WORLD BANK GROUP

ECREEE

TOWARDS SUSTAINABLE ENERGY

REGIONAL OFF-GRID ELECTRIFICATION PROJECT

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

CABO VERDE REPORT

JULY 2019

GreenMax Capital Advisors

Energio Verda
Renewable Energy for Development

ASD

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS & ACRONYMS

AEB	Águas e Energia da Boa Vista
ADAD	Associaoção par a Defensa de Ambiente e Desenvolvimento
AFD	Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
ARE	Economic Regulatory Agency
ASD	African Solar Designs
BCV	Banco De Cabo Verde
C&I	Commercial and Industrial
CAPEX	Capital Expenditure
CAR	Capital Adequacy Ratio
CERMI	Centro de Energias Renováveis e Manutenção Industrial (Center for Renewable Energy and Industrial Maintenance)
COD	Cash-on-Delivery
CVE	Cabo Verdean Escudo
DFI	Development Finance Institution
DNICE	Direcção Nacional da Indústria Comercio e Energia (National Directorate of Industry, Commerce and Energy)
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
EIB	European Investment Bank
ESMAP	Energy Sector Management Assistance Program
EU	European Union
EUR	Euro
EVA	Energio Verda Africa
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
FEI	Facility for Energy Inclusion
FGD	Focus Group Discussion
FI	Financial Institution
FX	Foreign Exchange
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information Systems
GNI	Gross National Income
GoCV	Government of Cabo Verde
GOGLA	Global Off-Grid Lighting Association
GSMA	Groupe Spéciale Mobile Association (Global System for Mobile Communications)
HC	Health Center
HDI	Human Development Index
HH	Household
ICIEG	Instituto Caboverdiano para a Igualdade e Equidade do Género (Cabo Verdean Institute for Gender Equality)
ICT	Information and Communications Technology

IEA	International Energy Agency
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IMF	International Monetary Fund
INS	Instituto Nacional de Estadística (National Institute of Statistics)
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
JICA	Japan International Cooperation Agency
kWh	Kilowatt-hour
LTO	Lease-to-Own
MICE	Ministério da Indústria, Comércio e Energia (Ministry of Industry, Trade and Energy)
MFI	Microfinance Institution
MTF	Multi-Tier Energy Access Framework
MW	Megawatt
NGO	Non-Governmental Organization
NPL	Non-Performing Loan
NREAP	National Renewable Energy Action Plan
O&M	Operation and Maintenance
OGS	Off-Grid Solar
PANER	Plano de Acão Nacional no Sector das Energias Renovaveis (National Renewable Energy Action Plan)
PAYG	Pay-As-You-Go
PPA	Power Purchase Agreement
PPP	Public Private Partnership
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
SIDS	Small Island Developing States
SME	Small and Medium Enterprise
SPV	Special Purpose Vehicle
SSA	Sub-Saharan Africa
TA	Technical Assistance
UN	United Nations
UNDP	United Nations Development 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
Wh	Watt-hour
Wp	Watt peak

ACKNOWLEDGEMENTS

The consortium of GreenMax Capital Advisors (GreenMax), African Solar Designs (ASD) and Energio Verda Africa (EVA) would like to thank the ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE), including Mahama Kappiah, Executive Director, ECREEE; Festus William Lartey Amoyaw, ROGEP Project Coordinator; and the entire ROGEP Expert and Technical Specialist team: Hamadou Tchiemogo, Kwabena Adom-Opare, Nouhou Amadou Seini, Daniel Paco, Ermelinda Tavares Lima, Sire Abdoul Diallo and Collins Osae for their leadership and guidance. We would also like to thank Nicola Bugatti and Yuri Handem for their support.

In addition, we would like to acknowledge the following individuals and organizations in Cabo Verde for their assistance:

Rito Evora and Ariel Assunção, Ministry of Industry, Trade and Energy; Jesus Moreira, Ministry of Agriculture and Environment; Osvaldo Borges, Carlos Mendes and Clodemir Pereira, Bureau / Office of Statistics; Christopher Pauly and Faon Peckham, GTEK; Emilio Benrós, LoboSolar; Helder Andrade, ARES; Alexandre Martins, Repower; Nasolino Monteiro, Achada Lagoa Representative; Claudino Mendes, University of Cabo Verde; Ricardo Monteiro, GEF-SGP; Miriam Vera Cruz, LuxDev; Heleno Sanches, UNIDO; Guilherme Bragança, European Union Delegation; Talina Pereira and Neusa Costa, ICIEG / National Institute for Gender Equality; Arlind Peixoto, Itech; Gilson Correia, CERMI; Orisandra Furtado and Evelyne Mello, MORABI; Idalina Freire, OMCV; Manuel Alves, Soldifogo; Antero Semedo, FAMIPiCOS; Paul Gomis, Aguas de Santiago; Edson Nascimento and Emerson Fonseca, ELECTRA; Jorge Silva, Ministry of Economy; Guntar Campos, Direção Geral das Alfandegas; Rui Maia, Cabo Verde Trade Invest; Manuel Fernando Monteiro Pinto, Banco Interatlantico; Herminalda Rodrigues, Banco Comercial do Atlântico; Carlitos Fortes, Banco Caboverdiano Negócios; Mário Rui Fernandes, Banco Internacional Cabo Verde; Regina Furtado, Denise Santos and Antão Fortes, Caixa Económica de Cabo Verde; José Mendes, EcoBank; Amilton Fernandes, Banco Angolano Investimentos Cabo Verde; Susana Silva e Farailda Évora, Banco de Cabo Verde; Carlos Mendes and Clodomir Pereira, National Institution of Statistics; and all focus group and survey participants in the country. This report would not have been possible without their support.

We would especially like to thank Ana R. Monteiro and José Oliveira Da Fonseca for their significant contributions to this research effort.

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

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
ATTRIBUTES	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

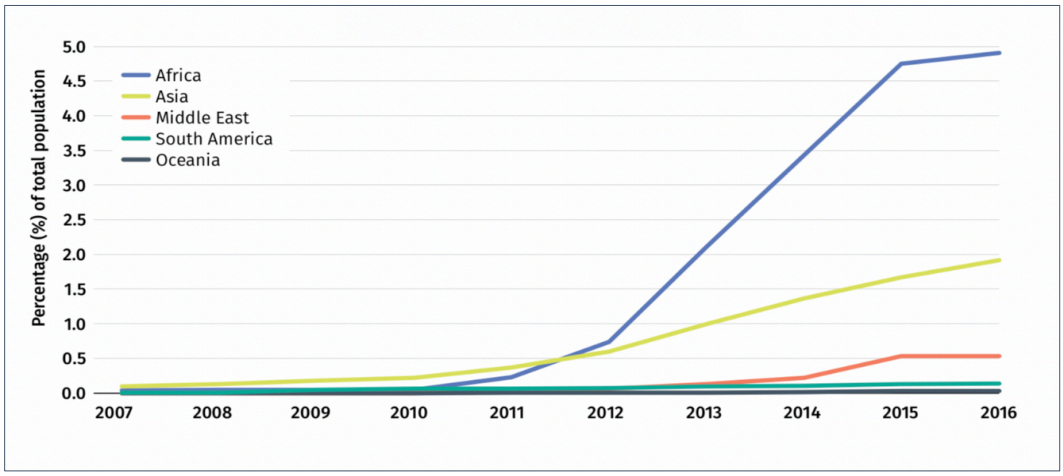
The term "West Africa and the Sahel" as it is used to throughout this report refers to the 19 countries covered by the first phase of the Regional Off-Grid Electrification Project (ROGEP). The countries include the 15 member states of the Economic Community of West African States (ECOWAS) – Benin, Burkina 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 tha n 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).

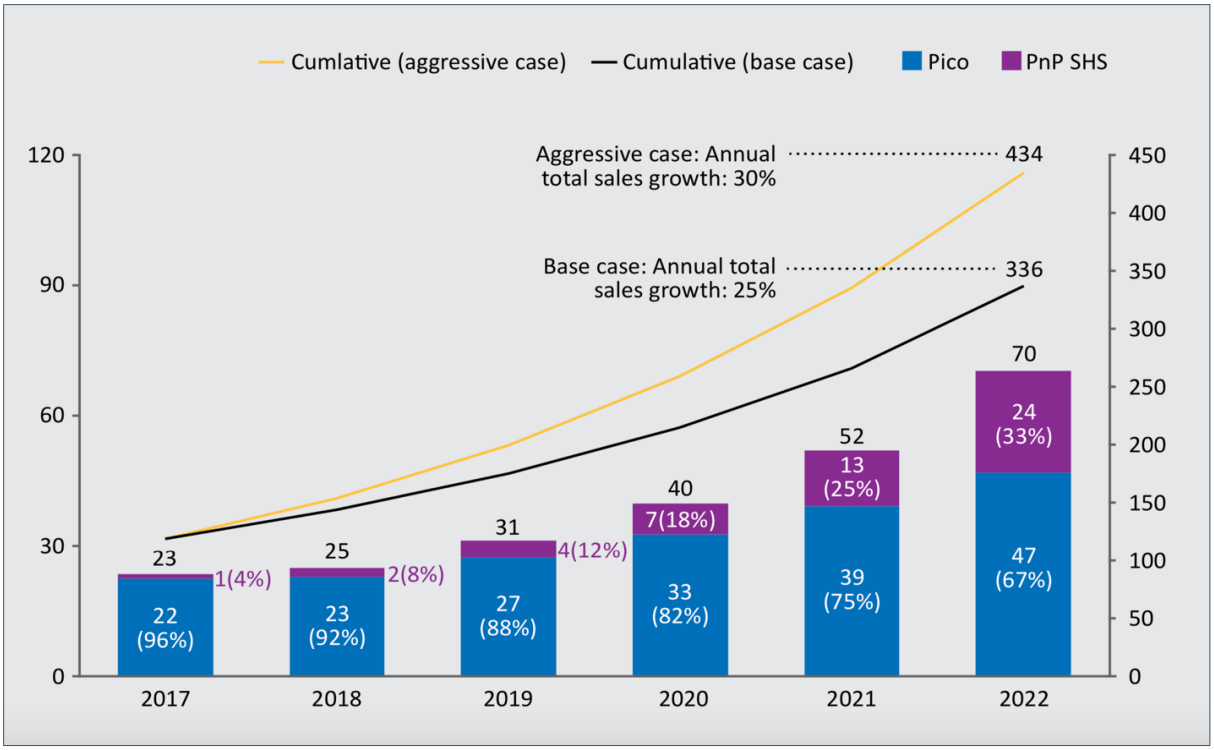
Until recently, diesel generators largely served as the expensive alternative both for rural electrification and for urban and peri-urban "bad grid" areas, where electricity was unreliable or only available for part of the day. However, the advent of decentralized renewable energy technologies, particularly 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.

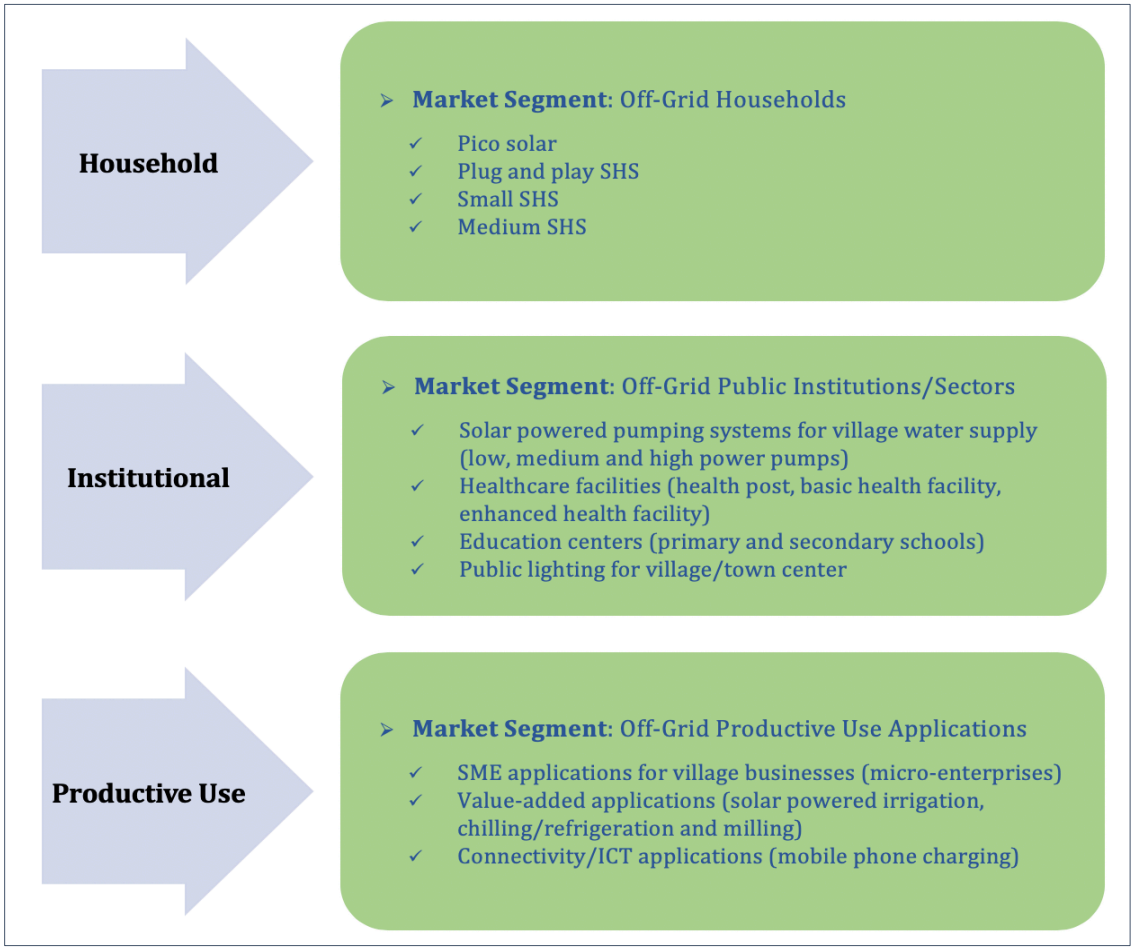
The institutional sector analysis combines available GIS data with secondary research to estimate potential demand based on assumptions about the electricity needs, usage patterns and associated costs of solar electrification of four public/institutional markets – water supply for off-grid communities, 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

Cabo Verde is a country of 10 islands situated 500 km off the coast of West Africa in the North Atlantic Ocean, with approximately half of the population living on the island of Santiago, the main island. Cabo Verde's economy is predominantly service-oriented and relies mainly on tourism, foreign trade, investment, and emigrant remittances, mainly from Europe and the United States. The country's geography prevents the formation of economies of scale and makes the provision of basic services costly and difficult. Despite these challenges, Cabo Verde has experienced rapid economic growth over the last two decades, with a nearly six-fold increase in GDP per capita, becoming the only non-extractive Sub-Saharan African country to attain middle-income status.[24]

Cabo Verde has received significant public and donor investment in the energy sector since 2001, including for rural electrification programs and grid extension projects. Altogether, these initiatives have nearly doubled the country's national electrification rate from about 50% in 2000 to 97% in 2016, with urban areas fully electrified and a rural electrification rate of 89%.[25] The Government of Cabo Verde (GoCV) has set a target to achieve universal electricity access by 2030.[26]

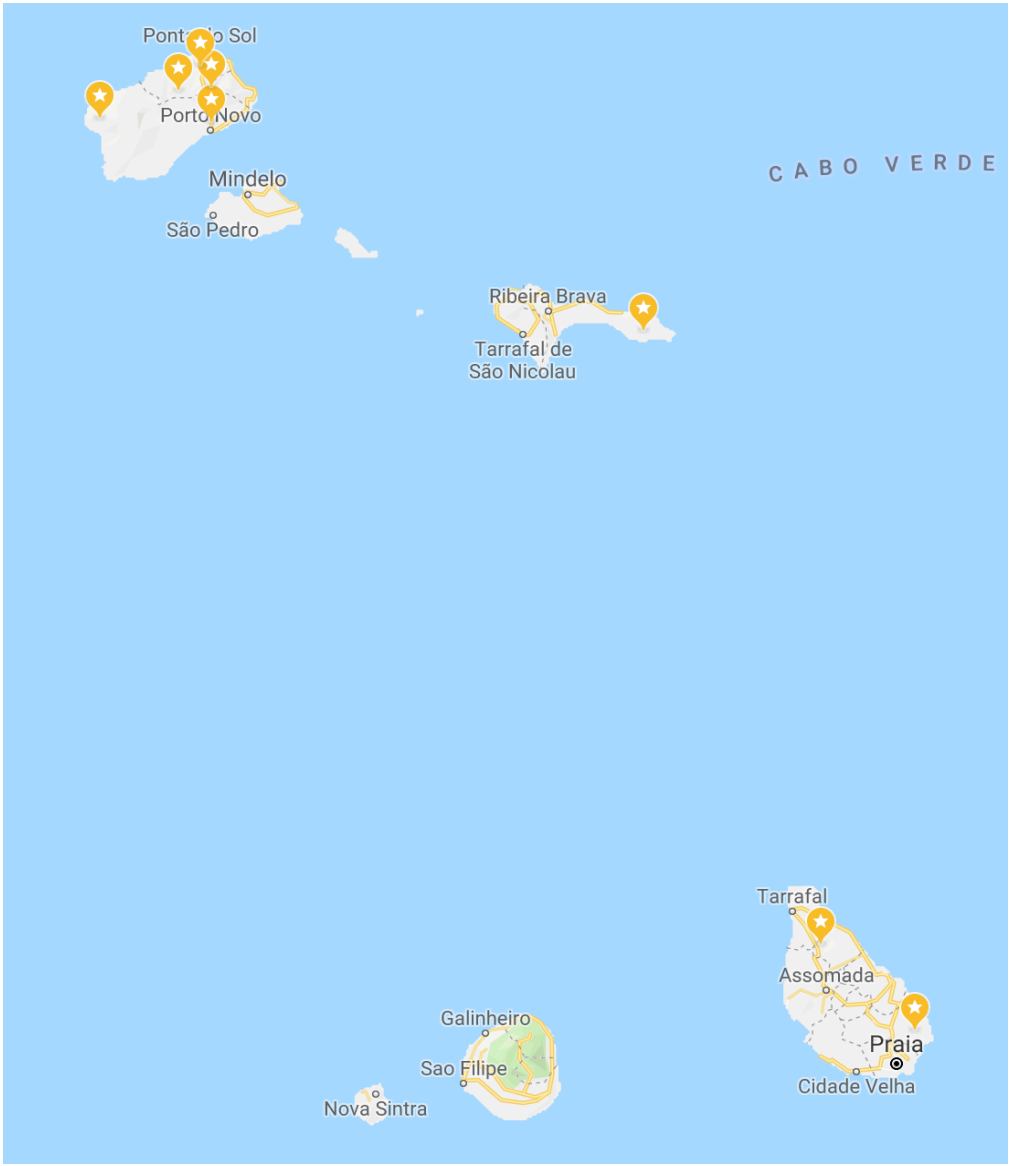
Despite the country's complex geography, Cabo Verde has a very high rate of electricity access and extremely reliable electricity service. The Government aims to achieve a higher share of renewable electricity production in the generation mix and to reduce electricity production costs. With support from 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 (Plano de Acão Nacional no Sector das Energias Renovaveis, PANER). The Ministry of Industry, Trade and Energy (Ministério da Indústria, Comércio e Energia, MICE) is also developing a Master Plan to provide a roadmap for achieving these objectives.

Cabo Verde's geography limits the country's ability to extend its grid. Instead, over the course of the last decade, the GoCV has served communities without access to electricity using micro-grids with diesel generators. As of 2018, the National Directorate of Industry, Commerce and Energy, (Direcção Nacional da Indústria Comercio e Energia, DNICE), which regularly collects data to identify the country's unelectrified communities, had identified about 30 off-grid communities in rural areas on three islands – Santiago, Fogo and Santo Antão – with the remaining islands considered to be covered by the grid. As of 2018, DNICE reported a total of eight off-grid communities on the islands of Santiago, Santo Antão and São Nicolau that have benefitted from the implementation of solar mini-grids, with an installed capacity of 165 kWp (**Figure ES-4**).

The majority of off-grid solar projects in Cabo Verde to date have been financed by development partners such as LuxDev and the GEF Small Grant Programme, among others. In 2018, Lorentz, a German solar water-pumping company, installed the first solar-powered water pumping system in rural Sao Felipe on the island of Fogo, with financing from LuxDev.

[24] "Cabo Verde Country Overview," World Bank, (2018): http://www.worldbank.org/en/country/Caboverde/overview
[25] IEA Energy Access Outlook, 2017.
[26] "SEforALL Action Agenda for Cabo Verde," Government of Cabo Verde and ECOWAS, (2015): https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_AAs/Action_Agenda_Sustainable_Energy_4_All_SE4ALL_CBV_-_Eng.pdf

Figure ES-4: Off-Grid Communities in Cabo Verde with DNICE Solar Mini-Grid Installations



Off-grid communities on the islands of Santiago, Santo Antão and São Nicolau that have benefitted from DNICE solar mini-grid installations (total of 165 kWp installed capacity)

Source: DNICE

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 Cabo Verde (**Figure ES-5**). According to the assessment, the estimated annualized off-grid solar cash market potential in 2018 is USD 6.5 million. The productive use sector (USD 6.3M) makes up the majority of estimated demand, followed by the institutional (USD 108K) and household (USD 87K) sectors.

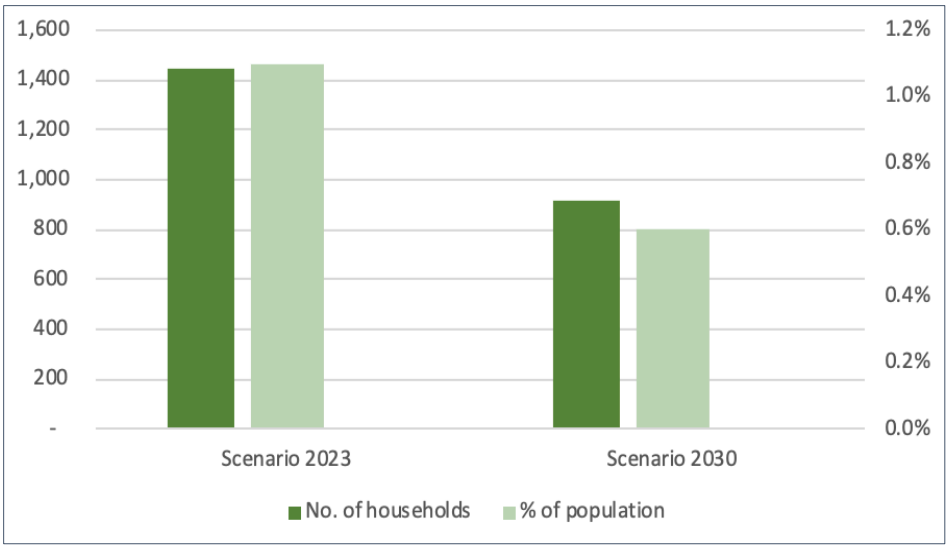
Figure ES-5: Indicative Total Cash Market Potential for Off-Grid Solar Products in Cabo Verde, 2018

Source: African Solar Designs analysis

Outside of the main grid areas, the un-electrified villages (on the islands of Santiago, Santo Antão and São Nicolau) with higher economic growth potential and higher population can be optimally electrified with mini-grid projects. The least-cost electrification analysis found that by 2023, 9 settlements across Cabo Verde (1,531 households) will be served my mini-grids constituting 1.1% of the population. By 2030, this figure will increase to 12 settlements (2,345 households) equivalent to 1.6% of the population.

The remaining more dispersed villages are optimally served by off-grid stand-alone systems. The analysis identified 27 settlements (1,450 households), representing 1.1% of the population, as suitable for stand-alone solutions. By 2030, the number will decrease to 24 settlements (917 households), constituting 0.6% of the population. (**Figure ES-6**). The analysis assumes that the percentage of the population connected to the main grid (97.8%) will remain the same between 2023 and 2030. These findings suggest that off-grid solar technologies (both mini-grids and stand-alone systems) can be utilized to help the Government achieve its goal of universal access by 2030.

Figure ES-6: Estimated Number of Households and Share of Population Suitable for OGS Systems in Cabo Verde, 2023 and 2030

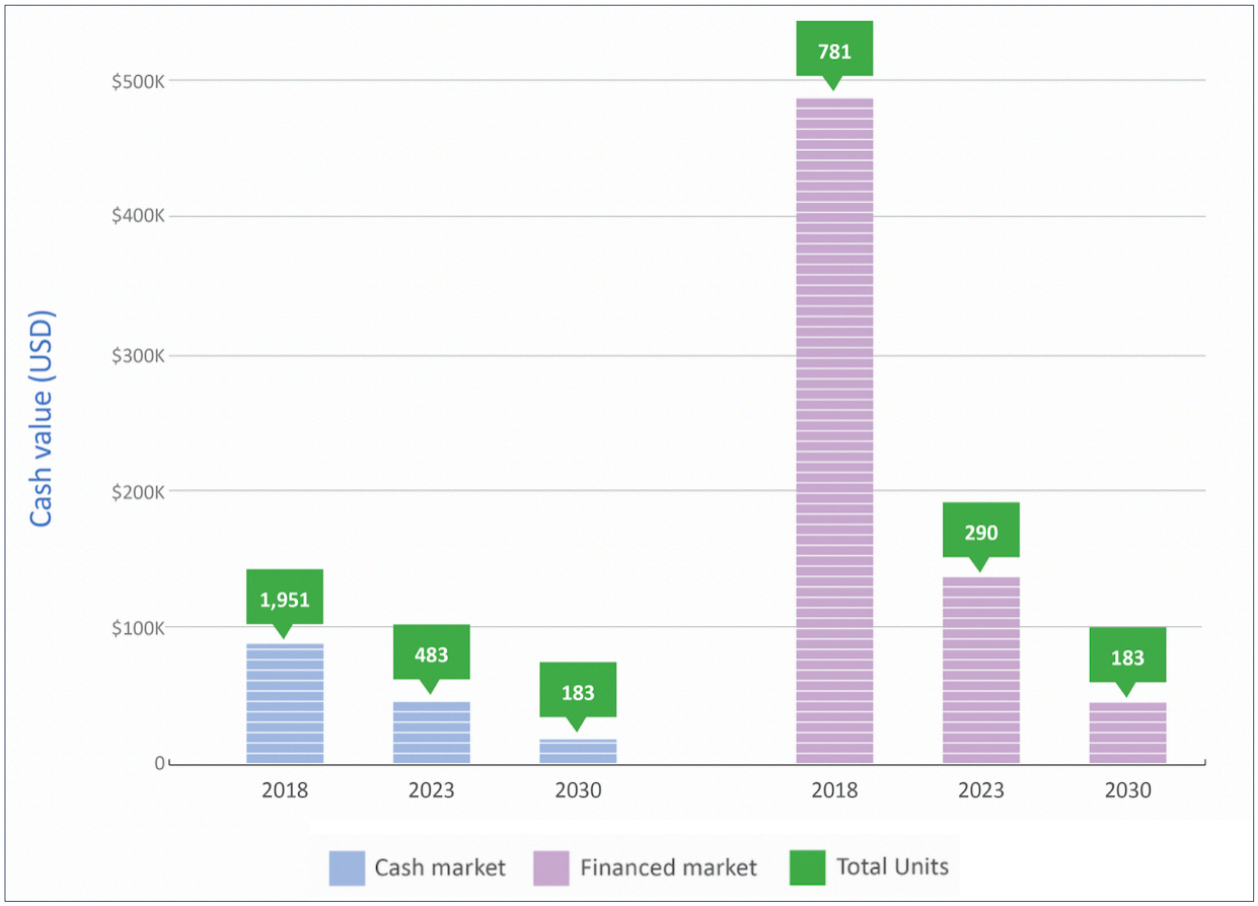


Source: Energio Verda Africa GIS analysis

According to the analysis, the annualized off-grid solar cash market potential for the household sector in 2018 is USD 87,812 with the estimated market value more than tripling in size to USD 487,846 with the addition of consumer financing (**Figure ES-7**). Consumer financing allows the poorest households to enter the market and those already in the market to afford larger systems.

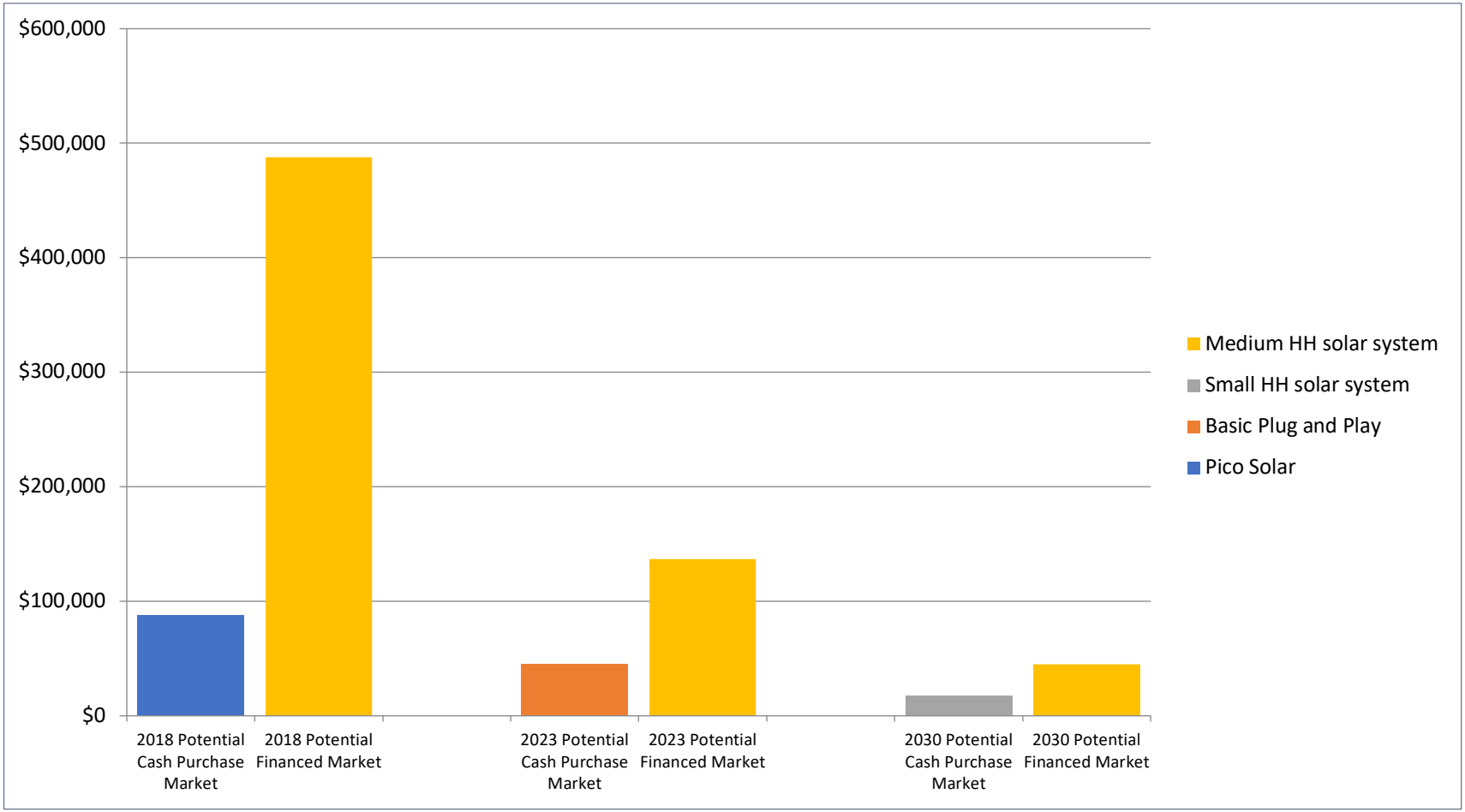
According to the assessment, the most common types of systems the market can afford on a cash basis are pico solar systems; however, this changes significantly with the introduction of financing (**Figure ES-8**). While affordability improves over time, households in the lowest income quintiles can only afford to purchase pico solar systems without financing. Consumer financing will therefore accelerate off-grid solar market growth and help meet electrification targets through 2030.

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



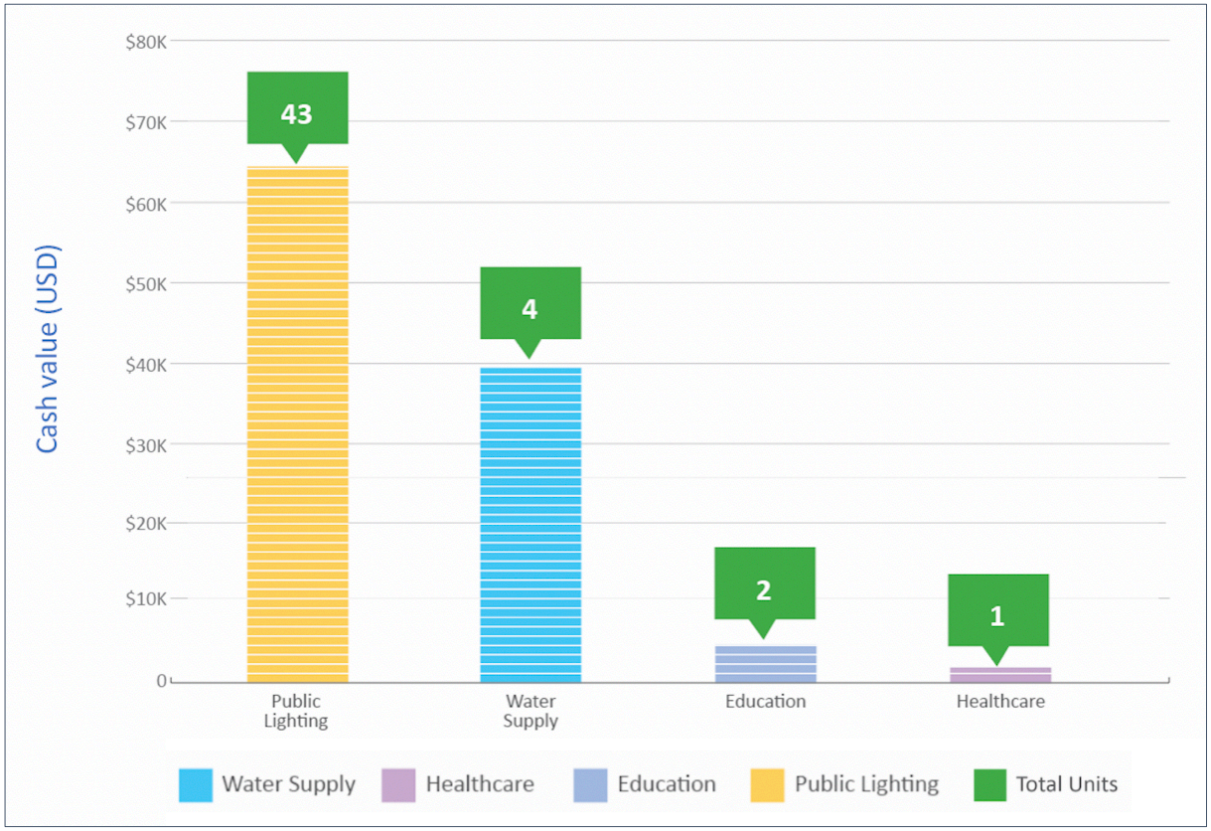
Source: African Solar Designs analysis

Figure ES-8: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type



Source: African Solar Designs analysis

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

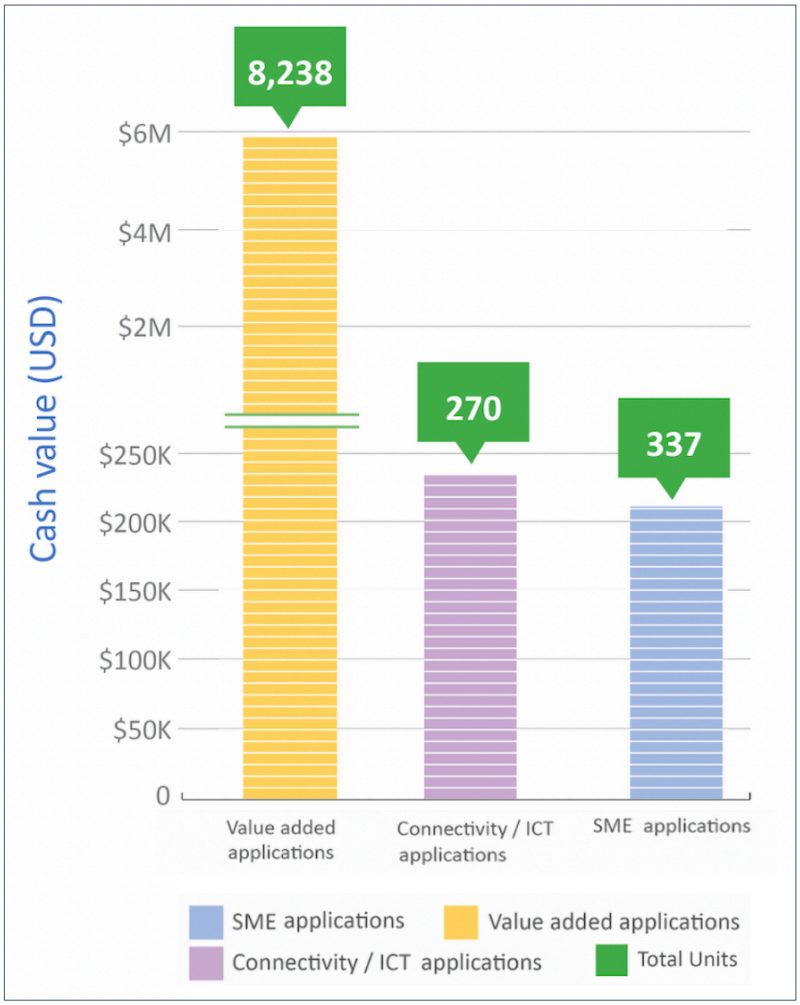


Source: African Solar Designs analysis

The estimated annualized cash market potential for Cabo Verde's public/institutional sector in 2018 is USD 108,925 (**Figure ES-9**). The institutional market segments with the largest potential are public lighting (USD 64,050), followed by water supply (USD 39,125), education (USD 4,350), and healthcare (USD 1,400). 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 6.3 million (**Figure ES-10**). The estimated demand from value-added applications represents most of the PUE market potential (USD 5.9M), followed by applications for connectivity (USD 232K) and SMEs (USD 210K).

Figure ES-10: 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.

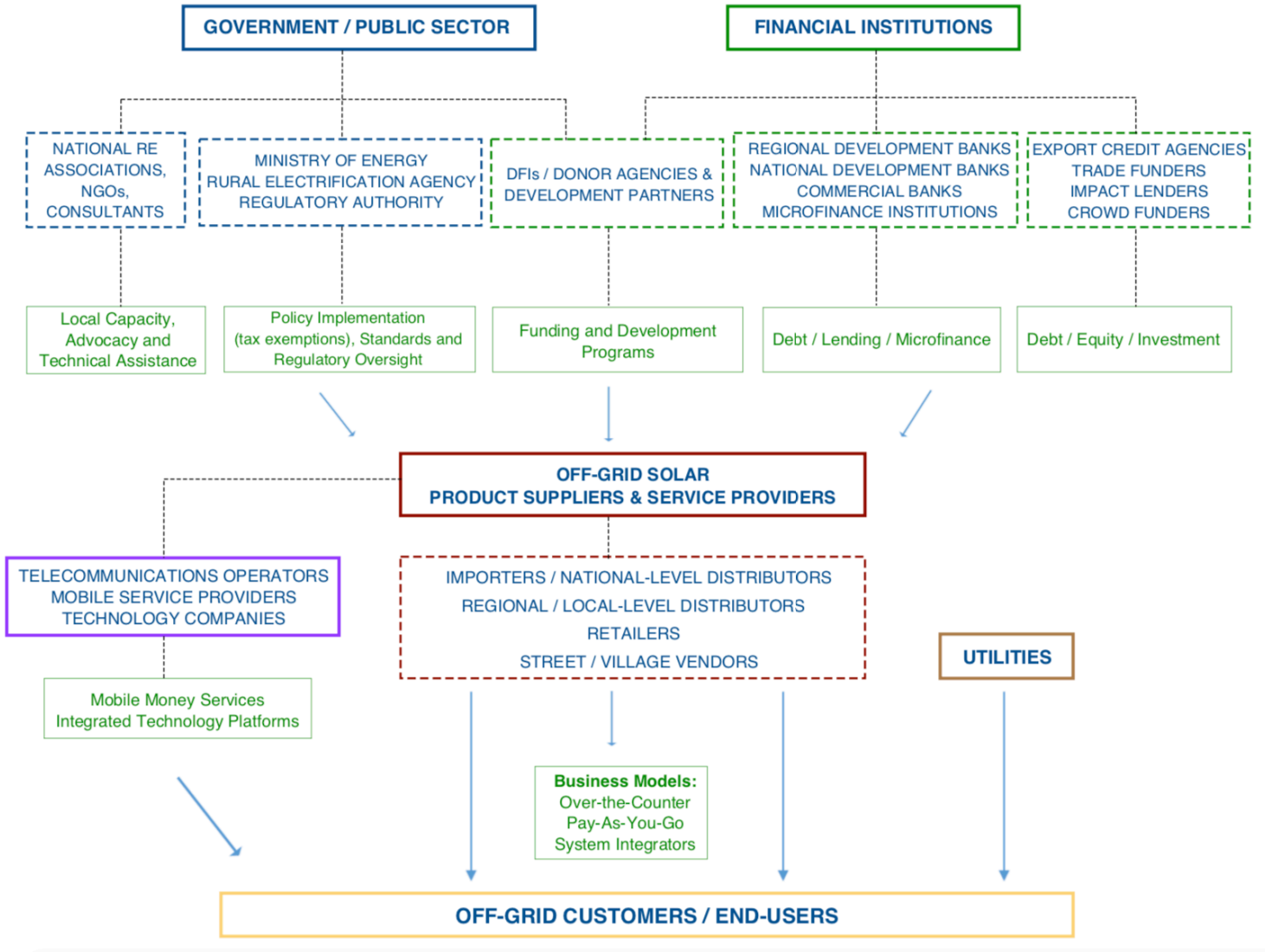
It should be noted that the Task 2 market sizing assesses the total *potential* demand for off-grid solar, as well as variables that affect demand, such as changes in population density, household income, expansion of national grids and access to finance, among other factors. This data will support policymakers 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 Cabo Verde, which includes a wide range of stakeholders, including importers, distributors, wholesalers, retailers and end-users (**Figure ES-11**). Although the overall market environment for solar companies in Cabo Verde is favorable, the opportunity is limited given the country's small market size. Large institutional clients, international development agencies, donors and NGOs, and private sector businesses make up the main market for off-grid lighting products in the country. A relatively limited number of developers and companies are currently deploying stand-alone systems to households and SMEs in the country. The last few off-grid areas in the country where grid development is not feasible are a key source of demand for off-grid solar products. Nevertheless, urban households, both electrified and non-electrified, may also be a noteworthy consumer market, as they tend to have greater ability to afford OGS products and systems.

Cabo Verde'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. Off-grid solar companies face even more challenges in Cabo Verde due to the country's unique geographic and logistical constraints.

Figure ES-11: 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 Cabo Verde:

Key Barriers to Off-Grid Solar Market Growth
• High rate of electrification
• Geographic constraints
• 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
• 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
• Government policy and action is supportive of the industry, which helps attract substantial/sustained investment to the market
• 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 international development community provides confidence that the market will continue to receive financial, policy and technical support 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 Cabo Verde and throughout the region to support development of the OGS sector.

Cabo Verde has made significant progress in developing the formal financial sector and expanding geographic coverage of commercial banks and access to financial services across all islands. Cabo Verde's level of financial intermediation is very high compared to other countries in the West Africa and Sahel region, as adults in the country almost universally have to access to basic financial services. The country also has a higher rate of financial inclusion among women compared to other markets in the region.

Yet, there are still areas where improvement is needed. Access to financing with affordable terms is a significant barrier for local companies. In an effort to boost financial inclusion among lower-income segments of the population, in 2017, the GoCV took steps to increase liquidity in the country's microfinance sector.[27] In 2018, the World Bank launched the USD 15 million Access to Finance for Micro, Small and Medium Enterprises (MSMEs) Project, which aims to improve access to credit for creditworthy MSMEs that are unable to grow their business due to a lack of finance.

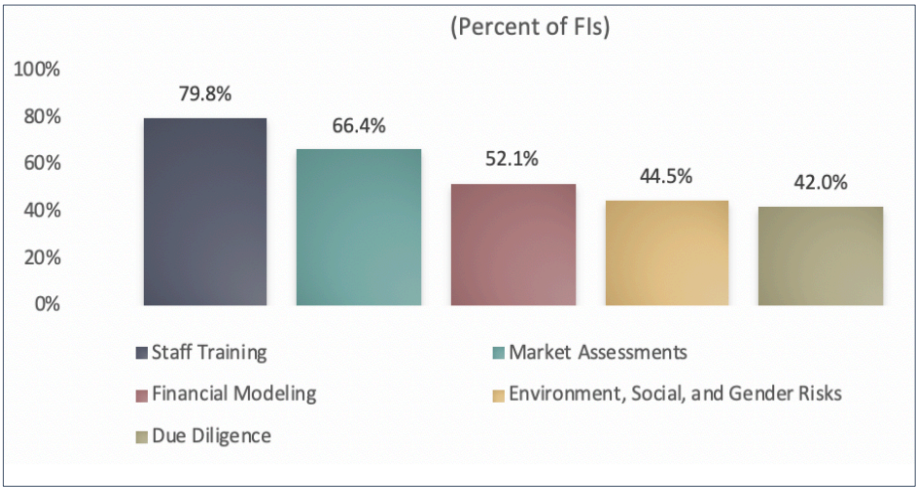
While several donor-funded programs and initiatives have provided financing to support development of Cabo Verde's off-grid communities, none of these funds have been channeled through local commercial banks or MFIs to specifically finance the off-grid solar sector. Historically, only a few Cabo Verdean banks have sought renewable energy sector lending opportunities, but mainly in the on-grid segment and most banks still lack a good understanding of the technologies, markets and business models for clean energy. Moreover, due to Cabo Verde's high electricity access rate, there is comparatively lower interest in lending to the off-grid solar sector in the country vis-a-vis banks in other countries in West Africa and the Sahel. Nonetheless, interviews with local commercial banks and MFIs revealed an increasing willingness to

[27] "Micro-creditos. Governo e bancos comerciais abrem linha de credito de 100 mil contos," Santiago Magazine, (2017): http://www.santiagomagazine.cv/index.php/economia/514-micro-financa-governo-e-bancos-comerciais-abrem-linha-de-credito-de-100-mil-contos

participate in providing financing to the sector and receive technical assistance (for the bank itself but also for its customers).

According to the Task 3 survey of financial institutions in Cabo Verde and across the region,[28] 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-12**). 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-12: Financial Institution Needs to Increase Off-Grid Solar Lending

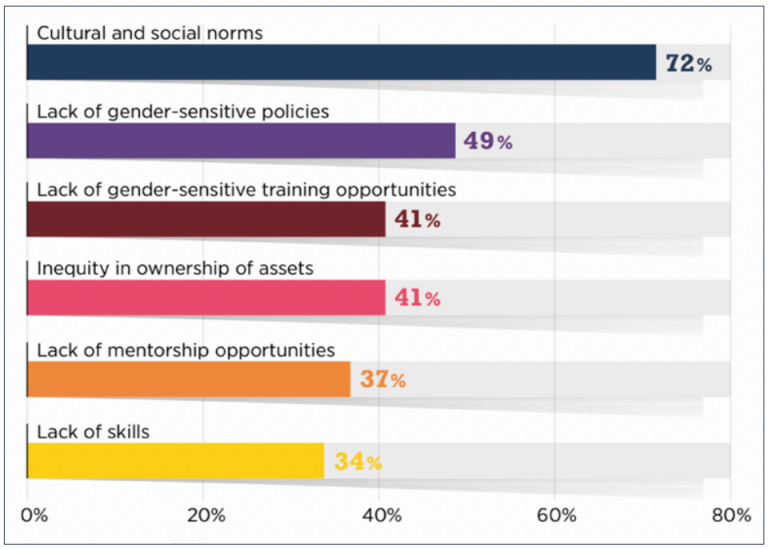


Source: Financial Institution survey; Stakeholder interviews; GreenMax Capital Advisors analysis

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 Cabo Verde, women are not yet highly engaged in the sector. 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 ES-13**). 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.[29] 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-14**).[30]

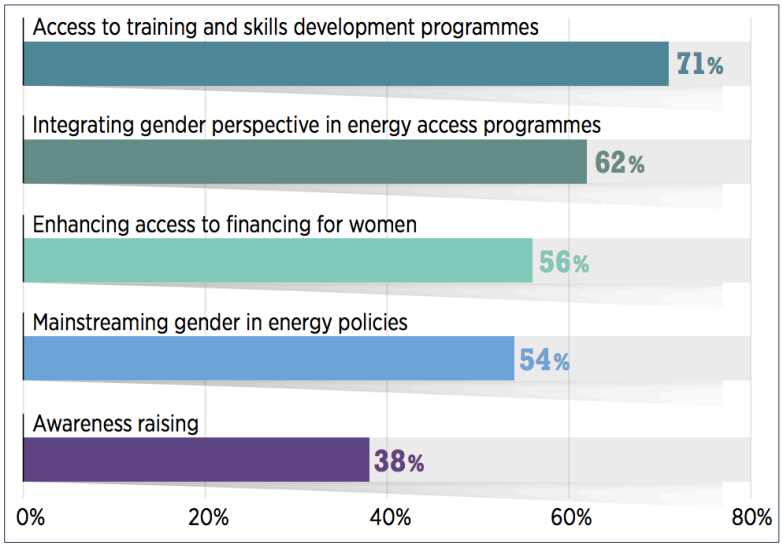
[28] The results are based on feedback from a total of 121 FIs (including commercial banks, microfinance institutions and other non-bank FIs) that were interviewed across the 19 countries.
[29] "Renewable Energy: A Gender Perspective," International Renewable Energy Agency, (2019): https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Jan/IRENA_Gender_perspective_2019.pdf
[30] Ibid.

Figure ES-13: Key Barriers to Women's Participation in Expanding Energy Access



Source: International Renewable Energy Agency

Figure ES-14: Measures to Improve Women's Engagement in Energy Access



Source: International Renewable Energy Agency

The gender analysis undertaken in Cabo Verde found that women in the country face several of these barriers and related challenges, albeit to a lesser extent than the West Africa and Sahel region. One initiative that seeks to address some of these challenges and help improve the rate of participation among women in the renewable energy sector is being launched by ECREEE and AfDB. 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 Cabo Verde.[31]

[31] "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 Cabo Verde (**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 stand-alone systems[32] in Cabo Verde 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

Cabo Verde is a country of 10 islands situated 500 km off the coast of West Africa in the North Atlantic Ocean, with approximately half of the population living on the island of Santiago, the main island. Tourism is the main driver of economic growth, as the country remains largely dependent on foreign trade, investment, and emigrant remittances, mainly from Europe and the United States. In 2017, Cabo Verde's GDP per capita was USD 3,086, while its real GDP growth rate was approximately 4%.[33]

With a limited natural resource base, Cabo Verde's economy is predominantly service-oriented, with tourism, commerce, transport, and public services accounting for 75% of GDP. The country's population is distributed across nine inhabited islands, which prevents the formation of economies of scale and makes the provision of basic services (energy, water, education, healthcare etc.) costly and difficult. Despite these challenges, Cabo Verde has experienced rapid economic growth over the last two decades, with a nearly six-fold increase in GDP per capita, becoming the only non-extractive Sub-Saharan African country to attain middle-income status.[34]

Table 1: Macroeconomic and Social Indicators

Population	546,388[35]
Urban Population	65% of total
GDP	USD 1.7 billion
GDP growth rate	4%
GNI per capita*	USD 3,030
Unemployment rate	15%
Poverty rate	26.6% (2015)
Urban	13.2%
Rural	44.3%
Currency	Cabo Verdean escudos (CVE)
Official language	Portuguese
Natural resources	Agricultural (fish); ores (salt, limestone, gypsum)

* World Bank Atlas method (current USD)[36]

All figures from 2017 unless otherwise indicated
Source: AfDB, World Bank and Instituto Nacional de Estatística

[32] 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
[33] "Cabo Verde Economic Outlook," African Development Bank, (2018): https://www.afdb.org/en/countries/west-africa/cabo-verde/
[34] "Cabo Verde Country Overview," World Bank, (2018): http://www.worldbank.org/en/country/Caboverde/overview
[35] 50.2% male/49.8% female
[36] "World Bank Open Data: Cabo Verde," World Bank, (2017): https://data.worldbank.org/country/Cabo-verde

1.2 Energy Market

1.2.1 Energy Sector Overview

As an island nation, Cabo Verde is highly dependent on imported fossil fuels to power its economy. The Empresa Nacional de Combustiveis (ENACOL) and Vivo Energy Cabo Verde are the two main suppliers of petroleum to the country, while ELECTRA, Águas e Energia da Boa Vista, and Águas da Ponta Preta are the electricity utility companies. The Ministry of Industry, Trade and Energy (Ministério da Indústria, Comércio e Energia, MICE), develops the country's energy policies, laws and regulations. Electricity production is liberalized with an independent regulator – the Multisectoral Economic Regulatory Agency (Agência Reguladora Econômica Multissetorial, ARME).[37]

Table 2: Institutional and Market Actors in the Energy Sector

Institution / Company	Role in the Electricity Sector
Ministry of Industry, Trade and Energy (Ministério da Indústria, Comércio e Energia, MICE)	MICE reports to the Office of the Prime Minister and is responsible for developing and implementing policy, overseeing electrification planning, laws, and regulations and promoting renewable energy development at the legislative level
National Directorate of Industry, Commerce and Energy, (Direcção Nacional da Indústria Comercio e Energia, DNICE)	Responsible for promoting and implementing measures for energy savings; contributes to the design, promotion and evaluation of energy-related policies, and reports to the MICE
ELECTRA, S.A.R.L	Public utility company operating in eight of the inhabited islands, responsible for generation, transmission, and distribution of electricity. Manages the state-owned electricity grid and reports to its shareholders, Federal & Local Governments, through DNICE
Águas e Energia da Boa Vista (AEB)	Public-private utility company operating on Boa Vista island, providing electricity water, and sanitation to the population; reports to its shareholders BUCAN Group and Federal and Local Governments, through the Boa Vista and Maio Tourism Development Society (STDIM).
Águas de Ponta Preta	Private utility company operating on Sal island providing electricity, water and sanitation to hotel customers in Ponta Preta area; reports to its shareholders CASSA Group and Cabocan
Multisectoral Economic Regulatory Agency (Agência Reguladora Econômica Multissetorial, ARME)	Independent regulatory authority responsible for regulating electricity, fuel, water, urban and maritime transports and for tariff fixation and realignment, in the case of electricity, the tariff is based on data provided by the producers and confirmed by ARME
Center for Renewable Energy and Industrial Maintenance (Centro de Energias Renováveis e Manutenção Industrial, CERMI)	Center responsible for promoting energy efficiency in buildings, appliances, and industrial equipment for large consumers and for providing training in the area of renewable energy and maintenance, and responds to the MICE and LuxDev
Electric Wind	Private wind IPP operating in Santo Antão island supplying wind energy to ELECTRA, and reports to its shareholder, Green Energy Service, abiding to its PPA
Cabeólica S.A.	Public-private wind IPP operating in 4 main islands: Santiago, Sal, São Vicente and Boa Vista, supplying wind energy to ELECTRA, and reports to its shareholders Anergi Asset Company, the State of Cabo Verde, through the Ministry of Finance and MICE, and to ELECTRA.

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

[37] "Energy Profile Cabo Verde," UNEP, (2015): http://wedocs.unep.org/bitstream/handle/20.500.11822/20498/Energy_profile_Cabo%20Verde.pdf?sequence=1&isAllowed=y

1.2.2 Electricity Access: *Grid and Off-Grid*

Cabo Verde has received significant public and donor investment in the energy sector since 2001, including for rural electrification programs and grid extension projects. Altogether, these initiatives have nearly doubled the country's national electrification rate from 47% in 2000[38] to about 90% in 2015.[39] In 2016, the country's national electrification rate was 97%, with urban areas fully electrified and a rural electrification rate of 89%.[40] The GoCV has set a target to achieve universal electricity access by 2030.[41] The Government also aims to achieve higher percentages of renewable electricity production and to reduce electricity production costs in the country. As of 2018, MICE was developing a Master Plan to provide a roadmap for achieving these objectives.

1.2.2.1 Off-Grid Market Overview

Over the course of the last decade, the conventional strategy for increasing access in rural areas of Cabo Verde has been to either extend the national grid or serve communities through autonomous micro-grids with diesel generators. However, due to the country's complex geography and the dispersed nature of villages on the major islands, grid extension is not a feasible option for the population that remains without access. Under these circumstances, stand-alone solar electrification systems are a clean alternative to provide electricity to isolated households in a reliable and efficient manner.[42]

Due to the size of the islands, the distribution of the population, and the electrification rate of the country, Cabo Verde presents a unique challenge in that many of the remaining off-grid communities tend to be extremely small and relatively close to a center with access to electricity and to public institutions.[43] This dynamic can be observed in communities such as Lagoa and Achada Lagoa on the island of Santiago, where public institutions such as health centers and schools are not present. Sustaining such small off-grid communities becomes economically unfeasible for the GoCV, and the same can be said of grid extension to these areas, particularly with the country's off-grid population permanently moving to nearby villages, towns, and cities with better economic and infrastructure conditions.[44]

As of 2018, the National Directorate of Industry, Commerce and Energy, (Direcção Nacional da Indústria Comercio e Energia, DNICE), which regularly collects data to identify the country's unelectrified communities, has identified about 30 off-grid communities in rural areas on three islands – Santiago, Fogo and Santo Antão (**Table 3**) – with the remaining islands considered to be covered by the grid.

[38] "Facing the needs of rural electrification," Vienna Energy Forum, (2011): http://www.stoffstrom.org/fileadmin/userdaten/dokumente/Veranstaltungen/KWK11/11.00_1_Praesentation_Jose_Brito_Kapverden.pdf

[39] "Action agenda for sustainable energy for all Cabo Verde," GoCV and ECREEE, (2015): https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_AAs/Action_Agenda_Sustainable_Energy_4_All_SE4ALL_CBV_-_Eng.pdf

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

[41] "SEforALL Action Agenda for Cabo Verde," Government of Cabo Verde and ECOWAS, (2015): https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_AAs/Action_Agenda_Sustainable_Energy_4_All_SE4ALL_CBV_-_Eng.pdf

[42] "Renewable energy project to electrify rural communities in Cabo Verde," Universitat Politecnica de Catalunya Barcelonatech, (2014): https://pdfs.semanticscholar.org/e733/0cd3f444dbabeb7a49dee0fec74eaea8d48b.pdf

[43] One notable exception are communities such as Chã das Caldeiras on the island of Fogo.

[44] "Report on Suitable Isolated Communities for Decentralized Renewable Energy Systems -Cabo Verde," UNIDO, GoCV, ECREEE (2015).

Table 3: Off-Grid Communities in Cabo Verde

Island	Municipality	Area / Community
Santiago	Ribeira Grande de Santiago	Mosquito de Horta
		Ponta de Txuba Txobe
	São Lourenço dos órgãos	Barragem de Polião
	S. Domingos	Daca Balio
		Chaminé
		Mendes Faleiro Cabral
	S. Salvador do Mundo	Degredo
		Achada igreja
		Mato Limão
	Santa Catarina	Mantaba
		Lebrão
		João Bernardo
		Mato Gégé
		Fonteana
		Pinha dos Engenhos
		Bombardeiro
		Sidiguma
		Chadinha
		Manto Sancho
		Achada Borges
		Ponta Pico
		Chiqueirinho
		Rotcha Fora
		Achada Braz
Fogo	Santa Catarina	Achada Polo
		Chã das Calderias
	Mosteiros	Ribiera do Illhéu
Santo Antäo	Porto Novo	Pascoal Alves
	Ribeira Grande	Espdaná
		Morrinho
		Moroços

Source: DNICE

In 2018, DNICE reported a total of eight off-grid communities on the islands of Santiago, Santo Antão and São Nicolau that have benefitted from the implementation of solar mini-grids, with an installed capacity of 165 kWp (**Table 4**).

Table 4: Communities with Off-Grid Solar Installations

Name/Location	Island	Total Capacity (kW)	Renewable Energy Capacity (kWp)	Status
Vale da Custa Hybrid Solar PV-Wind	Santiago	75	31	Not-operational
Carrical-Sao Nicolau Solar PV Mini-grid	Sao Nicolau	38	22	operational
Monte Trigo Solar PV System	Santo Antao	55.5	39	operational
Cha Feijoal - Porto Novo Ilha de Santo Antao Solar PV System	Santo Antao	5	5	operational
Xaxa - Sao Miguel (Serra Malagueta) Hybrid Solar PV-Wind	Santiago	8.5	8.5	operational
Figueiras - Santo Antao Solar PV System	Santo Antao	37.5	37.5	operational
Ribeira Alta Solar PV System	Santo Antao	22	22	operational
PLanalta Norte Solar PV System	Santo Antao	35	35	Not-operational

Source: DNICE

The majority of off-grid solar projects in Cabo Verde, including solar mini-grids and stand-alone PV systems, have been financed by donor institutions and development financial institution such as LuxDev and GEF – Small Grant Programme, among others. In 2018, Lorentz, a German solar water-pumping company, installed the first solar-powered water pumping system in rural Sao Felipe on the island of Fogo, with financing from LuxDev. The energy engineering firm, Studer Innotec, has been involved in off-grid development in Monte Trigo and has recently supported a solar PV expansion project there.[45] Another partner on the Monte Trigo project, Trama TechnoAmbiental, has recently worked with ECREEE to strengthen management models and develop microgrid energy tariff procedures.[46]

1.2.2.2 Demand and Supply/Generation Mix

Total installed generation capacity in Cabo Verde is 170 MW, the majority of which is on the main island of Santiago (**Table 5** and **Table 6**). Localized power grids also exist on all other inhabited islands.[48] In 2017, over 80% of Cabo Verde's generating capacity came from fossil fuels and the remaining 20% from renewable energy sources, including wind (15%) and solar PV (3%). Electricity generation in the country continues to be dependent on imported diesel fuel.

Table 5: Electricity Sector Indicators, 2017[47]

Installed Capacity	172.5 MW
Thermal	135.5 MW
Renewable	31.5 MW
Solar	5.5 MW
Wind	26 MW
National electrification rate (2016)	97%
Urban electrification rate	100%
Rural electrification rate	89%
Population without access	17,000
Households without access	3,903
Electrification target	Universal access by 2030

Source: DNICE, IEA, World Bank and JICA[49]

Table 6: Installed Capacity and Electrification Rate by Island (MW)[50]

Island	Combined Fuel	Solar	Wind	Total	Electricity Access (% of households)
Santo Antão	6.0		0.5	6.5	87%
S. Vicente	18.8		6.6	25.4	94%
S. Nicolau	3.4			3.4	93%
Sal	19.6	2.5	7.7	29.8	94%
Boa Vista	11.6		2.6	14.2	90%
Maio	2.0			2.0	86%
Santiago	68.8	3	9.4	81.2	85%
Fogo	6.0			6.0	83%
Brava	1.7			1.7	95%
TOTAL	**137.9**	**5.5**	**26.8**	**170.2**	**90%**

Source: Cabeolica, ELECTRA, JICA and Instituto Nacional de Estatística

Cabo Verde's electrification rate is very high compared to other countries in West Africa. Moreover, continuous public and donor investments in grid extension and maintenance as well as installed capacity

[45] "Project Overview," Studer Innotec, (2018): http://www.studer-innotec.com/en/references/photalia-4204
[46] "TTA Projects," Trama TechnoAmbiental, (2018): http://www.tta.com.es/en/projects
[47] See **Section 2.1** for more details on households/population without access to electricity.
[48] "Africa: Cabo Verde," CIA, (2018): https://www.cia.gov/library/publications/the-world-factbook/geos/cv.html
[49] Évora, R., "JICA Knowledge Co-Creation Program Country Report Cabo Verde," (2017): https://eneken.ieej.or.jp/data/7460.pdf
[50] "Annual Report 2017," Cabeólica S.A., (2018): http://www.cabeolica.com/site1/about-us/annual-reports/;
"Relatorio e Contas 2017," ELECTRA S.A.R.L., (2018): http://www.electra.cv/index.php/2014-05-20-15-47-04/relatorios-sarl;
"JICA: Knowledge Co-creation Program Cabo Verde Presentation," Rito Évora, (2017): https://eneken.ieej.or.jp/data/7460.pdf; and
"Anuario Estatistico Cabo Verde 2016," INE, (2017): http://ine.cv/wp-content/uploads/2017/11/aecv-2016.pdf

has resulted in increased grid reliability in comparison to other West African countries. Improvement in the electricity sector resulted in 2017 seeing 12% fewer grid blackouts than in the previous year.[51] Given the country's geography, it will be difficult to provide economically viable electricity services to the remaining population through grid extension. Importing diesel for power generation is expensive and susceptible to price volatility and also come with associated health and environmental concerns.

Electricity tariffs in Cabo Verde range between USD 0.26-0.32/kWh, averaging USD 0.30/kWh in 2018.[52] These prices are largely the result of the high cost of importing fuel to the island nation. Low income energy consumers benefit from a social tariff policy based on their level of consumption.

1.2.2.3 Transmission and Distribution Network

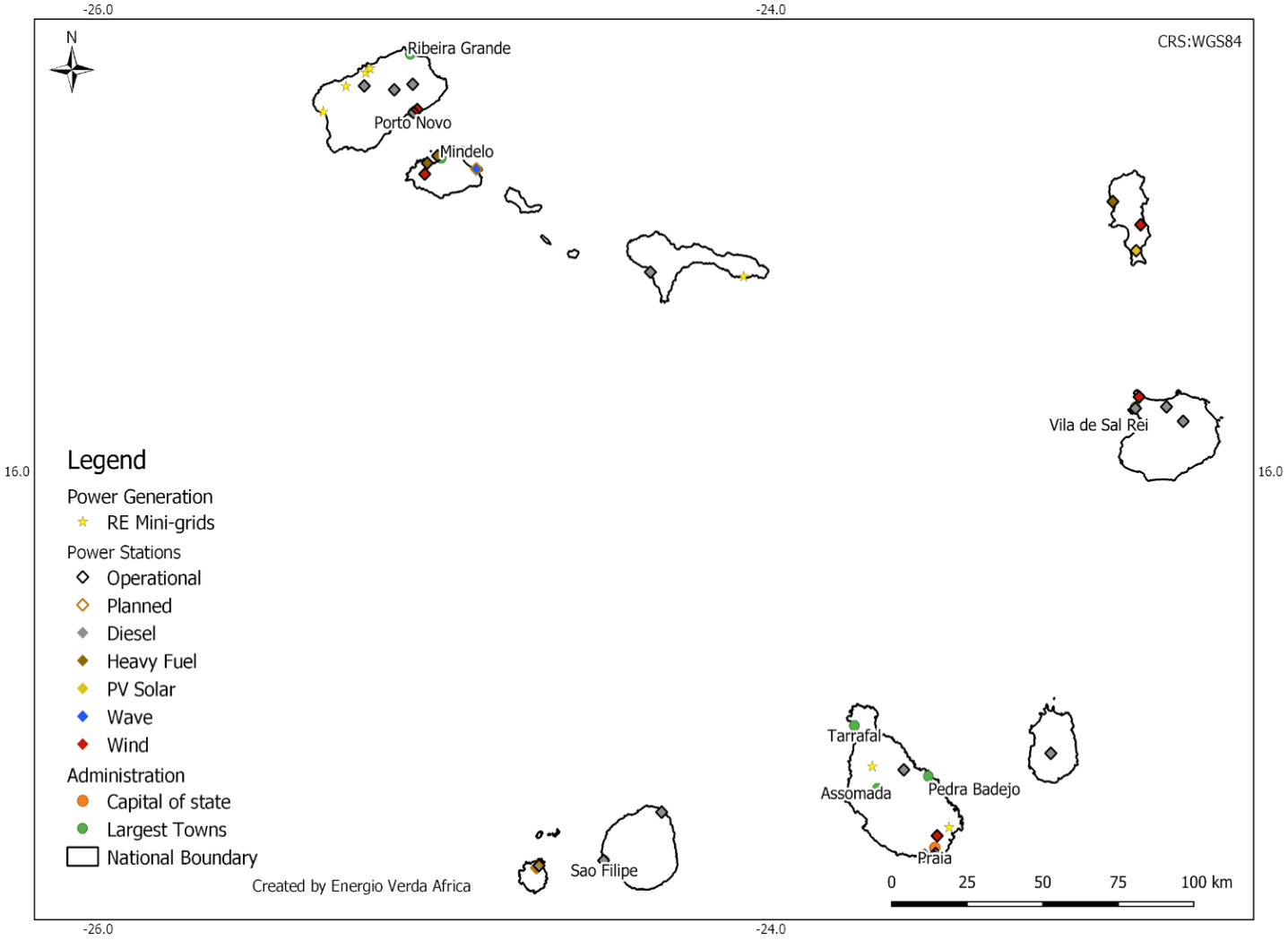
The complex geography of Cabo Verde's population across islands makes the provision of energy services both logistically challenging and costly (**Figure 1**). Nevertheless, the national rate of access to electricity is high and the country is ranked first in Africa in the reliability of electricity service (**Figure 2**).

ELECTRA is the vertically integrated public utility company responsible for electricity generation, transmission, and distribution, with its main power station based in Praia. The company also has power stations on every inhabited island, except for Boa Vista where the utility company AEB operates instead, and in Sal which is operated by APP and ELECTRA. ELECTRA also operates the medium tension transmission networks (maximum of 60k volts in Praia) and low tension and low tension distribution networks across the islands, with the exception of Boa Vista.[53]

The GoCV, with support from the Japan International Co-operation Agency (JICA) and the African Development Bank, is currently in the process of finalizing a project to centralize generation electricity in six islands (Santo Antão, Santiago, Fogo, São Vicente, Sal and Maio) through the installation of stronger power production points, including the introduction of the SCADA system, thus putting an end to the operation of older plants that have become inefficient in terms of production and environmental friendliness.[54]

[51] "Relatório e Contas 2017," ELECTRA S.A.R.L., (2018): http://www.electra.cv/index.php/2014-05-20-15-47-04/relatorios-sarl
[52] "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
[53] "Energy Profile Cabo Verde," UNEP, (2015): http://wedocs.unep.org/bitstream/handle/20.500.11822/20498/Energy_profile_Cabo%20Verde.pdf?sequence=1&isAllowed=y
[54] "Summary of the Environmental and Social Management Plan," African Development Bank (2015): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/Resume_PGES_CaboVerde_DevelopReseauTransportDistribution_ORQR_final-_EN.pdf

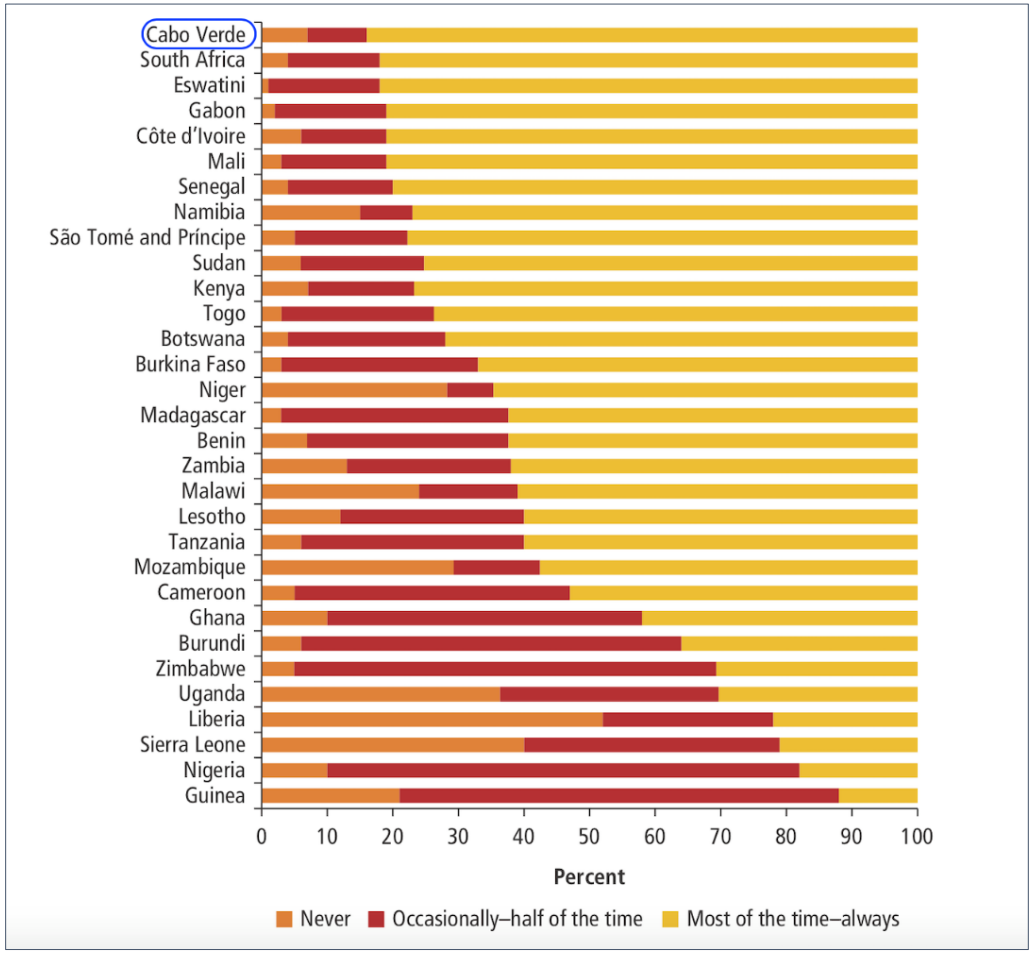
Figure 1: Power Stations in Cabo Verde[55]



Source: Energio Verda Africa GIS analysis

[55] NOTE: Transmission and Distribution network data is not currently available; See **Annex 1** for more details, including data sources.

Figure 2: Reliability of Grid Electricity in Connected Households in Africa[56]



Source: Afrobarometer household surveys, 2014-2015

Figure 2 shows the variation in the reliability of grid electricity for connected households across African countries. In Cabo Verde, about 80% of households reported receiving electricity supply at least most of the time.

[56] 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 Cabo Verde through 2023 and through 2030 ("Scenario 2023" and "Scenario 2030").[57] 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 Cabo Verde 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 Cabo Verde. According to the National Statistics Service (Instituto Nacional de Estadística, INE) 31 villages with 333 communities were un-electrified in 2018. These villages are located dispersed on the islands of Santiago, Santo Antão and Fogo (**Table 3**), which makes it challenging and costly to connect to the national grid.

Due to the dispersed nature of these villages and the increase in load shedding and in the number of blackouts in the existing national grid, it is assumed that these villages will not be connected to the national grid until 2030. Therefore, these communities will be optimal for electrification via mini-grid or off-grid stand-alone solutions.

For the scenario 2023 analysis, it is assumed that all un-electrified villages with a population above 300 and an active local economy (indicated by the presence of a social facility) are well suited for a mini-grid solution. The remaining villages – those with a population below 300 and no presence of a social facility – are considered candidates for off-grid stand-alone systems.

For the scenario 2030 analysis, it was assumed that all of the villages with a population above 500 or within 1 km of mini-grid villages (average distance of mini-grid coverage of different developers) identified in the five-year analysis will be suitable for electrification via mini-grid. All other villages are considered candidates for off-grid stand-alone systems.

Additional analysis was undertaken to estimate the population within each settlement. Satellite images from Google and Bing were used to count the number of houses within the villages to estimate the population, given the average household size of 4.2 (persons/household).[58] This data was compared with the national census of 2010. The current annual national population growth rate of 1.3%[59] was then applied to project population figures for the scenario 2023 and 2030 analyses.[60]

[57] NOTE: Rather than presenting a 10-year projection through 2028, the analysis conforms to GoCV electrification targets for 2030
[58] "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
[59] https://data.worldbank.org/indicator/SP.POP.GROW?locations=CV
[60] See **Annex 1** for the results of this analysis as well as more details on the approach and methods used

- **Results**

Table 7 summarizes the results of the least cost electrification analysis. The total number of villages and towns was unknown for the analysis. The population connected to the main grid was assumed by using the total population of 539,560 in 2018 (**Table 1**).[61] **Figure 3** and **Figure 4** 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.

Table 7: Results of Least-Cost Electrification Analysis

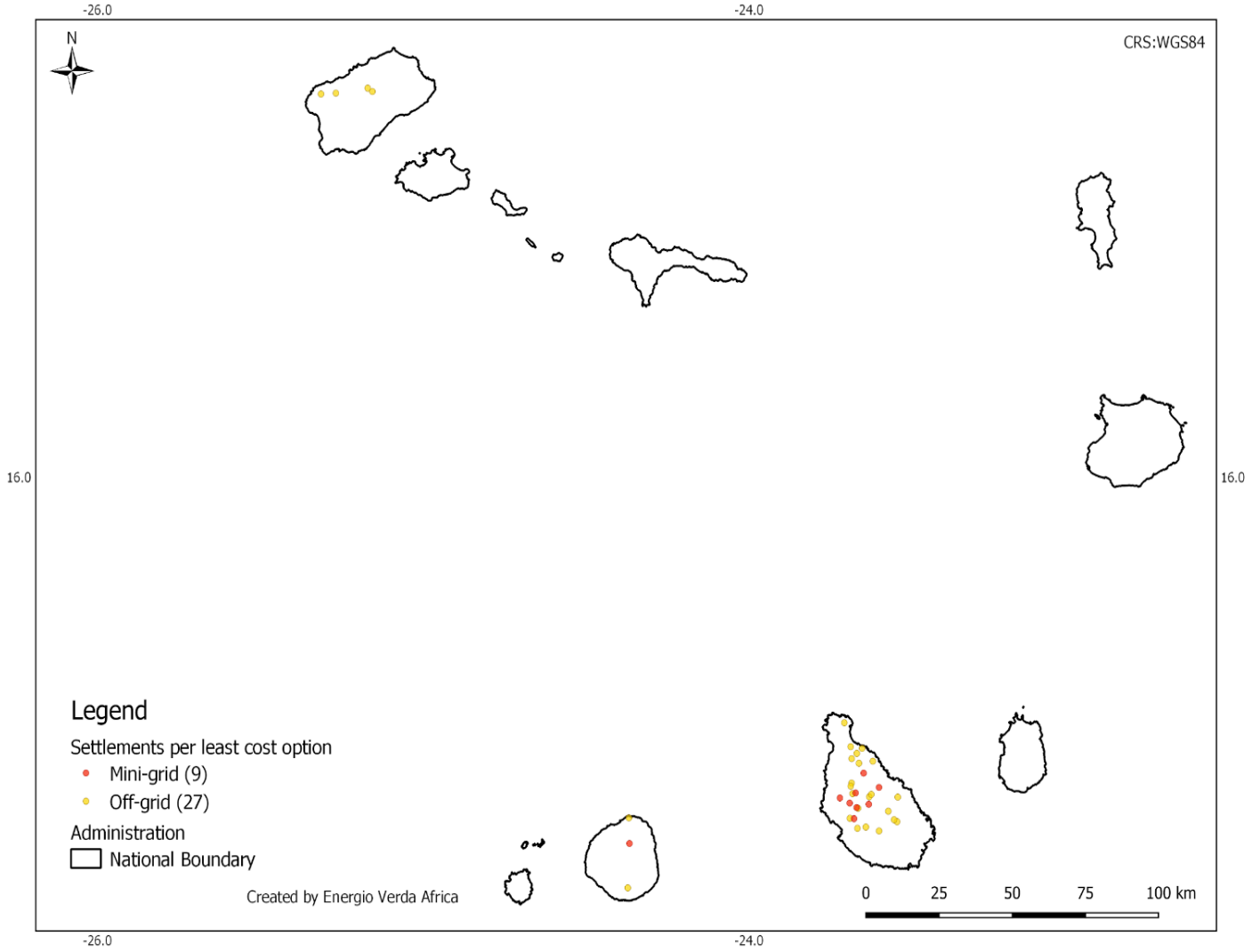
Scenario	Indicator	Least-Cost Electrification Option			Grid Vicinity		
		Grid extension	Mini-grid	Off-grid stand-alone systems	Under-grid un-served	Total under-grid	Total outside grid vicinity
Scenario 2023	Number of settlements	no data	9	27	no data	no data	no data
	% of settlements	n/a	n/a	n/a	n/a	n/a	n/a
	Total population	563,039	6,428	6,088	no data	563,039	12,517
	% of population	97.8%	1.1%	1.1%	n/a	97.8%	2.2%
	Number of households	134,057	1,531	1,450	n/a	134,057	2,980
Scenario 2030	Number of settlements	no data	12	24	Not calculated	no data	no data
	% of settlements	n/a	n/a	n/a	Not calculated	n/a	n/a
	Total population	616,317	9,850	3,851	Not calculated	616,317	13,701
	% of population	97.8%	1.6%	0.6%	Not calculated	97.8%	2.2%
	Number of households	146,742	2,345	917	Not calculated	146,742	3,262

Source: Energio Verda Africa GIS analysis

.

[61] NOTE: The population in existing mini-grids is unknown. The number is therefore reflected in the "on-grid" data.

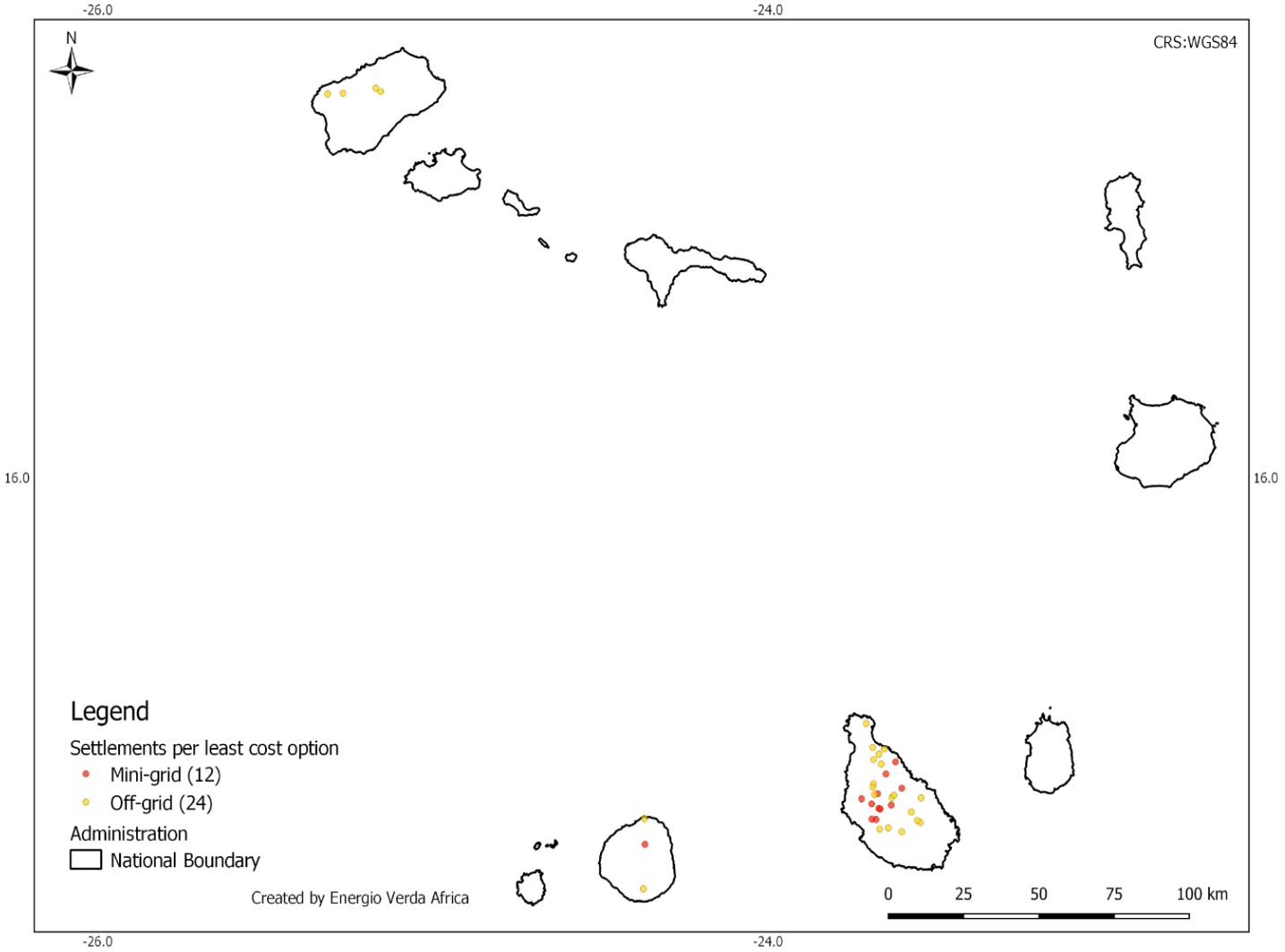
Figure 3: Distribution of Settlements by Least-Cost Electrification Option, 2023[62]



Source: Energio Verda Africa GIS analysis

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

Figure 4: Distribution of Settlements by Least-Cost Electrification Option, 2030[63]



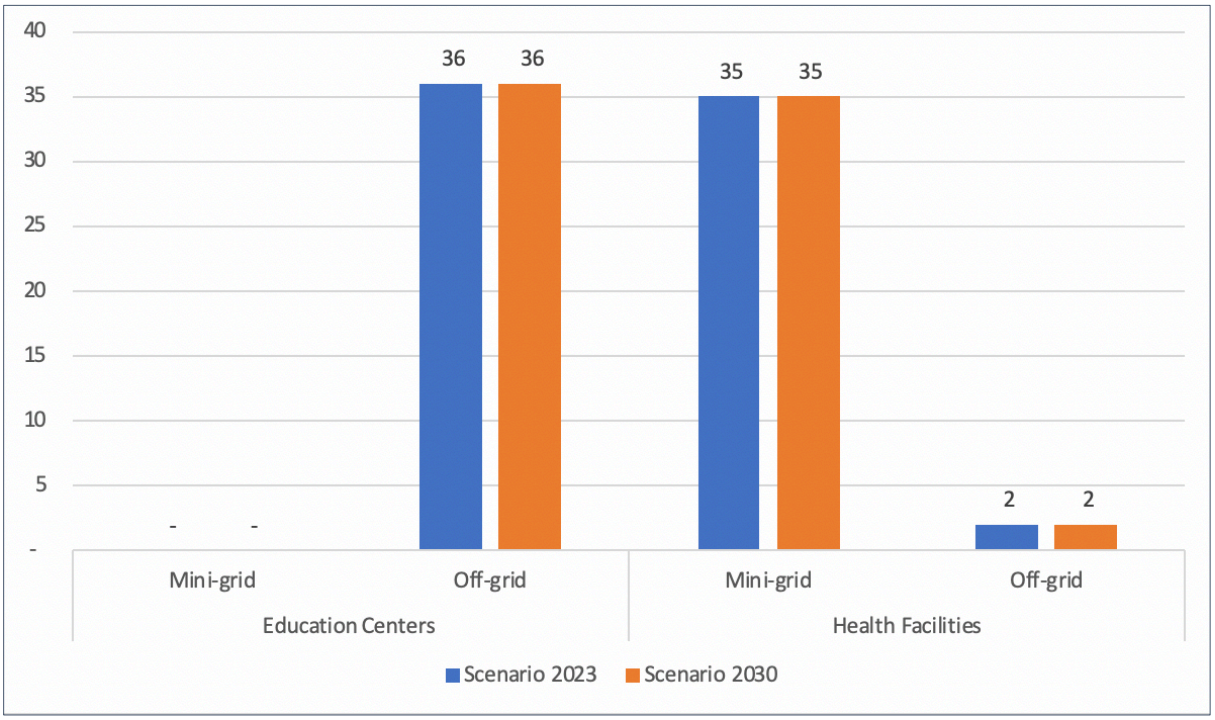
Source: Energio Verda Africa GIS analysis

[63] 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. It is assumed that the social facilities located outside the un-electrified villages are connected to the main-grid.[64] The total number of education centers in 2018 was not available for the analysis.

Figure 5 summarizes the number of education centers and health facilities that may be electrified by the grid or suitable for off-grid solutions (including mini-grids and stand-alone systems) in scenarios 2023 and 2030. **Figure 6** illustrates the distribution of potential off-grid social facilities across the country under the two scenarios.

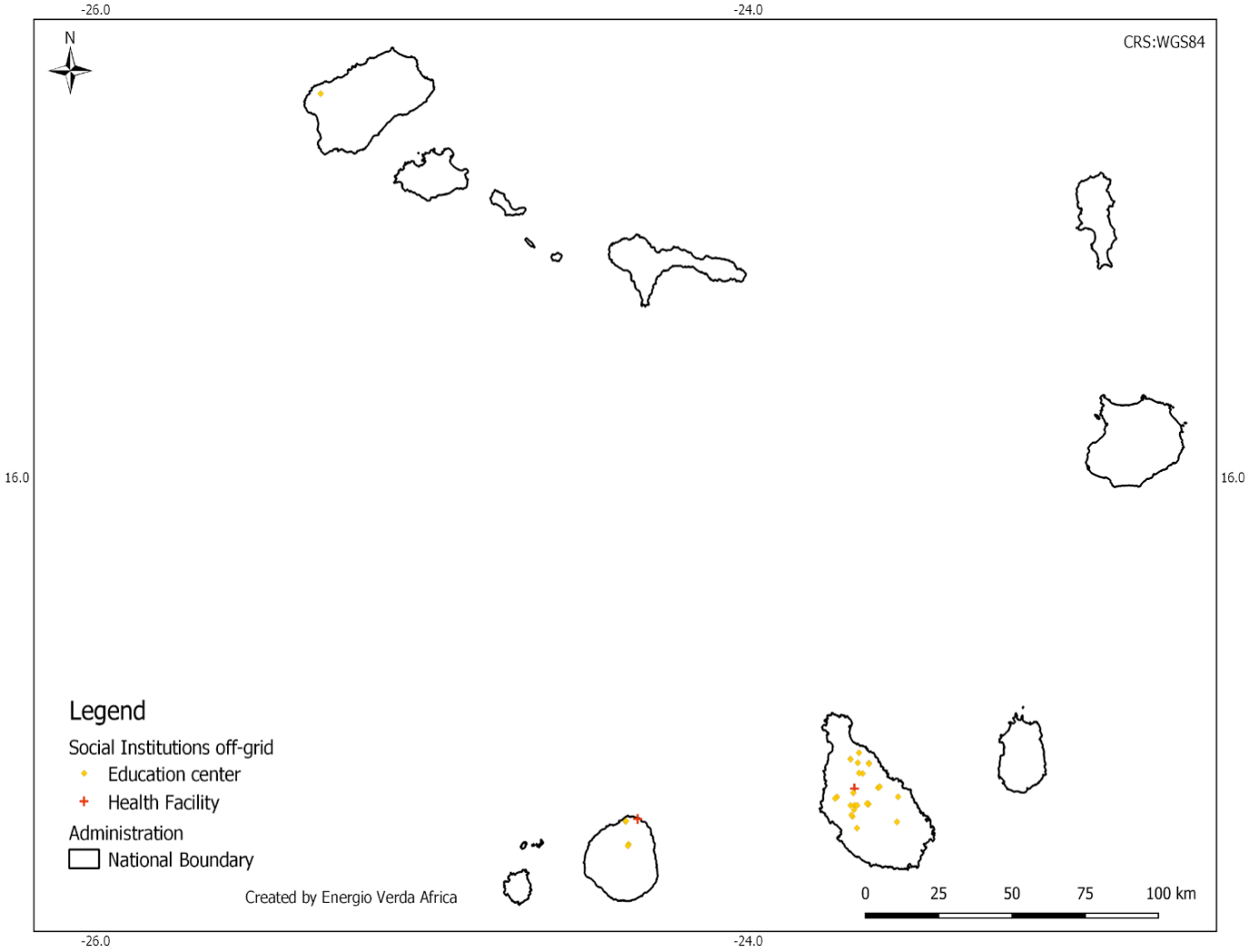
Figure 5: Identified Social Facilities for Mini-Grid and Stand-alone Solutions, 2023 and 2030



Source: Energio Verda Africa GIS analysis

[64] This was corroborated by interviews with local officials.

Figure 6: Distribution of Potential Off-Grid Social Facilities, 2023 and 2030[65]

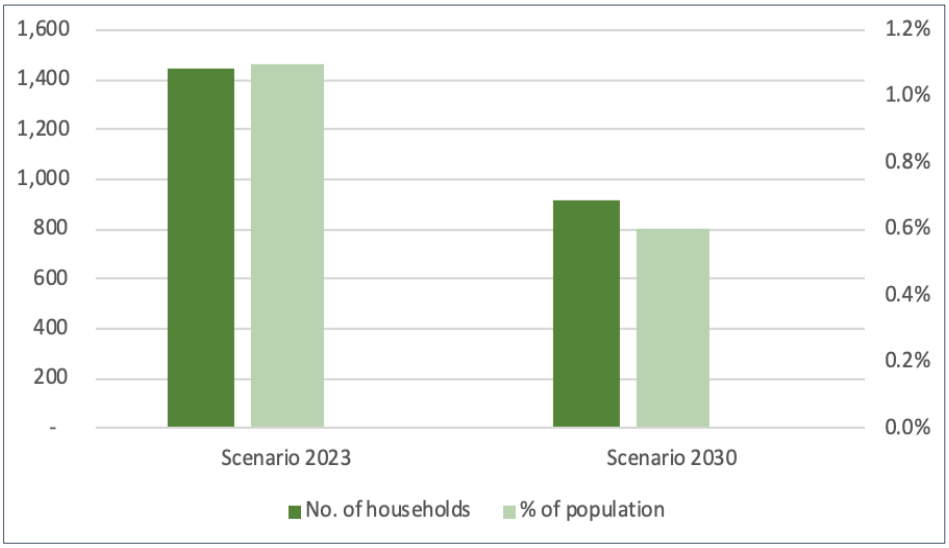


Source: Energio Verda Africa GIS analysis

[65] NOTE: The displayed social institutions are currently non-electrified; the assumption is that they will remain for mini-grid or off-grid solutions until 2030; See **Annex 1** for more details.

The analysis revealed that, given no significant population migration is taking place within Cabo Verde, the electricity access rate via the main grid remains at 97.8% from 2023 until 2030. The villages without access to the main grid are located on three of the ten islands - Santiago, Fogo and Santo Antão. Outside of the main grid areas the un-electrified villages of 2018 with higher economic growth potential and higher population can be optimally electrified with mini-grid projects. By 2023, this represents 9 villages or 1.1% of the total population, increasing to 12 villages or 1.6% of the population by 2030. The remaining more dispersed villages are optimally served by off-grid stand-alone systems. This comprises 27 villages (1,450 households) and 1.1% of the total population, decreasing in 2030 to 24 villages (917 households) and 0.6% of the population (**Figure 7**).

Figure 7: Estimated Number of Households and Share of Population Suitable for OGS Systems, 2023 and 2030



Source: Energio Verda Africa GIS analysis

1.2.2.5 Inclusive Participation[66]

Cabo Verde has significantly improved the social and economic conditions for women, although there still remains a wide gender gap in economic opportunity and employment. Despite impressive gains realized in health and social areas, women are still constrained by gender roles and face a number of challenges associated with economic empowerment that hinder them from contributing to sustainable and equitable growth.[67] On average, women spend almost 10 hours per day in domestic work – twice the amount of time as men. At the decision-making level women in Cabo Verde continue to be underrepresented. In parliament, out of 72 deputies, only 17 are women. In the Government, 3 out of 12 ministers are women, according to data from the National Statistical Institute of Cabo Verde. While the country's unemployment rate stood at 15%, unemployment for women was 17.4% and 12.9% for men. Data indicates that 58.5% of women who are employed in the informal economy only have a basic education. This is largely linked to the difficulties of access to the formal market and therefore related to access to training and education.[68]

[66] See **Annex 4** for more details
[67] "Cabo Verde: Country Gender Profile," UN Women (2018): http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/country-gender-profile-Cabo-verde-en.pdf?la=en&vs=1331
[68] "Mulheres e Homens em Cabo Verde Factos e Numeros", INE, (2017): http://ine.cv/wp-content/uploads/2018/03/mulheres-e-homens-em-cabo-verde-factos-e-numeros-2017.pdf

Cabo Verde has pursed several gender policies and continues to work with development partners and civil society to successfully address gender equality and improve women's rights. The lead government agency is the Institute for Gender Equality (Instituto Caboverdiano para a Igualdade e Equidade do Género, ICIEG), while the National Plan for Gender Equality and Equity (Plano Nacional de Igualdade de Género) provides a framework to implement gender policy. ICIEG is responsible for advancing government policies for equal rights for women and for women's full participation in all spheres of national life. The GoCV has also signed related key international and regional framework agreements, including 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.

Cabo Verde's National Action Plan for Renewable Energy (2015) proposes partnering with relevant health organizations to raise awareness and introduce new equipment and practices. At a regional level, efforts have been made to implement measures under the ECOWAS Policy for Gender Mainstreaming in Energy Access framework. In general, there are very few projects in the solar off-grid sector in Cabo Verde due to the country's high electrification coverage rate. 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 GoCV has established a gender focal point to promote inclusive participation for women.[69]

1.2.3 Key Challenges

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

- **Investment in Grid Maintenance:** Increases in electricity demand will continue to put pressure on power supply, which will always need to be managed and maintained to reduce losses and improve the overall quality of service.

- **Geographic Challenges:** Cabo Verde consists of nine populated islands that each have their own independent power systems, which makes it costly and difficult for the utility to maintain each system.

- **Electricity Prices:** The average electricity tariff in Cabo Verde (USD 0.30/kWh) is among the highest in the ECOWAS region (**Figure 8**).[70] Despite this, the tariff is affordable within the context of the income per capita of the country (**Figure 9**).[71] Nonetheless, reduction in electricity production costs and corresponding end-user tariffs are currently the main challenge facing the electricity sector. Reduction in electricity prices will alleviate households from a heavy economic burden and stimulate industry, including the country's all-important tourism sector. Moreover, since the majority of the potable water in the country is desalinated using electricity, there is also a direct impact on the cost of water for households and businesses.

- **Electricity Losses:** Electricity service in Cabo Verde has always experienced high losses. This situation often results in financial difficulties for the operators and in turn has implications on available funds necessary for grid maintenance and investments. In 2017, technical and commercial losses together accounted for 25.7% of the total electricity distributed by ELECTRA throughout the country, a slight reduction from the 27.3% loss registered in 2016.[72] There has been no analysis conducted as of yet to determine what percentage of these losses can be attributed to technical losses compared to commercial

[69] In Cabo Verde this focal point is in the Ministry of Tourism given the sector's importance as a key driver of economic growth. The Government is developing a new National Strategic Plan for the Tourism Sector (Plano Estratégico Nacional para o Turismo).
[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
[71] Ibid.
[72] "Annual Report," ELECTRA S.A.R.L., 2016.

losses. ELECTRA aims to reduce losses to 16.2% by 2020 through implementation of various measures, including pre-paid metering.

- **Rural Electrification:** Cabo Verde's high rates of electrification make electrification less of a policy priority for the Government. Moreover, local FIs lack sufficient internal capacity and credit appetite to invest in the off-grid sector, given its relatively small market size and corresponding perceptions about the profitability of offering financing in rural off-grid areas, where the creditworthiness of potential clients may be an issue. The off-grid RE sector is particularly complicated given relatively high transaction costs. As a result, the sector currently relies exclusively on donor funding.

- **Efficiency in Production:** The conventional electricity producers in the country seek to reduce the number of grams of fuel consumption/kWh produced, having progressed gradually through the years. In 2016, ELECTRA managed to reduce 3 grams of fuel/kWh produced. As a small country with low economies of scale, coupled with the dispersed geography of its islands, it is important to reach optimum efficiency to reduce production costs and contribute to the economic stabilization of the operating companies, which would also have positive implications for end user tariffs. Automatic dispatch centers/SCADA systems are now being implemented for the first time in the country to increase efficiency in electricity production and distribution. There are currently no frameworks in place to address electricity storage or demand side management – which would allow for better use of available resources and improved management of energy systems. It has been a challenge to implement these measures due to difficulty in identification of the ideal systems (in the case of storage) and lacking regulatory frameworks in the case of feed in mechanisms.

- **Energy Mix:** The country's power sector continues to rely mainly on fossil fuels, which are susceptible to price volatility and security of supply issues. While the public and private sector has been responsible for the development of several solar and wind projects, the country has not experienced the anticipated surge of further renewable energy development by the private sector. To expedite this effort, the GoCV aims to design an effective public procurement framework to attract Independent Power Producers (IPPs) through a public tendering process. By early 2019, the Government had launched several solicitations for IPP grid-connected wind and solar projects on the islands of Santiago and Boa Vista.[73] Cabo Verde experienced a significant increase in RE penetration in its electricity mix from 2010 to 2011, when both the largest wind farm project in ECOWAS (25.5 MW) and two Government-owned solar parks (totaling 7.5 MW) were commissioned, boosting the country from 2% RE penetration to roughly 25% in 2012, peaking in 2014 at nearly 30% penetration. Cabo Verde was among the first emerging markets in the world to make such a transition to clean energy without the benefit of hydropower generation. The share of RE in the generation mix has been decreasing since 2014, primarily due to an increase in electricity demand being met by thermal power, driven by a drop in oil prices. Curtailments to wind energy also occur on some islands when electricity demand is low compared to the amount of wind energy available. Some islands already produce about 35% of their energy from the wind but cannot increase this share due to potential grid instability, considering there are limited storage options and other mechanisms available to stabilize intermittent RE supply.

[73] Energias Renováveis Cabo Verde: http://energiasrenovaveis.cv/index.php/noticias/37-solicitacao-para-manifestacao-de-interesse-smi-eol-10mw-st2

Figure 8: Average End-User Tariffs in ECOWAS Countries, 2018

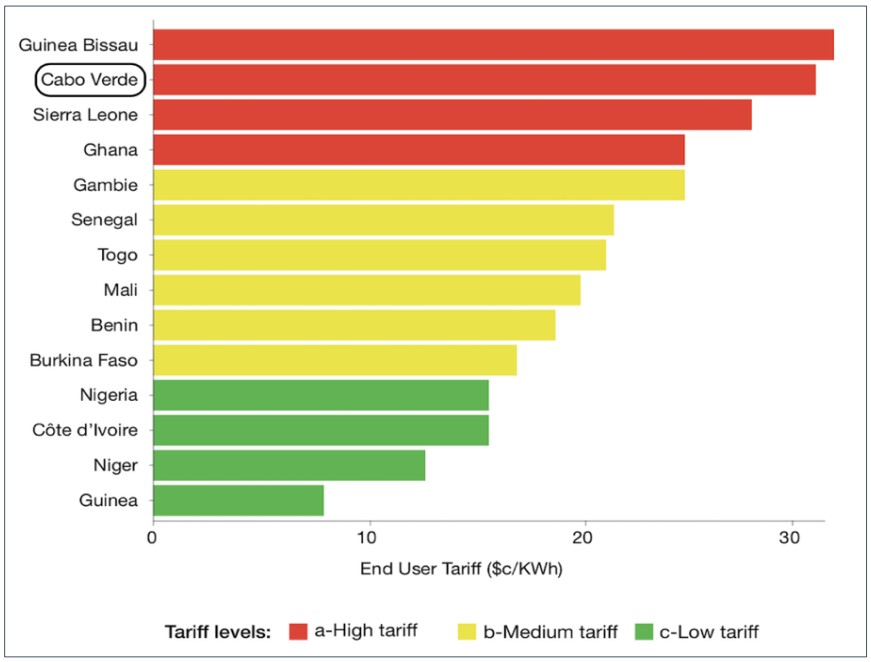
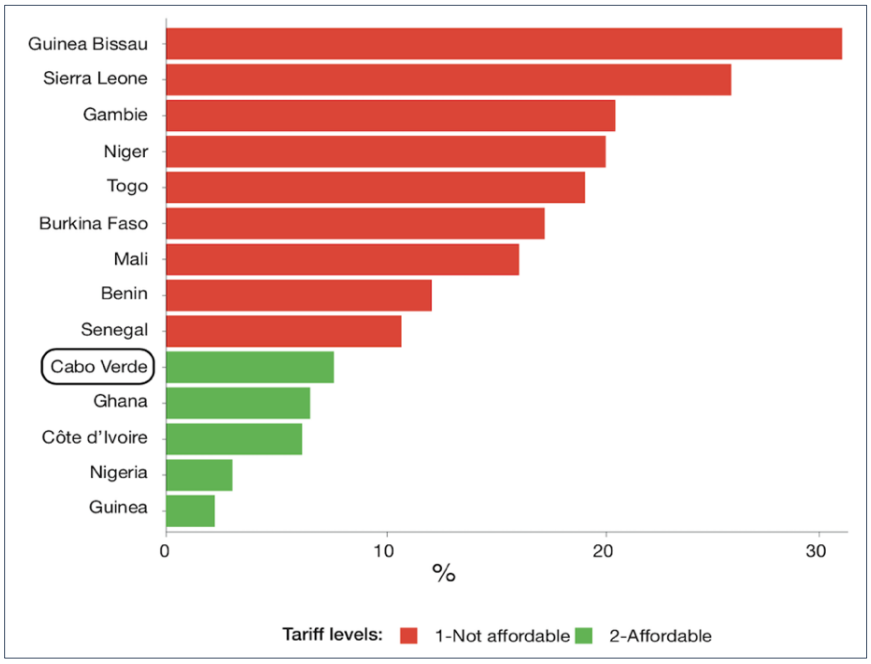


Figure 9: Share of Income Spent on Household Electricity in ECOWAS Countries, 2018



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 (Figures 8-9): ECOWAS Regional Electricity Regulatory Authority

- **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.

1.3 National Policy and Regulation

1.3.1 National Electricity/Electrification Policy

The Cabo Verde National Energy Policy was approved in 2008 and an Electricity Master Plan was prepared by the Ministry of Energy, Commerce and Industry. The energy policy set out to introduce a legal framework for the energy sector, with a vision to increase the country's installed capacity independent of fossil fuels. Within this context, the Government set a target to increase the penetration of renewable energy to 100% of installed capacity by 2025.[74] Since the election of a different party to the Government in 2016, the current government has redefined the target by setting it to wherever technically possible and economically feasible[75] – with indication of revised target of 50% by 2030. In terms of energy access, the objective is to achieve universal access by 2020 through some combination of grid-extension, renewable micro-grids and solar home systems.[76]

The National Energy Plan for 2003-2012 kick-started investments in the clean energy sector, with the objective of gradually increasing RE production.[77] In 2011, the GoCV created an incentive regime for renewable energy promotion that included special procedures for licensing RE projects, energy and territorial planning, fiscal incentives and remuneration.[78] As a member state of ECOWAS, The GoCV is also committed to the ECOWAS Regional Renewable Energy Policy for the period of 2015-2030, which seeks to (i) set national RE targets, (ii) create a harmonized regulatory framework with common tax 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 generation in the power mix by 2030 as well as the share of the off-grid population served by mini-grid and stand-alone systems.[79]

1.3.2 Integrated National Electrification Plan

Cabo Verde does not currently have an integrated national electrification plan with off-grid provisions; however, the DNICE is working to develop a rural electrification plan. This includes carrying out load demand assessment of unserved remote communities in order to determine the supply needed, the size of off-grid systems to be built and calculate the expected investment needs.[80]

1.3.3 Energy and Electricity Law

A 2006 Decree on IPP licensing establishes rules on access, licensing and exploration of electricity production and is the framework supporting the National Energy Plan for 2013-2012.[81] The law provides incentives for renewable energy (special regime for off-production and cogeneration) and obliges the

[74] "Cabo Verde: African island nation plans to run on 100% renewable energy by 2025," Independent, (2017): https://www.independent.co.uk/news/world/africa/Cabo-verde-renewable-energy-100-per-cent-africa-island-total-environment-climate-change-sea-levels-a8043946.html
[75] "Programa do Governo IX Legislatura" Estado de Cabo Verde (2016): http://www.governo.cv/index.php/programa-do-governo
[76] "Energy Scenario Development for Cabo Verde," ECREEE, SEforALL and Ministerio de Turismo, Investimentos e Desenvolvimento Empresarial, (2015).
[77] "World Access to Modern Energy," National Energy Plan for 2003-2012: http://www.wame2015.org/policy-and-regulation/579/national-energy-plan-for-2003-2012
[78] "ECOWAS Program on Access to Sustainable Electricity Services," ECREEE, (2015-2020): http://www.ecreee.org/sites/default/files/epases_document_final.pdf
[79] "ECOWAS Renewable Energy Policy," ECOWAS, (2015): http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf
[80] "ECOWAS Program on Access to Sustainable Electricity Services," ECREEE, (2015-2020): http://www.ecreee.org/sites/default/files/epases_document_final.pdf
[81] Cabo Verde Energy Analysis and Recommendation," UNIDO & ECREEE, (2010): http://www.ecreee.org/sites/default/files/unido-ecreee_report_on_Cabo_verde.pdf

national utility to buy electricity from renewable energy with tariffs set by the regulating authority. In 2011, the GoCV passed another Decree that included specific renewable energy incentives, including provisions for (i) an Action Plan for Renewable Energy (PNAER), (ii) fiscal incentives with customs duty exemptions and tax reductions, (iii) a modified remuneration period with access to renewable production credits, (iv) a dedicated regime for micro-generation, and (v) a fund for the promotion of decentralized rural electrification.

1.3.4 Framework for Stand-alone Systems

Figure 10 is an overview of the key national policies, programs, laws, and regulations pertaining to Cabo Verde's framework for stand-alone systems. The gaps in this framework are addressed in **Section 1.3.5**.

Figure 10: Policy and Regulatory Framework for Stand-alone Systems

CABO VERDE			
Policy/Regulatory Support and Financial Incentives	**Specific national policies, laws and programs**		
	National electrification policy with off-grid provisions	x	
	Integrated national electrification plan	x	
	Energy/electricity law with off-grid provisions	√	2011 Decree
	National programs promoting off-grid market development	x	
	Specific target for rural electrification	√	Universal access by 2020
	Financial incentives		
	Subsidies, tax exemptions or related incentives for solar equipment/stand-alone systems	√	Tax exemptions for solar equipment
	Standards and quality		
	Government-adopted international quality standards for stand-alone systems	x	
	Government-certified program for solar equipment installers	x	
	Consumer awareness/education programs	x	
	Concession Contracts and Schemes	x	
	Business Model Regulation	x	

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

Source: Stakeholder interviews; GreenMax Capital Advisors analysis

1.3.4.1 Existence of Specific National Programs

Cabo Verde has several specific programs and targets for renewable energy, but no existing national program for off-grid rural electrification – this plan is currently under development by the DNICE.

1.3.4.2 Financial Incentives

Cabo Verde's law on the Promotion and Incentive for the Use of Renewable Energy creates provisions for the PNAER and provides numerous financial incentives to promote renewable energy including VAT exemptions and tax reductions, renewable generation credits with a fixed value of 15 years and plans to form a Decentralized Rural Electrification Support Fund.[82]

[82] "Cabo Verde Standardized baseline for the Power Sector," Clean Development Mechanism UNFCCC, (2013): https://cdm.unfccc.int/methodologies/standard_base/psb_CV.pdf

1.3.4.3 Standards and Quality

For the quality of off-grid solar products and systems to meet the expectations of end-users, a set of standards, which are not currently in place, need to be implemented to ensure equipment is reliable, adequately covered by warranties and post-sale O&M. There are currently no government-adopted international quality standards for stand-alone systems in Cabo Verde.

1.3.4.4 Concession Contracts and Schemes

The existing legal framework governing the electricity sector includes provisions for licensing on environmental impact assessments, bidding procedures, and technical requirements, as well as specific rules on access, licensing and exploration of electricity production activities. It is the framework supporting the National Renewable Energy Plan for 2015-2030.[83] In the rural electrification plan that is under development, the DNICE also intends to include a simplified scheme for independent producers to serve geographically isolated communities.[84]

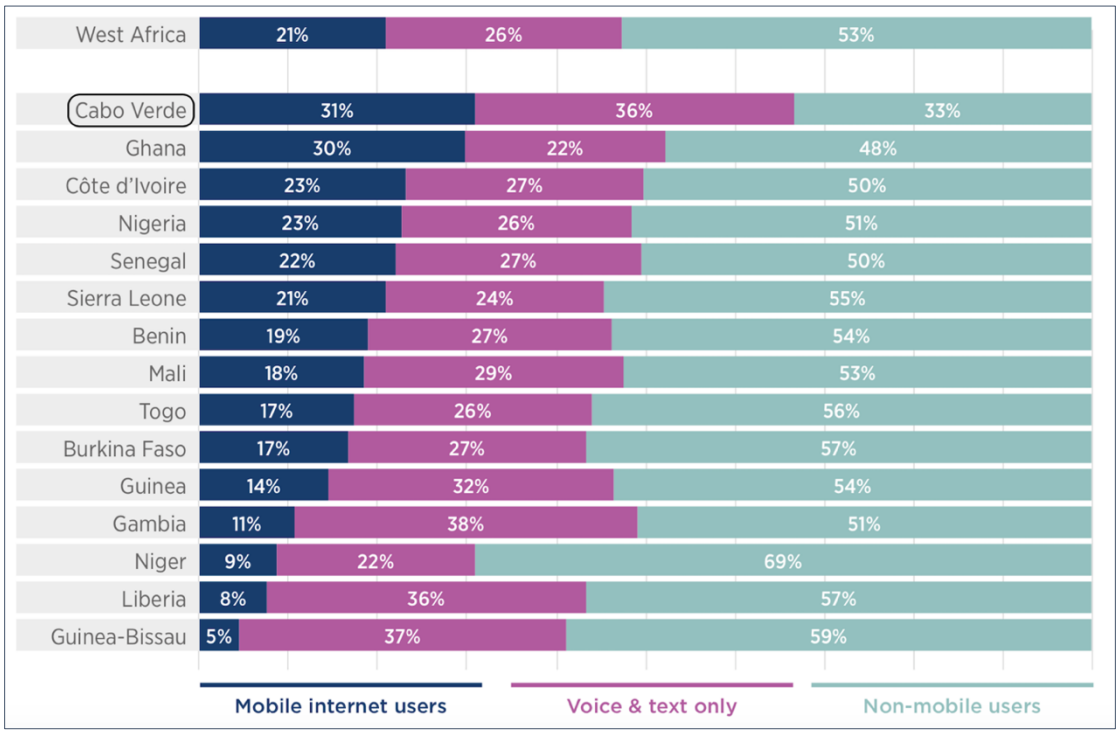
1.3.4.5 Specific Business Model Regulation

Specific business model regulation does not currently exist for the off-grid sector in Cabo Verde. In 2012, the ACP-EU Energy Facility launched a solar/battery storage pilot project in Monte Trigo using a mixed private/public-utility concept, with the local private electricity and water company, Aguas de Ponta Preta, in consortium with the municipality (Câmara Municipal de Porto Novo) directly responsible for the O&M activities of the facility. This regulatory arrangement was successful within the community by allowing flexibility with the use of an Energy Daily Allowance system that allows families and other consumers to select a usage profile that fits their needs and financial ability. The system has played a key role in helping avoid blackouts that have plagued other microgrid projects in Cabo Verde. Tariff collection is based on fixed monthly rates related to the program and accounts for the population's payment capacity. This arrangement not only sustains O&M but also partially pays back the capital costs.[85] This innovative business model could potentially be replicated in other off-grid development initiatives throughout the country.

There is also an opportunity for the Government to bring together key stakeholders in the off-grid sector (solar suppliers, technology providers, telecommunications companies etc.) to support the deployment of PAYG business models to take advantage of the country's rapidly growing mobile Internet usage, which was ranked highest in the ECOWAS region in 2017 (**Figure 11**).

[83] "Cabo Verde Energy Analysis and Recommendation," UNIDO & ECREEE, (2010): http://www.ecreee.org/sites/default/files/unido-ecreee_report_on_Cabo_verde.pdf
[84] "ECOWAS Program on Access to Sustainable Electricity Services," ECREEE, (2015-2020): http://www.ecreee.org/sites/default/files/epases_document_final.pdf
[85] "Sun and Ice," PV Magazine, (2012): https://www.pv-magazine.com/magazine-archive/sun-and-ice_10007566/

Figure 11: West Africa Mobile Internet Penetration Rates, 2017[86]



Source: GSMA Intelligence

1.3.5 Capacity Building and Technical Assistance

To overcome the challenges surrounding rural electrification, a range of technical and financial resources from both the public and private sector must come together. At the institutional level, the DNICE, ARME, and other institutions will play key roles in establishing a supportive policy and regulatory framework. Additional reforms to the power sector may be required to provide the incentives necessary to increase private sector participation. 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. International and local solar companies will need policy and financial support. 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 8 identifies some of the policy/regulatory challenges facing off-grid market development in Cabo Verde and the proposed mitigation measures/TA interventions to overcome these gaps.

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

Table 8: Gaps in the Off-Grid Policy and Regulatory Framework[87]

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
1. Specific National Policies, Laws and Programs	**A. Lack of National Electricity / Electrification Policy** a. No policy exists for rural electrification	a. Help Government establish a clear Rural Electrification Policy which encourages least cost, integrated planning for all options
	B. Lack of Integrated National Electrification Plan a. No integrated plan exists b. Insufficient focus on or understanding of framework to support private sector participation	a. Help Government develop a comprehensive, least cost, integrated plan for all rural electrification options (including review of best practices / successful approaches to off-grid electrification in the unique context of small island countries) b. Help Government improve the planning framework to encourage private participation in mini-grid and stand-alone solar system options
	C. Insufficient Energy and Electricity Law	a. Help Government revise existing legal framework to ensure that it is flexible and helps create appropriate incentives for private sector participation in off-grid market development
	D. Insufficient national policies, laws, programs and/or action plans targeting off-grid market development a. No specific Off-Grid Policy, Law, or Action Plan in place b. Insufficient focus on or understanding of framework to support private sector participation	a. Help Government establish a rural electrification strategy in the country through development and implementation of a rural electrification Master Plan b. Improve off-grid framework to create appropriate incentives for private sector participation
2. Financial Incentives (import duties, taxes, etc.)	**A. Insufficiently supportive financial incentives / tax regime**	a. Help Government expand existing financial incentives[88] 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 to (i) mitigate potential difficulties in customs clearance and import logistics, and (ii) oversee implementation of tax exemptions by coordinating with all agencies and regulatory bodies involved

[87] "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 Cabo Verde (**Table 2**), including the Ministry of Industry, Trade, and Energy (MICEC), the National Directorate of Industry, Trade, and Energy (DNICE), the Economic Regulatory Agency (ARME), the Center for Renewable Energy and Industrial Maintenance (CERMI), and the national utilities, ELECTRA and AEB, among other national and local authorities.

[88] The GoCV has implemented financial incentives to promote renewable energy, including VAT exemptions and tax reductions

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
		c. Help Government introduce appropriate grant and subsidy schemes which require private funding matches, and are predictable and not overly bureaucratic (e.g. through the Decentralized Rural Electrification Support Fund) d. Help Government create PPP schemes to share high project development and market entry costs particularly with developers in remote areas (e.g. through the Decentralized Rural Electrification Support Fund)
3. Standards and Quality	A. Insufficient Market Data	a. Help Government establish a Special Task Force 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 establish 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. 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 (e.g. through the Center for Renewable Energy and Industrial Maintenance, CERMI) b. Support development of database of best practices / information sharing services to ensure skills transfer from international, local and regional initiatives (e.g. through DNICE or CERMI)
	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 the implementation of a repair and recycling framework for off-grid solar systems and equipment

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
	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 off-grid solar products and the existence of related national programs b. Support development and implementation of programs to educate consumers, retailers and distributors on the benefits of quality certified solar products vs. counterfeit products
4. Concession Contracts and Schemes	**A. Need for clear communication and streamlining in licensing and permitting procedures**	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. Need for 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[89]
	b. Need for understanding of emerging models for 'Integrated Private Utilities' or 'Energy Companies of the Future'	b. Help Government to understand and develop approaches to facilitate pilots of 'Integrated Private Utility' or 'Energy Company of the Future' schemes.[90]
	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. 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[91]

[89] Different models used to grant geographic concessions to SHS providers can yield wide-ranging results. Some observers have lauded the approaches being used in Rwanda, Nigeria, Togo and DRC as highly successful while, there has been criticism of the approach deployed in Senegal.

[90] 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.

[91] 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.

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
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[92] 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[93] 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

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

[92] 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.

[93] 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 a particular 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

Although more than 90% of the population in Cabo Verde has access to electricity, grid extension on the island of Santiago has been identified as a priority in order to reach universal access by 2020. However, grid extension alone is not sufficient to achieve 100% electrification. In remote areas, the expansion of off-grid solar PV is a crucial part of bringing clean energy access to social facilities, community centers, and solar home systems (SHS) in areas where the only alternative is diesel generators. There are currently no specific government initiatives dedicated to the promotion of stand-alone solar in Cabo Verde.

1.4.2 DFI and Donor Programs

There are several Development Finance Institutions (DFIs) and donor agencies active in Cabo Verde, including ECREEE, the World Bank, the Europena Union (EU), United Nations Industrial Development Organization (UNIDO), and LuxDev among others. In general, there are very few efforts specifically focused on off-grid/standalone projects. Most development initiatives have focused primarily on providing budget support and institutional strengthening in order to improve the financial situation of Electra. The Monte Trigo solar/battery storage off-grid project, financed by the EU, is one key example of a successful multilateral initiative in the country's off-grid space. The EU is also financing development of a Master Plan for the sector. JICA has also been a key bilateral partner, supporting grid extensions and power generation on several islands.

Additionally, The World Bank and ECREEE are financing a RE generation project, the Cabo Verde Distributed Solar Energy Systems (SIDS DOCK), through solar PV and solar water systems for Cabo Verde's hospitals.[94] Luxembourg (through LuxDev) was a major supporter of rural electrification in the 1990's and 2000's and is now focusing on various renewable energy sector studies as well as the development of a procurement scheme for IPPs.[95] The Portuguese government also previously worked with the GoCV to assess potential pilot RE projects.

A summary of Development Finance Institutions (DFI) and donor programs and initiatives supporting development of the renewable energy and off-grid sectors in Cabo Verde are summarized below.

- **LuxDev**

Renewable energy and energy access in more remote communities, as well as the reduction of electricity tariffs have been a priority area of cooperation between Luxembourg and Cabo Verde through the 4th Indicative Cooperation Program (2016-2020). The overall objective is to improve the population's access to clean, reliable, durable, modern and affordable energy while ensuring energy independence. More specifically, the emphasis was given to strengthening governance, regulation and commercial conditions in the renewable energy sector. In 2017, EUR 3.4 million were disbursed, of which (i) 50% to education and vocational training and access to employment, (ii) 40% to local development (e.g. water and health) and (iii) 10% to renewable energies. To support Cabo Verde in the renewable energy and energy efficiency sector, LuxDev is engaged in the financing of technical assistance to improve the governance and the mobilization of funds in these two sub-sectors.

[94] "Cabo Verde: Distributed Solar Energy System, Project Document," The World Bank, (2018): http://documents.worldbank.org/curated/en/838921513954732796/pdf/Disclosable-Restructuring-Paper-Cabo-Verde-Distributed-Solar-Energy-Systems-SIDS-DOCK-P151979.pdf

[95] "Cabo Verde: Étude de diagnostic du sous-secteur des énergies renouvelables," LuxDev, (2015): https://luxdev.lu/files/documents/Etude_diagnostic_initital_ER_CVE_avril_2015.pdf

Program for the Support of Renewable Energy: This is a EUR 4.5 million program financed by LuxDev for the period 2017-2020, with two main components: institutional support and sustainable financing support.[96] The objective is to increase the use of renewable energies for the production of electricity, through better planning conditions and a transparent legal and regulatory framework based on market mechanism, as well as a simplified regime for decentralized rural electrification.

Partnership between the Center for Renewable Energies and Industrial Maintenance (CERMI) and the Center of Competence-Technical Engineering of Luxembourg (CdC-GTB):[97] This EUR 4 million project has been financed by LuxDev for the period 2018-2021 to finance education, vocational training and TA in the renewable energy sector. It is being implemented by the Cabo Verdean entrepreneurial public company, the Center for Renewable Energy and Industrial Maintenance (CERMI), in partnership with the Center of competence-Technical Engineering of Luxembourg (CdC-GTB). The final goal of the project is to establish a Cabo Verdean Competence Center (CdC-3C) in the areas of education engineering, engineering and energy efficiency and renewable energy consulting.

Strengthening the regional positioning of the Center for Renewable Energy and Industrial Maintenance of Cabo Verde: [98] This EUR 2 million program, financed by European Development Fund (EDF) and implemented by LuxDev, also aims to support CERMI. The objective is reach universal access to modern energy services, double energy efficiency in order to reduce total energy consumption and double the share of renewable energy mix in the global energy mix. The first component aims at setting up specific training for 16 West African countries in the region, while the second component targets the transformation of the CERMI as a Regional Skills Center.

- **EU Delegation**

Renewable energy and energy efficiency are only indirectly part of the scope of intervention of the European Union in Cabo Verde. Priority is given to budget support through the Good Governance and Development Contract (GGDC) instrument, as indicated in the National Indicative Programme (2014-2020) under the 11th European Development Fund.[99] Of EUR 55 million, EUR 30 million are allocated to support poverty reduction and growth, while EUR 20 million are to strengthen the special partnership between the EU and Cabo Verde. Nonetheless, the energy sector was included and the EU provided funding for the development of the Country SEforALL documents and the Energy Master Plan. EU stakeholders interviewed in Cabo Verde underlined that the EU provided budget support and does not have direct involvement concerning the choice and follow-up of projects (including those in the energy and off-grid sector). However, for both projects mentioned below, the EU grants directly to promoters of projects, through the budget of certain relevant EU programs (grant-based).

Improving the Governance of the Renewable Energy and Energy Efficiency Sector in West Africa: The regional program was launched by ECREEE and the EU in 2018 to build upon the UN SEforALL program with the goal of harmonizing the country's national, legislative and regulatory framework in order

[96] "Renewable Energies Project – CV0083," LuxDev, (2017): https://caboverde.luxdev.lu/en/activities/project/CVE/083
[97] "Partnership between the Center for Renewable Energies and Industrial Maintenance (CERMI) and the Center of competence-Technical Engineering of Luxembourg (CdC-GTB) – CV0085," LuxDev, (2018): https://caboverde.luxdev.lu/en/activities/project/CVE/085
[98] "Strengthening the regional positioning of the Center for Renewable Energy and Industrial Maintenance of Cabo Verde – CV881," LuxDev, (2017): https://caboverde.luxdev.lu/en/activities/project/CVE/881
[99] National Indicative Programme 2014-2020, 11th European Development Fund," European Commission and GoCV, (2014): https://cdn2-eeas.fpfis.tech.ec.europa.eu/cdn/farfuture/ybxDr7aNom34kh1LbKm_CojtDX9WHGzl3GHydWtTqy8/mtime:1477656013/sites/eeas/files/nip-Cabo-verde-edf11-2014_en.pdf

to promote investments in RE and EE sector (grid-connected and off-grid RE systems).[100] It will also seek to develop the West African electricity market and build the capacity of key stakeholders (public and private) from the 15 ECOWAS countries and Mauritania. The program will provide TA, support the development of RE projects, and the development of regional corridors for solar energy, hydropower and wind across West Africa.[101]

Monte Trigo Solar PV Mini-grid: This solar PV mini-grid project was commissioned in 2012 , financed at 75% by the EU-ACP[102] Energy Facility (EUR 281,250) and 25% by the local municipality of Porto Novo (EUR 93,750). For the first time, a rural micro grid with 100% renewable energy generation was implemented in Cabo Verde, with the installation of a 27.3 kW solar PV microgrid in the village of Monte Trigo. The objective of the project was the electrification of Monte Trigo village (600 inhabitants) in Santo Antão island with a Multiuser Solar Micro-grid (MSG).[103] A key aspect was to ensure long-term and sustainable energy services, through the implementation of energy tariffs designed as fixed monthly rates based on an Energy Daily Allowance (EDA), a concept developed by the Spanish firm Trama Tecnoambiental.[104]

- **UNDP Global Environment Facility-Small Grant Programme (GEF SGP)**

The Small Grants Programme (SGP) is a corporate program of the Global Environment Facility (GEF), implemented by the United Nations Development Programme (UNDP) in over 125 countries since 1992, which entered a partnership with the Australian Government's Department of Foreign Affairs and Trade (DFAT) in 2009. The program promotes community-based innovation, capacity development, women, youth and indigenous people empowerment through projects of local civil society organizations. In Cabo Verde, GEF SGP funds allocated to the country during the period 2015-2018[105] financed two projects in the renewable energy sector – the Small to Medium Scale Renewable Energy Systems and Production Station of Wind and Solar Energy projects.

Small to Medium Scale Renewable Energy Systems in Cabo Verde:[106] The project consisted in the installation of a hydrid off-grid electrical system (solar and diesel) for two local communities, Ribeira Alta and Figueras (800 inhabitants in total), in the municipality of Ribeira Grande in Santo Antão island's rural areas. 36% of the project was financed by the Municipality of Ribeira Grande, 34% by GEF SGP and 30% by ECREEE (USD 435, 000 total amount, of which USD 150,000 were grant by GEF SGP). The main objective was to mitigate shortage and irregularity of electricity supply, based on two diesel generators facing difficulties in fuel supply and maintenance. While the project was satisfactorily completed in 2016, SGP's coordinator indicated that the experience in the off-grid sector was gratifying but also difficult, due to the lack of experience in planning, execution and follow-up activities: post-project management and

[100] "ECREEE And Donor Partners Strategize To Improve Governance Of The Sustainable Energy And Energy Efficiency Sector In West Africa," ECREEE, (August 2018): http://www.ecreee.org/news/ecreee-and-donor-partners-strategize-improve-governance-sustainable-energy-and-energy

[101] "Launch of EU Project: Improving the Governance of Renewable Energy and Energy Efficiency in West Africa," EU-EEAS, (August 2018): https://eeas.europa.eu/delegations/cabo-verde/49019/launch-eu-project-improving-governance-renewable-energy-and-energy-efficiency-west-africa_en

[102] African Caribbean and Pacific Group of States (ACP)

[103] "Implementation Of A PV Rural Micro Grid In The Island Of Santo Antão (Cabo Verde) With An Individual Energy Allowance Scheme For Demand Control," ECOWREX, (2012): http://www.ecowrex.org/system/files/documents/2012_implementation-of-pv-rural-micro-grid-in-santo-antao-Cabo-verde_matteo-briganti.pdf

[104] "General Introduction to the Training - ECREEE Regional Training of Trainers Workshop: HOMER Software for RE Design," ECREEE, (May 2013): http://www.ecreee.org/sites/default/files/event-att/indroduction_workshop_homer_ecreee_public.pdf

[105] "Cabo Verde Programme Strategy (2015-2018)," GEF SGP and UNDP, (2015): https://sgp.undp.org/all-documents/country-documents/619-op6-sgp-Cabo-verde-country-programme-strategy/file.html

[106] "Promotion of Small and Medium-Sized Renewable Energy Systems in Cabo Verde," GEF SGP, (2016): https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results/spacial-itemid-project-detailpage.html?view=projectdetail&id=23114

follow-up continue to be neglected. The management of the system is still at an experimental phase, carried out by the communities themselves and by water company Águas de Porto Novo (Santo Antão).

Production Station of Wind and Solar Energy:[107] The project also consisted in the implementation of a clean energy production system (hybrid wind and solar system), in the community of Xaxa, a small community in Santiago island. This USD 80,000 project was financed by GEF SGP (concessional debt with USD 48,000 grant component, USD 19,959 co-financing in-cash and USD 12,175 in co-financing in-kind), implemented by local community based organization, the Association of Friends of Serra Malagueta, and completed in 2015. Despite satisfactory completion of the project, SGP's national coordinator also highlighted the limits in local organization's internal governance, as well as the issue of post-projects management and follow-up. Besides, the Xaxa project is faced with illegal connections on the installed renewable energy network.

- **UNIDO (GEF)**

Promoting market-based development of small to medium-scale renewable energy system, village of Carriçal:[108] The project consisted in the construction of a 2MW renewable energy system, as a pilot project demonstrating the viability of small to medium-scale for a replication in the rest of the country, over the period 2015-2015. Total amount of the project was of USD 7.67 million, of which USD 1.97 million from GEF-UNIDO (USD 0.29 million in grant), USD 1.9 million soft loan and USD 2.06 million hard loan from the private sector. Other implementing partners included the Ministry of Industry and Energy, national utility ELECTRA and ECREEE.

- **World Bank**

Distributed Solar Energy Systems (SIDS DOCK):[109] The project consists in a grant of USD 1 million to the Support for Small Island Developing States Sustainable Energy Initiative SIDS Dock Support Program Multi Donor Trust Fund. The project has four components: (i) the installation of RE generation capacity of 300 kWp systems in six regional hospitals (USD 434,500) and of solar thermal water heaters in two hospitals; (ii) a market study and framework (USD 320,000) to promote energy investments, including an activity of awareness raising for commercial banks; and (iii) implementation support, communication and dissemination (USD 245,000) to ensure the implementation of the project, while communication and dissemination were planned once the systems are installed. While the project started in 2015, the closing date was extended to 2018 due to changes in the Cabo Verdean administration – the Head of the General Directorate of Energy of the Ministry of Economy and Employment – which slowed the project's execution.

1.4.3 Other Initiatives

Though there are a number of non-governmental organizations (NGOs) interested in sustainable development in the remote and rural areas of Cabo Verde, none have engaged in off-grid solar. The majority of off-grid projects in the country have been directly managed either by utility companies or development partners (i.e. the GoCV, the EU, LuxDev, GEF-Small Grants Program etc.). Associação para a Defensa do Ambiente e Desenvolvimento (ADAD) and Sol & Vento are organizations active in the RE sector. ADAD has previously submitted rural electrification projects to IRENA and GEF.

[107] "Production Station of Wind and Solar Energy," GEF SGP, (2015): https://sgp.undp.org/biz/index.php?option=com_sgpprojects&view=projectdetail&id=21068&Itemid=272

[108] "Project Identification Form: Promoting market-based development of small to medium-scale renewable energy system in Cabo Verde, GEF-UNIDO, (2009): https://www.thegef.org/sites/default/files/project_documents/Revised%2520PIF_0.PDF

[109] "Cabo Verde: Distributed Solar Energy System, Project Document," The World Bank, (2018): http://documents.worldbank.org/curated/en/838921513954732796/pdf/Disclosable-Restructuring-Paper-Cabo-Verde-Distributed-Solar-Energy-Systems-SIDS-DOCK-P151979.pdf

II. OFF-GRID SOLAR PV MARKET ASSESSMENT

This section presents the overall market assessment for stand-alone off-grid solar (OGS) energy systems in Cabo Verde. **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 9** 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 9: Indicative Total Cash Market Potential for Off-Grid Solar PV Products in Cabo Verde, 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	1,951	6	$87,812	$0.00
Plug and play	0	0	$0.00	$0.00
Small SHS	0	0	$0.00	$0.00
Medium and Large SHS	0	0	$0.00	$487,846
Household Subtotal	**1,951**	**6**	**$87,812**	**$487,846**
Institutional				
Water supply	5	16	$39,125	-
Healthcare facilities	2	1	$1,400	-
Primary and secondary schools	2	2	$4,350	-
Public lighting	43	21	$64,050	-
Institutional Subtotal	**50**	**40**	**$108,925**	**-**
Productive Use				
SME applications for microenterprises	337	84	$210,500	-
Value-added applications	8,238	1,222	$5,923,877	
Connectivity applications	270	108	$232,985	-
Productive Use Subtotal	**8,845**	**1,414**	**$6,367,362**	**-**
TOTAL	**10,846**	**1,460**	**$6,564,099**	

Source: African Solar Designs analysis

2.1 Demand – Households

This section analyzes the main characteristics of the household (HH) OGS demand in Cabo Verde. 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 3,903 households (16,392 people) in Cabo Verde without access to electricity.[110] In that year, an estimated 97% of the population had access to electricity, with the rate of access at 100% in urban areas and 89% in rural areas.

This section gives an introduction to household consumer market segments, their characteristics and size (**Table 10**). 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.

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

Table 10: Household Consumer Market Segments[111]

Income Quintile	% w/o Access	# of HH w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# of HH w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# of HH w/o Access	Avg. GDP per HH per year	Energy Tier	Geographic segments	Description
	2018 Scenario				2023 Scenario				2030 Scenario					
Highest 20%	0%	0	$39,589	Tier 3	0%	0	$47,554	Tier 3	0%	0	$57,169	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[112]
Fourth 20%	0%	0	$14,855	Tier 3	0%	0	$17,844	Tier 3	0%	0	$21,452	Tier 3	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%	0%	0	$9,656	Tier 3	0%	0	$11,599	Tier 3	0%	0	$13,944	Tier 3		
Second 20%	0%	0	$6,462	Tier 3	0%	0	$7,762	Tier 3	0%	0	$9,331	Tier 3	Low income rural	• Engaged in farming, SME or mining support activities • Lives more than 15km from the nearest grid connection.
Lowest 20%	15%	3,903	$3,714	Tiers 2	5%	1,450	$4,461	Tier 2	3%	917	$5,363	Tier 2		
Total Households without Access to Electricity		**3,903**			**Total**	**1,450**			**Total**	**917**				

Source: IEA and World Bank; African Solar Designs analysis

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

[112] 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**

Cabo Verde has a low level of poverty, with just 8.1% of the population living below the USD 1.90 a day poverty line, according to the World Bank.

According to feedback from local stakeholders, households without electricity access have little to no income. Although there is no official data to support this; there is a perception that these households have the lowest income in the country. Off-grid household income does not vary widely across island regions. Standard income groupings for Cabo Verde can be defined as follows, based on the official table for withholding tax on income (USD):

- Up to 2,345.20
- Up to 10,233.60
- Above 10,233.60 and up to 19,188.00
- Over 19,188.00

- **Geographic Components of the Solar Market**

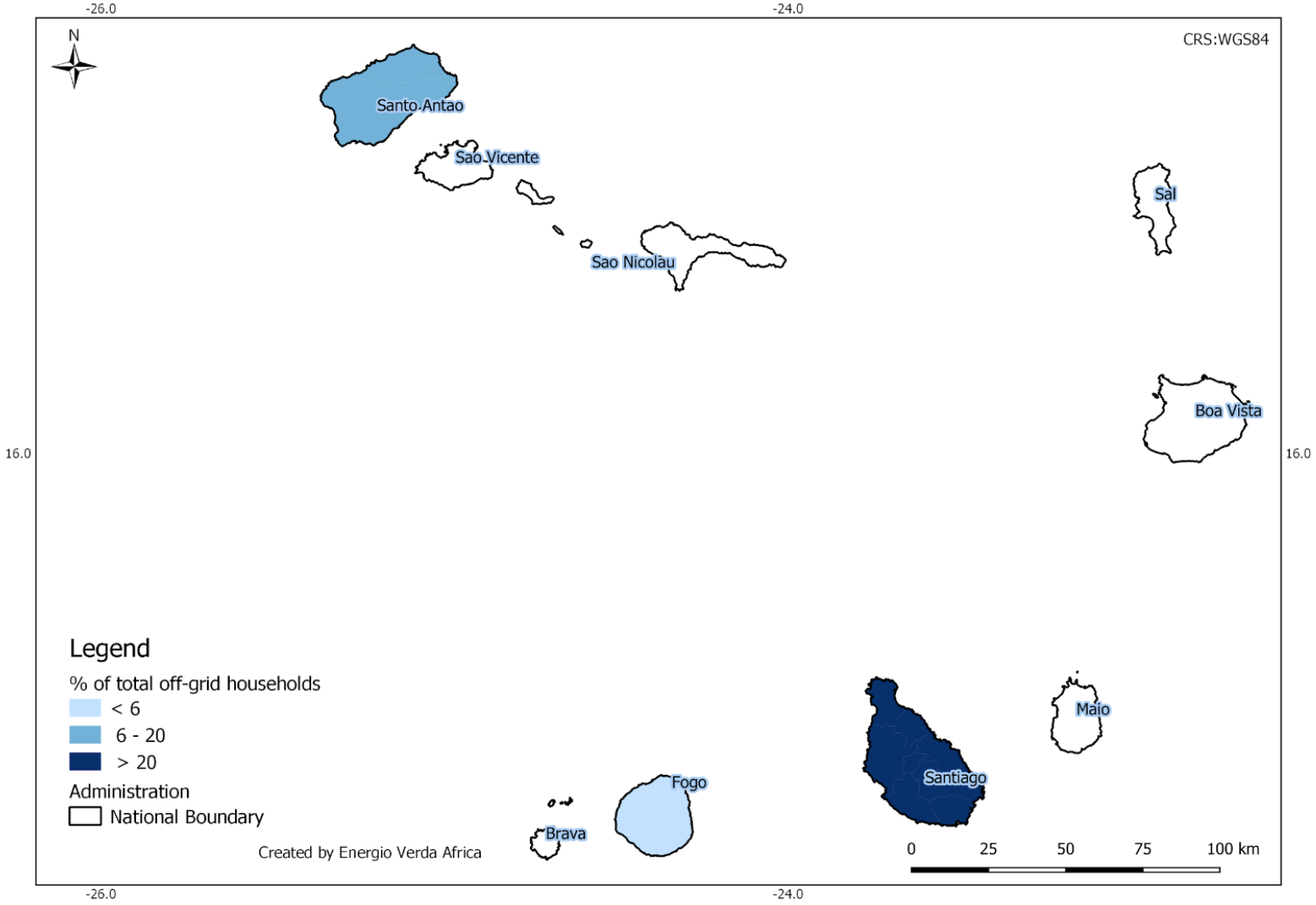
The total number of households without electricity access can change over time. To analyze the potential OGS market over time, GIS maps were prepared for this study from demographic information to present potential market areas for OGS. GIS calculations consider drivers of off-grid household market change including grid extension around current urban and peri-urban centers, mini-grid development for more densely populated rural areas, and population growth. However, GIS analysis for Cabo Verde differs significantly from other countries in this study because of limited available data. Feedback from focus group discussion participants as well as interviews with local stakeholders revealed the following:

- No grid extension to the remote un-electrified locations will take place until 2030. Because:
  - Electra has to focus on increasing the generation capacity
  - Due to high dependency on importing fossil fuel one of the targets of GoCV is to increase the share of RE generation in the electricity grid
  - Data on electricity lines is not available
- Data is based on currently un-electrified villages/ communities rather than total settlements
- Based on a visit in July 2018, there are 300 people living in the village of CHÃ DAS CALDEIRAS on the island Fogo. According to the Census 2010, 697 people were living in the village. Before the eruption of a volcano in 2014, around 2,000 people were living there. Many households were destroyed in the eruption. The population will likely grow in the coming years.

Further sources of information for the maps presented below (**Figures 12-15)** can be found in **Annex 1**. GIS maps shown here are for 2023 and 2030.

As shown in the maps and chart summaries below, the total size of the OGS market will decrease slightly over time, concentrated largely on the island of Santiago.

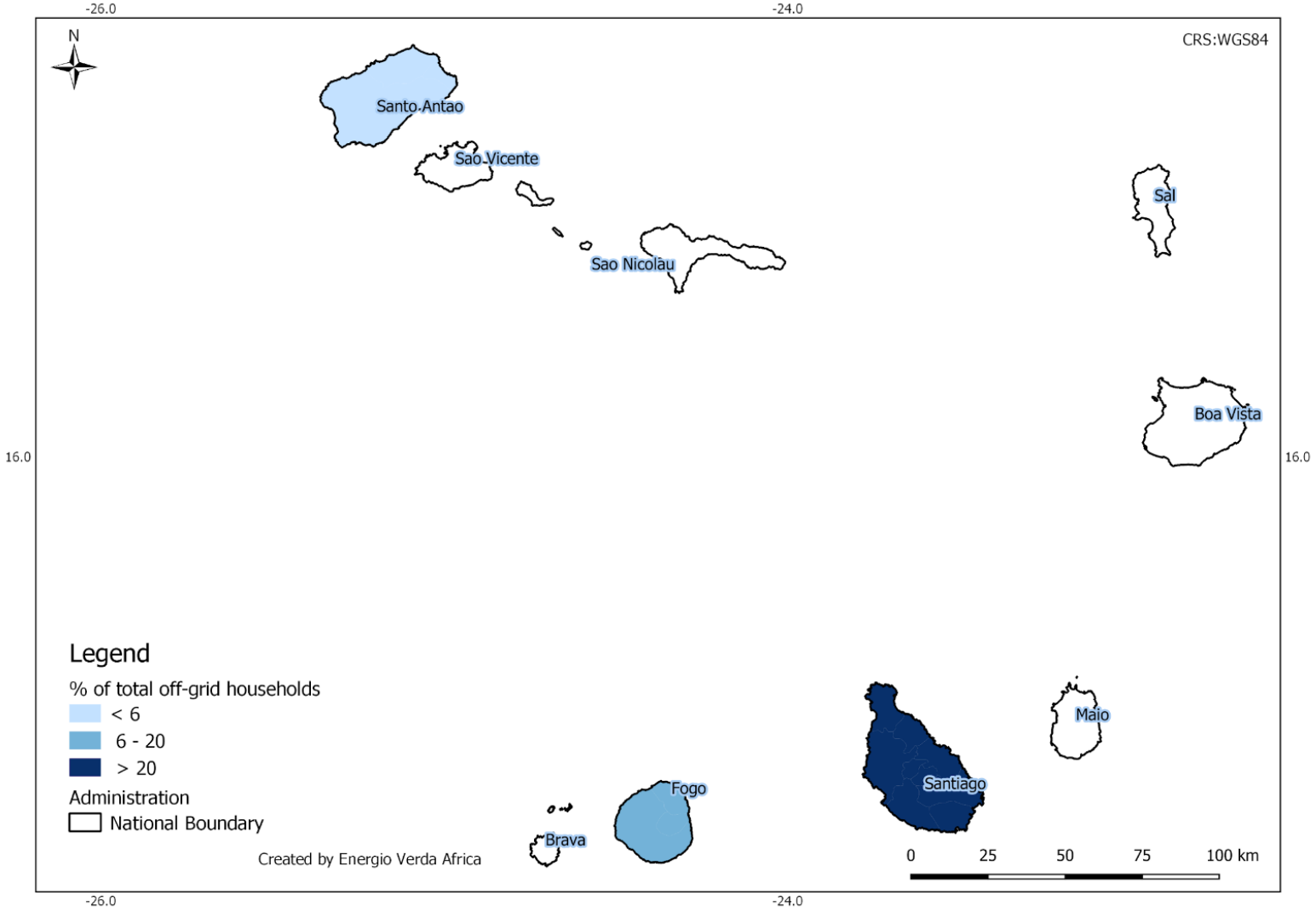
Figure 12: Distribution of Potential Off-Grid Households by Island, 2023[113]



Source: Energio Verda Africa GIS analysis

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

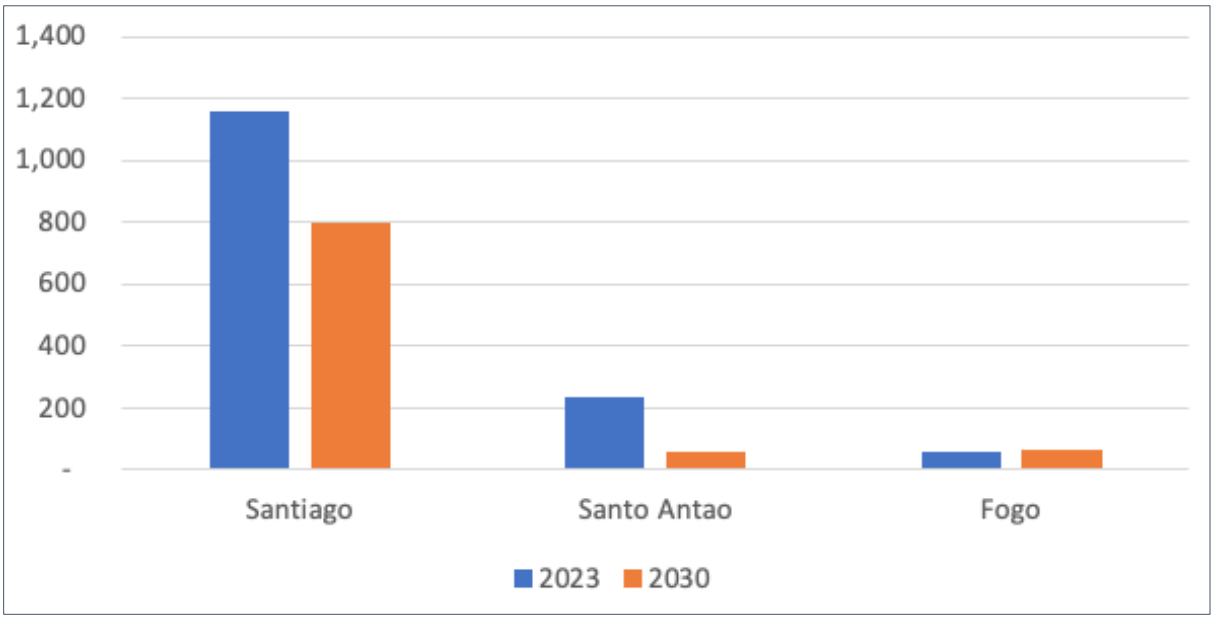
Figure 13: Distribution of Potential Off-Grid Households by Island, 2030[114]



Source: Energio Verda Africa GIS analysis

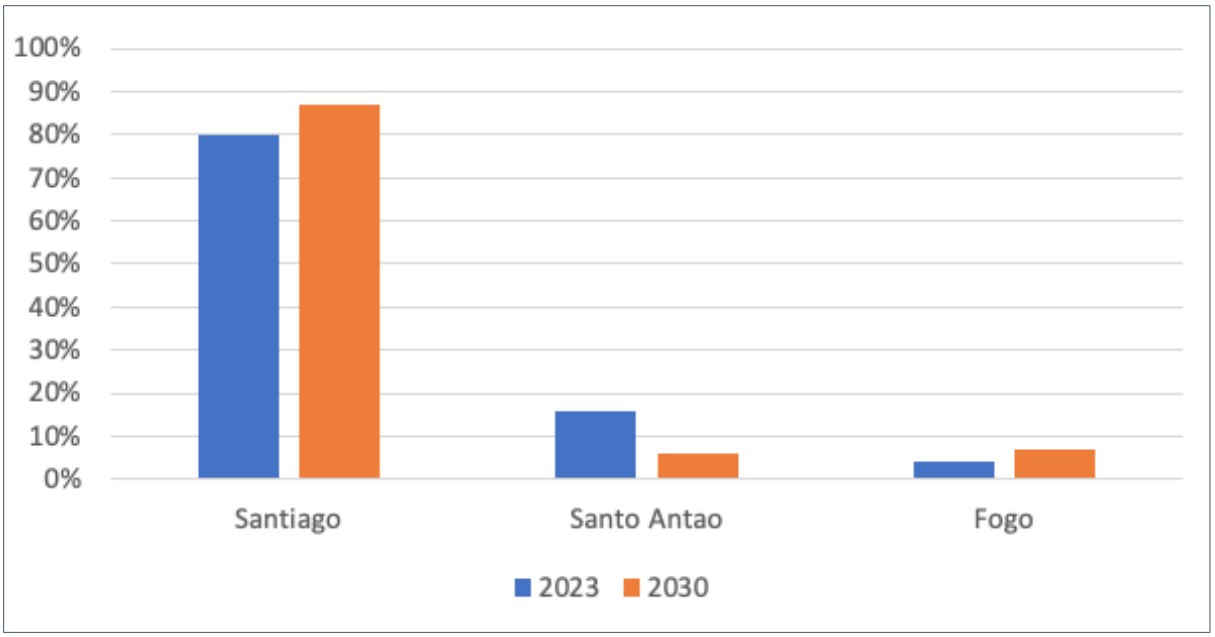
[114] See **Annex 1** for more details, including data sources.

Figure 14: Estimated Number of Off-Grid Households by Island, 2023 and 2030



Source: Energio Verda Africa GIS analysis

Figure 15: Estimated Percentage of Off-Grid Households by Island, 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 examines several indicators:

- 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 for both cash purchases and financed purchases.

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

According to feedback from focus group discussion (FGD) participants, common sources of electricity currently used in off-grid rural households include diesel gen sets, solar, and informal grid access (through illegal rerouting of electricity distribution cables from other regions). Household energy consumption increases slightly during the summer.

Table 11 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 12**. 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 16** and **Table 13**.

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 11: Rural Energy Technology and Costs[115]

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	$2.12	$2.72	$2.44	$3.12
Cell Phone Charging	Done at a charging station	-	8	$0.14	$0.00	$1.12	$0.00	$1.19	$0.00	$1.37
Smart Phone Charging	Done at a charging station	-	16	$0.14	$0.00	$2.24	$0.00	$2.38	$0.00	$2.73
Battery-powered DC Radio	Radio powered by dry cells replaced two times per month	-	8	$0.16	$0.00	$1.28	$0.00	$1.36	$0.00	$1.56
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	$1.34	$100.00	$40.20	$106.10	$42.66	$121.90	$49.00

Source: African Solar Designs analysis

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

Table 12: 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	$3.68	$3.91	$4.49
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	$7.52	$9.34	$9.17
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	$13.60	$14.43	$16.58
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	$40.2	$42.66	$49.00

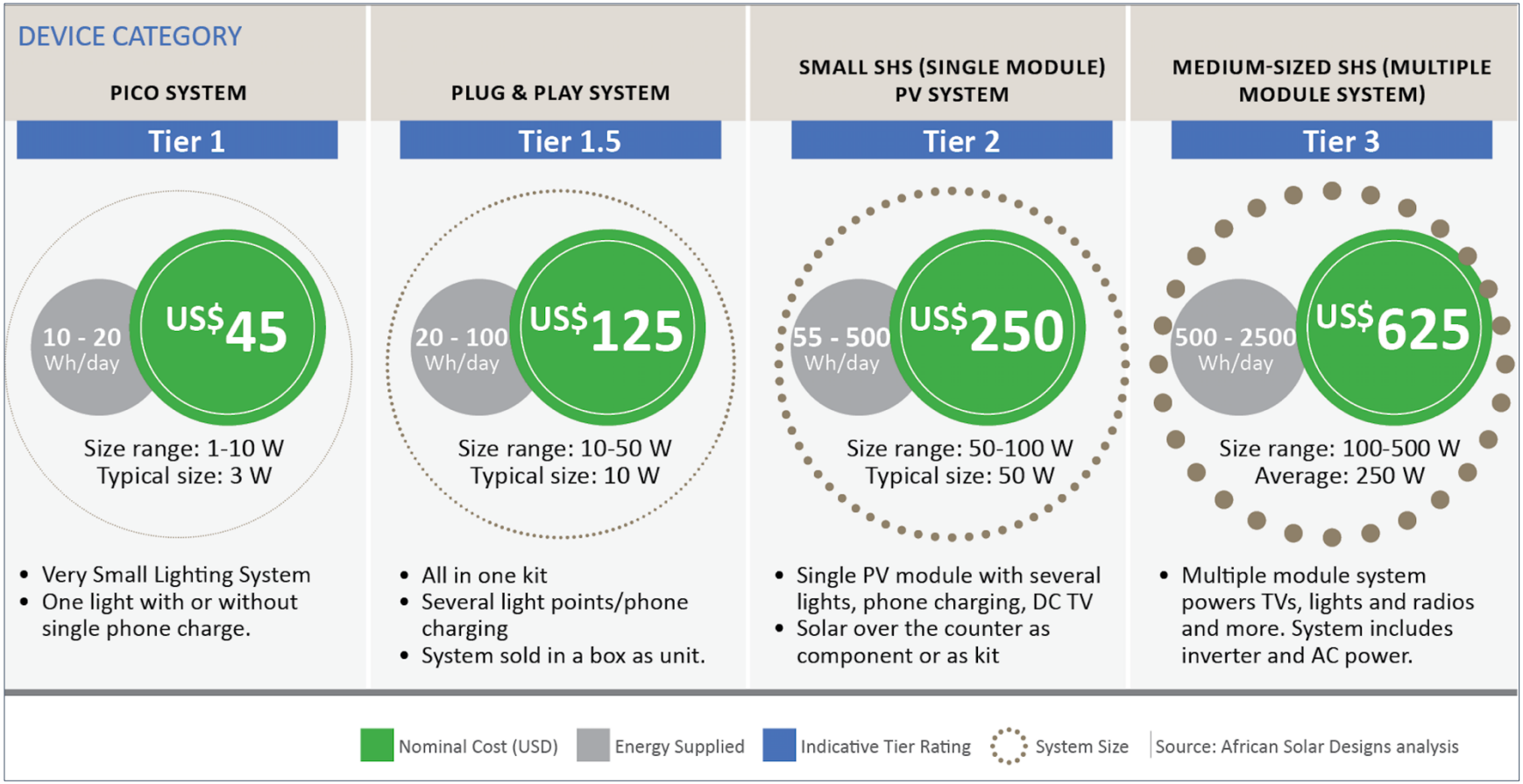
Source: African Solar Designs analysis

Per **Table 12**, 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 16**.

Figure 16: Household PV System Descriptions and Market Segments



Source: African Solar Designs analysis

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

According to feedback from focus group participants, less than 1% of the population is currently using household solar products. There is a general awareness in off-grid communities that renewable energy could be a potential solution. However, there is no awareness regarding the technology, how it works and how to procure products. Households have expressed a desire to have solar systems installed by the government. However, no concrete information is being disseminated to the population about solar energy. Current suppliers are not meeting the needs of many off-grid households. Suppliers are present in the main islands only but can travel to other islands for installation and periodic maintenance.

Focus group discussion participants noted that the cost of solar PV systems is lowering but still expensive for the Cabo Verdean market. Incentives are ambiguous and not adequately in place. The scale of national demand does not permit stocking of equipment, while the customs process is complex and not transparent. It was also shared that communities are not satisfied with a system that provides only electricity for households. Once the system is installed for household electricity, individuals seek opportunities to create income generating and entertainment activities, which tend to overwhelm the current system installed. This is the case with various mini-grid systems installed in Cabo Verde.

There are eight solar mini-grids serving households and SMEs in Cabo Verde (**Table 4**). In Monte Trigo, for example, a mini-grid of 27.3 kWp is serving a population of roughly 270 people and supporting the primary economic activity of fishing. Because solar energy is more expensive than grid-based electricity, it is a challenge to obtain a balance between the household contribution for their consumption (due to their low incomes), and government subsidies (that could allow for a normal payback period).

- **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 13** 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 **Annex 2**). 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.

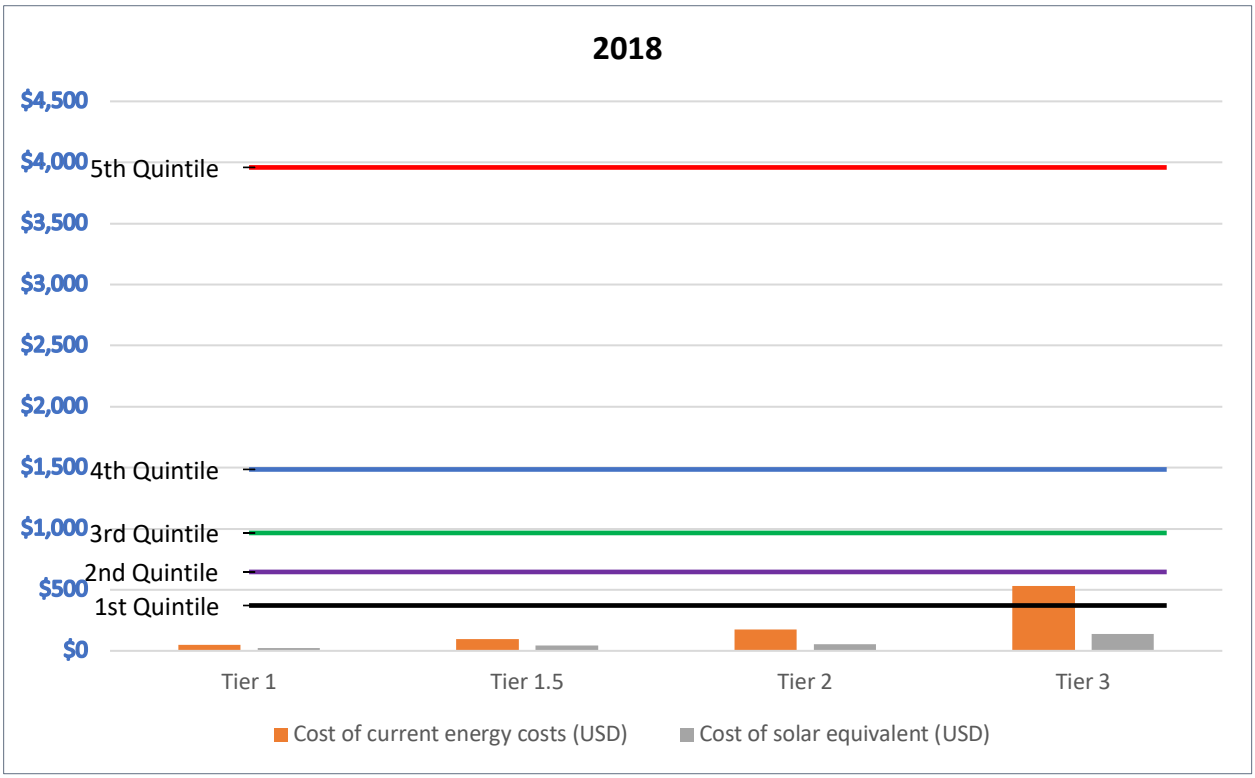
Table 13: Energy Expenditure of Different Income Groups

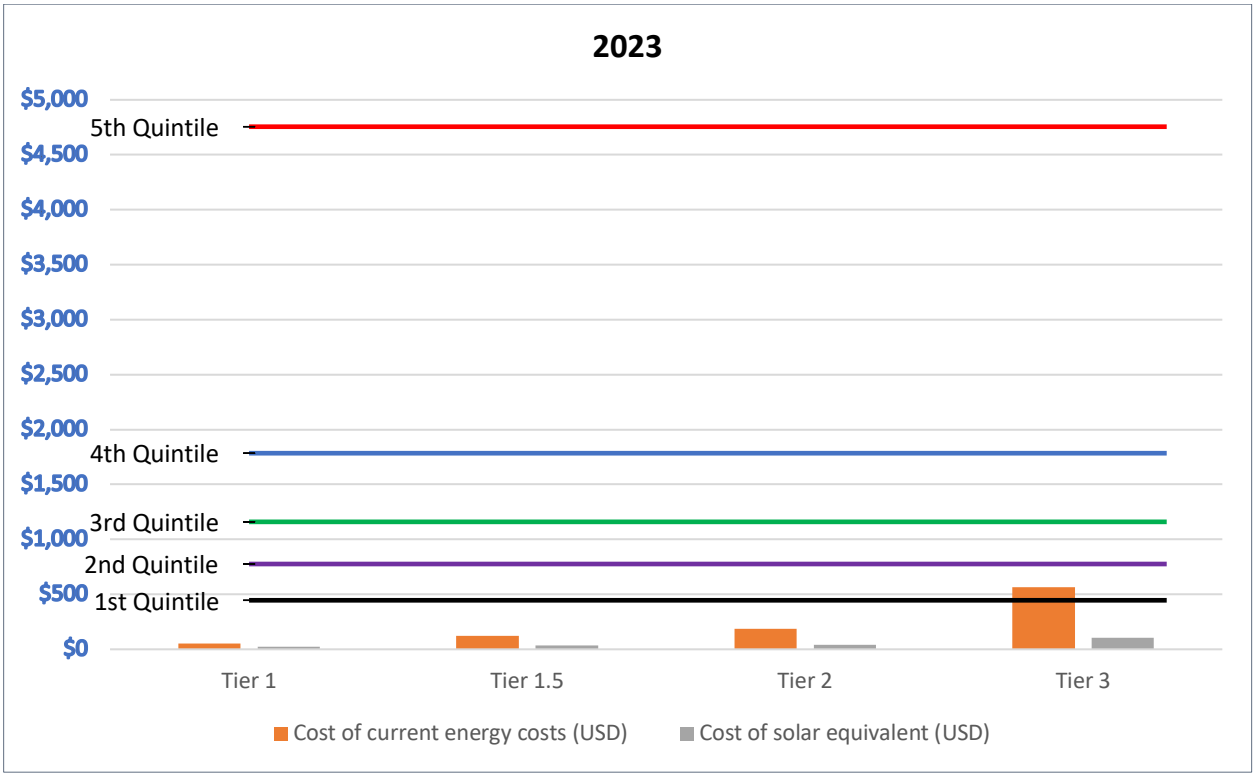
Population Income Quintiles	Per Capita Income (USD per month)	Household Income (USD per month)	Energy as % of Income	Monthly Energy Budget (USD)
2018 Scenario				
Lowest Quintile of Population	$73.69	$309.48	10%	$30.95
2nd Quintile of Population	$128.21	$538.50	10%	$53.85
3rd Quintile of Population	$191.59	$804.66	10%	$80.47
4th Quintile of Population	$294.75	$1,237.93	10%	$123.79
Highest Quintile of Population	$785.50	$3,299.10	10%	$329.91
2023 Scenario				
Lowest Quintile of Population	$88.51	$371.75	10%	$37.18
2nd Quintile of Population	$154.01	$646.85	10%	$64.68
3rd Quintile of Population	$230.13	$966.55	10%	$96.66
4th Quintile of Population	$354.05	$1,487.00	10%	$148.70
Highest Quintile of Population	$943.54	$3,962.86	10%	$396.29
2030 Scenario				
Lowest Quintile of Population	$106.41	$446.91	10%	$44.69
2nd Quintile of Population	$185.15	$777.62	10%	$77.76
3rd Quintile of Population	$276.66	$1,161.96	10%	$116.20
4th Quintile of Population	$425.63	$1,787.64	10%	$178.76
Highest Quintile of Population	$1,134.30	$4,764.05	10%	$476.41

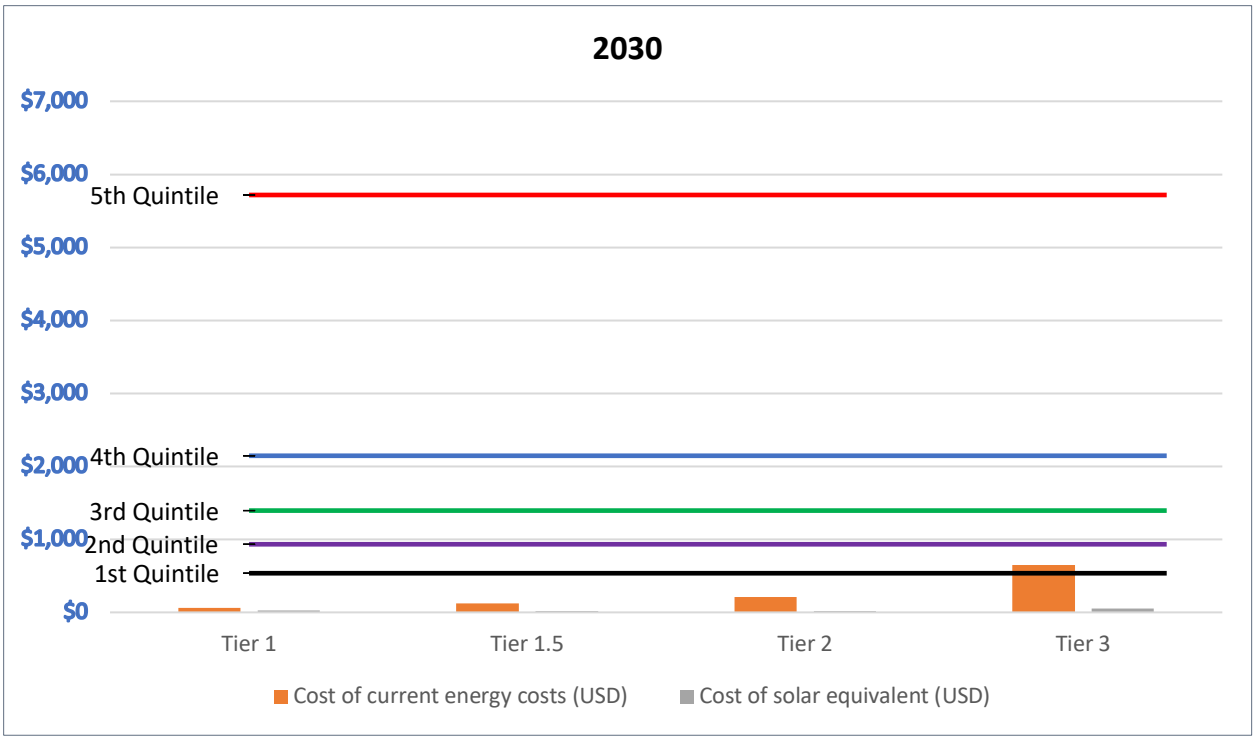
Source: African Solar Designs analysis

Figure 17 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.

Figure 17: Annual Household Energy Budget by Quintile, Annual Energy Costs and Cost of Solar Equivalents







Source: African Solar Designs analysis

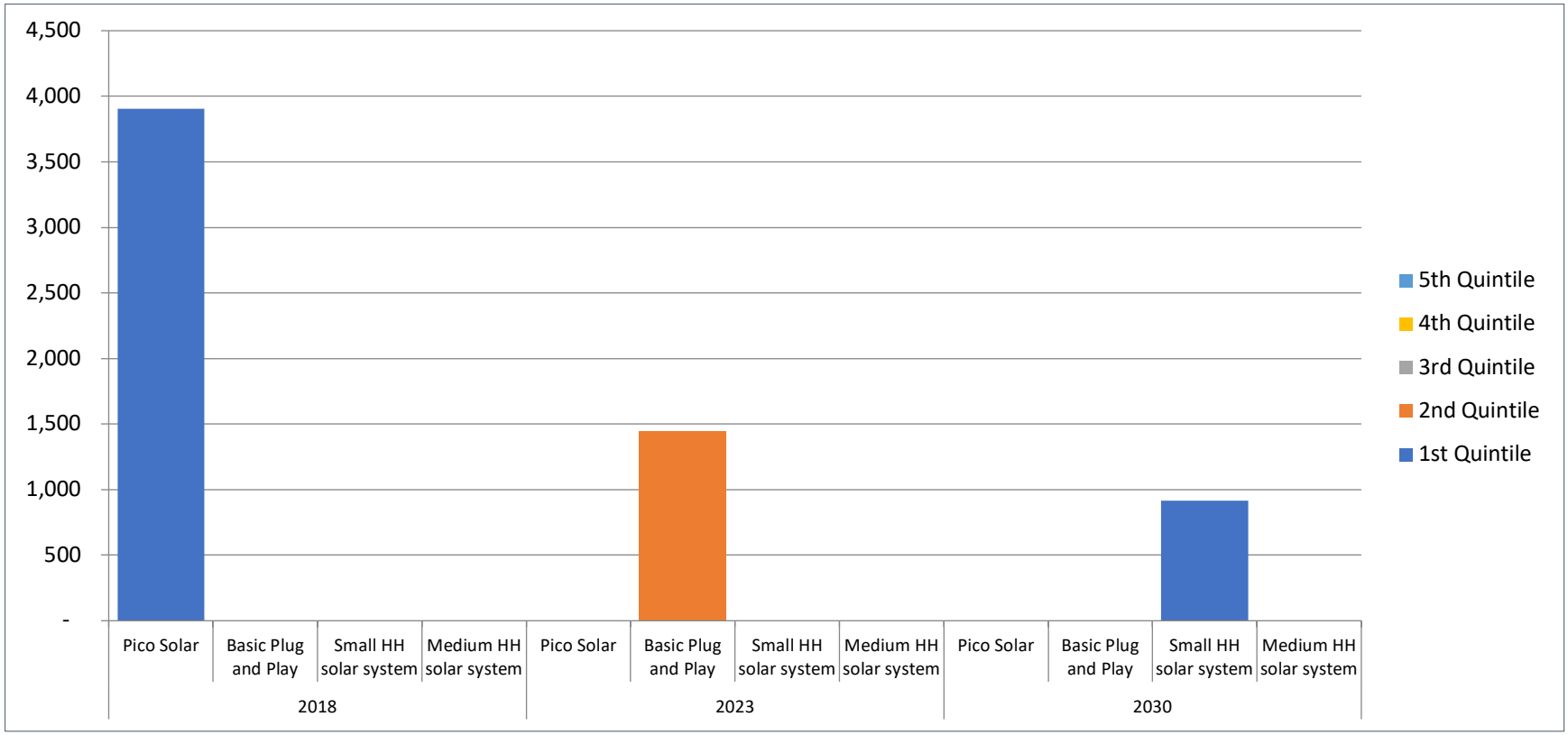
Household energy spending is estimated as 10% of the average household income for each quintile. The data clearly shows strong potential savings for households to switch to solar products. Affordability also increases over time, as the cost of solar technology reduces, while the cost of traditional energy 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 may indicate the need for short term financing, as many households still struggle to pay up front unit capital costs to achieve subsequent savings.

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, all households without electricity access can afford an OGS system unfinanced. However, these households, which are all assumed to be in the lowest income quintile, can only afford to purchase pico solar systems in the 2018 scenario. Based on the assumption that 100% of the households in the higher quintiles live in urban areas and are connected to the grid, the annualized off-grid cash market for pico solar systems is limited to 1,951 units in 2018. This market size would decrease further in 2023 and 2030, as shown below. 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 18: Estimated Number of Households Able to Afford Cash Purchase of OGS Systems by Income Group



Source: African Solar Designs analysis

Table 14 presents the estimated annualized cash market potential for off-grid solar product sales in the country's household sector.

Table 14: Estimated Cash Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
2018 Scenario			
Pico Solar	1,951	6	$87,812
Basic Plug and Play	0	0	$0.00
Small HH solar system	0	0	$0.00
Medium HH solar system	0	0	$0.00
Total	**1,951**	**6**	**$87,812**
2023 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	483	5	$45,552
Small HH solar system	0	0	$0.00
Medium HH solar system	0	0	$0.00
Total	**483**	**5**	**$45,552**
2030 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH solar system	183	9	$17,900
Medium HH solar system	0	0	$0.00
Total	**183**	**9**	**$17,900**

Source: African Solar Designs analysis

2.1.4 The Financed Market for Off-Grid Solutions

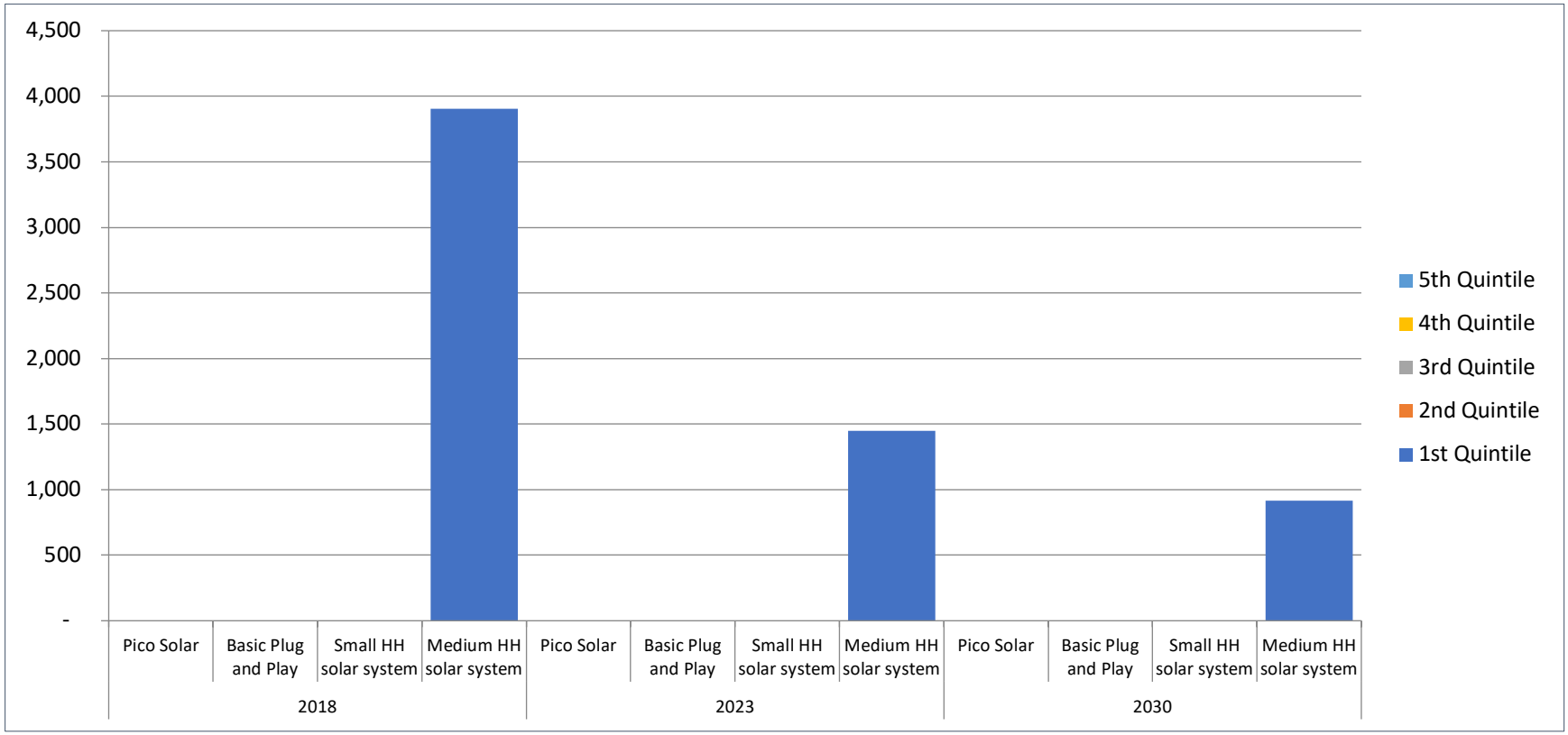
- **Financial Model**

In order to portray the effects of finance, a simple model was prepared that provides OGS system finance with a 20% p.a. interest rate[116] 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 service 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.

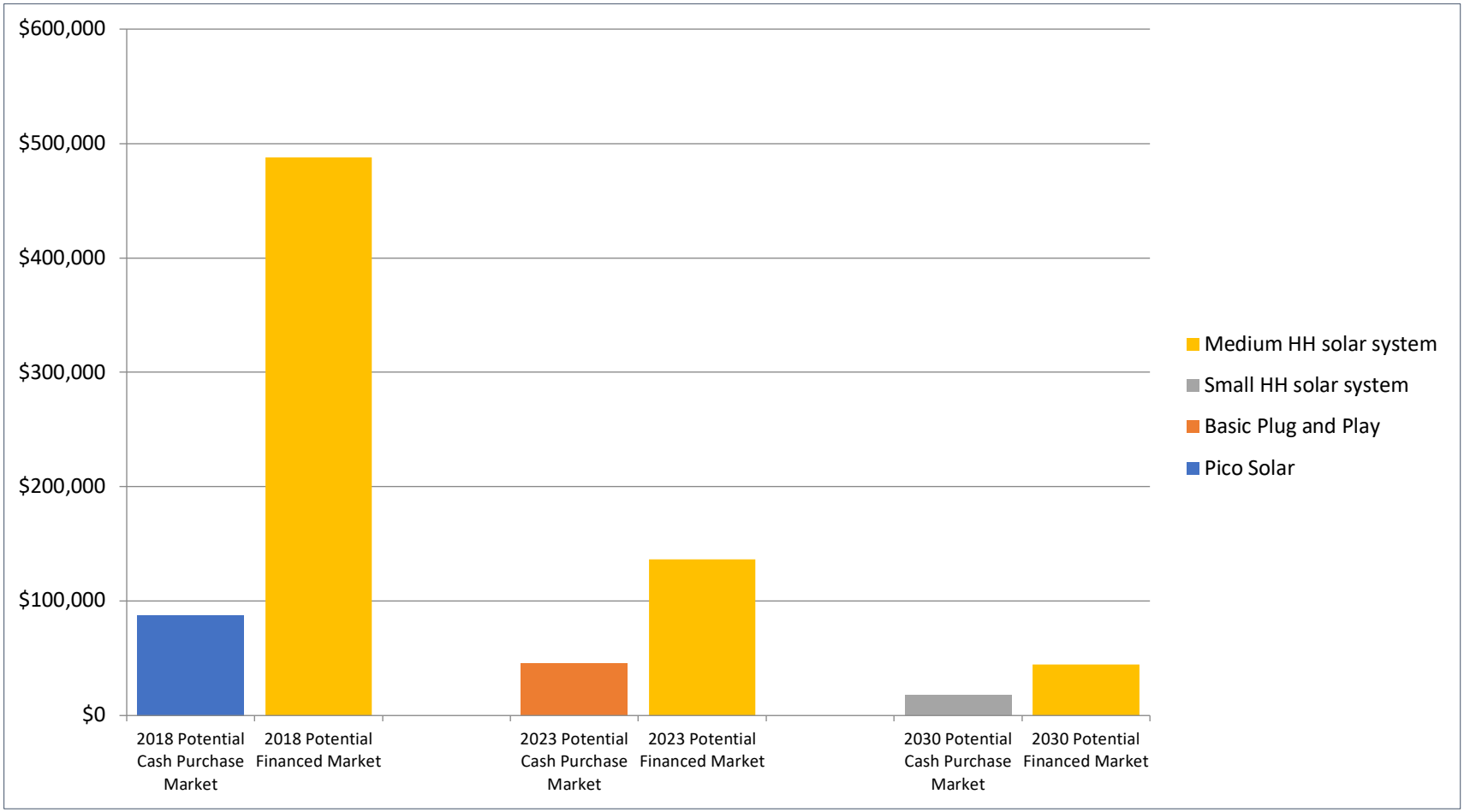
[116] "Cabo Verde: Access to Finance for MSMEs (P163015)," World Bank, (Sept 26, 2017): http://documents.worldbank.org/curated/en/825171511262268770/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Cabo-Verde-Access-to-Finance-for-MSMEs-P163015-Sequence-No-00.pdf

Figure 19: Estimated Number of Households Able to Afford Financed OGS Systems by Income Group



Source: African Solar Designs analysis

Figure 20: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type



Source: African Solar Designs analysis

In 2018, without financing, all 3,903 households without electricity access in the country could afford an OGS system. However, with financing, they were enabled to acquire the larger systems. Consequently, the annualized potential market size increases from USD 87,812 to USD 487,846 (**Figure 20**).

The least-cost electrification 2023 scenario calculates that 1,450 households could be electrified by stand-alone systems. Also under this scenario, all the households without electricity access have the ability to acquire at least one OGS system; however, financing enables them to acquire the larger systems. The annualized potential market size increases from USD 45,552 to USD 136,657 (**Figure 20**).

The least-cost electrification 2030 scenario calculates that the total number of households that could be electrified by stand-alone systems would rise slightly to 917. Under this scenario as well, all the households without electricity have the ability to acquire at least one OGS system; however, financing enables them to acquire the larger systems. The annualized potential market size therefore increases from USD 17,900 to USD 44,750 (**Figure 20**).

Table 15 presents the estimated annualized financed market potential for off-grid solar product sales in the country's household sector.

Table 15: Estimated Financed Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
2018 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH solar system	0	0	$0.00
Medium HH solar system	781	195	$487,846
Total	**781**	**195**	**$487,846**
2023 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH solar system	0	0	$0.00
Medium HH solar system	290	72	$136,657
Total	**290**	**72**	**$136,657**
2030 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH solar system	0	0	$0.00
Medium HH solar system	183	46	$44,750
Total	**183**	**46**	**$44,750**

Source: African Solar Designs analysis

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 Cabo Verde. 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 16 shows the estimated annualized cash market potential for institutional users in Cabo Verde. 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 similar countries to analyze certain sectors as described below.[117]

Table 16: Indicative Total Cash Market Potential for Institutional Sector[118]

Institutional Sector		Units	kW Equivalent	Cash Value (USD)
Water supply	Low power pumping system	3	4	$10,875
	Medium power pumping system	0.5	2	$4,500
	High power pumping system	0.5	10	$23,750
	Subtotal	4	16	$39,125
Healthcare	Health post (HC1)	0.5	0.25	$500
	Basic healthcare facility (HC2)	0.25	0.25	$375
	Enhanced healthcare facility (HC3)	0.25	0.5	$525
	Subtotal	1	1	$1,400
Education	Primary schools	1	1	$1,950
	Secondary schools	1	1	$2,400
	Subtotal	2	2	$4,350
Public lighting	Public lighting (excluding street lighting)	43	21	$64,050
TOTAL		**50**	**40**	**$108,925**

Source: African Solar Designs analysis

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

[118] 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 17: 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 Ghana[119] identified off-grid potable water points such as boreholes and wells that could be electrified by stand-alone systems. Based on these assumptions, the estimated annualized cash market potential for the water supply sector is presented in **Table 18.**

Table 18: Estimated Cash Market Potential for Water Supply[120]

Pump Type	Units	Size (kW)	Cash Value (USD)
Low power	3	4	$10,875
Medium power	0.5	2	$4,500
High power	0.5	10	$23,750
Total	**4**	**16**	**$39,125**

Source: African Solar Designs analysis

- **Healthcare**

Table 19: Key Assumptions for Healthcare Sector Analysis

Sector	System Sizes	Key Assumptions
Healthcare	• HC1: Dispensary health post (300 W) • HC2: Basic health facility (1500 W) • HC3: Enhanced health facility (4200 W)	A per capita comparison identified a total of 7 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.

[119] Ghana was grouped in the same category as Cabo Verde; See **Annex 2** for more details

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

As GIS data was not available to conduct the analysis, a per capita comparison made using data from Ghana[121] identified off-grid health facilities categorized according to their size (HC1, HC2, and HC3) that could be electrified by stand-alone systems.[122] 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 20**). The assumptions of system size below are based on the services offered at each of these facilities.

Table 20: Healthcare Facility Categorization and Electricity Demand[123]

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 21**. The distribution of potential off-grid health facilities is shown in **Figure 6** in **Section 1.2.2.4**.

Table 21: Estimated Cash Market Potential for Healthcare Facilities[124]

Type of Facility	Units	kW Equivalent	Cash value (USD)
Health post (HC1)	0.5	0.25	$500
Basic healthcare facility (HC2)	0.25	0.25	$375
Enhanced healthcare facility (HC3)	0.25	0.5	$525
Total	**1**	**1**	**$1,400**

Source: African Solar Designs analysis

[121] Ghana was grouped in the same category as Cabo Verde; See **Annex 2** for more details
[122] NOTE: This represents a small subset of the overall health infrastructure in the country; See **Annex 1** for more details.
[123] "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
[124] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

- **Education**

Table 22: Key Assumptions for Education Sector Analysis[125]

Sector	System Sizes	Key Assumptions
Education	• Elementary schools (500 W) • Secondary schools (1,920 W)	A per capita comparison identified a total of 26 off-grid primary schools and 10 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.[126] 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 Ghana[127] 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 load of the school (**Table 23**).

Table 23: Education Center Categorization and Electricity Demand[128]

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 the education sector is presented in **Table 24**. The distribution of potential off-grid education centers is shown in **Figure 6** in **Section 1.2.2.4**.

Table 24: Estimated Cash Market Potential for Primary and Secondary Schools[129]

Type of Facility	Units	kW Equivalent	Cash value (USD)
Primary school	1	1	$1,950
Secondary school	1	1	$2,400
Total	**2**	**2**	**$4,350**

Source: African Solar Designs analysis

[125] 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**).
[126] 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.
[127] Ghana was grouped in the same category as Cabo Verde; See **Annex 2** for more details
[128] "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
[129] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

- **Public Lighting**

Table 25: Key Assumptions for Public Lighting Sector Analysis

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 2,000 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 26**.

Table 26: Estimated Cash Market Potential for Public Lighting[130]

Public Lighting Network	Units	kW Equivalent	Cash value (USD)
Village lighting (excluding street lighting)	43	21	$64,050

Source: African Solar Designs analysis

2.2.3 Ability to Pay and Access to Finance

Financing for institutional off-grid systems in Cabo Verde 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.[131]

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.

[130] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[131] 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 and increase productivity in Cabo Verde. Focus group discussions highlighted the applicability of solar appliances for ice production for fish preservation, particularly on remote islands. However, limited technical capacity to design, install, operate, manage and maintain renewable energy based energy systems makes it difficult to scale-up off-grid solar productive uses of energy.

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.

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.

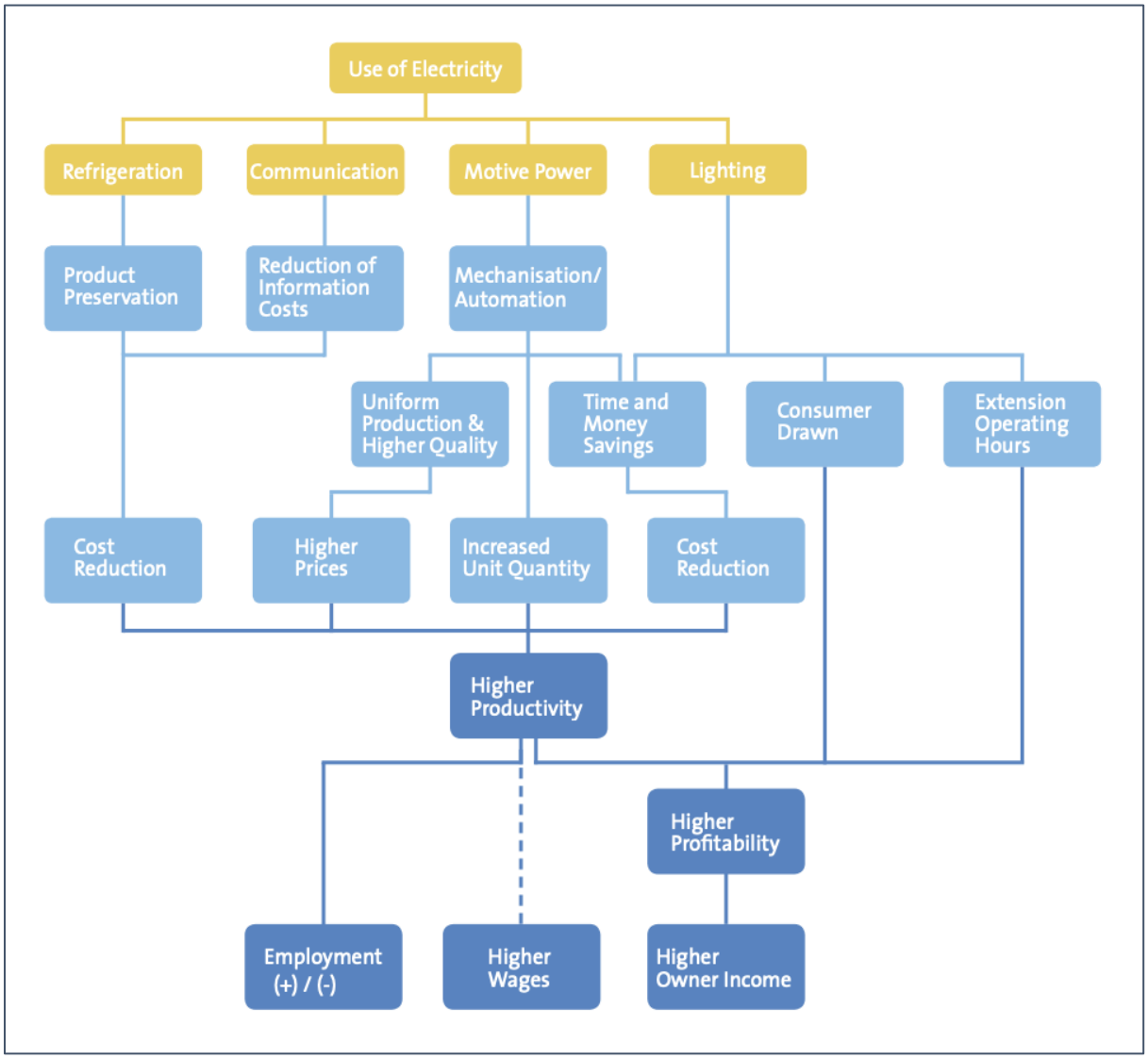
Cabo Verde has been experiencing impressive economic growth (3.9% in 2018), primarily driven by strong performances in electricity and water, manufacturing, tourism, fisheries, and retail trade sectors.[132] While its overall share of GDP contribution remains low, between 2007-2016, agriculture and fishing industries grew by 4.6% per year reflecting a boost and growing shift from subsistence farming to a sector increasingly oriented toward meeting market demands.[133] These industries remain susceptible to risks from climate change as well as limited access to production technologies and markets. However, in the near term, the GoCV and international donors aim to realize the potential for these sectors (especially fishing) to be scaled up to provide enhanced livelihoods and incomes to the poorer segments of the population.[134]

As services make up over 60% of Cabo Verde's GDP, high energy costs have a substantial impact on firms.[135] It is important to note that 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 to which firms will invest in off-grid solar solutions is determined

[132] "Cape Verde Economic Outlook, Macro Performance," African Development Bank: https://www.afdb.org/en/countries/west-africa/cabo-verde/cabo-verde-economic-outlook/
[133] "Republic of Cabo Verde: Adjusting the Development Model to Revive Growth and Strengthen Social Inclusion," World Bank (2018): http://documents.worldbank.org/curated/en/875821538129394201/pdf/130289-REPLACEMENT-PUBLIC-WB-Cabo-Verde-English-WEB.pdf
[134] Ibid.
[135] Ibid

largely by increases in productivity, profitability, and employment/wages related to the investment in the off-grid appliance (**Figure 21)**, as well as by access to finance.

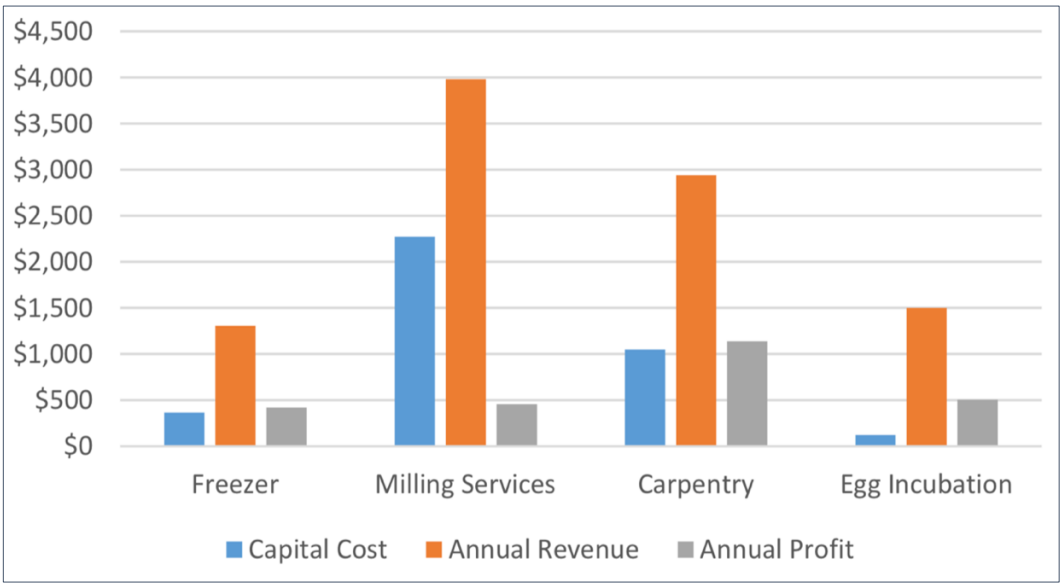
Figure 21: Pathways from Electricity to Income Generation[136]



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

[136] 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 22: Analysis of Cost, Revenue, and Profit for Various Off-Grid Productive Use Applications[137]



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 27**).

Table 27: 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 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

[137] "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**

Cabo Verde's main economic activities are largely categorized into the following groups – agriculture in Santiago, Fogo and Santo Antão; fishing and maritime in São Vicente; tourism in Sal and Boa Vista; and energy in Santiago, Sal and São Vicente.[138] Focus group participants indicated that most of the country's solar-powered productive use would be carried out in only a few areas due to the country's high electrification rate. Nonetheless, the installation of solar would be most feasible in communities on islands with high solar irradiation; namely, Santiago, Sao Vicente and Sal, where 160, 90 and 53 possible areas for solar installations were identified, respectively, in a study undertaken by UNIDO and ECREEE.[139]

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 28** presents the estimated annualized cash market potential for off-grid solar productive use applications.

Table 28: Indicative Total Cash Market Potential for Productive Use Sector[140]

Productive Use Sector		Units	kW Equivalent	Cash Value (USD)
SME Applications for Village Businesses	Microenterprises	337	84	$210,500
Value-added Applications	Irrigation	8,194	983	$5,326,389
	Milling	1	4	$10,363
	Refrigeration	43	235	$587,125
	Subtotal	8,238	1,222	$5,923,877
Connectivity Applications	Phone Charging	270	108	$232,985
TOTAL		**8,845**	**1,414**	**$6,367,362**

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.[141] For ECOWAS countries, independent power generation via fossil fuel powered generators is especially prevalent.[142]

The FGD identified several opportunities for utilizing solar such as supporting the fishing economy, agriculture and tourism. Nonetheless, since Cabo Verde has a high electrification rate and small population, the opportunities for scaling the productive use of off-grid solar are relatively limited.

[138] Cabo Verde: Multi-Sector Market Study Focused on Tourism Value Chain Development, Netherlands Enterprise Agency (2017): https://www.rvo.nl/sites/default/files/2017/08/Cape%20Verde%20Multi-Sector%20Market%20Report_Focus%20Tourism_pub.pdf
[139] "Promoting Market Based Development of Small to Medium Scale Renewable Energy Systems In Cape Verde: Energy Analysis and Recommendation," UNIDO and ECREEE: http://www.ecreee.org/sites/default/files/unido-ecreee_report_on_cape_verde.pdf
[140] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[141] 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
[142] Ibid.

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.[143]

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 210,500 (**Table 29**).

Table 29: Estimated Cash Market Potential for SMEs – Barbers and Tailors[144]

No. of SMEs with Constrained Access to Finance[145]	Units	kW Equivalent	Cash Value (USD)
1,684	337	84	$210,500

Source: World Bank; African Solar Designs analysis

[143] 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

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

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

- **Value-Added Applications**

Nearly half of Cabo Verdeans live on the main island of Santiago where there are three main livelihood zones.[146] Despite the country's heavy reliance on imported food, most of the population living in these zones practice agricultural production on rain-fed land and keep livestock. Irrigation is mostly done through flood or drip irrigation systems whereby farmers pay for the water and payment is determined by the type of irrigation practiced. According to the World Bank livelihoods assessment, zone 2, which consists of vegetables, banana and papaya for livelihoods, holds the highest potential for agricultural development compared to zones 1 and 3, whose activities involve production of maize, beans, fishing and livestock rearing.

Agricultural practices, especially for smallholder farmers, would benefit from a wide number of off-grid solar technologies. 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 focuses instead on a small-scale private sector driven approach and estimates the market potential for off-grid solar pumping systems to support smallholder farmers.

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 30 presents the estimated annualized off-grid solar cash market potential for smallholder value-added solar irrigation applications in Cabo Verde, which has an estimated cash value of USD 5.3 million (see **Annex 2** for more details).

Table 30: Estimated Cash Market Potential for Value-Added Applications – Irrigation[147]

Estimated No. of Smallholder Farms Suitable for OGS Pumping for Irrigation	Units	kW Equivalent	Cash Value (USD)
49,167	8,194	983	$5,326,389

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

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.

[146] Zone 1: Maize, Beans and Livestock Livelihood; Zone 2: Vegetables, Banana and Papaya; Zone 3: Fisheries, Goats and Pigs

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

Table 31 presents the estimated annualized off-grid solar market potential for smallholder value-added solar grain milling applications in Cabo Verde, which has an estimated cash value of USD 10,363 (see **Annex 2** for more details).

Table 31: Estimated Cash Market Potential for Value-Added Applications – Milling[148]

Estimated No. of Solar Mills	Units	kW Equivalent	Cash Value (USD)
13	1	4	$10,363

Source: Food and Agriculture Organization; African Solar Designs analysis

Solar Powered 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 32** presents the estimated annualized off-grid solar market potential for smallholder value-added solar refrigeration applications in Cabo Verde, which has an estimated cash value of USD 587,125 (see **Annex 2** for more details).

Table 32: Estimated Cash Market Potential for Value-Added Applications – Refrigeration[149]

Off-Grid Market Centers	Units	kW Equivalent	Cash Value (USD)
854	43	235	$587,125

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/ICT Applications**

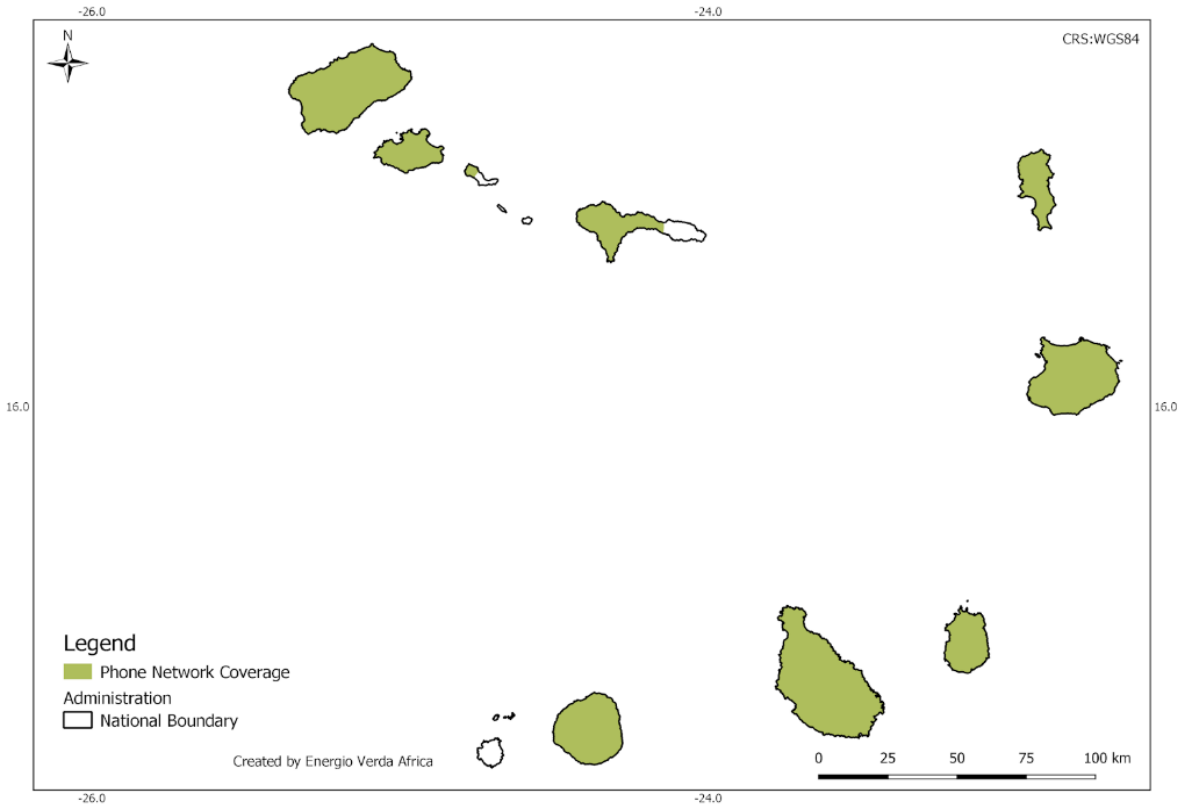
Cabo Verde boasts a very high penetration rate for mobile phone and internet usage (67%).[150] Hence, off-grid solar can support the electrification of telecommunications towers more so than through phone charging due to the high level of grid electrification. Nonetheless, the Government has prioritized efforts to lower ICT costs in the country.[151] The increased deployment of solar PV for telecommunications tower electrification may also serve to contribute to the lowering of consumer costs.

Figure 23 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

[148] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[149] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[150] The Mobile Economy Sub-Saharan Africa 2017: https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download
[151] "Cape Verde Country Strategy Paper: 2014-2018," African Development Bank: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2014-2018_-_Cape_Verde_Country_Strategy_Paper__Draft_Version_.pdf

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 23: Mobile Phone Network Geographic Coverage[152]



Source: GSMA

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 33** presents the estimated annualized cash market potential for off-grid solar mobile phone charging enterprises in Cabo Verde, which has an estimated cash value of USD 232,985 (see **Annex 2** for more details).

Table 33: Estimated Cash Market Potential for Mobile Phone Charging Enterprises[153]

Mobile Subscribers[154]	Rural Population (%)[155]	Units	kW Equivalent	Cash Value (USD)
400,000	45.1%	270	108	$232,985

Source: GSMA; World Bank; African Solar Designs analysis

[152] See **Annex 2** for more details
[153] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[154] "The Mobile Economy: Sub-Saharan Africa," GSMA, (2017): https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download
[155] World Bank: Rural Population (% of total population) https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS

2.3.3 Ability to Pay and Access to Finance

Increased financial and entrepreneurial education, the promotion of diaspora engagement and increased linkages with the quickly expanding tourism industry would greatly support the scaling of successful investments in productive use applications in Cabo Verde.[156]

With regard to microenterprises, further study would need to be done to determine the effect of off-grid appliances (especially those analyzed – phone charging, barbers and tailors) on incomes, and therefore affordability, and particularly how finance can support efforts to overcome the challenge of the isolation of Cabo Verde's various communities to access to finance. Importantly, due to the country's high mobile penetration rate, PAYG solutions may be well-suited to enable financing of PUE appliances.

[156] "Investment Policy Review: Cabo Verde," United Nations Conference on Trade and Development, (2018): https://unctad.org/en/PublicationsLibrary/diaepcb2018d2_en.pdf

2.4 Supply Chain

This section reviews the off-grid solar supply chain in Cabo Verde, 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 34**.

Table 34: 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

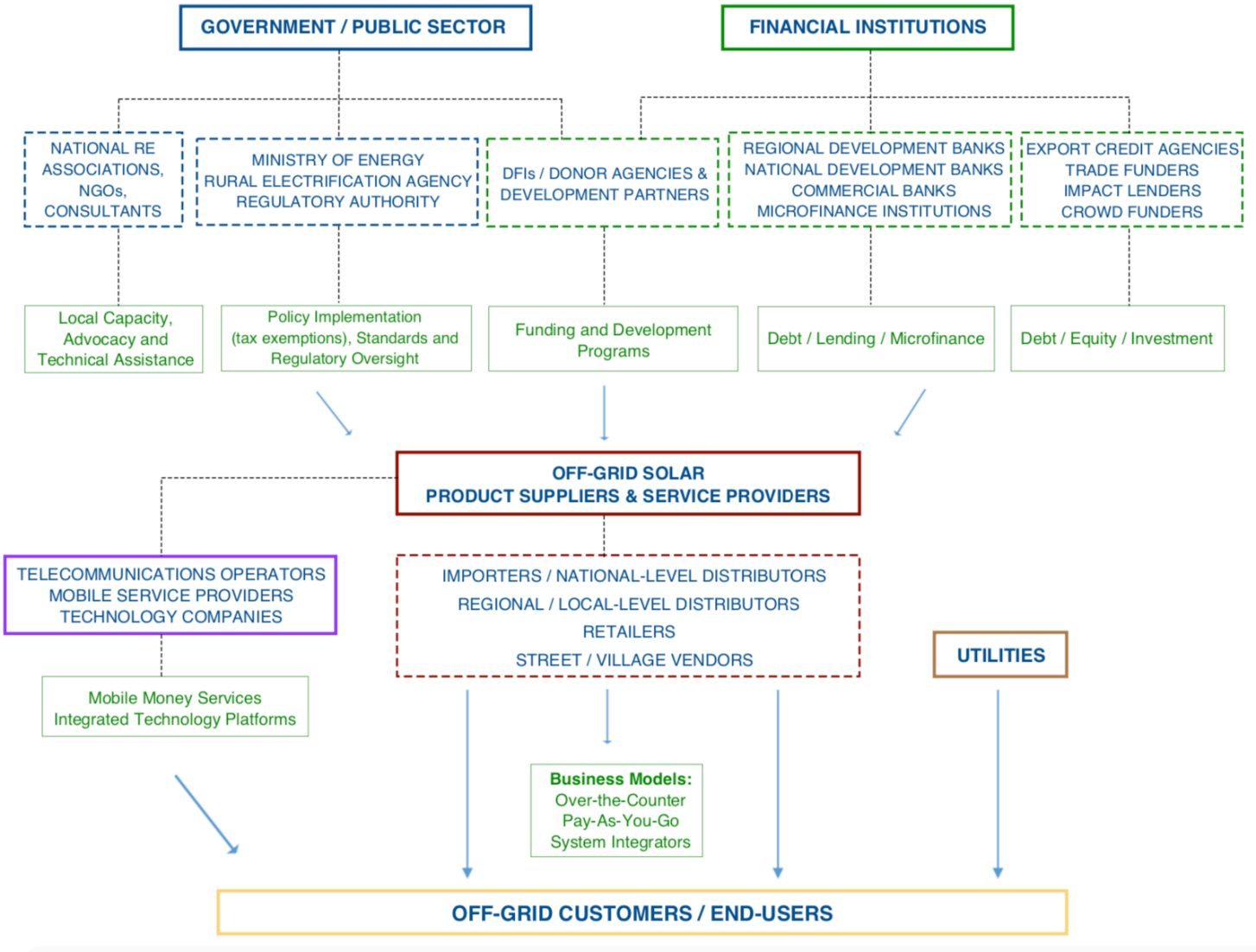
2.4.1 Overview of Commercial Market for Solar PV Equipment

A typical off-grid solar supply chain is made up of a range of stakeholders – importers, distributors, wholesalers, retailers, NGOs, and end-users (**Figure 24**). In Cabo Verde, the supply chain is smaller due to the country's relatively high rate of electrification and corresponding low levels of demand for OGS products. In general, given low demand, opportunities for the market to grow are somewhat limited to households and businesses upgrading to stand-alone solutions.

The overall market environment and opportunity for solar companies in Cabo Verde is favorable. A limited range 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 being utilized. Large institutional clients, international development agencies, donors and NGOs, and private sector businesses make up the main market for off-grid lighting products in the country. The last few off-grid areas in the country where grid development is not feasible are a key source of demand for OGS products. Nevertheless, urban households, both electrified and non-electrified, may also be a noteworthy consumer market, as they tend to have greater ability to afford OGS products and systems.

To date, most stand-alone solar projects in the country for public institutions and/or in rural areas have been financed by international development funds, donor agencies and GoCV electrification projects. Very few solar companies are actively deploying OGS systems to households in the country. Surveys of local industry players and focus group discussions noted that a clear implementation of duty exemption and further reduction of taxes would be necessary to offer more affordable systems to customers, while increased awareness would help to develop further the OGS market.

Figure 24: Off-Grid Solar Supply Chain Overview



Source: GreenMax Capital Advisors

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.

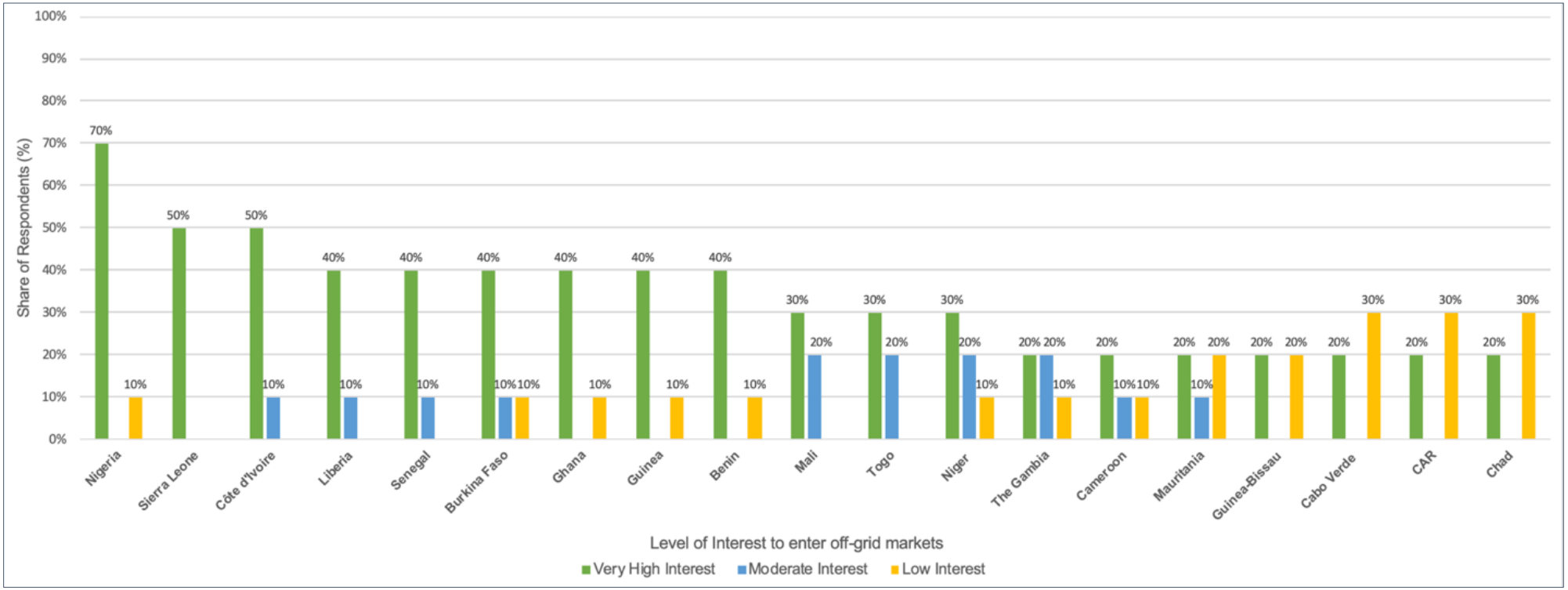
Market entry into Africa began in East Africa for a majority of the leading companies, a trend that can be attributed to advancements in mobile money transfer systems such as M-Pesa that have facilitated the PAYG off-grid business model. As the East African market becomes more crowded and mobile money 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 25**. 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.

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



Source: GreenMax Capital Advisors analysis; Stakeholder interviews

[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 Cabo Verde

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**

Focus groups and stakeholder interviews identified a total of 24 companies operating in Cabo Verde's solar sector (see **Annex 2** for a complete list of identified companies). Focus group participants named Atlantic Renewable Energy Solutions (ARES), GTeK, Lobosolar, CV-Energias Renovavéis, Prosol, Repower, Solar Boundless World Solutions (SBWS) and Speedsun as the most active and experienced companies in the market.

Despite being limited in the scale of their operations due to the country's size and geography, these companies provide a range of quality solar products and professional services to consumers across the main islands. Companies mostly sell multiple modular systems and very large solar systems. Household demand is relatively limited due to low purchasing power and high on-grid connectivity across the country.

Most companies work with larger institutional clients, either through GoCV on donor-funded projects, associations, municipalities, partner NGOs, and sometimes provide private companies with lighting (business offices, restaurants etc.) and water pumping (e.g. Repower for irrigation in the islands of Santiago, Fogo and Antão). GTeK, Lobosolar, ARES, SBWS, and Repower sell single modular systems for households. Lobosolar and GTeK sell pico solar products, although this does not represent a significant share of business. While some firms are specialized in the solar industry (Lobosolar CV-Energias Renovavéis, Boundless World Solutions), others operate in other renewable energies as well (e.g. ARES offering in wind, biomass, and hydrogen solutions; GTEK wind and hydraulic solutions).

Many locally-based solar companies have strong ties to Europe – GTeK was started by two German engineers; SBWS is based in the Netherlands; Speedsun is based in Portugal and Lobosolar is a subsidiary of Portuguese Lobo Group. ARES, GTeK, Lobosolar and SBWS are manufacturer representatives and distributors of European brands such as Open Renewables, SMA, Sikla, Grundfos etc. (**Table 35**).

Most companies design, operate and maintain systems for their clients, offering after-sales services. Companies typically do not offer consumer financing to their customers. Several of the interviewed firms indicated that they have access to external sources of financing, including bank loans and grants, while others are self-financed.

- **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. The DNICE, however, is carrying out ongoing field work to estimate the size of the market as part of the agency's electrification planning. Given the country's geographic configuration, combined with the high level of connectivity (and low demand for off-grid solar products), it is safe to assume that Cabo Verde represents one of the smaller markets in the West Africa and Sahel region.

- **Main Solar Products and Components**

Table 35 lists the brands of common solar products and components in Cabo Verde.

Table 35: Off-Grid Solar Products and Components in Cabo Verde

Systems	**Companies**
Distributors of Pico Solar Lanterns	GTeK, Lobosolar, ARES
Single Module distributors	GTeK, Lobosolar, ARES, Solar Boundless World Solutions, Repower
Multi module system distributors	Lobosolar, Speedsun, GTeK, Repower
Very large system supplier	Lobosolar, Speedsun, GTeK, ARES, Solar Boundless World Solutions
Products/Components	**Brands**
Pico solar lanterns	Black Out Bulb, Ampersun
Solar modules	Open Renewables, Aztech, AmeriSolar, Stion (USA), Cencorp MWT
Structure for panels	Sikia
Inverters	SMA, Fronius, Victron, Pico, Costal, Effekta APC (Germany, EUA)
Lead Acid Batteries	Powerballs, Iskra, BAE (dry battery), OPEC (dry battery)
Battery controller	Victron
Solar Water Pumps	Grundfos, Lorentz

Source: Stakeholder interviews

- **Market Prices**

Table 36 presents average prices for systems and components in Cabo Verde's solar market.

Table 36: Estimated Prices of Solar Components in Cabo Verde

Off-Grid System / Component	**Price range (USD per unit)**
Solar Module (130Wp-250W)	$90-$220
Inverter (2,400W)	$1,280-$1,600
Lead Acid Battery (200Ah)	$317-$450

Source: Stakeholder interviews

- **Importation Clearance Processes**

Feedback from focus group participants indicated that there is a tax exemption on all renewable energy equipment in Cabo Verde, including on off-grid solar products, based on Decree – Law 1/2011. While this regulation benefits solar companies, stakeholders also noted that these provisions require more careful administration, as they are not applied adequately and effectively, with certain exemptions not always applied and certain products not covered (e.g. ecological fee on batteries). Furthermore, off-grid solar providers indicated that these provisions apply mostly to mini-grid equipment, while stand-alone systems are not specifically regulated. While stakeholders did not express concern over the customs issues, some companies indicated that it takes about one month to import OGS products into the country.

2.4.4 Overview of Business Models

- **Company Approach to Market**

Solar companies in Cabo Verde have developed as integrated renewable energy companies focusing on mini-grid development and large institutional and donor clients. While all these companies have an excellent knowledge of the local market, some of them are specialized PV players, while other also work in the wind, biomass and hydraulic sectors. These companies are mostly based and operating on the main islands, while providing installation and periodic maintenance for the smaller islands. While GTeK and Lobosolar have longstanding experience in the country (Lobosolar has been in the industry since 2000), Repower and ARES have been operating in the solar sector for less than five years, and Prosol for fewer than three years.

- **Business Models**

There are two primary business models used in the market (**Table 37**), although, in reality, solar companies utilize a number of business models to reach essentially large institutional clients and to a lesser extend businesses and households:

- **Over-the-counter cash sales** is the dominant model to deal with private clients (households and businesses) in Cabo Verde. Formal sector solar companies also stock modules, batteries and balance of system and offer them over-the-counter to do-it-yourselfers and agents. In Cabo Verde, some companies do not have inventory (e.g. GTeK indicated that due to import taxes and low levels of demand they typically do not maintain local inventories of equipment).
- **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. Most companies in Cabo Verde utilize procurement to work with international donors, GoCV and NGOs.
- The **PAYG sector** is almost non-existent in Cabo Verde. Stakeholders indicated that PAYG is not typically utilized. In general, consumer finance is limited in Cabo Verde, as purchasing power is too low in off-grid areas to access bank financing. However, surveyed stakeholders indicated that microfinance, donor funding, loans for house construction and renovation are three alternative solutions more accessible to rural households.

Table 37: Overview of Off-Grid Solar Business Models

Business Model	Strategy and Customer Base	State of Development
Over-the-counter solar market	Companies are small-scale manufacturer representatives, wholesalers and retailers in Cabo Verde, operating in the main islands. They sell lighting/electrical products, solar home systems and also large panels for urban customers.	Mature commercial market
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
PAYG / Consumer finance	Consumer finance is not widely available in Cabo Verde, as PAYG is not typically utilized by off-grid solar companies.	Early stage commercial development

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

- **Company Financing**

Without sufficient financial assistance and dedicated financing mechanisms available for the off-grid sector, it can become difficult for companies to finance their operations, especially cash flow to build new inventory, high transportation and inventory costs, import fees on solar equipment and in some cases, irregularity of supply. Nevertheless, in Cabo Verde suppliers require moderate working capital to purchase equipment and cover field cost, compared to the rest of West African markets mostly due to Cabo Verde's small scale market. Distributors of international OGS products receive basic trade finance and marketing support options, though typically limited. Most of the firms surveyed in Cabo Verde are self-financed or have access to bank loans.

Feedback from focus group participants indicated that all solar companies are stable enough in Cabo Verde to self-finance an inventory increase if necessary. Cabo Verde's companies are also able to access bank financing, as they have sufficient collateral to request loans. They can make use of cash-flow/credit line financing against signed contracts with major commercial clients, large NGOs or donors. While FOREX risk was not specifically mentioned as a major issue, the lack of consumer finance impedes the development of residential pico solar and solar home systems market. Although access to finance was not mentioned as a key barrier to OGS market growth, additional sources of finance would help local solar companies build up inventory and off-set the high cost of importing products to the island nation.

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. Informal traders sell modules, inverters, batteries and pico-products. Given that informal sellers are largely unregulated and do not report sales figures, very little data is available on this sector. The informal sector, however, is not particularly influential in Cabo Verde, especially compared to other markets in the West Africa and Sahel region.

2.4.6 Equipment Quality and the Impact of Uncertified Equipment

Despite the presence of some informal traders who sell over-the-counter systems and components, the overall quality of solar products in the country is high. Nonetheless, 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, informal traders can 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.

2.4.7 Local Capacity to Manage Business Development, Installation and Maintenance

Cabo Verde's solar market would benefit from technical assistance (TA) and financial support. The market environment is challenging for solar companies, particularly given the country's unique geography. This complicates decisions that companies need to make about their operations, especially in relation to product imports and stocks of inventory given the long lead-time associated with shipping supply chain services. Companies also face a number of technical competency requirements – the selection of approaches and solar PV technologies, the design of their associated promotion instruments and the implementation of related initiatives. Local capacity to support solar PV market development, installation and maintenance was noted to be high in Cabo Verde, as most of the surveyed companies indicated that they have a sufficient number of qualified technicians to handle repairs. The main concern expressed by stakeholders was the fact

that OGS companies are all small-scale companies, due to the size of the market. As a result, one company alone would not be able to address a large-scale project (providing on-time and adequate services).

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 (but are not limited to) the following:

- 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.
- It may be difficult and costly to send solar technicians to islands for maintenance of systems. Training people based locally on islands to support O&M of 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 regulatory, financial, awareness and structural. The focus groups and supplier surveys found that:

- Exemption should be clarified and applied consistently to all off-grid solar products (including components, component-based systems), and regulation should include further provisions for household segment smaller systems.
- Local financing should be strengthened to support the sector's development, as some companies still do not have access to bank loans; as a result, 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.
- Low level of awareness and consumer low ability to pay were noted to be major challenges companies are facing. Most companies indicated that solar knowledge and sensitization is low in Cabo Verde. As a result, sales and marketing support, demonstrating alternatives to grid connection, would be the most appropriate to build up the sector.
- Cabo Verde's small market size and highly electrified population automatically reduce opportunities for off-grid solar players to grow. Untapped market is extremely limited in the country and further expansion will be driven by the few remaining off-grid areas and high-end urban consumers willing to upgrade electricity access for increased comfort.

Table 38 presents various areas of support and associated capacity building for the OGS supply chain in Cabo Verde. Attention should be given to the following:

- **Importers/Suppliers**: Reduce the cost of importing solar PV products and components must be a priority as most of the solar companies operating in Cabo Verde are Tier 1 firms that cannot afford to maintain a stock of inventory. Make financing available for importers and distributors to allow suppliers

to more easily stock and renew inventory. The way the market is currently structure inhibits their growth. Financing should be made available to end-users to enable purchase of OGS systems and build up minimum inventory.

- **Over-the-counter/ System Integrators**: Focus on growing the number of solar technicians who are adequately skilled to support the supplier network, especially on remote islands. 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.

Table 38: Capacity Building and Technical Assistance for the OGS Supply Chain in Cabo Verde[161]

Area of Support	Description	Rationale
Tax exemptions on solar technology	• Consistent and complete implementation of import duty and tax exemption on all solar products	• The cost of solar products is inflated by import duties/fees; these costs are passed on to customers, making solar less affordable.
Quality control/certification center	• Suppliers are able to effectively monitor the quality of products imported in Cabo Verde	• Ensure the quality of 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	• Increase awareness on alternative to on-grid electricity • 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 the 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	Solar companies: • 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	• Make the business environment more conducive and profitable • Strengthen the overall ecosystem surrounding the solar market • Strengthen capacity across the sector (vs having capacity centralized in the capital only) • Ensure knowledge transfer from abroad for faster, more cost-efficient progress

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

[161] 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 Cabo Verde, 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 39 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 39: Key Barriers to Off-Grid Solar Market Growth in Cabo Verde

Market Barrier	Description
Demand[162]	
High rate of electrification	• Cabo Verde has a very high rate of electrification and grid connected electricity is reliable; this limits the overall uptake of off-grid solar to the few remaining off-grid island communities and to urban households and businesses looking to transition to stand-alone solutions
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 • Consumers rather choose cheaper one-off solutions – like generators and fuel – rather than more expensive up-front solutions that will be cheaper long-term
A lack of understanding of and trust in solar solutions among consumers impedes development of the market	• There is still considerable 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. • Any poor history / track record with OGS will deter consumers from taking expensive risks
Supply	
Geographic constraints	• As an island nation, Cabo Verde's geography complicates decisions that companies need to make about their operations, especially in relation to product imports and stocks of inventory • Managing O&M is also extremely challenging if systems need to be maintained on remote islands (most companies are based on the capital island of Santiago)
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 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
Lack of data	• Although DNICE carries out field research to collect market data, there are no limited figures on the actual needs, actual usage or experience of off-grid consumers • The data for the private market players on the available opportunities is therefore constrained
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

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

2.5.2 Drivers of Off-Grid Solar Market Growth

Table 40 is a summary of the key drivers of OGS market growth in the country.

Table 40: Key Drivers of Off-Grid Solar Market Growth in Cabo Verde

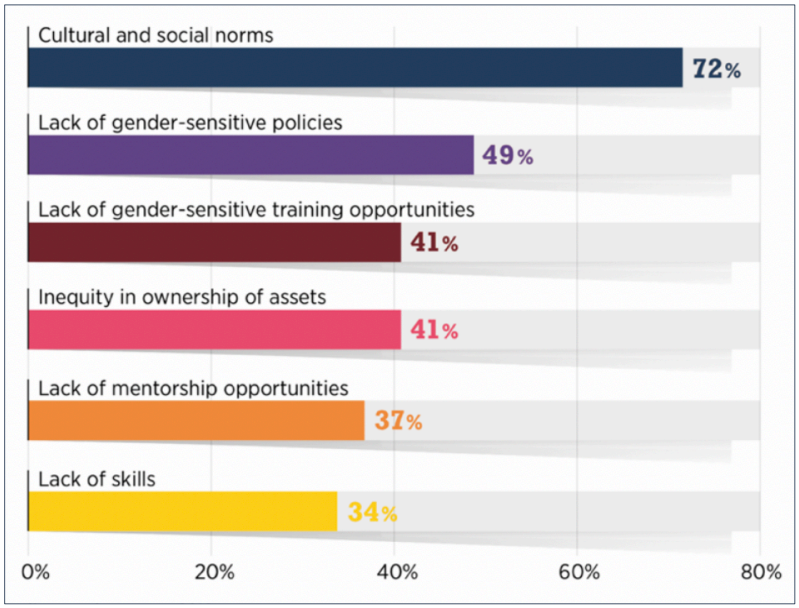
Market Driver	Description
Willing government to support the industry	• The Government is viewed by sector players as forward- leaning and action-oriented, creating and supporting momentum and positive attention for the solar sector, which helps attract substantial and sustained investment to the market. The GoCV has set a target to achieve universal electrification by 2030.
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
Engaged and open-minded private sector	• Local off-grid solar suppliers are actively engaged in efforts to improve / reform the sector, accept new business models and strategies and take measures to attract external investment

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

2.5.3 Inclusive Participation[163]

Given the relatively small size of the off-grid market in Cabo Verde, women are not highly engaged in the sector. The overall lack of inclusive participation in the off-grid space can be attributed 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 (**Figure 26**). 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.[164]

Figure 26: Key Barriers to Women's Participation in Expanding Energy Access



Source: International Renewable Energy Agency

[163] See **Annex 4** for more details.

[164] "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

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.[165] 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.[166]

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, technicians, and part time and full-time employees and entrepreneurs.[167] 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, the gender analysis undertaken in Cabo Verde found that women in the country face several interrelated challenges. Women are typically not part of key household decision-making processes, tend to have fewer opportunities in education and training, and often have more difficulty accessing financing.

A number of initiatives exist that seek to address some of these challenges and help improve the rate of participation among women in Cabo Verde's energy and off-grid sectors. At the national level, The GoCV has adopted several policies and action plans to promote gender equality. The regional policy aims to achieve this by securing the local support of a gender focal point in government to integrate gender into energy policies and by conducting gender audits of the sector (see **Section 1.2.2.5**).

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 Cabo Verde.[168]

[165] "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
[166] "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
[167] "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
[168] "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.[169]

- **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.[170]

[169] 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.

[170] 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

Cabo Verde's financial sector is large given the country's size and level of development, having benefited from a stable currency pegged to the euro. As of 2016, financial sector assets were estimated at 138% of GDP, while domestic credit was estimated at 86% of GDP.[171] The country has 28 authorized financial institutions (**Table 41**), comprised of asset management companies, commercial banks, microfinance institutions, insurance providers, exchange bureaus and service payment providers, all of which are supervised by the Central Bank of Cabo Verde (Banco de Cabo Verde, BCV). The GoCV has made progress in growing the country's financial sector infrastructure, including development of a primary market for government securities and corporate bonds, insurance companies and a credit registry.

Commercial banks are typically risk adverse and characterized by high levels of liquidity. In order to encourage bank lending, in 2018 the GoCV considered direct promotion of bank lending, including partial guarantees on loans to SMEs.[172] The financial sector is dominated by seven domestic commercial banks that hold 85% of the sector's total assets. Cabo Verde is also characterized by a significant off-shore banking sector (similar in size to the domestic banking sector) but with limited linkage to domestic banks and to the domestic economy.[173] The microfinance sector has a limited footprint in the country, mostly structured around non-profit organizations with financing from donor agencies.

Table 41: Licensed Financial Institutions in Cabo Verde, 2018[174]

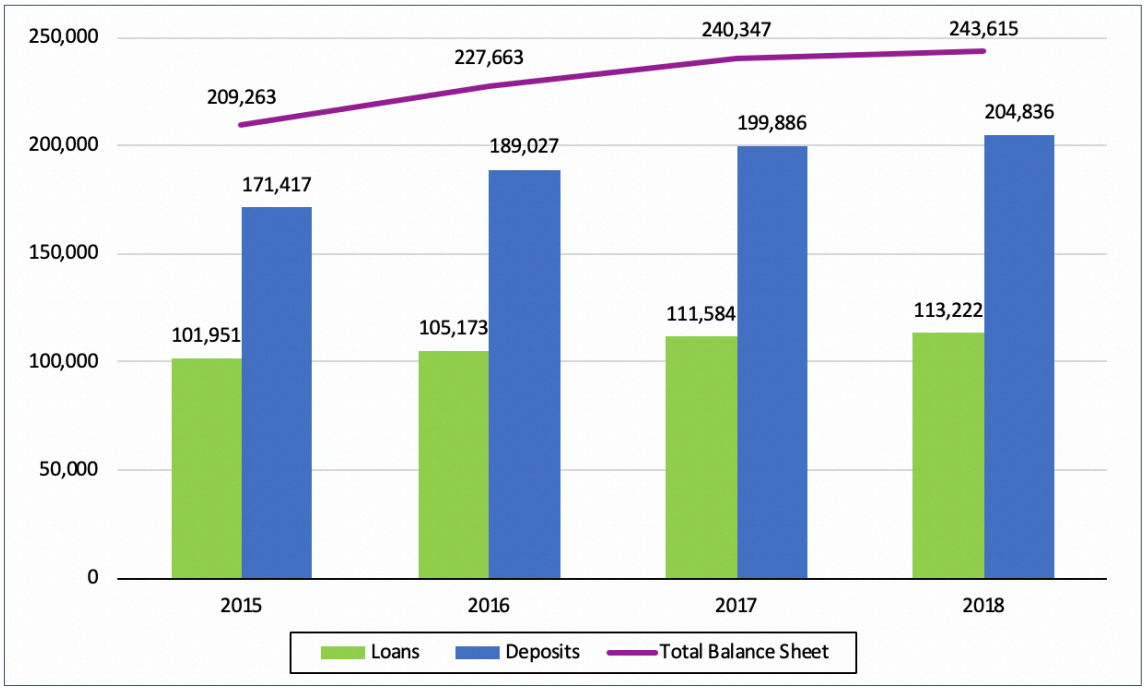
License Type	Number of FIs
Asset Management /Investment Companies	4
Exchange Bureaus/Forex Bureaus	2
Commercial Banks	11
Microfinance Institutions	5
Insurance Providers	5
Service Payment Providers	1

Source: Banco de Cabo Verde and World Bank

[171] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf
[172] "Cabo Verde: IMF Country Report No. 18/105," International Monetary Fund, (April 2018): https://www.imf.org/en/Publications/CR/Issues/2018/04/18/Cabo-Verde-Selected-Issues-Paper-45804
[173] Ibid.
[174] "Authorized Institutions," Banco de Cabo Verde, (2018): http://www.bcv.cv/vEN/supervision/informationonfinancialinstitutions/Paginas/EnderecosFAQs.aspx; and "Registered Microfinance Institutions," Banco de Cabo Verde, (2018): http://www.bcv.cv/vEN/supervision/supervisionofmicrofinance/registeredinstitutions/Paginas/Instituicoesinscritas.aspx

Of all the FIs in Cabo Verde, the commercial banking sector holds the largest share of total assets, loans and deposits (**Figure 27**).

Figure 27: Banking Sector Total Balance Sheet, Loans and Deposits (CVE million)[175]



Source: BCV

Table 42 shows the concentrated structure of the banking system along with the market shares of the largest banks in the country with respect to deposits and assets. As of 2018, the country's two largest domestic banks controlled nearly 70% of total assets.

Table 42: Market Shares of the Largest Banks in Cabo Verde, 2018[176]

Commercial Banks in Cabo Verde	Total Assets (%)
Top 2 Largest Banks	68%
Top 4 Largest Banks	80%
Other Banks	20%

Source: World Bank

[175] "Banking System Main Indicators," Banco de Cabo Verde, (September 2018): http://www.bcv.cv/vEN/Search/Pages/SearchResults.aspx?k=Banking%20Indicators

[176] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

- **Banking Industry Financial Soundness Indicators**

Table 43 provides a summary of commercial bank financial indicators as of FY 2017 in Cabo Verde.

Table 43: Banking Sector Financial Indicators

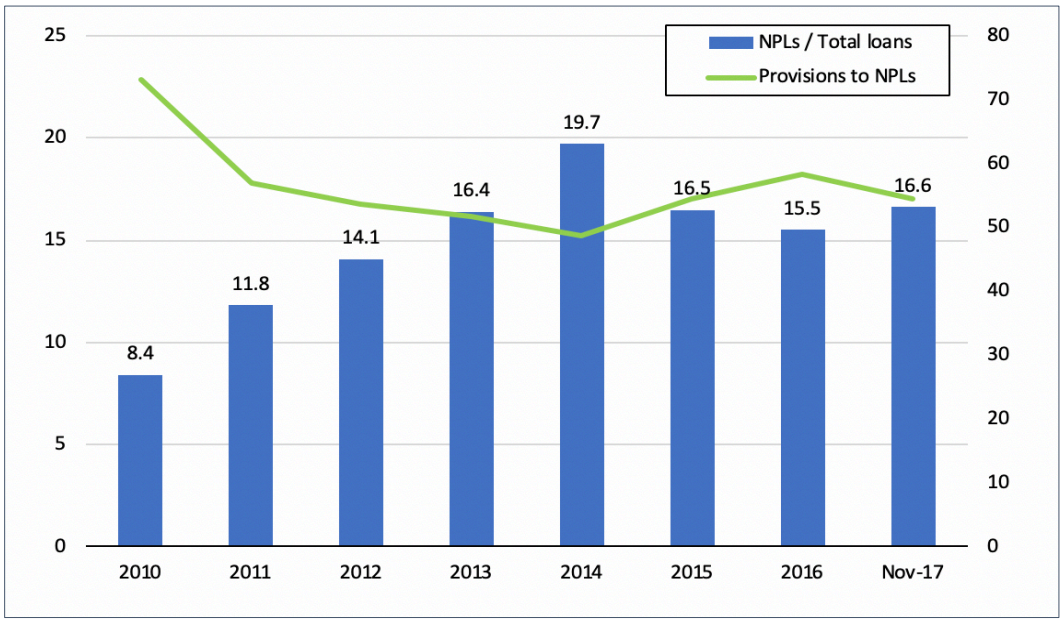
Indicator	2010	2011	2012	2013	2014	2015	2016	2017
Balance Sheet								
Total Assets (USD million)	-	-	-	-	-	2,073	2,178	2,603
Deposit Liabilities (USD million)	-	-	-	-	-	1,698	1,807	2,165
Total Loans (USD million)	-	-	-	-	-	1,010	1,006	1,208
Asset Quality								
Nonperforming gross loans (NPLs) / total loans (%)	8.4	11.8	14.1	16.4	19.7	16.5	15.5	16.6
NPLs net of provisions / capital (%)	17.1	40.2	47.9	53.5	62.8	49.4	45.5	50.8
Provisions to NPLs (%)	73.1	57.0	53.7	51.6	48.6	54.4	58.3	54.5
Liquidity								
Liquidity of assets to total assets (%)	8.1	7.1	15.0	22.1	30.3	30.3	32.6	30.8
Liquidity to short-term liabilities (%)	10.5	9.7	21.1	29.0	37.3	37.0	39.2	36.9
Capital Adequacy								
Risk-weighted capital to assets ratio (%)	12.8	15.2	14.2	15.1	15.6	16.2	15.5	16.9
Regulatory Tier 1 capital to risk-weighted assets (%)	13.0	15.9	13.9	13.7	14.4	15.0	15.5	15.7
Earnings and Profitability								
ROA - Return on assets, net income to average assets (%)	0.7	0.4	0.2	0.3	0.2	0.4	0.3	0.6
ROE - Return on equity, net income to average capital (%)	9.1	5.6	2.7	3.5	3.1	4.8	4.0	8.1
Interest margin to gross income (%)	76.1	76.2	75.5	75.3	71.8	73.1	76.7	78.9
Non-interest expense to gross income (%)	67.0	68.5	76.5	78.1	72.5	75.8	67.7	62.9
Additional Indicators								
Total credit over total deposits (%)	79.1	85.9	79.0	67.4	61.5	59.5	55.6	56.5
Personal cost over cost of operations (%)	49.0	49.9	50.1	48.4	54.8	56.6	58.8	58.6
Spread - 90 days lending / time deposit rate (%)	7.5	5.2	7.9	7.1	7.1	8.3	6.6	5.0

Source: IMF, *Source*: Banco de Cabo Verde

Assets-Based Indicators: Banks in Cabo Verde are faced with low asset quality due to economic downturn (2009-2015) and its impact on tourism and real estate.[177] As a result, non-performing loans (NPLs) increased to 16.6% of total loans at end-November 2017 from 8.4% in 2010 (**Table 43** and **Figure 28**). Real estate projects legacy loans during the period 200-08 still accounted for about 70% of NPLs' stock at end-September 2017. Excluding these real estate NPLs, total NPLs would be at about 6.0% of total loans. High-level of NPLs have a negative impact on credit growth and economic growth.

[177] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

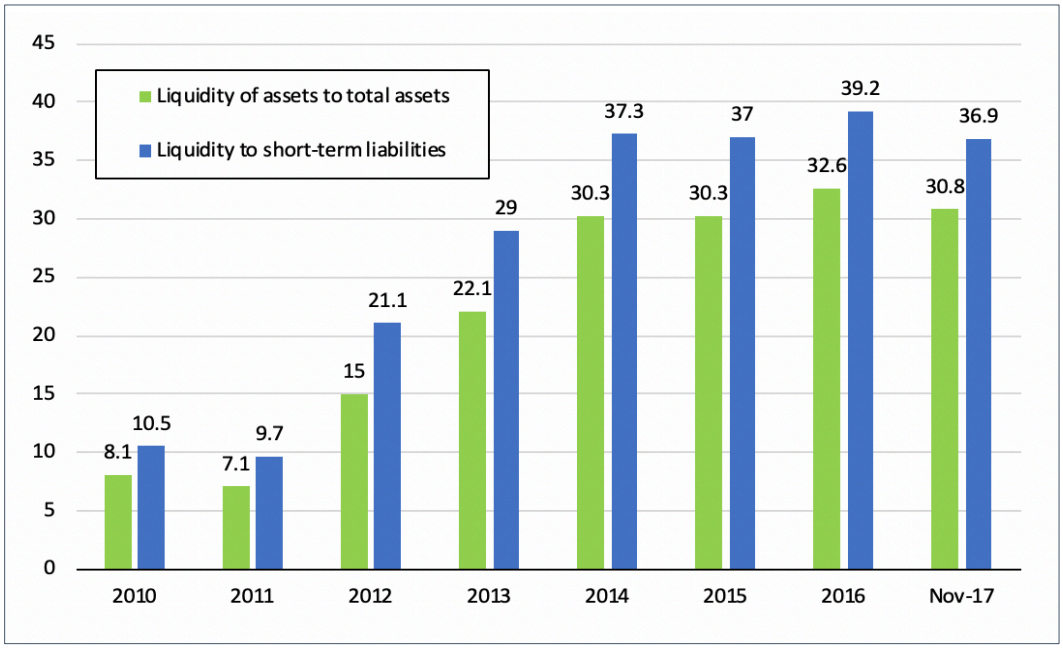
Figure 28: Banking Sector Non-Performing Loans (%)



Source: International Monetary Fund

Liquidity Indicators: The banking sector is characterized by high levels of liquidity, exceeding 10% of GDP in 2017 (**Table 43** and **Figure 29**).[178]

Figure 29: Banking Sector Liquidity Ratios (%)

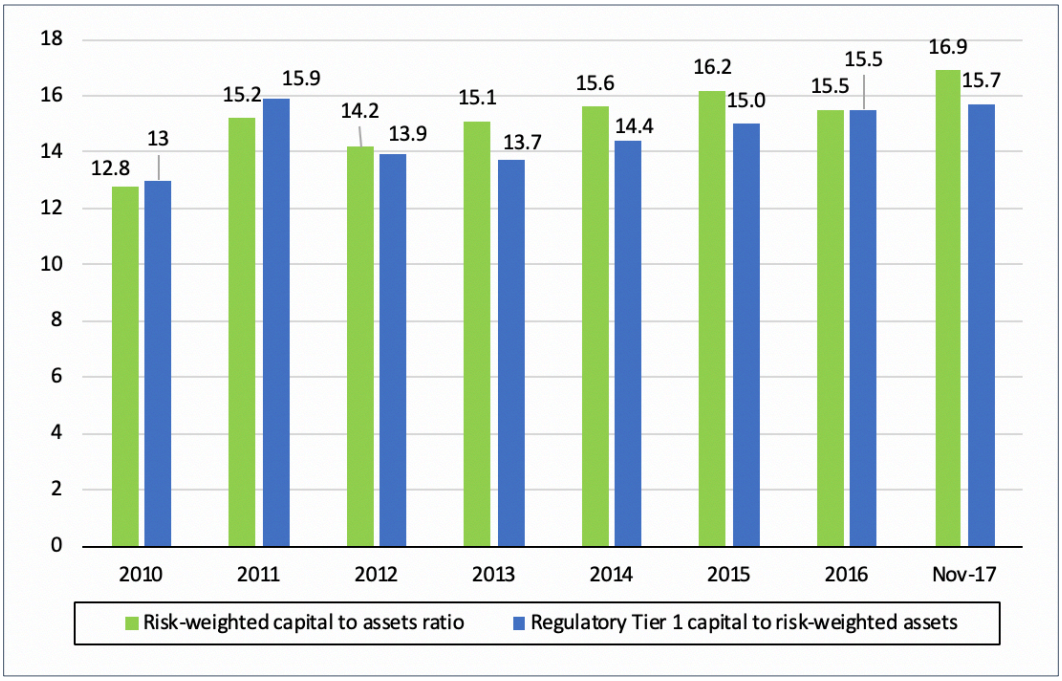


Source: International Monetary Fund

[178] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

Capital-Based Indicators: As of November 2017, the capital adequacy ratio (CAR), also called the solvency ratio, was above the minimum capital requirement of 10% and increased to 16.9% from 12.8% in 2010 (**Table 43** and **Figure 30**). However, in the event of default by the largest debtors – taking into account the high exposure to a small number of counterparts – banks would experience losses and would not meet the minimum regulatory capital requirements.[179]

Figure 30: Banking Sector Capital Adequacy Indicators (%)



Source: International Monetary Fund

Income and Expense-Based Indicators: As of November 2017, profitability and efficiency remain low, with return on assets (ROA) and return on equity (ROE) ratios at 0.6% and 8.1%, respectively (**Table 43**). Cabo Verde's banking system has high operation costs; in November 2017, non-interest expense to income and personal cost over cost of operations ratios were at 62.9% and 58.6%, respectively (**Table 43**). These high costs reflect inefficiencies in capital allocation (also reflected by the country's high levels of NPLs and liquidity), as well as the fact that bank branches operate on small archipelago islands, which makes economies of scale difficult.[180]

- **Distribution of Credit by Sector**

In Cabo Verde, 20% of net domestic credit was credit to the Government, while the remaining 80% was credit to the economy. Credit to the economy (i.e. credit to the private sector and credit to public enterprises) increased from 76% to 80% of total net domestic credit over the period 2014-2017. Credit to the economy slowed considerably in the aftermath of the global and European financial crises, decreasing from about 18% average annual growth over the period 2007-2011 to 0.6% between 2012 and 2014, before increasing again in 2016-2017, when credit to the economy grew by 5.1% (annual increase).

[179] IMF Country Report No. 18/105, 2018.

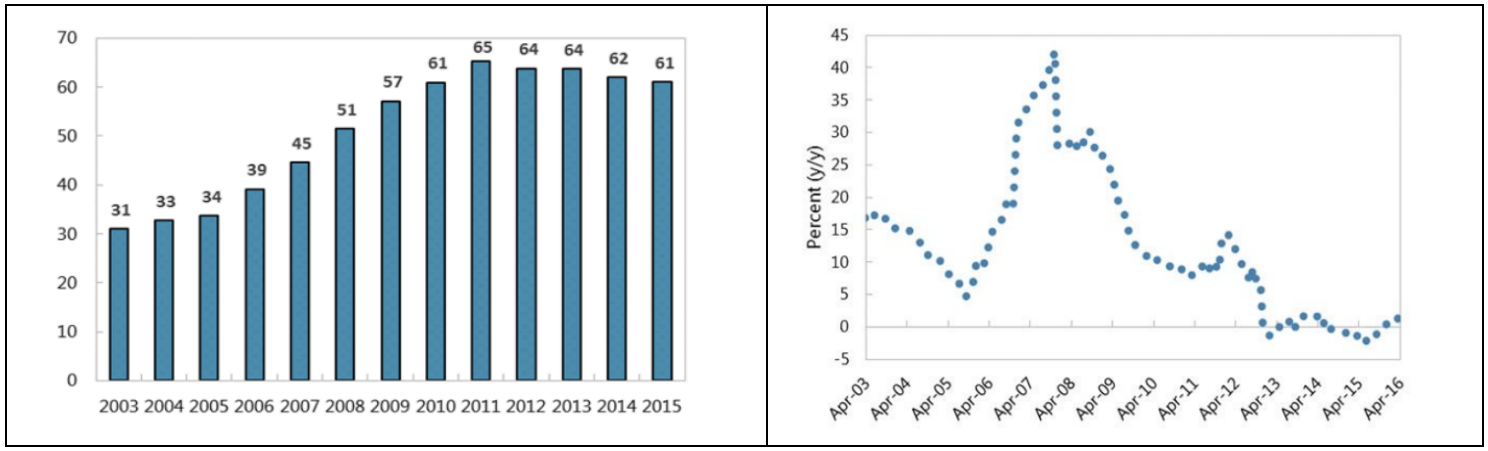
[180] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

Private sector credit accounted for 61% of nominal GDP in 2015, compared to 45% in 2007 and 31% in 2000. Private sector credit growth peaked to over 40% in 2007 but then dropped significantly before rebounding slightly in 2015 (**Figure 31**). Several factors explain this declining trend, including rising operating costs and NPLs, as well as reduced profit margins and increased perception of risks, which have discouraged banks from lending.[181]

In 2015, private sector credit was divided about evenly between consumer and business loans (**Figure 32**). The proportion of business loans increased progressively from 35% in 2005 to 50% in 2015. Trade and services represented about 60% of business loans, followed by transportation and manufacturing (19% and 11% respectively). Consumer housing loans accounted for about 70% of total consumer credit in 2015. Credit to the private sector remains highly concentrated in the construction and housing sectors and in real estate and tourism businesses (**Figure 33**).[182]

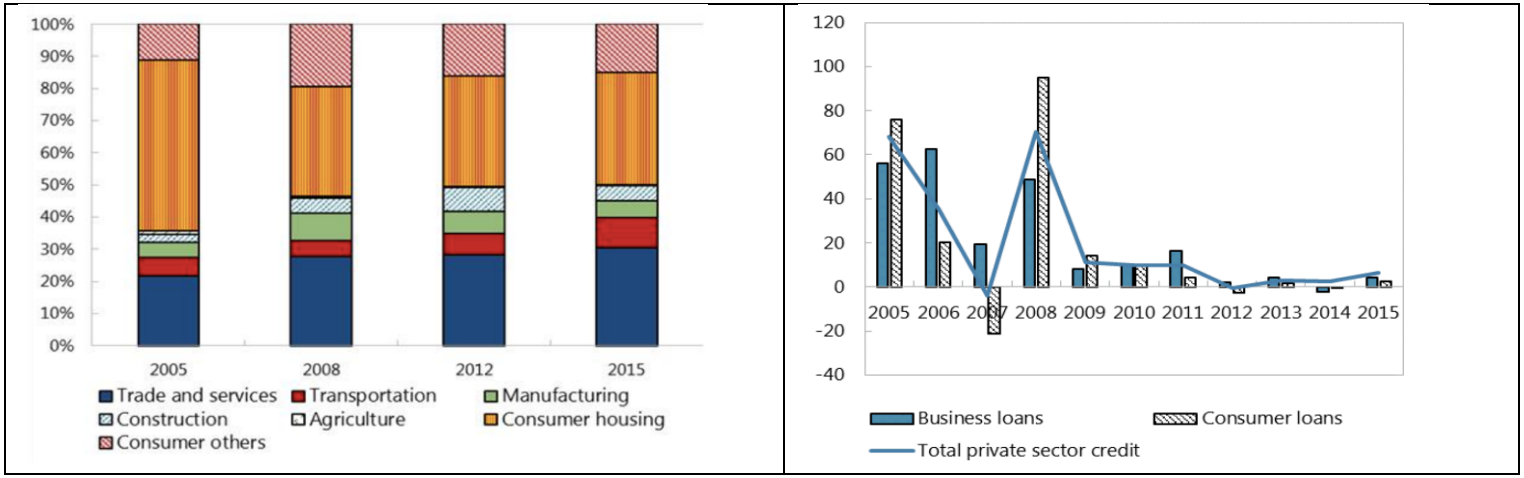
[181] "Cabo Verde: IMF Country Report No. 16/367," International Monetary Fund, (November 2016): https://www.imf.org/external/pubs/ft/scr/2016/cr16367.pdf
[182] Ibid.

Figure 31: Private Sector Credit – Share of GDP and Annual Growth (%)[183]



Source: International Monetary Fund

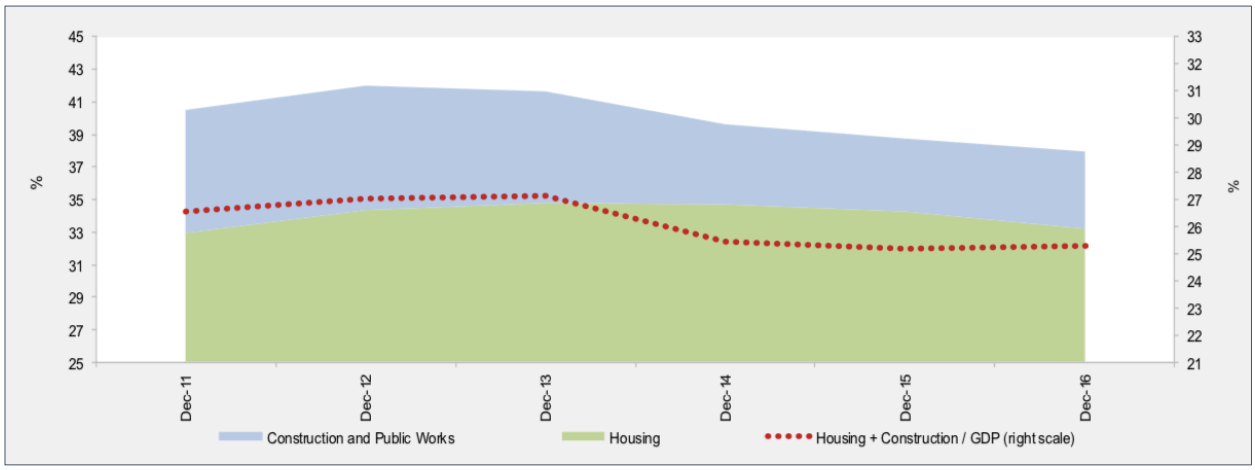
Figure 32: Distribution of Credit to the Private Sector (%)



Source: International Monetary Fund

[183] "Cabo Verde: IMF Country Report No. 16/366," International Monetary Fund, (November 2016): https://www.imf.org/external/pubs/ft/scr/2016/cr16366.pdf

Figure 33: Bank Exposure to the Construction and Housing Sectors[184]



Source: BCV

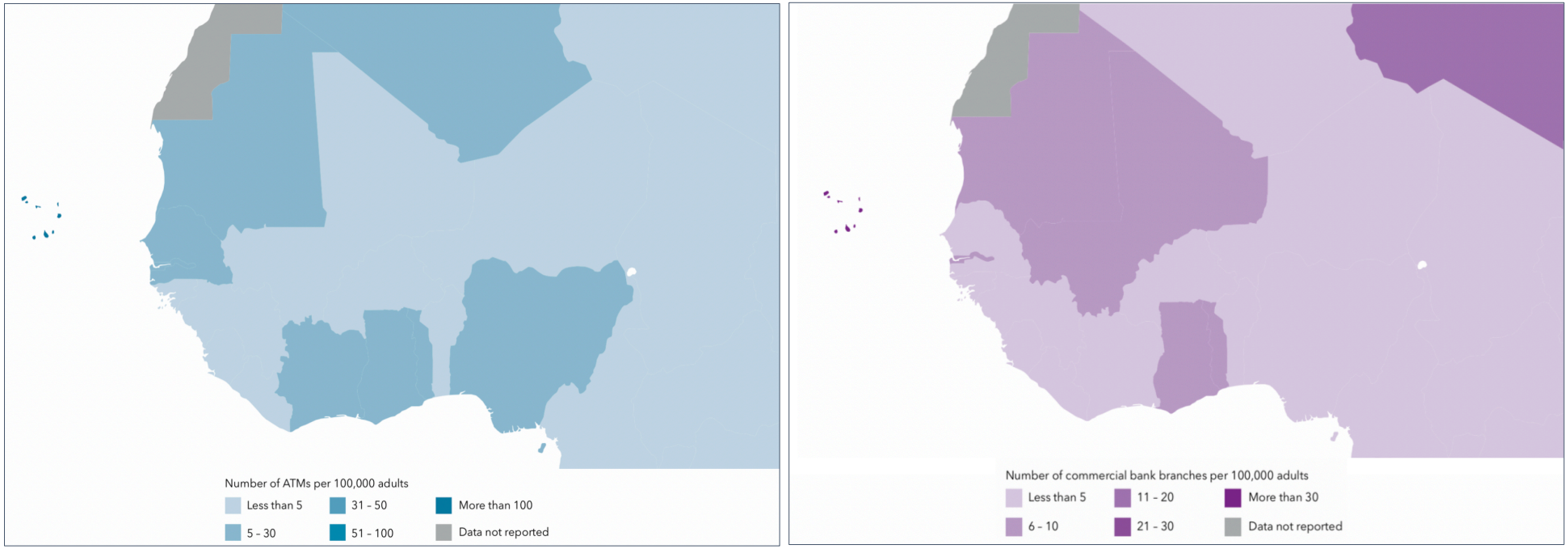
3.2.2 Financial Inclusion

- **Access to Financial Services**

Cabo Verde has made significant progress in developing the formal financial sector and expanding geographic coverage of commercial banks and access to financial services across all islands. Data from the World Bank indicates that financial inclusion is almost universal, with 98% of adults in Cabo Verde able to access basic financial services for depositing, savings and transaction payments. Cabo Verde's level of financial intermediation is very high compared to other countries in the West Africa and Sahel region (**Figure 34** and **Table 44**).

[184] "Financial Stability Report 2017," Banco de Cabo Verde, (2017): http://www.bcv.cv/SiteCollectionDocuments/2019/2017_REF_vEN.pdf

Figure 34: ATMS and Branches of Commercial Banks per 100,000 Adults in West Africa and the Sahel, 2017[185]



Source: International Monetary Fund

Figure 34 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.

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

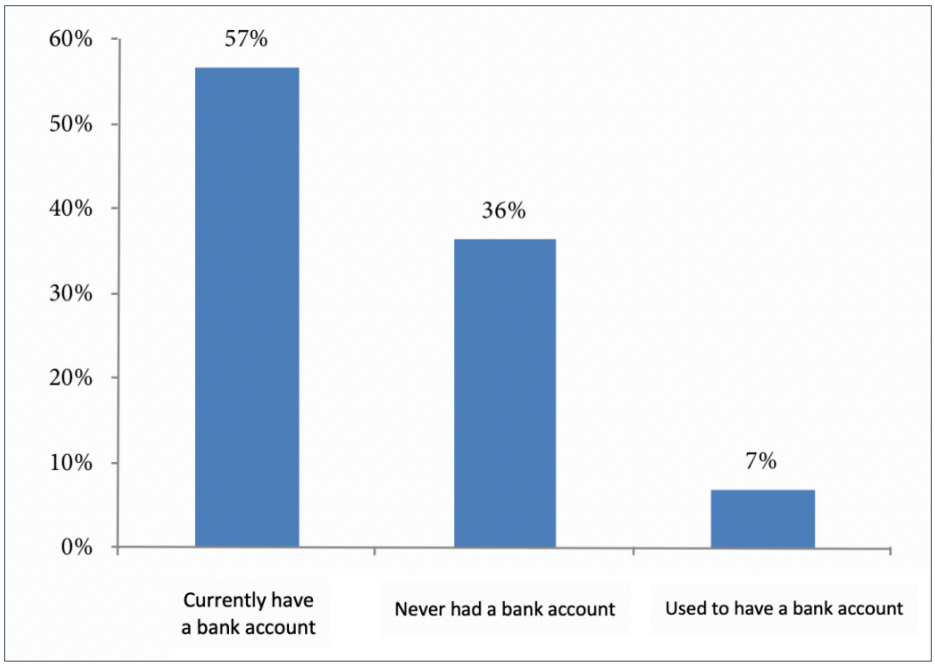
Table 44: Access to Financial Services[186]

Indicator	2014	2015	2016	2017
ATMs	171	169	171	179
ATMs per 100,000 adults	47.5	46.1	45.7	46.9
Branches of commercial banks per 100,000 adults	33.9	33.8	33.4	31.2
Depositors with commercial banks per 100,000 adults	1,778	1,861	1,847	2,051
Borrowers at commercial banks per 100,000 adults	155	189	183	154

Source: International Monetary Fund

A survey conducted by the BCV in 2015 found that about two-thirds of respondents either had or used to have a bank account (**Figure 35**).

Figure 35: Financial Institution Account Ownership in Cabo Verde, 2015[187]



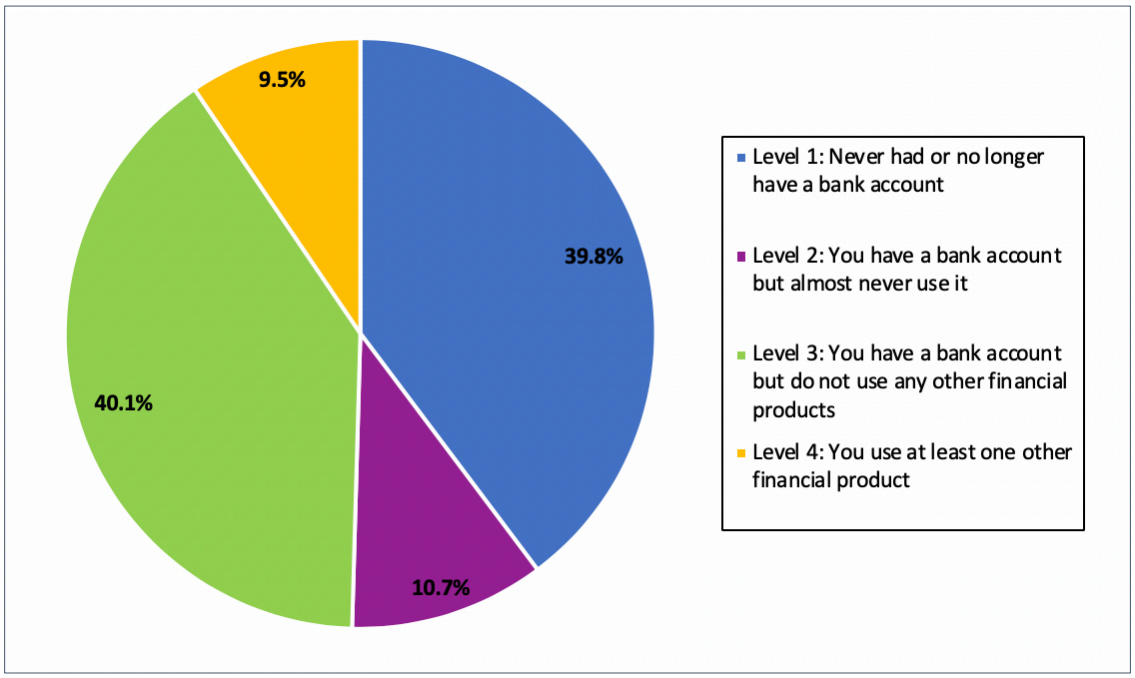
Source: BCV

The survey also found that 40.1% of respondents who had a bank account used it regularly but did not use any other financial products, while only 10.7% of respondents utilized at least another financial product in addition to their bank account (**Figure 36**). Three-quarters of respondents without a bank account indicated that lack of sufficient income was the main reason for not using bank accounts. Of the respondents who did not have a bank account, 56% were women.

[186] IMF – Financial Access Survey: http://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C&sId=1460043522778

[187] "Inquérito à Literacia Financeira da População Adulta Activa Cabo Verde," Banco de Cabo Verde, (2016): http://www.bcv.cv/vPT/Consumidores/operacoescambiaisesobreoouro/Documents/2016/Relat%C3%B3rio_%20Inqu%C3%A9rito%20sobre%20o%20nivel%20de%20literacia%20financeira.pdf

Figure 36: Levels of Financial Inclusion in Cabo Verde, 2015



Source: BCV

In an effort to boost financial inclusion, in 2017, the GoCV took steps to increase liquidity in the country's microfinance sector by subsidizing interest rates on commercial bank credits to MFIs by 50% for a total amount of up to CVE 100 million (USD 1 million) for each MFI.[188]

In 2018, the World Bank launched the USD 15 million Access to Finance for Micro, Small and Medium Enterprises (MSMEs) Project (2018-2023). The objective of this project is to improve access to credit for creditworthy MSMEs that are unable to grow their business due to a lack of finance. The two main activities under this project include the implementation of a partial Credit Guarantee Fund to enhance MSME financing as well as to fund technical assistance provided to these enterprises. Women-led enterprises in particular will benefit from this guarantee facility, with a target of 330 guarantees for women-led enterprises (out of 1,100 enterprises in total), 75 first time borrower women-led enterprises (out of 250 enterprises), 50 women-led enterprises benefiting from technical assistance (out of 100 enterprises).[189]

- **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.[190]

[188] "Micro-creditos. Governo e bancos comerciais abrem linha de credito de 100 mil contos," Santiago Magazine, (2017): http://www.santiagomagazine.cv/index.php/economia/514-micro-financa-governo-e-bancos-comerciais-abrem-linha-de-credito-de-100-mil-contos

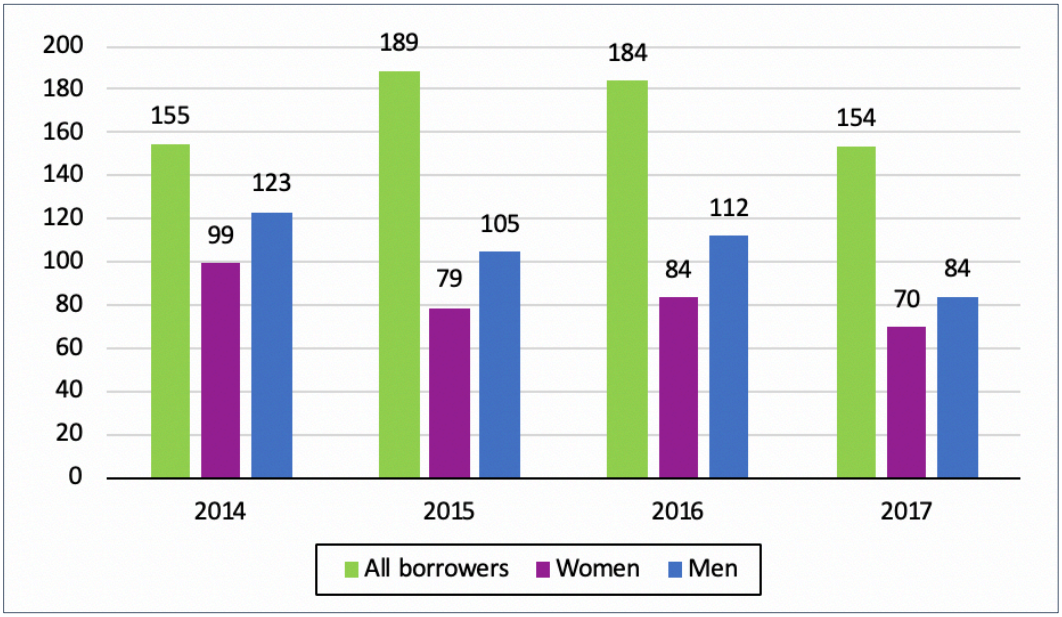
[189] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

[190] 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

Cabo Verde ranks among the more advanced markets in Africa vis-à-vis financial inclusion for women. The country ranks high in several categories of the AfDB Gender Gap Index: it is 5th among low-middle income countries, 6th in sub-Saharan Africa, and 36th out of 144 countries worldwide. Nonetheless, while Cabo Verde ranks highly in three of the four areas of the index – education, healthcare and political representation – it ranks poorly (115th) in the fourth area – economic participation and opportunity.[191] Female economic activity is characterized by informal trade with comparatively limited access to financial services.

In 2017, there were 70 female borrowers per 1,000 adults compared to 84 male borrowers (**Figure 37**), and 857 female depositors per 1,000 adults compared to 970 men and (**Figure 38**). Based on the Gender Equality Action Plan (2011-2022), the GoCV and international donors are focusing on entrepreneurship and economic empowerment programs targeting inclusive participation for women.[192] The World Bank Access to Finance for MSMEs program includes a gender component.

Figure 37: Gender Gap – Borrowers per 1,000 Adults[193]



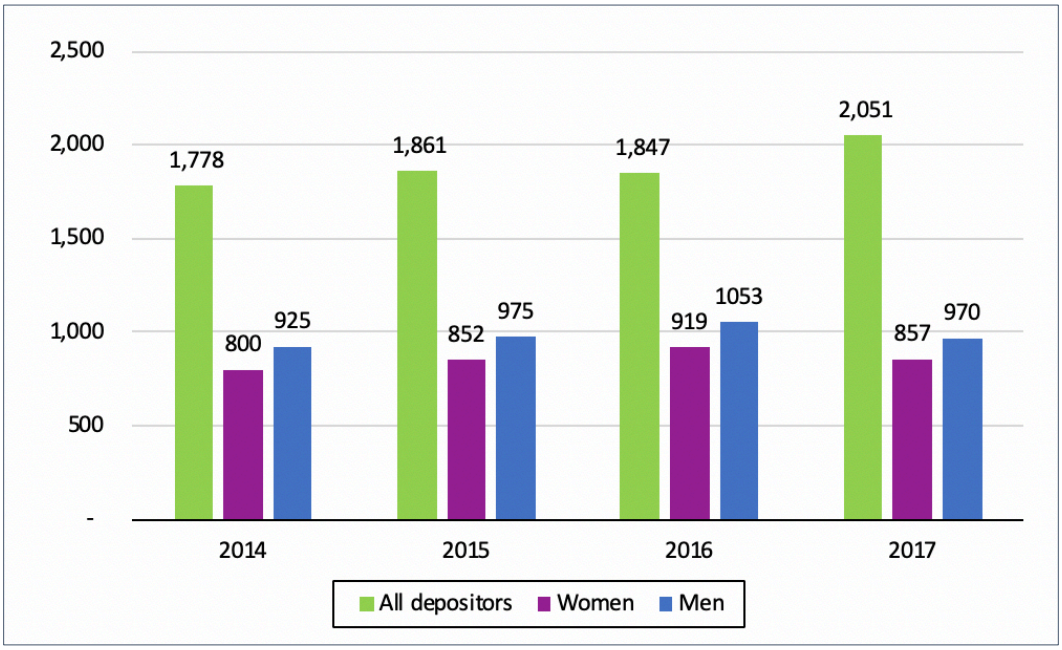
Source: International Monetary Fund

[191] "Cabo Verde: Country Gender Profile," UN Women, (January 2018): http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/country-gender-profile-cabo-verde-en.pdf?la=en&vs=1331

[192] "Country Profile – Cabo Verde," UN Women , (2018): http://africa.unwomen.org/en/where-we-are/west-and-central-africa/cabo-verde

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

Figure 38: Gender Gap – Depositors per 1,000 Adults[194]



Source: International Monetary Fund

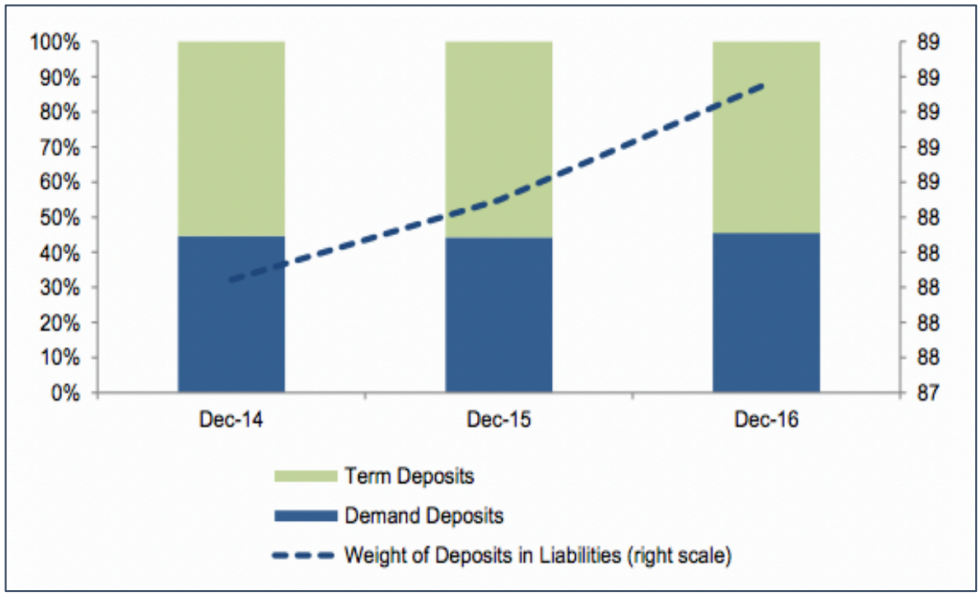
3.2.3 Commercial Lending Environment

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

Deposits is Cabo Verde's banking system, which rely heavily on deposits from emigrants, are the main source of financing in the country. These deposits account for 94.5% of total funds, with the remaining balance coming from credit institutions, the BCV and subordinated bonds. As of June 2017, the banking sector's deposit liabilities were dominated by long-term deposits, which accounted for 49.1% of all deposits (**Figure 39** and **Table 45**). Long-term deposits are typically domestic customers' deposits but also long-term deposits of emigrants. Decrease in time deposit (- 2.9%) between end-December 2016 and end-June 2017 was due to a decrease in time deposit from residents and emigrants.

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

Figure 39: Growth and Composition of Deposits by Maturity[195]



Source: BCV

Table 45: Maturity Structure of Bank Deposits[196]

Indicator	Share of Total Deposits		% Change over the Period
	Dec 2016	June 2017	
Total Deposits	100%	100%	5.7%
Time Deposits	53.4	49.1%	-2.9%
Demand Deposits	44.0%	48.3%	16.1%
Other	2.6%	2.5%	8.1%

Source: BCV

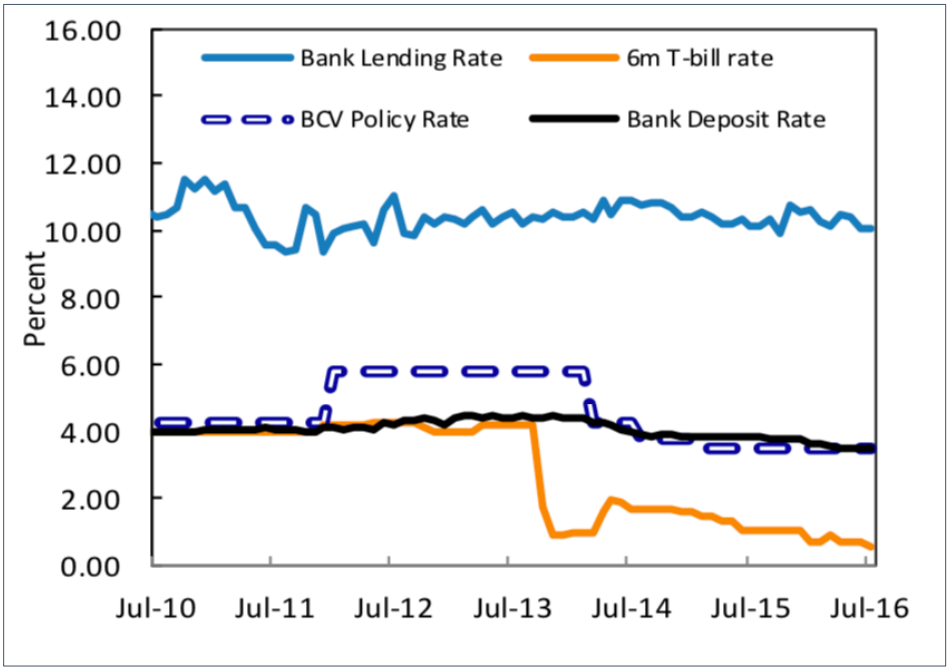
BCV and the Credit Bureau Registry do not provide publicly available data on the distribution of commercial bank credit by maturity (short term, medium term and long term). However, the high percentage of long-term deposits suggest that long-term maturities dominate the credit market, while the World Bank also indicates that long-term loans are typically availed for large corporations (business loans) and housing mortgage (consumer loans), which both account for the majority of total loans granted by commercial banks in the country.[197] For business loans, distribution of loans shows that 53.6% of loans are above CVE 100 million, hence concentrated in large operations and large companies. For consumer loans, long-term mortgage loans accounted for 67.1% of total loans to individuals (and 31.4% of total loans to the economy).[198]

[195] "Financial Stability Report 2016," Banco de Cabo Verde, (2016): http://www.bcv.cv/SiteCollectionDocuments/2017/Financial%20Stability%20Report%202016.pdf
[196] BCV Financial Stability Report, 2017.
[197] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf
[198] BCV Financial Stability Report, 2017.

- **Interest Rates**

The average interest rates on bank deposits and loans is presented in **Figure 40** and **Table 46**. The gap between lending and deposit rates remains large. In 2017, the average short-term interest rate spread (90 day lending – time deposit rate) was high, reflecting a high cost of finance, but decreased to 5%, from 6.6% and 8.3% in 2016 and 2015, respectively.

Figure 40: Interest Rates on Deposits and Loans[199]



Source: International Monetary Fund

[199] IMF Country Report No. 16/367, 2016.

Table 46: Commercial Bank Interest Rates (%)[200]

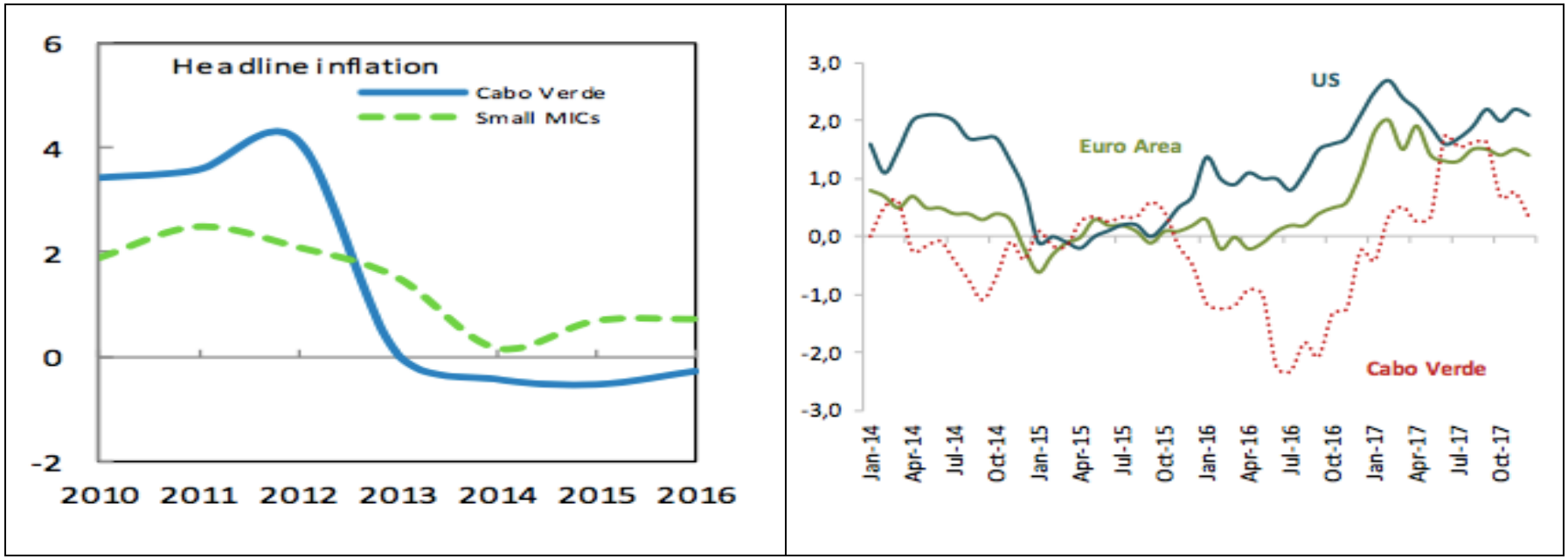
Indicator	2015	2016	2017
Deposit Rate (average)	0.3	0.3	0.1
Lending Rate (average)	6.5	6.5	4.5
Interest Rates on Credit (weighted average)			
91 to 180 days	10.4	9.6	9.5
181 days to 1 year	8.7	8.7	7.4
Over 10 years	8.8	8.6	8.7
Overdraft	16.6	16.7	16.5
Resident Deposit Interest Rates (weighted average)			
31 to 90 days	2.9	2.6	2.5
91 to 180 days	3.5	3.3	2.6
181 days to 1 year	4.3	3.9	3.4
1 to 2 years	4.6	4.2	3.7
Interest Rates on Emigrant Deposits (weighted average)			
31 to 90 days	3.1	2.9	2.5
91 to 180 days	3.8	3.5	2.7
181 days to 1 year	4.2	4.0	3.6
1 to 2 years	4.8	4.4	3.7
Interest Rates on Treasury Bills (weighted average)			
91 days	4.8	4.4	0.7
182 days	1.0	0.6	0.6
364 days	4.5	4.5	3.6

Source: Banco de Cabo Verde

Cabo Verde's inflation is influenced by external price development and the currency's peg to the euro – national inflation is anchored to expected inflation in the Eurozone. Inflation was positive between 2010 and 2013, reaching a peak in 2012 at above 4% but has dropped sharply since 2013 due to lower food and energy prices. In 2017, average inflation turned positive and reached 0.8%, after reaching -1.4% in 2016 (**Figure 41**). In the context of very low inflation, at an average 1.4% for the period 2014 to 2017, the BCV decided to adopt a more accommodative policy and lowered its monetary policy rate by 200 basis points, from 3.5% to 1.5% in June 2017. Although there was an important delay in bank rates to adjust, the change in monetary policy bolstered credit growth.

[200] BCV Financial Stability Report, 2017.

Figure 41: Inflation Rate Trends in Cabo Verde (%)[201]



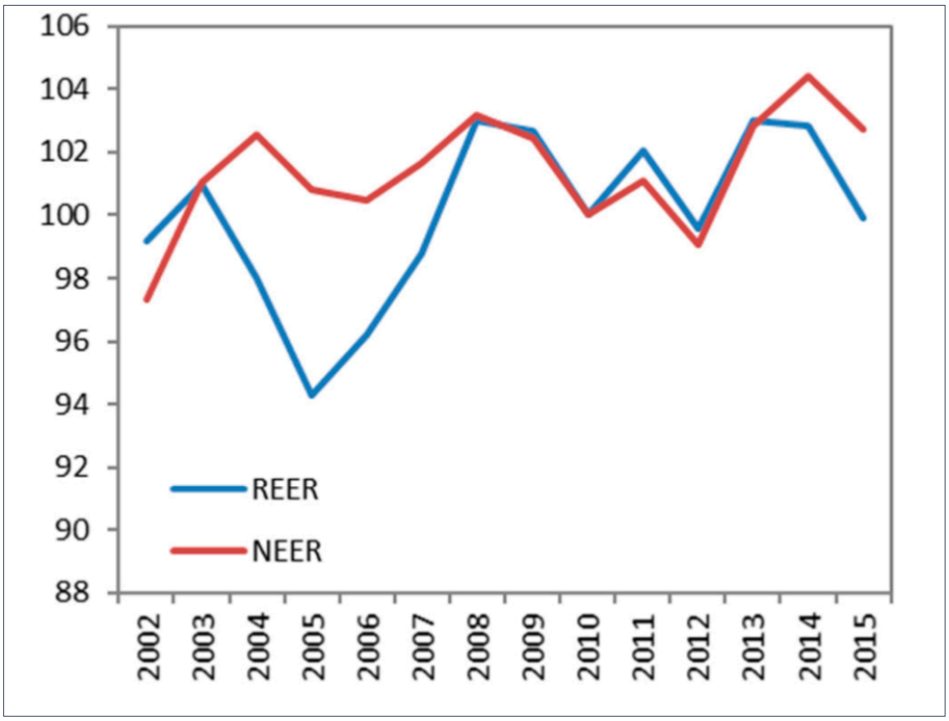
Source: International Monetary Fund (left) and BCV (right)

[201] IMF Country Report No. 16/367, 2016; and BCV Financial Stability Report, 2017.

➢ Foreign Exchange Market

Cabo Verde's fixed exchange rate regime has allowed long-term macroeconomic and external stability, although the country is vulnerable to external shocks from Europe and is highly dependent on remittances and tourism. The exchange rate regime is based on a conventional fixed peg, with the escudo pegged to the euro at a rate of CVE 110.265 per euro since 1999. Movements in the escudo are therefore linked to variations in the euro. This exchange system is free of restrictions on the making of payments and transfers for current international transactions.[202] The latest IMF assessment indicates that the real exchange also remained stable over the last five years, although with a slight overvaluation (**Figure 42**). A new law on foreign exchange, which would liberalize the capital and financial accounts is currently under consideration. In 2018, average exchange rate was at CVE 93.41 per USD (**Table 47**).

Figure 42: Real Exchange Rate[203]



Source: International Monetary Fund

Table 47: Official Exchange Rate, (CVE-USD)[204]

Exchange Rate USD	2013	2014	2015	2016	2017	2018
Period Average	83.07	83.03	99.39	99.69	97.81	93.41
End of Period	80.54	89.35	101.52	10.56	93.26	96.27

Source: International Monetary Fund

[202] IMF Country Report No. 16/366, 2016.
[203] Ibid.
[204] International Financial Statistics (IMF): http://data.imf.org/regular.aspx?key=61545862

- **Collateral Requirements**

In a context of high NPLs, banks in Cabo Verde do not want to take on more credit risk and have high collateral requirements, at an average of 176% of the loan principal for all firms and at an average of 201% for small businesses (micro and small enterprises, MSMEs).[205] The banks require collateral mainly in form of real estate, cash deposits and third-party guarantees (*aval*) but do not lend against inventory or make use of cash-flow based financing. The credit risk policies of the banks are influenced by the BCV's capital allocation requirements and regulations in its role of protecting depositors and promoting stability and efficiency in the financial systems.

These collateral requirements eliminate commercial credit from the purview of many Cabo Verdean businesses, especially MSMEs, due to their inability to provide acceptable collateral – MSMEs often lack fixed assets (e.g. real estate) to offer banks as a collateral. As a result, there is limited credit available for MSMEs; despite representing 90% of the number of companies in the economy (about 8,000 of MSMEs), this group only received 58% of bank loans. The country also lacks the judicial framework (lack of commercial courts) to execute collateral guarantees and contract enforcement is long and unreliable. Insolvency and repossession of collateral can take up to two years and represent less than 50% of the original loans (except for mortgages for which 75% of the original loan can be recovered).

Financial intermediation reforms are focused on improving collateral repossession and the credit information system. In an effort to improve access to finance for companies and more particularly MSMEs, the GoCV is working with the World Bank to modernize the legal framework for insolvency and secured transactions as well as for effective implementation of the new Insolvency and Recovery Code. The objective is to reduce the level of NPLs in the sector and expand the range of assets eligibility for collateral. Planned activities include notably the launch of an electronic moveable collateral registry, supervised by BCV for MSMEs to access finance using moveable collateral (e.g. inventory, crops, and equipment).[206]

- **Banking Supervision**

Following the 2009 Financial Sector Analysis Program,[207] the IMF recommended that Cabo Verde take measures to strengthen financial surveillance, including stronger compliances measures, risk-based supervision and the reform of the off-shore banking sector. In 2018, the IMF highlighted the need to strengthen banking supervision and regulation in Cabo Verde, notably through the adoption of measures that would address the resolution of NPLs and improve existing 2002 anti-money laundering/combating the finance of terrorism framework (AMT/CFT) up to international standards (financial governance).

Based on these recommendations, the GoCV has taken several steps to increase supervision of the financial sector, focusing on increased minimum insolvency ratio (capital adequacy ratio). The BCV has (i) created a Financial Stability Committee to focus on financial crisis prevention and management, (ii) introduced stress tests and the annual publication of a Financial Stability Reports, (iii) increased on-site audits, and (iv) revised the banking legislative and regulatory framework. A key measure to address NPLs and rebuild capital buffers was the BCV's adoption of a gradual increase of the minimum capital requirement from

[205] "Competitiveness for Development Tourism Project, Project Appraisal Document," World Bank, (April 2016): http://documents.worldbank.org/curated/en/784941468196144217/pdf/PAD1347-PAD-P146666-IDA-R2016-0069-1-OUO-9.pdf
[206] "How Movable Collateral Gets Credit Moving," International Finance Corporation, https://www.ifc.org/wps/wcm/connect/7b0e2e804782fbfa9644f7299ede9589/How+movable+collateral+gets+credit+moving.pdf?MOD=AJPERES
[207] "Cabo Verde, Namibia and Kingdom of Swaziland: Selected Issues Paper," International Monetary Fund, (September 2013): https://www.imf.org/external/pubs/ft/scr/2013/cr13292.pdf

10% to 12% of risk weighted assets.[208] The minimum capital requirement increased to 10.5% in 2018, to 11.25% in 2019 and will finally increase to 12% in 2020.

In 2017, a new credit impairment model (risk-based) and a partial credit guarantee company were established to mitigate credit risk. The BCV revised its credit impairment's calculation method, with the objective to improve loan portfolio information, credit processes and the linkage between banks and the Credit Risk Center. The BCV also authorized the creation of PRÓ-GARANTE, the new Partial Credit Guarantee Company (Notice No. 3/2018). The objective is to issue guarantees for companies willing to access bank finance, increasing their eligibility and reducing the risk profile of these companies, and also creating a loss mitigation instrument for banks. Another important supervision measure undertaken in 2017 was the completion of the first risk and control assessment on the country's two largest banks (with the aim of scaling it to the entire banking system by 2019).

3.2.4 Lending to the Off-Grid Solar Sector

Historically, only a few Cabo Verdean banks have sought Renewable Energy (RE) lending opportunities, but mainly in the on-grid segment and most banks still lack a good understanding of the technologies, markets and business models for clean energy. Only one bank, BICV, offers a credit line dedicated to the renewable energy sector, the "Environment and Energy Credit Line," with loan maturities between 2 and 10 years. Nonetheless, interviews with local commercial banks and MFIs revealed an increasing willingness to participate in providing financing to the sector and receive technical assistance (for the bank itself but also for its customers).

Despite the capacity of local lenders to grant medium and long-term loans, an 11% interest rate was applied to a RE project in 2015. Moreover, banks remain hesitant to grant commercial loans to the sector for several reasons: (i) lack of guarantees by project developers / guarantors, (ii) rigorous internal policy to structure credit facilities, notably due to the fact that decision-making centers are outside of Cabo Verde, (iii) lack of bankable projects and the lack of track record of project developers, and (iv) banks do not have the technical capacity / knowledge to assess renewable energy projects. [209]

Due to Cabo Verde's exceptionally high electricity access rate (95%), there is relatively low interest in lending to the off-grid solar sector compared to other countries in West Africa and the Sahel and in Sub-Saharan Africa. A relatively small number of developers and companies are deploying stand-alone systems to households and SMEs in the country. While several donor-funded programs and initiatives have provided financing to support development of Cabo Verde's off-grid communities (see **Section 3.3.1**), none of these funds have been channeled through local commercial banks or MFIs to specifically finance the off-grid solar sector. 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.

3.2.5 Key Barriers to Off-Grid Solar Lending

- **Electrification Rates / Geography**

Cabo Verde's high rates of electrification make the off-grid solar sector less appealing to local lenders. The opportunity for local FIs to provide OGS financing is constrained by the relatively limited the size of the

[208] BCV Financial Stability Report, 2017.
[209] "Cabo Verde: Études de Diagnostic Initial du sous-secteur des énergies renouvelables," LuxDev, (April 2015) : https://caboverde.luxdev.lu/files/documents/Etude_diagnostic_initital_ER_CVE_avril_2015.pdf

market. Moreover, the country's unique geography as an island state increases transaction costs for FIs, which further diminishes the profitability of offering financing the sector.

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

Much like other African markets, local FIs in Cabo Verde are unfamiliar with lending to off-grid solar projects and companies and have a limited understanding of the nascent sector. Many of the interviewed FIs noted a lack of expertise in assessing off-grid solar risks and in structuring/developing customized products for the sector and stressed that technical assistance would be necessary to facilitate OGS lending.

- **Low Credit to SMEs and High Interest Rates**

Overall commercial banks credit to the private sector in Cabo Verde is high, but credit to MSMEs remains low. Financial depth, measured by credit to the private sector to GDP, was 62.44% in 2017 – among the highest rates in Sub-Saharan Africa.[210] The figure has decreased due to increased share of assets deposited with the BCV and credit to GoCV and state-owned companies. This reflects the banking sector's risk aversion and lack of sustainable investment opportunities.[211] In 2016, the average cost of finance was about 10% in real terms for loans up to one year. While MSMEs represent 90% of the total number of enterprises (10% are medium and large corporations), they receive only 58% of bank loans. The microfinance sector contributes marginally to financing the private sector, and most MFIs are associations that are not financially sustainable. Low levels of MSME credit are largely a result of (i) a lack of fixed assets (e.g. real estate) as collateral for MSMEs, (ii) asset-based lending rather than cash-flow lending offered by banks, and (iii) the absence of an efficient credit reporting system, which undermines credit allocation by FIs. To address this, the World Bank has launched a program to support access to finance for MSMEs, through the implementation of a dedicated Partial Guarantee Fund and technical assistance.

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

Historically, the country's financial reporting framework has been weak. This is another major bottleneck hampering financing of off-grid energy projects as the banks consider them too risky. The lack of mobile money operations, which in other African countries provide credit history on new clients excluded from the formal financial system, also hinders development of credit scoring in Cabo Verde. Even when loans are made available, potential borrowers often consider collateral requirements too stringent. Furthermore, Cabo Verde's collateral laws do not permit the use of movable assets as collateral, which poses a challenge for the solar sector.

Although a mutual credit guarantee system – based on mutual guarantee companies that provide guarantees directly to MSMEs and benefits from a counter-guarantee from a public fund – was launched in 2010, it has remained largely ineffective.[212] A study conducted by the World Bank in 2016 confirmed that it was an unattractive risk-sharing mechanism for commercial banks. Given high NPLs and structural excess of liquidity in the banking sector, most of the interviewed commercial banks emphasized that the availability of adequate credit guarantees is critical to encourage lending to the sector and overcoming this barrier. Some of the interviewed banks expressed the need of a 50% third-party risk coverage.

[210] "Domestic Credit to Private Sector (% of GDP)," World Bank, (2017): https://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS?locations=CV
[211] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf
[212] Ibid.

3.3 Financial Institutions[213]

3.3.1 Development Finance Institutions

There are no Development Finance Institutions (DFI) programs specifically focused on the off-grid solar sector in Cabo Verde. To date, most development initiatives have focused on providing funding and institutional strengthening in order to improve the financial situation of the utility, Electra, or have backed larger utility-scale renewable energy projects in the country. See **Section 1.4** for an overview of bilateral and multi-lateral donor-funded initiatives in Cabo Verde's off-grid sector.

3.3.2 Microfinance Institutions

Figures from the Ministry of Finance indicate that the MFI sector had 11,603 customers in 2016, compared to 8,681 in 2009. Over the same period, the number of accounts increased from 442,000 to 600,000, the volume of transactions increased from 3,000 to 4,000, and the average loan size increased from USD 545 to USD 900. Most of the sector's activity has been concentrated on the islands of Santiago and Fogo.[214]

As defined by Law 15/VII/2007, microfinance institutions (MFIs) are supervised by Banco de Cabo Verde (BCV), while a Microfinance Office (Gabinete de Micro Finanças - GMF) was established within BCV.[215] Law No. 83/VIII/2015 from January 2015 created an MFI legal regime and was later amended by Law No. 12/IX/2017, which indicates that all associations and institutions that have microfinance activities should create separate legal entities by the end of 2018 in order to continue performing these activities.[216] This recent amendment initiated a process that aims to reform the sector by improving its efficiency and allocation of resources and by strengthening regulation and prudential supervision. Categories of MFIs, their minimum capital requirements and types of operations are described in **Table 48**.

[213] Excluding commercial banks, which are reviewed in detail in **Section 3.2**.
[214] "Micro-creditos. Governo e bancos comerciais abrem linha de credito de 100 mil contos," Santiago Magazine, (2017): http://www.santiagomagazine.cv/index.php/economia/514-micro-financa-governo-e-bancos-comerciais-abrem-linha-de-credito-de-100-mil-contos
[215] Supervisions of Microfinance, Banco de Cabo Verde: http://www.bcv.cv/vEN/supervision/supervisionofmicrofinance/presentation/Paginas/Apresentacao.aspx
[216] "Regulação e Supervisão das Microfinanças: Processo the Transformação," Banco de Cabo Verde, (July 2017): http://www.bcv.cv/vPT/Supervisao/SupervisaoMicroFinancas/Legislacao/Documents/Altera%C3%A7%C3%A3o%20%C3%A0%20Lei%20de%20Microfinan%C3%A7as%202017.pdf

Table 48: Categories of Microfinance Institutions

MFI Category	Type		Minimum Capital	Operations allowed	Limits to credit and savings operations
Under Prudential Supervision					
Category A	Microbanks	Rural Credit Bank (Caixa de Crédito Rural)	CVE 50 million (USD 542,500)	Collection of savings from the public, extension of credit to all clients	< or = 10% of Equity
		Caixa Economica Rural	CVE 60 million (USD 651,000)		
		Savings Postal Bank (Caixa de Poupança Postal)	CVE 40 million (USD 433,000)	Collection of savings from the public	
Category B	Savings and Credit Mutuals		CVE 15 million (USD 163,000)	Collection of savings from members only, extension of credit to all clients	< or = 10% of Equity
	Savings and Credit Cooperatives		CVE 10 million (USD 108,500)		
Under Monitoring					
Category C	Intermediaries Collecting Deposits		-	Collection of savings from the public	-

Source: BCV

3.3.3 Informal Financial Institutions

Although Cabo Verde's financial sector is well developed, there is a relatively limited supply of financial products available to the market. As a result, SMEs often experience difficulty accessing credit from formal institutions and instead utilize informal sources of financing. In fact, a study on entrepreneurs undertaken by the GoCV Ministry of the Economy revealed that small businesses in Cabo Verde rely primarily on informal sources to access external funding. Of the respondents, 24% rely on informal investors (including private money lenders), 24% from family and friends, 22% from banks and 14% from microcredit institutions.[217]

[217] "Cabo Verde – Access to Finance for Micro, Small and Medium Enterprises, Appraisal Document," World Bank, (January 2018): http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

3.4 Summary of Findings

- **Opportunity for ROGEP Credit Lines**: Stakeholder interviews revealed that there is limited local FI interest in ROGEP credit lines, especially given the banking sector's persistent excess of liquidity.

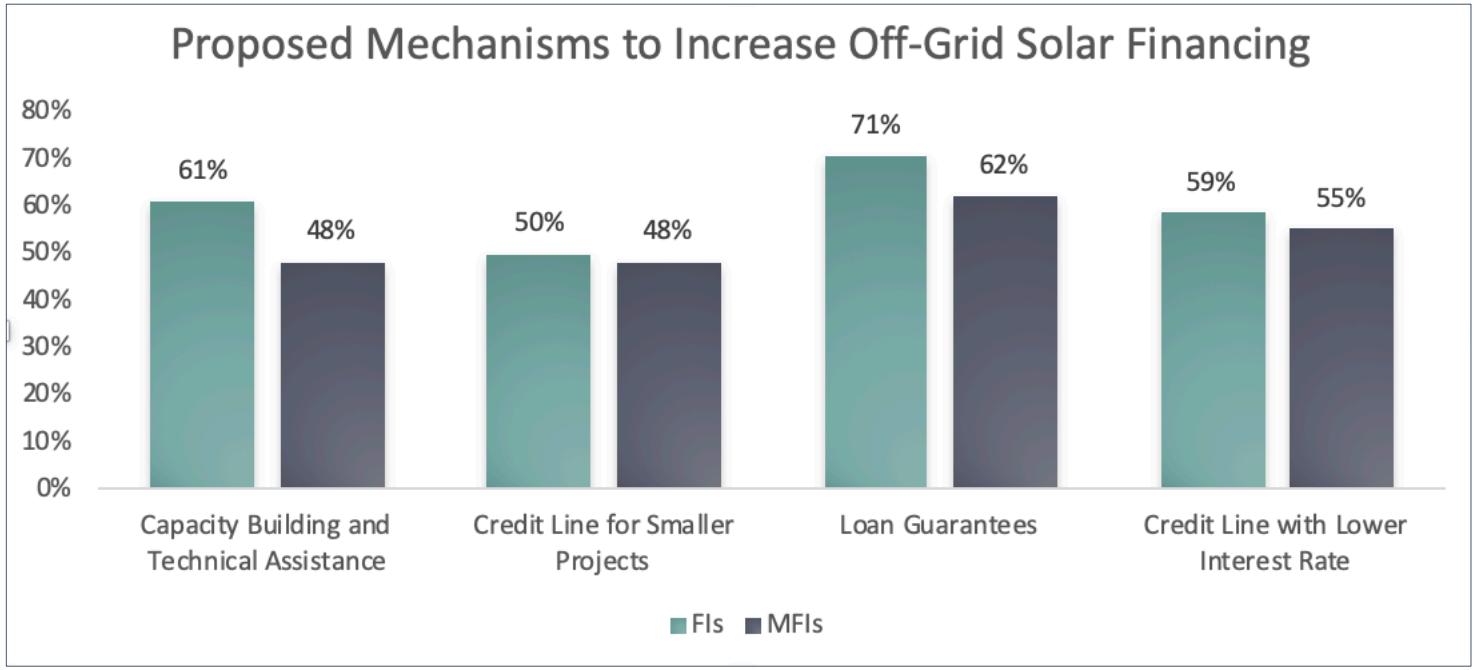
- **Local Currency and Pricing**: Most loans to off-grid enterprises and all loans for consumer purchases of stand-alone solar devices must be denominated in local currency. However, taking up hard currency denominated credit lines presents challenges for local lenders who would have to bear the FX risk. This risk is somewhat mitigated in Cabo Verde, however, as the escudo 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 Cabo Verde are very high particularly for small firms (e.g. 175% of loan principal on average and 200% for MSMEs). 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.

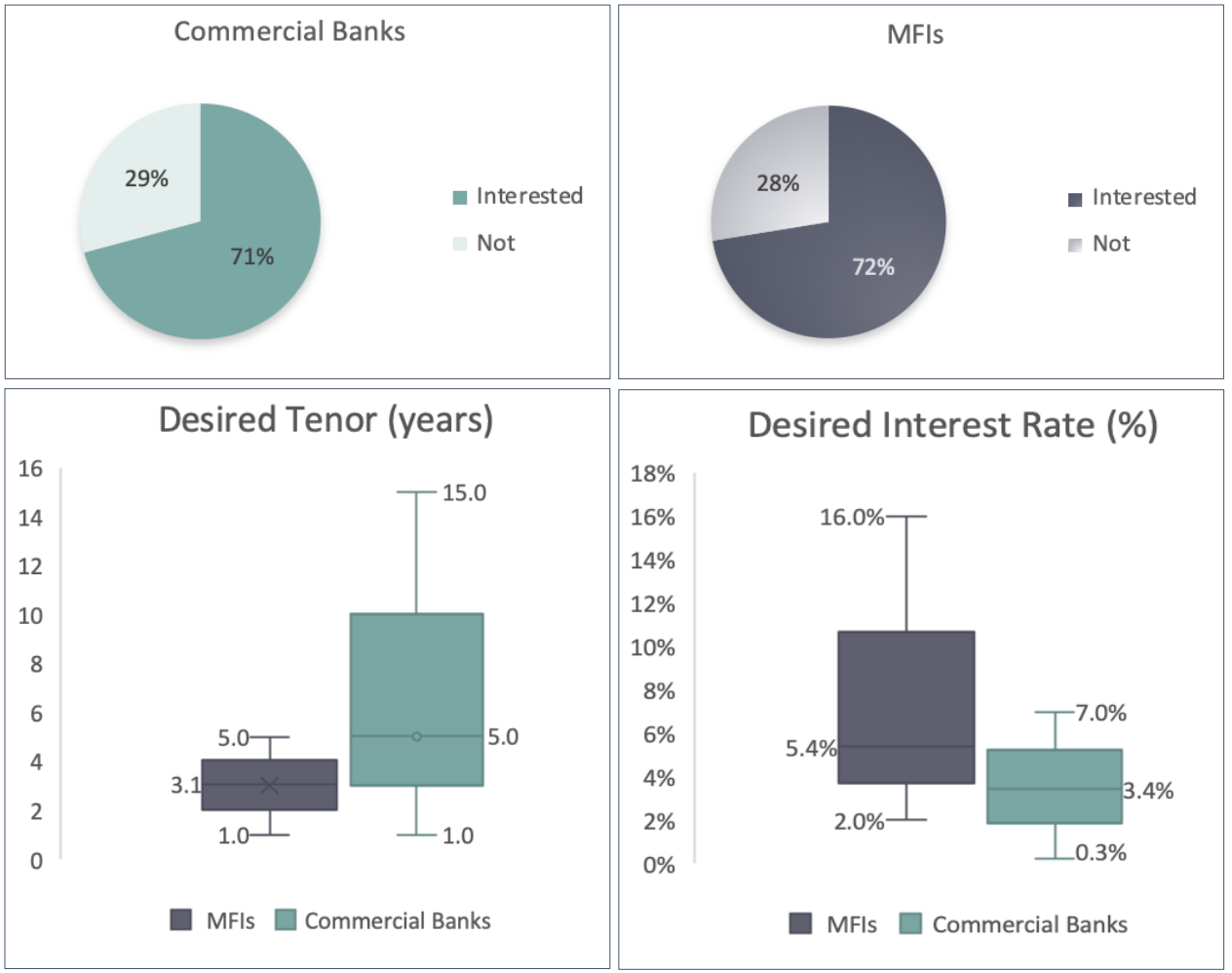
- **Technical Assistance:** Stakeholder interviews revealed the following key areas where TA intervention(s) could provide support: training of bank credit department and account representative personnel to originate deals and appropriately assess the credit risk of stand-alone solar firms and projects; 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. Special attention should also be paid to offering advisory services on the side of the stand-alone solar enterprises.

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.[218] 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.

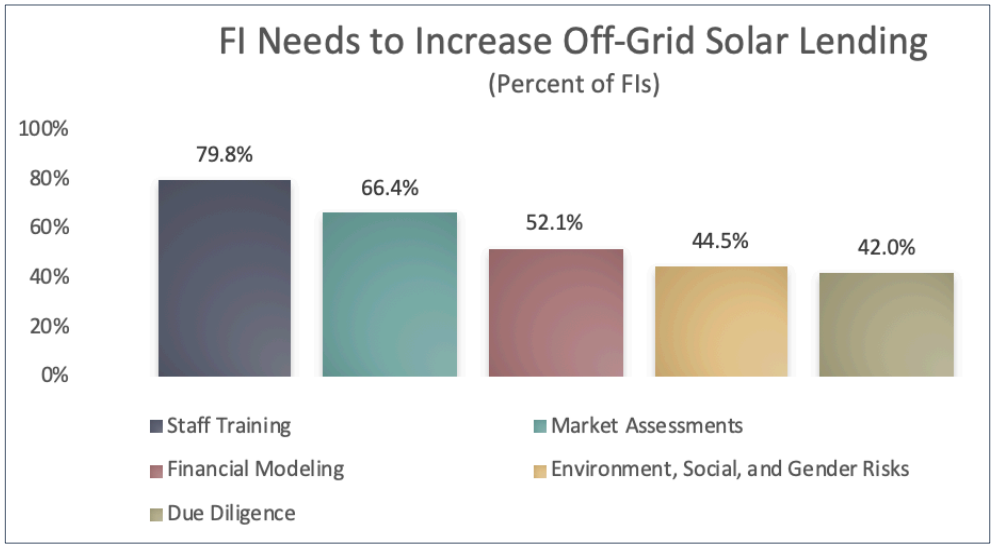


According to the survey, there is strong financial-sector interest across ROGEP countries to finance renewable energy projects, especially in off-grid solar. Commercial banks and MFIs identified loan guarantees as the most important measure that could improve their capacity to lend to the renewable energy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

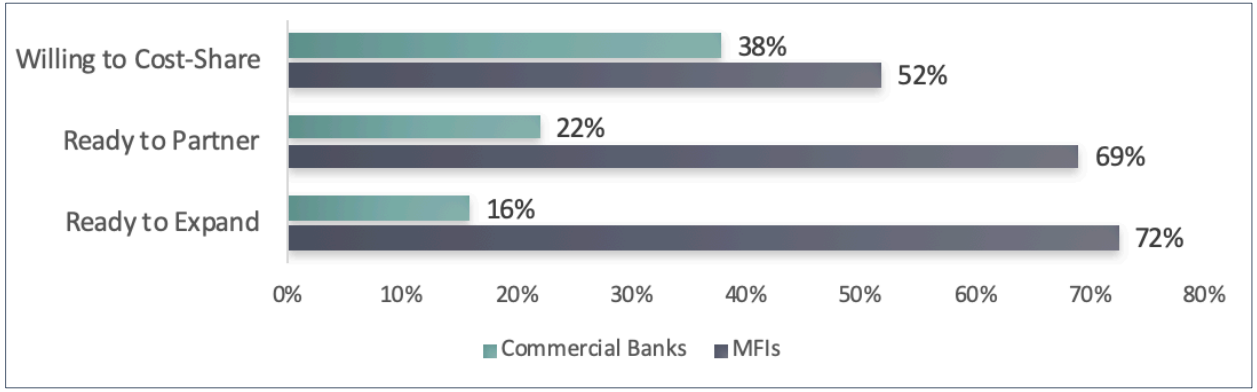
[218] NOTE: Given that Cabo Verde is unlike the rest of the countries that were assessed in West Africa and the Sahel (e.g. island state, high electrification rate etc.), some of the findings and survey results presented in this section may not be applicable.



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 villages: scenario 2023;
(ii) Categorization/definition of villages: scenario 2030; and
(iii) Determination of population per settlement

1.1. Categorization/definition of villages: Scenario 2023

1.1.1. *Electrification by grid extension* – Grid extension to the un-electrified villages is considered as economically not feasible. Therefore, the un-electrified villages of 2018 will remain un-electrified.

1.1.2. *Electrification by mini-grid* – villages that:
- Have a population greater than 300
- Are within 1 km[219] of a social facility (education center or health facility).

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

1.2. Categorization/definition of villages: Scenario 2030

1.2.1. *Electrification by grid extension* – Grid extension to the un-electrified villages is considered as economically not feasible. Therefore, the un-electrified villages of 2018 will remain un-electrified.

1.2.2. *Electrification by mini-grid* – villages that:
- Were defined as mini-grid villages in scenario 2023
- Have a population greater than 500
- Are located within 1 km of the above mini-grid villages, which is the preferred distance of mini-grid developers for their grid according to discussions with several international developers.

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

[219] Preferred maximum distance for mini-grids from discussions with different international developer.

1.3. 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." [220]

For the analysis in Cabo Verde, satellite images from Google were used to count the number of houses within the un-electrified villages to estimate the population, given the average household size of 4.2.[221] This data was compared with the national census of 2010 and verified by local expert. The current annual national population growth rate of 1.3%[222] was applied to the analysis to project populations for the 2023 and the 2030 analyses.

[220] https://www.worldpop.org
[221] "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
[222] https://data.worldbank.org/indicator/SP.POP.GROW?locations=CV

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)	Not available for the analysis.	--	--	--	--	--	--	--
Electricity grid network (planned)	Not available for the analysis.	--	--	--	--	--	--	--
Mini-grids	Existing mini-grids in 2018 were not available for the analysis; Potential mini-grids from scenario 2023 were used in scenario 2030 to establish potential growth of mini-grids.	--	--	--	Not considered	≤ 1km distance from all identified mini-grids in Scenario 2023	≥ 1km distance from all identified mini-grids in Scenario 2023	Scenario 2023 analysis
Population	Representing the population living within the un-electrified villages; Indicator for mini-grid or off-grid solutions.	--	≥ 300 people per village	≤ 300 people per village	--	≥ 500 people per village	≤ 500 people per village	National Statistics Institute (INE), census 2010
Villages	All un-electrified villages and communities in 2018	Used	Used	Used	Used	Used	Used	INS, National Statistics Service, 2018
Social facility: education centers	Education centers (nursery and schools) within un-electrified villages; Indicator of active local economy	Not considered	≤ 1km distance[223]	≥ 1km distance	Not considered	Not considered	Not considered	OpenStreetMap (OSM), 2018
Social facility: health centers	Hospitals within un-electrified villages; Indicator of active local economy	Not considered	≤ 1km distance[224]	≥ 1km distance	Not considered	Not considered	Not considered	INS, National Statistics Service, 2018

[223] Preferred maximum distance for mini-grids from discussions with different international developer.
[224] Preferred maximum distance for mini-grids from discussions with different international developer.

ANNEX 2: TASK 2 METHODOLOGY

OFF-GRID SOLAR PV MARKET ASSESSMENT METHODOLOGY

Focus Group Discussions (FGDs) were held in Praia in June 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 that was undertaken.

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 was calculated using World Bank total population figures,[225] multiplied by electricity access rates from the International Energy Agency (IEA),[226] 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 details.

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.

[225] World Bank Open Data, 2017: https://data.worldbank.org/

[226] IEA Energy Access Outlook, 2017: https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf

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 Cabo Verde, 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%	0%
Fourth 20%	0%
Third 20%	0%
Second 20%	0%
Lowest 20%	15%

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 quintiles. Similarly, it was assumed that the bottom quintile has the highest share of off-grid households.

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."[227] Other research has shown household energy spending between 6-12% for low income segments in sub-Saharan Africa.[228] 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:

- **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.

[227] 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).
[228] 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 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 Cabo Verde, 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 estimated to be 20% p.a., based on the average commercial lending rate of about 10% in the country and an assumed interest rate spread of 10% for Microfinance Institutions.[229]

2023 and 2030 Household Demand Scenario: Assumptions

1. The GIS analysis[230] estimated that by 2023, 97.8% of the population will be grid connected while 1.1% of the population will be connected by off-grid stand-alone solutions. By 2030, the GIS analysis estimated that 97.8% of the population will be grid connected, while only 0.6% 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. Hence, the highest four quintiles were assumed to have only 0.5%, 1.0%, 1.5%, and 2.0% off-grid households respectively, while the lowest quintile was assumed to have 5.9% 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.

[229] "Cabo Verde: Access to Finance for MSMEs (P163015)," World Bank, (Sept 26, 2017): http://documents.worldbank.org/curated/en/825171511262268770/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Cabo-Verde-Access-to-Finance-for-MSMEs-P163015-Sequence-No-00.pdf

[230] See **Annex 1** for GIS methodology.

- 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 percentages of off-grid households in each quintile remain the same as in the 2023 scenario. 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%	0%	0%
Fourth 20%	0%	0%
Third 20%	0%	0%
Second 20%	0%	0%
Lowest 20%	5.3%	3.1%

2. Inflation rates for Cabo Verde: According to the IMF World Economic Outlook data, inflation in Cabo Verde is estimated to be at 2% 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 1.02

3. Based on a 1.3% population growth rate from the World Bank[231] and the population density dataset used in the study, the estimated total population will be 575,555 in 2023 and 630,018 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 98.9% in 2023 and 99.4% in 2030.

5. To estimate GDP, it was assumed that the current annual GDP growth rate of 4% will be maintained through 2023 and 2030:

Parameter	2023	2030
Population	575,555 (GIS estimate)	630,018 (GIS estimate)
GDP (constant 2010 USD)	$2,445,293,270	$3,217,839,124

6. According to the Lighting Global Off-Grid Solar Market Trends Report 2018,[232] 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).

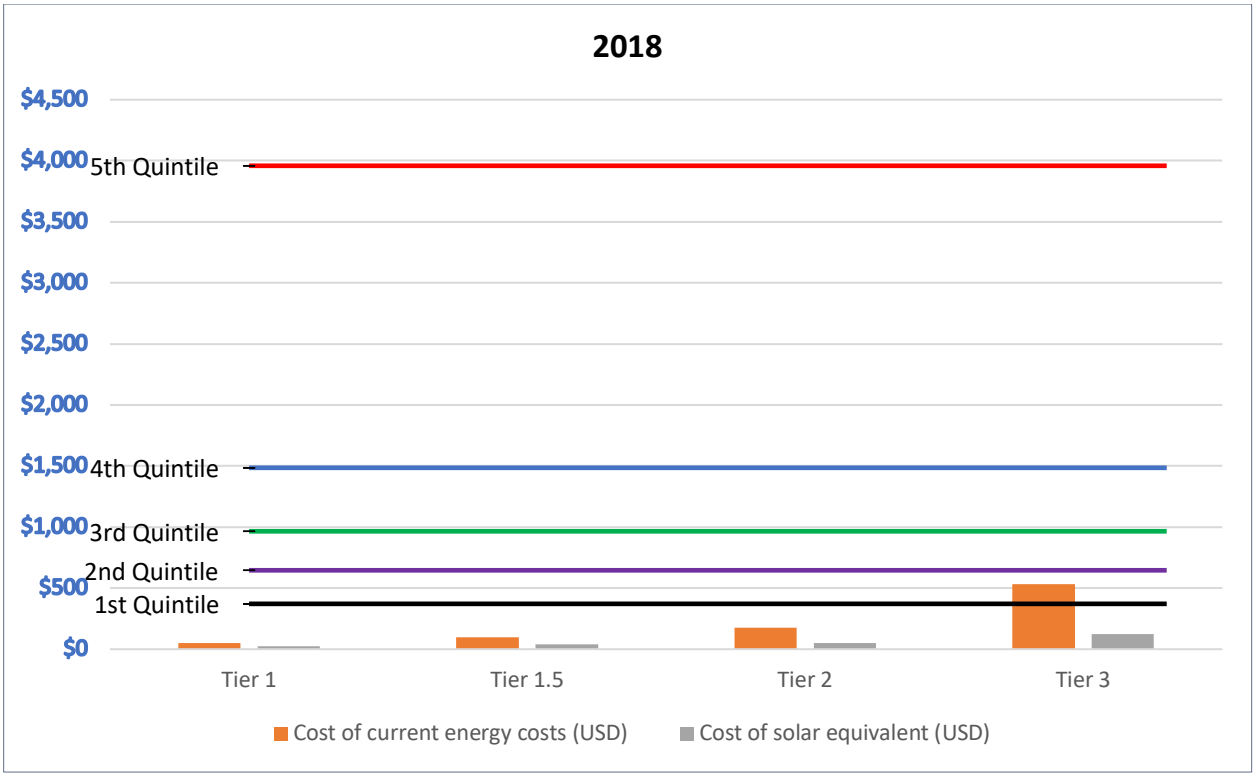
8. It was assumed the interest rates in Cabo Verde will stagnate at the rate of 20% or possibly decline.

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

[232] "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

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:

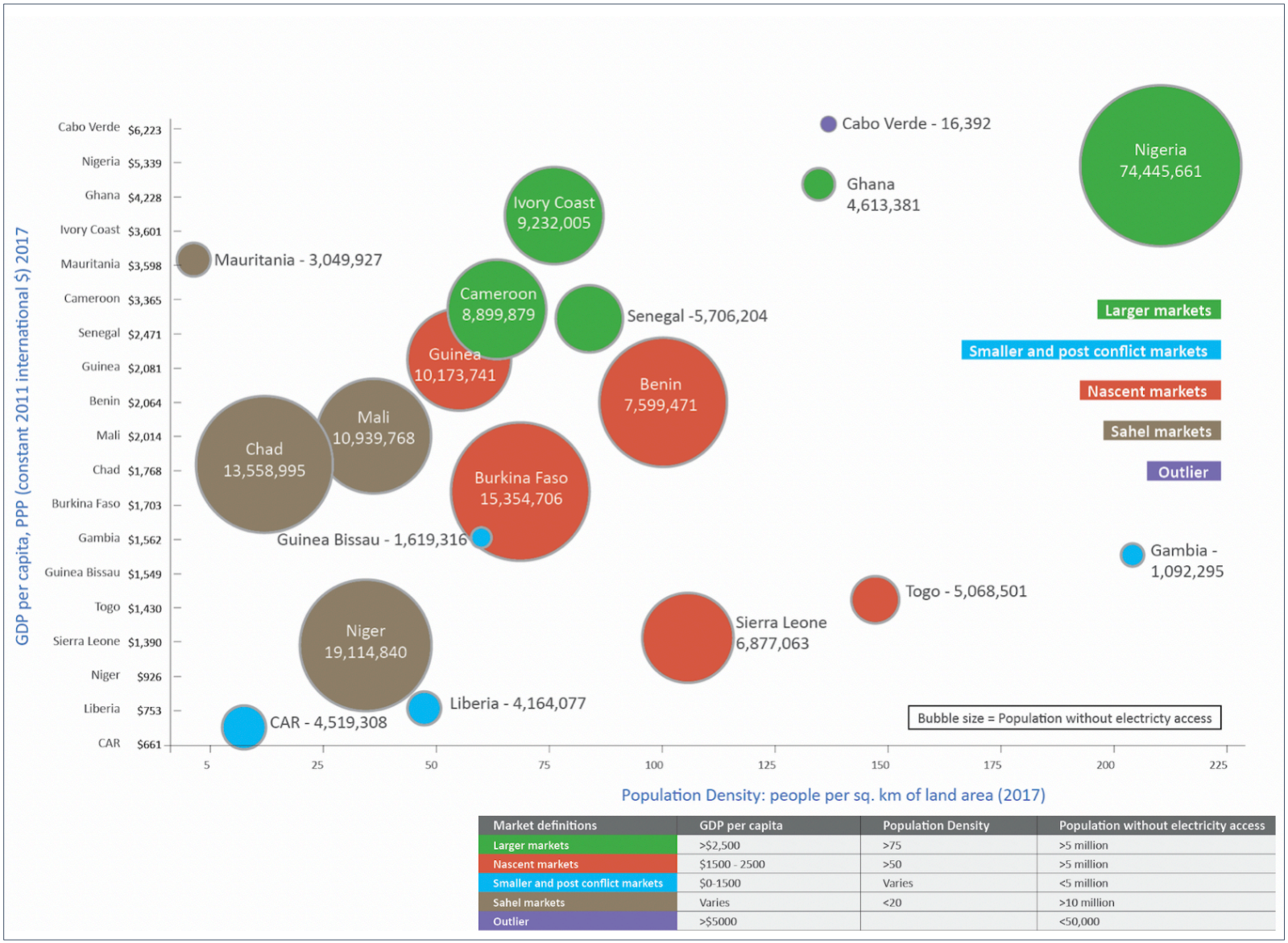
Country Categorization by Income and Population Density			
Category 1: Low-income / low population density	**Category 2:** Low-income / high population density	**Category 3:** High-income/ low population density	**Category 4:** High-income / high population density
Niger	Benin	Cameroon	Nigeria
Burkina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

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.[233] The solar PV sizing factor is based on the peak sun hours available across most of Africa.

[233] "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 the school and number of students determines the amount of energy each school requires.

Public lighting: The electricity needs of a given town/market center (assuming two [2] public lighting points per market center)

2.3 Institutional Market Sizing Calculations

Household systems, cost and price per watt:

System Type	Tier Rating	USD/Watt[234]	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

[234] 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

CABO VERDE			
Water Supply	**Healthcare**	**Education**	**Public Lighting**
Per capita assumption	Per capita assumption	Per capita assumption	Per capita assumption

Data was collected on the total number of off-grid institutions by institutional market segment for Cabo Verde 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:[235]

- **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 2,000 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.

[235] 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[236]	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)[237]	X 25%	=	Smallholder Irrigation Potential (hectare)[238]	Divided by 0.3[239]	=	Estimated No. of Smallholder Farms Suitable for Solar Irrigation	X	$650 (cost of solar pumping kit)[240]	Divided by 6 year (life of system)	=	Estimated Annualized Off-Grid Solar Market Potential for irrigation

3.2.2 Milling

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.

---

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

[237] AQUASTAT – Food and Agriculture Organization: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en

[238] 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

[239] 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/

[240] 120W solar pumping kit: https://futurepump.com/futures-bright-farmers-kenya/

Value-Added PUE Applications – Solar Milling													
Cereals, roots tuber crops (tons)[241]	X	70% [242]	X	50%[243]	=	Smallholder Milling Potential (tons)	Divided by 2 tons per day X 70% capacity factor[244]	=	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[245]	X	5,500 W[246]	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[247]	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

[241] Food and Agriculture Organization: http://www.fao.org/faostat/en/#data/RF
[242] Assumption that 70% of crops are milled
[243] Assumption that 50% of milled crops are processed at smallholder farmer level
[244] 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/
[245] https://www.citypopulation.de
[246] 5.5kW solar powered refrigeration system – *See*: https://www.deutschland.de/en/solar-powered-coldhubs-nigeria
[247] "The Mobile Economy, Sub-Saharan Africa," GSMA Intelligence, (2017): https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download

* Indicative Costs for Phone Charging Appliances[248]

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 23)**. 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

[248] "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 Praia in July 2018
- Survey of 5 locally-based solar companies/suppliers in the country
- Survey of 10 larger international solar product suppliers
- ECREEE supplier database
- 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 Cabo Verde is included below:

1	Aguatech
2	APP
3	ARES
4	Boundless World Solutions
5	Circuitos
6	Elseg
7	Electric
8	Electrosystem
9	GTeK
10	Indutech
11	LoboSolar CV – Energias Renováveis,S.A.
12	MTCV
13	NEDCABO SOLAR
14	Praia Solar
15	Prosol
16	REPOWER
17	Resul
18	Semedo e Brito
19	Solar Boundless Solutions
20	Sonasa Energias
21	SpeedSun
22	STEE
23	WATT-TEC
24	180º CEA Unip.
25	3MSG Solar

Source: ECREEE, Focus Group Discussions; Stakeholder interviews

ANNEX 3: TASK 3 METHODOLOGY

FINANCIAL INSTITUTION ASSESSMENT – APPROACH / METHODOLOGY

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 Cabo Verde. 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.[249]

The questionnaire that was administered to FIs in the country and across the ROGEP region is included below.[250] 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

[249] The results of this assessment and corresponding recommendations were prepared for ECREEE in a separate, confidential report.
[250] 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.[251] 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.[252]

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.[253] 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.[254] 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.[255]

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).[256] 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).

---

[251] "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

[252] 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

[253] "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

[254] Ibid.

[255] "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/

[256] "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 Praia in June 2018 to share their insights and inform the overall market study. A gender questionnaire was also distributed to key stakeholders in Cabo Verde 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[257] (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 Cabo Verde

Cabo Verde has made tremendous progress in advancing gender equality since its independence. Cabo Verde is ranks very highly among other West Africa countries in gender equality; the country ranks 5th among low-middle income countries and 6th in sub-Saharan Africa.[258] Cabo Verde performs particularly well in the areas of education, healthcare and political representation. However, there are still issues in economic participation and opportunities for women. Although the law in Cabo Verde guarantees equal rights to men and women, traditional patriarchal stereotypes and gender roles remain deeply rooted in society and hinder women's rights.

2.2 Gender and Poverty

The Republic of Cabo Verde has made significant improvements in social and economic conditions since its independence despite recording one of the lowest GDPs among ECOWAS member states. Data from the National Institute of Statistics (INE) in 2015 shows a national poverty rate of about 35% (**Table 1**). According to UNDP statistics, 37.2% of the labor force is considered working poor at PPP USD 3.10/day.[259] However, men and women have comparable HDI indicators, although income levels are comparatively lower for women, who constitute a slightly larger share of the country's poor.[260]

2.3 Gender, Human Capital and Economic Empowerment

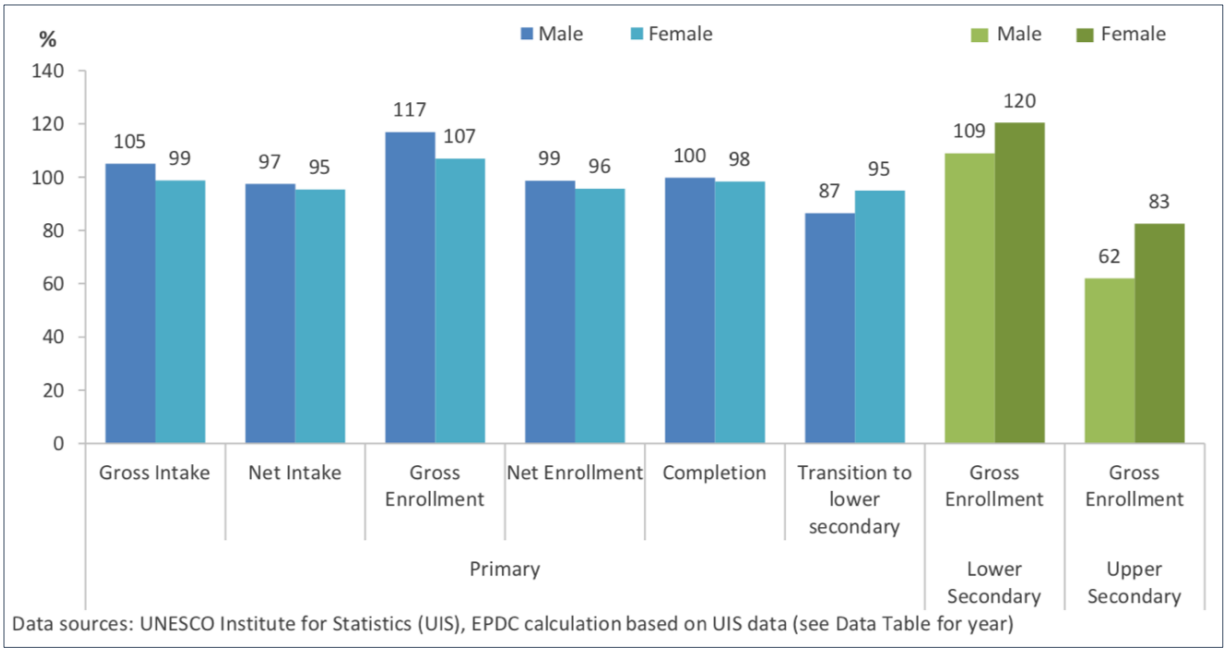
2.3.1 Education, Skills Development and Training

Cabo Verde has achieved gender parity across virtually every level of its education system and has one of the highest female school enrollment rates in the region. The country has the highest rate of female participation in higher education in Africa.[261] Adult literacy in the country is 80% for women and 90% for

[257] **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.
[258] Cabo Verde Gender Country Profile, AfDB, 2018.
[259] "UN Human Development Indicators: Cabo Verde," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/CPV
[260] In Cabo Verde there has historically been a high share of households headed by women, with higher poverty rates among female-headed households.
[261] Situation analysis of Energy and Gender in ECOWAS, SE4All, 2015, https://www.seforall.org/sites/default/files/Situation-Analysis-of-Energy-and-Gender-Issues.pdf

men, with a larger discrepancy in rural areas.[262] As of 2018, 29.4 % of the country's adult had reached a secondary or higher level of education.[263]

Trends in Primary and Secondary Education in Cabo Verde



Source: UNESCO Institute for Statistics

Cabo Verde also offers professional training mainly through Professional Training Centers from the Institute for Professional Training and Employment (IEFP), *Cursos de Estudos Superiores Professionalizantes* (CESP) from UNI-CV and through the Tourism and Hotels Schools (EHCTV). According to the data on student registration, only one-third (35 %) enroll in technical-scientific training.[264]

2.3.2 Fertility Rates and Reproductive Health

As of 2017, the fertility rate in Cabo Verde was low, at 2.3 children per woman. The country has the lowest material mortality rate in Africa; for every 100,000 live births, 47 women die from pregnancy related causes.[265] Reproductive health services and improvement in sanitary conditions are also credited with a huge decline in infant mortality.

2.3.3 Participation and Decision-Making

Female participation in certain sectors and public positions has increased in recent years; as of 2017, women hold 20.8% of the seats in parliament.[266] Women in Cabo Verde are generally well represented in public

[262] "Cabo Verde: National Education Profile, 2014 Update," Education Policy and Data Center, (2014): https://www.epdc.org/sites/default/files/documents/EPDC%20NEP_Cabo%20Verde.pdf
[263] "UN Human Development Indicators: Cabo Verde," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/CPV
[264] Cabo Verde Gender Country Profile, AfDB, 2018.
[265] "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
[266] "UN Human Development Indicators: Cabo Verde," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/CPV

and political life, especially compared to other ECOWAS countries. Cabo Verde adopted a legal and institutional framework promoting gender in 1975, guaranteeing equality and non-discrimination before the law. The 1999 Electoral Code established various measures for the promotion of women in public and political life and guaranteeing equal employment rights between men and women. As a result of these policies and efforts, Cabo Verde has nearly achieved gender parity at the cabinet level.[267]

While women are relatively well represented at the national level of government, they tend to be less represented at the local level, where men still dominate as presidents and members of city councils. Among the 22 municipalities (*concelhos*), there is just one female president of a municipal assembly and one women president of a municipal council. However, in non-elected local leadership positions, there are more women than men. Women are also visible and influential in senior management positions of government ministries and agencies and in the media, but they are less represented in the private sector.[268] Despite strong representation in politics and decision-making, female participation in the labor market (49.6%) remains below their male counterparts (75.1%).[269]

2.4 Gender Policy, Institutional and Legal Framework in Cabo Verde

2.4.1 Gender Mainstreaming initiatives by the Government

The current government is committed in advancing gender equality. Government priorities as described in the Government Program from the 9th Legislature (*Programa do Governo para a IX Legislatura*) include a detailed section on gender issues and needs. The Program in addressing social inclusion focuses on the causes of gender inequalities. And the Government is currently developing a New National Plan for 2017-2021, the Strategic Plan for Sustainable Development - PEDS (*Plano Estrategico para o Desenvolvimento Sustentavel).* The draft for this forthcoming PEDS continues the commitment of prior plans to the priority of gender equality which is included as one of the four goals under the Society pillar. The proposed Parity Law (*Lei de Paridade*) will strongly contribute to greater opportunity for voice and participation by women.[270]

In Cabo Verde, the lead governmental organization for gender issues is the Cabo Verdean Institute for Gender Equality (ICIEG) established in 1994 and the Institute for the Status of Women. ICIEG is responsible for advancing government policies for equal rights for women and men.

The GoCV 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. At the international level, Cabo Verde was one of the first countries to ratify the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) signed in December 1980 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 Caïro Action Plan, the Solemn Declaration on Gender Equality in Africa and the Beijing Platform for Action, among others.

The 1980 country's Constitution recognizes the participation in society of all citizens as a fundamental right and specifically guaranteeing equal employment rights to men and women in its Art 1.2. The constitution —adopted in 1980 and revised in 1992, 1995 and 1999— defines the basic principles of its government. The Constitution has been amended and update most recently in 2010. To date, the Government has enacted

[267] Women participation in Politics, www.iknowpolitics.org
[268] Cabo Verde Gender Country Profile, AfDB, 2018.
[269] "UN Human Development Indicators: Cabo Verde," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/CPV
[270] Cabo Verde Gender Country Profile, AfDB, 2018.

a number of laws to ensure the protection and promotion of the rights of women and children and to create an enabling environment to ensure inclusive participation in the country's development.[271]

The GoCV, through its policy, institutional and legal frameworks has significantly advanced women's rights and opportunities in recent years. Furthermore, women's participation in certain nominated posts has increased and the next step for the government is pushing for more representation in local community associations and city councils. As a result, there are more opportunities for women that will certainly drive greater participation in the off-grid sector for women. In the energy sector, efforts have been made to implement measures under the regional framework, ECOWAS Policy for Gender Mainstreaming in Energy Access that is committed to promoting favorable policies and frameworks and mobilizing resources to more fully engage women in all areas of energy access.[272]

2.4.2 Gaps in the Gender Policy/Legal Framework

Despite the Government's policies and legislative reforms, women still face barriers to inclusive participation in economic participation as well as socio-culturally. This is particularly true for women in rural areas vis-à-vis access to and ownership of land.

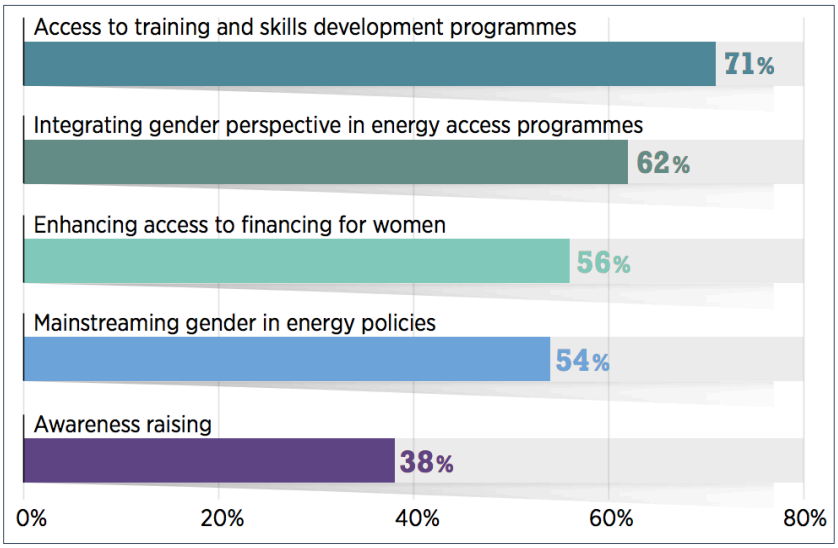
2.5 Summary of Recommendations

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.[273]

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.[274]

[271] These include the National Plan for Gender Equality and Equity (PNIEG) which is implemented under the vision for Cabo Verde for the period 2011-2016, the third Gender Plan (the Plano Nacional de Igualdade Género (PNIG) 2015-2018, Criminal Code (2004) specifically criminalizing Domestic violence, the Family Code (1997), the National Action Plan to fight Gender Violence (Plano Nacional de combate à viôencia baseada no Généro (2015-2018), and the Gender Equality Action Plan (2011-2012) among others.
[272] "Situation Analysis of Energy and Gender Issues in ECOWAS Member States," ECREEE, (2015).
[273] "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
[274] 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 Cabo Verde's energy sector:[275]

- Commitment for social provision of care services through the 9th Program Legislature and the PNIG
- Finalization and implementation of the parity law
- 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 (e.g. through ICIEG and INE) to collect, synthesize and publish gender-specific/sex-disaggregated data to inform public policy development on inclusive participation
- 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.[276]

[275] 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

[276] "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

GreenMax Senior Consultant, José Oliveira Da Fonseca (center, background), with ROGEP focus group participants in Praia, Cabo Verde, in June 2018.

An off-grid village in the settlement of Lagoa on the island of Santiago, Cabo Verde.

REFERENCES

Acumen, 2018, "Accelerating Energy Access: The Role of Patient Capital," https://acumen.org/wp-content/uploads/Accelerating-Access-Role-of-Patient-Capital-Report.pdf

African Development Bank, 2014, "Cape Verde Country Strategy Paper: 2014-2018," https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2014-2018_-_Cape_Verde_Country_Strategy_Paper__Draft_Version_.pdf

African Development Bank, 2018, "Cabo Verde Economic Outlook," https://www.afdb.org/en/countries/west-africa/cabo-verde/cabo-verde-economic-outlook/

African Development Bank Group, 2015, "Summary of the Environmental and Social Management Plan," https://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/Resume_PGES_CaboVerde_DevelopReseauTransportDistribution_ORQR_final-_EN.pdf

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

Banco de Cabo Verde, 2016, "Inquérito à Literacia Financeira da População Adulta Activa Cabo Verde," http://www.bcv.cv/vPT/Consumidores/operacoescambiaisesobreoouro/Documents/2016/Relat%C3%B3rio_%20Inqu%C3%A9rito%20sobre%20o%20nivel%20de%20literacia%20financeira.pdf

Banco de Cabo Verde, 2017, "Financial Stability Report 2017," http://www.bcv.cv/SiteCollectionDocuments/2019/2017_REF_vEN.pdf

Banco de Cabo Verde, 2017, "Regulação e Supervisão das Microfinanças: Processo the Transformação," http://www.bcv.cv/vPT/Supervisao/SupervisaoMicroFinancas/Legislacao/Documents/Altera%C3%A7%C3%A3o%20%C3%A0%20Lei%20de%20Microfinan%C3%A7as%202017.pdf

Bavier, J., 2018, "Off-grid power pioneers pour into West Africa," Reuters, https://www.reuters.com/article/us-africa-power-insight/off-grid-power-pioneers-pour-into-west-africa-idUSKCN1G41PE

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

Bloomberg New Energy Finance, 2016, "How can Pay-As-You-Go Solar Be Financed?" https://www.bbhub.io/bnef/sites/4/2016/10/BNEF_WP_2016_10_07-Pay-as-you-go-solar.pdf

Brito H., 2011, "Facing the needs of rural electrification, presentation Vienna Energy Forum," Stoffstrom, http://www.stoffstrom.org/fileadmin/userdaten/dokumente/Veranstaltungen/KWK11/11.00_1_Praesentation_Jose_Brito_Kapverden.pdf

Cabeólica S.A., 2018, "Annual Report 2017," http://www.cabeolica.com/site1/about-us/annual-reports/

Dahlberg Advisors and Lighting Global, 2018, "Off-Grid Solar Market Trends Report, 2018," https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

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

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2016, "Photovoltaics for Productive Use Applications: A Catalogue of DC-Appliances," https://www.sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/GIZ__2016__Catalogue_PV_Appliances_for_Micro_Enterprises_low.pdf

ECOWAS Center for Renewable Energy and Energy Efficiency, 2015, "Action agenda for sustainable energy for all Cabo Verde," https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_AAs/Action_Agenda_Sustainable_Energy_4_All_SE4ALL_CBV_-_Eng.pdf

ECOWAS Center for Renewable Energy and Energy Efficiency, 2015, "ECOWAS Program on Access to Sustainable Electricity Services," http://www.ecreee.org/sites/default/files/epases_document_final.pdf

ECOWAS Center for Renewable Energy and Energy Efficiency, 2015, "ECOWAS Renewable Energy Policy," http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf

ECOWAS Center for Renewable Energy and Energy Efficiency, 2018, "ECREEE And Donor Partners Strategize To Improve Governance Of The Sustainable Energy And Energy Efficiency Sector In West Africa," http://www.ecreee.org/news/ecreee-and-donor-partners-strategize-improve-governance-sustainable-energy-and-energy

ECOWAS Observatory for Renewable Energy and Energy Efficiency (ECOWREX), 2012, "Implementation of a PV rural micro grid in the island of Santo Antao (Cabo Verde) with an individual energy allowance scheme for demand control," http://www.ecowrex.org/system/files/documents/2012_implementation-of-pv-rural-micro-grid-in-santo-antao-Cabo-verde_matteo-briganti.pdf

ELECTRA S.A.R.L., 2018, "Relatorio e Contas 2017," http://www.electra.cv/index.php/2014-05-20-15-47-04/relatorios-sarl

ESI Africa, 2018, "Feasibility study promotes women's participation in energy transition," https://www.esi-africa.com/feasibility-study-promotes-womens-participation-in-energy-transition/

Estado de Cabo Verde, 2016, "Programa do Governo IX Legislatura," http://www.governo.cv/index.php/programa-do-governo

European Commission and Government of Cabo Verde, 2014, "National Indicative Programme 2014-2020, 11th European Development Fund," https://cdn2-eeas.fpfis.tech.ec.europa.eu/cdn/farfuture/ybxDr7aNom34kh1LbKm_CojtDX9WHGzl3GHydWtTqy8/mtime:1477656013/sites/eeas/files/nip-Cabo-verde-edf11-2014_en.pdf

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

Évora R., 2017, "JICA Knowledge Co-Creation Program Country Report Cabo Verde," Japan International Cooperation Agency, https://eneken.ieej.or.jp/data/7460.pdf

Food and Agriculture Organization of the United Nations, “Family Farming Knowledge Platform, Smallholders DataPortrait,” http://www.fao.org/family-farming/data-sources/dataportrait/farm-size/en/

Foster, V., and Steinbuks, J., 2009, “Paying the Price for Unreliable Power Supplies: In-House Generation of Electricity by Firms in Africa,” World Bank Policy Research Working Paper, https://openknowledge.worldbank.org/handle/10986/4116

Global Environment Facility, 2016, “Promotion of Small and Medium-Sized Renewable Energy Systems in Cabo Verde,” https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results/spacial-itemid-project-detailpage.html?view=projectdetail&id=23114

Global Environment Facility and United Nations Development Programme, 2015,” Cabo Verde Programme Strategy (2015-2018),” https://sgp.undp.org/all-documents/country-documents/619-op6-sgp-Cabo-verde-country-programme-strategy/file.html

Government of Cabo Verde, ECOWAS Center for Renewable Energy and Energy Efficiency, United Nations Industrial Development Organization, 2015, “Report on Suitable Isolated Communities for Decentralized Renewable Energy Systems -Cabo Verde”

Grimm, M., Harwig, R., Lay, J.,2012, “How much does Utility Access matter for the Performance of Micro and Small Enterprises?” World Bank, 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

GSMA, 2017, “The Mobile Economy: Sub-Saharan Africa,” https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download

GSMA Intelligence, 2018, “The Mobile Economy: West Africa 2018,” https://www.gsmaintelligence.com/research/?file=e568fe9e710ec776d82c04e9f6760adb&download

Independent, 2017, “Cabo Verde: African island nation plans to run on 100% renewable energy by 2025,” https://www.independent.co.uk/news/world/africa/Cabo-verde-renewable-energy-100-per-cent-africa-island-total-environment-climate-change-sea-levels-a8043946.html

Instituto Nacional de Estadística, 2017, “Anuario Estatistico Cabo Verde 2016,” http://ine.cv/wp-content/uploads/2017/11/aecv-2016.pdf

Instituto Nacional de Estadística, 2017, “Mulheres e Homens em Cabo Verde Factos e Numeros,” http://ine.cv/wp-content/uploads/2018/03/mulheres-e-homens-em-cabo-verde-factos-e-numeros-2017.pdf

International Energy Agency, 2017, “Energy Access Outlook, 2017: From Poverty to Prosperity,” https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf

International Finance Corporation, “How Movable Collateral Gets Credit Moving,” https://www.ifc.org/wps/wcm/connect/7b0e2e804782fbfa9644f7299ede9589/How+movable+collateral+gets+credit+moving.pdf?MOD=AJPERES

International Finance Corporation, 2017, “MSME Finance Gap,” https://finances.worldbank.org/Other/MSME-Finance-Gap/ijmu-5v4p/data; and https://www.smefinanceforum.org/sites/default/files/Data%20Sites%20downloads/MSME%20Report.pdf

International Monetary Fund, 2013, “Cabo Verde, Namibia and Kingdom of Swaziland: Selected Issues Paper,” https://www.imf.org/external/pubs/ft/scr/2013/cr13292.pdf

International Monetary Fund, 2016, "Cabo Verde: IMF Country Report No. 16/367," https://www.imf.org/external/pubs/ft/scr/2016/cr16367.pdf

International Monetary Fund, 2018, "Cabo Verde: IMF Country Report No. 18/105," https://www.imf.org/en/Publications/CR/Issues/2018/04/18/Cabo-Verde-Selected-Issues-Paper-45804

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

LuxDev, 2015, "Cabo Verde: Étude de diagnostic du sous-secteur des énergies renouvelables," https://luxdev.lu/files/documents/Etude_diagnostic_inititat_ER_CVE_avril_2015.pdf

LuxDev, 2017, "Strengthening the regional positioning of the Center for Renewable Energy and Industrial Maintenance of Cabo Verde – CV881," https://caboverde.luxdev.lu/en/activities/project/CVE/881

LuxDev, 2018, "Partnership between the Center for Renewable Energies and Industrial Maintenance (CERMI) and the Center of competence-Technical Engineering of Luxembourg (CdC-GTB) – CV0085," https://caboverde.luxdev.lu/en/activities/project/CVE/085

Netherlands Enterprise Agency, 2017, "Cabo Verde: Multi-Sector Market Study Focused on Tourism Value Chain Development," https://www.rvo.nl/sites/default/files/2017/08/Cape%20Verde%20Multi-Sector%20Market%20Report_Focus%20Tourism_pub.pdf

Santiago Magazine, 2017, "Micro-creditos Governo e bancos comerciais abrem linha de credito de 100 mil contos," http://www.santiagomagazine.cv/index.php/economia/514-micro-financa-governo-e-bancos-comerciais-abrem-linha-de-credito-de-100-mil-contos

Scaling Off-Grid Energy: A Grand Challenge for Development, 2018, "Scaling Access to Energy in Africa: 20 Million Off-Grid Connections by 2030," US Agency for International Development, UK Department for International Development, Shell Foundation, https://static.globalinnovationexchange.org/s3fs-public/asset/document/SOGE%20YIR_FINAL.pdf?uwUDTyB3ghxOrV2gqvsO_r0L5OhWPZZb

United Nations, 2017, "Household Size and Composition Around the World," https://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf

United Nations Conference on Trade and Development, 2018, "Investment Policy Review: Cabo Verde," https://unctad.org/en/PublicationsLibrary/diaepcb2018d2_en.pdf

United Nations Development Programme and ETH Zurich, 2018, "Derisking Renewable Energy Investment: Off-Grid Electrification," https://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Strategies/DREI%20Off-Grid%20Electrification%20-%20Full%20Report%20(20181210).pdf

United Nations Environment Programme, 2015, "Energy Profile Cabo Verde," http://wedocs.unep.org/bitstream/handle/20.500.11822/20498/Energy_profile_Cabo%20Verde.pdf?sequence=1&isAllowed=y

United Nations Industrial Development Organization, "Bringing solar power to rural areas of Cabo Verde," https://www.unido.org/news/bringing-solar-power-rural-areas-cabo-verde

United Nations Industrial Development Organization and ECOWAS Center for Renewable Energy and Energy Efficiency, "Promoting Market Based Development of Small to Medium Scale Renewable Energy Systems In Cape Verde: Energy Analysis and Recommendation," http://www.ecreee.org/sites/default/files/unido-ecreee_report_on_cape_verde.pdf

United Nations Industrial Development Organization and ECOWAS Centre for Renewable Energy and Energy Efficiency, 2010, "Cabo Verde Energy Analysis and Recommendation," http://www.ecreee.org/sites/default/files/unido-ecreee_report_on_Cabo_verde.pdf

United Nations Women, 2018, "Cabo Verde: Country Gender Profile," http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/country-gender-profile-Cabo-verde-en.pdf?la=en&vs=1331

United Nations Women, 2018, "Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Development," http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/sdg-report-fact-sheet-sub-saharan-africa-en.pdf?la=en&vs=3558

United States Agency for International Development – National Renewable Energy Laboratory and Energy 4 Impact, 2018, "Productive Use of Energy in African Micro-Grids: Technical and Business Considerations," https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/productive_use_of_energy_in_african_micro-grids.pdf

Universitat Politecnica de Catalunya Barcelonatech, 2014, "Renewable energy project to electrify rural communities in Cabo Verde," https://pdfs.semanticscholar.org/e733/0cd3f444dbabeb7a49dee0fec74eaea8d48b.pdf

World Bank, 2016, "Competitiveness for Development Tourism Project, Project Appraisal Document," http://documents.worldbank.org/curated/en/784941468196144217/pdf/PAD1347-PAD-P146666-IDA-R2016-0069-1-OUO-9.pdf

World Bank, 2017, "Cabo Verde: Access to Finance for MSMEs (P163015)," http://documents.worldbank.org/curated/en/825171511262268770/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Cabo-Verde-Access-to-Finance-for-MSMEs-P163015-Sequence-No-00.pdf

World Bank, 2018, "Cabo Verde: Access to Finance for Micro, Small and Medium Enterprises: Project Appraisal Document," http://documents.worldbank.org/curated/en/640541519162779286/pdf/P163015-Approved-PAD-Final-3-01292018.pdf

World Bank, 2018, "Cabo Verde: Distributed Solar Energy System, Project Document," http://documents.worldbank.org/curated/en/838921513954732796/pdf/Disclosable-Restructuring-Paper-Cabo-Verde-Distributed-Solar-Energy-Systems-SIDS-DOCK-P151979.pdf

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

World Bank, 2018, "Republic of Cabo Verde: Adjusting the Development Model to Revive Growth and Strengthen Social Inclusion," http://documents.worldbank.org/curated/en/875821538129394201/pdf/130289-REPLACEMENT-PUBLIC-WB-Cabo-Verde-English-WEB.pdf