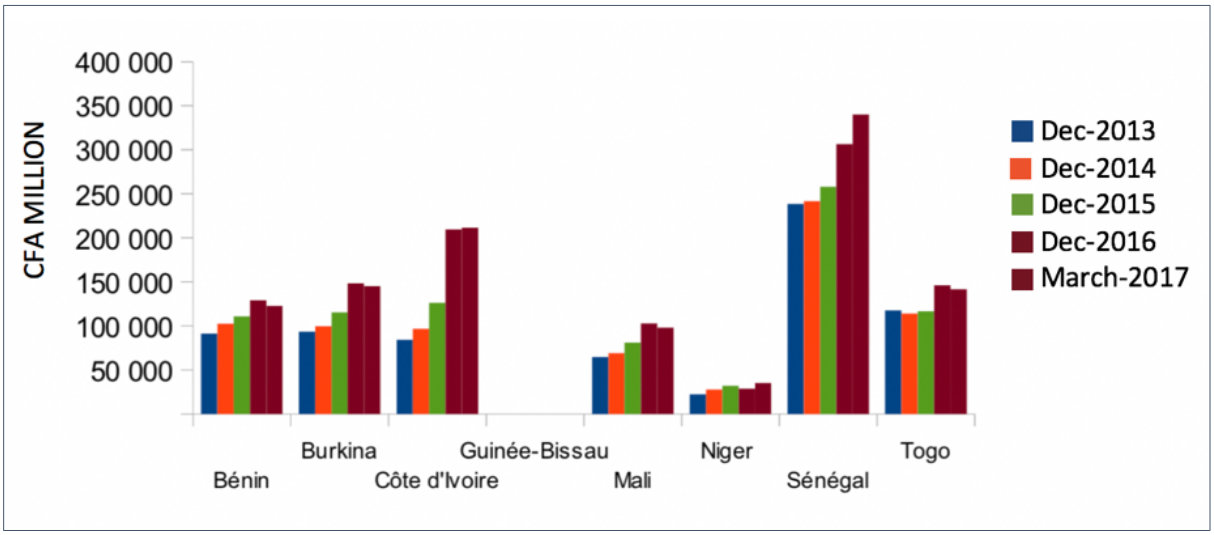
[237] Facility for Energy Inclusion – Off-Grid Energy Access Fund: https://www.ogefafrica.com
[238] Lee, A. Doukas, A. and DeAngelis, K., "The African Development Bank and Energy Access Finance in Sub-Saharan Africa: Trends and Insights from Recent Data," Oil Change International and Friends of the Earth U.S., (November 2018): http://priceofoil.org/content/uploads/2018/11/AfDB-Energy-Access-Finance-report-high-quality.pdf
[239] "African Development Bank, Nordic Development Fund and Partners launch Off-Grid Energy Access Fund with US$ 58 million," African Development Bank Group, (August 27, 2018): https://www.afdb.org/en/news-and-events/african-development-bank-nordic-development-fund-and-partners-launch-off-grid-energy-access-fund-with-us-58-million-18432/
[240] "IFC Invests in Bank of Africa to Expand SME Lending in Eight Countries," International Finance Corporation, (4 June 2018): https://ifcextapps.ifc.org/ifcext/pressroom/ifcpressroom.nsf/0/947B76E4C106A246852582A200440E1C?OpenDocument
[241] "Situation du Secteur de la Microfinance dans L'UMOA au 31 Mars 2017," BCEAO (2017): https://www.bceao.int/sites/default/files/2017-11/situation_de_la_microfinance_a_fin_mars_2017_1.pdf

Figure 51: Microfinance Deposits in WAEMU



Source: BCEAO

Figure 52: Microfinance Loans in WAEMU



Source: BCEAO

In Togo, local MFIs are governed by the Ministry of Finance and Economy. The Mutualist Cooperative Savings and Credit Institutions (CAS-IMEC), created in 1996, is the Togolese national body responsible for regulating mutual institutions, savings, and credit cooperatives and for overseeing the microfinance sector.[242] The majority of MFIs in the country are unable to adhere to regulatory requirements; consequently, 174 of the 190 MFIs in the country are licensed (**Table 53**), which makes supervision of these institutions a significant challenge for national and regional regulatory bodies.[243]

[242] FInDev Gateway: http://www.findevgateway.org/fr/pays/Togo

[243] "Togo: Staff Report; and Statement by the Executive Director for Togo" International Monetary Fund, (2017): https://www.imf.org/en/Publications/CR/Issues/2017/05/17/Togo-2016-Article-IV-Consultation-and-Request-for-a-Three-Year-Arrangement-Under-the-44928

Table 53: Microfinance Sector Indicators, 2017

Microfinance Institution	Number
Micro Financial Institution	190
MFI Supervised by Banking Commission	16
Informal MFIs (Unlicensed)	174
Follow Prudential Ratios	20
Fully Comply with Prudential Ratios	4

Source: International Monetary Fund

3.3.3 Informal Financial Institutions

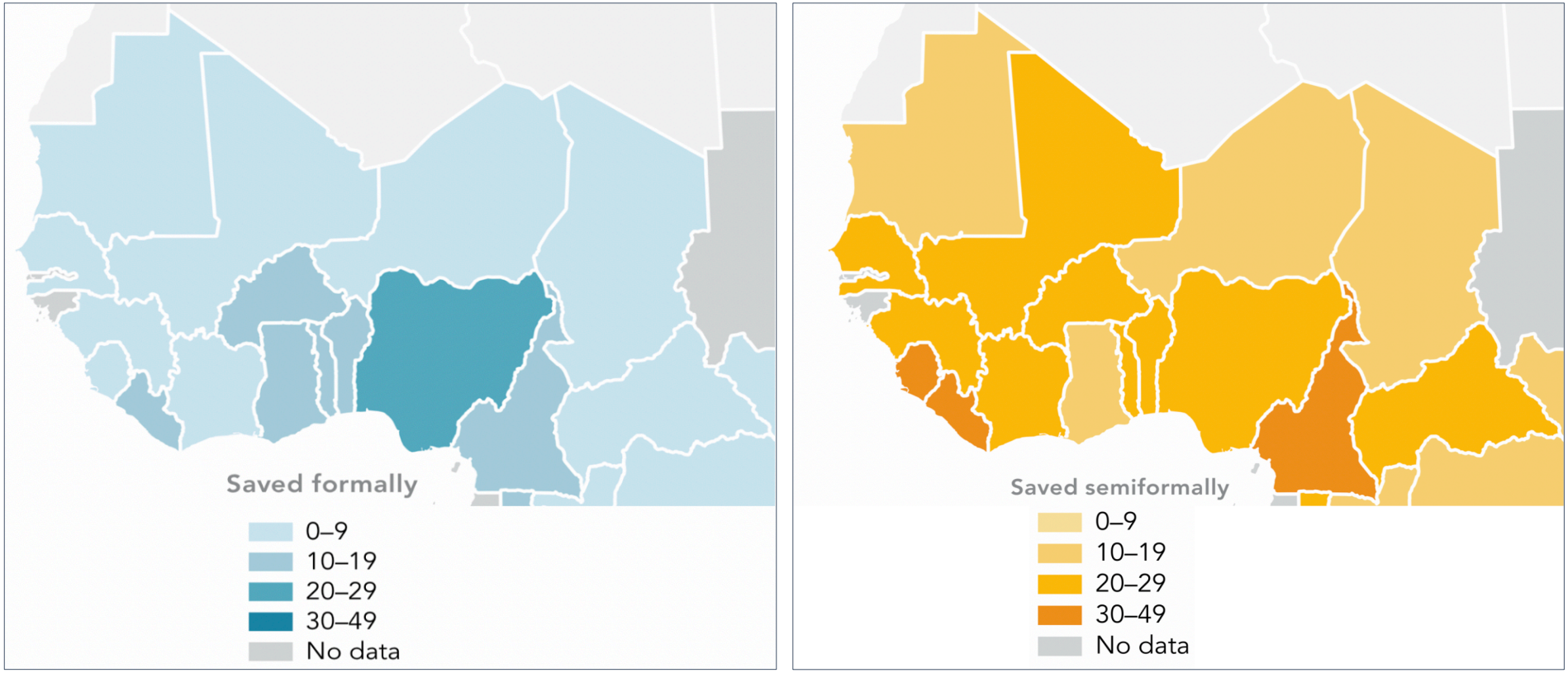
A 2017 World Bank study found that 38% of adults in Africa had borrowed money from an informal FI as opposed to 5% who borrowed from a formal FI. Although informal borrowing occurs at different rates across Africa, roughly 100 million adults in Sub-Saharan Africa use informal sources of finance.[244] The informal financial sector often serves as a major source of savings and credit services for women, the low-income population and others who lack access to formal institutions. Informal financial institutions typically include individual money lenders as well as collective entities such as Rotating Savings and Credit Associations and Accumulated Savings and Credit Associations, among other groups.[245]

Much like in other African states, there is a large informal financial sector in Togo (**Figure 53**). Data from this sector remains limited, largely due to the informal nature of these institutions, which does not facilitate access to information on their practices, cost standards and transaction levels. The World Bank's Findex survey suggests that between 2011 and 2014, although savings at FIs increased slightly, other informal financial sector indicators remained largely consistent (**Figure 54**).

[244] "Demirguc-Kunt, A., Klapper, L., and Singer, D., "Financial Inclusion and Inclusive Growth: A Review of Recent Empirical Evidence," World Bank Policy Research Working Paper 8040, (April 2017): http://documents.worldbank.org/curated/en/403611493134249446/pdf/WPS8040.pdf

[245] Klapper, L., Singer, D., "The Role of Informal Financial Services in Africa," Journal of African Economies, (24 December 2014): https://academic.oup.com/jae/article-abstract/24/suppl_1/i12/2473408?redirectedFrom=fulltext

Figure 53: Share of Adults Saving in the Past Year (%), 2017[246]



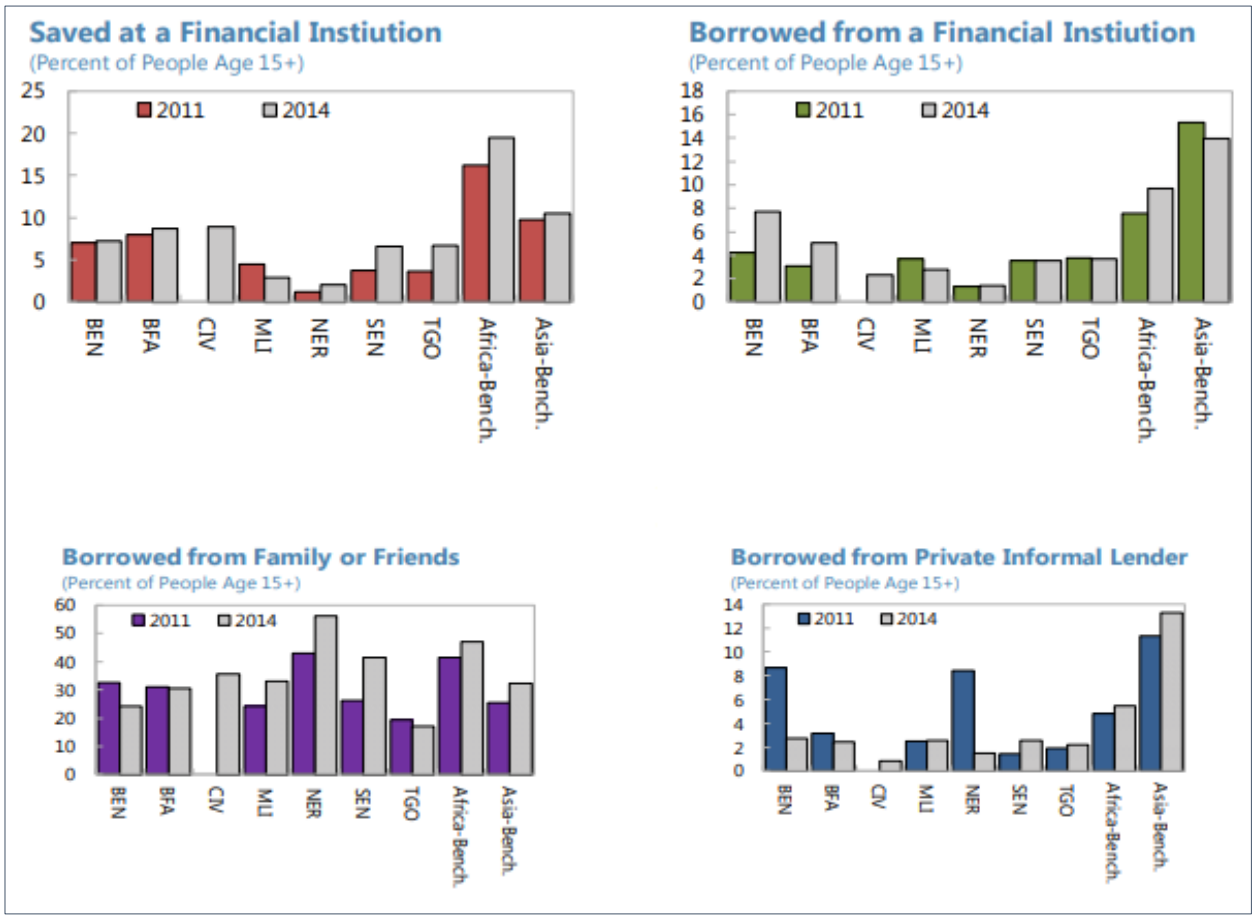
NOTE: Maps exclude Cabo Verde (no data)

Source: World Bank Global Findex Database

Figure 53 shows how the savings behavior of adults varies in West Africa and the Sahel. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. Saving semi-formally is much more common than saving formally across the region, including in Togo.

[246] Demirguc-Kunt et al., 2017.

Figure 54: Informal Financial Sector Indicators in WAEMU, 2011-2014[247]



Source: International Monetary Fund

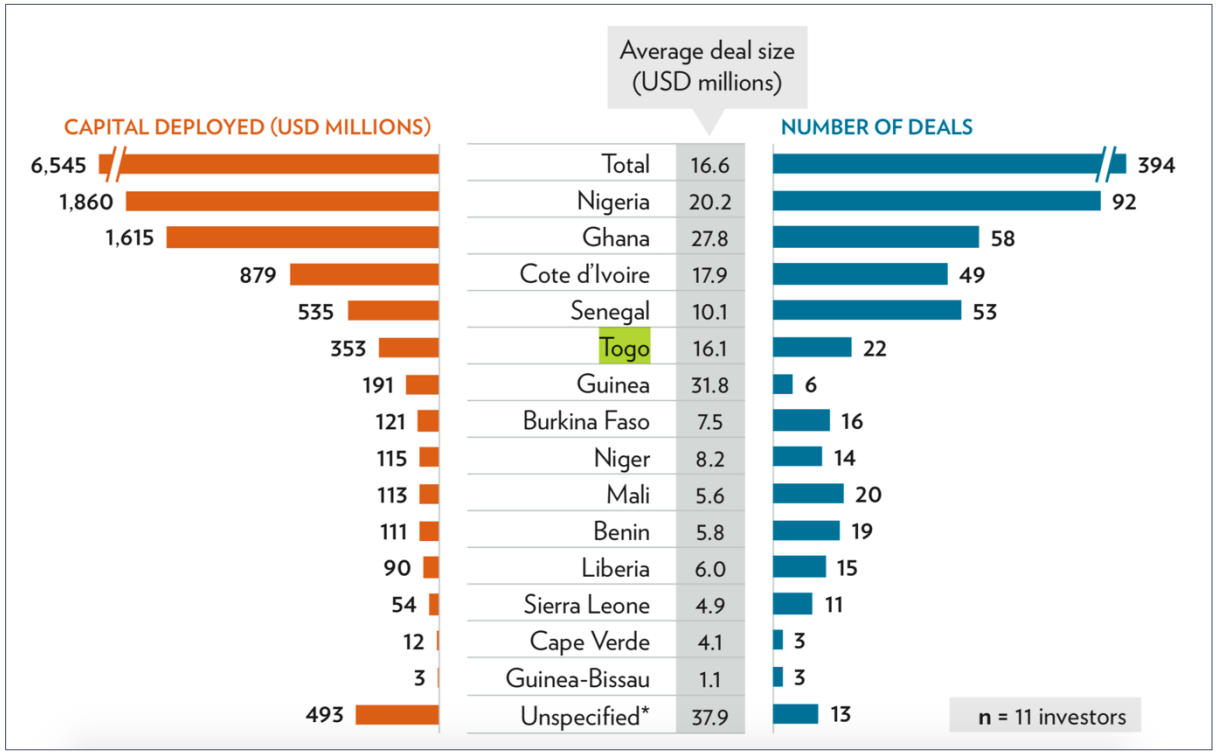
3.3.4 Impact Investors

An assessment carried out by the Global Impact Investing Network (GIIN) found that while impact investing steadily increased across Africa between 2005-2015, most of the investment in West Africa has been highly concentrated. During this period, impact investors deployed 22 direct investments totaling USD 353 million in Togo (**Figure 55**).[248]

[247] "West African Economic and Monetary Union," International Monetary Fund, (2016): https://www.imf.org/~/media/Websites/IMF/imported-full-text pdf/external/pubs/ft/scr/2016/_cr1698.ashx

[248] "The Landscape for Impact Investing in West Africa: Understanding the Current Status, Trends, Opportunities, And Challenges," Global Impact Investing Network and Dahlberg, (2015): https://thegiin.org/assets/upload/West%20Africa/RegionalOverview_westafrica.pdf

Figure 55: Non-DFI Investment in West African Countries, 2005-2015



Source: Global Impact Investing Network and Dahlberg

- **FRAGG Investment Management**

FRAGG Investment Management is an impact investor and SME-focused fund that mobilizes investment and raises capital for high-growth companies in West Africa. FRAGG finances and invests in growing and inclusive SMEs that create social and environmental impact but are not able to attract capital for their business at affordable conditions. The fund provides businesses with long-term risk capital that allows them to operate at their full potential; these come by way of long-term debt facility and equity investments.[249] Outside of Togo, the fund is also engaged in Benin, Nigeria, Ghana and Côte d'Ivoire.

3.3.5 Crowd Funders

Crowdfunding in Togo has been limited. Although the demand for capital continues to grow, crowdfunding remains a challenging source of financing for SMEs. Across Africa as a whole, crowdfunding amounted to USD 70 million in 2015 – less than 1% of global crowdfunding.[250] Moreover, roughly 75% of the capital raised by African start-up companies in 2017 was raised in Kenya, Nigeria, and South Africa.[251] Additionally, unlike most emerging markets, countries in West Africa and the Sahel do not have regulatory frameworks in place to offer protection to investors, which discourages potential investment. The following crowd-finding platforms have been identified in Togo:

[249] FRAGG Investment Management: http://www.fragginvest.com/about-us/
[250] "Crowdfunding in Emerging Markets: Lessons from East African Startups," World Bank (2015): https://www.infodev.org/infodev-files/crowdfunding-in-east-africa.pdf
[251] Disrupt Africa: https://www.siliconcape.com/disrupt-africa-funding-report-2017/

- In 2019, **BBOXX** and **Trine** raised EUR 6 million in funding – in what is the largest crowd-funded debt raise in the history of solar energy in Africa to date. The collaboration between Trine and BBOXX will accelerate BBOXX's installation of pay-as-you-go solar home systems in Togo under the Government's CIZO program, as well as in Kenya, Rwanda, DRC, Mali, Senegal and Guinea.[252]

- **Kiva** is a crowdfunding platform designed to connect entrepreneurs to potential investors to help alleviate poverty in low-income counties. The platform offers USD 25 loans to small business as seed capital or for expansion, loans for education, or to grant access to clean and reliable energy. Since 2005, Kiva has created $575 million in microloans to over 1.3 million entrepreneurs in 75 countries, with a 98% repayment rate. Kiva has been active in Togo since 2006.[253]

- **SunFunder** is solar finance business that connects investors to high-impact solar projects in low-income African, Asian and Latin American countries for both private and crowd investors, the platform grants access to financing for solar energy projects in emerging markets.

[252] "BBOXX / Trine Crowdfunding Initiative Hits Milestone," Alternative Energy Africa, (March 5, 2019): https://ae-africa.com/read_article.php?NID=9848
[253] Kiva Country Profile – Togo: https://blog.kiva.org/blog/kiva-country-profile-Togo

3.4 Summary of Findings

- **Opportunity for ROGEP Credit Lines:** Togolese banks lack access to funding with the interest rates and tenors required to make off-grid solar projects attractive to end-users and SMEs. Local currency cost of capital remains very high for FIs, which in turn results in prohibitively high pricing for typical loans. Furthermore, loans are usually short-term, as customer deposits (mostly short-term) remain the largest source of funding for banks. This dynamic severely constrains OGS market growth. Stakeholder interviews revealed that there is indeed an opportunity for ROGEP credit lines to provide liquidity to local commercial banks and MFIs to support lending to the off-grid solar sector.

- **Local Currency and Pricing:** Most loans to off-grid enterprises and all loans for consumer purchases of stand-alone solar devices must be denominated in local currency. However, taking up hard currency denominated credit lines presents challenges for local lenders who would have to bear the FX risk. This risk is somewhat mitigated in Togo, however, as the CFA franc is pegged to the euro, which shields it from volatile currency fluctuations. As a result, even after pricing in a hedge to cover this risk, many hard currency denominated credit lines can stay attractive, as the all-in cost of capital to local FIs is manageable to provide competitive offers to borrowers.

- **Collateral Requirements**: The collateral requirements of commercial banks in Togo are extremely high, particularly for small firms. Moreover, lenders already in the space are deeply constrained from originating loans where the borrower cannot meet these requirements. Hence, the use of third-party *pari-passu* guarantees as an alternative form of collateral would enable banks to extend loans to borrowers without such high collateral requirements. Accordingly, many of the interviewed commercial banks emphasized the need for partial credit guarantees to encourage lending to the OGS sector (50% coverage is helpful; 70-80% coverage could be transformative). However, pricing from most available third-party guarantors can be in the range of 3%+ per annum, which some lenders view as too high to remain competitive. This creates an opportunity for ROGEP to either provide low-cost guarantees directly or to subsidize the premiums offered by existing third-party guarantors such as GuarantCo, Afrexim and Africa Guarantee Fund.

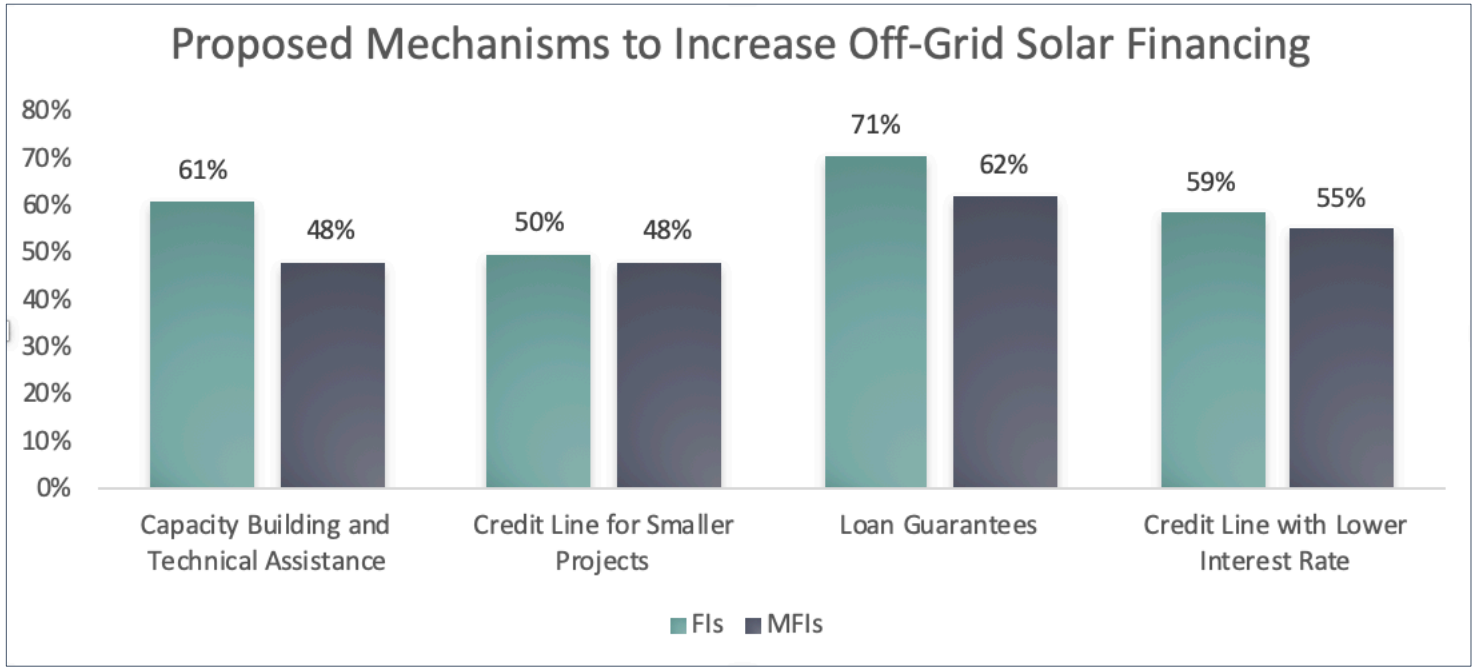
- **Risk Perception of New Lenders**: In order to attract additional lenders into the off-grid solar market segment, there is need for strong, reasonably priced credit enhancement mechanisms. In order to cover "market entry" risks for lenders unwilling to enter this market, guarantee instruments that cover first loss are needed. However, first-loss coverage, while necessary for attracting new lenders to the off-grid sector, does not address the key issue of collateral and is therefore likely insufficient on its own to stimulate growth in FI engagement unless coupled with third-party guarantee coverage.

- **Technical Assistance:** A well designed TA intervention is critical to accelerating OGS lending in the country. Stakeholder interviews revealed the following key areas of support: training of bank credit department and account representative personnel to originate deals and appropriately assess the credit risk of stand-alone solar firms and projects; extensive due diligence support to qualify products and approve vendors; and targeted support for new lenders to the sector with product structuring and development as well as building deal-flow. The TA intervention should build upon previous and existing programs such as CIZO and SUNREF to avoid duplication of efforts. Special attention should also be paid to offering advisory services on the side of the stand-alone solar enterprises. Lenders opine that these entrepreneurs often do not have proper financial management and accounting systems in place, are unable to present quality financial models and lack the expertise required to structure their companies to take on debt obligations.

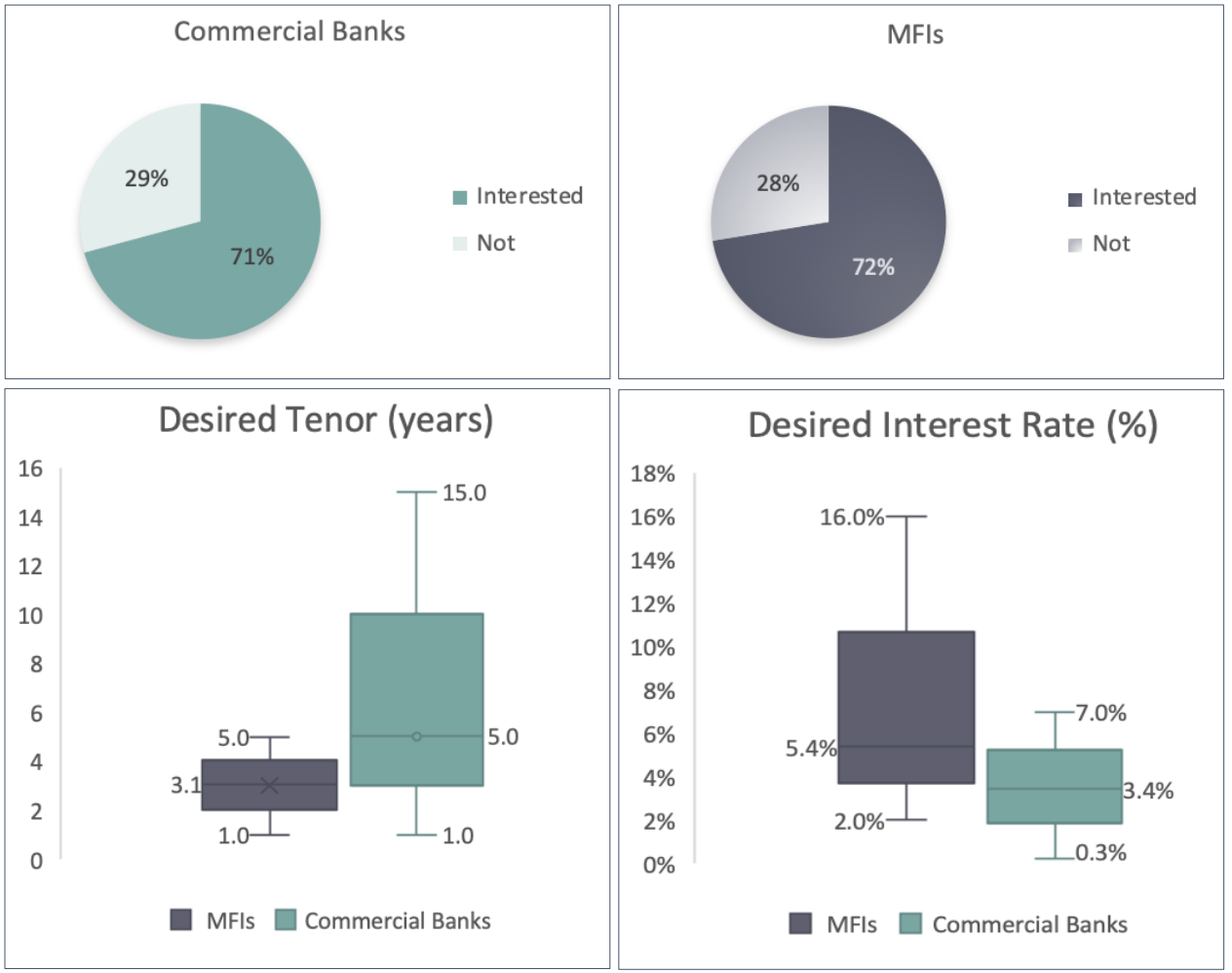
- **Digital Financial Services**: The advent of digital financial services and mobile money is one of the most important developments in off-grid solar market development to date, as it has allowed new and

innovative business models to emerge that are now driving unprecedented growth in the sector. Mobile communication technology facilitates payments for solar products and systems (lease-to-own, pay-as-you-go) and/or for electricity usage (energy-as-a-service) and enables monitoring for operations and maintenance of equipment. Expanding access to mobile money services also creates new opportunities to better serve women, the lower-income population, and other groups that are traditionally excluded from the formal financial system. The Government should take steps to support capacity building of and foster linkages between off-grid solar companies operating in the market and key stakeholders from various sectors, including energy access policymakers and regulators, financial and telecommunications companies, mobile network operators, financial service providers (commercial banks and microfinance institutions), mobile money service providers, international organizations, NGOs and civil society groups involved in financial inclusion etc.

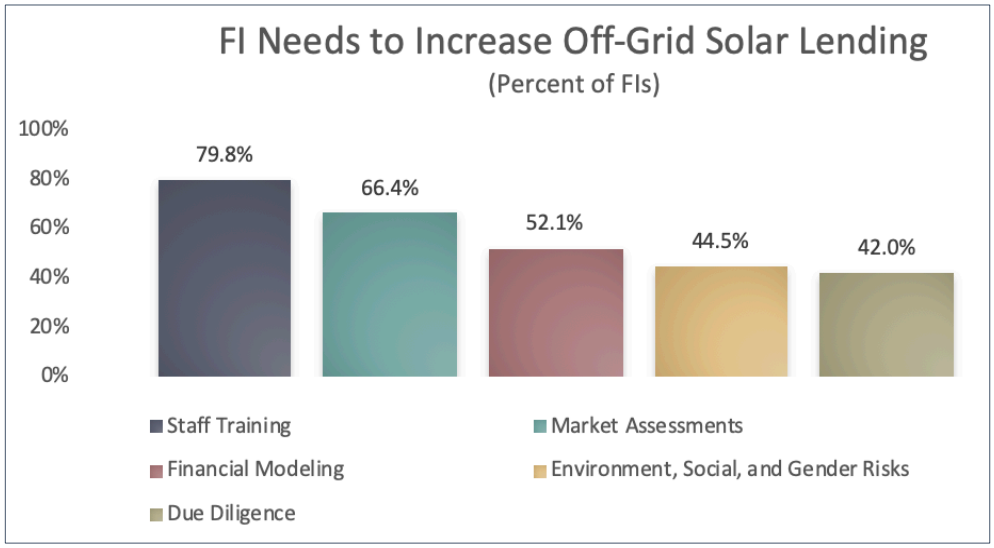
Key findings from the Task 3 FI survey activity are presented below. The results are based on feedback from a total of 121 FIs (including commercial banks, microfinance institutions and other non-bank FIs) that were interviewed across the 19 ROGEP countries. This summary only focuses on responses from commercial banks and MFIs, which together account for 92% of all respondents. See **Annex 3** for more details.



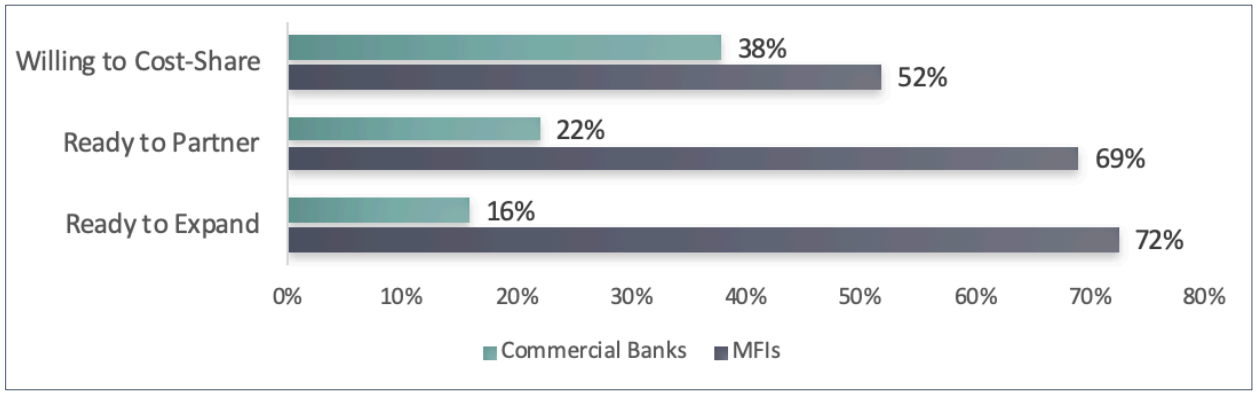
According to the survey, there is strong financial-sector interest across ROGEP countries to finance renewable energy projects, especially in off-grid solar. Commercial banks and MFIs identified loan guarantees as the most important measure that could improve their capacity to lend to the renewable energy sector. Most of the surveyed institutions also identified clear interest in credit lines.



More than 70% of surveyed commercial banks and MFIs are interested in a credit line to finance off-grid solar projects. Commercial banks want tenors of 1-15 years and interest rates from 0.25-7%. MFIs are seeking tenors of 1-5 years with interest rates from 2-16%. On average, commercial banks want a credit line with a 5-year tenor and 3.4 % interest rate, and MFIs want a 3.1-year tenor with 5.4% interest rate.



In addition to their clear interest in credit lines and loan guarantees to finance off-grid projects, surveyed financial institutions (commercial banks and MFIs) in ROGEP countries also identified several areas of internal capacity that require improvement in order to lend (or increase lending) to the off-grid solar sector.



Compared to commercial banks, MFIs reported a greater willingness to cost-share capacity building activities and a higher level of readiness to partner with solar companies and expand operations to serve rural and off-grid areas.

ANNEX 1: TASK 1 METHODOLOGY

STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT

Data presented in this section was collated from a range of public documents and reports as well as primary source documents either provided by ECREEE or obtained through supplemental market research (desk research and interviews with local public officials and industry stakeholders). These findings were subsequently corroborated by attendees of national validation workshops held in each country at the conclusion of the market assessment. Information obtained from the Task 2 focus group discussions and surveys of industry stakeholders (see **Annex 2**) was also used to support the Task 1 analysis.

GIS DATA ANALYSIS APPROACH / METHODOLOGY

1. Categorizations, key definitions and datasets for geospatial least-cost analysis

The main steps of the GIS analysis are as follows:

(i) Categorization/definition of settlements: scenario 2023;
(ii) Categorization/definition of settlements: scenario 2030;
(iii) Definition of un-electrified settlements within grid areas; and
(iv) Determination of population per settlement

1.1. Categorization/definition of settlements: Scenario 2023

1.1.1. *Electrification by grid extension* – settlements which are located within 5 km of the current electrical grid network[254] (according to WAPP densification plans).

1.1.2. *Electrification by mini-grid* – settlements that:
- Are located within 15 km of areas that have a high night-lights value (above 50/225 on grayscale raster)[255]
- Are located within areas that have a population density of more than 350 people per km^2 (as defined by Eurostat for rural areas),[256] plus an additional 50 people per km^2 for greater feasibility of mini-grids[257] and are within 1 km[258] of a health facility.

1.1.3. *Electrification by off-grid stand-alone systems* – settlements that do not fall into the above categories

1.2. Categorization/definition of settlements: Scenario 2030

1.2.1. *Electrification by grid extension* – settlements which are located within 15 km of the current electrical grid network (average distance mentioned by energy utilities in West Africa) or within 5 km of planned future line extensions[259]

[254] NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)
[255] The 50/225 classification represents the areas emitting light of the country with reduction of scattering light. The classification was first introduced in the USAID report ZAMBIA ELECTRIFICATION GEOSPATIAL MODEL and evaluated in cross-checks throughout the country. USAID: https://pdf.usaid.gov/pdf_docs/PA00T2JC.pdf
[256] http://ec.europa.eu/eurostat/web/rural-development/methodology
[257] Identified in discussions with different international mini-grid developers
[258] Preferred maximum distance for mini-grids from discussions with different international developer.
[259] NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)

1.2.2. *Electrification by mini-grid* – settlements that:
- Were defined as mini-grid settlements in the 2023 scenario
- Are located within 1 km of the above mini-grid settlements, which is the preferred distance of mini-grid developers for their grid according to discussions with several international developers.
- Are located within 15 km of economic growth centers – airports, mines and urban areas; average worker distance in Africa is 10 km, a distance of 5 km is added to include the growth of businesses in the periphery of the growth centers.[260]

1.2.3. *Electrification by off-grid stand-alone systems* – settlements that do not fall into the above categories

1.3. Definition of un-electrified settlements within grid areas

To identify settlements that are located close to the national electrical grid but are not served by it, the following criteria were used:

- Within the main grid line zones (see buffer zones for *electrification by grid extension* above)
- Outside 15 km night-lights of buffered areas to capture the densification within 5 years
- Within areas of low population density (less than 350 people per km^2)

1.4. Determination of population per settlement

A key component of the least-cost analysis was the number of people living in each settlement (city, town, village, hamlet) of a given country. While there are different publicly available sources of information on total population (e.g. World Bank demographic data), a more granular view of the population distribution was necessary to perform the geospatial analysis.

Another difficulty was the identification of locations of settlements. The exact location of each settlement (with given coordinates) was not available / accessible in many of the countries. As a result, the least-cost analysis had to revert to other studies of population distribution – such as the population distribution developed by WorldPop. WorldPop utilizes a range of geospatial datasets to develop accurate population data:

"New data sources and recent methodological advances made by the WorldPop program now provide high resolution, open and contemporary data on human population distributions, allowing accurate measurement of local population distributions, compositions, characteristics, growth and dynamics, across national and regional scales. Statistical assessments suggest that the resultant maps are consistently more accurate than existing population map products, as well as the simple gridding of census data." [261]

A Voronoi polygon analysis[262] was used to create boundaries for each identified settlement. These boundaries were then used in combination with the population density layer to estimate the total settlement population of the given year. The current annual national population growth rate of 2.5%[263] was applied to the geospatial analysis to project populations for the Scenario 2023 and 2030 analyses.

[260] Lall, Somik Vinay; Henderson, J. Vernon; Venables, Anthony J. 2017. Africa's Cities: Opening Doors to the World. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/25896 License: CC BY 3.0 IGO.
[261] https://www.worldpop.org
[262] To learn more about Voronoi polygons, see wikidot: http://djjr-courses.wikidot.com/soc128:qgis-voronoi-polygons
[263] https://data.worldbank.org/indicator/SP.POP.GROW?locations=TG

2. Summary of Key Datasets

The table below summarizes the key datasets used for scenarios 2023 and 2030 as well as the criteria applied, and sources used.

Overview of Key Datasets of the Least-Cost Electrification Analysis								
Dataset	Description	Criteria used by technology						Source and Year
		Scenario 2023			Scenario 2030			
		On-grid	Mini-grid	Off-grid	On-grid	Mini-grid	Off-grid	
Electricity grid network (current)	Current national grid network (HV & MV lines)	≤ 5km distance	≥ 5km distance	≥ 5km distance	≤ 15km distance	≥ 15km distance	≥ 15km distance	ECOWREX, 2018[264]
Electricity grid network (planned)	Future network planned to be built (HV & MV lines)	Not considered	Not considered	Not considered	≤ 5km distance	≥ 5km distance	≥ 5km distance	Togolese Electricity Company, 2018[265]
Mini-grids	No mini-grids were available for the study	--	--	--	Not considered	≤ 1km distance from all identified mini-grids in Scenario 2023	≥ 1km distance from all identified mini-grids in Scenario 2023	Identified mini-grids of Scenario 2023 analysis
Night-lights	Night-time light emissions used to identify electrified areas	Not considered	≤ 15km distance	≥ 15km distance	Not considered	Not considered	Not considered	NASA Earth Observatory, 2016
Population density	Population distribution in people per km^2.	≥ 350 people per km^2 [266]	≥ 350 people per km^2	≤ 350 people per km^2	Not considered	Not considered	Not considered	WorldPop, 2015
Settlements	Settlement layer giving location of settlements across Togo (cities, towns, villages, hamlets)	Used	Used	Used	Used	Used	Used	OpenStreetMap (OSM), 2018
Social facility: education centers	None available for the study	--	--	--	--	--	--	-

[264] http://www.ecowrex.org/mapView/index.php?lang=eng
[265] Shared by EU-TAF
[266] Based on Eurostat definition plus an additional 50 people per km2 for greater feasibility of mini-grids as identified in discussions with different international mini-grid developer. Source: http://ec.europa.eu/eurostat/web/rural-development/methodology

Social facility: health centers	Hospitals and clinics; Indicator of active local economy	Not considered	≤ 1km distance[267]	≥ 1km distance	Not considered	Not considered	Not considered	Humanitarian Data Exchange (HDX), 2015
Growth center: airport, mines, urban areas	Economic growth centers for the analysis up to 2030; Urban areas as defined by Electricity Demand	Not used	Not used	Not used	Not considered	≤ 15km distance	≥ 15km distance	airports: HDX, 2017 mines: HDX, 2015 urban areas: ECOWREX website, 2015[268]

[267] Preferred maximum distance for mini-grids from discussions with different international developer.
[268] http://www.ecowrex.org/mapView/index.php?lang=eng

ANNEX 2: TASK 2 METHODOLOGY

OFF-GRID SOLAR PV MARKET ASSESSMENT METHODOLOGY

Focus Group Discussions (FGDs) were held in Lomé in July 2018 with key stakeholders from each of the four off-grid market segments analyzed under Task 2: (i) household, (ii) institutional, (iii) productive use, and (iv) supplier. Focus group participants included representatives from government, the donor community, NGOs, solar companies, business and industry associations, academia, community groups, and women's groups. Each market segment had its own dedicated meeting, although some stakeholders attended more than one discussion. Each FGD lasted approximately 90 minutes and covered a range of topics related to demand for off-grid solar vis-à-vis each market segment.

In addition to the FGDs, three additional survey activities were undertaken to support the Task 2 analysis: (i) a survey of large-scale international solar companies to gauge their level of interest in the country and wider region; (ii) a survey of local small-scale retail suppliers of solar equipment; and (iii) an assessment of an off-grid village to better understand how solar was being utilized for productive uses. The FGDs and surveys largely yielded qualitative inputs to supplement the quantitative analysis presented in Task 2.

The methodology and assumptions utilized to assess each market segment under Task 2 is presented below.

1. HOUSEHOLD DEMAND

1.1 Household market segments

1.1.1 Total population without access to electricity is calculated using World Bank total population figures,[269] multiplied by electricity access rates from the International Energy Agency (IEA)[270], and translated to households using World Bank open data average household size. This method is used to align population data throughout the report, with IEA seen as an overarching source for energy access data and the World Bank providing important population and household income data. See **Annex 1** for more detail.

1.1.2 Based on the country demographic and income data, the household solar market was broken down into segments by income quintile, as shown in **Section 2.1.1**. For the purpose of this analysis, income quintiles were aligned with energy tiers, as indicated by the Multi-Tier Energy Access Framework, which is roughly determined by household ability to pay for tier levels of energy. Quintiles were also aligned roughly with geographic segments.

1.1.3 World Bank demographic data used does not provide household income data broken down by rural, urban, on-grid or off-grid. For example, the data shows the total population falling under a certain poverty line, shows the total population that does not have access to electricity, and shows the total population that is rural, but does not cross reference any of these indicators to e.g. show the total rural population without access to electricity living under the poverty line. For this reason, assumptions were made regarding the number of households per income quintile that are off-grid (detailed in section 1.3.1 of these assumptions). It was assumed that the majority of off-grid households are rural. The data gap prevents the presentation of an overlapping map of the traditional poverty line income pyramid with electricity access.

[269] World Bank Open Data 2017, accessible at https://data.worldbank.org/
[270] IEA Energy Access Outlook Report, 2017

1.1.4 Tier 4 is not included in this analysis since the off-grid solar systems that can provide a Tier 4 level of service are beyond the reach of the vast majority of the population.

1.2 Household energy expenditure and potential savings

1.2.1 Current household expenditure on energy-related items (believed to be candidates for replacement with solar products) was estimated using information from the FGDs.

1.2.2 From the existing household expenditures, "typical" monthly costs were estimated that households would incur in order to receive a standard level of electricity service according to the Multi-Tier Energy Access Framework.

1.2.3 The unit monthly costs were used for each of the energy-related items identified above.

1.2.4 The cumulative monthly expenditure was then determined for each tier.

1.2.5 Monthly expenditure by tier was compared with monthly cost associated with OGS products by tier to estimate potential household cost savings. Monthly cost for OGS products was based on representative data from the West African region.

1.2.6 In the process of this analysis, the following assumptions were made:

1.2.6.1 Solar system sizes and costs:

- Cost per watt on solar systems vary greatly and have changed rapidly in the past five years. Smaller pico and plug and play systems have a much higher per cost per watt. The USD/Watt prices are based on sample cost ranges from Lighting Global equipment available on the open market.
- Average system size by watts: values are chosen as representative values for solar systems from each of the Tier values. They are intended to represent system sizes that typical members of each group would purchase.
- Average system life values represent typical expected operating life of Lighting Global products.

1.2.6.2 Current household energy usage:

Current Household Energy Usage (# Units/HH)				
Technology	**Tier 1**	**Tier 1.5**	**Tier 2**	**Tier 3**
Torch lights/Lanterns	1	2	3	
Mobile Phone Charging	1	1	2	
DC Radio	-	1	-	-
DC Music Player/Radio	-	-	1	-
Small Generator	-	-	-	1

- Numbers of units of torch lights/lanterns, cell phones, dc radio, and small generator represent the numbers of appliances that are demonstrated to be in use in typical households of each tier based on FGDs and multiple survey documents.

1.2.6.3 Current household energy costs

- Typical purchase and operation costs of HH off-grid appliances were based on FGDs, field energy surveys and reports.

1.3 Total Cash and Financed Market for Off-Grid Solar

1.3.1 Beginning with World Bank demographic and population data for Togo, the number of off-grid households by income quintile was derived. For this, a percentage of off-grid households by quintile was assumed, as follows:

Quintile	% Off-Grid
Highest 20%	1%
Fourth 20%	35%
Third 20%	90%
Second 20%	99%
Lowest 20%	100%

It was assumed that there is a general correlation between income and access to electricity. The highest quintile has the highest percentage of population that are both urban and connected to the grid. Evidence indicates that the vast majority of households connected to the grid are from the top two quintiles Similarly, it was assumed that virtually all people in the bottom two quintiles are off-grid.

1.3.2 From this, average household energy expenditure was determined based on income, with the assumption that all households spend an average of 10% of their income on energy.

Average rural household expenditure on energy varies considerably. A study from Sierra Leone found that the "cost of lighting, on average, occupied between 10-15% of household incomes. Households using generators were found to spend a greater proportion of their income (upward of 20%) on lighting."[271] Other research has shown household energy spending between 6-12% for low income segments in sub-Saharan Africa.[272] For the purpose of this research, we have assumed that households can allocate 10% of their income on average to energy.

1.3.3 The monthly energy budget for each household per quintile was calculated by multiplying monthly Household income by the assumed 10% of Household income spent on energy. Monthly Household income per month was calculated by multiplying per capita income per month by the avg. # of persons/household. Per capita income per month for each quintile is calculated by dividing the Share of the country GDP for each quintile by the population of each quintile, which is one-fifth of the country population. The share of the country GDP for each quintile is based on World Bank, World Development Indicators demographic data.

1.3.4 A simple model was used to evaluate the market using the World Bank income quintile data and average energy expenditures as input data.

1.3.5 In determining the monthly energy expenditure related to each tier, the following assumptions were made with guidance from the FGDs output:

[271] Lai, K., Munro, P., Kebbay, M., and Thoronko, A., "Promoting Renewable Energy Services for Social Development in Sierra Leone: Baseline Data and Energy Sector Research, Final Report," European Union, (July 2015).
[272] 10% is an acceptable figure for lighting and cell phone charging costs for low income groups. See: https://www.brookings.edu/blog/africa-in-focus/2017/03/17/figures-of-the-week-benefits-of-off-grid-electricity-solutions/

- **Tier 0**: Assumed to be an absolute energy poor household, relying solely on kerosene and charcoal both for cooking and lighting.
- **Tier 1**: The household was assumed to have access to 1 torch light/lantern powered by dry cells, charging services for a phone charged on average 8 times a month.
- **Tier 1.5**: The household was assumed to have access to 1 torch light and 1 lantern each powered by dry cells, one regular cell phone charged on average 8 times a month, and a radio powered by dry cells (assume access to 2 low quality cells) replaced 4 times a month.
- **Tier 2**: The household was assumed to have access to 1 torch light and 2 lanterns each powered by dry cells, one regular cell phone charged on average 8 times a month, and one smart phone charged on average 16 times a month, a radio/music player powered by dry cells (assume access to 4 low quality cells), replaced 4 times a month.
- **Tier 3**: The household was assumed to have access to a generator powering a number of appliances but available only for 2-3 hours a day.
- **Annualized energy costs** for each of the systems = ([Capital system cost/average system life in years]+[Monthly operating cost*12])

1.3.6 The potential market size for each solar tier was then calculated by multiplying the number of off-grid households per quintile that will be willing to pay for each solar tier by the cost of each system (system cost is based on representative data from Togo, as shown in 2.2.5).

1.3.7 In determining the number of off-grid households per quintile that will be willing to pay for each solar tier, the key assumption of the model is that each off-grid household purchases only one system and that they will opt for the highest solar system tier they can afford.

- For cash purchases, the assumption was that they will be willing to save (set aside) up to 3 months (number of months can be adjusted on the 'HH Assumptions' tab) of their monthly energy budget to purchase the system.
- For PAYG/financed, the assumption was that they will be willing if their monthly energy budget is less than or equal to the monthly PAYG payment AND if the PAYG upfront payment is less than or equal to 3 months of their monthly energy budget.

1.3.8 The interest rate for consumer finance was conservatively estimated to be 24% p.a., based on the interest rate cap for Microfinance Institutions in WAEMU countries.[273]

<u>2023 and 2030 Household Demand Scenario: Assumptions</u>

1. The GIS analysis[274] estimated that by 2023, 67.8% of the population will be grid connected, 11.4% will be connected by mini-grids while 20.8% of the population will be connected by off-grid stand-alone solutions. By 2030, the GIS analysis estimated that 87.4% of the population will be grid connected, 2.4% will be connected by mini-grids while only 10.2% of the population will be connected by off-grid stand-alone solutions. Based on these dynamics in the demographic patterns, coupled with the existing government plans, the following assumptions regarding the off-grid population based on the quintiles were made:
   - In the 2023 scenario, it was assumed that as the grid gets extended and mini-grids are deployed (based on GIS data), the households in the quintiles with the highest income will be given priority due to their relatively higher power demand and ability to pay for power consumption.

[273] Ferrari, A., Masetti, O., Ren, J., "Interest Rate Caps: The Theory and the Practice," World Bank Policy Research Working Paper, (April 2018): http://documents.worldbank.org/curated/en/244551522770775674/pdf/WPS8398.pdf
[274] See **Annex 1** for GIS methodology

Hence, the highest four quintiles were assumed to have only 1%, 2%, 3%, and 4% off-grid households respectively, while the lowest quintile was assumed to have 94% off-grid households. These assumptions have been made such that the total number of off-grid households assumed is equal to the GIS data 2023 estimate.

- Similarly, in the 2030 scenario, it was assumed that the higher income quintiles will be prioritized for electrification, based on economic considerations, above the lower quintiles. Hence, the highest four quintiles were assumed to have only 1%, 2%, 3%, and 4% off-grid households respectively, while the lowest quintile was assumed to have 41% off-grid households. These assumptions have been made such that the total number of off-grid households assumed is equal to the GIS data 2030 estimate.

Quintile	% Off-Grid (2023)	% Off-Grid (2030)
Highest 20%	1%	1%
Fourth 20%	2%	2%
Third 20%	3%	3%
Second 20%	4%	4%
Lowest 20%	94%	41%

2. Inflation rates for Togo: According to the IMF World Economic Outlook data, inflation in Togo is estimated to be at 3% in 2023. It was assumed that the rate will remain the same through 2030. Based on this assumption, the expected prices of the current household energy technologies and the solar alternatives were estimated using an annual price escalation factor of 1.03.

3. Based on a 2.5% population growth rate from the World Bank[275] and the population density dataset used in the study, the estimated total population will be 8,099,988 in 2023 and 9,628,340 in 2030.

4. The least-cost electrification analysis found that the share of the population with access to electricity via the national grid and mini-grids will be 79.2% in 2023 and 89.8% in 2030.

5. To estimate GDP, it was assumed that the current annual GDP growth rate of 4.5% will be maintained through 2023 and 2030:

Parameter	2023	2030
Population	8,099,988 (GIS estimate)	9,628,340 (GIS estimate)
GDP (constant 2010 USD)	$5,863,100,848	$7,978,870,152

6. According to the Lighting Global Off-Grid Solar Market Trends Report 2018,[276] the price of pico solar products is expected to fall to USD 10.60 in 2020 and USD 10.10 in 2022 down from USD 10.90 in 2016. Based on these 2020 and 2022 figures, the average annual decrease in prices from 2020 was estimated at 2.36%. It was assumed that the annual price decrease will be maintained at this rate through 2030 (annual cost reduction factor of 0.98).

7. According to the same report, the price of small SHS components is expected to fall to USD 60.40 in 2020 and USD 47.40 in 2022, down from USD 77.80 in 2016. Based on these 2020 and 2022 figures, the average annual decrease in prices from 2020 was estimated at 10.76%. It was assumed that the annual price decrease will be maintained at this level through 2030 (annual cost reduction factor of 0.89).

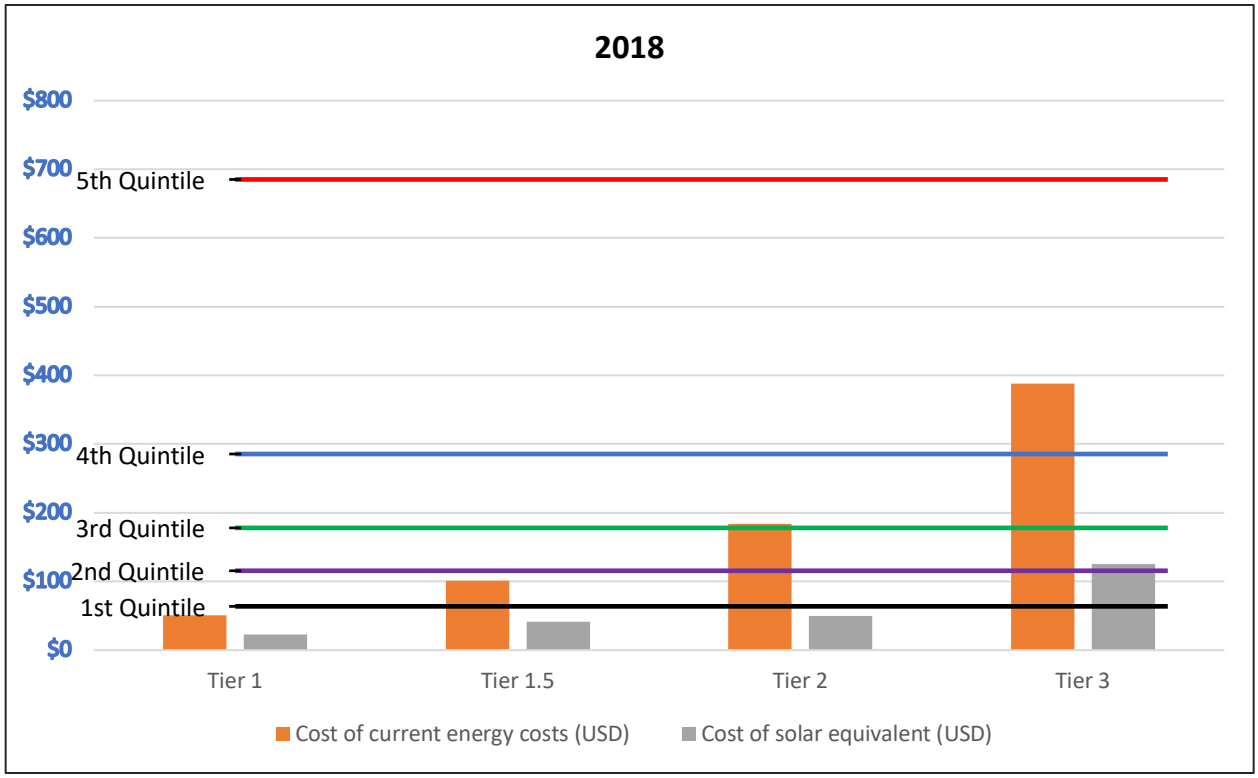
[275] https://data.worldbank.org/indicator/SP.POP.GROW?locations=BJ

[276] "Off-Grid Solar Market Trends Report 2018," Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018): https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

8. It was assumed the maximum interest rates in Togo will stagnate at the current rate of 24% or possibly decline.

Household Cost Savings and Affordability Calculation

Annual Household Energy Budget by Quintile, Annual Energy Costs and Annual Costs of Solar Equivalents



- This analysis presents annualized costs (not including financing cost) of current energy technologies for each energy tier, compared with the annual cost of an equivalent solar product. The same analysis was also completed for the 2023 and 2030 scenarios.

- Both the annual costs of current energy technologies and equivalent solar solutions considered the capital cost of each unit as well as the operating cost over the average lifetime of a unit.

- These costs were compared with a 10% monthly energy budget for households of different income quintiles. The analysis did not assess affordability for a cash vs. financed purchase over time.

2. INSTITUTIONAL DEMAND

2.1 Country Categorization

To assess institutional sector demand, the ROGEP countries were grouped into four categories based on income and population density, which are two key factors that influence the number of public service institutions in a given country. The countries were categorized as follows:

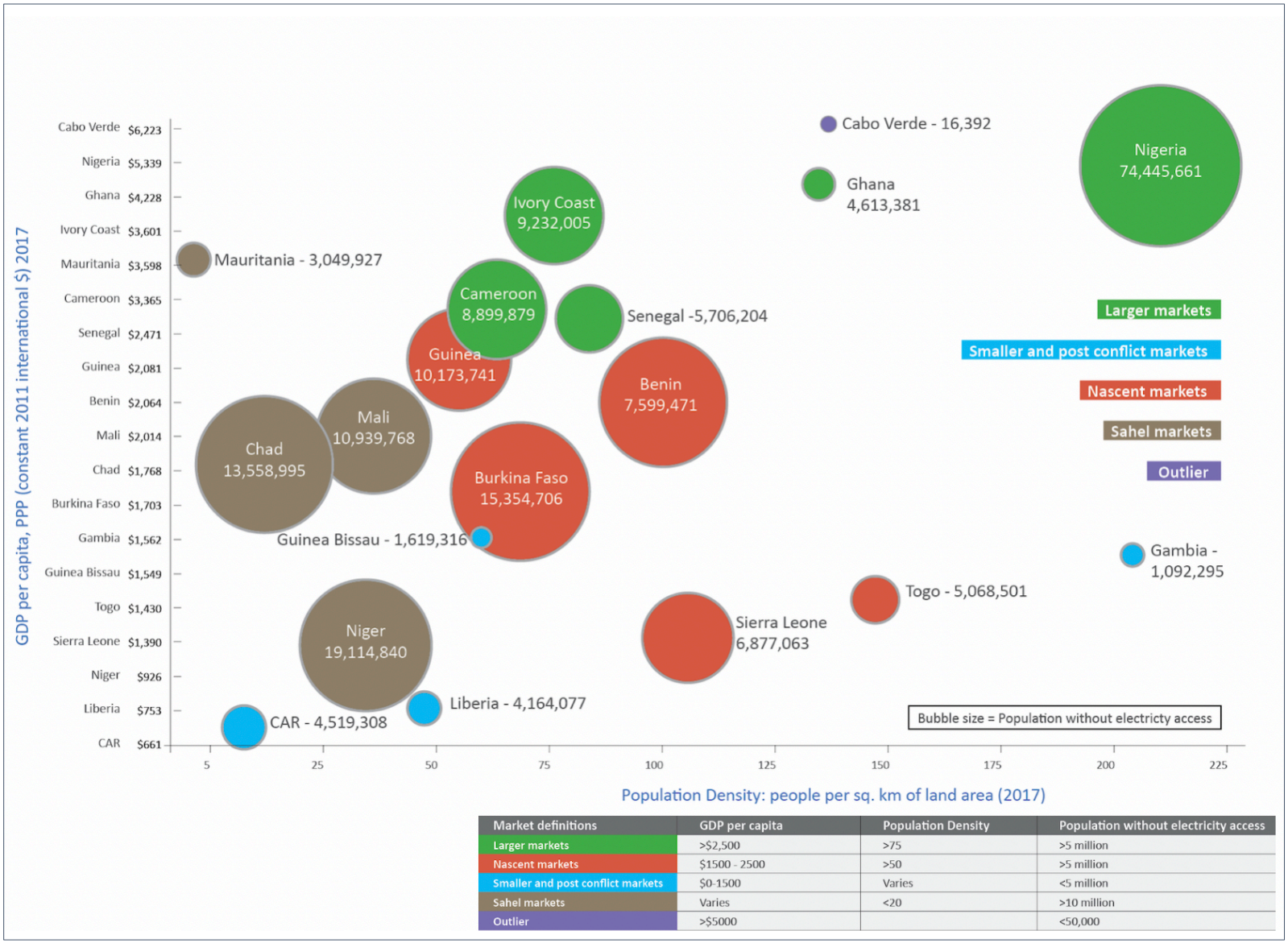
Country Categorization by Income and Population Density			
Category 1: Low-income / low population density	**Category 2:** Low-income / high population density	**Category 3:** High-income/ low population density	**Category 4:** High-income / high population density
Niger Burkina Faso Chad Mali Guinea Guinea-Bissau Central African Republic Liberia	Benin Sierra Leone Togo Gambia	Cameroon Côte d'Ivoire Mauritania Senegal	Nigeria Ghana Cabo Verde

These categories were used to address data gaps, as obtaining accurate and comprehensive data on the number of off-grid public institutions in many of the countries was challenging. Where data was not available, per capita assumptions based on data from similar countries in the same category were used. The following countries were used as reference countries for each category:

Category 1	Guinea, Liberia, Niger
Category 2	Benin, Sierra Leone
Category 3	Côte d'Ivoire
Category 4	Ghana

Categories are defined as follows (and illustrated in the figure below):

- Low population density: <95 people per square km of land area
- High population density: >95 people per square km of land area
- Low income: <$2,200 GDP per capita
- High income: >$2,200 GDP per capita



Market definitions	GDP per capita	Population Density	Population without electricity access
Larger markets	>$2,500	>75	>5 million
Nascent markets	$1500 - 2500	>50	>5 million
Smaller and post conflict markets	$0-1500	Varies	<5 million
Sahel markets	Varies	<20	>10 million
Outlier	>$5000		<50,000

Source: African Solar Designs analysis

2.2 Energy Needs by Institutional Market Segment

Institutional Sector	Description	Rating (W)	Time of use (hrs)	Total Wh/day	Total Load	Recommended system (W)
Water Pumping						
Low power		1,500	6	9,000		1,500
Medium power		4,000	6	24,000		4,000
High power		10,000	6	60,000		10,000
Healthcare						
HC1 Health post	Lighting	30	8	240		
	Communication	20	8	160		
	ICT	100	8	800	1,200	250
HC2 Basic healthcare facility	Lighting	200	8	1,600		
	Maternity	200	4	800		
	Vaccine refrigeration	100	8	800		
	Communication	100	4	400		
	Medical exams	200	2	400		
	ICT	200	8	1,600		
	Staff housing	50	8	400	6,000	1,500
HC3 Enhanced healthcare facility	Lighting	400	8	3,200		
	Communication	200	8	1,600		
	Medical exams	600	2	1,200		
	ICT	300	8	2,400		
	Maternity	600	4	2,400		
	Laboratory	1,000	2	2,000		
	Sterilization	1,200	1	1,200		
	Vaccine refrigeration	150	8	1,200		
	Staff housing	200	8	1,600	16,800	4,200
Education						
Primary school	Communication	20	8	160		
	Lighting	80	8	640		
	ICT	100	8	800		
	Staff house	50	8	400	2,000	500
Secondary school	Communication	20	8	160		
	Lighting	240	8	1,920		
	ICT	400	8	3,200		
	Laboratory use	100	8	800		
	Staff house	200	8	1,600	7,680	1,920
Public Lighting						
Street lighting	Lights	200	8	1,600	1,600	500

Source: The estimates in the table above are based on data obtained from local experts, interviews with solar industry stakeholders and corroborated by secondary desk research.

CALCULATIONS: Rating of systems is based on data for sizes of the appliances from a 2016 GIZ solar PV catalogue.[277] The solar PV sizing factor is based on the peak sun hours available across most of Africa.

[277] "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ__2016__Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf

Energy Needs Assumptions:

Water Supply: Power requirements (low, medium, high) are based on the type of water point.

- Borehole: 40% low power pumps; 40% medium power; 20% high power
- Protected dug well: 80% no pump; 10% low power pumps; 10% medium power; no high-power
- Unprotected dug well: No pump
- Protected spring: No pump
- Unprotected spring: No pump
- Public tap/standpipe (stand-alone or water kiosk): No pump
- Sand/Sub-surface dam (with well or standpipe): No pump
- Piped water into dwelling/plot/yard: No pump
- Rainwater harvesting: No pump

Healthcare: The size of the healthcare facility (HC1, HC2, HC3) determines the amount of energy each facility requires.

Education: The size of school and number of students determines the amount of energy each school requires.

Public lighting: It was assumed that two [2] public lighting points would be required to meet the energy needs of a town/market center.

2.3 Institutional Market Sizing Calculations

Household systems, cost and price per watt:

System Type	Tier Rating	USD/Watt[278]	Average Size (Watts)	Total Cost (USD)
Pico solar system	Tier 1	$15.00	3	$45.00
Basic Plug and Play system	Tier 1.5	$12.50	10	$125.00
Small HH solar system	Tier 2	$5.00	50	$250.00
Medium HH solar system	Tier 3	$2.50	250	$625.00

Size of systems used in institutional sector market sizing calculation:

Sector	Description	Size (corrected for time of use)	HH systems
Water Supply	Low Power	1,500	N/A
	Medium Power	4,000	N/A
	High power	10,000	N/A
Healthcare	HC1	250	Tier 3
	HC2	1,500	N/A
	HC3	4,200	N/A
Education	Primary	500	N/A
	Secondary	1,920	N/A
Public lighting		500	N/A

[278] Cost per watt derived from African Solar Designs analysis and from IRENA: https://www.irena.org/publications/2016/Sep/Solar-PV-in-Africa-Costs-and-Markets

Institutional Sector Market Sizing Calculations:

NOTE: Prices cover only solar components (except for the HC1 tier 3 system, which comes with lighting)

Water Supply						
# of water pumps	X	Size of solar system (watts) (low, medium, high power)	X	Cost per watt for pumping ($2.50) divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Water Supply Sector

Healthcare						
# of healthcare facilities						
HC 1	X	Cost per tier 3 system ($625)	X	Divided by system lifetime of 5 years	=	Estimated Annualized Off-Grid Solar Market Potential for Healthcare Sector
HC 2		Size of solar system in Watts (1500W)		Cost per watt ($2.50) divided by system lifetime of 20 years		
HC 3		Size of solar system in Watts (4200W)		Cost per watt ($2.50) divided by system lifetime of 20 years		

Education						
# of schools						
Primary	X	Size of solar system in Watts (500W)	X	Cost per watt ($3) divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Education Sector
Secondary		Size of solar system in Watts (1920W)		Cost per watt ($2.50) divided by system lifetime of 20 years		

Public Lighting						
# of off-grid market centers	X	Size of solar system in Watts (500W)	X	Cost per watt ($3) divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Public Lighting Sector

2.4 Data Collection Approach by Institutional Market Segment

Togo			
Water Supply	**Healthcare**	**Education**	**Public Lighting**
Per capita assumption	Per capita assumption	Per capita comparison	Per capita assumption

Data was collected on the total number of off-grid institutions by institutional market segment for Togo from a combination of available GIS data, input from local experts, stakeholder interviews and desk research. Where there were gaps in available data, per capita assumptions were made, as explained in **Section 2.2**.

Assumptions:

Water Supply: Of the identified potable water points, it was assumed that 50% would be equipped with a solar-powered water pump. Of the equipped water sources, the division of pumps between low, medium and high-powered pumps was: 50%, 35% and 15%, respectively. The lower cost of the low power pumps

is the driving factor for this assumption. Where this information was not available, a per capita comparison was made with a country in the same category.

Healthcare: Wherever possible, specific data on the number of off-grid healthcare facilities by size was used (i.e. HC1, HC2, HC3). Where this information was not available, a per capita comparison was made with a country in the same category.

Education: Wherever possible, specific data on the number of off-grid primary and secondary schools was used. Primary schools encompass both primary and nursery schools. Vocational schools and universities were not considered because they tend to be in cities, which are often grid-electrified. Where this information was not available, a per capita comparison was made with a country in the same category. The following per-capita assumptions were made:[279]

- **Primary school**: Per capita calculation using the off-grid population that is 0-14 years
- **Secondary school**: Per capita calculation using the off-grid population that is 15-19 years

Public lighting: Using population figures by region, and assuming that the population per market center was 5,000 people, the number of market centers was calculated. An assumption of two [2] public lighting points per market center was used in the calculation. No data on street lighting was included, as it was assumed that street lighting projects are linked to road infrastructure rather than institutions.

2.5 Ability to Pay Analysis (Strongest Potential Market Segment)

Data was not available to estimate the monthly energy expenditures of institutional users. Secondary data was available through government and donor program annual budgets for public services but was not comprehensive. A rudimentary analysis was undertaken based on these funding sources and compared to the total solar product market estimate for each institutional market segment in order to discuss the realistic potential market outlook based on the ability to pay. Due to a lack of data, the analysis was not able to take into account other potential sources of funding, such as funds pooled at the national or local level, fees for services etc.

[279] Population without access to electricity:
https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf
Population ages 0-14: https://data.worldbank.org/indicator/SP.POP.0014.TO
Population ages 15-19: https://data.worldbank.org/indicator/SP.POP.1519.MA.5Y;
https://data.worldbank.org/indicator/SP.POP.1519.FE.5Y

3. PRODUCTIVE USE DEMAND

3.1 PUE Applications for Off-Grid Microenterprises (barbers and tailors)

The market sizing calculation for the barbers and tailors sector assumed that hair cutting and sewing appliances will be retrofitted to be powered by a Tier 3 DC solar system (5-year system life). By using a single price for all of the ROGEP countries, this methodology does not take into account country-specific cost and supply chain constraints.

Microenterprises					
# of financially constrained SMEs[280]	X	Cost per tier 3 system ($625)	Divided by system lifetime of 5 years	=	Estimated Annualized Off-Grid Solar Market Potential for SMEs

3.2 Value-Added PUE Applications

Available data from various sources such as the World Bank, the UN's Food and Agriculture Organization and GSMA was used to estimate the potential OGS market for productive use applications in each of the analyzed market segments – solar pumping for agricultural **irrigation**, solar powered **milling** and solar powered **refrigeration**.

3.2.1 Irrigation

The market sizing calculation for solar-powered irrigation was based on smallholder irrigation potential (i.e. the amount of irrigable land suitable for smallholder farmers) that could benefit from a solar pumping system ($650, 6-year system life, 120 W system). This methodology does not take into account affordability (ability to pay) nor does it account for country-specific cost and supply chain constraints.

Value-Added PUE Applications – Solar Irrigation											
Irrigation Potential (hectare)[281]	X 25%	=	Smallholder Irrigation Potential (hectare)[282]	Divided by 0.3[283]	=	Estimated No. of Smallholder Farms Suitable for Solar Irrigation	X	$650 (cost of solar pumping kit)[284]	Divided by 6 year (life of system)	=	Estimated Annualized Off-Grid Solar Market Potential for irrigation

Methodology for identifying areas suitable for irrigation activities on farms:

The areas for potential irrigation activities were calculated using the visible cropland[285] adjacent to permanent surface water sources. As identified by experts in a study in Zambia[286] and based on other expert consultations, beyond a 5 km distance from surface water, the returns are not economically feasible. **Figure 31** is a map of the cropland within a 5 km distance from permanent surface water.

3.2.2 Milling

[280] "MSME Finance Gap," SME Finance Forum: https://www.smefinanceforum.org/data-sites/msme-finance-gap
[281] AQUASTAT – Food and Agriculture Organization: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en
[282] Assumption that 25% of irrigable land irrigated by smallholder farmers;
See: "Lessons Learned in the Development of Smallholder Private Irrigation for High Value Crops in West Africa," World Bank, (2011): http://siteresources.worldbank.org/INTARD/Resources/West_Africa_web_fc.pdf
[283] Assumption that smallholder private irrigation consists of small farms (0.3 hectare);
See: "Off-grid Solar Market Assessment in Niger and Design of Market-based Solutions," World Bank, (December 2017): https://www.lightingafrica.org/publication/off-grid-solar-market-assessment-niger-design-market-based-solutions/
[284] 120W solar pumping kit: https://futurepump.com/futures-bright-farmers-kenya/
[285] "Prototype Land Cover Map over Africa at 20m Released," Esa, (February 2018): https://www.esa-landcover-cci.org/?q=node/187
[286] "Zambia Electrification Geospatial Model," USAID and Power Africa, (April 2018): https://pdf.usaid.gov/pdf_docs/PA00T2JC.pdf

The market sizing calculation for solar-powered milling utilized a series of inputs from the UN Food and Agriculture Organization to estimate the smallholder milling potential that could benefit from a 6.5 kW solar powered milling system (20-year system life). Cereals (e.g. rice, maize, millet and sorghum) as well as roots and tuber crops (e.g. cassava, yams and potatoes) were analyzed, as they provide an opportunity for value addition through hulling or milling.

Value-Added PUE Applications – Solar Milling													
Cereals, roots tuber crops (tons)[287]	X	70%[288]	X	50%[289]	=	Smallholder Milling Potential (tons)	Divided by 2 tons per day X 70% capacity factor[290]	=	Estimated No. of Solar Mills	X	6,500 W x $2.50 per watt Divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Milling

Ultimately, the ability for an agricultural community to benefit from productive use applications has as much to do with access to markets and improved crop inputs, as it has to do with the pricing and availability of financing to purchase the equipment. Hence, the macroeconomic approach used to carry out this market sizing does not account for country-specific cost and supply chain constraints.

3.2.3 Refrigeration

The market sizing calculation for solar-powered refrigeration utilized the estimated number of off-grid market centers in each country to estimate the number that could benefit from a 5.5 kW solar refrigeration system (20-year system life).

Value-Added PUE Applications – Solar Refrigeration							
# Off-Grid Market Centers by country[291]	X	5,500 W[292]	X	$2.50 per watt	Divided by system lifetime of 20 years	=	Estimated Annualized Off-Grid Solar Market Potential for Refrigeration

3.3 PUE Applications for Connectivity/Mobile Phone Charging Enterprises

The market sizing calculation for solar-powered phone charging enterprises was based on each country's mobile phone penetration rate (number of unique subscribers), rural population rate, and the average costs of OGS phone charging appliances ($862, 5-year system life, 400 W system).

Mobile Phone Charging Enterprises							
# of Mobile Phone Subscribers in 2017[293]	X	% rural population	Cost of solar phone charging appliances* divided by lifetime of 5 years	X	0.01 (assuming 1 phone charger per 100 mobile phone users)	=	Estimated Annualized Off-Grid Solar Market Potential for Phone Charging Enterprises

[287] Food and Agriculture Organization: http://www.fao.org/faostat/en/#data/RF
[288] Assumption that 70% of crops are milled
[289] Assumption that 50% of milled crops are processed at smallholder farmer level
[290] Solar mill (6.5 kW system) can mill 2 tons of produce per day; assume capacity factor of 70% (for maintenance/seasonality)
See: "Off-grid Solar Market Assessment in Niger and Design of Market-based Solutions," World Bank, (December 2017): https://www.lightingafrica.org/publication/off-grid-solar-market-assessment-niger-design-market-based-solutions/
[291] https://www.citypopulation.de
[292] 5.5kW solar powered refrigeration system – *See*: https://www.deutschland.de/en/solar-powered-coldhubs-nigeria
[293] "The Mobile Economy, Sub-Saharan Africa," GSMA Intelligence, (2017): https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download

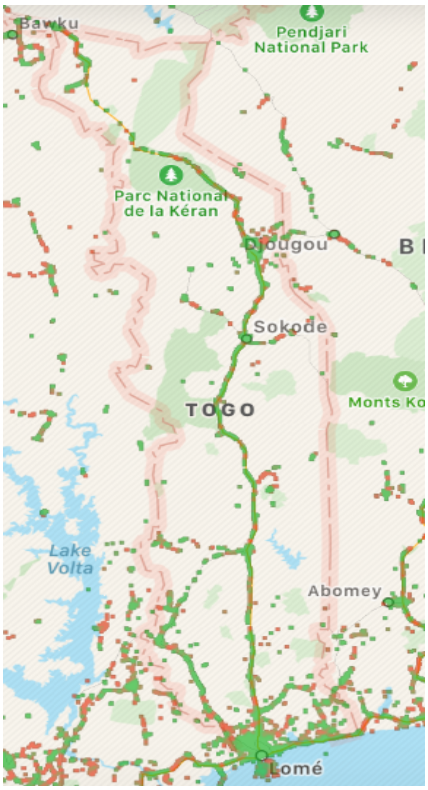
* Indicative Costs for Phone Charging Appliances[294]

Charging Stations	Cost (USD)	Manufacturer
Charging ECOBOXX Qube (sizes - 50) 5Wp panel	$83	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Charging ECOBOXX Qube (sizes - 90) 10Wp panel	$205	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Charging ECOBOXX Qube (sizes - 160) 2*10Wp panel	$209	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station ECOBOXX 300	$681	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station ECOBOXX 600	$965	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable Charging Station ECOBOXX 1500	$1,532	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station BOSS Kit Portable	$3,025	Phaesun GmbH
Charging Sundaya Charging Station	$193	Sundaya
Average Cost	**$862**	

Source: GIZ and African Solar Designs analysis

Identifying areas of phone network coverage

The mobile phone network geographic coverage was mapped across each country **(Figure 33)**. The source for this data is GSMA, which gives a radius ranging between 2-30 km. The radius is affected by a number of variables including tower height, power output, frequencies in use, and antenna type. Since this does not indicate the quality of network, the data was compared with data from OpenSignal, which tracks the signal from users registered on the platform.



Green: Strong Signal (>-85dBm)
Red: Weak Signal (<-99dBm)
Source: Open Data Signal

[294] "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," GIZ, (2016): https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ__2016__Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf

4. SUPPLY CHAIN ANALYSIS

The Task 2 supply chain analysis was based on the following key sources of data:

- Supplier focus group discussions held in Lomé in July 2018
- Survey of 10 locally-based solar companies/suppliers in the country
- Survey of 10 larger international solar product suppliers
- ECREEE supplier database
- GOGLA semi-annual sales reports[295]
- Additional supplemental desk research and solar industry stakeholder interviews

These findings were subsequently corroborated by attendees of national validation workshops held in each country at the conclusion of the market assessment.

A list of identified solar companies that are active in Togo is included below:

1	ACDI-Solar
2	Africa Digi BioTech
3	AIDEV
4	BBOX Togo
5	Calafi
6	CEGET Togo
7	Dulosolar Togo
8	EBP-ESL
9	ECM Togo
10	Eco Energy Togo
11	Electro Hydrotech
12	Energie Stable
12	Entrepreneur du Monde (EDM/Mivo Énergie)
13	ESTN
14	Ezo Énergies du Futur
15	Great
16	FFB Green Power
17	Halo Energy Int'l Co
18	Intech-2E
19	Jeunes Volontaires pour l'Environnement (JVE)
20	Kya Energy Group
21	Mono Eco Green Energy
22	Nettcom
23	Ong Fondena

[295] "Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2018): https://www.gogla.org/sites/default/files/resource_docs/global_off-grid_solar_market_report_h1_2018-opt.pdf
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2017): https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth2-2017_def20180424_web_opt.pdf
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2017): https://www.gogla.org/sites/default/files/resource_docs/gogla_sales-and-impact-reporth12017_def.pdf
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (July – December 2016): https://www.gogla.org/sites/default/files/recource_docs/final_sales-and-impact-report_h22016_full_public.pdf
"Global Off-Grid Solar Market Report: Semi-Annual Sales and Impact Data," GOGLA, Lighting Global and World Bank, (January – June 2016): https://www.gogla.org/sites/default/files/recource_docs/global_off-grid_solar_market_report_jan-june_2016_public.pdf

24	Otamari
25	PES Togo
26	Projet Production Solaire (PPS) Togo
27	Reper
28	Solartec
29	Soleil Énergie
31	Soleva
32	Solven Energy
33	SOS-Energie Togo
34	Sud-Biogaz
35	Togo Energy
36	Total Access Solar (Awango)
37	TMSU International
38	Urbis
39	Veso

Source: ECREEE, Focus Group Discussions; Stakeholder interviews

ANNEX 3: TASK 3 METHODOLOGY

FINANCIAL INSTITUTION ASSESSMENT

Data collection under Task 3 included a combination of desk research, collaboration with local experts, and extensive stakeholder engagement with key officials and representatives from local and regional commercial banks, microfinance institutions and other development banks and agencies in Togo. Interviews were also conducted with regional development banks (namely BOAD and EBID) and other financiers active in the African off-grid solar sector, including export credit agencies, trade funders, crowd funders and impact investors.

The stakeholder engagement activity, which included both phone interviews as well as in-person meetings with key representatives from each FI, was undertaken across the 19 countries with extensive support from ECREEE. As a follow up to each interview/meeting, a questionnaire was administered in order to gather critical data on each institution, including *inter alia* their level of experience and capabilities with off-grid sector lending, SME and consumer lending, relationships with local and international partners etc. Feedback from the interviews and questionnaire, as well as quantitative data from each bank's published annual reports, was compiled and analyzed in order to assess which FIs could be most suitable local partners / implementing agents for the proposed ROGEP facility.[296]

The questionnaire that was administered to FIs in the country and across the ROGEP region is included below.[297] The results of the survey are summarized in **Section 3.4**.

- Has the bank provided any loans to any segment of the off-grid sector? If so, please describe.
- Has the bank received any inquiries from any segment of the off-grid sector? How many inquiries?
- Did the bank engage in serious discussions or dismiss the inquiry(ies) as not within the bank's area of lending or not interesting as a new business line? If dismissed, please provide the bank's reasons.
- If the bank engaged in serious review/discussions and rejected the opportunity, please describe the bank's due diligence approach and reasons for rejection.
- Is the bank interested to pursue lending to any segment of the off-grid sector? Which segment and which of the bank's departments and existing products apply?
- Describe the bank's current loan products and lending activity for the SME, Corporate, Consumer and Agri markets. Please provide rough figures on volumes in number of loans and value in each category. For each category please provide average margins, pricing, loan tenors to borrowers, collateral requirements.
- Does the bank have a structured finance department? Has the bank provided financing to any IPPs? If so, please provide details on the transactions (location, technology, size, maturity, portion of bank engagement in the total financing)
- Does the bank have a trade finance department? What are standard terms and conditions? What are the volumes in number of loans and values?
- Does the bank operate nationwide or only in certain regions? Does the bank have a presence in rural areas and is rural consumer and SME and Agri lending a key business focus?
- Does the bank have experience with managing DFI credit lines? In which sectors/departments? Which DFIs? What volumes? Were the lines fully committed and disbursed? What was the bank's overall experience with these credit lines?
- Has the bank had dealings with the ECOWAS Bank for Investment and Development (EBID)? What type of relationship? Credit lines? Co-lending? Credit enhancement? Have the experiences been positive?
- What is the bank's view on accepting hard currency credit lines and on-lending in hard currency? Would the bank hedge hard currency credit lines and on-lend in local currency?
- Is the bank interested to explore a credit line with ROGEP? What size of credit line would the bank be

[296] The results of this assessment and corresponding recommendations were prepared for ECREEE in a separate, confidential report.
[297] The survey was adapted based on the type of FI that was being interviewed (commercial banks, MFIs, Regional Development Banks)

comfortable launching with initially?

- Does the bank feel that it would need a third-party guarantee in order to reduce risk enough to make loans to off-grid enterprises? If so, would it be enough if a guarantor were to cover 50% of losses on par with the bank? Or will the bank need the guarantor to take the first 10-20% of losses in an off-gird loan portfolio?
- What pricing does the bank consider to be fair and affordable for third party pari-passu guarantees? For first loss coverage?
- Has the bank had experience with any of the following as guarantors on the bank's loans: Africa Guarantee Fund, Africa Trade Insurers, Afrexim Bank, GuarantCo, IFC, USAID DCA? Has their pricing been fair and affordable? Does the bank have any preference in working with one over the others?
- To engage in lending to the off-grid market segments, would Technical Assistance be helpful? What types of TA would be most useful? Outside consultants to help design specific loan products and underwriting guidelines for the off-grid sector? Outside consultants to develop deal flow and conduct due diligence? Training of bank credit department and account representative personnel? Direct funding to the bank to develop marketing and promotional materials and hire staff?
- Does the bank adhere to and is in compliance with all aspects of the Basel II and III accords?
- Does the bank adhere to and have implemented controls for the Equator Principals and the World Bank/IFC Environmental and Social Standards?

ANNEX 4: GENDER ASSESSMENT

1. Context and Purpose of the Gender Analysis

Within the context of this assignment, a gender-focused analysis was undertaken to assess the level of participation of women in each country's off-grid energy sector. This analysis is critical to the overall market assessment given the clear linkages between energy and gender, namely different rates of access and use as well as the impacts of energy sources and appliances in the home, community and wider society. Energy sector studies often fail to obtain gender-disaggregated data, which is necessary to inform policymakers and better understand the needs and priorities of women in the context of sustainable development.

Women in energy-poor households are at substantially higher risk of illness attributable to indoor air pollution and solid fuel (biomass) use.[298] Moreover, the significant time burdens that women and girls face in collecting fuel and water, cooking and processing food often keep girls from attending school; there is evidence that electrified milling equipment and water pumps can significantly reduce this burden. Lack of access to electricity also means that women do not have access to information and communication technologies that could improve their lives.[299]

As a region, West Africa and the Sahel has remained traditionally gender-stratified whereby males on average have greater access to resources, are more empowered by society and have more opportunities than women.[300] To address these challenges, governments across the region have adopted a range of policies to improve gender equality and promote gender mainstreaming. Member states of ECOWAS have adopted a Policy for Gender Mainstreaming in Energy Access, an initiative committed to promoting favorable policies and frameworks and mobilizing resources to more fully engage women in all areas of energy access, including as energy suppliers, planners, financiers, educators and customers.[301] ECREEE, the agency that is administering this policy throughout the region, is supporting implementation of regulatory and institutional measures that aim to improve inclusive energy access in each country by 2030. ECREEE has also partnered with AfDB to launch a separate regional initiative to advance the participation of women entrepreneurs in the renewable energy sector.[302]

Outside of ECOWAS, Cameroon, Chad and Central African Republic are pursuing gender mainstreaming at a regional level through the Economic Community of Central African States (ECCAS) Regional Policy for universal access to modern energy services and economic and social development (2014-2030).[303] Mauritania is also implementing a national policy to address this issue – the National Strategy of Institutionalization of Gender (la Stratégie Nationale d'institutionalisation du genre).

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[298] "The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa," UNDP and World Health Organization, (2009): http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Sustainable%20Energy/energy-access-situation-in-developing-countries.pdf

[299] Rewald, R., "Energy and Women and Girls: Analyzing the needs, uses, and impacts of energy on women and girls in the developing world," Oxfam, (2017): https://www.oxfamamerica.org/static/media/files/energy-women-girls.pdf

[300] "Situation Analysis of Energy and Gender Issues in ECOWAS Member States," ECREEE, National Energy Laboratory, (2015): https://www.seforall.org/sites/default/files/Situation-Analysis-of-Energy-and-Gender-Issues.pdf

[301] Ibid.

[302] "Feasibility study promotes women's participation in energy transition," ESI Africa, (May 7, 2018): https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/

[303] "Central Africa Regional Integration Strategy Paper," African Development Bank, (2011-2015): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/RISP%20CENTRAL%20AFRICA-ECCAS%20English%20FINAL.pdf

➢ Description of Approach / Methodology

While the data collection for this assignment was not sex dis-aggregated (which was beyond the scope of work), a gender-focused perspective was applied to the overall analysis. The methodology adopted to carry out this exercise included a combination of desk research, literature review, focus group discussions (FGDs) and face-to-face interviews with key gender "focal points" identified by ECREEE in each country. Representatives from women's groups, female-led businesses and energy sector organizations attended the focus group meetings that were held in Cotonou in July 2018 to share their insights and inform the overall market study. A gender questionnaire was also distributed to key stakeholders in Togo to assess the main barriers/constraints for inclusive participation in the country. The survey examined a number of key gender issues, including *inter alia* access to credit, access to education and information, entrepreneurial and income-generating activities for women (including productive use of energy), representation of women in leadership positions in business and government.

➢ Gender Questionnaire

The following questionnaire was administered to key stakeholders in each country. Respondents were asked to reply Yes/No to each question and elaborate as needed.

HOUSEHOLD

Are women generally involved in influencing decisions on household energy use/services?
Are off-grid solar solutions (E.g. solar lanterns, solar home systems) largely accessible/made available to the household sector, particularly women-headed households?
Are there any related programs and initiatives (donor, government, private sector, NGO etc.) that are specifically targeting energy access for women in the household sector?
Are off-grid solar products and services generally affordable for households headed by women? If not, are Microfinance Institutions or other organizations in the country providing credit/financing (grants/loans) to the household sector, particularly women-headed households to increase energy access?
Are women aware of the health impact of unclean energy (e.g. fuel-wood for cookstoves) and the solutions (i.e. solar) to address it?

COMMUNITY/INSTITUTIONAL

Are women represented in any high-level energy sector positions? Please provide names/examples, if available, of women in senior management positions in government, committees, boards etc.
Is the mobility and safety of women constrained due to poor energy services (e.g., unavailability of streetlights due to unreliable electricity supply)?

PRODUCTIVE USE

What kind of productive use activities do women engage in and what women-led productive use activities can be supported by off-grid solar solutions?

- Agriculture (irrigation, water pumping etc.)
- Shops (retail, artisanal/handicrafts, grocery, salons etc.)
- Restaurants (bar, cafe etc.)
- Kiosks (e.g. mobile money etc.)
- Tourism
- Other

SUPPLIER

Please describe the level of engagement that women have in in the off-grid energy services sector. Are women highly employed in this area (e.g. is there data collected on the number of women-owned businesses/SMEs)?
Are there any related programs and initiatives (donor, government, private sector, NGO etc.) that provide training for women to manage or be employed by energy-related enterprises?

ADDITIONAL:
What are the main barriers women face to access information?
What are the main barriers/constraints for women entrepreneurs to have access to credit?
Do women have equal access to capacity building and training services (e.g. vocational training/technical education) or do they experience discrimination in access to these services?
What policy, regulatory and institutional framework(s) exist, if any, to address gender mainstreaming[304] (e.g. national gender action plans/related policies etc.)?
Are gender-related issues taken into consideration in energy policy provisions and/or are energy-related issues reflected in gender policies (e.g. existence of 'gender units' within public sector agencies and/or 'gender audits' in energy sector)?

2. Gender Profile

2.1 The state of gender equality in Togo

Structural inequalities and gender discrimination against women and girls persist in Togo, as inclusive participation remains an ongoing challenge. The gender assessment found that while there have been modest improvements in recent years to certain social indicators, gender disparities still exist across the economy, particularly in access to resources, higher education, land ownership, and inheritance systems, political power and decision-making. These findings are supported by the UNDP Human Development Index (HDI) on Gender Inequality, where Togo performs extremely poorly, ranking 140 out of 189 countries in the index.[305]

2.2 Gender and Poverty

Poverty remains widespread in Togo, particularly in rural areas where a large share of the country's poor population lives. It is estimated that about 49.2% of the population lives below the poverty line. According to UNDP statistics, 61.4% of the labor force is considered working poor at PPP USD 3.10/day.[306] HDI indicators and income levels are comparatively much lower for women, who constitute a disproportionate share of the country's poor and extremely poor population.

2.3 Gender, Human Capital and Economic Empowerment

2.3.1 Education, Skills Development and Training

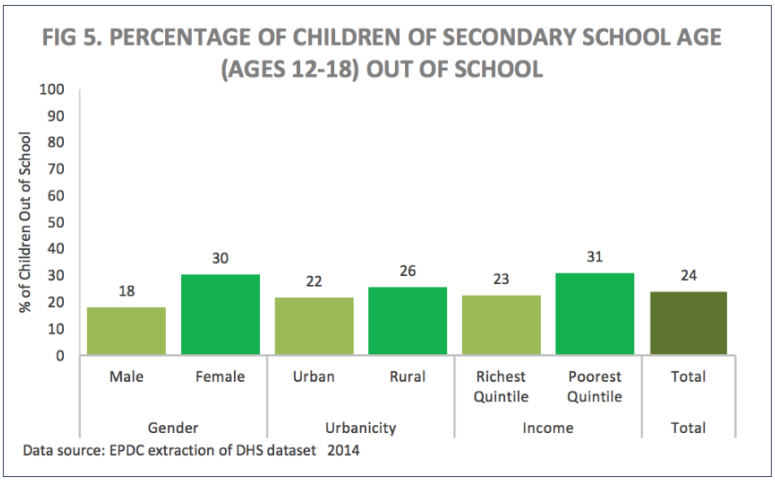
While Togo has achieved gender parity in rates of access to primary education, there is still a considerable gap in higher levels of education; only 26.3% of adult women in Togo have attained some level of secondary education compared to 52.5% of men.[307] The gender gap is even worse for tertiary education (see **Section 1.2.2.5**).

However, the primary and secondary education sector have shown signs of robust educational access. An estimated 11% of children of official primary school age are out of school. Approximately 10% of boys of primary school age are out of school compared to 14% of girls of the same age. Nearly 30% of female youth of secondary school age are out of school compared to 14% of male youth of the same age. Across the

[304] **Gender mainstreaming**: The process of ensuring that women and men have equal access to and control over resources, development benefits and decision-making, at all stages of development process, projects, programs or policy.
[305] "UN Human Development Reports: Gender Inequality Index (GII)," UN Development Programme, (2018): http://hdr.undp.org/en/composite/GII
[306] "UN Human Development Indicators: Togo," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/TGO
[307] Ibid.

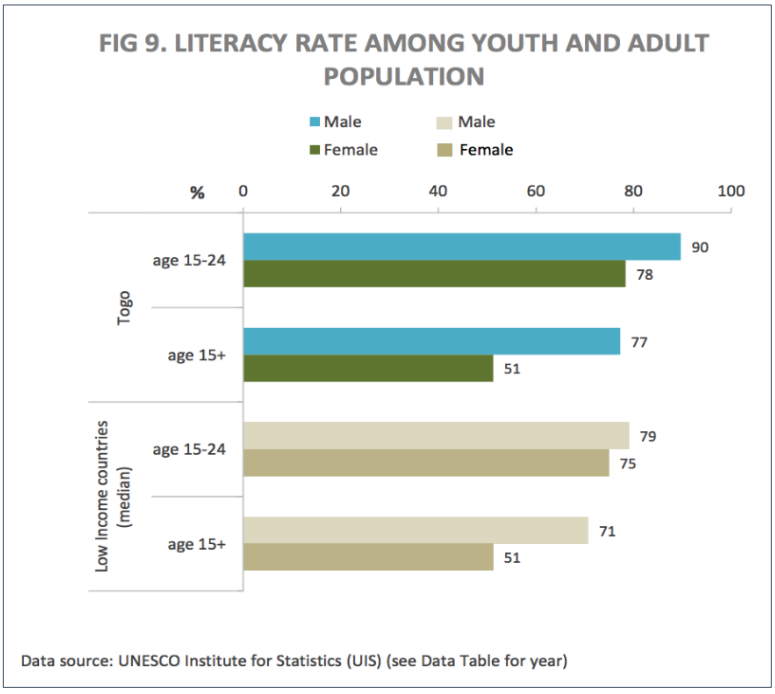
entire sector, there are huge disparities between the poorest and the richest youth in terms of access to education.[308] This trend remains consistent in literacy rates among Togo's youth and adult populations, as just 51% of the country's female adult population is literate, compared to 77% of the adult male population.[309]

Percentage of Children of Secondary School Age (13-19) Out of School



Source: Education Policy Data Center

Literacy Rate Among Youth and Adult Population



Source: UNESCO Institute for Statistics

[308] "Togo: National Education Profile, 2014 Update," Education Policy and Data Center, (2014).
[309] Ibid.

According to the UN, as of 2017, only 37.6% of women in Togo had an account at a financial institution or with a mobile money service provider.[310] This can be attributed to the country's elevated levels of poverty, low or irregular sources of income, low rates of financial literacy, and a perceived lack of need. This is also a result of the fact that most banks are focused on serving the formal sector, while many women remain engaged in informal economic activities – especially subsistence agriculture.

2.3.2 Fertility Rates and Reproductive Health

As of 2017, the fertility rate in Togo remained high, at five children per woman. The country also has a high maternal mortality rate; for every 100,000 live births, 368 women die from pregnancy related causes. An estimated 33.6% of women have an unmet need for family planning.[311]

2.3.3 Participation and Decision-Making

Socio-cultural perspectives in Togo remain male-dominated, as conventional gender roles continue to hold women back. This is reflected in household decision-making, which often plays a role in restricting the rights and empowerment of women. These dynamics are also present in the rates of representation of women in the labor market as well as in leadership positions in business and government.

Although women's level of participation in the economy is growing, they still lag behind men, with an adult labor force participation rate of 75.8% compared to 79.4% for men.[312] Women are also poorly represented in the private sector, especially in the energy related organization. For example, in the Compagnie Energie Electrique du Togo (CEET), 140 of 818 (17 %) employees are women. As of 2018, women held only 17.6% of the country's seats in parliament.[313]

2.4 Gender Policy, Institutional and Legal Framework in Togo

2.4.1 Gender Mainstreaming initiatives by the Government

The GoT has adopted several policies and action plans to promote gender mainstreaming and equality and has signed on to key international and regional framework agreements protecting women's rights. At the international level, Togo has ratified the Convention on the Elimination of All Forms of Discrimination Against Women[314]and is also signatory to the Protocol to the African Charter on Human and People's Rights on the Rights of Women in Africa, the Solemn Declaration on Gender Equality in Africa and the Beijing Platform for Action, among others.

The 2007 Constitution of Togo forbids discrimination "based on race, gender, religion, disability, language, or social status". Pursuant to this, Togo's policy framework for promoting gender equality and women's empowerment is guided mainly by two policies: (i) National Equity and (ii) Gender Equality Policy (PNEEG) with its gender equality Action Plan (le Plan d'Action National pour l'Equité et l'Egalité de Genre, PANEEG). Both policies were adopted in 2011 to guide the Government's efforts to promote gender equality, empowerment of women and their effective participation in decision-making at all levels of the development process in Togo. The national department responsible for coordinating gender mainstreaming

[310] "Human Development Indices and Indicators: 2018 Statistical Update," UN Development Programme, (2018): http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf
[311] Ibid.
[312] "UN Human Development Indicators: Togo," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/TGO
[313] Ibid.
[314] Ratification Table : Protocole to the African Charter on Human and People's rights on the Rights of Women in Africa: http://www.achpr.org/instruments/women-protocol/ratification/

is the Ministry of Social Action, advancement of women and literacy (Ministère de l'Action Sociale, de la Promotion de la Femme et de l'Alphabétisation).

The GoT has also developed novel financing strategies to improve women's access to microcredit. This includes the creation of a national Fund for Inclusive Finance (FNFI). Its first product is a credit line intended to support and encourage income-generating activities for the country's poor population through a maximum loan of 30,000 FCFA (USD 51.35) per person.

2.4.2 Gaps in the Gender Policy/Legal Framework

Despite the Government's policy initiatives and legislative reforms, gender inequality remains an ongoing challenge across the country's political, economic and socio-cultural landscape, as women still face many barriers to inclusive participation. Togo's legal system consists of statutory, customary, and religious laws, leading to contradictions and inconsistencies among the three. Togo also has two parallel and overlapping judicial codes: one based on western, mainly French, systems and one based on traditional systems. These codes often disagree, particularly in areas related to gender.

As described above, significant gender gaps persist in the areas of education, literacy, access to information and decision-making. There is also still a lack of sex-disaggregated data across all sectors of the economy, which is critical to inform policy decision and promote gender mainstreaming on a national scale.

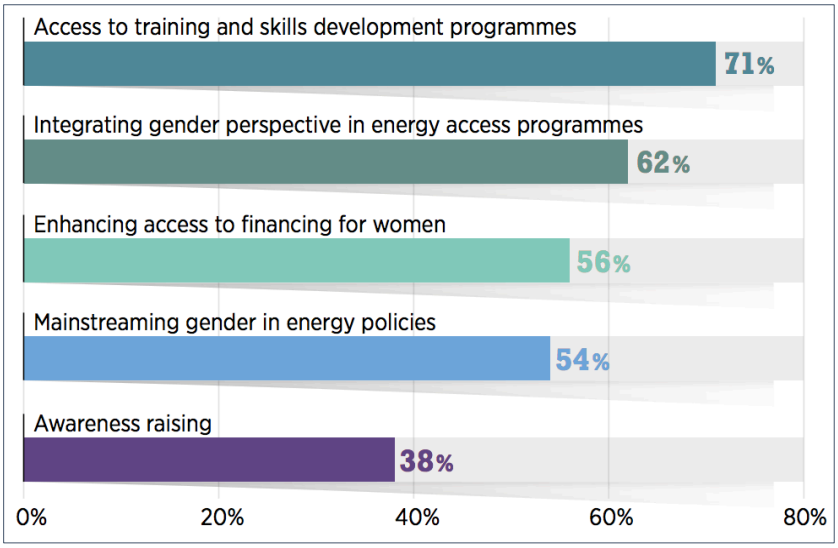
2.5 Summary of Recommendations

Given the increased attention that gender inclusion has received in development planning, there are a number of tools that are now available to policymakers that can be utilized to support gender mainstreaming and encourage women's participation in the energy sector. Despite encouraging progress in the discourse on gender and energy access, substantial efforts are still needed, especially in enabling women's participation in the sector in different roles, including as energy entrepreneurs and in leadership positions.[315]

In seeking solutions to improve women's engagement in energy access, a 2018 IRENA survey found that access to necessary technical, business or leadership skills development programs was the single most important measure that could be taken. Over half of survey respondents also highlighted the need to integrate gender perspectives in energy access programs as well as enhanced access to finance.[316]

[315] "Renewable Energy: A Gender Perspective," International Renewable Energy Agency, (2019): https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf
[316] Ibid.

Measures to Improve Women's Engagement in Energy Access



Source: International Renewable Energy Agency

In addition to the measures highlighted in the figure above, below is a list of additional policy recommendations that could further improve gender equality in Togo's energy sector:[317]

- Take measures to close the gender gap in access to education, particularly in higher levels of education
- Implement a quota system to increase the number of women employed in government's energy ministry and ensure that women are part of decision-making processes in the energy sector
- Implement policy and budgetary measures to support programs that aim to raise awareness and promote opportunities for women as energy customers, suppliers, financiers, and educators
- Commission studies to collect, synthesize and publish gender-specific/sex-disaggregated data on women's energy access and usage to inform (i) public policy development to improve rates of access for women; and (ii) private sector on potential customer needs (e.g. clean cooking technologies, productive use of energy applications etc.)
- Undertake a "gender audit" of the energy sector and develop a gender action plan to inform long-term policy objectives targeting gaps in the existing framework and promoting inclusive participation (e.g. by adding gender categories to policies and projects and accounting for gender impacts in strategic planning).
- Establish a Gender Focal Point or Unit within key national and local institutions in order to administer targeted gender policies and programs
- Raise awareness / provide training and technical support to private sector businesses / SMEs on (i) the benefits of gender inclusion and in viewing business decisions through a gender lens; (ii) the value of gender-disaggregated data; and (iii) how to develop and implement gender strategies to encourage inclusive participation.[318]

[317] NOTE: This is not an exhaustive list of recommendations as it is only intended to address inclusive participation in the energy sector; there are many gender-related challenges that warrant further study and attention within the context of the country's complex economic and social structures that are beyond the scope of this analysis

[318] "ECOWAS-CTCN Project on Mainstreaming Gender for a Climate Resilient Energy System in ECOWAS Countries: Final Report," ECREEE and CTCN, (May 2018): https://www.ctc-n.org/system/files/dossier/3b/180627_final_report-uk.pdf

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