WORLD BANK GROUP

ECREEE

TOWARDS SUSTAINABLE ENERGY

REGIONAL OFF-GRID ELECTRIFICATION PROJECT

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

GUINEA REPORT

JULY 2019

GreenMax Capital Advisors

Energio Verda
Renewable Energy for Development

ASD

TABLE OF CONTENTS

LIST OF FIGURES 5
LIST OF TABLES 7
ABBREVIATIONS & ACRONYMS 9
ACKNOWLEDGEMENTS 12
KEY DEFINITIONS 14
EXECUTIVE SUMMARY 17

I. STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT 37

1.1 Country Overview 37
1.2 Energy Market 37
1.2.1 Energy Sector Overview 37
1.2.2 Electricity Access: *Grid and Off-Grid* 39
1.2.2.1 Off-Grid Market Overview 39
1.2.2.2 Demand and Supply/Generation Mix 41
1.2.2.3 Transmission and Distribution Network 42
1.2.2.4 Least-Cost Electrification Analysis 47
1.2.2.5 Inclusive Participation 55
1.2.3 Key Challenges 56
1.3 National Policy and Regulation 59
1.3.1 National Electricity/Electrification Policy 59
1.3.2 Integrated National Electrification Plan 60
1.3.3 Energy and Electricity Law 60
1.3.4 Framework for Stand-alone Systems 61
1.3.4.1 Existence of Specific National Programs 63
1.3.4.2 Financial Incentives 63
1.3.4.3 Standards and Quality 63
1.3.4.4 Concession Contracts and Schemes 63
1.3.4.5 Specific Business Model Regulation 63
1.3.5 Capacity Building and Technical Assistance 66
1.4 Development Initiatives 71
1.4.1 National Government Initiatives 71
1.4.2 DFI and Donor Programs 71
1.4.3 Other Initiatives 72

II. OFF-GRID SOLAR PV MARKET ASSESSMENT 73

2.1 Demand – Households 74
2.1.1 Overview of Household Market Segment 74
2.1.2 Analysis of Household Market Segment Demand 80
2.1.3 The Market for Household Devices without Consumer Finance 88
2.1.4 The Financed Market for Off-Grid Solutions 91
2.1.5 Consumer Perceptions, Interest and Awareness 95
2.2 Demand – Institutional 97
2.2.1 Overview of Institutional Market Segment 97
2.2.2 Analysis of Institutional Market Segment Demand 97
2.2.3 Ability to Pay and Access to Finance 101
2.3 Demand – Productive Use 102
2.3.1 Overview of Productive Use Market Segment 102
2.3.2 Analysis of Productive Use Market Segment Demand 105
2.3.3 Ability to Pay and Access to Finance 113
2.4 Supply Chain 114
2.4.1 Overview of Commercial Market for Solar PV Equipment 114
2.4.2 Overview of OGS Companies in Africa and Level of Interest in the Region 116
2.4.3 Solar Market, Products and Companies in Guinea 118
2.4.4 Overview of Business Models 120
2.4.5 The Role of Non-Standard Players in the Market 122
2.4.6 Equipment Quality and the Impact of Uncertified Equipment 123
2.4.7 Local Capacity to Manage Business Development, Installation and Maintenance 123
2.4.8 Capacity Building Needs of the Supplier Market Segment 124
2.5 Key Market Characteristics 126
2.5.1 Barriers to Off-Grid Solar Market Growth 126
2.5.2 Drivers of Off-Grid Solar Market Growth 127
2.5.3 Inclusive Participation 128

III. ANALYSIS OF THE ROLE OF FINANCIAL INSTITUTIONS 130

3.1 Introduction to Financial Products for the Off-Grid Sector 130

3.1.1 Financial Products for End-Users 130

3.1.2 Financial Products for Suppliers/Service Providers 131

3.2 Financial Market Overview 133

3.2.1 Market Structure 133

3.2.2 Financial Inclusion 139

3.2.3 Commercial Lending Environment 149

3.2.4 Lending to the Off-Grid Solar Sector 153

3.2.4.1 Programs Supporting Financial Institutions in Off-Grid Solar Lending 153

3.2.4.2 Key Barriers to Off-Grid Solar Lending 154

3.3 Financial Institutions 156

3.3.1 Development Finance Institutions 156

3.3.2 Microfinance Institutions 157

3.3.3 Informal Financial Institutions 159

3.3.4 Crowd Funders 159

3.4 Summary of Findings 161

ANNEX 1: TASK 1 METHODOLOGY 166

ANNEX 2: TASK 2 METHODOLOGY 170

ANNEX 3: TASK 3 METHODOLOGY 186

ANNEX 4: GENDER ASSESSMENT 188

REFERENCES 197

LIST OF FIGURES

Figure 1: Rates of Electricity Access and Poverty 40
Figure 2: Electricity Transmission and Distribution Network 43
Figure 3: Mini-Grid and Off-Grid Systems 44
Figure 4: Access to Reliable Electricity by Firms and Households in Africa 45
Figure 5: Reliability of Grid Electricity in Connected Households in Africa 46
Figure 6: Population Density, 2014 48
Figure 7: Distribution of Settlements by Least-Cost Electrification Option, 2023 50
Figure 8: Distribution of Settlements by Least-Cost Electrification Option, 2030 51
Figure 9: Identified Social Facilities for On-Grid, Mini-Grid and Stand-alone Solutions, 2023 and 2030 52
Figure 10: Distribution of Potential Off-Grid Social Facilities, 2023 and 2030 53
Figure 11: Estimated Number of Households and Share of Population Suitable for OGS Systems, 2023 and 2030 54
Figure 12: Rates of Enrollment in Tertiary Education 55
Figure 13: Commercial/Industrial Tariff in Excess of Residential Tariff in ECOWAS Countries, 2018 57
Figure 14: Policy and Regulatory Framework for Stand-alone Systems 61
Figure 15: Distribution of RISE Electricity Access Scores in Access-Deficit Countries, 2017 62
Figure 16: West Africa Mobile Internet Penetration Rates, 2017 64
Figure 17: Electricity Access and Mobile Phone Ownership in Sub-Saharan Africa, 2016 (% of rural households) 65
Figure 18: Distribution of Potential Off-Grid Households by Region, 2023 77
Figure 19: Distribution of Potential Off-Grid Households by Region, 2030 78
Figure 20: Estimated Number of Off-Grid Households by Region, 2023 and 2030 79
Figure 21: Estimated Percentage of Off-Grid Households by Region, 2023 and 2030 79
Figure 22: Household PV System Descriptions and Market Segments 84
Figure 23: Annual Household Energy Budget by Quintile, Annual Energy Costs and Cost of Solar Equivalents 86
Figure 24: Estimated Number of Households Able to Afford Cash Purchase of OGS Systems by Income Group 89
Figure 25: Estimated Number of Households Able to Afford Financed OGS Systems by Income Group 92
Figure 26: Estimated Off-Grid Solar Cash and Financed Market Potential for Household Sector by System Type 93
Figure 27: Pathways from Electricity to Income Generation 103
Figure 28: Analysis of Cost, Revenue and Profit for Various Off-Grid Productive Use Applications 104
Figure 29: Guinean Firms and Power Reliability 106
Figure 30: Household Percentage Use of Improved Agricultural Inputs by Region 108
Figure 31: Area Suitable for Surface Irrigation and Identified Settlements Suitable for Off-Grid Solar Pumps 109
Figure 32: Estimated Annual Off-Grid Household Expenditure on Lighting and Mobile Phone Charging 111
Figure 33: Mobile Phone Network Geographic Coverage in Guinea 112
Figure 34: Off-Grid Solar Market and Supply Chain Overview 115
Figure 35: Level of Interest in Off-Grid Markets in West Africa and the Sahel among Major Suppliers 117
Figure 36: Key Barriers to Women's Participation in Expanding Energy Access 128

Figure 37: Non-Performing Loans and Credit Growth (% of Total Loans) 135
Figure 38: Banking Sector Liquidity Indicators 136
Figure 39: Banking Sector Profitability Indicators 137
Figure 40: Commercial Bank Credit to Government and Private Sector 138
Figure 41: ATMs and Branches of Commercial Banks per 100,000 Adults in West Africa and the Sahel, 2017 140
Figure 42: Share of Adults with a Mobile Money Account in West Africa and the Sahel (%), 2014 and 2017 141
Figure 43: Mobile Money Transactions per 1,000 Adults in West Africa and the Sahel, 2014 and 2017 142
Figure 44: Share of Adults with Access to Financial Services in West Africa and the Sahel (%), 2011 and 2017 143
Figure 45: Guinean Firms Access to Finance (%) 144
Figure 46: Use of Financial Services among Guinean Firms, 2016 144
Figure 47: Access to Finance Indicators 145
Figure 48: Penetration of Mobile Money and Bank Accounts at Financial Institutions (% of population) 146
Figure 49: Financial Inclusion Gender Gap in Guinea 148
Figure 50: Gender Gap in Mobile Money, 2017 148
Figure 51: Select Interest Rates 150
Figure 52: Average GNF-USD Exchange Rates 151
Figure 53: DFI Investment in West African Countries, 2005-2015 156
Figure 54: Share of Adults Saving in the Past Year (%), 2017 160

LIST OF TABLES

Table 1: Macroeconomic and Social Indicators 37
Table 2: Institutional and Market Actors in the Energy Sector 38
Table 3: Electricity Sector Indicators, 2017 41
Table 4: Average Electricity Tariffs and Production Costs, 2016 41
Table 5: Results of Least-Cost Electrification Analysis 49
Table 6: Estimated Share of Installed Capacity from Off-Grid Sources, 2030 54
Table 7: Planned Electricity Connections and Corresponding Investments 60
Table 8: Gaps in the Off-Grid Policy and Regulatory Framework 66
Table 9: DFI and Donor-Funded Off-Grid Development Programs 71
Table 10: Indicative Total Cash Market Potential for Off-Grid Solar PV Products in Guinea, 2018 73
Table 11: Household Consumer Market Segments 75
Table 12: Poverty Headcount in Guinea, 2012 76
Table 13: Rural Energy Technology and Costs 81
Table 14: Typical Tier-Based Energy Costs 82
Table 15: Energy Expenditure of Different Income Groups 85
Table 16: Estimated Cash Market Potential for Household Sector 90
Table 17: Estimated Financed Market Potential for Household Sector 94
Table 18: Indicative Total Cash Market Potential for Institutional Sector 97
Table 19: Key Assumptions for Water Supply Sector Analysis 98
Table 20: Estimated Cash Market Potential for Water Supply 98
Table 21: Key Assumptions for Healthcare Sector Analysis 98
Table 22: Health Facility Categorization and Electricity Demand 99
Table 23: Estimated Cash Market Potential for Healthcare Facilities 99
Table 24: Key Assumptions for Education Sector Analysis 100
Table 25: Education Center Categorization and Electricity Demand 100
Table 26: Estimated Cash Market Potential for Primary and Secondary Schools 100
Table 27: Key Assumptions for Public Lighting Sector Analysis 101
Table 28: Estimated Cash Market Potential for Public Lighting 101
Table 29: Overview of Productive Use Applications 104
Table 30: Indicative Total Cash Market Potential for Productive Use Sector 105
Table 31: Estimated Cash Market Potential for SMEs – Barbers and Tailors 107
Table 32: Estimated Cash Market Potential for Value-Added Applications – Irrigation 108
Table 33: Estimated Cash Market Potential for Value-Added Applications – Milling 110
Table 34: Estimated Cash Market Potential for Value-Added Applications – Refrigeration 110
Table 35: Estimated Cash Market Potential for Mobile Phone Charging Enterprises 113
Table 36: Solar Company Tier Classification 114

Table 37: Off-Grid Solar Products and Components in Guinea 119
Table 38: Estimated Prices of Solar Systems and Components in Guinea 119
Table 39: Overview of Off-Grid Solar Business Models 121
Table 40: Evolving Off-Grid Solar Business Models 122
Table 41: Capacity Building and Technical Assistance for the OGS Supply Chain in Guinea 125
Table 42: Key Barriers to Off-Grid Solar Market Growth in Guinea 126
Table 43: Key Drivers of Off-Grid Solar Market Growth in Guinea 127
Table 44: Licensed Financial Institutions, 2017 133
Table 45: Market Shares of Banks in Guinea 134
Table 46: Deposit Money Banks Assets and Liabilities (GNF billion) 134
Table 47: Banking Sector Asset-Based Indicators 135
Table 48: Banking Sector Capital-Based Indicators 136
Table 49: Banking Sector Profitability Indicators 137
Table 50: Banking Sector Performance Indicators 137
Table 51: Distribution of Credit by Sector 139
Table 52: Mobile Money Service Indicators 146
Table 53: Maturity Structure of Bank Deposits (GNF billion) 149
Table 54: Maturity Structure of Bank Credit (GNF billion) 149
Table 55: Interest Rates 150
Table 56: Official Exchange Rate (GNF-USD) 151
Table 57: Microfinance Sector Financial Indicators 158

ABBREVIATIONS & ACRONYMS

AFD	Agence Française de Développement (French Development Agency)
AfDB	African Development Bank
AGER	Agence Guinéenne pour l'Electrification Rurale (Guinean Agency for Rural Electrification)
ANAMIF	Agence Nationale pour la Microfinance (National Agency for Microfinance)
APB	Association Professionnelle des Banques (Professional Association of Banks)
APER	Association des Professionnels des Énergies Renouvelables (Professional Renewable Energy Association)
APIMG	Association Professionnelle des Institutions de Microfinance en Guinée (Professional Association of Microfinance Institutions in Guinea)
ARSEE	Autorité de Régulation du Secteur de l'Eau et de l'Electricité (Regulatory Authority of the Water and Electricity Sector
ASD	African Solar Designs
BCRG	Banque Centrale de la République de Guinée (Central Bank of the Republic of Guinea)
BERD	Bureau d'Electrification Rurale Décentralisée (Decentralized Rural Electrification Bureau)
BICIGUI	Banque Internationale pour le Commerce et l'Industrie (International Bank for Trade and Industry)
BOAD	Banque Ouest Africaine de Développement (West African Development Bank)
C&I	Commercial and Industrial
CAPEX	Capital Expenditure
CAR	Capital Adequacy Ratio
CEADIR	Climate Economic Analysis for Development, Investment and Resilience
COD	Cash-on-Delivery
CSLG	Côte d'Ivoire, Liberia, Sierra-Leone and Guinea
DEG	Deutsche Investitions-und Entwicklungsgesellschaft (German Investment and Development Company)
DER	Division Énergies Renouvelables (Renewables Energy Divisions)
DFI	Development Finance Institution
DNE	Direction Nationale de l'Energie / National Directorate of Energy
DRSPII	Guinea Poverty Reduction Strategy
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
EDG	Electricité De Guinée (Electricity Company of Guinea)
ESMAP	Energy Sector Management Assistance Program
FERD	Fonds d'Électrification Rural Décentralisée (Fund for Decentralized Rural Electrification)
EU	European Union
EUR	Euro
EVA	Energio Verda Africa
FAO	Food and Agriculture Organization of the United Nations
FEI	Facility for Energy Inclusion
FGD	Focus Group Discussion
FI	Financial Institution

FONDEM	Fondation Énergies pour le Monde
FX	Foreign Exchange
GDP	Gross Domestic Product
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit / German Corporation for International Cooperation
GNF	Guinée Nouveau Franc (Guinean Franc)
GNI	Gross National Income
GoG	Government of Guinea
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
ICT	Information Communication Technology
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IMF	International Monetary Fund
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
JICA	Japan International Cooperation Agency
kW	Kilowatt
kWh	Kilowatt-hour
LPDSE	Lettre de Politique de Développement du Secteur de l'Energie (Policy Letter on the Development of the Energy Sector)
LTO	Lease-to-Own
MEBD	Marché aux enchères en devises (foreign exchange auction market)
MOE	Ministry of Energy / Ministère de l'Energie
MFI	Microfinance Institution
MTF	Multi-Tier Energy Access Framework
MW	Megawatt
NGO	Non-Governmental Organization
NPL	Non-Performing Loan
O&M	Operations and Maintenance
OGS	Off-Grid Solar
OMVS	Organization pour la Mise en Valeur du fleuve Sénégal (Senegal River Basin Development Organization)
PAYG	Pay-As-You-Go
PERD	Programme d'Électrification Rurale Décentralisée (Decentralized Rural Electrification Program)
PNDES	Plan National de Développement Economique et Social (National Economic and Social Development Plan)
PNER	Plan National d'Électrification Rurale (National Rural Electrification Program)
PPER	Projets d'Électrification Rurale Prioritaires (Priority Rural Electrification Projects)
PPP	Public Private Partnership
PRONIASE	Programme National Intégré d'Accès aux Services Energétique (National Program for Integrated Access to Energy Services)
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
SGBG	Société Générale de Banques en Guinée
SHS	Solar Home System
SME	Small and Medium Enterprise
SNFI	Stratégie Nationale d'Inclusion Financière (National Financial Inclusion Strategy)
SOGEL	Société Guinéenne d'Electricité (Guinea Electricity Company)
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
WAEMU	West African Economic and Monetary Union
WAPP	West African Power Pool
WB	World Bank
Wh	Watt-hour
Wp	Watt peak
ZER	Zones d'Electrification Rurale (Rural Electrification Zones)

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 Guinea for their assistance:

Dr. Cheick T. Sylla, Sanfina Diakité, and Soriba Surcouf Bangoura, Ministère de l'Énergie (MOE);
Direction Nationale de l'Énergie (DNE); N'Faly Yombouno, Division Énergies Renouvelables (DER) de la DNE;
Aboubacar Kaloko, Directeur Général, Agence Guinéenne de l'Électrification Rurale (AGER),
Mamadou Saïdou Diallo, Directeur Général Adjoint de l'AGER;
Jacques Loua, Directeur du Fonds d'Électrification Rurale de l'AGER;
Mamadou Lamarana Diallo, Coordonnateur de Projet-Environnement PNUD;
Groupe de la Banque Mondiale;
Institut National de la Statistique;
Ministère de l'Agriculture Bureau de Stratégie et Développement et Programme National de Statistiques Agricoles;
Ministère de l'Élevage et de la Production Animale, Bureau de Stratégie et de Développement;
Ministère de l'Administration du Territoire et des Collectivités Locales;
Ministère de l'Enseignement Technique et de la Formation Professionnelle;
Dr. Rockfeler Herisse, Senior Advisor, United States Agency for International Development (USAID);
Dr. Aboubacar Conté, Directeur National, Ministère de la Santé;
Ibrahima Kalil Touré, Directeur Général, Ministère de l'Enseignement Pré – universitaire / Architecte, Service National des Infrastructures et Équipements Scolaires (SNIES);
Mamadou Baïlo Kaloga, Président de l'Association Professionnelle des Énergies Renouvelables (APER);
Hildeverd Bérété, Secrétaire Général de l'APER;
Amara Camara, Directeur des Études et Travaux de Électricité De Guinée (EDG);
Mamady Keïta, Chef de Service Ingénierie de EDG;
Kalil Kamano, Chef de Service Cartographie de EDG;
Salifou Camara, Ingénieur Cartographe de EDG;
Mamadou Dian Diallo, Inspecteur Régional du Travail à Labé;
Dr. Mamadou Malal Baldé, Directeur Régional de l'Élevage, Labé;
Maïmouna Yombouno Bangoura, Présidente de l'Association Fondation Solidarité Féminine;
Fatoumata Chérif, Présidente de Femmes, Développement et Pouvoirs;
Dr. Mohamed Ansoumane Camara, Chef de Département Génie Électrique, Université Gamal Abdel Nasser (UGAN);
Aliou Doumbouya, Programme de Gestion et d'Économie d'Énergie, au Département Génie Électrique, UGAN; Dr. Maïmouna Dramé, Responsable Chargée de la Formation au Centre de Technologie de la Petite Hydro-électricité (CTPH);
Dr. Mory Traoré, Directeur du CTPH / Chef de Département Génie Civil;
Mamadou Baïlo Kaloga, Directeur Général des Établissements KAMAB, Conakry;
Mohamed Magassouba, Directeur Général de Electricité de la Savane (ELSA), Conakry;
Mamadou Yebhè, Directeur Général de EOL - Guinée, Conakry;

Alsény Sow, Directeur Général de SOLEC ENERGY, Conakry;
Daouda Diallo, Directeur Général de RKOMP ENERGIE SOLAIRE, Conakry;
Hildeverd Bérété, Directeur Général de SOGER, Conakry;
Yaya Baldé, Président de CEBEL SOLAIRE, Conakry;
Mamadou Alpha Sow, Directeur Général de BILARE GROUP SERVICES, Conakry;
Ibrahima Kenda Bah, Directeur Général de 2 H K ENERGIES, Conakry;
Mamadou Djouldé Baldé, Directeur Général de BANTANKO & FRERES, Labé;
Mohamed Traoré, Directeur Général de EGPD, Kindia;
Paul Kolié, assisté par Thierno Aliou Bah, Directeur Général de SOLAR GUINEE, Conakry;
Djiba Doumbouya, Directeur Général de DOUMBOUYA SOLAR ELECTRIC, Kankan;
Abou Kawas Camara, Responsable de Communications, Marketing et Relations Publiques de SODEPER;
Ibrahima Baldé, Directeur Général de EG FIMME, Conakry;
Baîlo Baldé, Directeur Général de BB & FILS, Conakry;
Ismaël Diallo, Directeur Général de SINES, Conakry;
Abdourahmane Diallo, Directeur Général de ARD EQUIPMENTS, Conakry;
Mamoud Challoub, Directeur Général de BATCO ENGINEERING / Assisté par le Consultant en Travaux d'Infrastructures, Gérard Gaumet;
Yves Maigne, Directeur Général de FONDEM / Assisté par l'Assistant Technique, Cyril Durieu;
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 Alkhaly Mohamed Tahey Conde for his 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

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

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

WEST AFRICA AND THE SAHEL

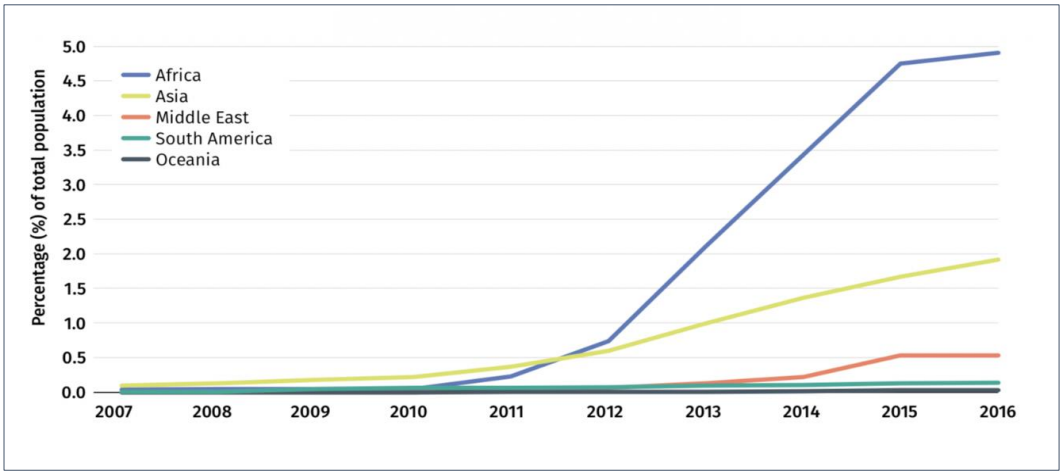
The term "West Africa and the Sahel" as it is used to throughout this report refers to the 19 countries covered by the first phase of the Regional Off-Grid Electrification Project (ROGEP). The countries include the 15 member states of the Economic Community of West African States (ECOWAS) – Benin, Burkina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

EXECUTIVE SUMMARY

I. INTRODUCTION

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

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



Tier 1 access and above

Source: International Renewable Energy Agency

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

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

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

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

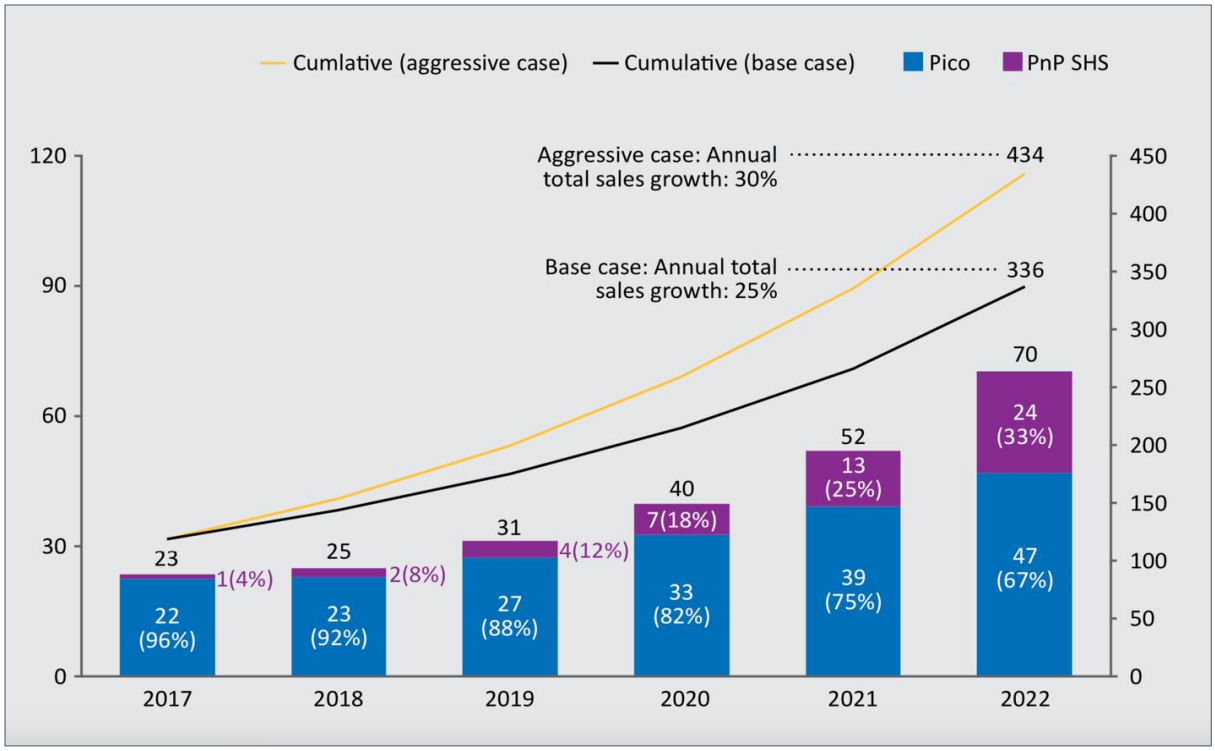
Until recently, diesel generators largely served as the expensive alternative both for rural electrification and for urban and peri-urban "bad grid" areas, where electricity was unreliable or only available for part of the day. However, the advent of decentralized renewable energy technologies, particularly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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

II. BACKGROUND AND CONTEXT OF THE ASSIGNMENT

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

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

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

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

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

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

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

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

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

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

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

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

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

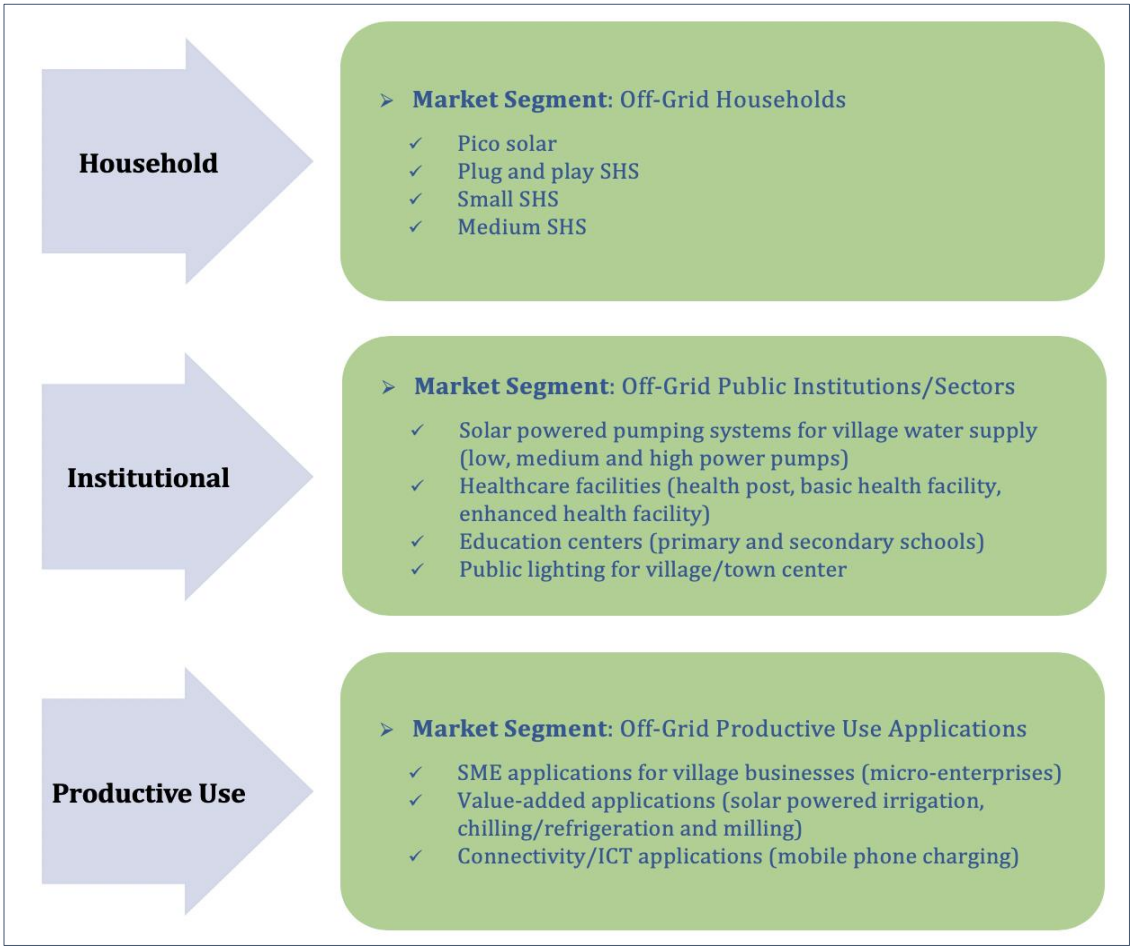
Section 2 estimates the potential market for off-grid solar products and systems by assessing potential demand from the household, institutional and productive use market segments (**Figure ES-3**), followed by an analysis of the supply chain. The household market sizing utilizes results from the least-cost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

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

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

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

Figure ES-3: Analyzed Off-Grid Market Segments



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

III. EXECUTIVE SUMMARY

Guinea is a resource-rich country that has experienced strong economic growth in recent years, with growth driven by the mining and energy sectors. Thanks to increased foreign investment in its vast mineral reserves, the Guinean economy has recovered from the 2014 Ebola outbreak, which caused massive disruptions to development efforts. This growth has not translated into significant improvement for the majority of the population, however, as the country remains one of the poorest in the world. Nearly two-thirds of the population lives in rural areas and three-quarters of the labor force relies on the agricultural sector.

Access to electricity remains an ongoing challenge. In 2016, approximately 80% of the population – an estimated 10 million people – lacked access to electricity, with a significant disparity between rates of access in urban (46%) and rural (1%) areas.[24] Even where grid connections exist, power supply is often unreliable, with fewer than one-fifth of surveyed firms and about one-third of households reporting reliable access to electricity when surveyed.[25] Off-grid electrification is a policy priority for the Government of Guinea (GoG), which is committed to achieving universal access by 2030. To date, the Government's efforts to establish a supportive policy and regulatory framework for the off-grid sector have had moderate success, as evidenced by the country's World Bank Regulatory Indicators for Sustainable Energy (RISE) energy access score. In the 2017 RISE evaluation, Guinea ranked eighth among countries in West Africa and the Sahel.[26]

With support from ECREEE, the Government has outlined its commitments and initiatives to develop renewable energy and meet its electrification targets in its SEforALL National Renewable Energy Action Plan (Plan d'Action National pour les Énergies Renouvelables, PANER). A new electricity law passed in 2017 established the Guinean Agency for Rural Electrification (Agence Guinéenne pour l'Électrification Rurale, AGER) to replace the Decentralized Rural Electrification Bureau (Bureau d'Electrification Rurale Décentralisée, BERD) and oversee the country's electrification programs and initiatives in rural and peri-urban areas. Under the World Bank-funded Decentralized Rural Electrification Project (Programme d'Électrification Rurale Décentralisée, PERD), which ran from 2003 to 2015,[27] BERD facilitated the development of micro-grids (mostly hybrid solar PV-diesel) in rural areas far from the national grid, providing electricity access to 15,000 households.[28] A funding mechanism, the Fund for Decentralized Rural Electrification (Fonds d'Électrification Rurale Décentralisée, FERD), was also established to subsidize the high up-front costs of rural electrification systems. The Government is currently developing a National Rural Electrification Plan (Plan National d'Électrification Rurale, PNER) with support from ECREEE. PNER intends to achieve the country's electricity access objectives through a combination of grid extensions, mini-grids and stand-alone solar systems.

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 Guinea (**Figure ES-4**). According to the assessment, there is a significant OGS market opportunity, with the annualized cash market potential in 2018 estimated to be USD 117 million. The productive use sector (USD 59.1M) makes up the majority of estimated demand, followed by the household (USD 45.7M) and institutional (USD 12.1M) sectors.

[24] IEA Energy Access Outlook, 2017.
[25] 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
[26] "Policy Matters: Regulatory Indicators for Sustainable Energy," World Bank ESMAP, (2018): http://documents.worldbank.org/curated/en/553071544206394642/pdf/132782-replacement-PUBLIC-RiseReport-HighRes.pdf
[27] "Decentralized Rural Electrification Project, Final Assessment Review," World Bank, (2015): http://documents.banquemondiale.org/curated/fr/598521467986262235/pdf/ICRR14655-P074288-Box393183B-PUBLIC.pdf
[28] "Élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement des capacités en planification de l'AGER : Rapport Final Volume 2, Tome 1 (version provisoire)," ECREEE, I2D, (2017).

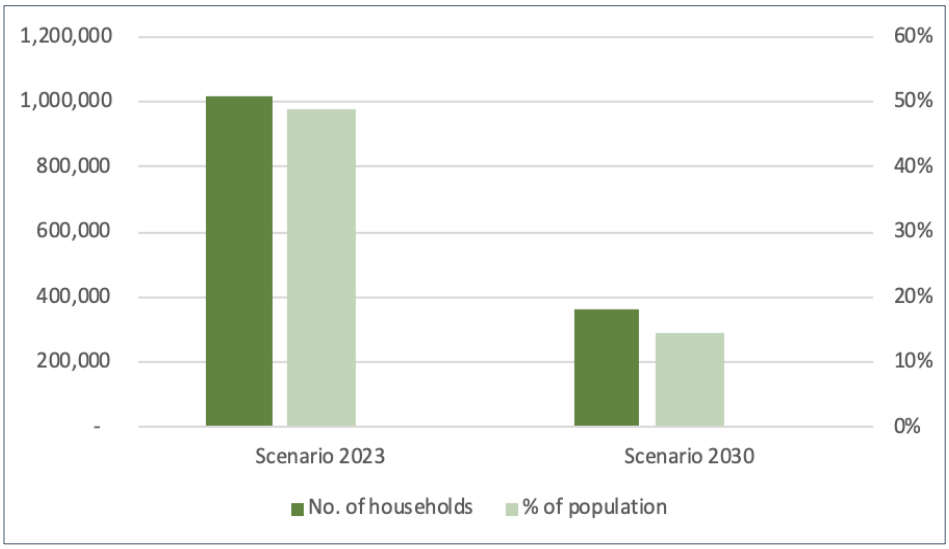
Figure ES-4: Indicative Total Cash Market Potential for Off-Grid Solar Products in Guinea, 2018

Source: African Solar Designs analysis

The least-cost electrification analysis found that by 2023, 286 settlements across Guinea (740,590 households) will be connected to the main grid, representing 35.5% of the population. By 2030, this figure will increase to 3,912 settlements (2,066,994 households), equivalent to 82.8% of the population. These estimates are based on the assumption that all planned grid extensions will be completed by 2030.

In the off-grid sector, the analysis identified 4,944 settlements (1,020,377 households), representing 48.9% of the population in 2023, as suitable for stand-alone systems, decreasing to 2,027 settlements (363,054 households) and 14.6% of the population in 2030 (**Figure ES-5**). While the total size of the OGS market for households will decrease over time, it will also become more concentrated in the remote eastern and western outer regions of the country, with the largest share of off-grid households located in the districts of Kankan, Nzerekore, and Boke in 2030. This has implications for long-term business models of the solar product market, which will need to consider broader distribution areas as the total number of off-grid households declines and becomes concentrated in areas far from urban centers in the southern part of the country.

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

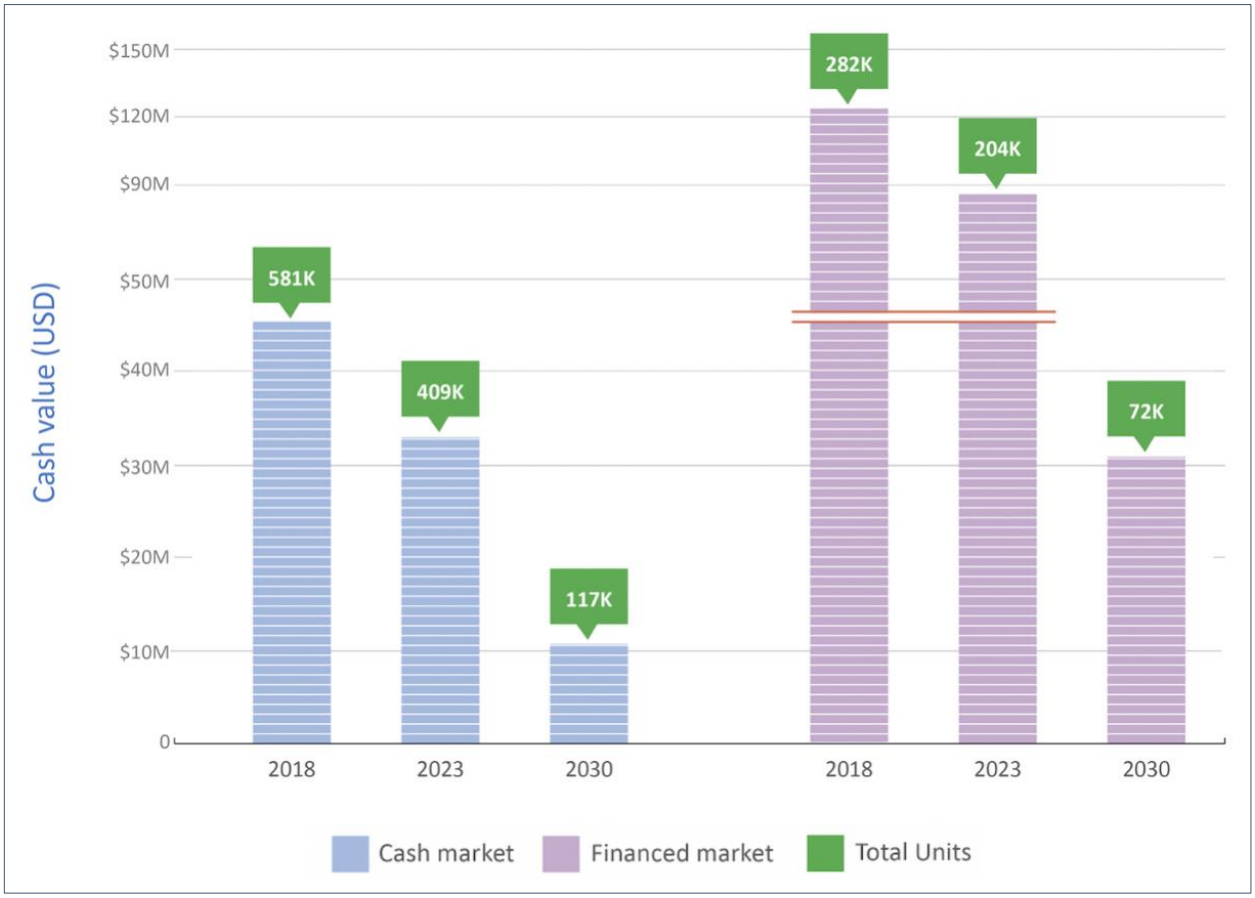


Source: Energio Verda Africa GIS analysis

According to the analysis, the annualized off-grid solar cash market potential for the household sector in 2018 is USD 45.7 million with the estimated market value more than doubling in size to USD 123.6 million with the addition of consumer financing (**Figure ES-6**). Consumer financing allows the poorest households to enter the market and those already in the market to afford larger systems.

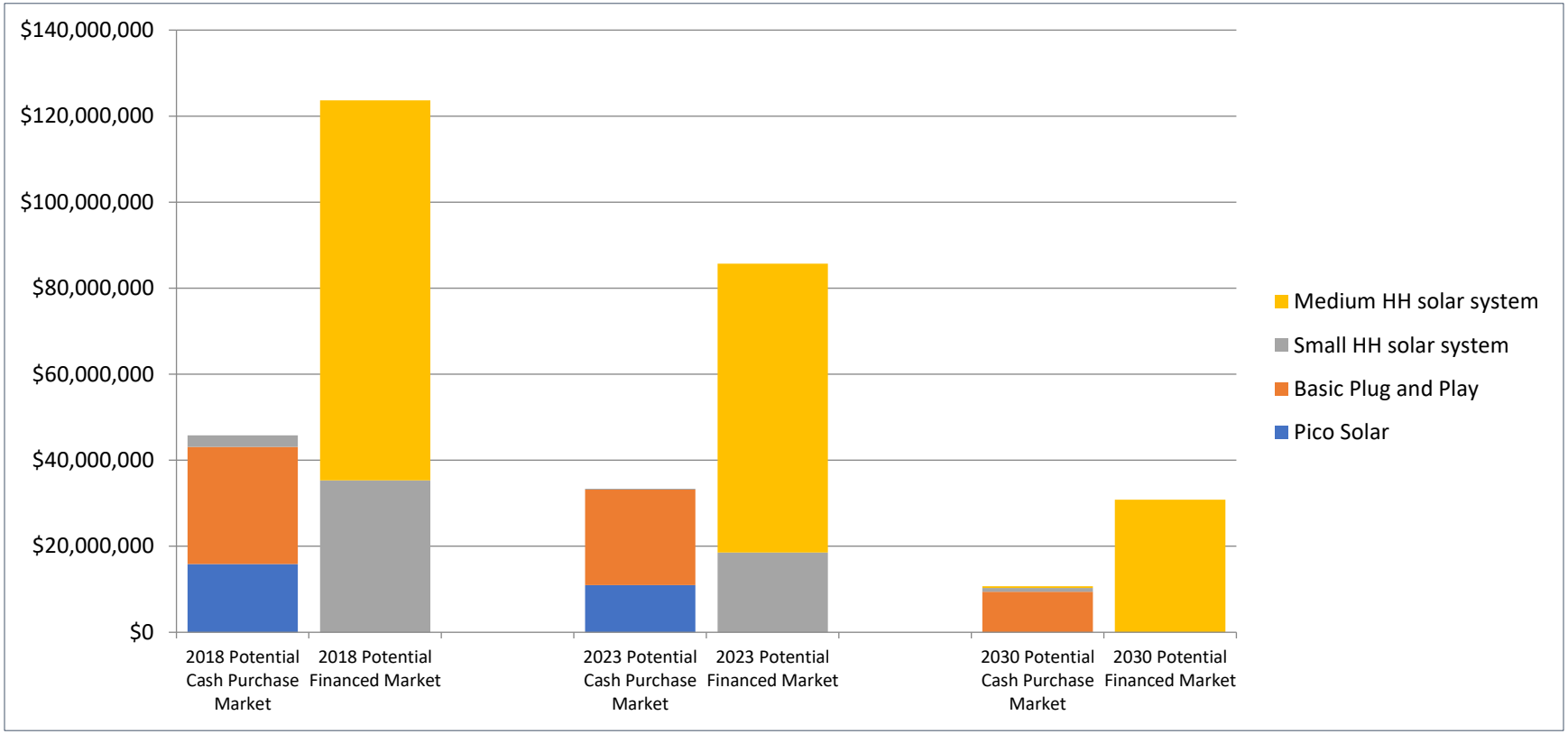
According to the assessment, the most common types of systems the market can afford on a cash basis are pico solar and small plug and play systems; however, this changes significantly with the introduction of financing (**Figure ES-7**). While affordability improves over time, households in the lowest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

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



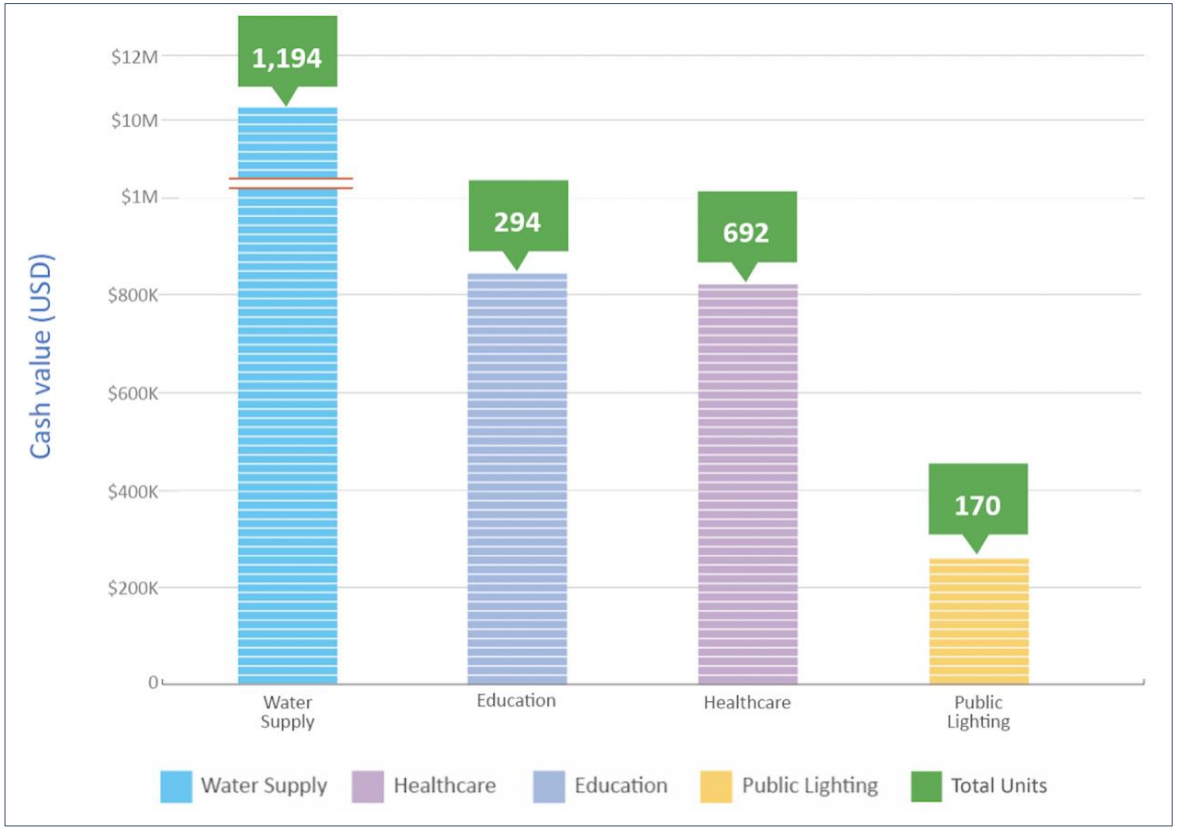
Source: African Solar Designs analysis

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



Source: African Solar Designs analysis

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

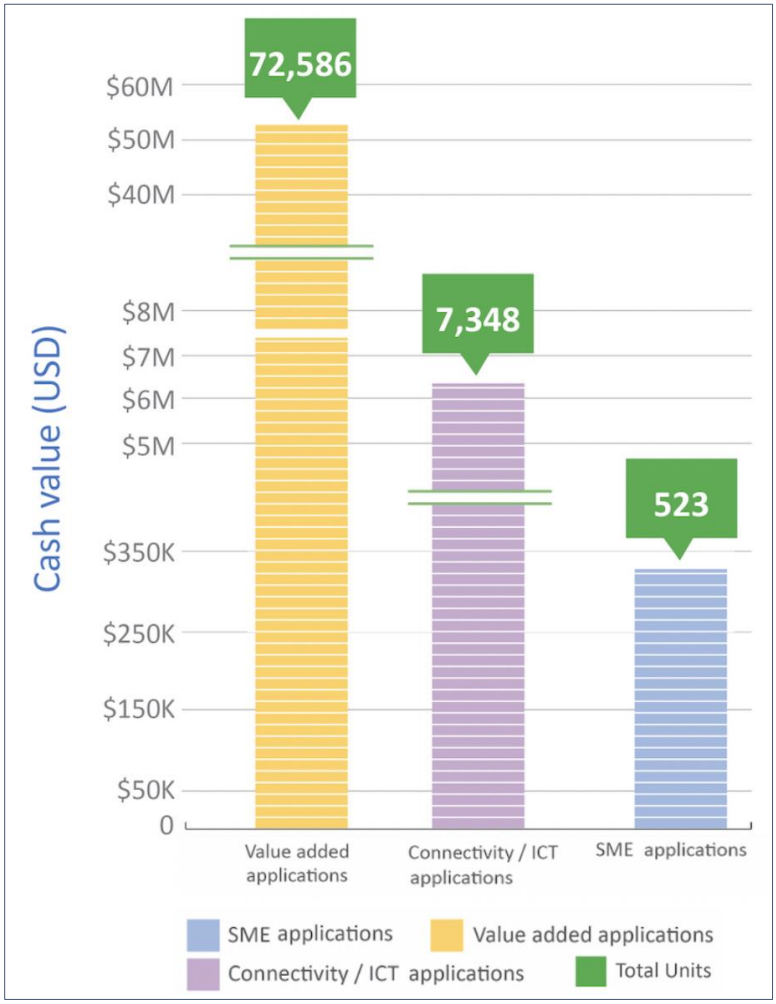


Source: African Solar Designs analysis

The estimated annualized cash market potential for Guinea's public/institutional sector in 2018 is USD 12.1 million (**Figure ES-8**). The institutional market segment with the largest potential is water supply (USD 10.2M), followed by education (USD 839K), healthcare (USD 829K) and public lighting (USD 255K). 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 59.1 million (**Figure ES-9**). The estimated demand from value-added applications (USD 52.4M) represents most of the PUE market potential, followed by applications for connectivity (USD 6.3M) and SMEs (USD 326K).

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



Source: African Solar Designs analysis

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

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

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

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

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

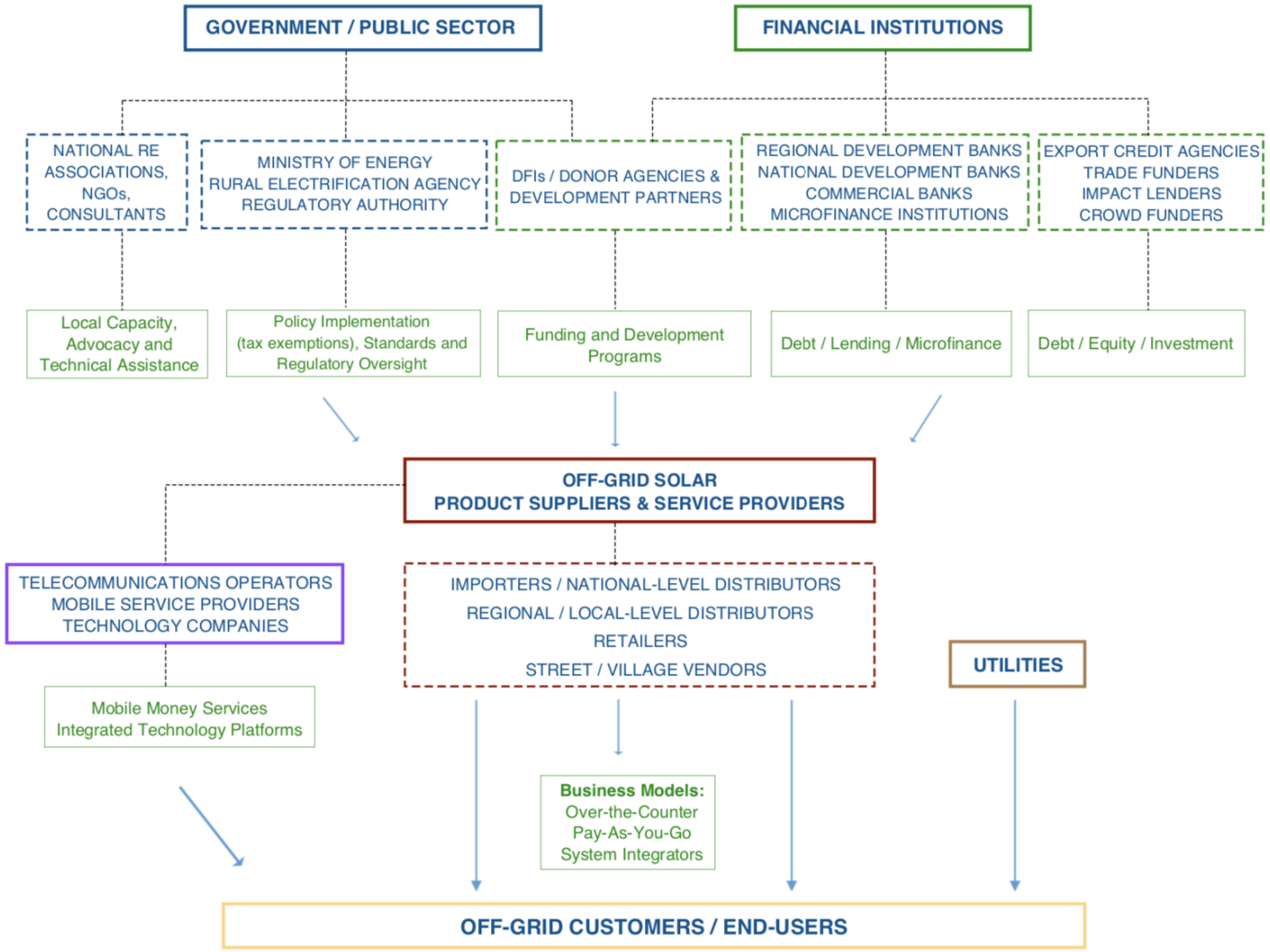
For household demand, the off-grid solar market is already tangible. Still, many factors will affect household demand for solar products, such as distribution realties, consumer education, competing economic priorities for households, financial shocks, etc. The institutional market will be affected largely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

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

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

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

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



Source: GreenMax Capital Advisors

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

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

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 Guinea and throughout the region to support development of the OGS sector.

Although access to banking and financial services through formal institutions remains limited, Guinea is experiencing a sharp increase in the availability and usage of digital financial services and mobile banking, driven by widespread mobile phone ownership, rapidly growing mobile internet usage and network coverage. This dynamic is driving greater financial inclusion; in 2017, 23% of the country's adult population had an account at a financial institution or with a mobile money service provider, up from 4% in 2011. However, this is still below the regional average of 33% in West Africa and the Sahel. Despite the country's overall improvement with regard to financial inclusion, there is still a significant gender gap in rates of access to financial services, as women in Guinea are 7% less likely than men to have an account at a financial institution or with a mobile money service provider.[29]

Expanding digital financial services, especially mobile money, can create new opportunities to better serve women, the lower-income population, and other groups that are traditionally excluded from the formal financial system. Moreover, mobile money technology also plays a critical role in the application of off-grid solar solutions, particularly for PAYG systems that rely on the interoperability between digital financial services and stand-alone solar devices. In 2018, for instance, the leading mobile money provider in the country, Orange, in collaboration with BBOXX, launched its off-grid solar energy service in Doko, in the northern Kankan region of the country. The service enables households to acquire SHS on a PAYG basis through weekly, monthly or quarterly subscriptions, with monthly subscriptions starting at GNF 100,000

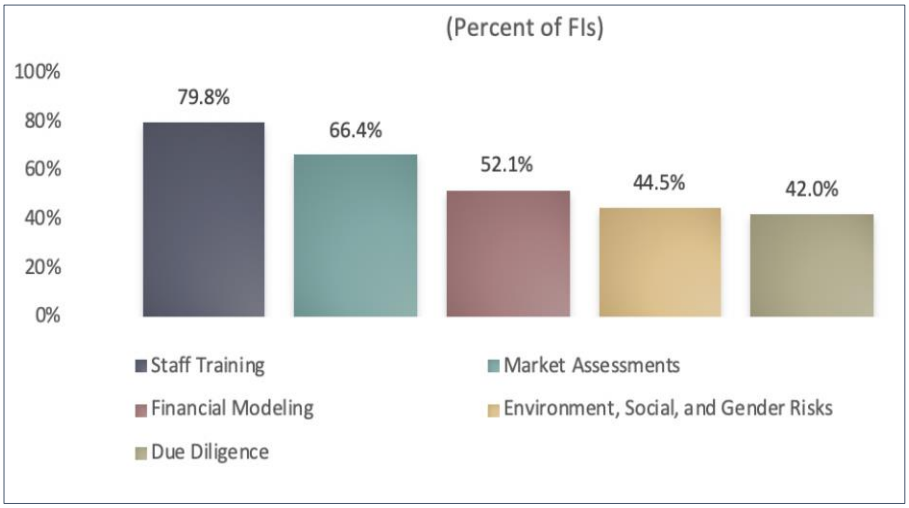
[29] Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution," World Bank, (2017): http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf

(USD 10). The customers make payments via the Orange mobile money platform and do not need to provide guarantees or bank accounts.[30]

While several donor-funded programs and initiatives have provided financing to support development of the country's OGS market, none of these funds have been channeled through local commercial banks or MFIs. ROGEP is therefore a pioneering initiative in the country, as it endeavors to boost OGS lending via engagement with local financial partners. Local FIs are increasingly becoming more aware of off-grid sector opportunities thanks to initiatives such as the recently completed USAID Climate Economic Analysis for Development, Investment, and Resilience (CEADIR) program.

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

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



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

[30] Ngounou, B., "Orange to deploy its new solar energy service in rural areas," Afrik21: Green Economy and Sustainable Growth in Africa, (July 6, 2018): https://www.afrik21.africa/en/guinea-orange-to-deploy-its-new-solar-energy-service-in-rural-areas/; and Brown, F., "France's Orange enters African off-grid solar market," PV Magazine, (March 28, 2018): https://www.pv-magazine.com/2018/03/28/frances-orange-enters-african-off-grid-solar-market/

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

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

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

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

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

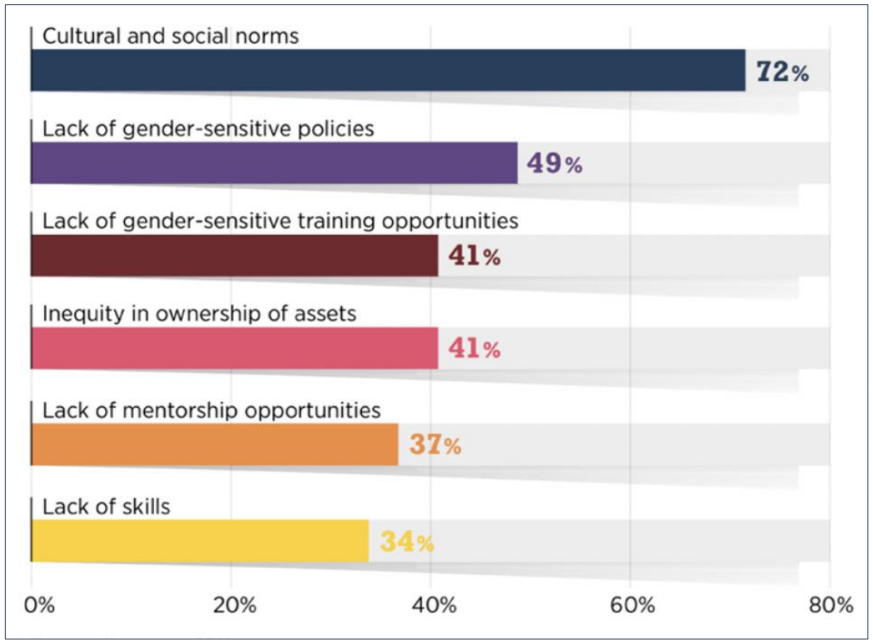
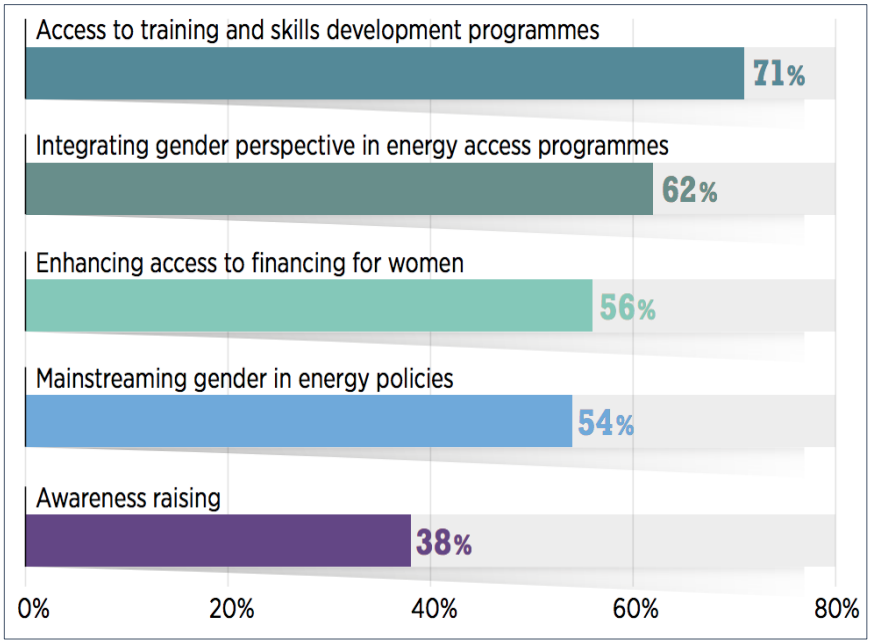


Figure ES-13: Measures to Improve Women's Engagement in Energy Access



Source: International Renewable Energy Agency

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

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

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

I. STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT

This section begins with a brief introduction of key macroeconomic and social indicators in Guinea (**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[35] in Guinea 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

Guinea is a resource-rich country that has experienced strong economic growth in recent years. Real GDP growth was an estimated 6.4% in 2017, with growth projected to continue along this trajectory in 2018-2019, driven by the mining and energy sectors.[36] Thanks to increased foreign investment in its vast mineral reserves, the Guinean economy has recovered from the 2014 Ebola outbreak, which caused massive disruptions to development efforts. This growth has not translated into significant improvement for the majority of the population, however, as basic social services remain inadequate and the country consistently ranks among the poorest in the world. Nearly two-thirds of the population lives in rural areas and three-quarters of the labor force relies on the agricultural sector.

Table 1: Macroeconomic and Social Indicators

Population	12.7 million[37]
Urban Population	38% of total
GDP	USD 10.4 billion
GDP growth rate	6.4%
GNI per capita*	USD 790
Unemployment rate	4.5% (2016)
Poverty rate	55.2% (2012)
Urban	35.4%
Rural	64.7%
Currency	Guinean franc (GNF)
Official language	French
Natural resources	Bauxite, iron ore, diamonds, gold

* World Bank Atlas method (current USD)
All figures from 2017 unless otherwise indicated
Source: AfDB and World Bank[38]

1.2 Energy Market

1.2.1 Energy Sector Overview

In Guinea, the Ministry of Energy (MoE) oversees the energy sector, while the National Directorate of Energy (Direction Nationale de l'Énergie, DNE) is responsible for defining and implementing the country's energy policies, including for renewable energy. The public utility, Électricité de Guinée (EDG), manages

[35] NOTE: The term "off-grid" as it is widely used throughout this report (e.g. "off-grid sector") refers to both mini-grids and stand-alone systems. When "off-grid solar" or its acronym "OGS" are used, this refers *only* to stand-alone systems and does not include mini-grids
[36] "Guinea Economic Outlook," African Development Bank (2018): https://www.afdb.org/en/countries/west-africa/guinea/guinea-economic-outlook/
[37] 50.5% male/49.5% female
[38] "Guinea Data," World Bank, (2017): https://data.worldbank.org/country/Guinea

the national grid and mainly provides electricity to the capital, Conakry, and other urban areas. EDG was created as a result of a merger between the National Electricity Company of Guinea, and Société Guinéenne d'Électricité (SOGEL) and is wholly-owned by the Government of Guinea (GoG of "the Government"). Since 2015, French private energy company Veolia[39] has been contracted to operate and manage EDG under a four-year Management Services Contract financed by the World Bank in order to improve the utility's operational, commercial and financial performance through a wide range of technical assistance and training of EDG's staff to improve efficiency and planning in the management of electricity infrastructure.

While the energy sector in Guinea is still dominated by public sector players, it is currently undergoing restructuring towards liberalization, beginning with power generation. A new electricity law that passed in 2017 established the Guinean Agency for Rural Electrification (Agence Guinéenne pour l'Électrification Rurale, AGER) to replace the Decentralized Rural Electrification Bureau (Bureau d'Electrification Rurale Décentralisée, BERD) and oversee the country's electrification programs and initiatives in rural and peri-urban areas, including through the use of decentralized off-grid solutions. The law, which is currently being updated by the GoG with support from the AfDB, also established an independent regulator, the Regulatory Authority of the Water and Electricity Sector (Autorité de Régulation du Secteur de l'Eau et de l'Electricité, ARSEE), and aims to encourage private sector participation in the solar sector.[40]

Table 2: Institutional and Market Actors in the Energy Sector

Institution / Company	Role in the Energy Sector
Ministry of Energy (Ministère de l'Énergie, MoE)	Ministry responsible for energy sector planning and program implementation; overall management of the sector is shared with the Ministry of Environment and the Ministry of Economy and Finance, which plays a key role in the sector's projects and programs. These institutions respond to the Prime Minister and the President of the Republic.
National Directorate for Energy (Direction Nationale de l'Energie, DNE)	Public entity under the MoE in charge of development and implementation of energy strategies, policies and programs including renewable energy, development and control of the application of energy regulations, and development of national energy resource potential
Electricité De Guinée (Electricity Company of Guinea, EDG	Public utility company under the MoE responsible for electricity production, transmission and distribution and sale of electricity
Inter-ministerial Management Service Contract Committee[41]	Created in 2017 to monitor the management service contract between EDG (managed by Veolia until 2019) and the GoG
Guinean Agency for Rural Electrification (Agence Guinéenne pour l'Electrification Rurale, AGER)	Public agency under the MoE responsible for promoting rural and peri-urban electrification throughout the country, which replaced the BERD (Decentralized Rural Electrification Bureau) in 2017; oversees the development of rural electrification programs
Rural Electrification Fund (Fonds d'Électrification Rurale Décentralisée, FERD)	Fund established in 2003 intended to subsidize the high up-front costs for rural electrification systems and provide loans and grants to private RE developers; the fund ultimately failed to become a revolving fund for electrification.
Regulatory Authority of the Water and Electricity Sector (Autorité de Régulation du Secteur de l'Eau et de l'Electricité, ARSEE)	Independent regulatory authority that reports to the Office of the Prime Minister and the Presidency of the Republic and is responsible for regulating the public services of water and electricity throughout the country.

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

[39] Veolia is a French multinational company operating in utility areas, traditionally managed by public entities: water management, waste management, transport and energy services

[40] "Guinea-Mali Interconnection Project: Combined Project Information Documents / Integrated Safeguards Datasheet," World Bank: http://documents.worldbank.org/curated/en/515871527263469191/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Guinea-Mali-Interconnection-Project-P166042.pdf

[41] "Additional Credit for the Power Sector Recovery Project, Guinea," World Bank, (2018): http://documents.worldbank.org/curated/en/172941521424821535/pdf/GUINEA-POWER-SECTOR1-PAD-02272018.pdf

1.2.2 Electricity Access: *Grid and Off-Grid*

The electricity access rate in Guinea is among the lowest in Africa, particularly in rural areas of the country. In 2016, approximately 80% of the overall population in Guinea – about 10 million people – did not have access to electricity, with a significant disparity in rates of access between the urban (46%) and rural (1%) rates.[42] In response, the GoG has set an ambitious target to achieve universal access by 2030.

1.2.2.1 Off-Grid Market Overview

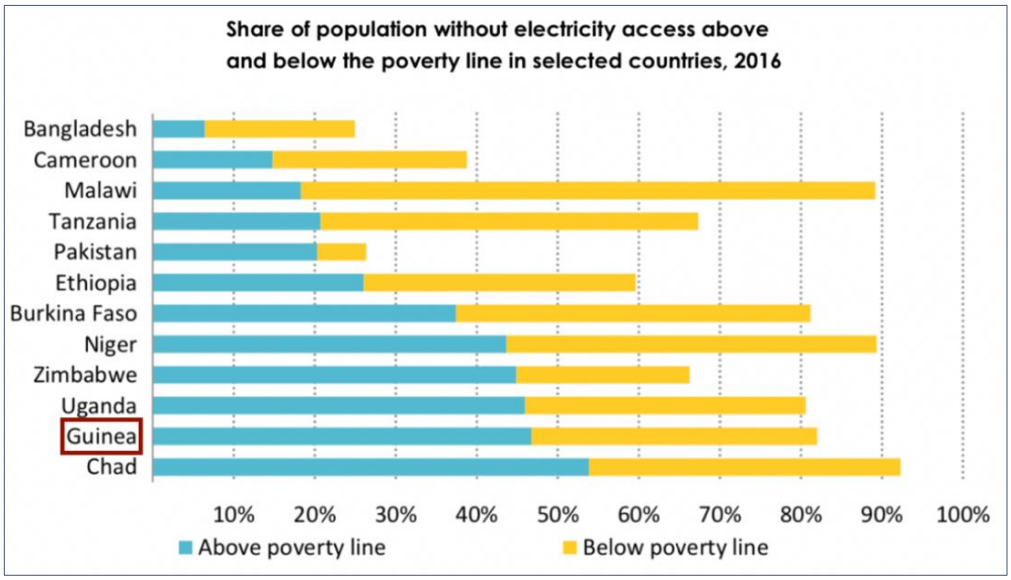
For Guinea to meet its electrification objectives, an estimated 1.7 million households need to be connected throughout 2030. In the long-run, the GoG estimates that 99% of these households would be served by the grid, while only 8,260 households would be served either by mini-grids or stand-alone solutions.[43]

A significant portion of Guinea's population lives above the poverty line without electricity access, signaling that the lack of access is due in part to systemic issues related to grid infrastructure and the relatively high cost of connection (**Figure 1**). In the short-term, grid extension is not a feasible option to serve a significant portion of the population residing in rural and peri-urban areas, due to their relatively small energy demand and an overall lack of financial resources for EDG to extend existing grid networks into remote areas. Stand-alone solar technologies provide a more cost-effective and efficient solution to meet electricity demand in these areas.

Prior to the establishment of the rural electrification agency, AGER, BERD had launched several small-scale pilot off-grid electrification initiatives. Under the World Bank-funded Decentralized Rural Electrification Project (PERD, 2003-2015),[44] BERD was able to complete decentralized rural electrification projects and sign 30 concession-type agreements with Guinean private operators. This led to the development of micro-grids (mostly hybrid solar PV-diesel) in rural areas far from the national grid, providing electricity access to 15,000 households.[45] A new funding mechanism, the Fund for Decentralized Rural Electrification (Fonds d'Électrification Rurale Décentralisée, FERD), was established to subsidize the high up-front costs of rural electrification systems.

[42] "Energy Access Outlook, 2017: From Poverty to Prosperity," IEA, (2017): https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf
[43] "Programme d'électrification de la Guinée: Prospectus d'Investissement," Castalia Strategic Advisors, (June 2017).
[44] "Decentralized Rural Electrification Project, Final Assessment Review," World Bank, (2015): http://documents.banquemondiale.org/curated/fr/598521467986262235/pdf/ICRR14655-P074288-Box393183B-PUBLIC.pdf
[45] "Élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement des capacités en planification de l'AGER : Rapport Final Volume 2, Tome 1 (version provisoire)," ECREEE, I2D, (2017).

Figure 1: Rates of Electricity Access and Poverty



Source: International Energy Agency

More recently, the Government has been developing a National Rural Electrification Program (PNER) with the support of ECREEE.[46] The PNER included capacity building and the development of a 15-year plan by AGER. The agency intends to build on PERD, which included an innovative model for off-grid rural electrification through SME-based micro-concessions.[47] In addition to public institutions, several private solar companies are also operating in the country's off-grid sector (see **Section 2.4.3**).

[46] "Termes de référence pour l'élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement de capacité en planification de l'AGER," ECREEE, (2016): http://www.ecreee.org/sites/default/files/procurment/attachments/tors_ager_pner_.pdf
[47] "Decentralized Rural Electrification Project: Republic of Guinea," The World Bank, (2014): http://documents.worldbank.org/curated/en/191951468274211905/pdf/ICR29350P074280IC0disclosed04040140.pdf

1.2.2.2 Demand and Supply/Generation Mix

Table 3: Electricity Sector Indicators, 2017[48]

Installed Capacity	617 MW
Thermal	249 MW
Hydropower	368 MW
Renewable (non-hydro)	-
National electrification rate (2016) Urban electrification rate Rural electrification rate	20% 48°% 3%
Population without access	10.2 million
Households without access	1.4 million
Electrification target	Universal access by 2030

Source: DNE, IEA, Castalia Strategic Advisors and World Bank

In 2017, Guinea's installed capacity reached 617 MW,[49] three-quarters of which is operated by EDG and the remaining by industrial and mining companies.[50] Since the commissioning of 240 MW hydropower plant Kaleta in 2015, hydroelectricity accounts for about 60% of the installed capacity.[51] Many of the country's hydropower and thermal plants are obsolete due to a lack of maintenance; as a result, the availability of supply was below 30%. It is estimated that EDG hydropower capacity alone can meet Conakry's electricity demand for nearly eight months out of the year, while thermal power is necessary for about four months.

To meet rising energy demand, estimated by EDG to be growing at an annual rate of over 10% per year, the GoG is taking measures to develop new generation capacity.[52] EDG has commissioned 175 MW of thermal power from Independent Power Producers (IPPs): Kaloum 1 (24 MW), Kaloum 2 (26 MW), Kipe (50 MW) and K-Energies (75 MW). The country is also endowed with significant hydropower potential, estimated at between 5,700 and 6,100 MW, yet only 5% of this capacity has been developed (Garafiri and Kaleta plants). EDG's priority is to develop 11 large hydropower sites totaling 1,600 MW, as much as 300 MW of small-hydropower, and to install at least 5 MW of PV to power urban lighting systems.[53] The largest upcoming projects include construction of the 450 MW Souapiti hydropower plant as well as regional hydropower projects through the Senegal River Basin Development Organization (Organization pour la Mise en Valeur du fleuve Sénégal, OMVS). The GoG also plans to implement a fund for renewable energy to further support development of the sector. In 2017, the French government signed an agreement with the GoG to develop an 88 MW solar PV plant, the country's first utility-scale solar PV plant in Khoumagueli, in the prefecture of Kindia in western Guinea.

Table 4: Average Electricity Tariffs and Production Costs, 2016

Consumer Tariff Categories (EDG)		
Average tariff (USD/kWh)	Residential	Commercial/Industrial
	USD 0.04/kWh	USD 0.19/kWh
Production Costs (EDG)		
Thermal	USD 0.10/kWh - 0.18/kWh	
Hydropower	USD 0.06/kWh	

Source: Castalia Strategic Advisors

[48] See **Section 2.1** for more details on households/population without access to electricity.
[49] "Situation of the Sub-Electricity Sector in Guinea: Guinea-Mali Electricity Interconnection Project," AfDB, (2017): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Multinational_-_225_KV_Guinea-Mali_Electricity_Interconnection_Project.pdf
[50] "Programme d'électrification de la Guinée: Prospectus d'Investissement," Castalia Strategic Advisors, (June 2017).
[51] "Rapport annuel 2016," Electricité de Guinée, (2016): https://www.sieguinee-dne.org/images/RAPPORT_ANNUEL_EDG_2016_partie1.pdf
[52] "Additional Credit for the Power Sector Recovery Project, Guinea," World Bank, (2018): http://documents.worldbank.org/curated/en/172941521424821535/pdf/GUINEA-POWER-SECTOR1-PAD-02272018.pdf
[53] Ibid.

Guinea utilizes a tiered social tariff system to support low-income customers (**Table 4**). The country has the lowest household tariff rate in the region (USD 0.04/kWh).[54] As a result, electricity revenues do not cover production costs, with the difference subsidized by the GoG. To address its financial situation, EDG aims to implement a progressive tariff increase to reach USD 0.17/kWh through 2030.[55]

1.2.2.3 Transmission and Distribution Network

Two electricity networks serve Guinea (**Figure 2**). One is a network that interconnects the main power plants in Conakry (Tombo Thermal Power Plant; Grandes Chutes; Kale/Donkea; Banéah; Garafiri; Kinkon) and another separate grid for the central region (interconnecting Tinkisso and Faranah power plants). Several isolated thermal mini-grid networks exist throughout the country, while mining companies produce their own captive power.

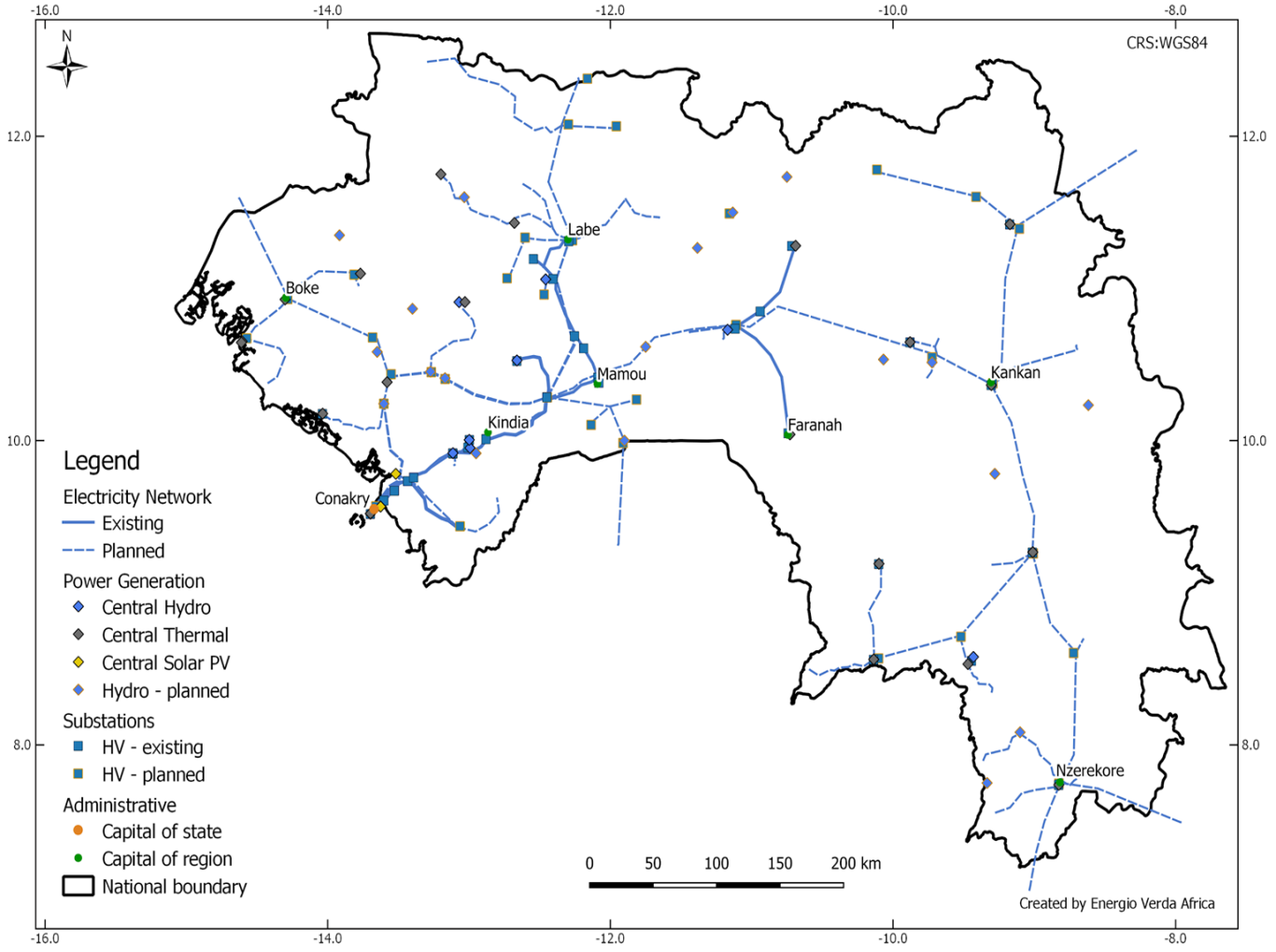
Despite the strong resource potential of the energy sector (hydropower and solar) and long-term opportunities to export low-cost electricity throughout West Africa, Guinea's power sector still faces significant challenges. EDG has extensive operational issues, including outdated and poorly maintained grid infrastructure, high levels of technical and commercial losses, and poor overall logistic and financial performance, stemming from high rates of illegal connections and inadequate billing systems/collection rates.[56] Overall, a significant gap exists between the infrastructure needs of the power sector and the availability of resources to invest in grid maintenance and extension to rural areas; as a result, the existing electricity network is unreliable (**Figure 4**).

In 2014, the Government developed a framework for a performance-based public-private partnership (PPP) for EDG in an attempt to improve the utility's operational performance.[57] The GoG also has an ambitious plan to prioritize privately financed generation and public sector financed transmission and distribution for energy access.[58] The MOE, represented by EDG, intends to select contractors and companies for restoration and extension of the Conakry electricity grid, with funding from the African Development Bank and the Islamic Development Bank. [59]

At a regional level, the Guinea-Mali interconnection project is a priority for the West African Power Pool (WAPP), as set by the ECOWAS Revised Master Plan.[60] It will be a part of the sub-regional WAPP interconnection project connecting Côte d'Ivoire, Liberia, Sierra-Leone and Guinea (CSLG).[61] The project includes the construction of a transmission line between Guinea and Mali and will be financed by the World Bank, the EU, AfDB, the West African Development Bank (Banque Ouest Africaine de Développement, BOAD) and the governments of Guinea and Mali.

[54] "Regulatory Indicators for Sustainable Energy: Guinea," World Bank, (2016): http://rise.worldbank.org/country/guinea
[55] "Programme d'électrification de la Guinée: Prospectus d'Investissement," Castalia Strategic Advisors, (June 2017).
[56] "Additional Credit for the Power Sector Recovery Project, Guinea," World Bank, (2018): http://documents.worldbank.org/curated/en/172941521424821535/pdf/GUINEA-POWER-SECTOR1-PAD-02272018.pdf
[57] "Public Private Partnership Stories," IFC, (2015): https://www.ifc.org/wps/wcm/connect/5110ac804bf90737871cdf7cbf6249b9/Guinea+Power_PPP+Stories_Final_9+March+2016.pdf?MOD=AJPERES
[58] "Power Sector recovery Project," World Bank, (2014): http://projects.worldbank.org/P146696?lang=en
[59] "Guinea seeks to extend Conakry electricity grids," ESI, (2017): https://www.esi-africa.com/guinea-extend-conakry-electricity-grids/
[60] "225kV Guinea Mali Electricity Interconnection Project," AfDB, (2017): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Multinational_-_225_KV_Guinea-Mali_Electricity_Interconnection_Project.pdf
[61] "WAPP Integration and Technical Assistance Project in the Support of the First Phase of the CLSG Power System Re-Development Sub-Program of the WAPP APL Program," World Bank, (2017): http://documents.worldbank.org/curated/en/369271509740134599/pdf/Sierra-Leone-Liberia-WAPP-PAD2375-PUBLIC.pdf

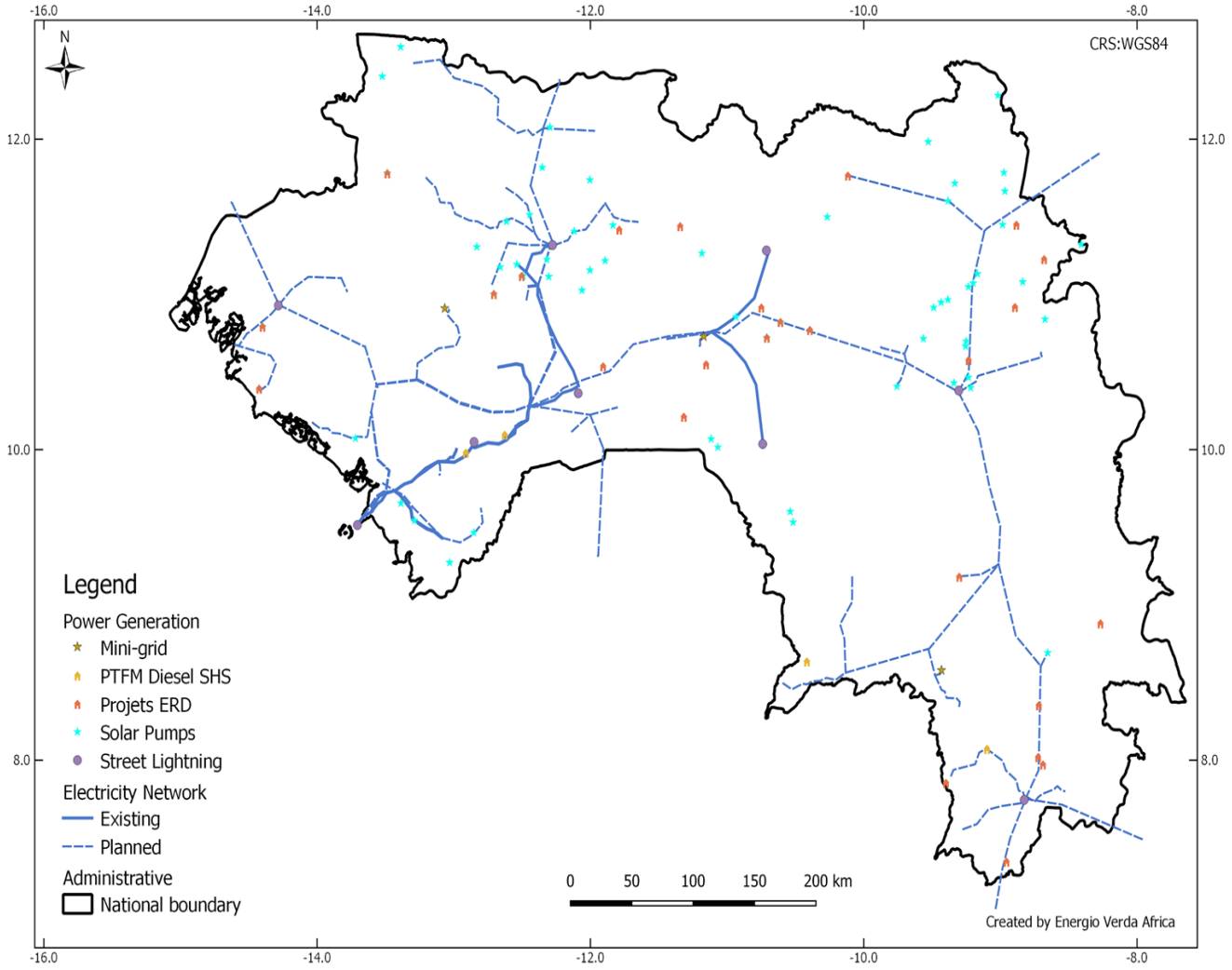
Figure 2: Electricity Transmission and Distribution Network[62]



Source: Energio Verda Africa GIS analysis

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

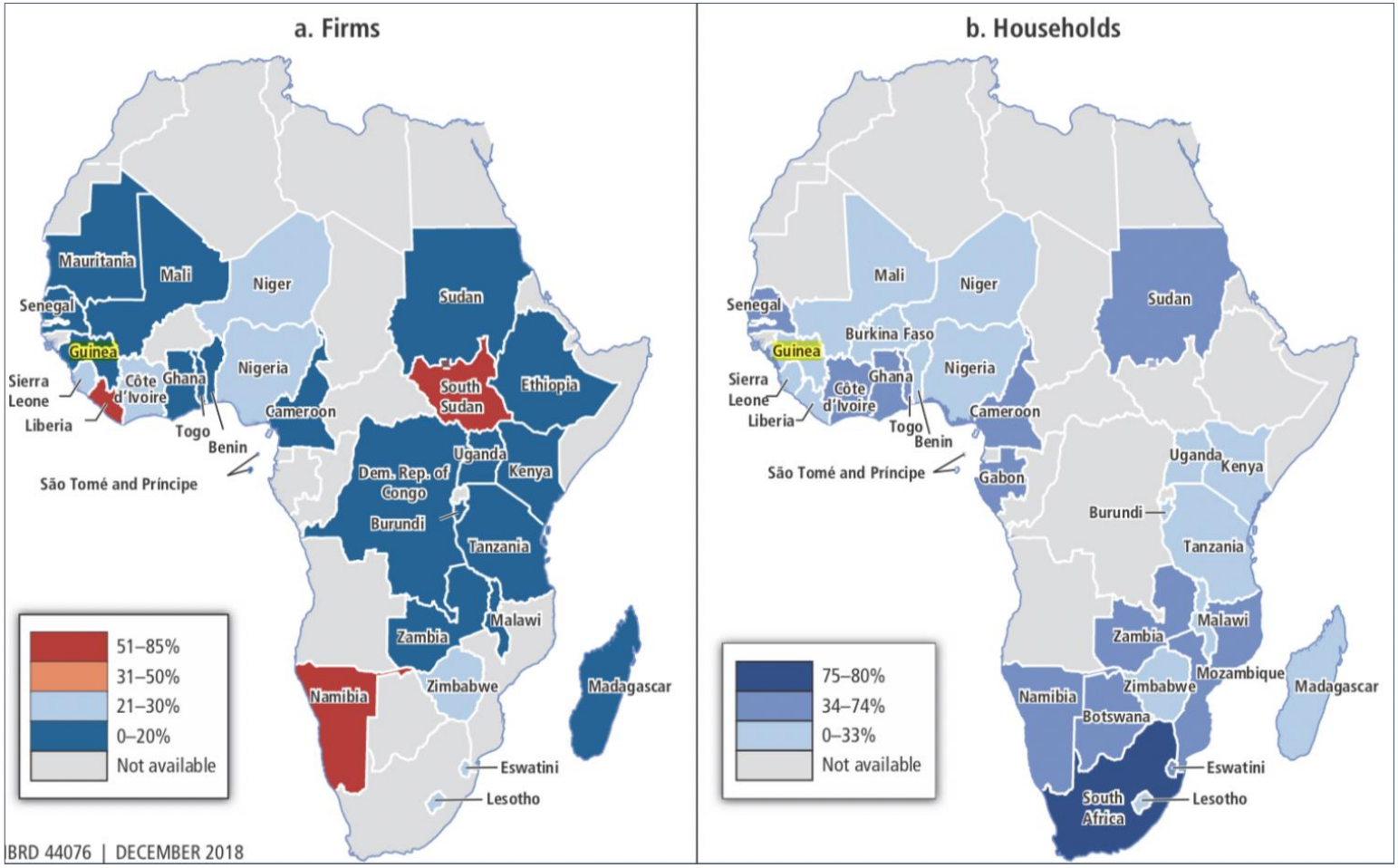
Figure 3: Mini-Grid and Off-Grid Systems[63]



Source: Energio Verda Africa GIS analysis

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

Figure 4: Access to Reliable Electricity by Firms and Households in Africa[64]

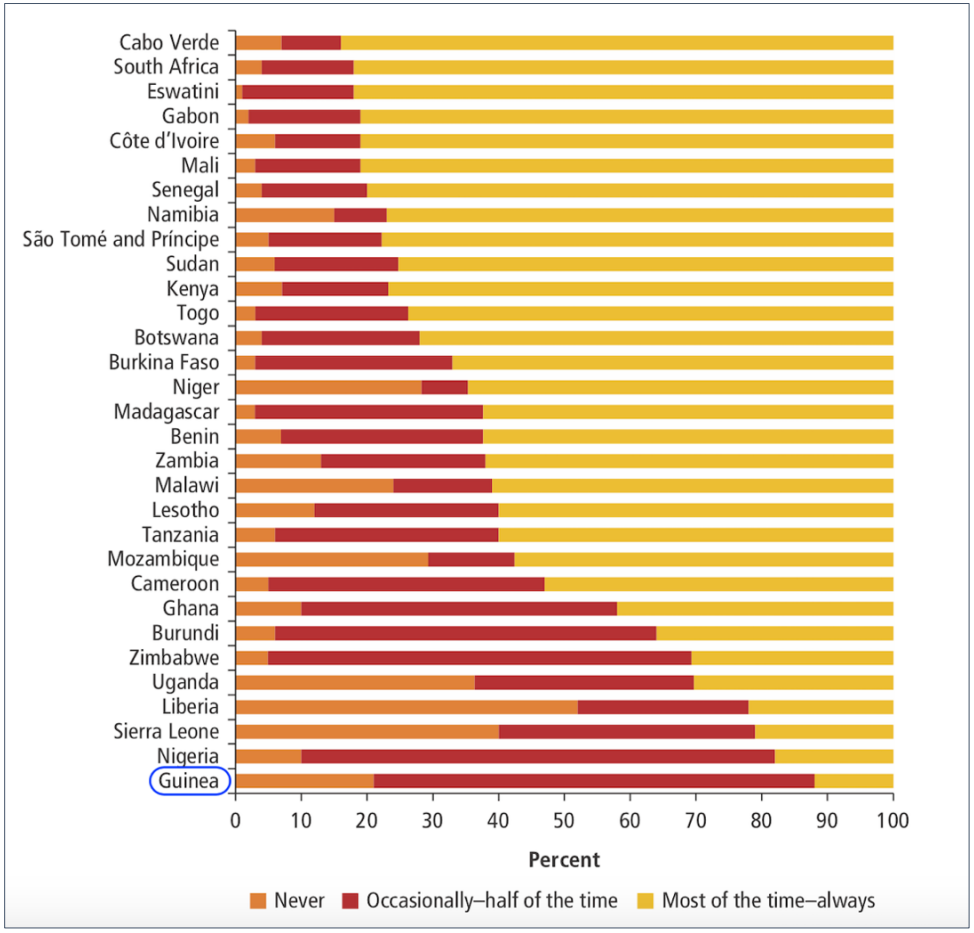


Source: World Bank Enterprise Surveys, 2013-2017 and Afrobarometer Household Surveys, 2014-2015

The maps in **Figure 4** illustrate the share of firms (Panel a) and households (Panel b) reporting access to reliable supply of electricity across Africa. In Guinea, fewer than 20% of surveyed firms and about one-third of households reported having reliable access to electricity.

[64] 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

Figure 5: Reliability of Grid Electricity in Connected Households in Africa[65]



Source: Afrobarometer Household Surveys, 2014-2015

Figure 5 shows the variation in the reliability of grid electricity for connected households across Africa. In Guinea, fewer than 20% of households reported receiving electricity supply at least most of the time, while nearly two-thirds of surveyed households indicated having electricity only occasionally.

[65] 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 Guinea through 2023 and through 2030 ("Scenario 2023" and "Scenario 2030").[66] 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 Guinea 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 Guinea based on their proximity to electrical infrastructure, population density or nodes of economic growth.

For the scenario 2023 analysis, it is assumed that widespread densification of the existing electrical grid will enable settlements within 20 km of existing grid lines to connect to the grid (according to EDG, AGER and DNE).[67] Beyond this area, the likely candidates for electrification by mini-grid systems are settlements that are relatively dense (above 350 people/km^2) and have active local economies, evidenced by the presence of social facilities and by their proximity to other settlements already with electricity access (i.e. within 15 km of night-lights areas). All remaining settlements – those in areas of lower population density (below 350 people/km^2) or far from the national grid – are considered candidates for stand-alone systems.

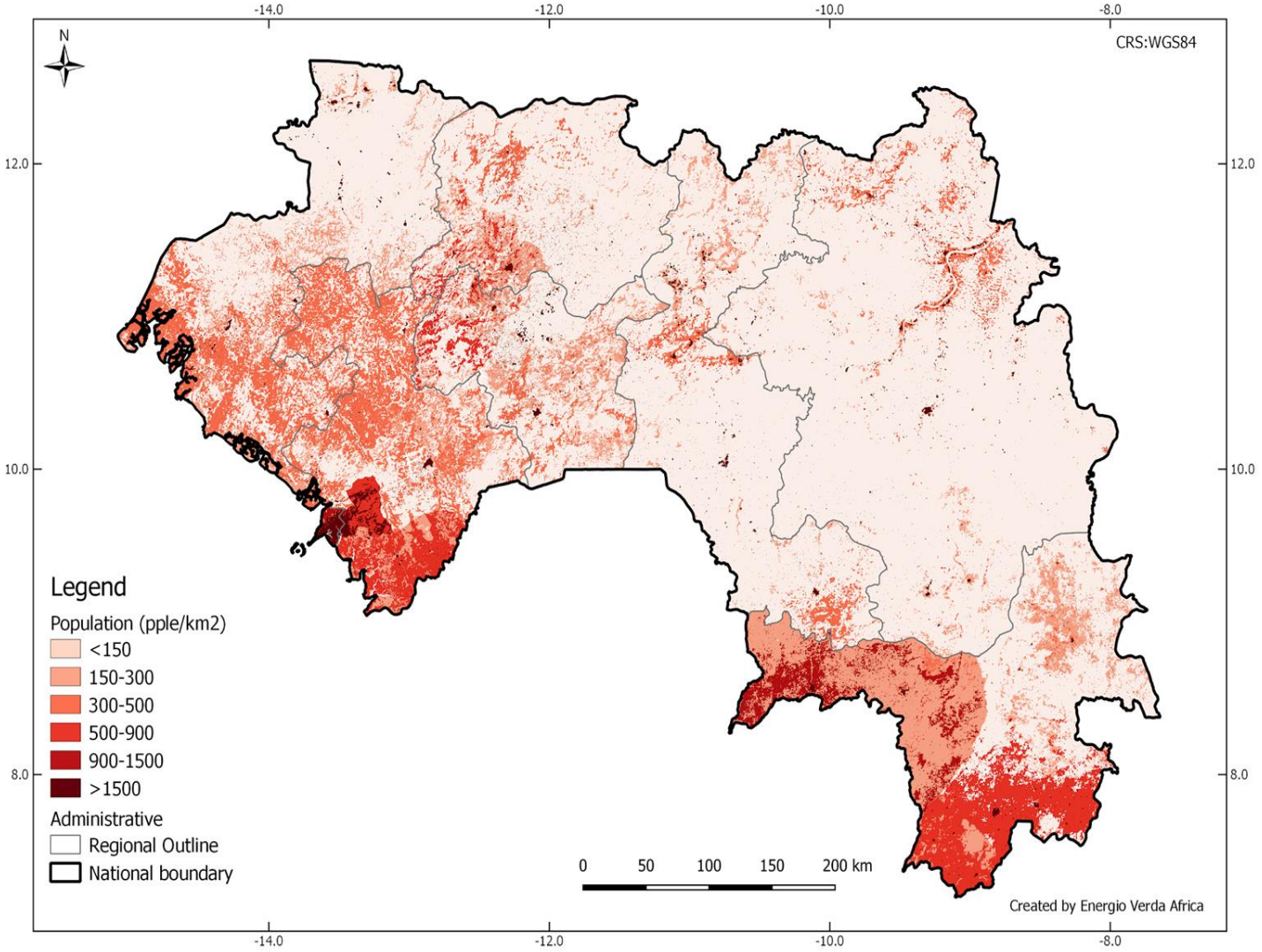
For the scenario 2030 analysis, it is assumed that the grid and the reach of grid densification efforts will extend far beyond the existing network. Hence, settlements that are within 50 km of current lines (according to stakeholder interviews with EDG) and 20 km of future planned line extensions are assumed to be connected. For mini-grids, future economic development – which will allow new settlements to grow sufficiently to become candidates for mini-grids – is assumed to occur in settlements within 1 km of mini-grid settlements (average distance of mini-grid coverage of different developers) identified in the scenario 2023 analysis, as well as within 15 km of economic growth centers – airports and urban areas. All other settlements are considered candidates for stand-alone systems.

Given the lack of low voltage distribution line data, it is necessary to approximate areas where un-electrified settlements in close proximity to the grid exist. The analysis therefore focuses on settlements that are within 20 km of the high and medium voltage network, but that are located beyond 15 km of areas with night-time light emissions (indicative of electrification). Settlements in areas of low population density (below 350 people/km^2) that met the above criteria are identified as both being currently un-electrified and unlikely to be electrified within scenario 2023.[68]

Additional analysis was undertaken to estimate the population within each settlement. The current annual national population growth rate of 2.6%[69] was applied to the geospatial analysis to project population figures for the scenario 2023 and 2030 analyses.[70] **Figure 6** shows population density across the country, which served as the basis for this analysis.

[66] NOTE: Rather than presenting a 10-year projection through 2028, the analysis conforms to GoG electrification targets for 2030
[67] NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable); Source: Interviews conducted for this study
[68] Note that this analysis was performed for scenario 2023 but not for scenario 2030 due to uncertainties regarding population densities being too high over such a long timeframe
[69] "World Bank Open Data: Source: https://data.worldbank.org/indicator/SP.POP.GROW?locations=GN
[70] See **Annex 1** for the results of this analysis as well as more details on the approach and methods used

Figure 6: Population Density, 2014[71]



Source: Energio Verda Africa GIS analysis

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

- **Results**

Table 5 summarizes the results of the least cost electrification analysis. **Figure 7** and **Figure 8** 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 (7.2 persons/households).[72]

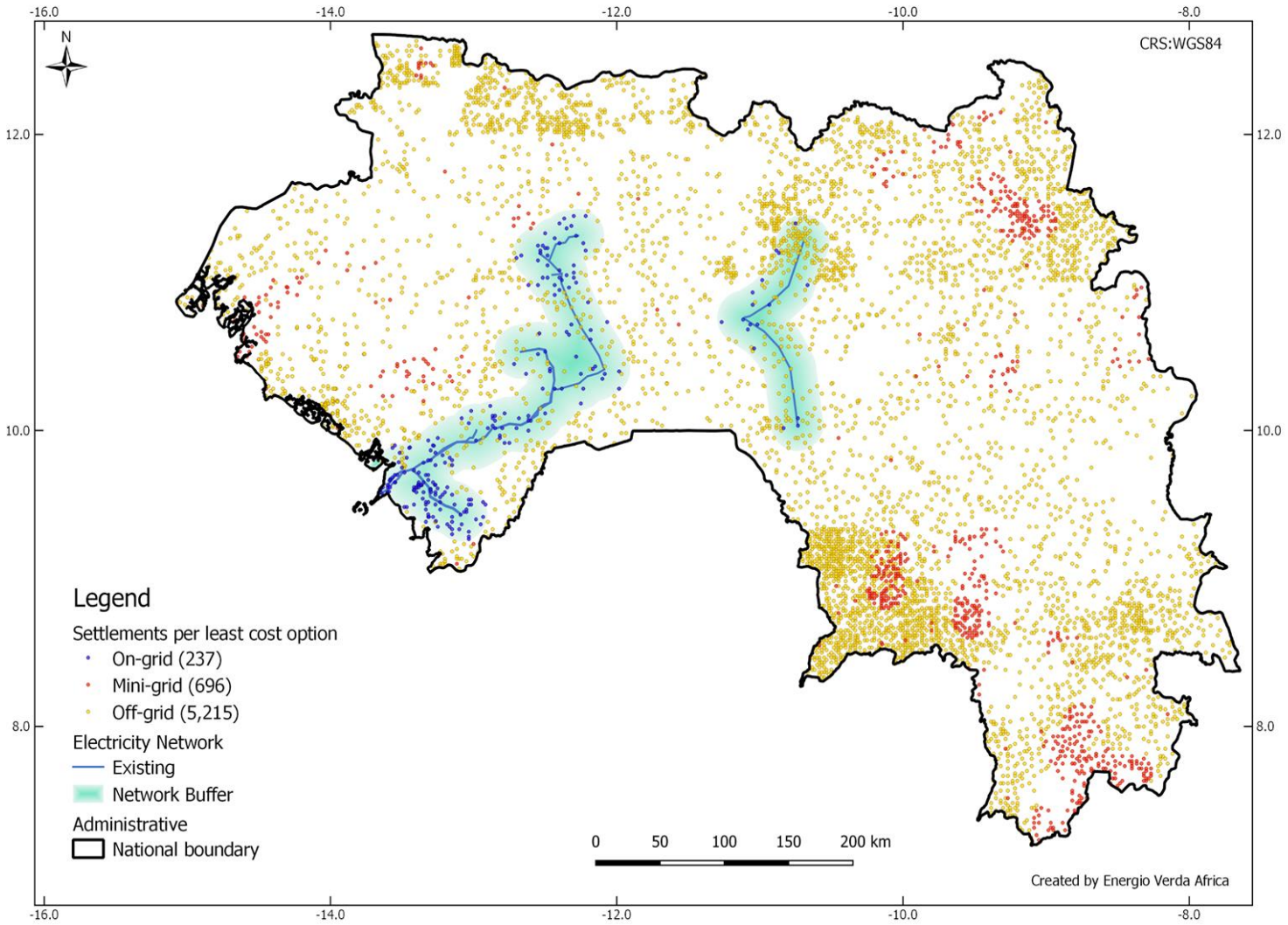
Table 5: Results of Least-Cost Electrification Analysis

Scenario	Indicator	Least-Cost Electrification Option			Grid Vicinity		
		Grid extension	Mini-grid	Off-grid stand-alone systems	Under-grid un-served	Total under-grid	Total outside grid vicinity
Scenario 2023	Number of settlements	286	918	4,944	336	622	5,526
	% of settlements	4.7%	14.9%	80.4%	54.0%	10.1%	89.9%
	Total population	5,332,252	2,330,998	7,346,714	847,054	6,179,305	8,830,658
	% of population	35.5%	15.5%	48.9%	13.7%	41.2%	58.8%
	Number of households	740,590	323,750	1,020,377	117,646	858,237	1,226,480
Scenario 2030	Number of settlements	3,912	209	2,027	Not calculated	3,912	2,236
	% of settlements	63.6%	3.4%	33.0%	Not calculated	63.6%	36.4%
	Total population	14,882,356	467,992	2,613,988	Not calculated	14,882,356	3,081,980
	% of population	82.8%	2.6%	14.6%	Not calculated	82.8%	17.2%
	Number of households	2,066,994	64,999	363,054	Not calculated	2,066,994	428,053

Source: Energio Verda Africa GIS analysis

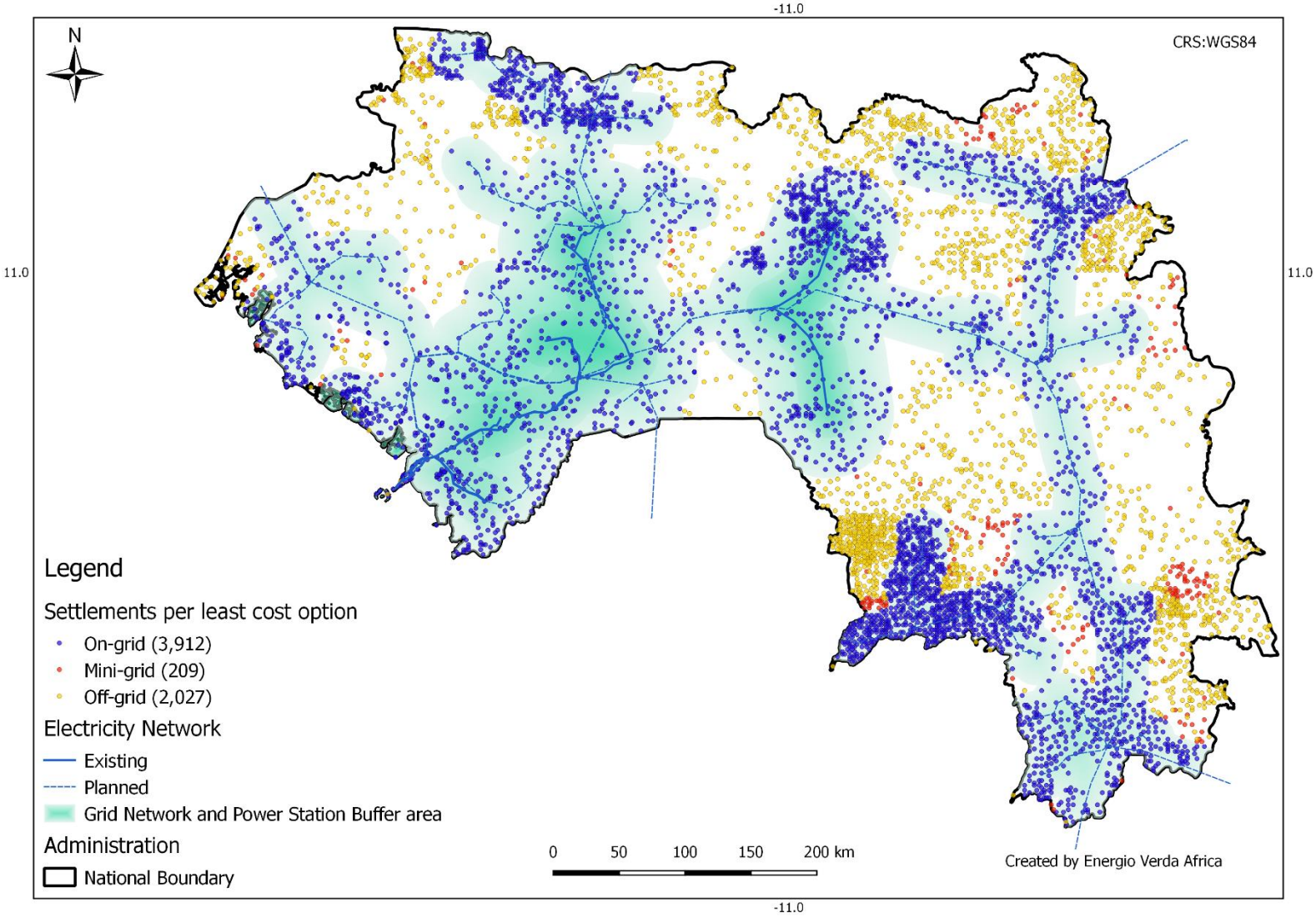
[72] "Household Size and Composition Around the World," United Nations, (2017): http://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf

Figure 7: Distribution of Settlements by Least-Cost Electrification Option, 2023



Source: Energio Verda Africa GIS analysis

Figure 8: Distribution of Settlements by Least-Cost Electrification Option, 2030 [73]



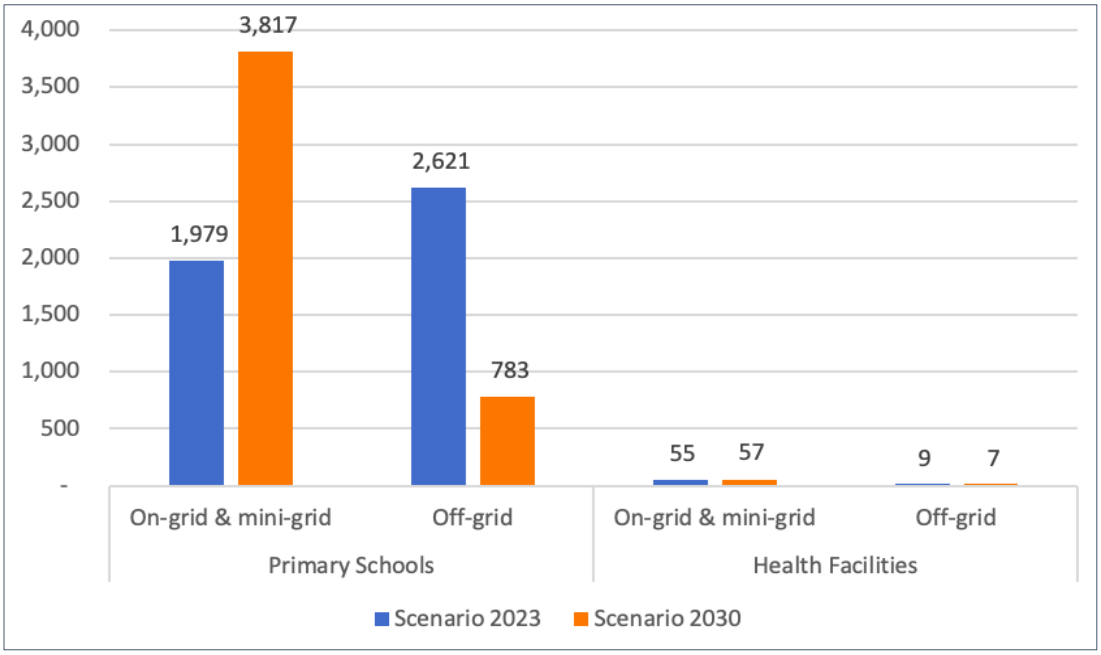
Source: Energio Verda Africa GIS analysis

[73] 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. The number of education centers and health facilities cannot be seen as comprehensive as not all were available for the geospatial analysis (institutions with known coordinates). For education centers, a full list of primary schools was obtained, but data for other education centers (such as secondary schools or universities) was unavailable; a total of 4,600 primary schools and 64 health facilities were analyzed.

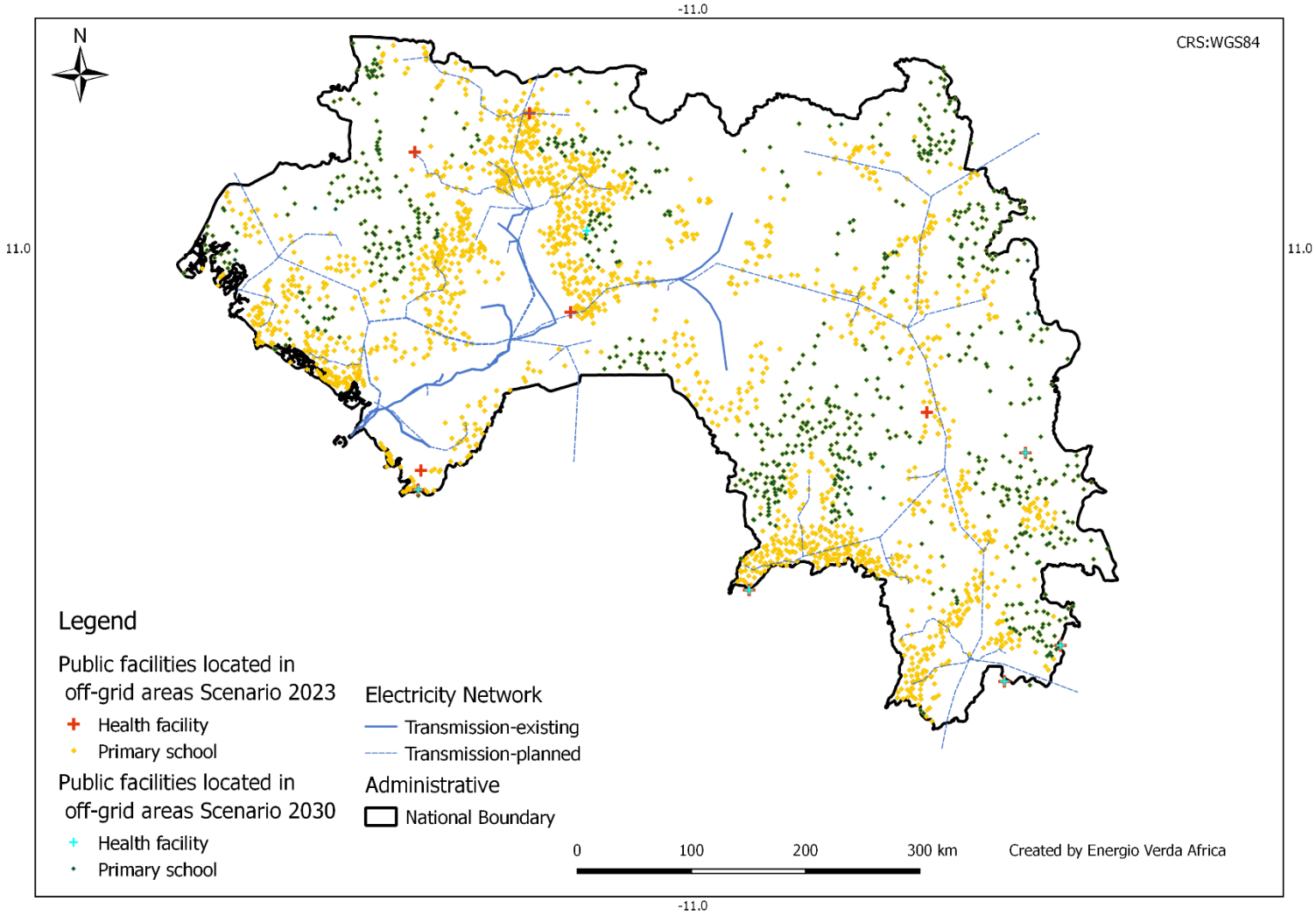
Figure 9 summarizes the number of primary schools and health facilities that may be electrified or suitable for off-grid solutions in scenarios 2023 and 2030. **Figure 10** illustrates the distribution of potential off-grid facilities across the country under the two scenarios.

Figure 9: Identified Social Facilities for On-Grid, Mini-Grid and Stand-alone Solutions, 2023 and 2030



Source: Energio Verda Africa GIS analysis

Figure 10: Distribution of Potential Off-Grid Social Facilities, 2023 and 2030[74]

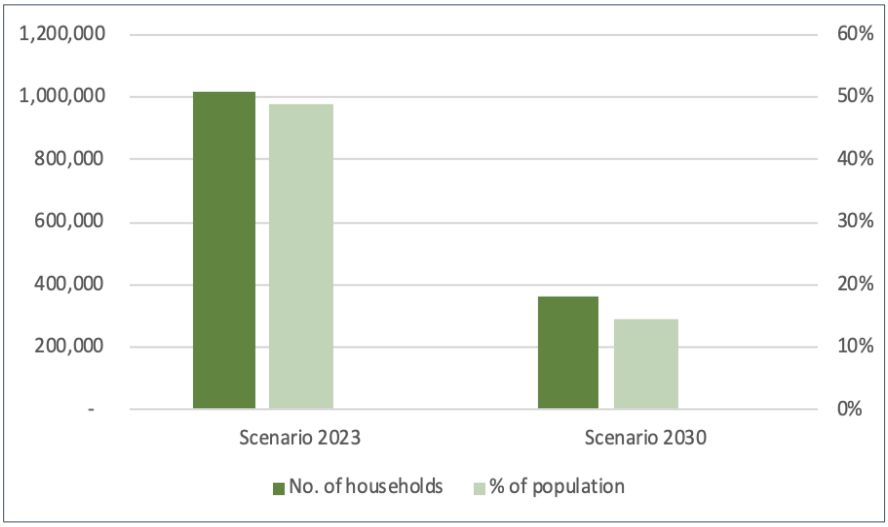


Source: Energio Verda Africa GIS analysis

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

According to the geospatial analysis (**Table 5**), by 2023, 286 settlements across Guinea (740,590 households) will be connected to the main grid, representing 35.5% of the population. By 2030, this figure will increase to 3,912 settlements (2,066,994 households), equivalent to 82.8% of the population. These estimates are based on the assumption that all planned grid extensions will be completed by 2030. Not all settlements in close proximity to electricity lines will connect to the main grid, largely due to the low density of these areas (dispersed settlements with a density below 350 people/km^2). By 2023, an estimated 336 settlements located under the grid will meet these criteria (or 54.0% of the settlements located within 5 km of the grid). Outside of the main grid areas, settlements with higher economic growth potential and higher population density can optimally be electrified by mini-grids. By 2023, this represents an estimated 918 settlements (323,750 households), or 15.5% of the population, decreasing to 209 settlements (64,999 households), or 2.6% of the population by 2030. The remaining more dispersed settlements (further from centers of economic activity) can optimally be served by off-grid stand-alone systems. This comprises 4,944 settlements (1,020,377 households) and 48.9% of the population in 2023, decreasing to 2,027 settlements (363,054 households) and 14.6% of the population in 2030 (**Figure 11**).

Figure 11: Estimated Number of Households and Share of Population Suitable for OGS Systems, 2023 and 2030



Source: Energio Verda Africa GIS analysis

The findings differ from previous similar studies undertaken in Guinea's off-grid sector. In its 2014, SEforALL Gap Analysis Report, the GoG estimated that off-grid solutions would provide 50 MW of the 2,684 MW of installed capacity that the country would need to achieve universal access by 2030 – representing only 2% of the total share (**Table 6**).

Table 6: Estimated Share of Installed Capacity from Off-Grid Sources, 2030[75]

Installed Capacity Targets, 2030	MW	Share of Total (%)
Estimated share of installed capacity from grid-connected sources (thermal, hydropower, imports etc.)	2,635	98%
Estimated share of installed capacity from off-grid sources *	50	2%
Total	2,684	

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

Source: SEforALL Gap Analysis Report

[75] "Evaluation et Analyse des Gaps par rapport aux objectifs de SEforALL," UNDP and SEforALL, (July 2014): https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_RAGAs/Guinea_RAGA_FR_Released.pdf

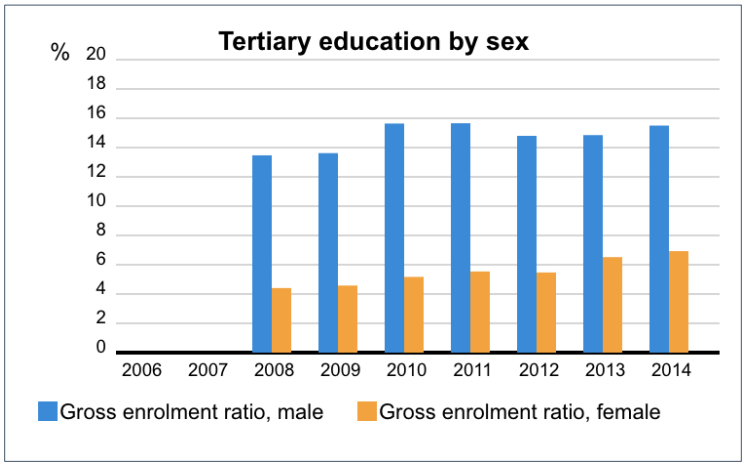
A subsequent report prepared in 2017 by Castalia Strategic Advisors[76] concluded that an estimated 1.7 million households would need to be connected to the grid through extension of the network by 2030 for the country to achieve its 100% electrification target. The analysis determined that nearly all (99%) of these households would eventually be served by the grid, but that until the grid arrives, about 8% of households could be electrified through temporary off-grid solutions (a combination of mini-grids and stand-alone systems). The disparity between the household figures presented in the Castalia report and the results of this least-cost analysis is a result of different assumptions regarding population growth. Castalia also assumes a more aggressive rate of construction of MV lines (distribution lines) far beyond the 50 km distance from the existing grid network – which is the targeted densification rate for a 10-year approach of the national utility, Electricité de Guinée (EDG).[77]

When compared to the findings of the SEforALL Gap Analysis or the assessment from Castalia Strategic Advisors, the findings of the least-cost analysis suggest that the Government may need to consider increasing the utilization of off-grid solutions (a combination of mini-grids and stand-alone systems) in its electrification planning in order to achieve its energy access targets, particularly in the near-term until planned grid extensions are realized.

1.2.2.5 Inclusive Participation[78]

Inclusive participation in Guinea remains an ongoing challenge. Gender inequality persists, as women are under-educated and generally have a lower socio-economic status, with inadequate access to basic social services and reduced economic opportunities compared to men. Guinea performs poorly in the United Nations Development Programme (UNDP) Gender Inequality Index, which measures several indicators to assess levels of gender inequality in the areas of health, access to education, economic status and empowerment.[79] Female participation in education, particularly higher education, remains disproportionately low (**Figure 12**).[80] While gender discrimination is widespread, these issues tend to be more pronounced in rural areas of the country.

Figure 12: Rates of Enrollment in Tertiary Education



Source: UNESCO Institute for Statistics

[76] "Programme d'électrification de la Guinée: Prospectus d'Investissement," Castalia Strategic Advisors, (June 2017).
[77] See **Annex 1** for more details.
[78] See **Annex 4** for more details
[79] "Gender Inequality Index," UNDP, (2015): http://hdr.undp.org/en/composite/GII
[80] "Guinea Participation in Education," UNESCO Institute for Statistics, (2018): http://uis.unesco.org/en/country/bf?theme=education-and-literacy

The Constitution of Guinea was revised in 2001 to introduce the principles of non-discrimination and gender equality. Article 8 upholds equality between men and women as a fundamental right. Guinea ratified the Convention on the Elimination of All forms of Discrimination against Women in 1982 but has yet to ratify the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa. Since 2007, Guinea's Civil Code has been under revision to remove a significant number of discriminatory measures regarding parental authority, divorce, child custody and other issues and is scheduled to be submitted to the legislative body (Assemblée Nationale) for adoption. A national policy on gender was adopted in 2011, while another gender equality law has been drafted and is in the process of being adopted.

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

1.2.3 Key Challenges

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

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

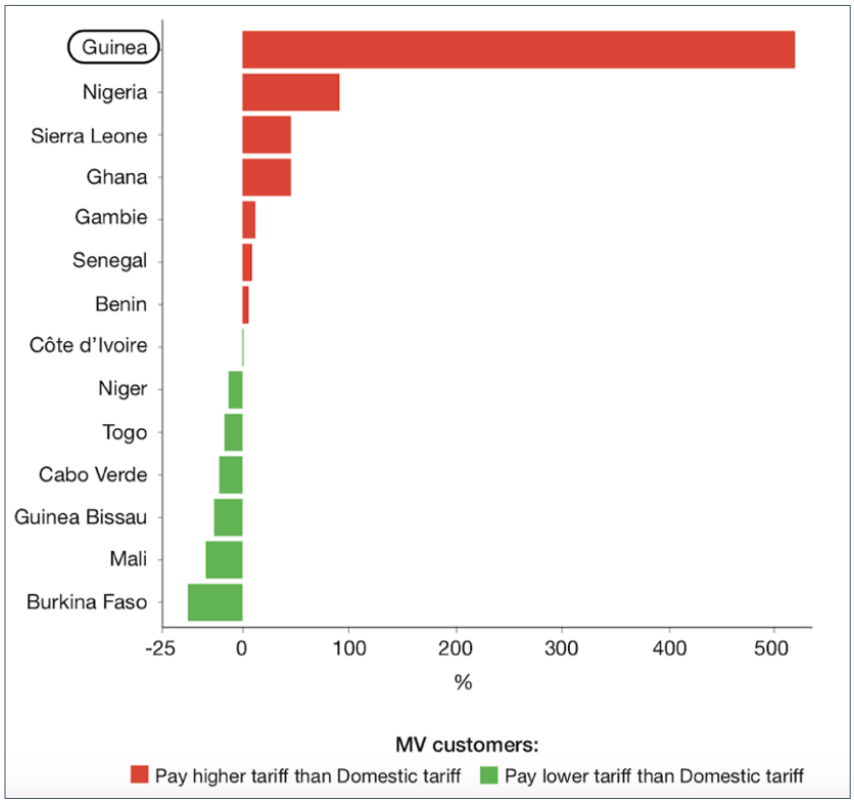
- **Electricity Tariffs / Utility Financial Performance:** Guinea heavily subsidizes electricity tariffs for low-income consumers, providing electricity to poorer households below the cost of supply through a range of residential, commercial and industrial consumers who pay higher electricity rates. While this subsidization scheme has made power very affordable for residential consumers (**Table 4**), particularly low-income households, larger commercial and industrial users pay the highest electricity tariffs in the region (**Figure 13**).[81] Without cost-reflective tariffs in place, EDG is not financially viable. As a result, Guinea's power sector remains largely dependent upon foreign assistance for grid extensions and maintenance.

- **Imbalanced Energy Mix:** The country's power supply mix is overly reliant upon thermal and large hydropower, which are susceptible to price volatility and climatic conditions, respectively. While power sector planning continues to support these technologies through 2030, there is comparatively little investment in non-hydro renewable energy, which cannot compete with cheaper baseload power in the country's existing regulatory environment.

- **Electricity Access:** Despite positive trends over the last few years, just 18% of the total population of Guinea has access to electricity and only is 3% in rural areas. Guinea's electrification target is to reach 50% of the population rate by 2020.[82] The GoG will need to utilize its off-grid solar potential in order to meet this target.

[81] "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
[82] "Guinea at a Glance," SEforALL-Africa, (2018): https://www.se4all-africa.org/seforall-in-africa/country-data/guinea/

Figure 13: Commercial/Industrial Tariff in Excess of Residential Tariff in ECOWAS Countries, 2018



NOTE: Liberia is excluded from the analysis; Medium-Voltage (MV) consumers are typically larger commercial and industrial enterprises. The disparity in electricity tariffs between commercial / industrial and residential consumers is an indication of the existence of a subsidization or cross-subsidization scheme that typically favors low-income residential consumers. On average, MV consumers in the ECOWAS region pay 40% higher tariff than residential Low-Voltage consumers (households).

Source: ECOWAS Regional Electricity Regulatory Authority

- **Local Financial Institutions:**[83] Local financial institutions (FIs) and microfinance institutions (MFIs) lack sufficient internal capacity and credit appetite to invest in the renewable energy/off-grid sectors. This challenge is complicated as it arises mainly from the risk perceptions of FIs, which influence whether efforts should be made to develop strategies and customize financial products to target a nascent market, where there is often limited knowledge of technologies, market characteristics and historical data on portfolio credit performance. There are also likely misperceptions about the potential size of these markets as well as doubts about the profitability of offering financial products in rural off-grid areas, where the creditworthiness of potential clients may be an issue. The renewable energy/off-grid space is particularly complicated given relatively high transaction costs and a comparatively unfavorable regulatory environment that exists in the country.[84]

- **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

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

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

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

With support from DFIs and development partners, the GoG has launched several national energy policies and electrification plans. The Energy Master Plan (2006, revised in 2018), the Energy Sector Tariffs Study (2009, revised in 2018), the EDG Business Plan (2009, revised in 2016) and the Policy Letter on the Development of the Energy Sector (Lettre de Politique de Développement du Secteur de l'Energie, LPDSE), created in 2009 and revised in 2012, are all key relevant to Guinea's national energy policy. The LPDSE sets the following objectives for the energy sector in Guinea to:

- Provide a high rate and quality of energy access, by upgrading and developing generation capacity
- Ensure financial autonomy of the electricity sector by providing a relevant tariff framework and adequate commercial management through the Diagnostic and Recovery Electricity Plan. This plan, with the help of the World Bank and AFD, aims to improve EDG's financial viability.
- Encourage private sector involvement in the production, transportation, and distribution segments, based on a fair regulatory framework
- Emphasize the Government's role and capacity to define policy and strategy documents while strengthening the role of the regulatory authority.
- The Letter also describes the significant contribution of solar energy to electrification, through the implementation of projects for electrifying rural villages to achieve the following objectives by 2025:

    - 6% coverage of rural electricity needs in Middle Guinea;
    - 12% coverage of rural electricity needs in Maritime Guinea;
    - 19% coverage of rural electricity needs in Upper Guinea;
    - 3% Coverage of rural electricity needs in Forestry Guinea.

Under the National Economic and Social Development Plan (Plan National de Développement Economique et Social, PNDES), the Government prioritizes (i) major hydropower projects, including Souapiti (515 MW) and Poudaldé (90 MW), (ii) the implementation of an appropriate legal and regulatory framework and restoring the financial stability and viability of national electric utility EDG, (iii) rural electrification, (iv) network extension in peri-urban areas, (v) diversification of energy sources with emphasis on renewable energies, especially micro hydropower plants, solar and wind energy, and biomass, and (vi) participation in the interconnection of sub-regional electricity networks.[85]

Another program, the National Program to Improve Electricity Access (Programme national d'amélioration de l'accès à l'électricité en Guinée), drafted in 2017, would require initial investment for network densification, while the second phase plans to extend the existing to increase electrification through 2030.[86] The related Feasibility Study and Investment Plan for this program that was carried out in 2016 included recommendations and estimates on the funding needed to achieve further energy access. The study underscored the importance of off-grid stand-alone solutions as well as development of mini-grids. The investment required for this program is estimated to be USD 643 million over the course of five years.[87] The **Table 7** summarizes the connection objectives and the necessary investments up to 2022.

[85] "National Economic and Social Development Plan," Republic of Guinea, (2017): https://groupe-consultatif-guinee.com/pndes-content/uploads/2017/11/Condense_ENGVersion_DEF_08112017_19h30.compressed.pdf
[86] "Projet: Programme National d'Amélioration d'Accès à l'Électricité en Guinée," Comité Consultatif de Guinée, (2017): https://groupe-consultatif-guinee.com/pndes-content/uploads/2017/10/Fiche-MOE-Programme-National-damelioration-de-lacces-a-lelectricite.pdf
[87] "Programme d'électrification de la Guinée: Prospectus d'Investissement," Castalia Strategic Advisors, (June 2017).

Table 7: Planned Electricity Connections and Corresponding Investments

Indicator	2018	2019	2020	2021	2022
Grid connections	9,256	28,256	78,256	198,256	348,256
Mini-grid connections and individual stand-alone systems (including temporary electrification solutions)	2.7	6.7	13.7	16.7	18.7
Investments for grid connection (USD million)	6.2	18.5	43.7	115.3	311.4
Investments for mini-grids and individual stand-alone systems (USD million)	7.1	17.1	34.6	42.3	47.3
Electrification rate (%)	18.3%	18.6%	20.2%	25%	36%

At a regional level, the GoG is committed to the ECOWAS Regional Renewable Energy Policy for the period of 2015-2030, which seeks to (i) set national Renewable Energy (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.[88]

1.3.2 Integrated National Electrification Plan

AGER is currently developing the National Rural Electrification Program (PNER) with support from ECREEE.[89] The PNER can be characterized as an integrated electrification plan that includes a combination of strategic regulatory approaches:

- The division of the Guinean territory into Rural Electrification Zones (Zones d'Electrification Rurale, ZER). In order to facilitate the implementation of public-private partnerships (PPP) between AGER and private operators, seven ZER have been created (based on the corresponding existing administrative division: Boké, Faranah, Kankan, Kindia, Labé, Mamou, Nzérékoré). Out of these seven zones, Boké and Faranah have already been selected to implement the first Priority Rural Electrification Projects (Projets d'Electrification Rurale Prioritaires, PPER); an international call for tenders will select two private operators for each ZER.[90]
- Technological neutrality based on lower costs: (i) grid extension currently operated by EDG, (ii) mini-grids supplied by hydroelectric, hybrid and biomass plants, or (iii) stand-alone solar PV systems.

1.3.3 Energy and Electricity Law

Guinea Electricity's sector laws from 1993 and 1998 provided a framework for electricity production, transmission, distribution and regulation, as well as privatization of the operation of the public electricity service. Recent changes include the 2013 Rural Electrification Law, which intends to redefine the institutional and regulatory framework. Its corresponding implementation decree was adopted in May 2017 and led to the creation of rural electrification agency AGER. The law establishing the independent regulatory agency (for electricity and water), ARSEE, was adopted in November 2017.[91] In addition, the current electricity law is being updated to reflect changes in the sector and promote private participation.

[88] "ECOWAS Renewable Energy Policy," ECOWAS, (2015): http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf
[89] "Termes de référence pour l'élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement de capacité en planification de l'AGER," ECREEE, (2016): http://www.ecreee.org/sites/default/files/procurment/attachments/tors_ager_pner_.pdf
[90] "Élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement des capacités en planification de l'AGER : Rapport Final Volume 3 (version provisoire)," ECREEE, I2D, (2017)
[91] "Additional Credit for the Power Sector Recovery Project, Guinea," World Bank, (2018): http://documents.worldbank.org/curated/en/172941521424821535/pdf/GUINEA-POWER-SECTOR1-PAD-02272018.pdf

A set of regulations, including the Rural Electrification Master Plan as well as the two above-mentioned Priority Electrification Projects (PPER) will be reflected in the new electricity law, which is currently being finalized. This new law will help define precisely the areas that are under the jurisdiction of AGER and those managed by EDG.

1.3.4 Framework for Stand-alone Systems

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

To date, the Government's efforts to establish a supportive policy and regulatory framework for the off-grid sector have had moderate success, as evidenced by the country's World Bank Regulatory Indicators for Sustainable Energy (RISE) energy access score (**Figure 14**). In the 2017 RISE evaluation, Guinea ranked eighth among countries in West Africa and the Sahel (**Figure 15**).

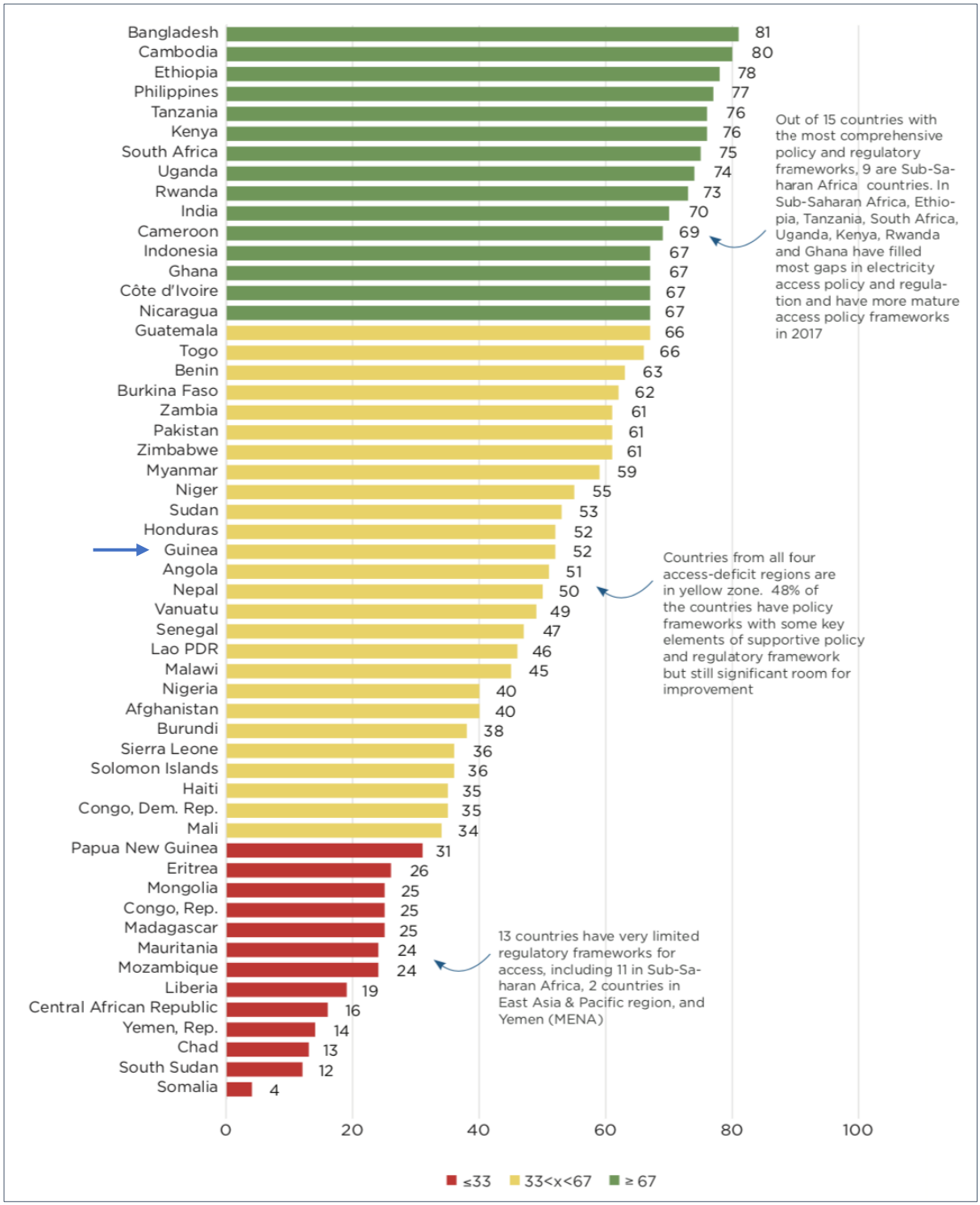
Figure 14: Policy and Regulatory Framework for Stand-alone Systems

GUINEA			
	World Bank RISE 2017 Energy Access Score: 52 World Bank RISE 2015 Energy Access Score: 57	2017 ranking among West Africa and the Sahel (ROGEP) countries: 8th	
Policy/Regulatory Support and Financial Incentives	**Specific national policies, laws and programs**		
	National electrification policy with off-grid provisions	√	LPDSE
	Integrated national electrification plan	[ ]	PNER
	Energy/electricity law with off-grid provisions	√	2017 Rural Electrification Law
	National programs promoting off-grid market development	x	
	Specific target for rural electrification	√	35% by 2020; universal access by 2030
	Financial incentives		
	Subsidies, tax exemptions or related incentives for solar equipment/stand-alone systems	x	
	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	[ ]	PNER
	Business Model Regulation	x	

√ = existing/implemented provisions in the current regulatory framework
X = no existing provisions
[ ] = planned/under development

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

Figure 15: Distribution of RISE Electricity Access Scores in Access-Deficit Countries, 2017[92]



Source: World Bank Regulatory Indicators for Sustainable Energy

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

1.3.4.1 Existence of Specific National Programs

Although there is no specific national program in place with provisions to develop Guinea's off-grid sector, the PNER intends to achieve the country's electricity access objectives through a combination of grid extension, mini-grids and stand-alone solar systems. Through SEforALL, Guinea has also integrated its energy access objectives directly into the National Program for Integrated Access to Energy Services (Programme National Intégré d'Accès aux Services Energétique, PRONIASE) in the Poverty Reduction Strategy and in the LPDSE.

1.3.4.2 Financial Incentives

While no specific financial incentives exist, the PNER framework includes parameters for rural electrification zones / concession areas that would include financial incentives to attract private operators.

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 need to be in place to ensure equipment is reliable, adequately covered by warranties and post-sale O&M. There are currently no government-adopted quality standards for stand-alone systems in Guinea.

1.3.4.4 Concession Contracts and Schemes

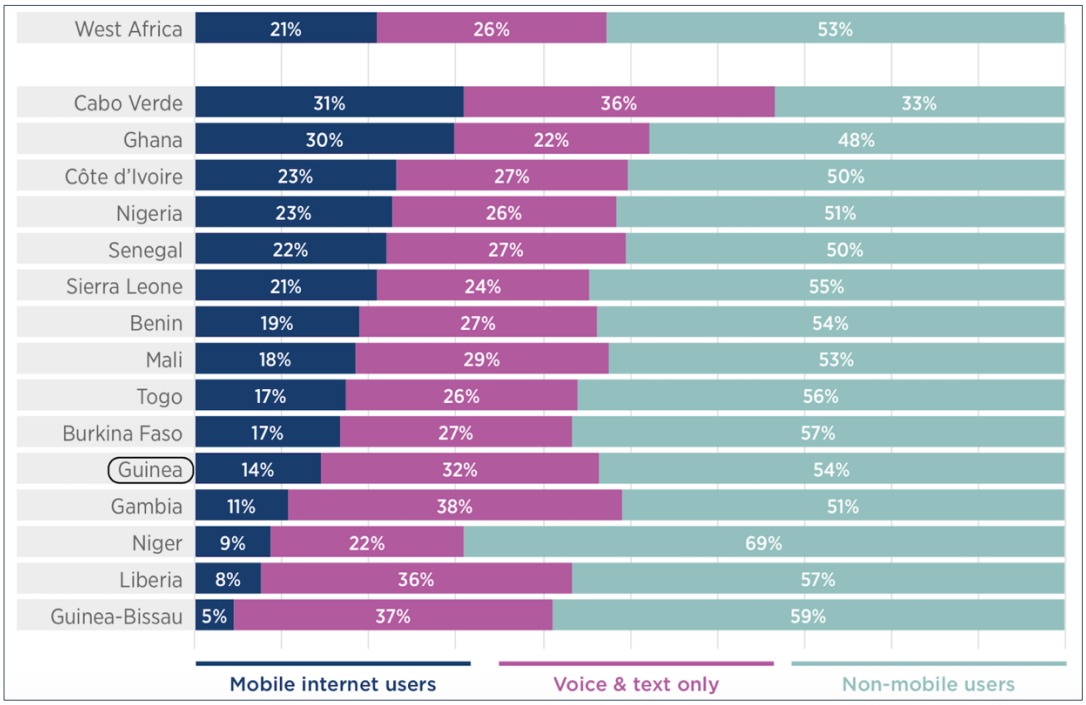
ECREEE is currently providing TA to the Government to support development of Guinea's Rural Electrification Agency, AGER, and its corresponding institutional/regulatory structures.[93] AGER is in the process of implementing the PNER, which aims to build off of the micro-concession scheme that was initially developed under the World Bank-sponsored Decentralized Rural Electrification Project (PERD) in 2014.[94] The model's key innovation, which was to utilized SME-based micro-concessions, was highly successful at achieving PERD rural electrification objectives. The PNER has created seven Rural Electrification Zones (ZER) in order to develop concession-type contracts with private operators and facilitate PPPs. These seven zones correspond to the country's existing administrative divisions – Boké, Faranah, Kankan, Kindia, Labé, Mamou, Nzérékoré.

1.3.4.5 Specific Business Model Regulation

No specific business model regulations exist for the off-grid sector in Guinea, although the Government (through the PNER framework) can take measures to support PAYG business models that have already been deployed by private solar companies engaged in the market. As was demonstrated in East Africa in recent years, the proliferation of mobile money platforms can rapidly facilitate energy access. Recent data suggests that there is an opportunity for the GoG to bring together key stakeholders in the off-grid sector (solar providers, telecommunications companies etc.) to take advantage of the country's growing usage of mobile internet services (**Figure 16**) and high rates of mobile phone ownership in rural areas (**Figure 17**).

[93] "Termes de référence pour l'élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement de capacité en planification de l'AGER," ECREEE, (2016): http://www.ecreee.org/sites/default/files/procurment/attachments/tors_ager_pner_.pdf
[94] "Decentralized Rural Electrification Project: Republic of Guinea," The World Bank, (2014): http://documents.worldbank.org/curated/en/191951468274211905/pdf/ICR29350P074280IC0disclosed04040140.pdf

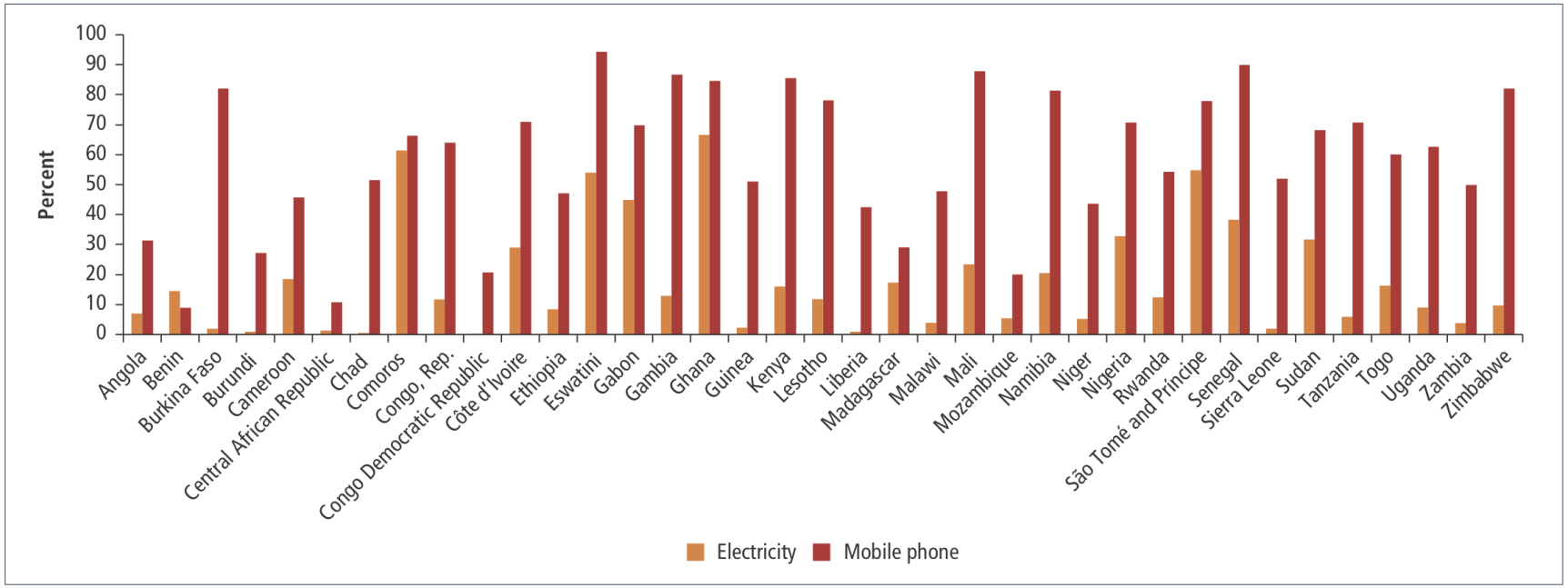
Figure 16: West Africa Mobile Internet Penetration Rates, 2017[95]



Source: GSMA Intelligence

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

Figure 17: Electricity Access and Mobile Phone Ownership in Sub-Saharan Africa, 2016 (% of rural households)[96]



Source: World Bank

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

1.3.5 Capacity Building and Technical Assistance

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 MOE and the electricity market regulator, ARSEE, among others, 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 below identifies some of the policy/regulatory challenges facing off-grid market development in Guinea and the proposed mitigation measures/TA interventions to overcome these gaps.

Table 8: Gaps in the Off-Grid Policy and Regulatory Framework[97]

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[98]	a. Help Government establish a clear Rural Electrification Policy which encourages least cost, integrated planning for all options
	b. Main focus of policy is on national grid extension only	b. Help Government develop a comprehensive, fully integrated electrification plan with least cost planning to consider where extension is the most efficient and sustainable approach to increasing energy access vs. development of the off-grid sector – mini-grids and stand-alone systems powered by local renewable resources
	c. Government is subsidizing fossil fuel electricity production	c. Help Government analyze where fossil fuel subsidies serve as an impediment to development of safe, clean energy access alternatives
	B. Lack of Integrated National Electrification Plan	
	a. No integrated plan exists[99]	a. Help Government develop a comprehensive, least cost, integrated plan for all rural electrification options

[97] **NOTE**: "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 Guinea (**Table 2**), including the Ministry of Energy (MOE), the National Directorate for Energy (DNE), Rural Electrification Agency (AGER), Regulatory Authority (ARSEE) and the public utility, EDG, among other national and local authorities

[98] The National Rural Electrification Plan, PNER, was still under development as of mid-2018

[99] ECREEE is currently providing TA to the Government to support development of Guinea's Rural Electrification plan (PNER) and its corresponding institutional/regulatory structures

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
	b. Insufficient focus on or understanding of framework to support private sector participation	b. Help Government improve the existing planning framework to encourage private participation in mini-grid and stand-alone solar system options, including *inter alia* preparation of guidelines to enhance collaboration between Government and private companies, industry associations, and other relevant stakeholders to coordinate development of effective policy that is flexible and responsive to the needs of the market
	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 (e.g. to expedite the process of electricity market liberalization)
	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	a. Help Government establish the medium-long term rural electrification strategy in the country through development and implementation of a rural electrification Master Plan (e.g. through the Guinean Agency for Rural Electrification, AGER)
	b. Insufficient focus on or understanding of framework to support private sector participation	b. Help Government improve policy and regulatory framework to create appropriate incentives for private sector participation to expedite off-grid solar market growth, including *inter alia* preparation of procurement schemes and financing mechanisms designed to encourage PPP engagement in the off-grid sector
2. Financial Incentives (import duties, taxes, etc.)	**A. Insufficiently supportive financial incentives / tax regime**	a. Help Government develop appropriate VAT and tariff policies covering the entire off-grid stand-alone solar product supply chain (including batteries, inverters or other system components) that would 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 c. Help Government introduce appropriate grant and subsidy schemes which require private funding matches, and are predictable and not overly bureaucratic d. Help Government create PPP schemes to share high project development and market entry costs particularly with developers in remote areas[100] e. Help Government analyze where subsidies or exemptions for non-renewable energy sources provide unfair advantage for fossil-fuels and impede development of clean energy solutions

[100] The PNER framework includes parameters for rural electrification zones / concession areas that would include financial incentives to attract private operators

Indicator	Policy/Regulatory/Market Gaps	Recommended TA Intervention
3. Standards and Quality	A. Insufficient Market Data	a. Help Government establish a Special Task Force (e.g. within MOE, DNE, AGER) responsible for collaborating with the private sector to compile and regularly update a database of critical off-grid market data (solar product imports, costs, sales volumes, resource potential etc., GIS data and other key indicators) that can be (i) utilized by policymakers to make informed electrification planning decisions based on accurate 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, and harmonization of equipment to expedite replacement of spare parts b. Help Government integrate standards with appropriate oversight agencies to ensure quality-verification procedures are in place to safeguard the reputation of licensed products and to in turn mitigate the detrimental impact of the counterfeit / inferior product market c. Help Government implement a legal framework that provides protections for consumers and suppliers, including *inter alia* regulations that (i) require licensing for the sale and installation of solar equipment; (ii) prohibit the sale of certain brands or models; and (iii) enable companies or public authorities to prosecute those caught distributing counterfeit / inferior 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 b. Support development of database of best practices / information sharing services to ensure skills transfer from international, local and regional initiatives (e.g. through MOE, DNE, AGER)
	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. counterfeits
4. Concession Contracts and Schemes	**A. Need for clear communication and streamlining in licensing and permitting procedures**	a. Help Government structure PNER to build on achievements of 2014 Decentralized Rural Electrification Project (PERD) and 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[101]
	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.[102]
	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[103]

[101] 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.

[102] 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.

[103] 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[104] 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[105] c. Support capacity building and foster linkages between off-grid solar companies and telecommunications companies/mobile money providers to help roll out technology platforms and PAYG business models

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

[104] 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.

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

1.4 Development Initiatives

1.4.1 National Government Initiatives

The GoG, through the MOE, has developed a number of strategic plans to address rural electrification and develop the off-grid sector with support from the World Bank, AfDB, AFD, ECREEE, and the EU among other partners. The current GoG program guiding the sector's development is the National Least Cost Electricity Access Scale Up Project – for which the corresponding investment prospectus has been launched under SEforALL/World Bank technical assistance.

1.4.2 DFI and Donor Programs

Development Finance Institution (DFI) and donor programs supporting development of the off-grid sector in Guinea are summarized in **Table 9**.

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

Project / Program	Sponsor	Timeline	Market Segment(s)	Description
Conakry Power Grid Rehabilitation and Extension Project	World Bank and AFD	2019 - present	Grid extensions and rural electrification	• In 2019, the World Bank and AFD lent USD 106 million to Guinea that will be used to rehabilitate and extend the electricity transmission network in Conakry and to develop remote off-grid areas. • The off-grid component of the project intends to finance the rural electrification of 3,000 households.[106]
Guinea Electricity Access Scale-Up Project	World Bank / SEforALL Trust Fund	2017-present	Rural electrification	• Financing the electricity access scale up investment prospectus (USD 2.1 million) in order to: (i) mobilize concessional financing to support development of a M&E framework to track the performance of the sector; (ii) increase capacity of the MOE in PPPs and (iii) develop a renewable energy atlas for the country
Guinea Power Sector Recovery Project	African Development Bank, Agence Française de Développement and World Bank	2018 - present	Institutional capacity building	• Component 1: Improvement of EDG's performance through a Management Services Contract (USD 14 million equivalent) • Component 2: Improvement of Conakry distribution network and commercial performance of EDG (USD 33.7 million) • Component 3: Technical assistance to MOE and AGER, monitoring and evaluation, and project Implementation support (USD 2.3 million)
Electricity Transport and Distribution Master Plan	AfDB	2018 - present	Power transmission and distribution	• AfDB is one of the major development partners for the GoG, providing TA for implementation of the Rural Electrification Project • The TA aims to help the Government align and coordinate efforts between the PNER and the Electricity and Distribution Master Plan

[106] Takouleu, J. "Guinea: World Bank and AFD grant $106 million for electrification projects," Afrik 21: Green Economy and Sustainable Growth in Africa, (April 4, 2019): https://www.afrik21.africa/en/guinea-world-bank-and-afd-grant-106-million-for-electrification-projects/

1.4.3 Other Initiatives

In addition to the Government and DFI/donor initiatives mentioned above, there are also several non-governmental organization (NGO) programs and other related initiatives in Guinea's off-grid sector. Fondem (Fondations Énergies pour le Monde) is a French NGO promoting off-grid solar solutions for the country's rural population, including the electrification of 20 villages (3,000 direct beneficiaries and 20,000 indirect beneficiaries) in Kouramangui and Moyenne-Guinée.[107] The Synergie Solaire – Micro Projects Agency[108] Consortium is currently offering financing (2018 grant opportunity of approximately EUR 2,000-15,000 per project) for micro and small renewable energy projects including OGS projects.

An off-grid solar installation in the town of Kouramangui, Guinea, implemented by Fondation Énergies pour le Monde (Fondem) in partnership with the Guinean Rural Electrification Agency (AGER) under the Petite Electricité Hybride en Guinée (PEHGUI) program.[109]

[107] "Projet Petite Hydraulique en Guinée," (PEGHUI), Fondem, (2015): http://www.fondem.ong/projets/projet.php?projet=7
[108] "Présentation des financements," Agence Micro-Projets, (2018): https://www.agencemicroprojets.org/financements/presentation-des-financements
[109] http://www.fondem.ong/projets/pehgui/

II. OFF-GRID SOLAR PV MARKET ASSESSMENT

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

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

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

Table 10: Indicative Total Cash Market Potential for Off-Grid Solar PV Products in Guinea, 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	353,255	1,060	$15,896,470	$0.00
Plug and play	217,841	2,178	$27,230,064	$0.00
Small SHS	10,598	530	$2,649,411	$35,325,489
Medium and Large SHS	0	0	$0.00	$88,313,722
Household Subtotal	**581,694**	**3,768**	**$45,775,945**	**$123,639,211**
Institutional				
Water supply	1,194	4,094	$10,232,938	-
Healthcare facilities	692	332	$829,500	-
Primary and secondary schools	294	318	$839,190	-
Public lighting	170	85	$255,675	-
Institutional Subtotal	**2,350**	**4,829**	**$12,157,303**	**-**
Productive Use				
SME applications for microenterprises	523	131	$326,625	-
Value-added applications	72,586	10,865	$52,441,284	-
Connectivity / ICT (phone charging)	7,348	2,939	$6,334,987	-
Productive Use Subtotal	**80,457**	**13,935**	**$59,102,096**	**-**
TOTAL	**664,501**	**22,532**	**$117,035,344**	

Source: African Solar Designs analysis

2.1 Demand – Households

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

2.1.1 Overview of Household Market Segment

According to the International Energy Agency (IEA), in 2016 there were 1.4 million households (10.2 million people) in Guinea without access to electricity.[110] In that year, an estimated 3% of the population had access to electricity, with the rate of access at 48% in urban areas and 21% in rural areas.

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

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

Table 11: Household Consumer Market Segments[111]

Income Quintile	% w/o Access	# of HHs w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# of HHs w/o Access	Avg. GDP per HH per year	Energy Tier	% w/o Access	# of HHs w/o Access	Avg. GDP per HH per year	Energy Tier	Geographic segments	Description
	2018 Scenario				2023 Scenario				2030 Scenario					
Highest 20%	15%	52,988	$12,800	Tier 3	1%	4,169	$15,735	Tier 3	1%	4,990	$20,297	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%	90%	317,929	$6,909	Tier 3	2%	8,339	$8,493	Tier 3	2%	9,980	$10,956	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%	95%	335,592	$5,058	Tier 3	43%	178,151	$6,218	Tier 3	3%	14,970	$8,021	Tier 2		
Second 20%	100%	353,255	$3,763	Tier 2	99%	412,774	$4,626	Tier 2	4%	19,960	$5,967	Tier 2	Low income rural	• Engaged in farming, SME or mining support activities • Lives more than 15km from the nearest grid connection.
Lowest 20%	100%	353,255	$2,344	Tier 2	100%	416,943	$2,882	Tier 2	63%	313,153	$3,717	Tier 1.5		
Total Households without Access to Electricity		**1,413,020**			**Total**	**1,020,377**			**Total**	**363,054**				

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**

The level of extreme poverty (households living below USD 1.90 a day) in Guinea is similar to neighboring countries in West Africa. However, as shown in **Table 12**, below the vast majority of the country's households have a low income.

Table 12: Poverty Headcount in Guinea, 2012

Poverty headcount ratio	% of population
Lives at or below $1.90 a day*	35.3%
Lives at or below $3.20 a day*	70.3%
Lives at or below $5.50 a day*	92.3%

*2011 PPP

Source: World Bank

According to feedback from the focus group discussions (FGDs), the average household income in Guinea for lower income families is between USD 100 - 300 per month. For higher income households, the average monthly income ranges from USD 500 up to USD 1,000. Incomes are lower in rural areas than in urban areas. Maritime Guinea and Forested Guinea, with greater agricultural opportunities, offer better income opportunities, with more abundant rainfall. However, the proximity of industrial, mining and commercial activities also stimulates relatively higher income opportunities in all four natural regions (Maritime Guinea, Middle Guinea, Upper Guinea and Forested Guinea).

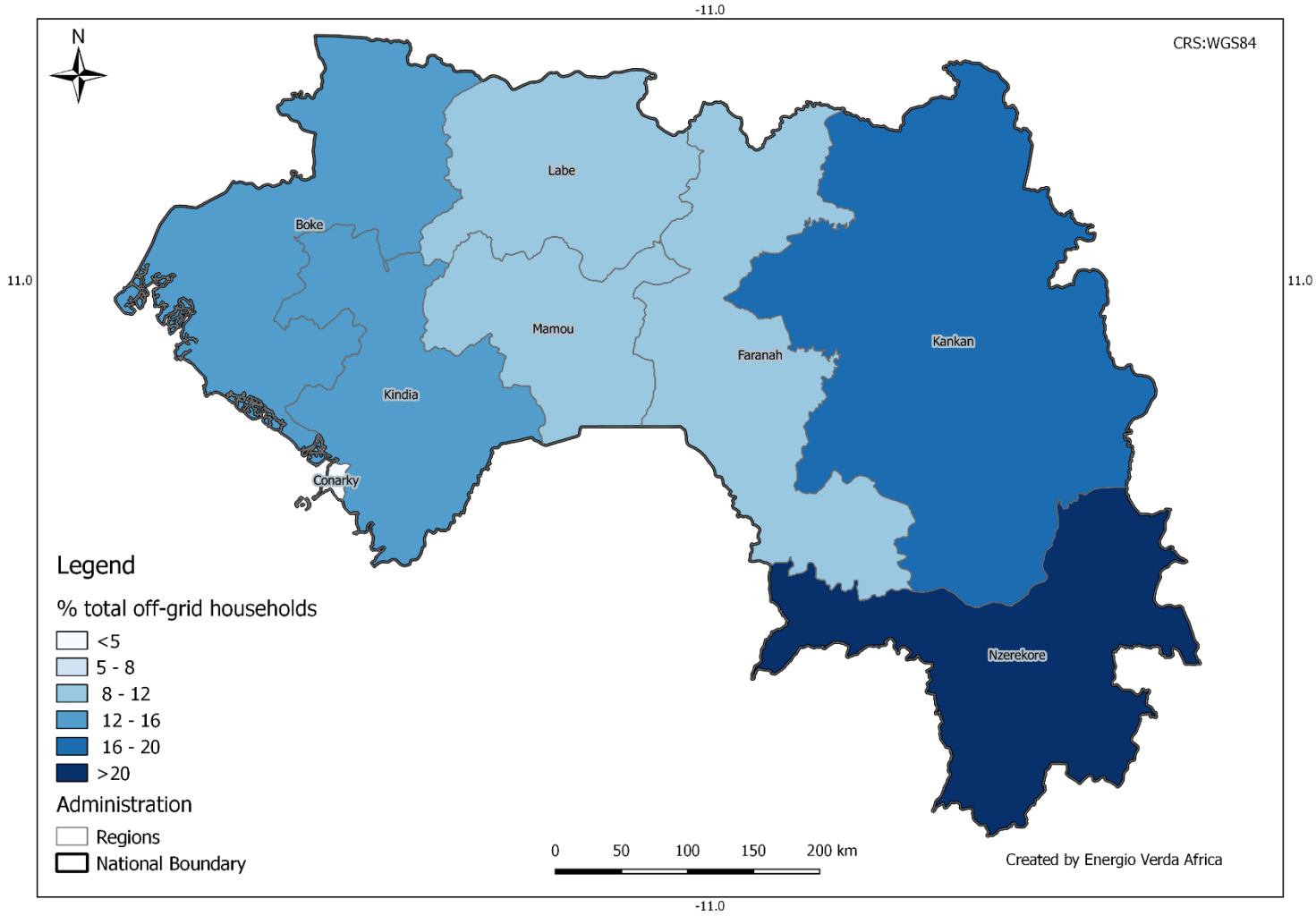
- **Geographic Components of the Solar Market**

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

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

As shown in the maps and chart summaries below **(Figures 18-21)**, the total size of the OGS market will decrease over time, while also becoming more somewhat more concentrated in remote regions. In Guinea, the number of off-grid households will remain about the same until 2030, at which point they will decrease dramatically as the national grid expands and mini-grids are built. However, off-grid households will remain relatively dispersed across the country. Important regions for off-grid solar products will also remain the same: Nzerekore, Kankan, and Boke. This consistency could help suppliers to focus distribution network development in regions with the most off-grid households over time.

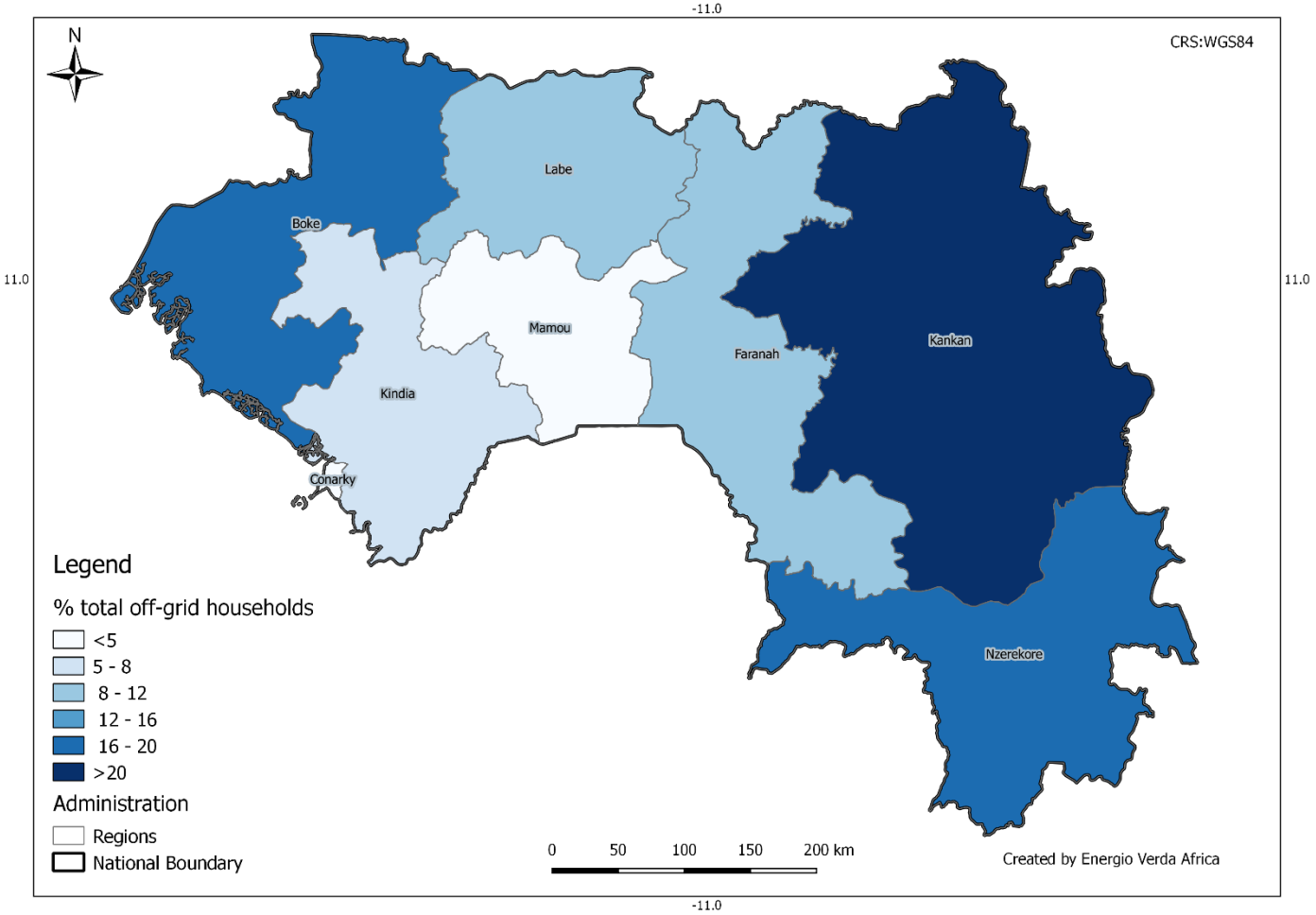
Figure 18: Distribution of Potential Off-Grid Households by Region, 2023[113]



Source: Energio Verda Africa GIS analysis

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

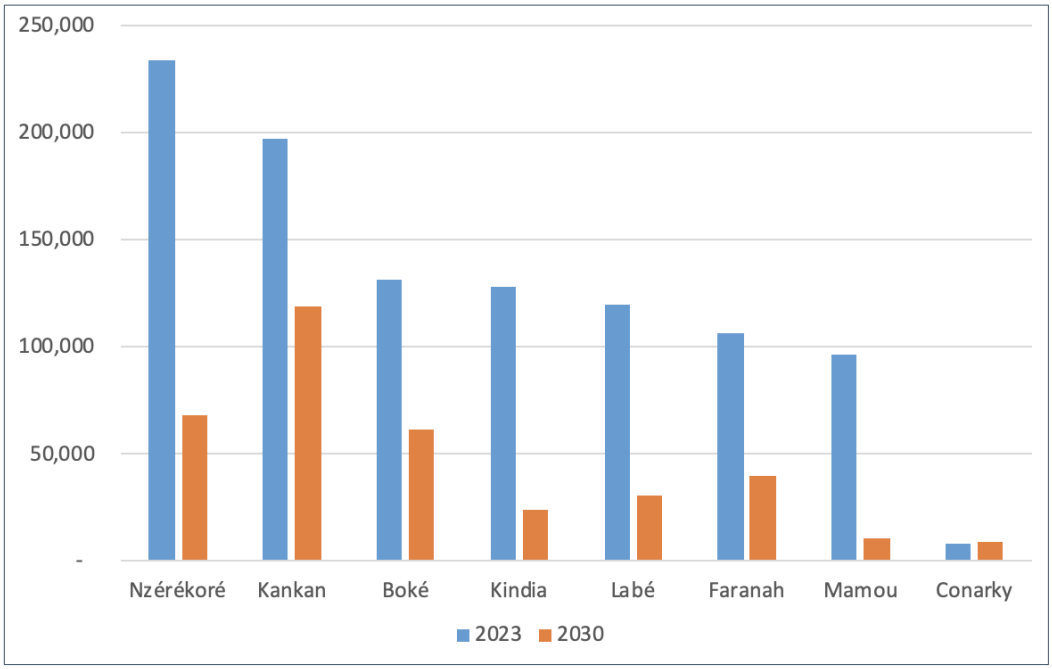
Figure 19: Distribution of Potential Off-Grid Households by Region, 2030[114]



Source: Energio Verda Africa GIS analysis

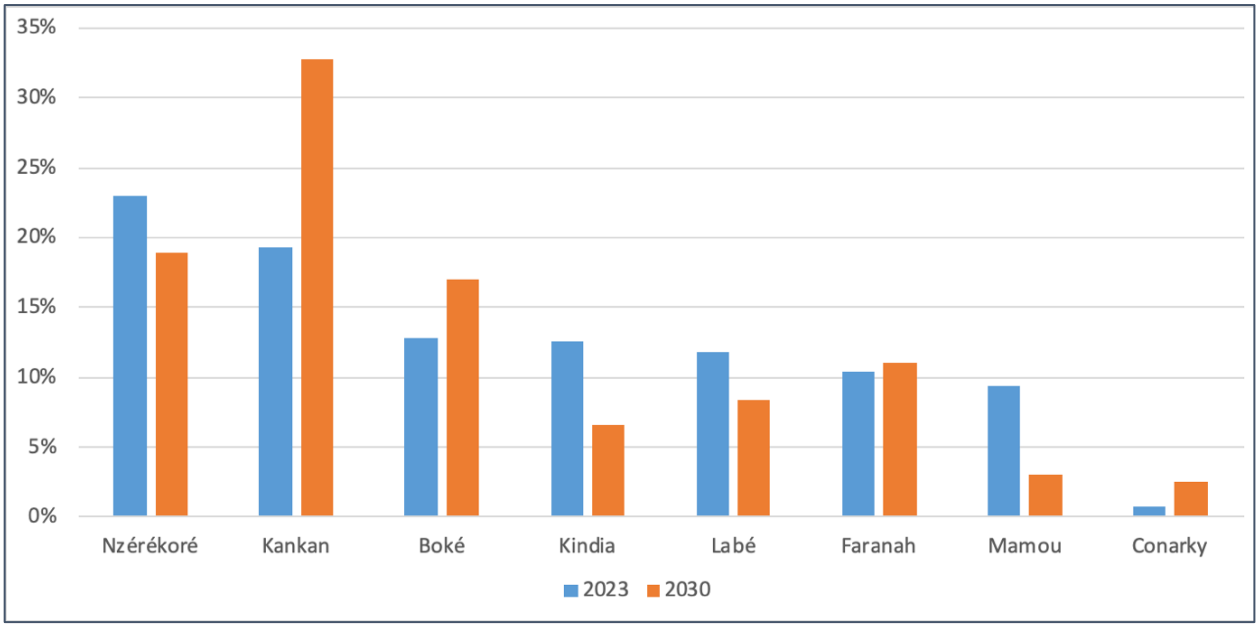
[114] See **Annex 1** for more details, including data sources.

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



Source: Energio Verda Africa GIS analysis

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



Source: Energio Verda Africa GIS analysis

2.1.2 Analysis of Household Market Segment Demand

In order to calculate total potential household demand for off-grid solar products for the national market, this section 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, the common sources of energy used by off-grid rural households include:

- Wood and Charcoal
- Agricultural, animal, craft and household waste
- Kerosene oil lamps
- Batteries and candles
- Power generators

The average household expenditure on these sources of energy is USD 33/month. This expense is relatively constant. Energy behaviors are permanent, and do not vary by region or season.

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

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

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

Table 13: Rural Energy Technology and Costs[115]

Technology	Description	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	$2.51	$3.21	$4.24	$5.43
Cell Phone Charging	Done at a charging station	-	8	$0.17	$0.00	$1.36	$0.00	$1.70	$0.00	$2.88
Smart Phone Charging	Done at a charging station	-	16	$0.17	$0.00	$2.72	$0.00	$3.41	$0.00	$5.76
Battery-powered DC Radio	Radio powered by dry cells replaced two times per month	-	8	$0.16	$0.00	$1.28	$0.00	$1.60	$0.00	$2.71
Lead Acid Battery-powered DC TV	DC TV powered by lead acid battery recharged once per week	2	4	$1.00	$50.00	$4.00	$62.64	$5.00	$106.00	$8.48
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	$1.10	$100.00	$33.00	$125.30	$41.34	$212	$70.00

Source: African Solar Designs analysis

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

Table 14: Typical Tier-Based Energy Costs

Device category and indicative energy supplied	Appliances and level of service	Non-solar devices used to power tier requirement	Typical Monthly Cost (USD) 2018	Typical Monthly Cost (USD) 2023	Typical Monthly Cost (USD) 2030
Tier 0 No electricity	• Characterized by complete lack of electricity services • Many cash-poor consumers are in this situation part of each month when they don't have money to buy dry cells or charge phones	• Rely solely on kerosene, wood and other fuel sources for cooking and lighting	• Subsistence level of energy • Absolute energy poverty	• Subsistence level of energy • Absolute energy poverty	• Subsistence level of energy • Absolute energy poverty
Tier 1 Range: 1 to 20 Wh/day	• Access to one torch powered by dry cell batteries • One cell phone powered by charging service	• One battery-powered light requires dry cell replacement on weekly basis • One cell phone charged 8 times per month	$3.92	$4.91	$8.31
Tier 1.5 Range: 20 to 100 Wh/day	• Access to one torch and one lantern each powered by dry cells • One cell phone powered by charging service • Radio powered by dry cells	• Two battery-powered light points require dry cell replacement on weekly basis • One cell phone charged 8 times per month • Radio dry cells replaced two times per month	$7.76	$9.72	$16.45
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	$15.76	$19.74	$33.40
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	$33.00	$41.34	$69.94

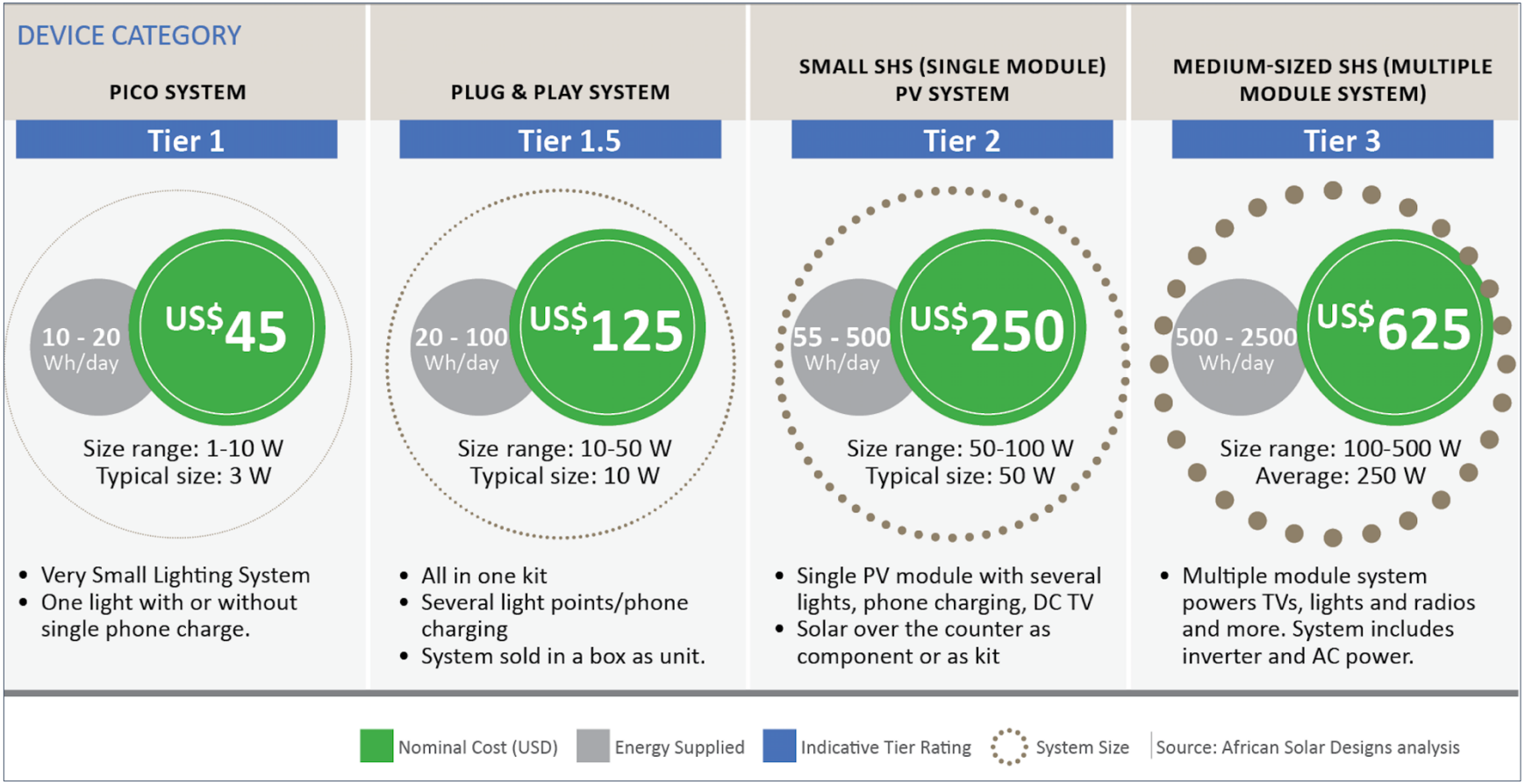
Source: African Solar Designs analysis

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

- **Household Solar PV System Types**

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

Figure 22: Household PV System Descriptions and Market Segments



Source: African Solar Designs analysis

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

According to FGD estimates, only 1% of the population of 12,600,000, or about 126,000 people in 18,000 households use solar energy systems. Households are not yet very well aware of the decisive advantages of solar solutions. There are off-grid geographic regions and sectors where off-grid solar is used in government or large donor/NGO projects which are geared towards household use. These include in Middle Guinea, Lower Guinea, Upper Guinea, and Guinea-Forestière. Actions are supported by the Government of Guinea and bilateral partners such as GIZ and JICA through the embassies of Germany and Japan, respectively.

Providers of OGS products are able to cover all areas where their interventions are requested by households. Energy products and services can be distributed in all localities of the country, even if there are deployment challenges in areas where infrastructure levels are very low.

Potential household demand for off-grid solar products

Looking beyond current use of off-grid solar products by households, this study analyzes potential for OGS market development by estimating potential household demand based on household income. Household income shown in **Table 15** below is sourced from World Bank demographic data based on household surveys, which reports income by population quintiles. From household income, potential for energy spending is estimated as 10% of monthly income (see methodology annex). Future scenarios project higher energy budgets as household incomes rise with economic development over time. In all scenarios, the large majority of off-grid households will fall under the lowest income quintile, as shown in **Table 11**.

Table 15: Energy Expenditure of Different Income Groups

Population Income Quintiles	Per Capita Income (USD per month)	Household Income (USD per month)	Energy as % of Income	Monthly Energy Budget (USD)
2018 Scenario				
Lowest Quintile of Population	$27.13	$195.34	10	$19.53
2nd Quintile of Population	$43.55	$313.58	10	$31.36
3rd Quintile of Population	$58.55	$421.53	10	$42.15
4th Quintile of Population	$79.97	$575.75	10	$57.57
Highest Quintile of Population	$148.15	$1,066.68	10	$106.67
2023 Scenario				
Lowest Quintile of Population	$33.35	$240.14	10%	$24.01
2nd Quintile of Population	$53.54	$385.48	10%	$38.55
3rd Quintile of Population	$71.97	$518.19	10%	$51.82
4th Quintile of Population	$98.30	$707.77	10%	$70.78
Highest Quintile of Population	$182.12	$1,311.27	10%	$131.13
2030 Scenario				
Lowest Quintile of Population	$43.02	$309.76	10%	$30.98
2nd Quintile of Population	$69.06	$497.24	10%	$49.72
3rd Quintile of Population	$92.84	$668.42	10%	$66.84
4th Quintile of Population	$126.80	$912.96	10%	$91.30
Highest Quintile of Population	$234.92	$1,691.43	10%	$169.14

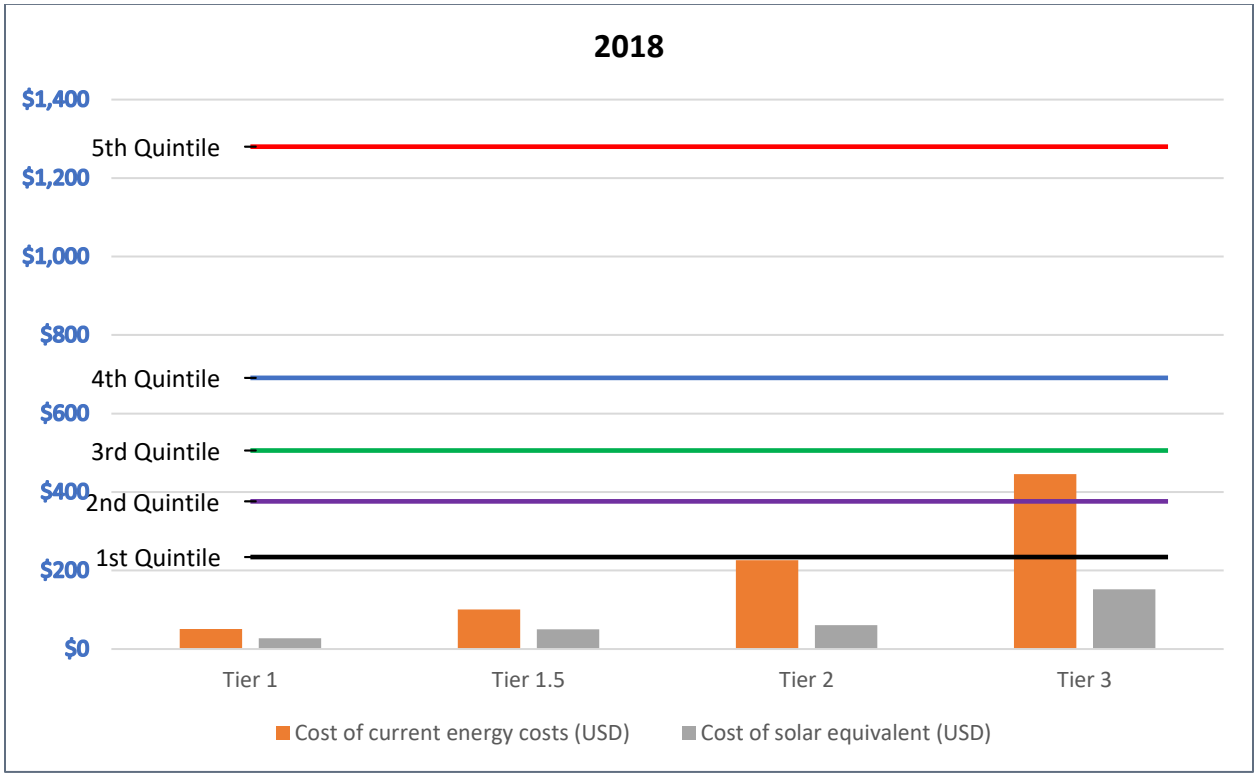
Source: African Solar Designs analysis

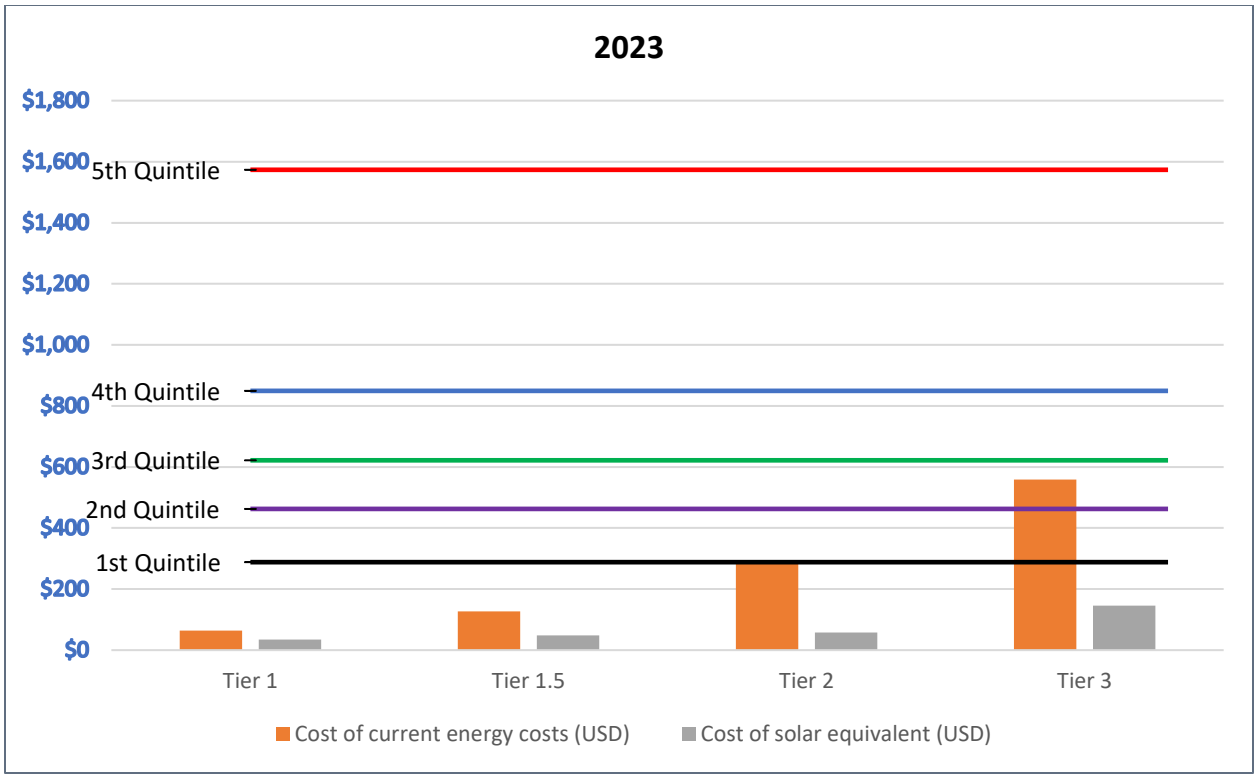
Figure 23 summarizes the preceding data in this section by comparing household energy spending with typical rural energy costs and their solar equivalents. This analysis presents annualized costs (not including financing cost) of current energy technologies for each energy tier, compared with the annual cost of an

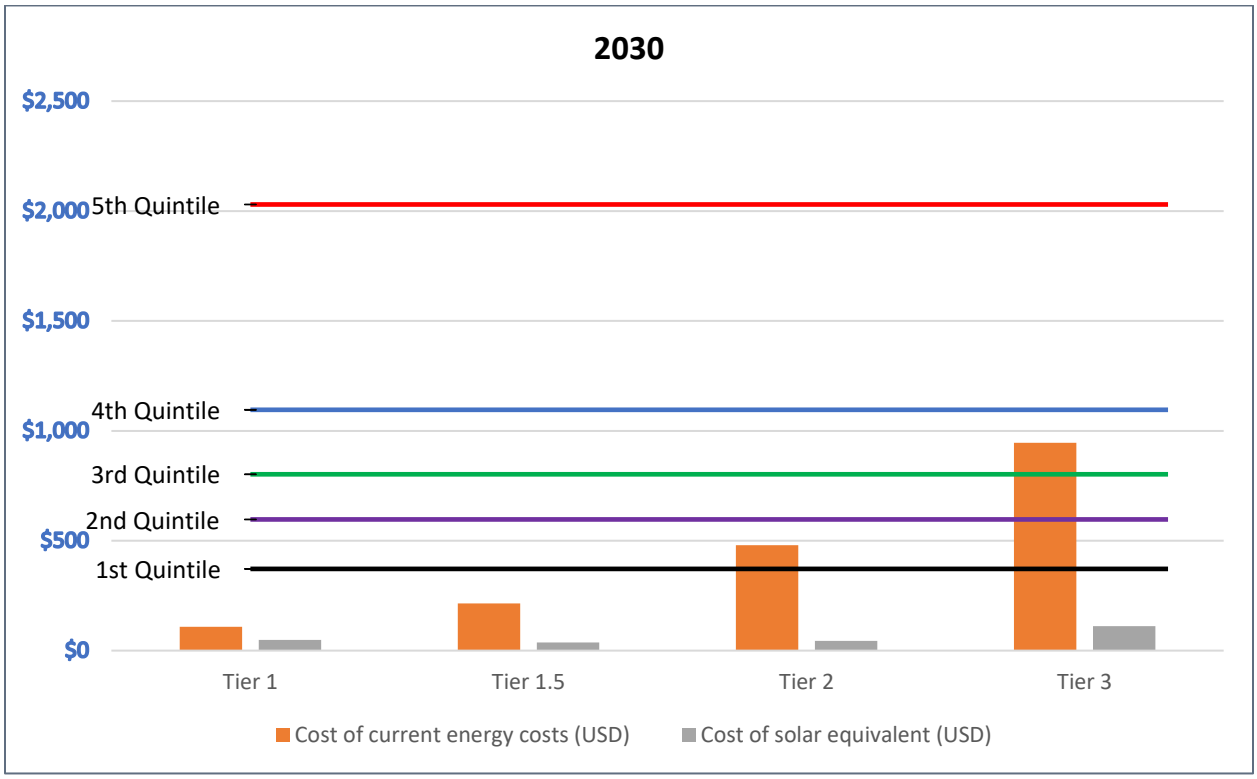
equivalent solar product. Both the annual costs of current energy technologies and equivalent solar solutions consider the capital costs of the units, and the operating costs considered over the average unit life times.

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

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







Source: African Solar Designs analysis

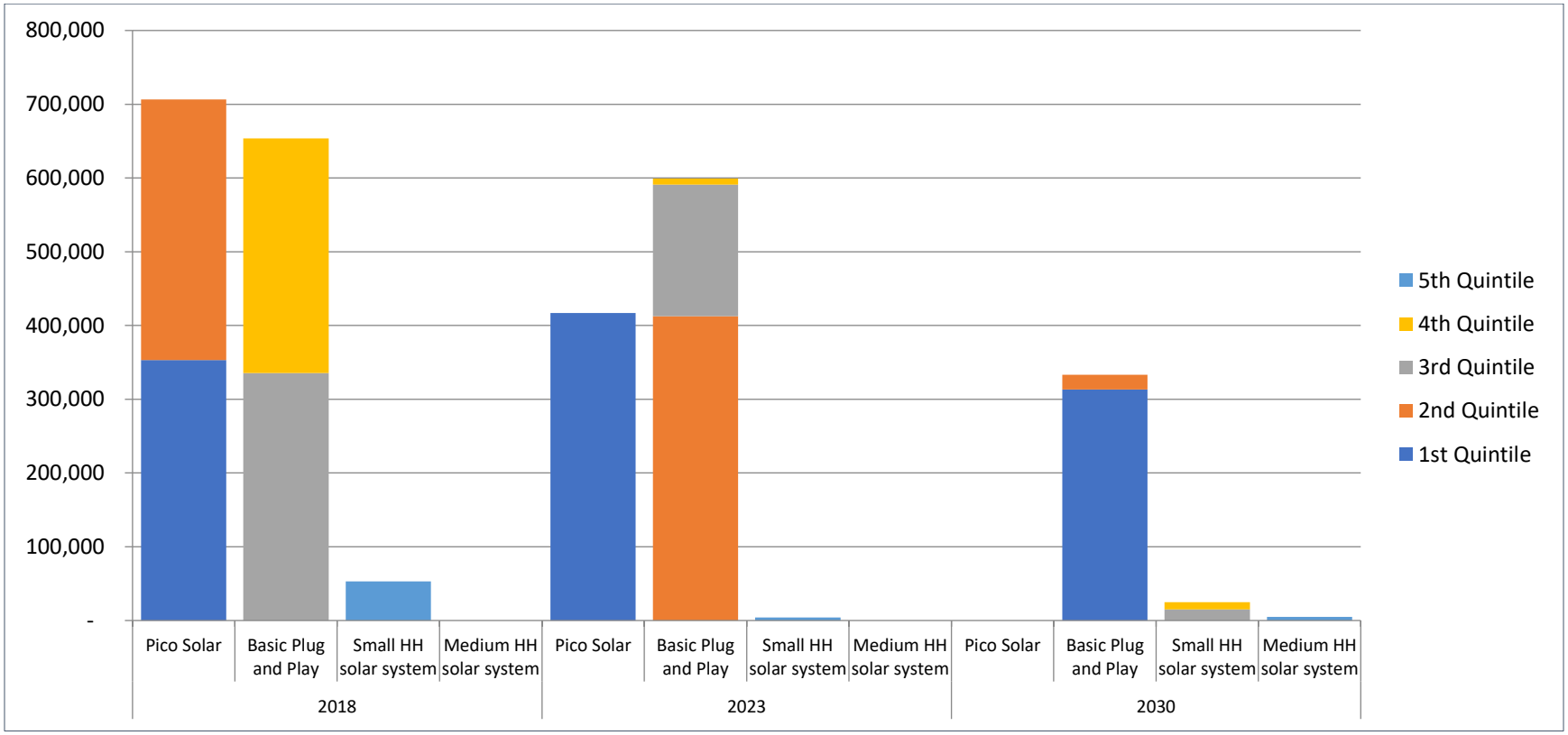
2.1.3 The Market for Household Devices without Consumer Finance

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

Based on the income quintiles and corresponding estimated current energy expenditure, in the 2018 scenario, only households without access in the highest income quintile can afford a small solar home system unfinanced. Households in the third and fourth quintile can only afford a plug and play system while the two lowest quintiles can only afford a pico solar product. Affordability increases significantly over time. However, the need for financing solutions for the lower income quintiles is clear.

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

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



Source: African Solar Designs analysis

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

Table 16: Estimated Cash Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
2018 Scenario			
Pico Solar	353,255	1,060	$15,896,470
Basic Plug and Play	217,841	2,178	$27,230,064
Small HH solar system	10,598	530	$2,649,411
Medium HH solar system	0	0	$0.00
Total	**581,694**	**3,768**	**$45,775,945**
2023 Scenario			
Pico Solar	208,472	625	$10,939,544
Basic Plug and Play	199,755	1,998	$22,230,127
Small HH solar system	834	42	$185,601
Medium HH solar system	0	0	$0.00
Total	**409,061**	**2,665**	**$33,355,272**
2030 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	111,038	1,110	$9,422,452
Small HH solar system	4,990	250	$846,900
Medium HH solar system	998	250	$423,450
Total	**117,026**	**1,610**	**$10,692,802**

Source: African Solar Designs analysis

The following observations should be considered when analyzing this data:

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

2.1.4 The Financed Market for Off-Grid Solutions

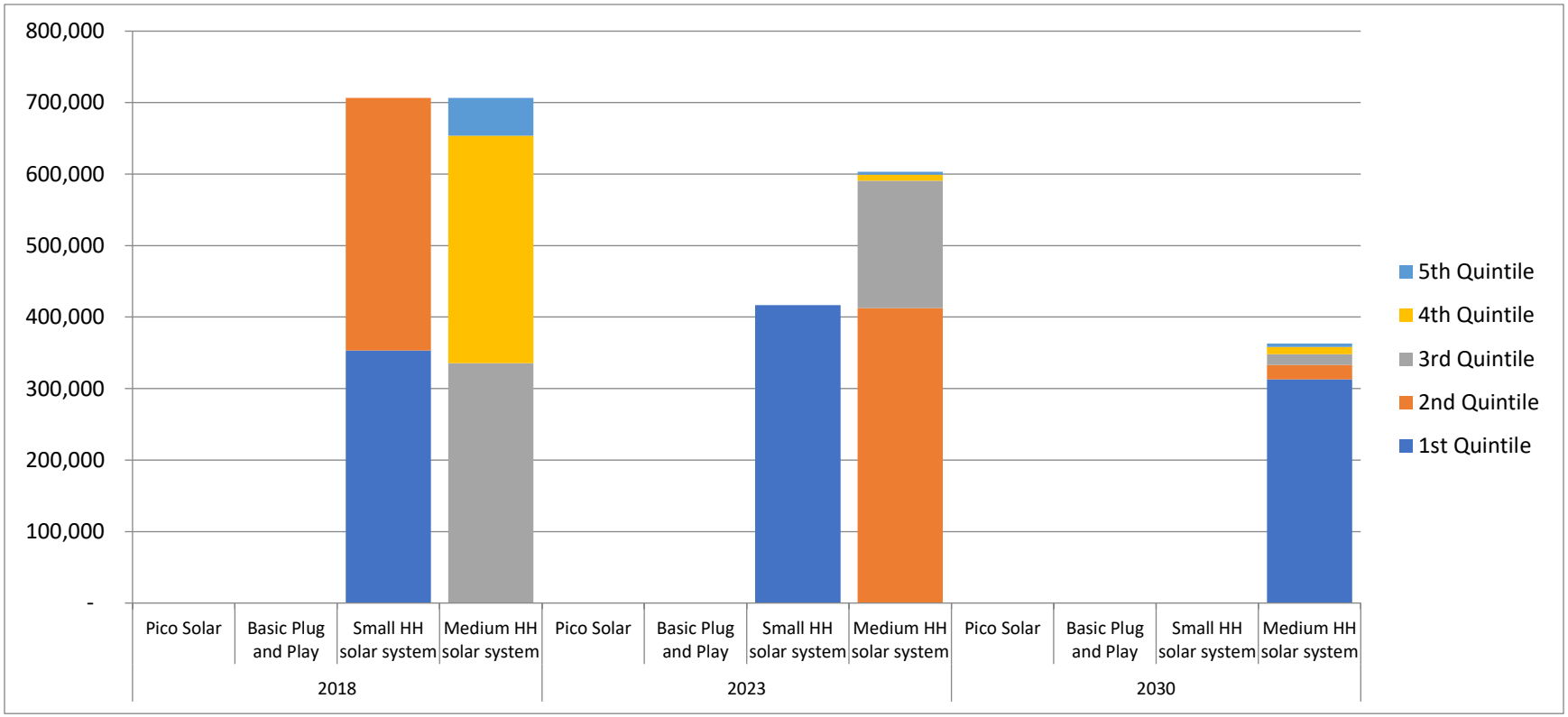
- **Financial Model**

In order to portray the effects of finance, a simple model was prepared that provides OGS system finance with a 30% 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 serve level they can afford. As with the cash market model, it assumes that each household purchases one unit each. However, this finance model greatly over-estimates the potential market for credit as both MFIs and PAYG companies would likely be extremely cautious in approving customers. Without concrete data on the loans given to consumers in each income quintile in the country, it is difficult to estimate what the more realistic figures are. Nevertheless, this model does give a clear indication that long loan tenors combined with a low upfront payment would result in significant market transformation. The results of this analysis are presented below.

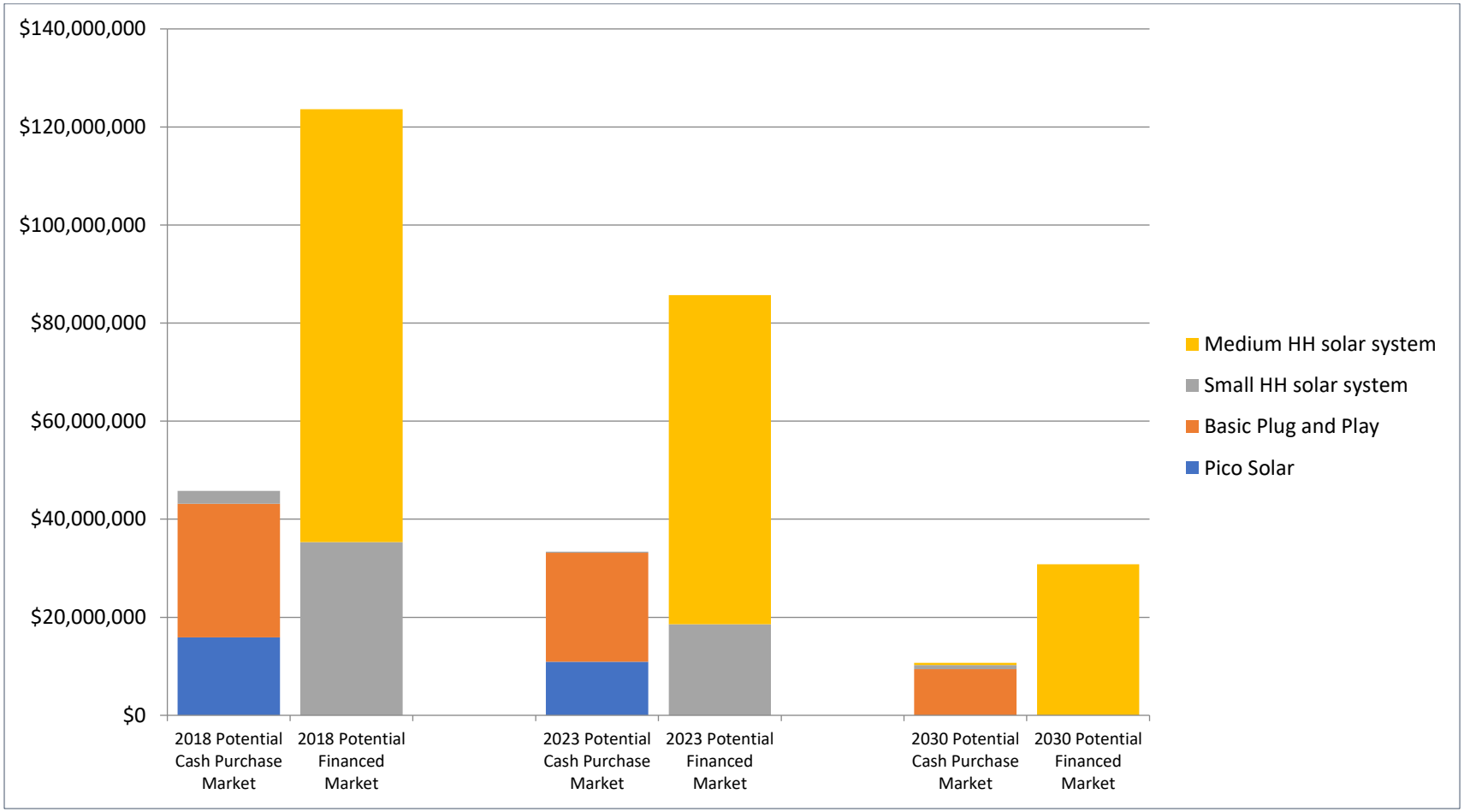
[116] http://housingfinanceafrica.org/app/uploads/Guinea-Housing-Investment-Landscapes-Final-October-2018.pdf

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



Source: African Solar Designs analysis

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



Source: African Solar Designs analysis

In 2018, without financing, all 1,413,020 households without access to electricity 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 45,775,946 to USD 123,639,211 (**Figure 26**).

The least-cost electrification 2023 scenario calculates that 1,020,377 households could be electrified by stand-alone systems. Under this scenario also, all the households without 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 33,355,273 to USD 85,714,562 (**Figure 26**).

The least-cost electrification 2030 scenario calculates that the total number of households that could be electrified by stand-alone systems would drop further to 363,054. Under this scenario as well, 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 therefore increases from USD 10,692,801 to USD 30,808,054 (**Figure 26**).

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

Table 17: Estimated Financed Market Potential for Household Sector

Solar System	Annualized Demand (Units)	Annualized Demand (kW)	Annualized Market Value (USD)
2018 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH solar system	141,302	7,065	$35,325,489
Medium HH solar system	141,302	35,325	$88,313,722
Total	**282,604**	**42,390**	**$123,639,211**
2023 Scenario			
Pico Solar	0	0	$0.00
Basic Plug and Play	0	0	$0.00
Small HH solar system	83,389	4,169	$18,560,177
Medium HH solar system	120,687	30,172	$67,154,385
Total	**204,076**	**34,341**	**$85,714,562**
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	72,611	18,153	$30,808,054
Total	**72,611**	**18,153**	**$30,808,054**

Source: African Solar Designs analysis

2.1.5 Consumer Perceptions, Interest and Awareness

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

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

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

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

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

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

- **Willingness to Pay is strongly associated with consumer understanding and perceptions of OGS**

  Although there is demonstrated ability to pay for households in higher income demographics on cash purchase, and for many households through a financed scenario, willingness to pay is strongly associated with consumer understanding and perceptions of OGS. Component-based Plug-and-Play SHS are much more expensive than battery-powered alternatives and are more than what households expect to pay for access to lighting. Consumers who purchase low-priced inferior lighting products for which they have low expectations are less likely to be willing to purchase a relatively high priced OGS system without understanding the difference between the products. Since most of the retail battery-powered lighting products are extremely low cost, conservative rural consumers are wary of expensive new products if they are unable to assess product quality and durability. For this reason, willingness to pay presents a much larger barrier for the development of sales than actual *ability* to pay. Consumer awareness campaigns can grow the demand for quality products.

2.2 Demand – Institutional

2.2.1 Overview of Institutional Market Segment

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

2.2.2 Analysis of Institutional Market Segment Demand

Table 18 shows the total estimated annualized cash market potential for institutional users in Guinea. 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 18: Indicative Total Cash Market Potential for Institutional Sector[118]

Institutional Sector		Units	kW Equivalent	Cash Value (USD)
Water supply	Low power pumping system	613	920	$2,298,938
	Medium power pumping system	440	1,762	$4,404,000
	High power pumping system	141	1,412	$3,530,000
	Subtotal	1,194	4,094	$10,232,938
Healthcare	Health post (HC1)	600	150	$375,000
	Basic healthcare facility (HC2)	75	113	$281,250
	Enhanced healthcare facility (HC3)	17	69	$173,250
	Subtotal	692	332	$829,500
Education	Primary schools	173	86	$259,350
	Secondary schools	121	232	$579,840
	Subtotal	294	318	$839,190
Public lighting	Public lighting (excluding street lighting)	170	85	$255,675
TOTAL		**2,350**	**4,829**	**$12,157,303**

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 19: Key Assumptions for Water Supply Sector Analysis

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

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

As GIS data was not available to conduct the analysis, a per capita comparison made using data from Niger[119] identified off-grid water points such as boreholes and wells that could be electrified by stand-alone systems. Based on the analysis, the estimated annualized cash market potential for the water supply sector is presented in **Table 20**.

Table 20: Estimated Cash Market Potential for Water Supply[120]

Pump Type	Units	kW Equivalent	Cash Value (USD)
Low power	613	920	$2,298,938
Medium power	440	1,762	$4,404,000
High power	141	1,412	$3,530,000
Total	**1,194**	**4,094**	**$10,232,938**

Source: African Solar Designs analysis

- **Healthcare**

Table 21: Key Assumptions for Healthcare Sector Analysis

Sector	System Sizes	Key Assumptions
Healthcare	• HC1: Dispensary health post (300 W) • HC2: Basic health facility (1,500 W) • HC3: Enhanced health facility (4,200 W)	4,830 off-grid healthcare facilities were identified 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] Niger was grouped in the same category as Guinea; 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.

Available GIS data identified off-grid health facilities categorized according to their size (HC1, HC2, and HC3) that could be electrified by stand-alone systems. 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 load of the facility (**Table 22**). The assumptions of system size below are based on the services offered at each of these facilities.

Table 22: Health Facility Categorization and Electricity Demand[121]

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 the healthcare sector is presented in **Table 23**. The distribution of potential off-grid health facilities is shown in **Figure 10** in **Section 1.2.2.4**.

Table 23: Estimated Cash Market Potential for Healthcare Facilities[122]

Type of Facility	Units	kW Equivalent	Cash value (USD)
Health post (HC1)	600	150	$375,000
Basic healthcare facility (HC2)	75	113	$281,250
Enhanced healthcare facility (HC3)	17	69	$173,250
Total	**692**	**332**	**$829,500**

Source: African Solar Designs analysis

[121] "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

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

- **Education**

Table 24: Key Assumptions for Education Sector Analysis[123]

Sector	System Sizes	Key Assumptions
Education	• Elementary schools (500 W) • Secondary schools (1,920 W)	3,458 off-grid primary schools and 2,416 off-grid secondary schools were identified that could be electrified by stand-alone systems

The education sector analysis considered the electricity needs of off-grid primary and secondary schools.[124] 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.

Available GIS data 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 25**).

Table 25: Education Center Categorization and Electricity Demand[125]

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

Source: GIZ; African Solar Designs analysis

Based on these assumptions, the estimated annualized cash market potential for primary and secondary schools is presented in **Table 26**. The distribution of potential off-grid primary and secondary schools is shown in **Figure 10** in **Section 1.2.2.4**.

Table 26: Estimated Cash Market Potential for Primary and Secondary Schools[126]

Type of Facility	Units	kW Equivalent	Cash value (USD)
Primary school	173	86	$259,350
Secondary school	121	232	$579,840
Total	**294**	**318**	**$839,190**

Source: African Solar Designs analysis

[123] 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**).
[124] 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.
[125] "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
[126] 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 27: Key Assumptions for Public Lighting Sector Analysis[127]

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

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

Table 28: Estimated Cash Market Potential for Public Lighting[128]

Public Lighting Network	Units	kW Equivalent	Cash value (USD)
Village lighting (excluding street lighting)	170	85	$255,675

Source: African Solar Designs analysis

2.2.3 Ability to Pay and Access to Finance

Financing for institutional off-grid systems in Guinea 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.[129]

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.

[127] Population figures used in this analysis were obtained from: https://www.citypopulation.de/Guinea.html
[128] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[129] Grundfos: https://www.grundfos.com/service-support/encyclopedia-search/maintenance-and-repaircostscm.html

2.3 Demand – Productive Use

2.3.1 Overview of Productive Use Market Segment

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

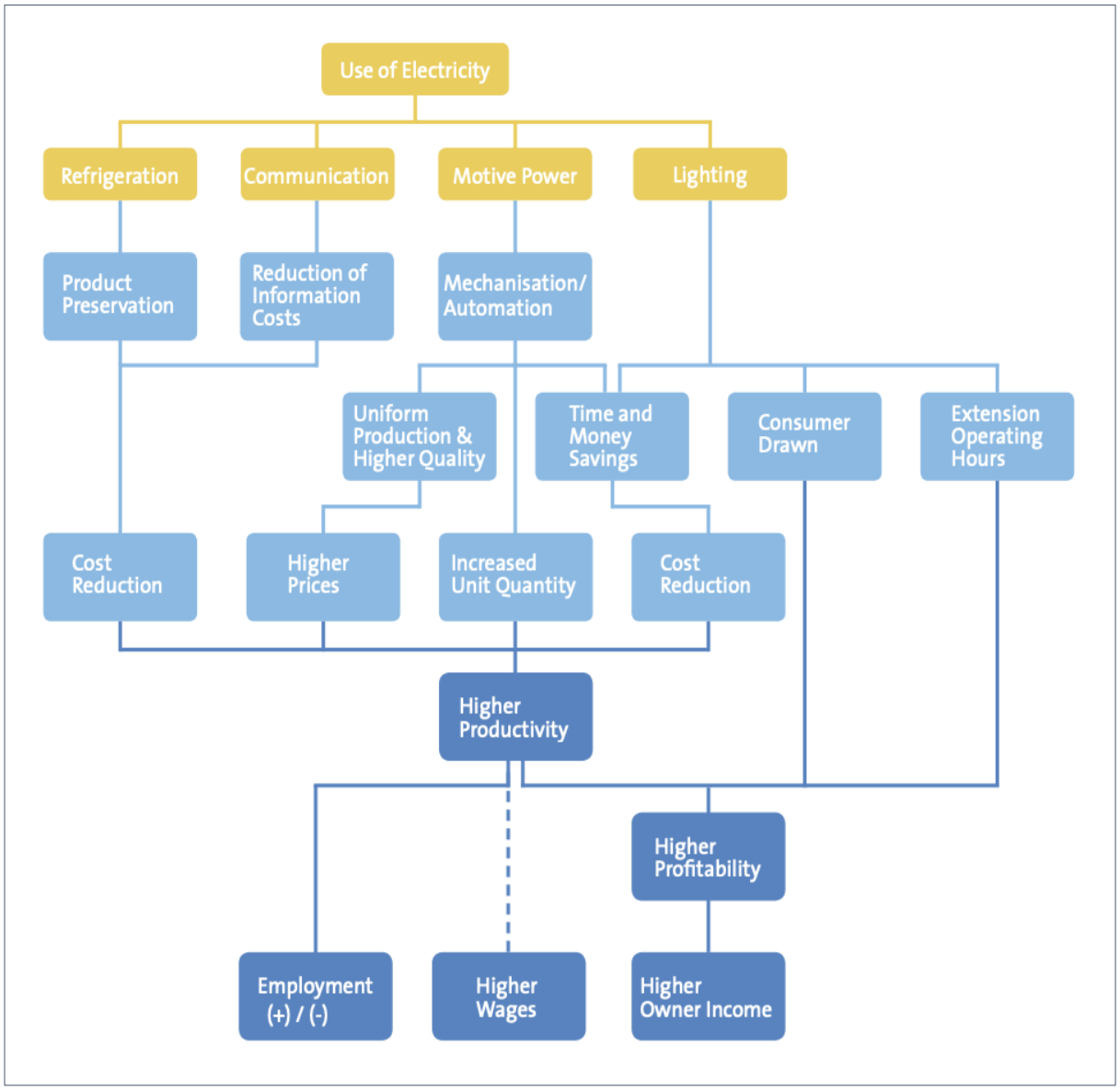
The calculation of the estimated off-grid solar market for SMEs focused only on barbering and tailoring appliances, which comprises a small portion of overall SME sector demand. These two microenterprises are indicative of the service-based SME off-grid solar market, as they benefit significantly from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

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

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

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

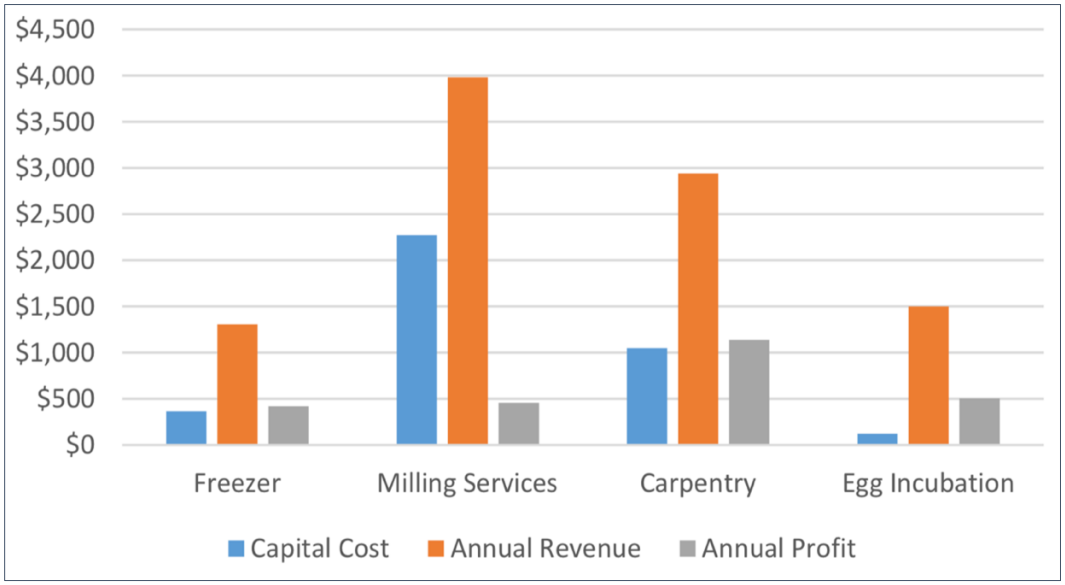
Figure 27: Pathways from Electricity to Income Generation[130]



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

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

Figure 28: Analysis of Cost, Revenue and Profit for Various Off-Grid Productive Use Applications[131]



NOTE: Annual profit does not include recovery of cost capital

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

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

Table 29: Overview of Productive Use Applications

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

Source: African Solar Designs

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

- **Geographic Locations**

Most PUE sector activities will take place in rural and peri-urban areas of the country, particularly in the regions of upper and middle Guinea. The target demographics in these areas are women and young people.

2.3.2 Analysis of Productive Use Market Segment Demand

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

Table 30: Indicative Total Cash Market Potential for Productive Use Sector[132]

Productive Use Sector		Units	kW Equivalent	Cash Value (USD)
SME Applications for Village Businesses	Microenterprises	523	131	$326,625
Value-added Applications	Irrigation	72,222	8,667	$46,944,444
	Milling	194	1,261	$3,153,152
	Refrigeration	170	937	$2,343,688
	Subtotal	72,586	10,865	$52,441,284
Connectivity Applications	Phone Charging	7,348	2,939	$6,334,987
TOTAL		**80,457**	**13,935**	**$59,102,096**

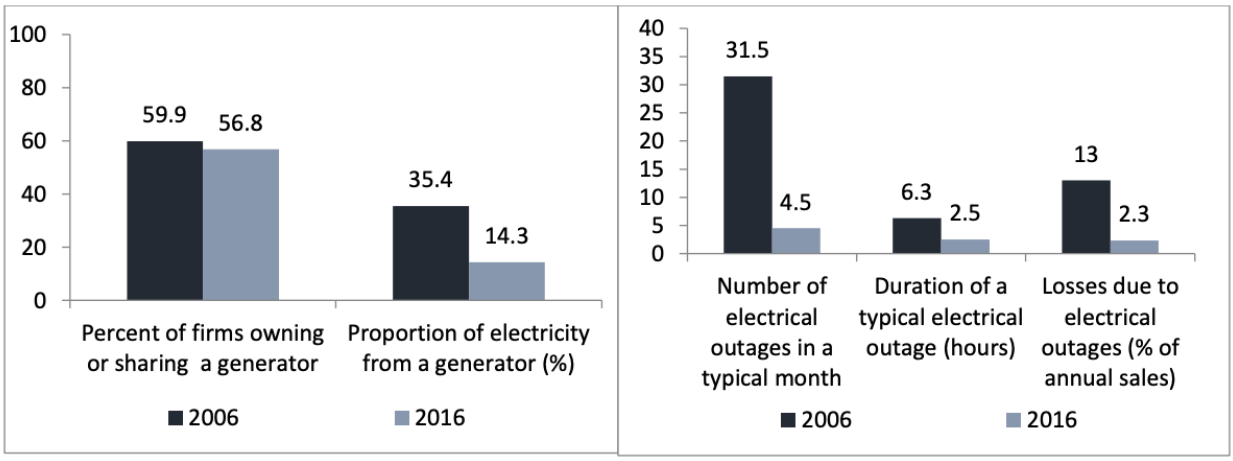
Source: Food and Agriculture Organization, GIZ and GSMA; African Solar Designs analysis

- **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- or petrol-powered generators to power their enterprises. Close to 33% of SMEs in emerging markets use fossil fuel powered generators in order to address energy insecurity.[133] For ECOWAS countries, independent power generation via fossil fuel powered generators is especially prevalent.[134] Despite experiencing improved electricity conditions within the last decade, Guinean firms continue to face power uncertainty and loss; 56.8% of firms either own or share a generator (**Figure 29**).

[132] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[133] 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
[134] Ibid.

Figure 29: Guinean Firms and Power Reliability[135]



Source: World Bank

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.[136]

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

[135] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty, Systematic Country Diagnostic," World Bank (2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf

[136] 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

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 326,625 (**Table 31**).

Table 31: Estimated Cash Market Potential for SMEs – Barbers and Tailors[137]

No. of SMEs with Constrained Access to Finance[138]	Units	kW Equivalent	Cash Value (USD)
2,613	523	131	$326,625

Source: World Bank

- **Value-Added Applications**

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

Solar Powered Irrigation:

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

Agriculture in Guinea is almost entirely carried out through rain-fed irrigation and use of traditional tools, which result in low levels of agricultural productivity. Further, rice, maize and manioc are the three most important crops and recent increases in direct investment in the mining sector have led the Government and foreign firms to invest in agricultural projects such as rice production in the northern region of Boke.[139] In an effort to become a self-sufficient rice producer by 2020, the GoG has also self-financed construction of a rice irrigation project in the Koundian Plain and launched an initiative to assist farmer cooperatives in Maferenya and Kindia regions and distributed water pumps and fertilizers to increase farm yield, productivity, and areas of arable land.[140] Thus, irrigation and agro-processing would be impactful productive uses of energy in Guinea (**Figure 30**).

[137] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.
[138] "MSME Finance Gap," SME Finance Forum: https://www.smefinanceforum.org/data-sites/msme-finance-gap
[139] "Guinea: Agriculture, Best Prospects," U.S. Export.gov: https://www.export.gov/article?id=Guinea-Agriculture
[140] Ibid.

Figure 30: Household Percentage Use of Improved Agricultural Inputs by Region[141]

Regions	Use of hitched of mechanized farming	Use of fertilizers	Use of pesticides	Use of manure	Access to irrigation
Boké	8.0	8.1	0.3	7.5	0.7
Conakry	21.4	34.3	11.2	28.1	10.6
Faranah	22.2	16.4	16.4	6.7	10.5
Kankan	33.4	47.5	43.2	8.2	0.6
Kindia	7.5	19.0	1.6	24.7	6.6
Labé	2.8	14.0	2.2	52.6	1.1
Mamou	5.1	18.0	2.9	48.8	1.3
Nzérékoré	2.5	14.0	11.5	8.8	0.6

Source: World Bank

The solar pumping systems reviewed varied in their wattage depending on the area of land irrigated, the depth of water abstracted and the quality of the soil and crops amongst other factors.[142] GIS analysis demonstrated that access to the water table and surface water is not a major determinant of the costing of applicable solar irrigation systems, as most farming settlements in Guinea are within close proximity to either surface water or relatively easily extractable sources of water (**Figure 31**).

Guinea has a number of issues with land rights, stemming from weak enforcement of the laws and regulations concerning the registration of customary land interests in rural areas, lack of clarity regarding the role of the customary law and balancing of pastoralist rights with that of farmers.[143] In order to increase agricultural productivity through improved irrigation practices, land reforms to enable long-term property rights are therefore necessary to attract private investment.[144] Without such reforms, there is no incentive for private sector engagement as no collateral can be arranged to support the financing of such investments.

In analyzing the available market for solar-powered irrigation, this market scoping exercise focused exclusively on smallholder farmers and solar water pumping irrigation technologies to address their needs. In doing so, this analysis took into consideration the emerging experience with small-scale productive use pumping in East Africa. Small pumps of 80 Wp-150 Wp (e.g. Futurepump and SunCulture) make up the bulk of sales, while larger-sized pumps (e.g., Grundfos) are also frequently marketed to address differing water access and crop conditions. **Table 32** presents the estimated annualized off-grid solar cash market potential for smallholder value-added solar irrigation applications in Guinea, which has an estimated cash value of USD 46.9M (see **Annex 2** for more details).

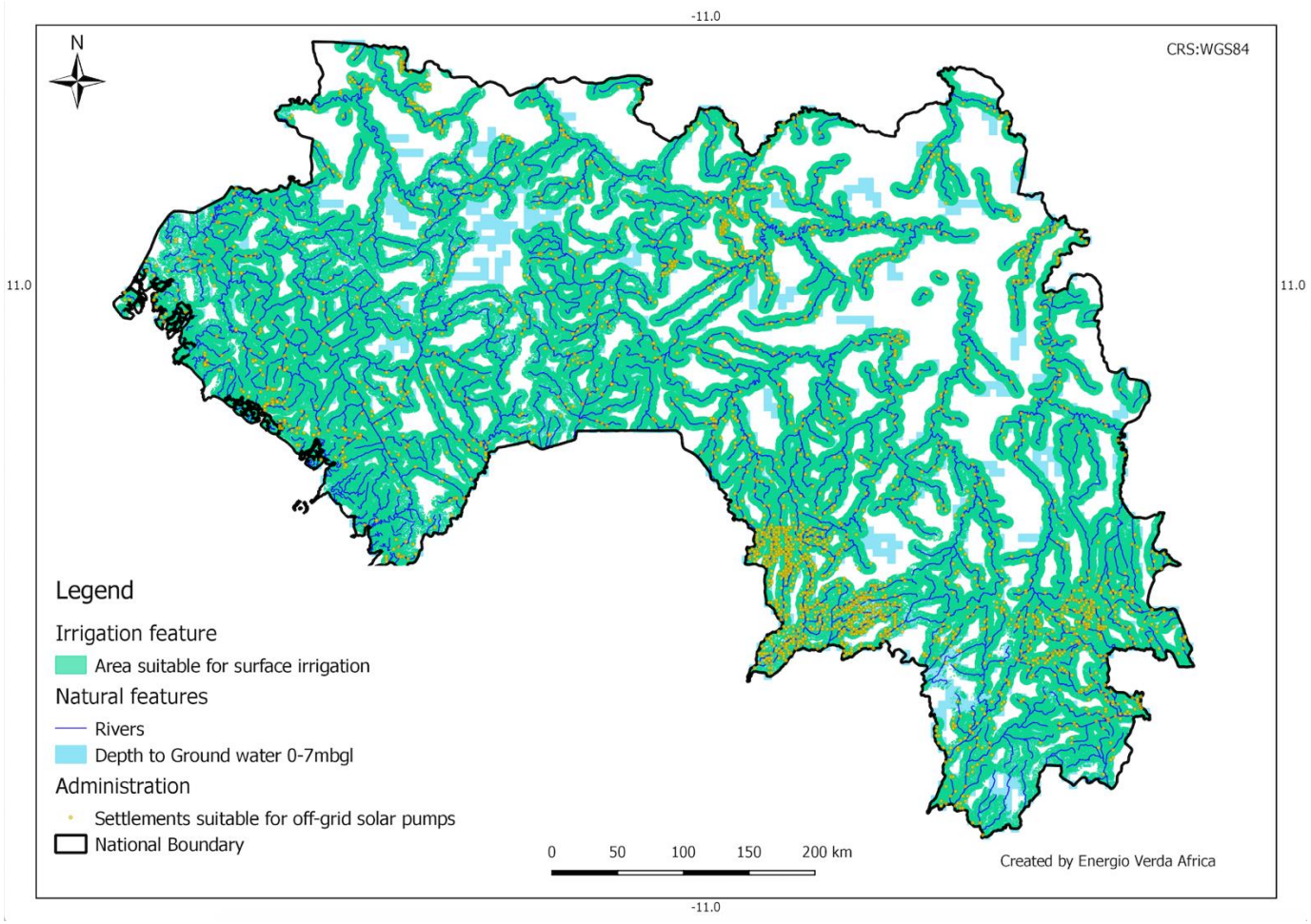
Table 32: Estimated Cash Market Potential for Value-Added Applications – Irrigation[145]

Estimated No. of Smallholder Farms Suitable for OGS Pumping for Irrigation	Units	kW Equivalent	Cash Value (USD)
433,333	72,222	8,667	$46,944,444

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

[141] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty, Systematic Country Diagnostic," World Bank (2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf
[142] *See* GIZ Powering Agriculture Toolbox on Solar Powered Irrigation Systems: https://energypedia.info/wiki/Toolbox_on_SPIS
[143] "LandLinks, Guinea Profile," USAID: https://land-links.org/country-profile/guinea/#land
[144] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty, Systematic Country Diagnostic," World Bank (2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf
[145] Estimated units, kW equivalent and cash value are annualized to reflect typical lifespan of OGS systems; see **Annex 2** for more details.

Figure 31: Area Suitable for Surface Irrigation and Identified Settlements Suitable for Off-Grid Solar Pumps[146]



Source: British Geological Survey, Bureau of Statistics; ESA Climate Change Initiative; Systeme d'Information Energetique; Energio Verda Africa GIS analysis

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

Solar Powered Milling:

Cereal crops like maize, sorghum, millet, and rice provide an opportunity for value addition through hulling or milling. Off-grid communities use maize or rice milling equipment that is typically powered by diesel generators. Discussions with off-grid community groups revealed that although many are aware of the long-term cost savings associated with solar powered mills, the up-front cost of purchasing equipment was viewed as too high.

Table 33 presents the estimated annualized off-grid solar market potential for smallholder value-added solar grain milling applications in Guinea, which has an estimated cash value of USD 3.1M (see **Annex 2** for more details).

Table 33: Estimated Cash Market Potential for Value-Added Applications – Milling[147]

Estimated No. of Solar Mills	Units	kW Equivalent	Cash Value (USD)
3,881	194	1,261	$3,153,152

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 34 presents the estimated annualized off-grid solar market potential for smallholder value-added solar refrigeration applications in Guinea, which has an estimated cash value of USD 2.3 million (see **Annex 2** for more details).

Table 34: Estimated Cash Market Potential for Value-Added Applications – Refrigeration[148]

Off-Grid Market Centers	Units	kW Equivalent	Cash Value (USD)
3,409	170	937	$2,343,688

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

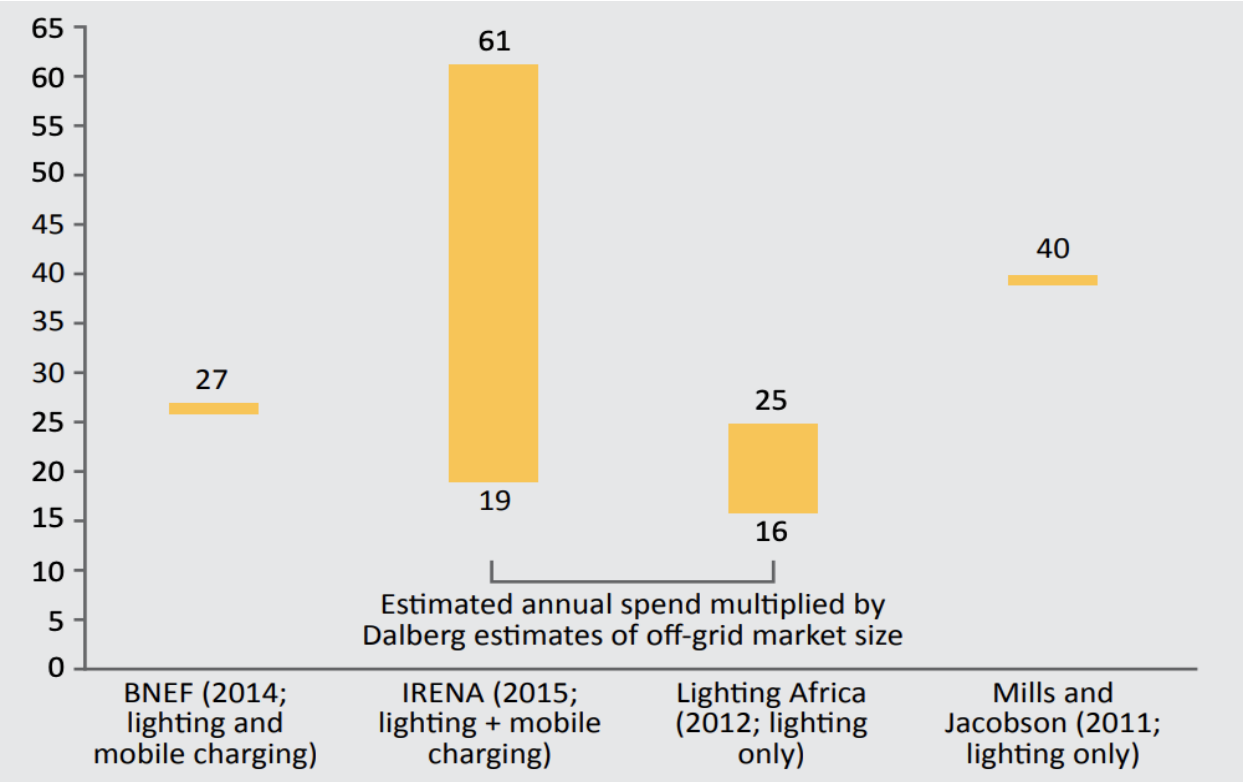
Ultimately, the ability for an agricultural community to benefit from productive use applications has as much to do with access to markets and improved crop inputs, as it has to do with the pricing and availability of financing to purchase the equipment. Hence, the macroeconomic approach used to carry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

- **Connectivity Applications**

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

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

Figure 32: Estimated Annual Off-Grid Household Expenditure on Lighting and Mobile Phone Charging[149]



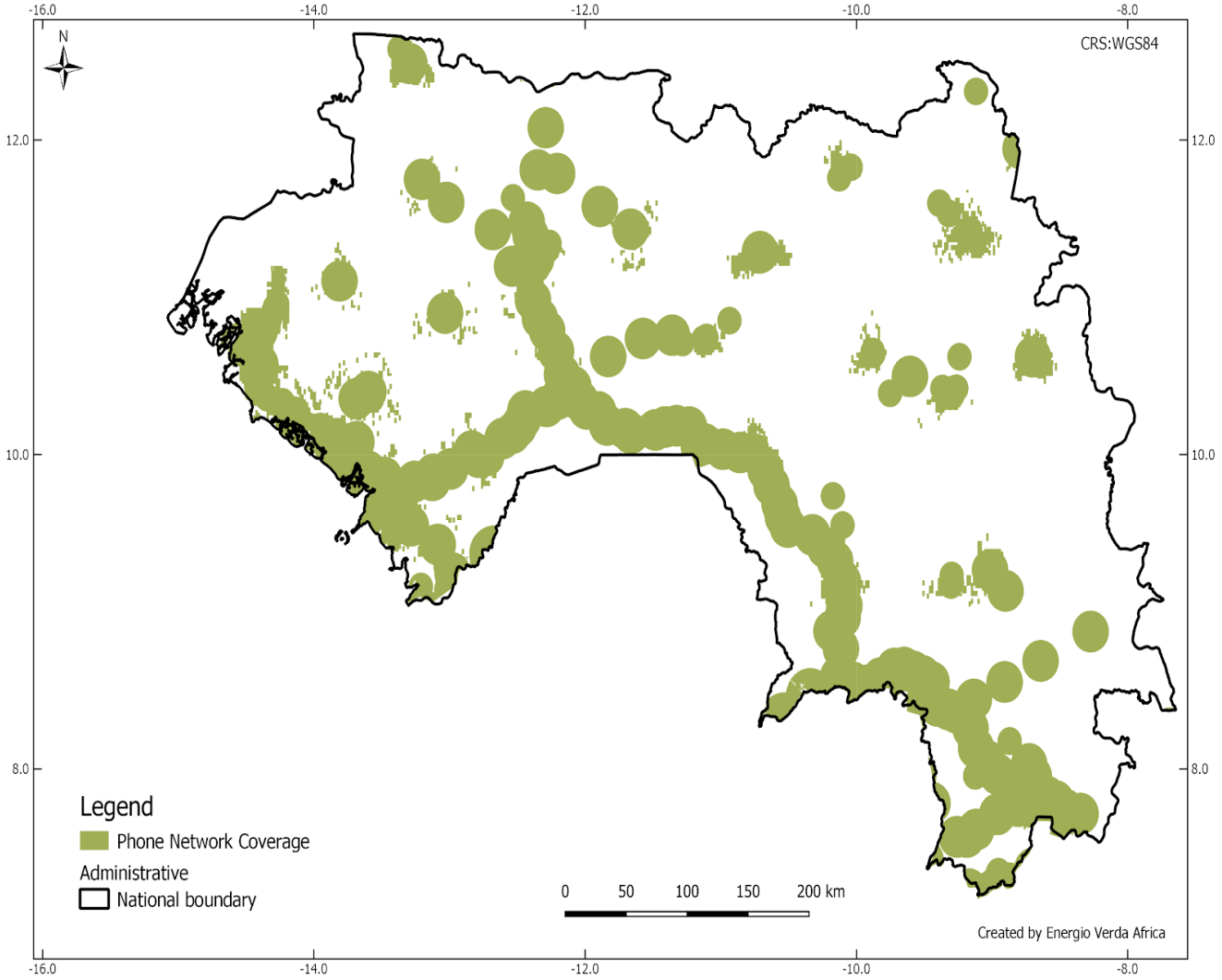
NOTE: Figures in Billion USD

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

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

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

Figure 33: Mobile Phone Network Geographic Coverage in Guinea[150]



Source: GSMA

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

The analysis of the potential solar-powered phone charging market was based on the country's mobile phone penetration rate, rural population rate, and the average costs of OGS phone charging appliances. **Table 35** presents the estimated annualized cash market potential for off-grid solar mobile phone charging enterprises in Guinea, which has an estimated cash value of USD 6.3 million (see **Annex 2** for more details).

Table 35: Estimated Cash Market Potential for Mobile Phone Charging Enterprises[151]

Mobile Subscribers[152]	Rural Population (%)[153]	Units	kW Equivalent	Cash Value (USD)
5,900,000	62.3%	7,348	2,939	$6,334,987

Source: GSMA; World Bank; African Solar Designs analysis

2.3.3 Ability to Pay and Access to Finance

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

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

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

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

- Many companies cannot afford the up-front cost of solar products and systems. A potential solution could be to implement a third-party ownership system to increase access to financing.
- The financing tool for solar appliances should not only be provided to end users, but also local and regional suppliers to enable them to effectively market to available end users
- Despite public and donor-led interventions to lower financial constraints, firms in rural areas still struggle to access financing solutions. This is especially the case for farmers that have invested in milling or solar drying but have not implemented irrigation schemes that would allow them to harvest crops year-round.
- There is also a high degree of skepticism regarding the reliability and quality of solar powered appliances, and as a result, more should be done to raise awareness and set appropriate standards for solar products.

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

2.4 Supply Chain

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

Table 36: Solar Company Tier Classification

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

Source: ECOWAS Center for Renewable Energy and Energy Efficiency

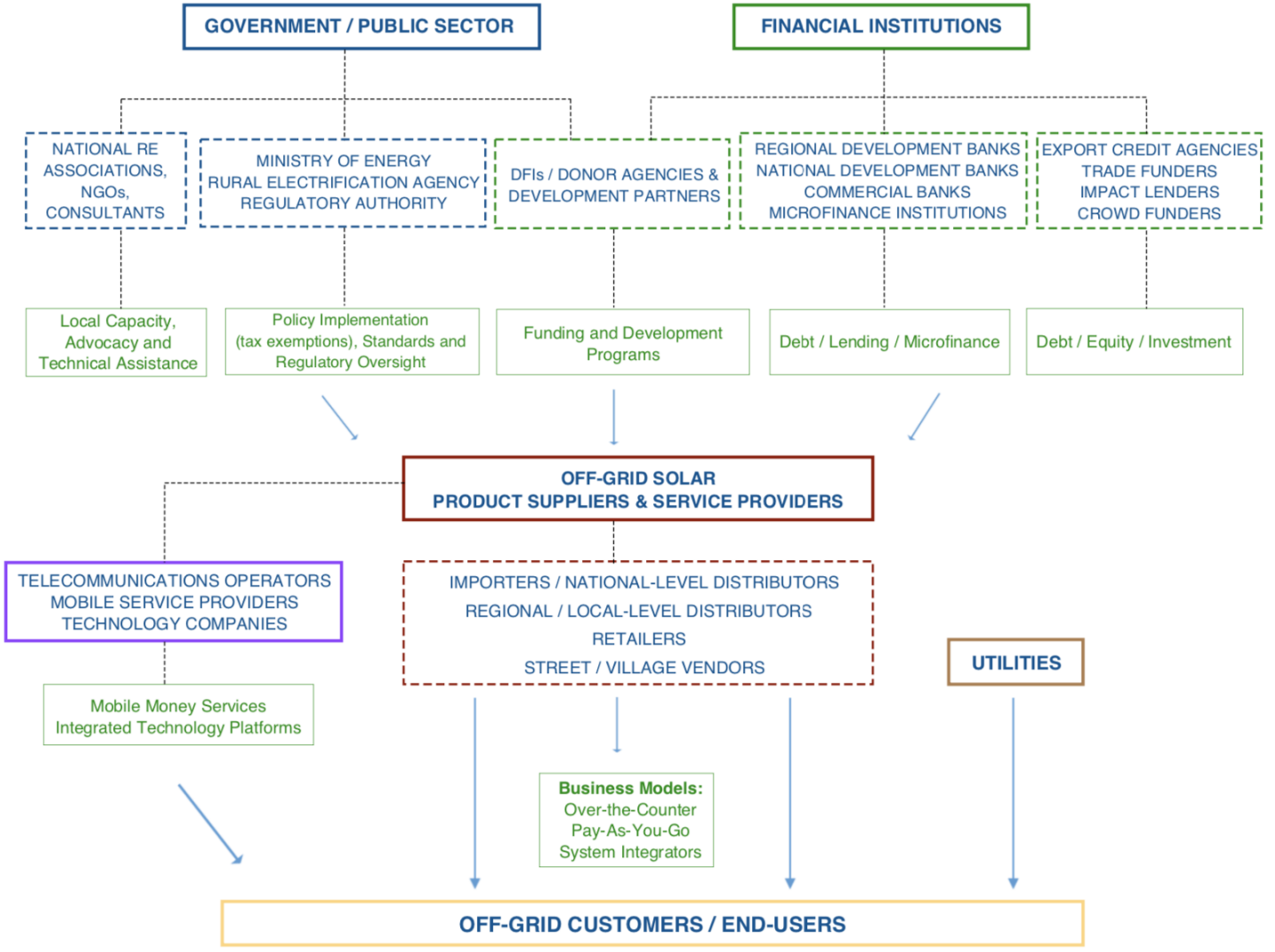
2.4.1 Overview of Commercial Market for Solar PV Equipment

The off-grid solar supply chain in Guinea is made up of a wide range of stakeholders – importers, distributors, wholesalers, retailers, NGOs, and end-users (**Figure 34**). Guinea is a small but quickly growing solar market, as the country's overall market environment and opportunity for solar companies is improving (**Figure 14**). Solar is used throughout the country but is particularly widespread in the regions of Middle Guinea (Moyenne-Guinée), Forest Region (Guinée Forestière) and Upper Guinea Region (Haute Guinée), while Lower Guinea (Basse Guinée) and the Conakry region have higher rates of grid-connections.

Rural households make up the main market for off-grid lighting products in the country. Nevertheless, urban households, both electrified and non-electrified, are also a key consumer market, as they may have greater ability to afford OGS products and systems. Moreover, power supply is often not sufficient, continuous, or reliable (**Figure 4** and **Figure 5**), further supporting the need for expanded use of solar PV equipment by this consumer segment. Regardless, a survey of local industry players as well as a focus group discussion found that solar companies face several challenges, including access to finance for both companies and customers, lack of incentives to bolster private sector market growth, and low-quality products flooding the market.

The main business model deployed by local solar companies is cash/over-the-counter sales, while a few companies have started to utilize PAYG sales. While large companies selling certified products play a central role in the market, the informal sector remains a key factor. Surveys of local industry stakeholders and focus group discussions noted that a regulatory framework was necessary to address the widespread sale of low-quality, uncertified products, which is hindering development of the country's OGS market.

Figure 34: Off-Grid Solar Market and 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.[154] 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 solar market and are now joining other major 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.

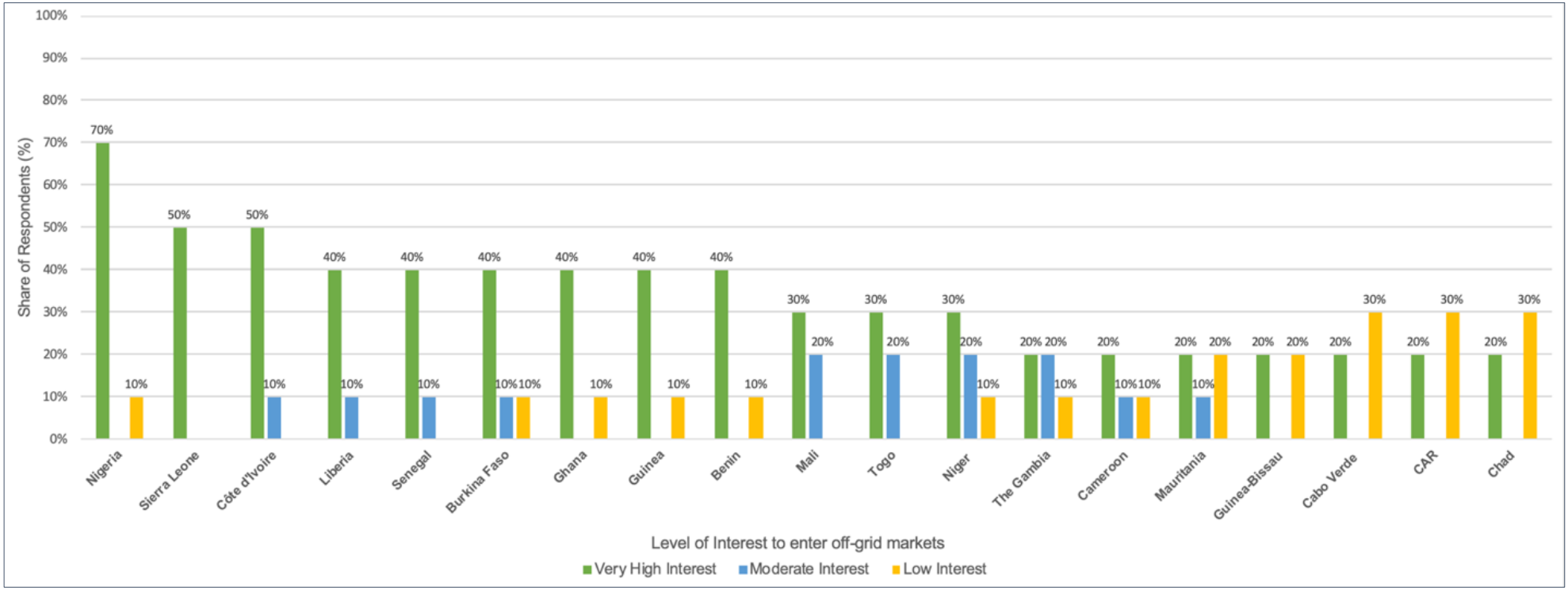
Market entry into Africa began in East Africa for a majority of the leading companies, a trend that can be attributed to advancements in mobile money transfer systems such as M-Pesa that have facilitated the PAYG off-grid business model. As the East African market becomes more crowded and mobile money 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.[155]

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.[156]

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

[154] "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
[155] Ibid.
[156] "Insights from Interviews with Off-Grid Energy Companies," ECREEE, (June 2018).

Figure 35: Level of Interest in Off-Grid Markets in West Africa and the Sahel among Major Suppliers[157]



Source: Stakeholder interviews; GreenMax Capital Advisors analysis

[157] 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 Guinea

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 30 companies operating in Guinea's solar sector, offering a wide range of products and services to consumers throughout the country (see **Annex 2** for a complete list of identified companies). In addition to local firms, the formal market includes international players that enter the market to install systems for donor-funded projects. As of 2018, most of the solar companies operating in Guinea were Tier 1 companies, with only one firm (Yandalux) identified as a Tier 2 company, and one firm (Woco Solar) as of the Tier 3 level. Woco Solar is a local company based in Guinea, while Yandalux is a German-based company with operations in eight West African companies.

Most local solar companies are organized through the local renewable energy association (l'Association Professionnelle des Énergies Renouvelables, APER-Guinée) and provide a wide range of high quality OGS products and systems to consumers as well as installation, O&M, and post-sale services. Given how few formal companies there are in the sector, sales volume and revenue are not reported to the Global Off-Grid Lighting Association (GOGLA). Of the Tier 1 firms, RKomp is the only local manufacturer. Others are manufacturer representatives (e.g. Batco Engineering, BB&Fils, SINES, Ets Bah Mamadou Bhoye et Fils, Ets Kamab and 2HK), acting as local distributors of international brands. While all of these firms utilize over-the-counter/cash transactions, very few offer PAYG consumer financing, although some offer consumer finance in the form of leasing.

- **Sale 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. Moreover, during surveys and FGDs, companies were reluctant to share confidential data on sales volumes and market shares. Most local solar market players in the country are not Lighting Global and GOGLA affiliated members; hence, relevant sales volumes and revenue from GOGLA are not available for Guinea.

➢ Main Solar Products and Components

Table 37 lists the brands of common solar products and components in Guinea. The list does not include non-certified brands that are also common in the country's grey market.[158]

Table 37: Off-Grid Solar Products and Components in Guinea

Systems	Companies
Distributors of Pico solar Lanterns	Rkomp Solar, BH Soger, BB & Fils, My Cebel Solaire, ETS Kamab, EG Fimmee, Sodeper, Solar Guinee, Sines, Solec Energy, ARD Equipements, Doumbouya Solar Electric, 2HK Energie
Single Module distributors	
Multi module system distributors	
Very large system supplier	
Product Systems	**Brands**
Solar modules-panels	AY Solar (Turkey), Solar Resta, Auversun, Ecoflex, Bosh (Germany), Shunsus (England), Shell (China), Atlas, Suntech (China), Recom-Sillia (France), Ifrisol (Tunisia), Tonobo (China, Dubai), Ecoflex (France), Auversun (France), Resta Solar (China)
Inverters	AY Solar (Turkey), Sukam / Orex (China/India), Victron, Steca, Schneider, APC (Germany, USA), Victron Energy (The Netherlands), Mustpower (China), Solax (France)
Batteries	Sunstone (China/Germany), Rolls (USA), Victron Energy, Atlas (Germany), Nippotec (France), Greenbat (France), U-Power, AY Solar (Turkey), Voltronic (France), Quanta (India), DK Solar (USA)
Solar pico kits	Schneider Electric

Source: Stakeholder interviews

➢ Market Prices

Table 38 presents average prices for off-grid systems and components in Guinea's solar market. Although sales volumes are growing, prices of Lighting Global and IEC-certified products for consumers are still significantly higher than in more mature solar markets.

Table 38: Estimated Prices of Solar Systems and Components in Guinea

Off-Grid System / Component	Price range (GNF)	Price range (USD)
Pico solar / lanterns	GNF 660,000	$75
Plug and play systems	GNF 3,900,000	$450
SHS (average/medium sized)	GNF 9,000,000	$1,000
Solar Module (80W-300W)	GNF 650,000 - 2,700,000	$77-$300
Inverter (300W-5,000W)	GNF 600,000 - 30,000,000	$66-$3,300
Lead Acid Battery (12V/250Ah-12V/418Ah)	GNF 800,000 - 4,500,000	$88-$500

Source: Stakeholder interviews

➢ Importation Clearance Processes

Two authorities are involved in the importation of solar equipment into Guinea – the Directorate General for Customs (Direction Générale des Douanes) and the National Tax Directorate (Direction Générale des Impôts). It takes about five weeks for an importer/distributor to receive solar goods, including four weeks for the products to reach the country and one additional week for custom clearance. There are no provisions to ensure the quality of imported products at national level, although APER is a member of the GOGLA international network and some imported SHS are approved by the Lighting Africa Program.

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

2.4.4 Overview of Business Models

- **Company Approach to Market**

Historically, solar companies in Guinea tend to deal with a wide range of products, although some formal solar companies are specialized providers of solar home systems. Most interviewed market players started their operations recently (i.e. within the last five years), with nearly half of the firms entering the market within the last three years. The country's off-grid sector does also include long-experienced local companies who have been in business for more than 10 years (e.g. Solar Guinée since 1991; Cebel Solaire since 2005; and ARD Equipment since 2006).

The cash payment model remains the main approach utilized by firms in Guinea, although it is increasingly being combined with other innovative business models. Most companies deal with all types of clients, including institutional (public institutions, Government, utility) and social (NGOs, donors) customers. These companies use procurement procedures and allow their clients to place orders directly. While suppliers commonly avail them credit terms, companies generally offer consumer finance to their clients (credit facilities in several installments, hire purchase, leasing). Compared to other countries in the region, Guinea has very few companies utilizing PAYG to reach out to low-income customers.

- **Business Models**

There are four primary business models used in the market (**Table 39**), although in reality solar companies utilize a number of business models to reach a variety of clients:

- **Over-the-counter cash sales** include both informal and formal components. Many traders simply offer solar products over-the-counter. Formal sector solar companies also stock modules, batteries and balance of system and offer them over-the-counter to do-it-yourselfers and agents.
- **Plug and play and pico suppliers** cooperate with many of the major OGS brands to distribute products in the country.
- **The PAYG sector** is still in its early stages in Guinea. Suppliers are building up large client bases and are quickly evolving to develop credit mechanisms that fit with local income patterns. Solar companies still offer other types of consumer finance, including leasing. Focus group participants indicated that some of their customers are able to access external sources of finance (e.g. microfinance consumer loans). For the PAYG sector to grow, companies first need to work with IT providers and telecommunications companies to take advantage of network coverage and mobile phone usage.
- **System integrators** handle larger 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. In Guinea, many companies offer the possibility for their large customers to place orders of solar equipment directly. Contracts with public institutions, local authorities and communities are significant in the solar market and many solar companies deal with social/institutional clients.

Table 39: Overview of Off-Grid Solar Business Models

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

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

- **Company Financing**

With a growing number of companies selling OGS products and systems on credit (sometimes with lengthy repayment periods), it can become difficult for companies to finance their operations and grow their business. In addition to granting consumer finance to a few customers, suppliers also require significant working capital to purchase equipment and renew inventory, conduct marketing campaigns, and cover field costs. Distributors of international OGS products receive basic trade finance and marketing support options, though typically limited. Most of the firms surveyed in Guinea are self-financed with cash flow covered by shareholders and founders and from on-going business transactions.

A majority of local companies in Guinea are unable to raise the funds necessary to expand their business, as local FIs are not affordable and procedures are too lengthy and complex. Focus group participants confirmed that renewable energy credit lines exist but are expensive (interest rates from 15%% up to 25-30%).[159] Local financiers have yet to develop an appetite for the solar sector. Local banks are extremely conservative with regard to solar enterprises. Commercial financiers – including banks and MFIs – are not set up to service solar distributor financing requirements. Local SME financing is not available to support businesses in their growth phase. If it was available, companies would make use of cash-flow/credit line financing against the signed contracts with major commercial clients, large NGOs or donors.

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

[159] Stakeholder interviews, 2018.

- **Evolving Business Models**

Guinea presents a fertile ground for new business model innovations. New models will require partnerships between developers, solar distributors, telco companies, commercial finance and the retail sector. One of the outcomes of the FGD discussions was a list of potential partnerships that can be explored to enhance existing and new business models (**Table 40)**.

Table 40: Evolving Off-Grid Solar Business Models

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

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

2.4.5 The Role of Non-Standard Players in the Market

Stakeholder interviews and FGDs were not able to estimate the share of the 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 sector, however, is very influential as it also controls the delivery of lighting products imported mainly from East Asia. Informal traders understand growing consumer interest in solar solutions and sell competitively-priced low-quality products. Informal traders do not actively cooperate with the GoG on formal projects.

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

2.4.6 Equipment Quality and the Impact of Uncertified Equipment

Guinea's solar market is largely dominated by informal market players, selling equipment through electronics shops, hardware stores, kiosks and even street vendors. The over-the-counter sales strategies of this group is to provide low-cost, fast moving products. As a sector, informal retailers provide widely-used lighting products mainly from East Asia to rural customers. However, most of their product range does not meet Lighting Global standards. Moreover, given that the most of their lighting products are low-cost and short-lived, involving more frequent purchases and O&M (especially batteries in Guinea), and they also ignore and avoid regulations and their products lack warrantees.

Nearly all of the companies surveyed considered the presence of counterfeit, low-quality products in the market as a significant barrier to market growth. These products negatively impact the entire market by creating a misperception about product quality, which in turn undermines consumer confidence in solar equipment. Moreover, grey-market traders significantly undercut the prices of registered businesses who are still subject to taxes and import duties. Low prices of over-the-counter products make compliant products uncompetitive as many customers opt to buy non-compliant goods that are cheaper. Feedback from focus group meetings suggested that the Government should set-up of a national quality control body for solar products to help customers purchase certified equipment. In Guinea, local industry stakeholders indicated that the market offered products of highly variable quality. While some suppliers are well-known for selling high-quality and certified ISO 9001 equipment (e.g. Schneider Electric and AY Solar), others noted that there also exists pressure from low-ability-to-pay customers who prefer cheaper and lower quality products.

2.4.7 Local Capacity to Manage Business Development, Installation and Maintenance

Guinea's nascent solar market is poised to grow if requisite technical assistance (TA) is provided. The existing market environment is challenging for solar companies. To operate effectively, companies need a significant amount of both local and international technical and financial expertise, and an ability to make practical decisions about their operations. Companies face a number of technical competency requirements – the selection of approaches and solar PV technologies, the design of their associated marketing instruments and the implementation of related initiatives.

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. FGDs acknowledged that while a number of initiatives had been undertaken to build local capacity in the sector, these efforts were inadequate. The Professional Renewable Energy Association (Association des Professionnels des Énergies Renouvelables, APER) provides services to support its members in terms of training, sector knowledge, administrative and fiscal support and provides access to GOGLA and Lighting Africa network and programs. In addition, a few established solar operators are GOGLA/Lighting Africa affiliates, which allows them to secure regular supply, training, and strategic market intelligence.

Yet, there remains a growing need to further develop and enhance local capacity as a precursor for continued uptake of solar PV technology in the country, including (but 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.
- Solar technicians were noted to be sparse for some areas and lacking in other areas; as a result, solar businesses send out teams from major cities/towns for any installation and maintenance work. Training people based locally in remote areas to support O&M of solar systems (e.g. battery replacement) could help address this issue and expedite market uptake.

2.4.8 Capacity Building Needs of the Supplier Market Segment

An analysis of the supplier market segment revealed a number of challenges that can be viewed in three ways – financial, awareness/communication, capacity, and quality. FGDs and supplier surveys found that:

- While the industry's largest players have access to various sources of financing, local financing is largely not available (or affordable) to support the sector's development; as a result, many companies are self-financed and do not have the working capital they need to grow and expand their operations.
- Reasons for denied finance by financial institutions included lack of collateral, lack of expertise in finance, the high cost involved in small transactions, and risk aversion.
- Low consumer ability to pay is a major challenge, as nearly all consumer market segments are low-income (households, institutions and SMEs). Moreover, consumer financing is not yet fully developed in the market. Some companies offer consumer finance (credit terms/payment facilities) but PAYG is not widely used across the industry.
- Low-consumer awareness has resulted in negative perception of solar. FGD stakeholders indicated that population in Guinea does not believe that solar is robust enough for large systems, and that it can only sustain low capacity systems (primary lighting needs and phone charging). Beyond solar, the population is not committed to environmental and protection enhancement.
- Knowledge, technical capacity and expertise is possessed by a few professionals in the industry, typically those who work for experienced solar companies and developers; the majority of vendors lack the expertise or knowledge necessary to adequately service the market.
- Improve regulations and develop framework to ensure product quality and address issues of low-quality products that compete with certified products sold by formal companies

Table 41 presents various areas of support and associated capacity building for the OGS supply chain in Guinea. Attention should be given to the following:

- **Importers/Retailers**: Push Government / relevant public agencies to draft a regulatory framework that accounts for tax and customs exemptions. Increase share of credit financing of solar PV products to enable longer term payment schedule for solar products.
- **Over-the-counter/System Integrators/ PAYG**: Capacity building for solar installers, technicians and entrepreneurs is critical in order to build capacity of the sector. Focus on growing the number of solar technicians who are adequately skilled to support the supplier network. Unskilled technicians have connections with solar distributors and retailers who subcontract them (often involves unlicensed technicians)
- **Consumers**: Deal with sociotechnical barriers. Although PV technology has advanced tremendously in the last decades, there are still several barriers to adoption, including the local conditions of the user's environment, the political and financial arrangements of the market. Like most countries in the region, various counterfeit solar PV products have infiltrated the market. Implementation of the existing regulations on quality/standards and development of consumer protection regulations could help reduce the prevalence of counterfeit, poor-quality products on the market. Awareness raising campaigns are also critical to education consumers.

Table 41: Capacity Building and Technical Assistance for the OGS Supply Chain in Guinea

Area of Support	Description	Rationale
Tax exemptions on solar technology	• Develop regulatory framework on solar products, including exemption from VAT and import duties	• Costs of solar products are inflated by high import duties; costs are passed on to customers, making solar less affordable.
Consumer education programs	• Supplier and consumer education and benefit awareness campaigns, targeting both segments, distributors and retailers, with a focus on rural populations	• Influence purchase decisions, with a focus on rural areas and ease access to distribution channels • Overcome negative perceptions and strengthen trust established over the years
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 facility	• 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
Training program	• Set up solar energy training programs in existing training institutes • Set up quality control and certification process for products entering the country	• Reinforce actors' capacities • Improve the quality of products on the market
Technical assistance	• Help solar companies build capacity in administration, planning, import procedures, management, finance and human resources • Support in marketing, sales and consumer awareness • Capacity building for solar vendors to improve nationwide solar equipment design installation and maintenance capacity. • Increased technical capacity will allow to develop after-sale services and customer relations	• Upgrade business and entrepreneurial skills • Make the business environment more conducive and profitable • Strengthen the overall ecosystem surrounding the solar market • Ensure knowledge transfer from abroad for faster, more cost-efficient progress

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

2.5 Key Market Characteristics

This section reviews the main characteristics of the off-grid solar market in Guinea, 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 42 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** above for an overview of the gaps in the country's off-grid policy and regulatory framework.

Table 42: Key Barriers to Off-Grid Solar Market Growth in Guinea

Market Barrier	Description
Demand[160]	
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 (especially with incremental payments, e.g. PAYG)
A lack of understanding of and trust in solar solutions among consumers impedes development of the market	• There is still 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. • Products are still not widely available in rural areas, so consumers are unfamiliar with them • Any poor history / track record with OGS will deter consumers from taking expensive risks
Informal sector competition and market spoilage	• The non-standard / unlicensed market still accounts for a majority of OGS product sales • Consumers need to understand the quality and value issues of quality solar products vis-a-vis inferior over-the-counter lighting products and generators. Educated consumers drive markets.
Lack of experience in maintaining the systems and sourcing qualified technicians	• A sustainable approach to O&M is critical for long-term success
Supply	
Technical capacity	• Technical skills lack through the supply chain within the sector, affecting both the upstream, midstream and downstream, thus adversely affecting the ability of the sector to pick up and grow. Majority of the firms decry lack of adequate number of technicians to support the downstream side of the market
Transportation costs	• High transportation costs of inventory deter new entrants; devices and equipment are shipped either from China or from Europe, creating long delivery lead times of up to three months and long inventory holding times once products have arrived in country • Typical supplier payment terms are 30% upon placement of the production order and the remaining 70% upon shipment before any cargo has even left its port of origin. • Transport by container would reduce the costs dramatically; however, this requires purchases in bulk, which local solar distributors aren't able to make without financing

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

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

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

2.5.2 Drivers of Off-Grid Solar Market Growth

Table 43 is a summary of the key drivers of OGS market growth in the country.

Table 43: Key Drivers of Off-Grid Solar Market Growth in Guinea

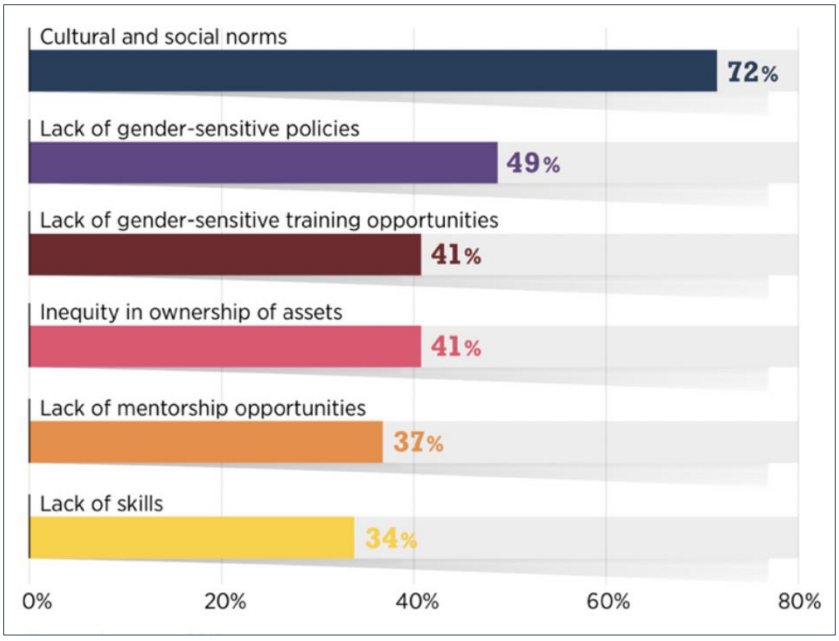
Market Driver	Description
Strong off-grid electricity demand	• Consumers from every market segment are aware of the high costs associated with energy access and consumption and are willing to take on quality, cost-effective alternatives
Willing government to support the industry	• The Government is viewed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

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

2.5.3 Inclusive Participation[161]

Given that the off-grid market is only beginning to emerge in Guinea, women are not yet highly engaged in the sector. The overall lack of inclusive participation in the off-grid space is attributable to a wide range of factors. In a 2018 survey that assessed barriers to women's participation in expanding energy access, nearly three-quarters of respondents cited cultural and social norms as the most common barrier, which reflects the need for gender mainstreaming (**Figure 36**). 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.[162]

Figure 36: Key Barriers to Women's Participation in Expanding Energy Access



Source: International Renewable Energy Agency

As a starting point, electrification (whether grid-connected or off-grid) increases access to information, which can help challenge gender norms and increase the autonomy of women.[163] 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.[164]

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,

[161] See **Annex 4** for more details
[162] "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
[163] "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
[164] "Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Development," UN Women, (2018): http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2018/sdg-report-fact-sheet-sub-saharan-africa-en.pdf?la=en&vs=3558

technicians, and part time and full-time employees and entrepreneurs.[165] Women also have unique social networks that typically offer greater access to rural households, which can be important to deploying energy access solutions.

Despite these opportunities, women are typically not part of key decision-making processes at nearly all levels of society. Women tend to have limited access to land and capital, as these are often determined by traditional and religious customs that remain deeply rooted in patriarchal traditions. Women also have more difficulty accessing finance due in part to lack of collateral required to guarantee payment and often resort to obtaining loans from money lenders who charge exorbitant interest rates.[166]

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

- Women lack access to skills, technical capacity, and education/training
- Women broadly lack access to capital, asset ownership, collateral and credit (e.g. to start a business)[167]
- Extensive household responsibilities reduce their ability to generate income and service credit
- Financial literacy among women remains low and there is a lack of education and information available to women on access to financial resources

A number of initiatives exist that seek to address some of these challenges and help improve the rate of participation among women in Guinea's off-grid sector. In 2018, ECREEE partnered with the 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 initiative ultimately seeks to develop a pipeline of investment-ready, women-owned energy businesses across the region, including in Guinea.[168]

Additional off-grid initiatives include Carbone Guinée – Programme Gaz Butane Guinée and UNDP's Multifunction Platform. The Chinese government, in partnership with UNIDO, GIZ and UNDP, has also organized trainings for women in the energy sector.

[165] "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

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

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

[168] "Feasibility study promotes women's participation in energy transition," ESI Africa, (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 (**Section 3.2**), including a summary of any off-grid solar lending. **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 6-12 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

Along with Mauritania, Guinea opted out of the CFA franc currency that is shared by all other former French colonies in West and Central Africa. Instead, Guinea is the only non-Anglophone member of the West African Monetary Zone, which aims to establish a common currency by 2020.[171] Guinea's financial system is small and dominated by the banking sector, which is overseen by the Central Bank of the Republic of Guinea (Banque Centrale de la République de Guinée, BCRG). In addition to supervising banking and credit operations in the country, the BCRG conducts monetary policy, manages foreign exchange reserves, and carries out operations with support from the International Monetary Fund (IMF), which acts as a financial agent of the state.

As of 2017, Guinea's financial system was made up of 16 active commercial banks operating a network of 170 branches with over 2,000 agents serving more than 600,000 customers, and 23 microfinance institutions with 321 branches across the country. Guinea also has 11 insurance companies, 33 money transfer companies, 44 foreign exchange bureaus and three mobile money service providers (**Table 44**).[172] Most of the country's banks are located in urban areas with a significant concentration in the capital city of Conakry.

Table 44: Licensed Financial Institutions, 2017

License Type	Number of FIs
Commercial Banks	16
Microfinance Institutions[173]	23
Foreign exchange bureaus	44
Insurance Companies	11
Money Transfer Companies	33
Mobile Money Providers	3

Source: BCRG

The Guinean banking sector is dominated by three major banks in terms of market share – the pan-African Ecobank Group, Société Générale de Banques en Guinée (SGBG), a subsidiary of France's Société Générale, and Banque Internationale pour le Commerce et l'Industrie (BICIGUI). In 2017, these three institutions held more than GNF 11 trillion of the total GNF 19.7 trillion in combined total assets of the country's 16 banks (**Table 45** and **Table 46**). This highlights the concentrated structure of the country's banking sector, with just three banks controlling more than half of the sector's assets and deposits.[174]

[171] In addition to Guinea, the West African Monetary Zone includes Gambia, Ghana, Nigeria, Sierra Leone and Liberia.
[172] "Bulletin des Statistiques Monétaires, Financières et de Balance des Paiements de la Guinée – 2017," Banque Centrale De La République de Guinée, (April 2018): https://www.bcrg-guinee.org/publications/publication-annuelle/782-bulletin-des-statistiques-monetaire-et-exterieures-2017
[173] MFIs in Guinea include 10 Credit Unions and Financial Cooperatives, 9 deposit-taking MFIs and 4 non-deposit-taking MFIs (see **Section 3.3** for more details).
[174] "Doing Business in Africa – Investing Guinea," Embassy of Guinea in New Delhi, (2018): http://www.ambaguinee-inde.org/pdf/guinea-brochure-2018.pdf

Table 45: Market Shares of Banks in Guinea[175]

Financial Institutions	Total Balance Sheet			
	2014	2015	2016	2017
3 Major Banks[176]	60%	55%	57%	56%
3 Average Size Banks[177]	19.6%	22%	21%	-
9 Small Banks[178]	21%	23%	22%	-

Source: West African Monetary Agency

Table 46: Deposit Money Banks Assets and Liabilities (GNF billion)[179]

Indicator	2015	2016	2017
Total Assets	16,254	17,924	19,649
Net foreign assets	502	595	2,034
Bank reserves	3,096	3,802	3,621
Deposits at the central bank	2,392	2,751	3,004
Cash in vaults of deposit banks	704	1,051	618
Domestic credit	9,966	10,702	11,319
Credit to the government (net)	2,457	2,683	3,127
Claims on public enterprises	40	10	13
Claims on the private sector	7,469	8,009	8,189
Other items, net (assets+)	-1,563	-1,998	-2,033
Liabilities to the private sector (deposits)	12,001	13,100	14,942

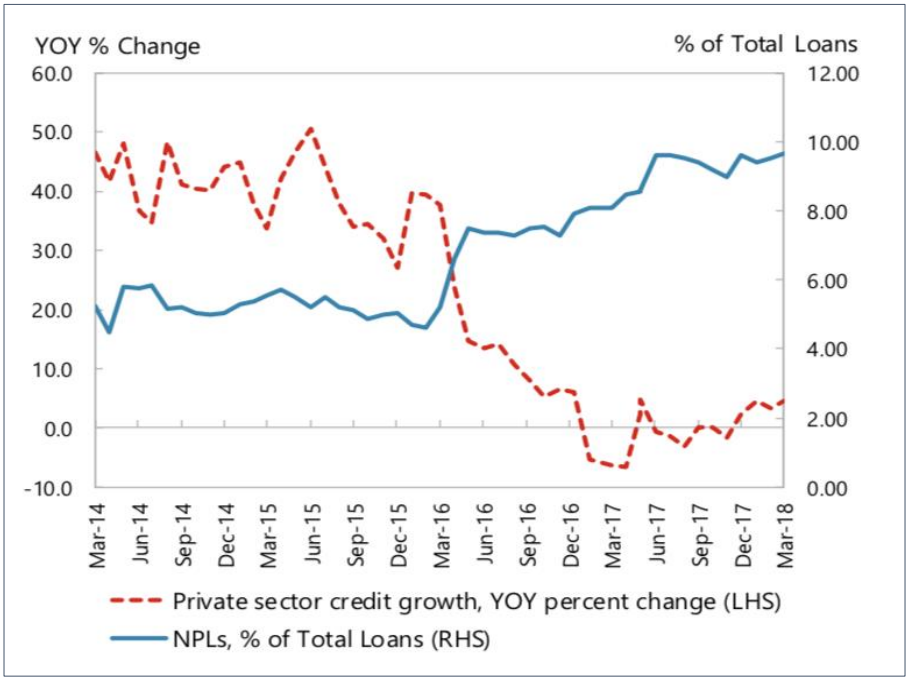
Source: BCRG and IMF

- **Banking Sector Financial Soundness Indicators**

Asset-Based Indicators: The non-performing loan (NPL) ratio of Guinean banks increased to 10.7% in December 2017 up from 9.4% in 2016 and 6% in 2015, mainly due to loans to private entities for the procurement of public infrastructure projects. As a result, banks have become hesitant to lend to the private sector, leading to a decline in credit growth as illustrated in **Figure 37** and **Table 47**.[180]

[175] "Financial Sector Developments and Stability in ECOWAS 2016 Report," West African Monetary Agency, (August 2017): http://amao-wama.org/publications/financial-stability-2016-report/; and
"Banking in Africa: Delivering on Financial Inclusion, Supporting Financial Stability," European Investment Bank, (October 2018): http://www.eib.org/en/infocentre/publications/all/economic-report-banking-in-africa-delivering-on-financial-inclusion-supporting-financial-stability.htm
[176] Market share of major banks >10%
[177] Market share of average size banks >5% and ≤10%
[178] Market share of small banks ≤ 5%
[179] BCRG, 2018.
[180] "Guinea: First Review of the Arrangement Under the Three-Year Extended Credit Facility, Financing Assurances Review," International Monetary Fund, Country Report No. 18/234 (July 2018): https://www.imf.org/en/Publications/CR/Issues/2018/07/20/Guinea-First-Review-of-the-Arrangement-Under-the-Three-Year-Extended-Credit-Facility-46109

Figure 37: Non-Performing Loans and Credit Growth (% of Total Loans)



Source: International Monetary Fund

Table 47: Banking Sector Asset-Based Indicators

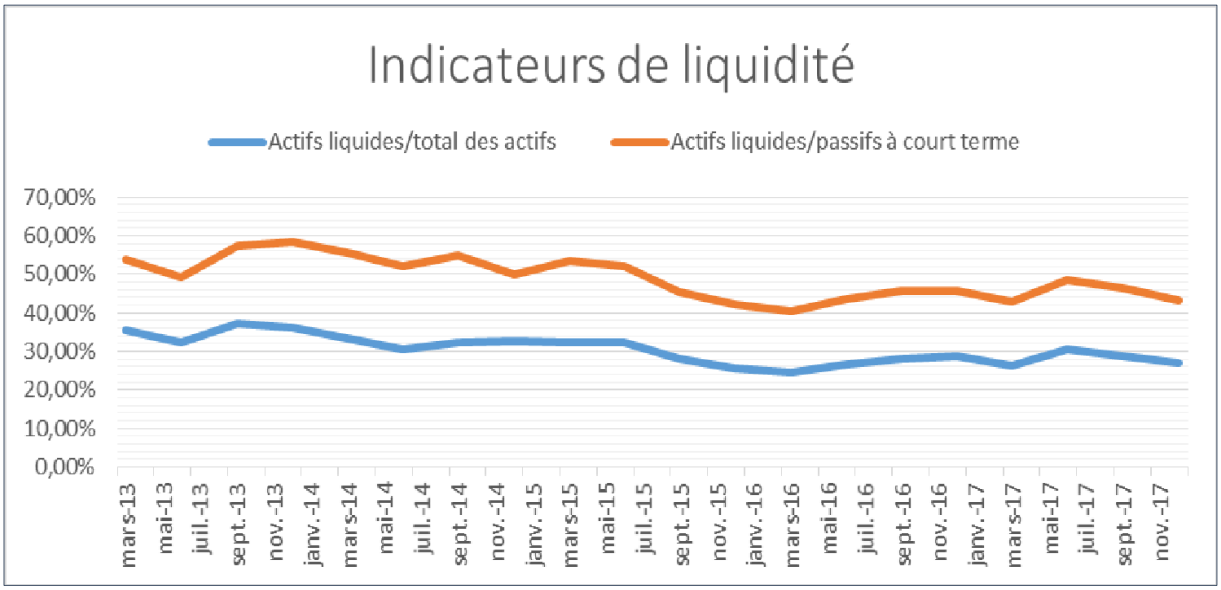
Indicator	Q4-2015	Q4-2016	Q4-2017
Non-performing Loans to Total Loans	6.1%	9.4%	10.7%
Liquid Assets to Total Assets (Liquid Asset Ratio)	25.6%	28.9%	26.8%
Liquid Assets to Short Term Liabilities	42.2%	45.8%	43.1%
Net Open Position in Foreign Exchange to Capital	-56.4%	25.1%	79.2%

Source: International Monetary Fund

Liquidity conditions in the banking sector started to improve in the second half of 2017, following tight liquidity conditions in 2016 and early 2017. This improvement was the result of the central bank's decision to lower reserve requirements in 2017 coupled with growth in deposits, which increased to 16.7% at the end of 2017, up from 10.6% in 2016. Deposits in foreign currency also increased, reflecting higher repatriation of export earnings from artisanal gold following the elimination of the tax on gold exports. However, most of the additional liquidity was absorbed by the banks' subscription of the GNF 500 billion government bonds to finance infrastructure development in the country. Yet, improved liquidity conditions still reflected an increase in the banks' excess reserves at the BCRG by 56% in 2017 and 35% in the first quarter of 2018 compared to end-2017. All banks were in compliance with reserve requirements as of the end of 2017.[181] Nevertheless, in 2017, the ratio of liquid assets to total assets declined by 2%, while the ratio of liquid assets to short-term liabilities declined by nearly 3% as shown in **Table 48** and **Figure 38**. This decrease in liquidity ratios can be largely attributed to a contraction in the national currency and simultaneous growth of 10.7% and 9.3% in total assets and current liabilities, respectively.[182]

[181] IMF, 2018.
[182] BCRG, 2018.

Figure 38: Banking Sector Liquidity Indicators



Source: BCRG

Capital-Based Indicators: As shown in **Table 48** below, at end-December 2017, regulatory capital and regulatory Tier 1 capital to risk-weighted assets both declined to 16.83% and 17.43%, respectively, due to a greater increase in risk-weighted assets compared to equity. On the other hand, provisioning for NPLs improved with NPLs net of provisions to capital falling to 11.3% at end-2017 from 14.7% in 2016 due to strengthening of banks' equity.[183]

As of the end of 2017, two banks were in non-compliance with capital adequacy requirements (six banks were non-compliant at end-2016). Thus, in line with its role of ensuring the stability of the financial system, the BCRG defined an action plan with the two non-compliant banks to bring them into capital regulatory compliance by end-2018.[184]

Table 48: Banking Sector Capital-Based Indicators

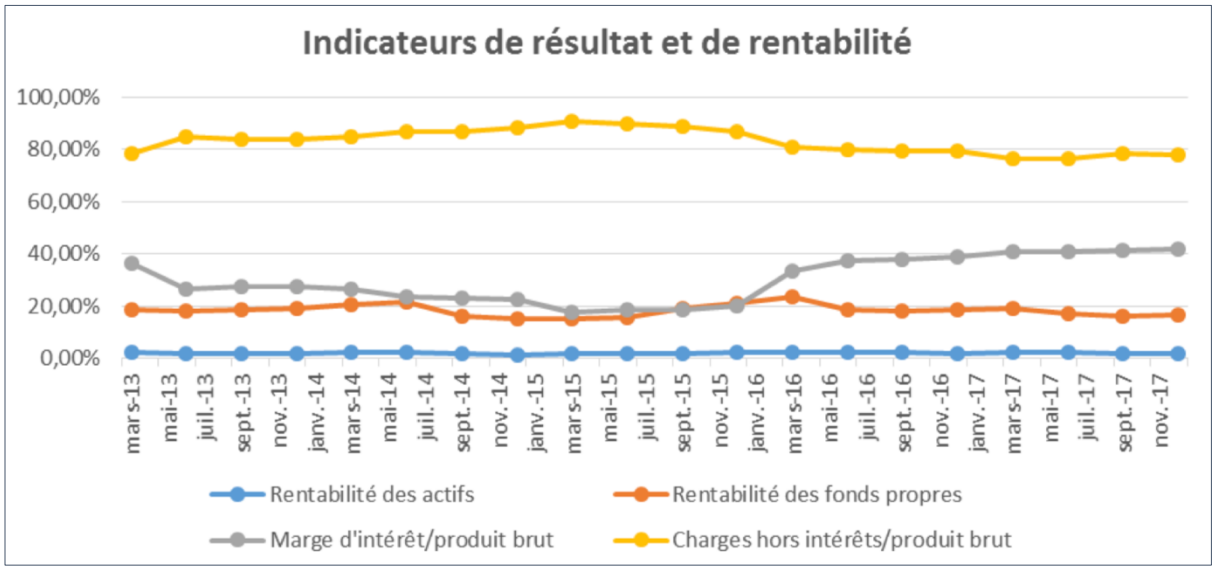
Indicator	Q4-2015	Q4-2016	Q4-2017
Regulatory Capital to Risk-Weighted Assets	16.5%	17.9%	16.8%
Regulatory Tier 1 Capital to Risk-Weighted Assets	16.8%	18%	17.4%
Non-performing Loans Net of Provisions to Capital	6.8%	14.6%	11.3%

Source: International Monetary Fund

Income and Performance Indicators: Figure 39 and **Table 49** illustrate key profitability indicators of the commercial banking sector, while **Table 50** provides a broader overview of the sector's performance.[185]

[183] BCRG, 2018.
[184] Stakeholder interviews, 2018.
[185] IMF, 2018.

Figure 39: Banking Sector Profitability Indicators



Source: BCRG

Table 49: Banking Sector Profitability Indicators

Indicator	Q4-2015	Q4-2016	Q4-2017
Return on assets	2.4%	2.2%	2.1%
Non-interest expenses to total income	86.6%	79.2%	78.1%
Interest margin to total Income	20.1%	38.9%	41.8%
Return on equity	21.7%	18.8%	16.7%

Source: International Monetary Fund

Table 50: Banking Sector Performance Indicators

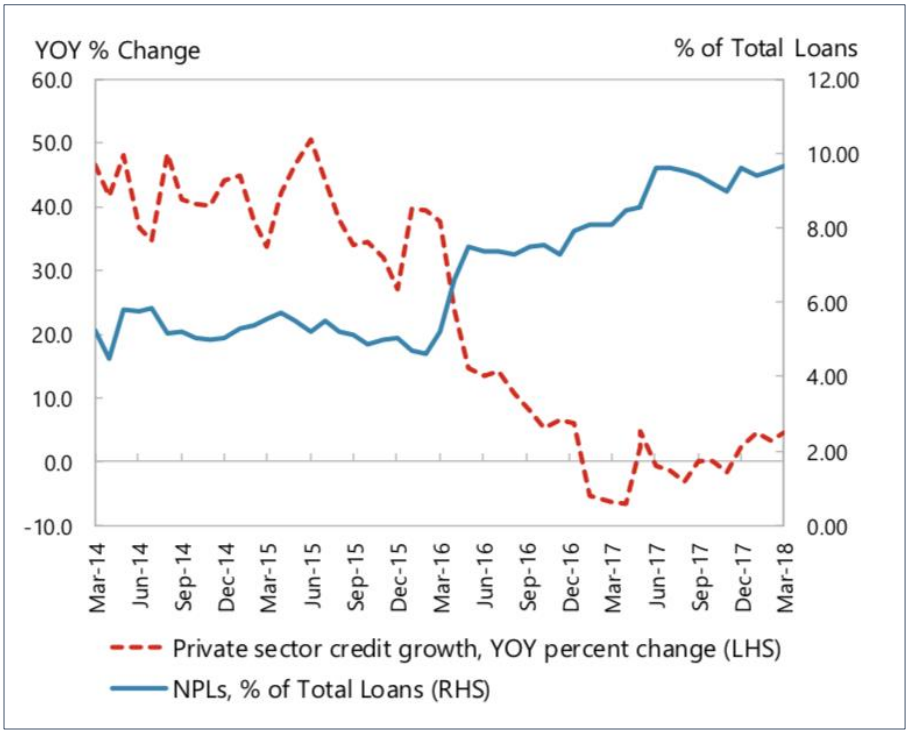
Indicator	2015	2016	2017
Number of institutions	15	16	16
Number of branches	160	163	170
Number of branches in the three largest cities	103	106	109
Number of depositors	451,526	454,512	524,690
Number of deposit accounts	555,082	537 014	616,572
Number of borrowers	104,013	79,101	74,706
Number of loan accounts	127,378	110,057	100,104
Outstanding deposits	GNF 11,280.7 billion	GNF 12,942.7 billion	GNF 13,077.4 billion
Outstanding loans	GNF 6,281.5 billion	GNF 7,021.6 billion	GNF 7,473.3 billion

Source: BCRG

- **Distribution of Credit by Sector**

Due to much larger-than-planned budgetary financing needs, commercial bank lending to the Government has been on the rise in recent years, thereby crowding out credit to the private sector. In addition, with the increase in NPLs discussed above, banks in Guinea have noted a preference to extend credit to the public sector due to lower levels of risk, compounded by a lack of viable lending opportunities. Consequently, private sector credit growth decreased considerably, from a high of around 40% in 2016 to 5.9% (y-o-y) by end-2016 and turned negative to -1.3% (average y-o-y) in 2017. On a cumulative basis, between 2016 and the first quarter of 2018, commercial bank lending to the government increased by over 42%, while lending to the private sector declined by 3.1% despite improved liquidity conditions (**Figure 40**).[186]

Figure 40: Commercial Bank Credit to Government and Private Sector



Source: International Monetary Fund

[186] IMF, 2018.

Table 51: Distribution of Credit by Sector[187]

Sector	2012	2013	2014	2015
Commerce	71%	81%	62%	19%
Public works and buildings	9%	2%	12.3%	16%
Agriculture and textiles	2%	1%	2%	0%
Merchant services	8%	9%	8%	4%
Other manufacturing industries	2%	1%	1%	5%
Transport	3%	3%	12.2%	14%
Energy generation and water	1%	1%	1%	19%
Other sectors including individuals	4%	2%	1.5%	23%
Total	100%	100%	100%	100%

Source: US Agency for International Development

In terms of sectoral distribution of credit, as shown in **Table 51**, historically, about 90% of bank lending is concentrated in the following economic sectors – commerce, energy and water, public works and buildings, transport and other sectors and individuals.

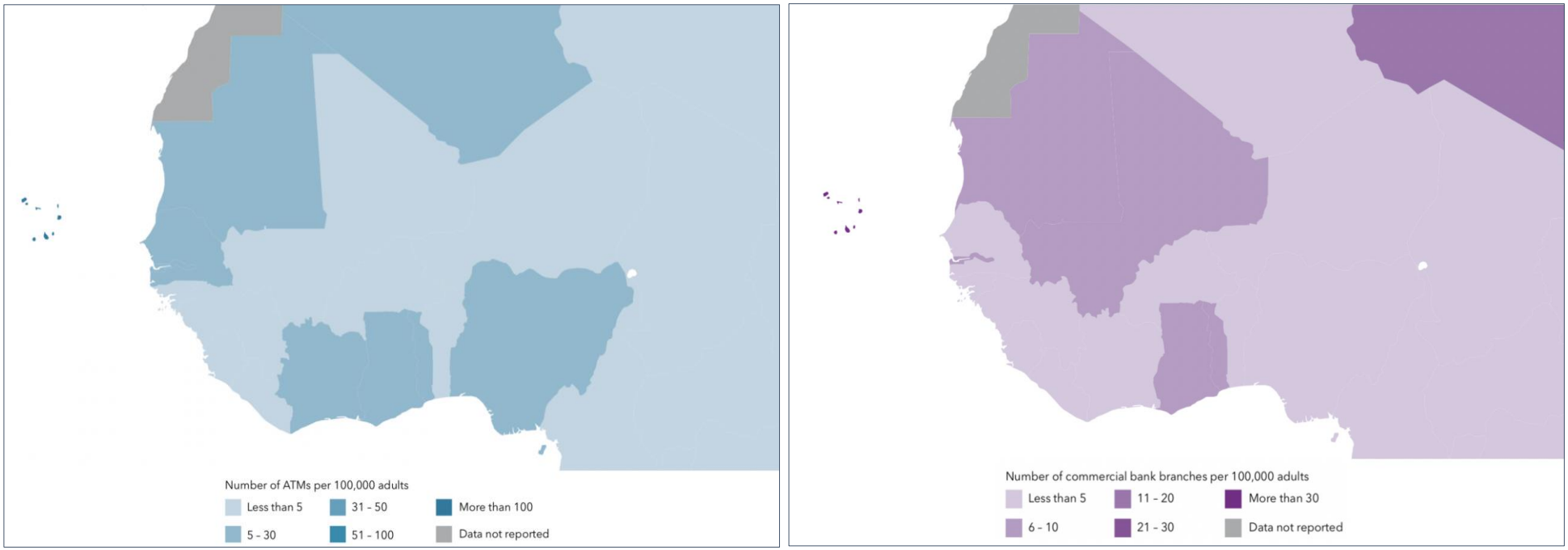
3.2.2 Financial Inclusion

- **Access to Financial Services**

Access to financial services represents an ongoing challenge in West Africa and the Sahel. Overall, about three-quarters of the region's population remains financially excluded, lacking access to banking and financial services through formal institutions (**Figure 41**).[188] There are, however, notable signs of progress. Between 2011 and 2017, the share of the population covered by formal financial institutions increased by nearly 10%.[189] Many countries across the region, including Guinea, have also seen a sharp increase in mobile money account ownership (**Figure 42**) and transaction volume (**Figure 43**).

[187] "Market Assessment Report on Clean Energy: Guinea," USAID Climate Economic Analysis for Development, Investment and Resilience (CEADIR), (June 2018): https://www.climatelinks.org/resources/renewable-energy-lending-west-africa
[188] "Le secteur bancaire en Afrique De l'inclusion financière à la stabilité financière," European Investment Bank, (October 2018): https://www.eib.org/attachments/efs/economic_report_banking_africa_2018_fr.pdf
[189] Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution," World Bank, (2017): http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf

Figure 41: ATMs and Branches of Commercial Banks per 100,000 Adults in West Africa and the Sahel, 2017[190]

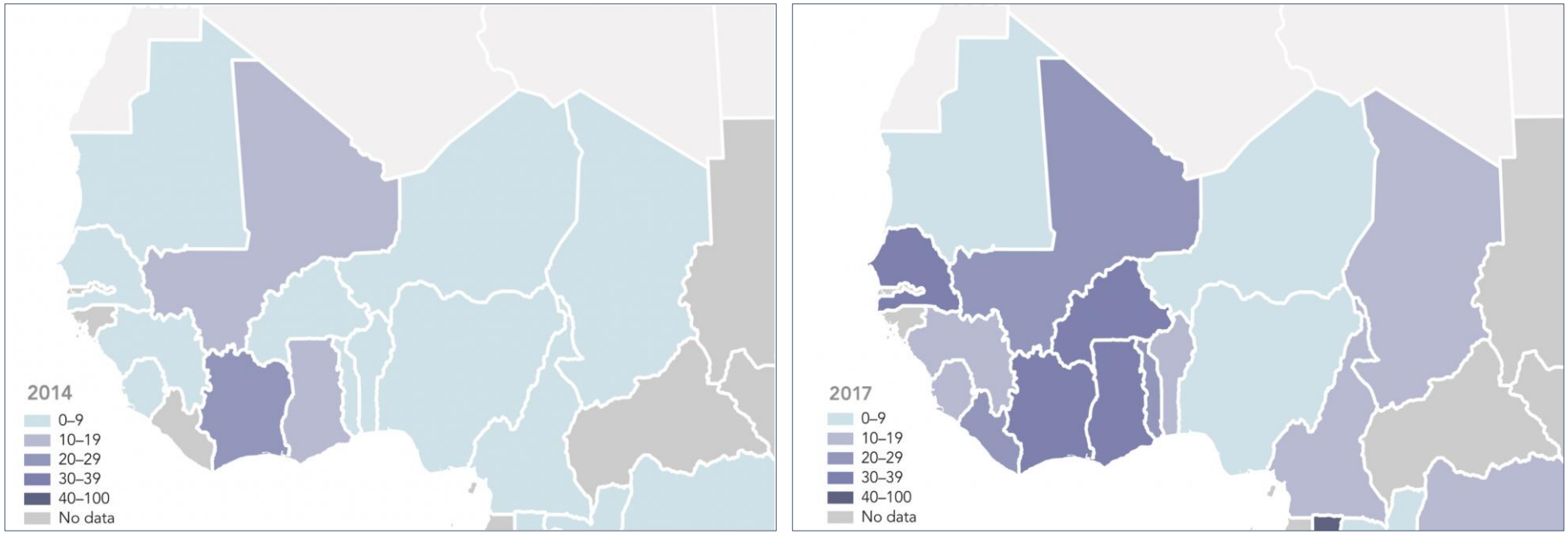


Source: International Monetary Fund

Figure 41 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.

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

Figure 42: Share of Adults with a Mobile Money Account in West Africa and the Sahel (%), 2014 and 2017[191]



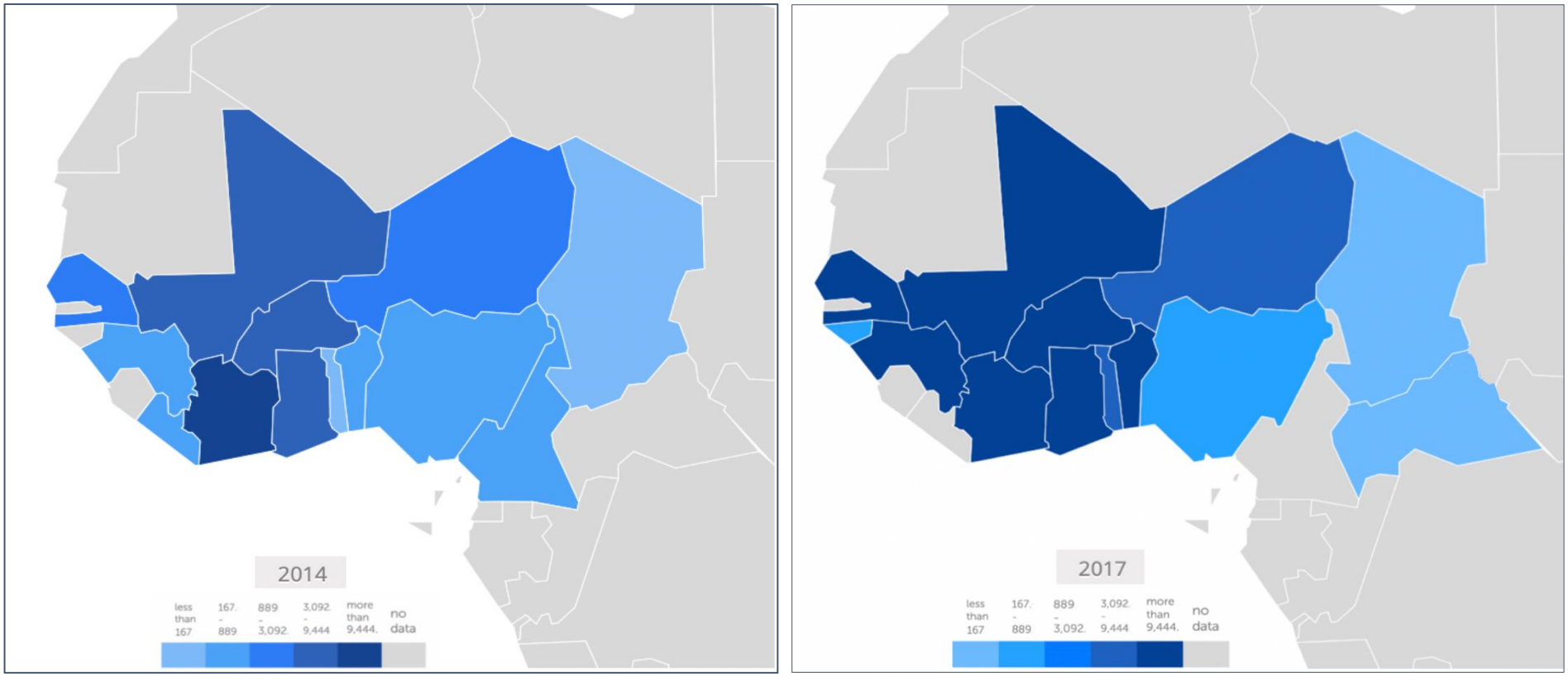
NOTE: Maps exclude Cabo Verde (no data)

Source: World Bank Global Findex Database

Figure 42 shows the increase in the share of adults (%) owning a mobile money account across West Africa and the Sahel between 2014 and 2017. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. As of 2017, the share of adults owning a mobile money account is about 33% in Burkina Faso, Côte d'Ivoire, and Senegal, and 39% in Ghana. Between 2014 and 2017, mobile money account ownership also increased significantly in Benin, Cameroon, Chad, **Guinea**, Mali, Sierra Leone and Togo, while growth in account ownership was slower in Niger, Nigeria and Mauritania. There was either no data or insufficient data available to assess account ownership in Cabo Verde, Central African Republic, The Gambia, Guinea-Bissau, and Liberia.

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

Figure 43: Mobile Money Transactions per 1,000 Adults in West Africa and the Sahel, 2014 and 2017[192]



NOTE: Maps exclude Cabo Verde (no data)

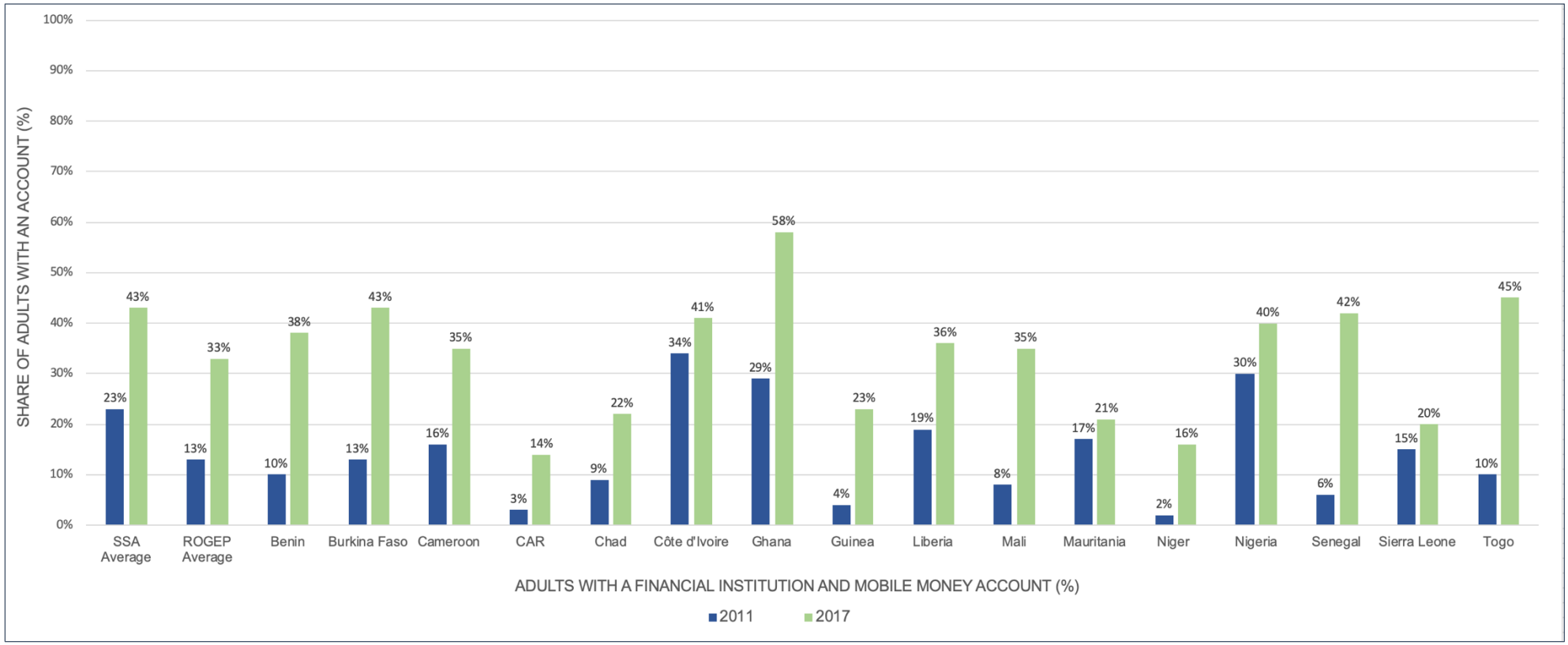
Source: International Monetary Fund

Figure 43 shows the increase in the number of mobile money transactions across West Africa and the Sahel between 2014 and 2017. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. Between 2014 and 2017, mobile money transaction volume increased significantly in Benin, Burkina Faso, Côte d'Ivoire, Ghana, **Guinea**, Mali, Niger, Senegal and Togo, while growth in transaction volume was slower in Nigeria and Chad. There was either no data or insufficient data available to assess transaction volume in Cabo Verde, Cameroon, Central African Republic, The Gambia, Guinea-Bissau, Liberia, Mauritania and Sierra Leone.

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

In 2017, 23% of Guinea's adult population had an account at a financial institution or with a mobile money service provider, up from 4% in 2011. Despite this huge improvement, in 2017, the country still had one of the lowest rates of financial inclusion in West Africa and the Sahel, 10% below the region's average and 20% below the average for Sub-Saharan Africa (**Figure 44**).

Figure 44: Share of Adults with Access to Financial Services in West Africa and the Sahel (%), 2011 and 2017[193]



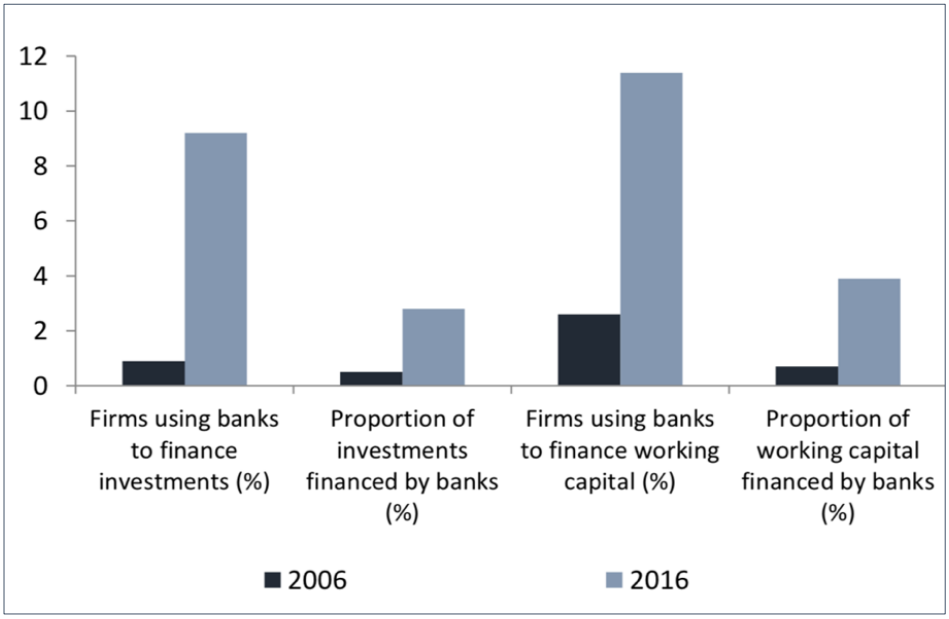
NOTE: Cabo Verde, Guinea-Bissau and The Gambia excluded (no data); data for Côte d'Ivoire is from 2014 and 2017

Source: World Bank Global Findex Database

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

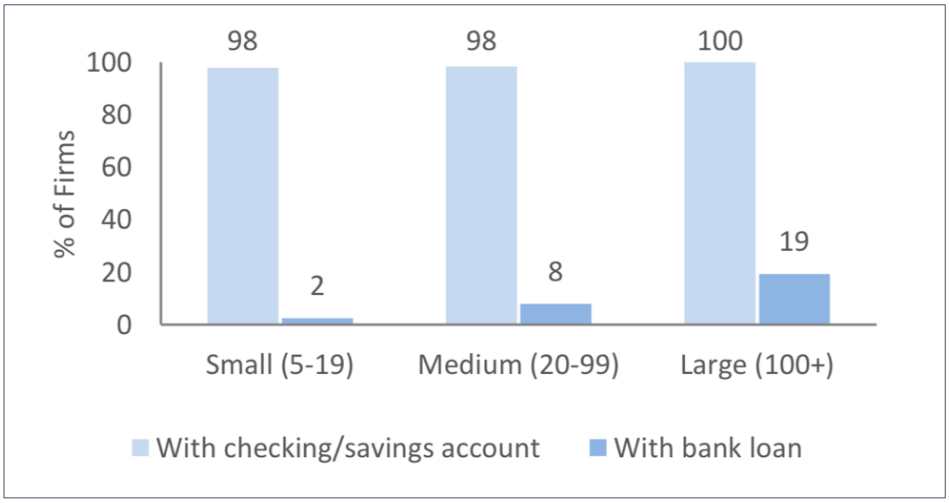
Financial inclusion remains an ongoing challenge in Guinea. According to the World Bank Global Findex database, 23% of Guineans had an account with a formal financial institution or mobile money provider in 2017. In the private sector, the 2016 World Bank Enterprise survey found that enterprises of all sizes lack funding to expand their activities and only 4% of Guinean firms relied on a bank loan. While the use of bank loans for working capital and investment among Guinean firms has increased slightly over the last decade (**Figure 45**), the vast majority of enterprises in the country, particularly small and medium-sized firms, still resort to internal sources of financing for investment rather than a bank loan (**Figure 46**).[194]

Figure 45: Guinean Firms Access to Finance (%)



Source: World Bank

Figure 46: Use of Financial Services among Guinean Firms, 2016

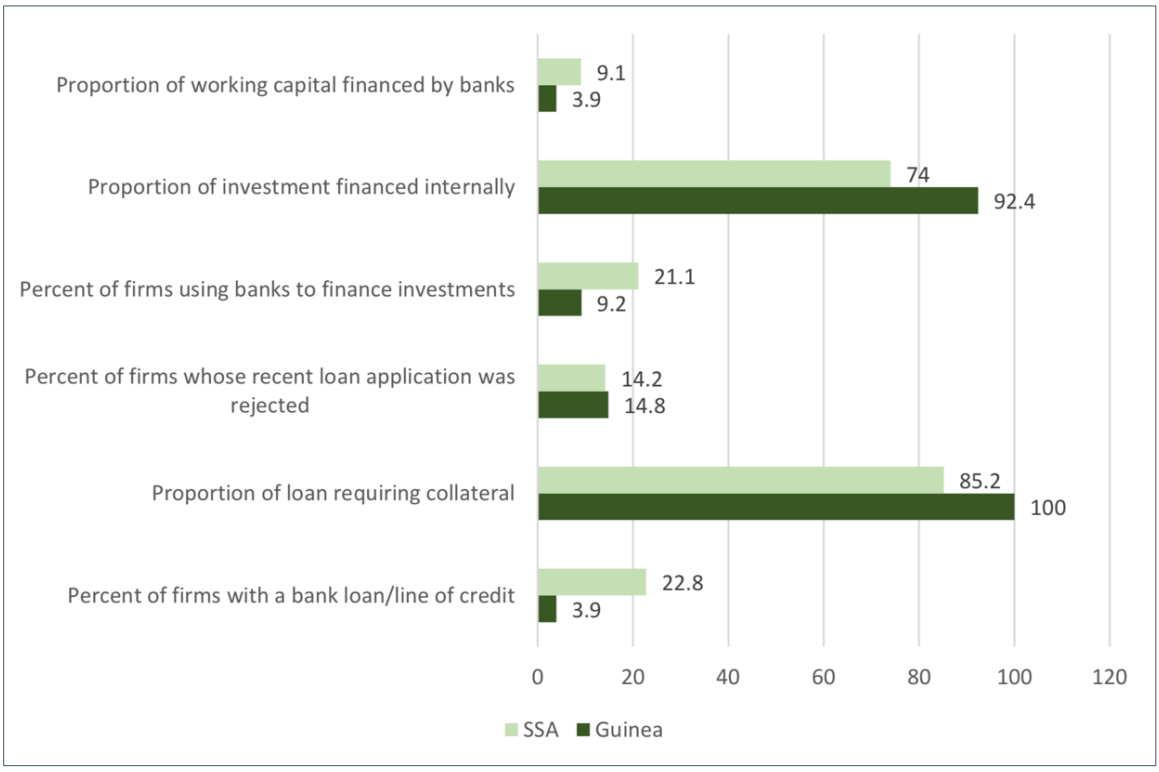


Source: World Bank

[194] "World Bank Enterprise Surveys: Guinea Country Profile," World Bank, (2016): http://www.enterprisesurveys.org/~/media/GIAWB/EnterpriseSurveys/Documents/Profiles/English/Guinea-2016.pdf

Furthermore, Guinea ranks well below average when compared to other countries in Sub-Saharan Africa in access to finance (**Figure 47**).[195]

Figure 47: Access to Finance Indicators



Source: World Bank Enterprise Surveys

Three mobile financial service providers are currently active in the country – Orange, MTN and PayCard. Orange, which was among the first providers to enter the market in 2012, has the largest market share, with 600,000 active accounts out of its 1.4 million registered accounts.[196] **Table 52** shows how rapidly the country's mobile money sector has been growing. Between 2016 and 2017, the number of registered customers in mobile banking increased by 40%, while the number of active accounts increased by 60%. Over the same period, the total value of transactions (GNF 18.5 trillion) nearly tripled. These trends can be largely attributed to expanded network coverage and the development and implementation of a variety of new mobile products and services (e.g. for payment of wages, bills, and other transactions).[197]

[195] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf
[196] Ibid.
[197] BCRG, 2018.

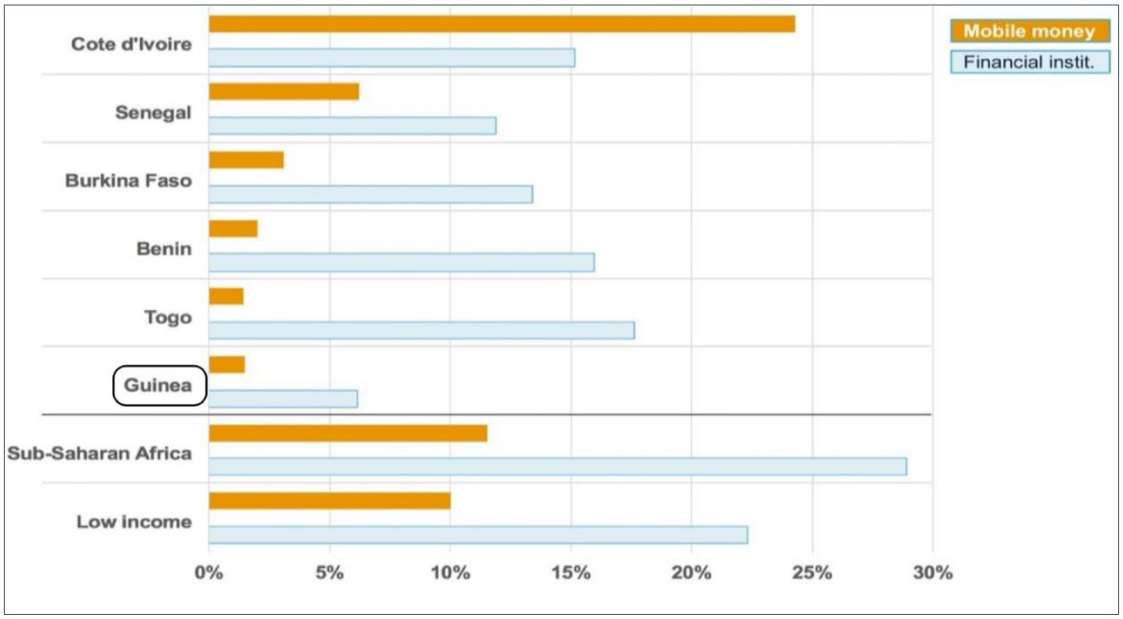
Table 52: Mobile Money Service Indicators

Indicator	2015	2016	2017
# of registered mobile bank accounts	983,834	1,674,475	2,329,281
# of active mobile bank accounts	190,157	662,855	1,071,818
# of registered agents	4,206	14,229	29,599
# of active agents	2,298	10,034	18,282
# of mobile banking transactions	6,685,860	44,360,694	129,064,591
Value of mobile banking transactions	GNF 842 billion	GNF 6,415 billion	GNF 18,471 billion
Current balances of mobile bank accounts	GNF 33 billion	GNF 9 billion	GNF 309 billion

Source: BCRG

Despite these encouraging figures, Guinea still lags behind other countries in West Africa and the Sahel as well as in the wider Sub-Saharan Africa region (**Figure 48**), as expanded access to mobile money services in the country is constrained by comparatively lower levels of broadband service penetration, poor signal quality in rural areas, high fiscal pressure on mobile operators, low levels of literacy and a lack of reliable identification among the rural population.[198]

Figure 48: Penetration of Mobile Money and Bank Accounts at Financial Institutions (% of population)[199]



Source: International Monetary Fund

Widespread mobile phone ownership (**Figure 17)**, growing mobile internet usage (**Figure 16**) and network coverage (**Figure 33**), have the potential to expand mobile money services and platforms in the country. These dynamics can collectively increase usage of mobile banking services and drive financial inclusion in Guinea. Mobile money technology also plays a critical role in the application of off-grid solar solutions,

[198] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf
[199] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty, Systematic Country Diagnostic," World Bank (2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf

particularly for Pay-As-You-Go systems that rely on the interoperability between digital financial services and stand-alone solar devices.

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

Another area where Guinea lags behind is in financial inclusion for women. According to data from the World Bank's 2017 Global Findex survey, women in Sub-Saharan Africa are 10 percentage points less likely to have an account in a financial institution or a mobile money account than men. In Guinea, the gender gap is slightly smaller than the regional average, with 20% of women compared to 27% of men holding an account (**Figure 49**). While the size of the financial inclusion gender gap has increased markedly since 2011, in absolute terms, as of 2017, 27% of women had financial and mobile money accounts – a fivefold increase in the percentage in 2014 – but still below the region's average of 37%.[200]

Women in Guinea experience financial exclusion mainly due to low or irregular sources of income and limited access to land and credit. The country's elevated levels of poverty, social and cultural norms, and lower levels of education and rates of literacy make it difficult for women to access and use financial services. Empirical evidence suggests that it is much harder for women to borrow money from a financial institution than men.[201]

The growth in the financial inclusion gender gap could be related to the weakness of Guinea's market for digital financial services. Expanding digital financial services, especially mobile money, can create new opportunities to better serve women, the lower-income population, and other groups that are traditionally excluded from the formal financial system. The development of mobile banking systems in Guinea would help to improve access to financial services for women, particularly by helping to integrate women who are active in the informal sector.[202] As of 2017, 14% of adult men only had a mobile money account, compared to 8% of women, which is well below the regional average (**Figure 50**).[203]

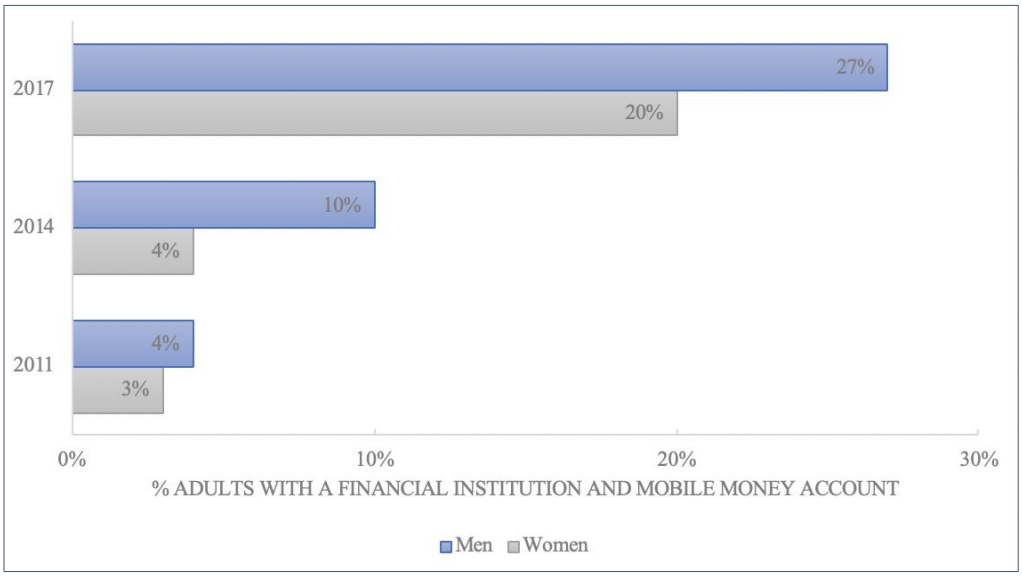
[200] Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., and Hess, J., "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution," World Bank, (2017): http://documents.worldbank.org/curated/en/332881525873182837/pdf/126033-PUB-PUBLIC-pubdate-4-19-2018.pdf

[201] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf

[202] "Financial Sector Modernization Support Project (PAMSFI)," African Development Bank, (March 2017): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Guinea_-_Approved_Financial_Sector_Modernization_ PAMSFI.pdf

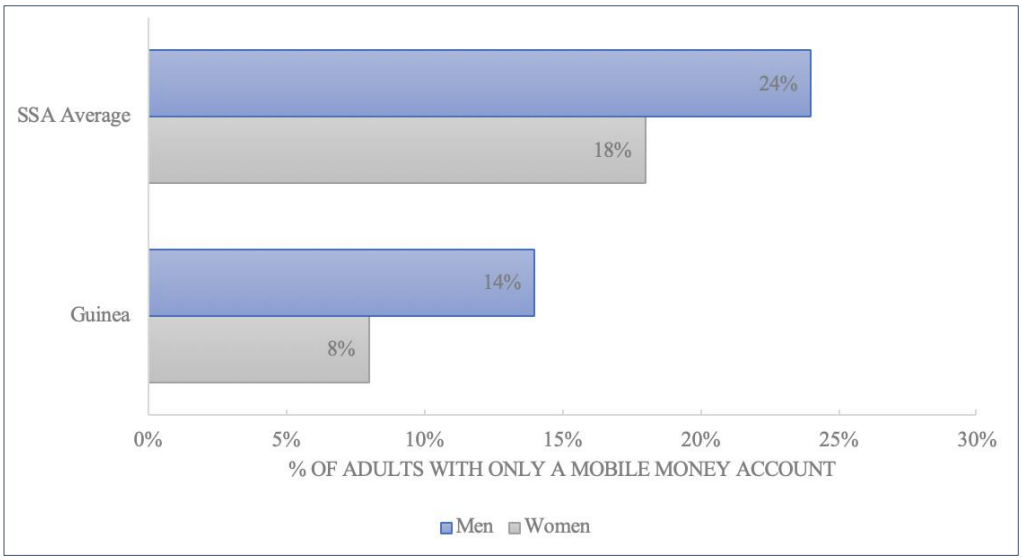
[203] Demirguc-Kunt et al., 2017.

Figure 49: Financial Inclusion Gender Gap in Guinea



Source: World Bank Global Findex Database

Figure 50: Gender Gap in Mobile Money, 2017



Source: World Bank Global Findex Database

Studies have found that increasing financial inclusion can significantly empower women by increasing savings, reducing levels of inequality, and improving decision-making power in the household. Supportive government policies and regulations are therefore critical to overcoming the barriers that women face and driving overall progress towards financial inclusion.[204]

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

In an effort to improve financial inclusion in the country, the Government of Guinea has initiated a series of reforms. In July 2017, a new Financial Inclusion Law was adopted to provide a framework for the activities of microfinance institutions, mobile money service providers and the financial services of the Guinean Post in supporting access to credit for SMEs, women and youth. As of 2018, the GoG was still in the process of implementing this new law with support from the World Bank.[205]

3.2.3 Commercial Lending Environment

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

Customer deposits are the largest source of funds for the Guinean banking sector. Historical data on the maturity structure of these deposits indicates that most are short-term current and savings account deposits (**Table 53**). The fact that these deposits are generally demand deposits highly constrains the ability of banks to provide long-term financing.[206]

Table 53: Maturity Structure of Bank Deposits (GNF billion)

Indicator	2011	2012	2013	2014	2015
Current account	6,197	5,380	5,224	6,342	7,556
Savings account	1,675	1,841	2,046	2,291	2,889
Term account	359	603	893	1,209	1,379
Other accounts	19	9	0.865	32	13
Total	**8,250**	**7,833**	**8,163**	**9,874**	**11,837**

Source: BCRG

As a result, most loans are short-term credits (**Table 54**). Of the 16 Guinean banks' GNF 5,520.1 billion (USD 600 million) commitments to companies in 2017, only GNF 799.4 billion (USD 86 million) were long-term loans. The Guinean banking sector continues to be hampered by the scarcity of long-term credit.[207]

Table 54: Maturity Structure of Bank Credit (GNF billion)

Indicator	2011	2012	2013	2014	2015	2016	2017
Short term credits	2,263	1,579	2,093	3,285	4,301	5,091	4,740
Medium term credits	842	1,344	1,804	2,206	2,453	2,943	3,480
Long term credits	22	27	45	59	310	-	-
Default loans/others	20	35	111	141	135	-	-
Total	**3,149**	**2,987**	**4,055**	**5,693**	**7,201**	-	-

Source: BCRG

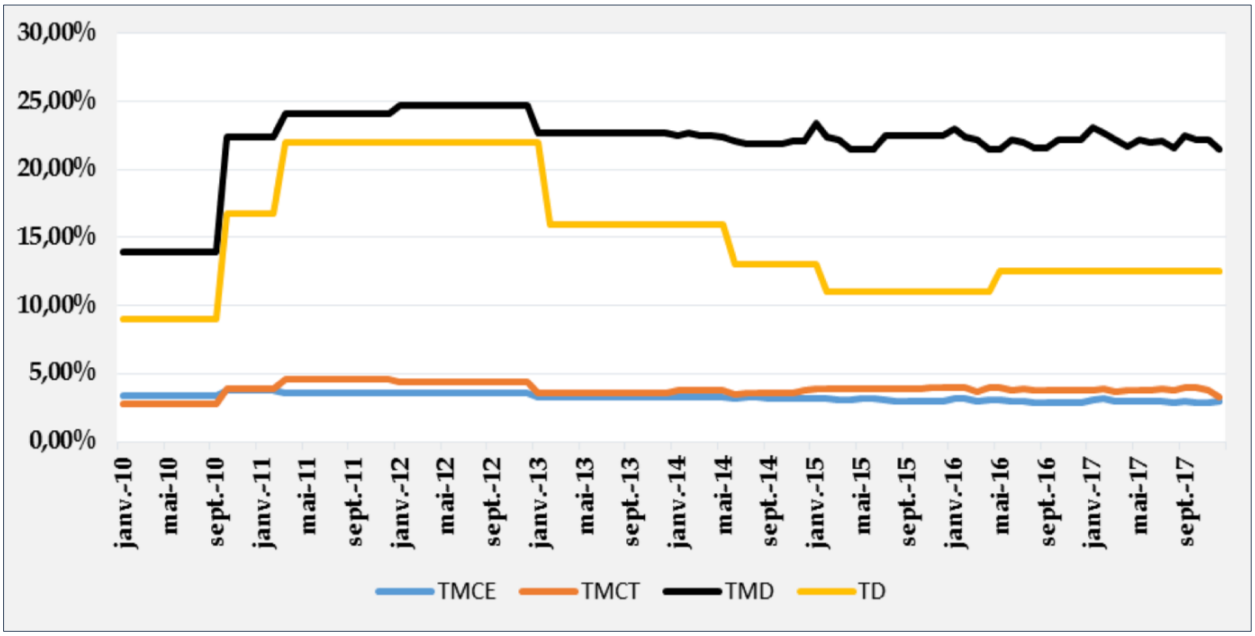
- **Interest Rates**

The cost of finance in Guinea is high due to the fact that the banking sector is highly concentrated, technologically inhibited, and banks tend to favor short-term lending at high interest rates, up to 25% and above. In response to the upward trend in prices since the beginning of 2016, the BCRG kept its guideline

[205] IMF, 2018.
[206] BCRG, 2018.
[207] "Doing Business in Africa – Investing Guinea," Embassy of Guinea in New Delhi, (2018): http://www.ambaguinee-inde.org/pdf/guinea-brochure-2018.pdf

rate unchanged at 12.5% in 2017. In the treasury bill market, all weighted average rates declined in 2017. The weighted average rate of 91-day treasury bills stood at 7.8% as of December 2017, compared to 14.4% in December 2016. The 182-day treasury bill rate came down to 9.5% in December 2017 compared to 15% in 2016, while the 364-day treasury bill rate fell to 11.1% in December 2017 compared to 16.5% the year prior. Likewise, the maximum lending rates and the minimum term deposit and savings rates also fell slightly in 2017 (**Figure 49** and **Table 55**).[208]

Figure 51: Select Interest Rates



TMCE: Average rate on Savings Account; TMCT: Average Rate on Term Accounts; TMD: Average Lending Rate; TD: Directors Rate

Source: BCRG

Table 55: Interest Rates

Interest Rates	Dec-2015	Dec-2016	Dec-2017
Guideline Rate of BCRG	11%	12.5%	12.5%
Rate for savings account (average)	3%	3% (min.)	2.93% (min.)
Rate for term deposits (average)	3.93%	3.78% (min.)	3.27% (min.)
Lending rate (average)	22.46%	22.16% (max.)	21.5% (max.)
Bank base rate (average)	15.95%	-	-

Source: BCRG

- **Foreign Exchange Market**

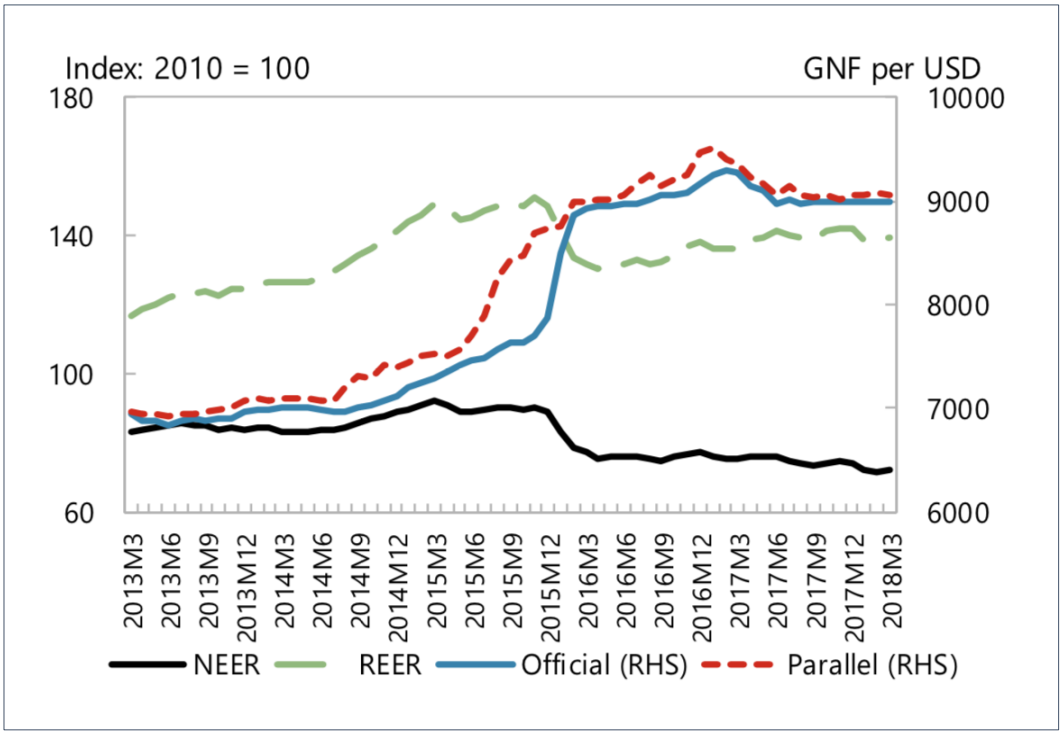
In 1960, the Republic of Guinea withdrew from the CFA franc monetary zone and established the BCRG and a domestic currency. Three monetary units have been used in the country since then – the Guinean franc from 1960 to 1972, the Guinean syli from 1972 to 1985, and the *Guinée Nouveau Franc* (GNF), introduced in 1985 following a sharp devaluation of the syli. Initially, the official rate for the GNF was set

[208] BCRG, 2018.

at 300 GNF/USD; however, the failure of the banking system to fully meet the demand for foreign currency and the increase in various charges (including taxes and fees) encouraged the development of a parallel market. In March 2005, the Government decided to liberalize the exchange rate market, which led to the establishment of foreign exchange bureaus, whose activities are regulated by the BCRG.[209]

From 2013-2015, the exchange rate remained relatively stable, maintaining a value between 7,000 and 7,500 GNF/USD (**Figure 52**). However, in late 2015, the unofficial rate reached a value 10% higher than the official rate while Guinea had nearly exhausted its foreign currency reserves (**Table 56**). As a result, the IMF recommended the BCRG float the GNF. In January 2016, the BCRG replaced its foreign exchange allocation system with a bilateral foreign exchange auction market (marché aux enchères en devises, MEBD), allowing for greater exchange rate flexibility and reducing the differential between the official and the market exchange rates. The official rate jumped to nearly 9,000 GNF/USD by March 2016.[210]

Figure 52: Average GNF-USD Exchange Rates



Source: International Monetary Fund

Table 56: Official Exchange Rate (GNF-USD)[211]

Exchange Rate	2013	2014	2015	2016	2017	2018
End of Period	7,005.8	7,227.7	8,003.7	9,225.3	9,006.3	9,080
Period Average	6,907.9	7,014.1	7,485.5	8,959.7	9,088.3	9,011.1

Source: International Monetary Fund

[209] "Trade Policy Review: Republic of Guinea," World Trade Organization, Document WT/TPR/S/370/Rev 1. (September 2018).
[210] IMF, 2018.
[211] International Financial Statistics (IMF): http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B

Under the MEBD, the BCRG intervenes twice a week through a multi-price, two-way, foreign exchange auction with active commercial banks. In order to make the MEBD more competitive and support greater flexibility of the exchange rate, the Government aims to gradually eliminate the limit on auction allocations to a single participant until it is fully eliminated by June 2019. The GoG also intends to establish an electronic platform to make MEBD operations more fluid and secure and is strengthening foreign exchange liquidity forecasting by better sharing of information and hosting regular meetings between the BCRG and the Ministry of Finance. In addition, the Government aims to ensure that the premium between the official exchange rate (which is the reference rate for all market participants)[212] and the commercial banks' purchase and sales rate does not exceed 2% on a given day. Furthermore, although external reserves were strengthened in 2017, they remain below three months of import coverage. This is despite the increased foreign exchange supply in the economy, particularly the mining and agricultural sectors. Consequently, in order to achieve its objective of reserve coverage of 3.8 months of imports by 2020, the BCRG is adopting an active strategy to accumulate reserves through regular and small purchases in unilateral and competitive auctions open to all Guinean banks and foreign non-bank entities operating in the MEBD. In parallel, BCRG interventions in the MEBD will be limited to maintaining liquidity and preventing disorderly market conditions.[213]

The exchange rate of the US dollar against the New Guinean franc at the end of 2017 stood at GNF 9,006.4 compared to GNF 9,225.3 at the end of 2016 on the official market and at GNF 9,073.3 compared to GNF 9,616.7 for the approved bureaus de change. Since early 2017, the spread between the reference exchange rate and the foreign exchange bureau rates has remained below 2%. However, the foreign exchange system gives rise to a multiple currency practice because the reference rate can potentially deviate by more than 2% from the commercial banks' purchase and sales rates on a given day.[214]

- **Collateral Requirements**

Banks in Guinea have very high and stringent collateral requirements as there is limited credit information on prospective borrowers in the country. In addition, banks typically require collateral for 100% of loans, compared to a Sub-Saharan Africa average of about 85%. Furthermore, local banks typically require traditional collateral such as land and buildings as laws currently do not permit the use of movable assets as collateral. The combination of these factors make it problematic for Guinean businesses especially SMEs to access credit. This is evidenced by the fact that the proportion of rejected loan applications in Guinea (14.8%) is slightly higher than the average across countries in Sub-Saharan Africa (14.2%).[215]

In an attempt to address this challenge, a new credit information system was recently set up with support from the World Bank. The system will provide a database on the creditworthiness and credit history of all customers, including credit scores and outstanding credit to other banks. The credit system began operating in February 2018.[216]

- **Banking Supervision**

The BCRG is taking a number of measures to strengthen banking supervision, including updating the accounting framework applicable to credit institutions, automating the process for reporting financial data, revising and drafting new regulations, and improving the rating methodology of banks and supervisory

[212] The reference exchange rate is calculated every morning on the basis of all foreign exchange transactions of the previous day and published daily by the BCRG. The reference rate is a weighted average of commercial banks' purchase and sale rates.
[213] IMF, 2018.
[214] BCRG, 2018 and IMF, 2018.
[215] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf
[216] IMF, 2018.

actions. In addition, the BCRG has designed an action plan to bring all banks in compliance with International Financial Reporting Standards and with Basel II requirements. The central bank is also in the process of establishing a banking resolution framework and a deposit guarantee scheme, both of which are expected to be finalized by 2019. The Professional Association of Banks (Association Professionnelle des Banques, APB) and BCRG commission were established for this purpose.[217]

3.2.4 Lending to the Off-Grid Solar Sector

Despite the enormous electricity demand-supply gap in Guinea, the number of households utilizing off-grid solar technology has remained insignificant. This is mainly due to the high up-front costs of these systems relative to the purchasing power of households and the lack of suitable financing mechanisms.[218] While several donor-funded programs and initiatives have provided financing to support development of Guinea's OGS market (see **Section 1.4**), none of these funds have been channeled through local commercial banks or MFIs.

ROGEP is therefore a pioneering initiative in the country, as it endeavors to boost OGS lending via engagement with local financial partners. Local FIs are increasingly becoming more aware of the opportunities in the off-grid space, and interviews FIs revealed a willingness to participate in providing financing to the sector.

The advent of mobile money and digital financial services technologies are also driving growth in the off-grid market. In 2018, the social MFI, Wakili, began financing and distributing solar kits in rural and peri-urban areas of the country. In June 2018, the leading mobile money provider in the country, Orange, in collaboration with BBOXX, launched its OGS energy service in Doko, in the northern Kankan region of the country. The service enables households to acquire SHS on a PAYG basis through weekly, monthly or quarterly subscriptions, with monthly subscriptions starting at GNF 100,000 (USD 10). The customers make payments via the Orange mobile money platform and do not need to provide guarantees or bank accounts.[219]

3.2.4.1 Programs Supporting Financial Institutions in Off-Grid Solar Lending

- **USAID Climate Economic Analysis for Development, Investment, and Resilience (CEADIR)**

The CEADIR engagement in West Africa took place from 2016 to 2018. The program's objective was to strengthen the capacity of FIs for clean energy lending in eight West African countries (Côte d'Ivoire, Ghana, Guinea, Liberia, Niger, Nigeria, Senegal and Sierra Leone) addressing their common challenges by developing the capacity of bank staff to provide loans for various clean energy technologies and business models and adapting their support to the specific context each country. CEADIR supported local banks by delivering a national workshop on stand-alone solar and mini-grids, which was complemented with one-on-one technical assistance to help banks develop clean energy lending strategies.[220]

In Guinea, CEADIR workshops were attended by five local FIs (Afriland First Bank, Islamic Bank of Guinea, ORABANK, FiBank, and NSIA Bank). The workshops were then complemented by technical assistance tailored to the needs of each FI. Orabank received support with development of financial

[217] Ibid.
[218] "Programme d'électrification de la Guinée: Prospectus d'Investissement," Castalia Strategic Advisors, 2017.
[219] Ngounou, B., "Orange to deploy its new solar energy service in rural areas," Afrik21: Green Economy and Sustainable Growth in Africa, (July 6, 2018): https://www.afrik21.africa/en/guinea-orange-to-deploy-its-new-solar-energy-service-in-rural-areas/; and Brown, F., "France's Orange enters African off-grid solar market," PV Magazine, (March 28, 2018): https://www.pv-magazine.com/2018/03/28/frances-orange-enters-african-off-grid-solar-market/
[220] USAID CEADIR: https://www.climatelinks.org/resources/renewable-energy-lending-west-africa

products for clean energy projects. CEADIR provided training to the bank to support the integration of clean energy projects into its existing pipelines, tailoring its existing lending products/creating new products for clean energy, and properly assessing risks for potential OGS investments. CEADIR also helped the bank develop a list of sources of financing for investment in clean energy projects and identified operational solar companies for potential partnership.[221]

3.2.4.2 Key Barriers to Off-Grid Solar Lending

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

Much like other African markets, local FIs in Guinea 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 OGS risks and in structuring/developing customized products for the sector. While programs such as CEADIR have provided a level of preliminary training to participating banks, there remains a significant gap in overall local capacity. Nearly all of the interviewed FIs stressed that technical assistance would be necessary to facilitate off-grid solar lending.

- **Low Private Sector Credit**

Commercial bank credit to the private sector in Guinea remains weak and continues to constrain private sector development. Data from the 2016 World Bank Enterprise survey found that firms in the country have difficulty accessing finance.[222] Financial depth, measured by credit to the private sector to GDP, was 13% in 2016, among the lowest in Sub-Saharan Africa. The use of bank loans for working capital and investment is lower in Guinea, as the proportion of investment that is internally financed by firms is nearly 20% higher than the average in Sub-Saharan Africa. Factors contributing to the low level of private sector credit in Guinea include the crowding out effects of government borrowing from commercial banks, the modest size of the financial sector and poor bank accessibility.[223]

- **High Interest Rates and Short Tenor of Loans**

The cost of finance, as measured by interest rates, is a key indicator of how accessible finance is for private businesses. In Guinea, the cost of finance is significantly higher than other countries in the region, with the average lending interest rate reaching 22%, compared to 7% in the West African Economic and Monetary Union (WAEMU).[224] Furthermore, unlike WAEMU countries, Guinean banks do not have access to secondary market liquidity and rely almost exclusively on short-term deposits. So despite the efforts of banks to offer new financial products, they lack term-matched capital.[225] All of the interviewed FIs emphasized that in order to make OGS projects attractive, it would be necessary to access alternative funding options with low interest rate and longer tenors for on-lending to providers and end users/SMEs.

[221] "Market Assessment Report on Clean Energy: Guinea," USAID Climate Economic Analysis for Development, Investment and Resilience (CEADIR), (June 2018): https://www.climatelinks.org/resources/renewable-energy-lending-west-africa
[222] "World Bank Enterprise Surveys: Guinea Country Profile," World Bank, (2016): http://www.enterprisesurveys.org/~/media/GIAWB/EnterpriseSurveys/Documents/Profiles/English/Guinea-2016.pdf
[223] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf
[224] Ibid.
[225] "Housing Investment Landscape: Guinea," Centre for Affordable Housing Finance in Africa, (October 2018): http://housingfinanceafrica.org/app/uploads/Guinea-Housing-Investment-Landscapes-Final-October-2018.pdf

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

Historically, there has been no integrated credit scoring system in the country for lenders to identify viable enterprises. As a result, banks have had to impose stringent collateral requirements. However, with time, the new credit information system, which began operating in early 2018, is expected to support bank lending to the private sector. Yet, the fact that Guinea's collateral laws still do not permit the use of movable assets as collateral remains a challenge. Hence, all of the interviewed commercial banks underscored the need for credit guarantees to encourage lending to the space. Furthermore, mobile operators in Guinea cite the lack of reliable identification as another critical factor hindering financial inclusion and the uptake of mobile money services in the country. To address this issue, the World Bank is collaborating with EU and UNICEF to support the GoG with development of a national digital identification system.[226]

- **Foreign Exchange/Regulatory Risk**

The capital expenditure (equipment importation) of off-grid solar companies occur mostly in foreign currency, usually denominated in U.S. dollars. However, by law, Guinean banks cannot issue loans in US dollars, and thus they are only able to offer loans in local currency at local rates. This has severely constrained the importation of off-grid solar equipment and products in the country.[227]

[226] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf

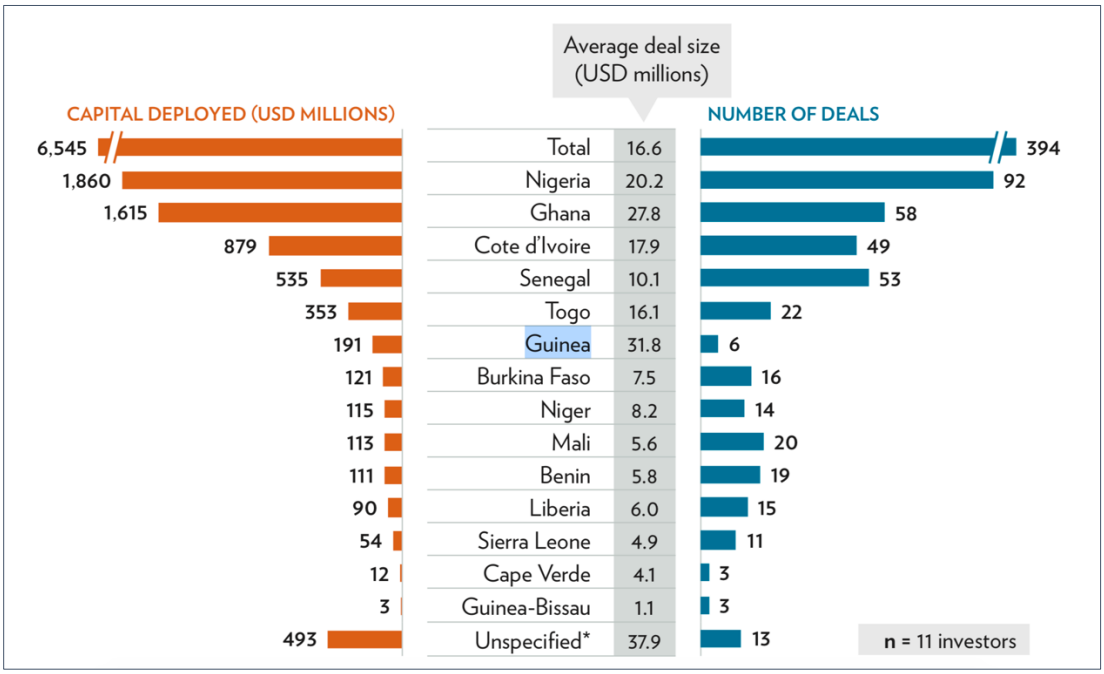
[227] "Housing Investment Landscape: Guinea," Centre for Affordable Housing Finance in Africa, (October 2018): http://housingfinanceafrica.org/app/uploads/Guinea-Housing-Investment-Landscapes-Final-October-2018.pdf

3.3 Financial Institutions[228]

3.3.1 Development Finance Institutions

Between 2005 and 2015, Guinea received a total of USD 191 million in DFI funds with an average deal size of USD 31.8 million; the amount comprised about 3% of the total DFI investment across West Africa over this period (**Figure 53**).[229]

Figure 53: DFI Investment in West African Countries, 2005-2015



Source: Global Impact Investing Network and Dahlberg

Several DFIs are active in Guinea, including AfDB, AFD/Proparco, IFC, and KFW/DEG among others. While these DFIs have regional OGS financing programs, their activity in Guinea has been largely focused on other sectors. The identified DFI programs relevant to the energy and off-grid solar sector in the country are described below.

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

The **Sustainable Energy Fund for Africa (SEFA)** is a USD 60 million multi-donor trust fund administered by the African Development Bank with the objective of supporting sustainable private sector led economic growth in African countries through the efficient utilization of clean energy resources and support small- and medium-scale renewable energy project development.[230]

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

The **Facility for Energy Inclusion (FEI)** is a USD 500 million Pan-African debt facility created by the AfDB to support the achievement of its access to energy goals by providing debt capital to SHS companies, small independent power producers and mini-grid developers. The FEI Off-Grid Energy Access Fund (OGEF), structured by Lion's Head in partnership with the Nordic Development Fund, supports transaction structuring, provides local currency options to reduce risk for borrowers and their customers, and also offers technical assistance to companies to support off-grid market development.[231] The launch of the FEI in 2016 led to a significant increase in AfDB financing for distributed renewable energy throughout Sub-Saharan Africa.[232] The FEI OGEF, which launched in 2018, will initially focus on East Africa, Côte d'Ivoire, Ghana and Nigeria.[233]

Through its **Conflict Affected States in Africa** initiative, IFC is supporting small businesses in the country by partnering with financial intermediaries to help SMEs obtain access to financing. In 2015, IFC announced its plan to invest USD 30 million in Guinea to reach more than 600 SMEs through risk sharing facilities. IFC has also provided training and capacity building to 1,000 SMEs in Guinea through its Africa Leasing Program and SME training tool IFC Business Edge.[234]

3.3.2 Microfinance Institutions

The Guinean microfinance sector is made up of 10 credit unions and financial cooperatives, nine deposit-taking MFIs and four non deposit-taking MFIs. The key stakeholders in the sector include the BCRG, National Agency for Microfinance (Agence Nationale pour la Microfinance, ANAMIF), the Professional Association of Microfinance Institutions Guinea (Association Professionnelle des Institutions de Microfinance en Guinée, APIMG), and other technical and financial partners. BCRG is responsible for supervising and monitoring the microfinance sector, while ANAMIF manages the design, implementation, monitoring and evaluation of Government microfinance policy. APIMG provides professional representation of the sector, while donors and other international development partners and organizations provide additional support.[235]

The Ebola crisis that hit Guinea in 2014 devastated the microfinance sector, particularly smaller institutions, leading to a surge in NPLs. Microfinance institutions were already facing serious challenges, including poor governance, insufficient supervision, an outdated regulatory framework, inadequate cost management and limited local technical capacity.[236] Consequently, the capital base of many MFIs in the country eroded with the solvency ratio for MFIs decreasing from 11% in 2013 to 2% in 2015.[237]

The sector rebounded with help from improved macroeconomic conditions and a series of recovery efforts. **Table 57** lists key financial indicators of the microfinance sector between 2015 and 2017**.** In 2017, the number of depositors and the borrowers increased by 2.1% and 6.7% to 218,042, and 346,961, respectively. Customer deposits also increased from GNF 280 billion (USD 3 million) in 2016 to GNF 336 billion (USD

[231] Facility for Energy Inclusion – Off-Grid Energy Access Fund: https://www.ogefafrica.com
[232] Lee, A. Doukas, A. and DeAngelis, K., "The African Development Bank and Energy Access Finance in Sub-Saharan Africa: Trends and Insights from Recent Data," Oil Change International and Friends of the Earth U.S., (November 2018): http://priceofoil.org/content/uploads/2018/11/AfDB-Energy-Access-Finance-report-high-quality.pdf
[233] "African Development Bank, Nordic Development Fund and Partners launch Off-Grid Energy Access Fund with US$ 58 million," African Development Bank Group, (August 27, 2018): https://www.afdb.org/en/news-and-events/african-development-bank-nordic-development-fund-and-partners-launch-off-grid-energy-access-fund-with-us-58-million-18432/
[234] "IFC Plans to Invest $30 Million to Support SMEs, Create Jobs in Guinea," International Finance Corporation, (26 January 2015): https://reliefweb.int/report/guinea/ifc-plans-invest-30-million-support-smes-create-jobs-guinea
[235] BCRG, 2018.
[236] "Strengthening Microfinance and Financial Inclusion in Guinea," First Initiative, https://www.firstinitiative.org/projects/strengthening-microfinance-and-financial-inclusion-guinea
[237] "Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty – Systematic Country Diagnostic," World Bank, (March 2018): http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf

37 million) in 2017, while outstanding loans came to GNF 316 billion (USD 35 million) in 2017 compared to GNF 245 billion (USD 27 million) in 2016. Yet, MFIs currently only serve a small fraction of the demand for financial services from the low-income and rural segments of Guinea's population, offering a relatively limited range of financial products.[238]

In an effort to strengthen the microfinance sector and expand financial inclusion, the GoG launched the National Financial Inclusion Strategy (Stratégie Nationale d'Inclusion Financière, SNFI). The SNFI expects to achieve the following results for the microfinance sector:[239]

- The sector penetration to increase from less than 5% to 15%
- The number of beneficiaries and borrowers to increase to 1,740,000 to 684,000, respectively
- Savings deposits and loans to increase to GNF 400 billion and GNF 650 billion, respectively
- Portfolio at risk (90 days) shall not exceed 5%
- Two-thirds of the MFIs will have an Operational Self Sufficiency (OSS) of at least 100%

Table 57: Microfinance Sector Financial Indicators

Indicator	2015	2016	2017
Credit Unions and Financial Cooperatives			
Number of institutions	11	11	10
Number of branches	51	90	90
Number of branches in the three largest cities	27	51	51
Number of depositors	107,247	134,542	134,980
Number of deposit accounts	108,462	117,886	118,438
Number of borrowers	13,133	23,203	23,316
Number of loan accounts	13,138	21,969	22,083
Outstanding deposits	GNF 54 billion	GNF 73.8 billion	GNF 73.8 billion
Outstanding loans	GNF 33 billion	GNF 67.6 billion	GNF 67.7 billion
Deposit-taking MFIs			
Number of institutions	6	6	9
Number of branches	209	220	224
Number of branches in the three largest cities	112	122	123
Number of depositors	89,302	78,992	83,062
Number of deposit accounts	97,176	85,488	90,259
Number of borrowers	264,639	299,431	321,075
Number of loan accounts	311,732	335,800	359,135
Outstanding deposits	GNF 170.5 billion	GNF 217.6 billion	GNF 220.4 billion
Outstanding loans	GNF 130 billion	GNF 307.3 billion	GNF 191.8 billion
Non-deposit-taking MFIs			
Number of institutions	3	3	4
Number of branches	7	7	7
Number of branches in the three largest cities	3	3	3
Number of depositors	0	0	0
Number of deposit accounts	0	0	0
Number of borrowers	2,244	2,420	2,570
Number of loan accounts	2,244	2,420	2,570
Outstanding deposits	0	0	0
Outstanding loans	GNF 10.7 billion	GNF 6.4 billion	GNF 7.5 billion

Source: BCRG

[238] BCRD, 2018; and
"Trade Policy Review: Republic of Guinea," World Trade Organization, Document WT/TPR/S/370/Rev 1. (September 2018).
[239] BCRG, April 2018.

3.3.3 Informal Financial Institutions

A 2017 World Bank study found that 38% of adults in Africa had borrowed money from an informal FI as opposed to 5% who borrowed from a formal FI. Although informal borrowing occurs at different rates across Africa, roughly 100 million adults in Sub-Saharan Africa use informal sources of finance.[240] The informal financial sector often serves as a major source of savings and credit services for women, the low-income population and others who lack access to formal institutions. Informal financial institutions typically include individual money lenders as well as collective entities such as Rotating Savings and Credit Associations and Accumulated Savings and Credit Associations, among other groups.[241]

Much like other African states, informal financial services are widely available in Guinea (**Figure 54**). Data from this sector remains limited, largely due to the informal nature of these institutions, which does not facilitate access to information on their practices, cost standards and transaction levels. The overall lack of geographic coverage by FIs in rural areas of the country means that a significant portion of the rural population either relies exclusively on informal sources of finance at the community level or utilizes a combination of informal and formal credit and savings methods.

3.3.4 Crowd Funders

Crowdfunding in Guinea has been limited. Although the demand for capital continues to grow, crowdfunding remains a challenging source of financing for SMEs. Across Africa as a whole, crowdfunding amounted to USD 70 million in 2015 – less than 1% of global crowdfunding.[242] Moreover, roughly 75% of the capital raised by African start-up companies in 2017 was raised in Kenya, Nigeria, and South Africa.[243] Additionally, unlike most emerging markets, countries in West Africa and the Sahel do not have regulatory frameworks in place to offer protection to investors, which discourages potential investment. The following crowd-finding platforms have been identified in Guinea:

- In 2019, BBOXX and Trine raised EUR 6 million in funding – in what is the largest crowd-funded debt raise in the history of solar energy in Africa to date. The collaboration between Trine and BBOXX will accelerate BBOXX's installation of pay-as-you-go solar home systems in Kenya, Rwanda, Togo, the Democratic Republic of Congo, Mali, Senegal and **Guinea**.[244]

- Syli Solaire, a local start-up, launched a crowdfunding campaign on Indigogo in 2016 to raise USD 30,000 for the purchase of solar kits and subsequent distribution to off-grid households in Guinea on a lease-to-own basis. It was only able to raise USD 1,530 of its goal.[245]

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

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

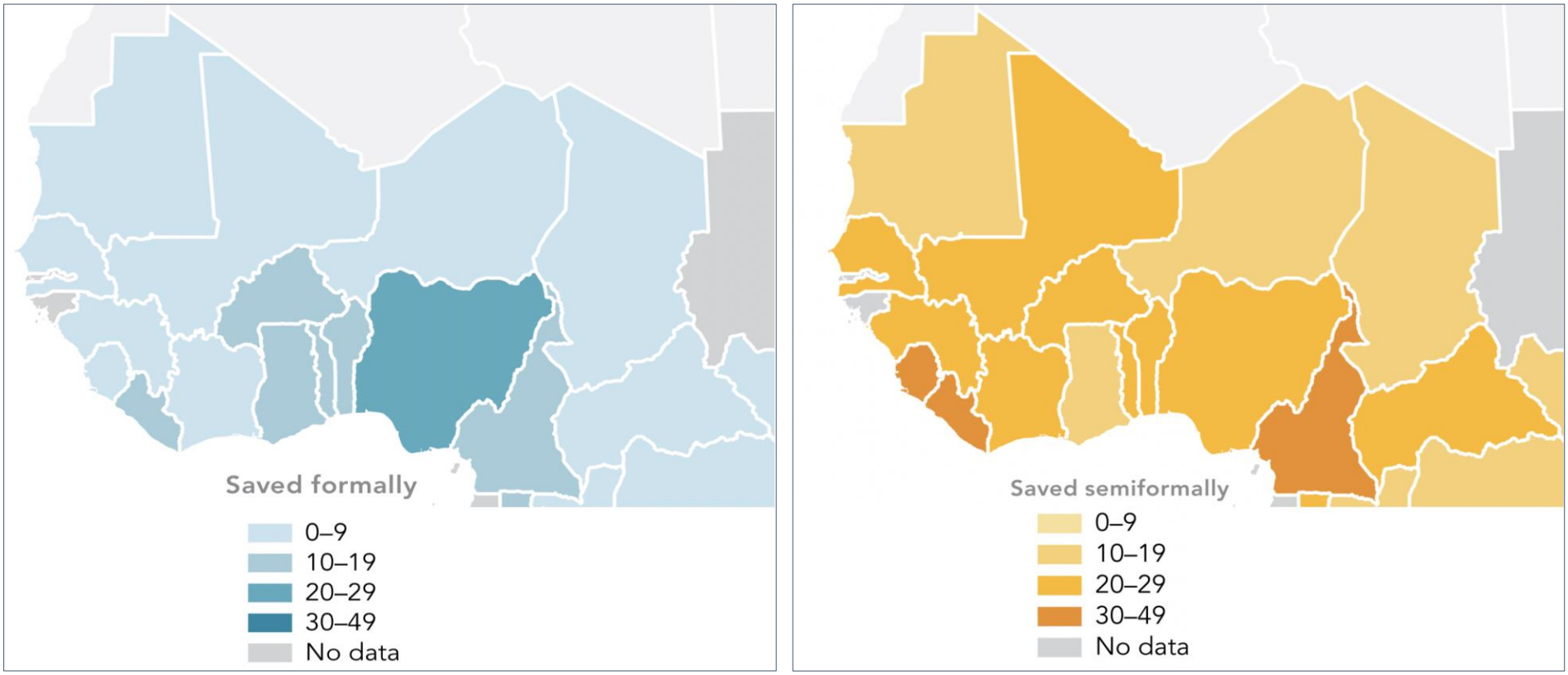
[242] "Crowdfunding in Emerging Markets: Lessons from East African Startups," World Bank (2015): https://www.infodev.org/infodev-files/crowdfunding-in-east-africa.pdf

[243] Disrupt Africa: https://www.siliconcape.com/disrupt-africa-funding-report-2017/

[244] "BBOXX / Trine Crowdfunding Initiative Hits Milestone," Alternative Energy Africa, (March 5, 2019): https://ae-africa.com/read_article.php?NID=9848

[245] Syli Solaire: https://www.indiegogo.com/projects/syli-solaire-solar-power-for-guinea-light/#/

Figure 54: Share of Adults Saving in the Past Year (%), 2017[246]



NOTE: Maps exclude Cabo Verde (no data)

Source: World Bank Global Findex Database

Figure 54 shows how the savings behavior of adults varies in West Africa and the Sahel. The shade of the country corresponds to the magnitude of the indicator; the darker the shade, the higher the value. Saving semi-formally is much more common than saving formally across the region, including in Guinea.

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

3.4 Summary of Findings

- **Opportunity for ROGEP Credit Lines**: The Guinean banking sector remains characterized by low levels of private sector credit mainly due to increase in government borrowing. Furthermore, local banks in Guinea are not allowed by the BCRG to issue loans denominated in US dollars. However, local currency cost of capital remains so high for banks that average pricing for loans remain as high as 22%. In addition, loans are typically short-term as the banks rely heavily on short-term customer deposits. This severely constrains OGS market growth. Yet, taking up hard currency denominated credit lines presents severe challenges for local lenders in Guinea who would have to bear the FX risk. When pricing in a hedge to cover this risk, most hard currency denominated credit lines become unattractive because the all-in cost of capital to the FI becomes too high to provide a competitive offer to borrowers. As a result, interviewed FIs stressed the need to access alternative funding options with low interest rates and longer tenors for on-lending to the off-grid market. Stakeholder interviews suggested that there is a potential for ROGEP to place as much as USD 80 million in credit lines if priced reasonably. Hard currency denominated lines of credit would need to be offered at deeply concessional pricing in the range of 1-6% with tenors of 3-7 years in order to be widely accepted by FIs operating in the market.

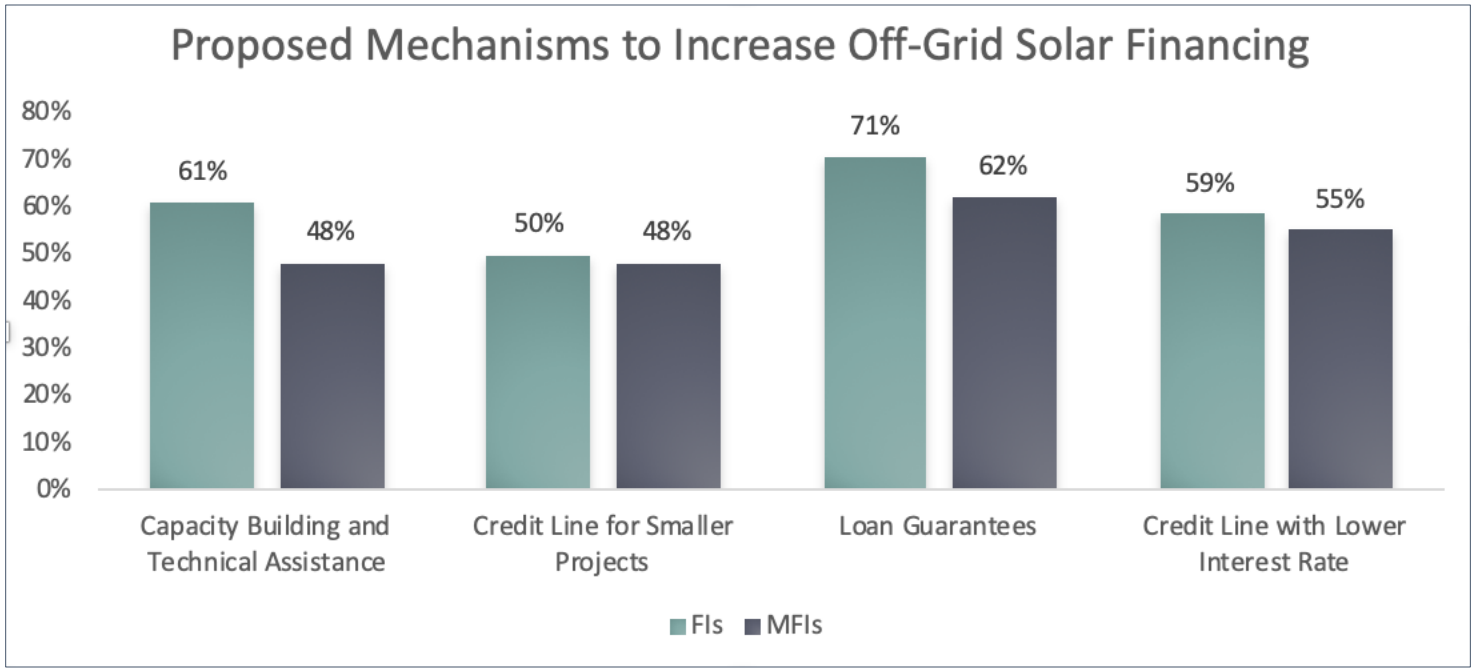
- **Collateral Requirements**: Commercial banks in Guinea have high collateral requirements of over 100% and are thus deeply constrained from originating OGS loans, as most local companies cannot meet these requirements. Therefore, the use of third-party *pari-passu* guarantees as an alternative form of collateral would be crucial in enabling the banks to extend loans to borrowers without sufficient acceptable collateral. Accordingly, most of the interviewed FIs 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 most 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**: Due to high level of NPLs, Guinean banks show reluctance in lending to local businesses in general. While some banks have engaged in the OGS space, most Guinean FIs remain cautious of lending to this sector due to high perceived risk. In order to attract lenders to this market segment, there is a need for reasonably priced credit enhancement mechanisms. To cover these "market entry" risks for lenders that are unwilling to enter the market, guarantee instruments that cover first loss are needed. However, first-loss coverage does not address the key issue of collateral and is therefore likely insufficient on its own to stimulate growth in FI engagement unless it is coupled with third-party guarantee coverage.

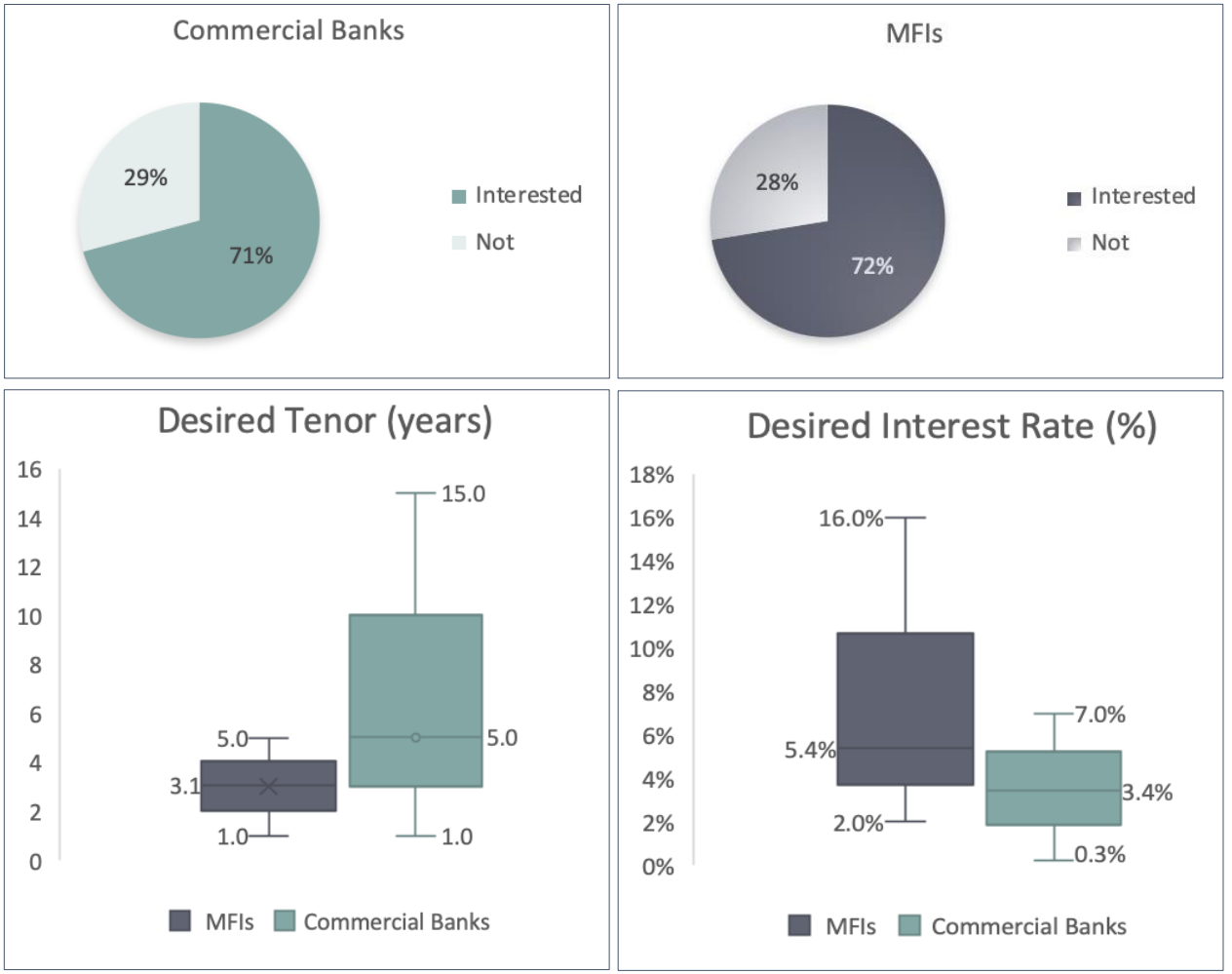
- **Technical Assistance**: A well designed TA intervention is just as important as reasonably priced credit lines and credit enhancements in accelerating OGS lending in Guinea. All of the interviewed FIs emphasized the need for TA in various forms and about half are willing to cover a portion of the costs of training. The recommended key areas of focus include: training of bank credit departments 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; consumer education and marketing; and support with product structuring and development as well as building deal flow. The TA intervention should build upon previous programs such as USAID CEADIR. Special attention should also be paid to offering advisory services on the side of the stand-alone solar enterprises. Lenders opine that these entrepreneurs often do not have proper financial management and accounting systems in place, are unable to present quality financial models, and lack the expertise required to structure their companies to take on debt obligations.

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

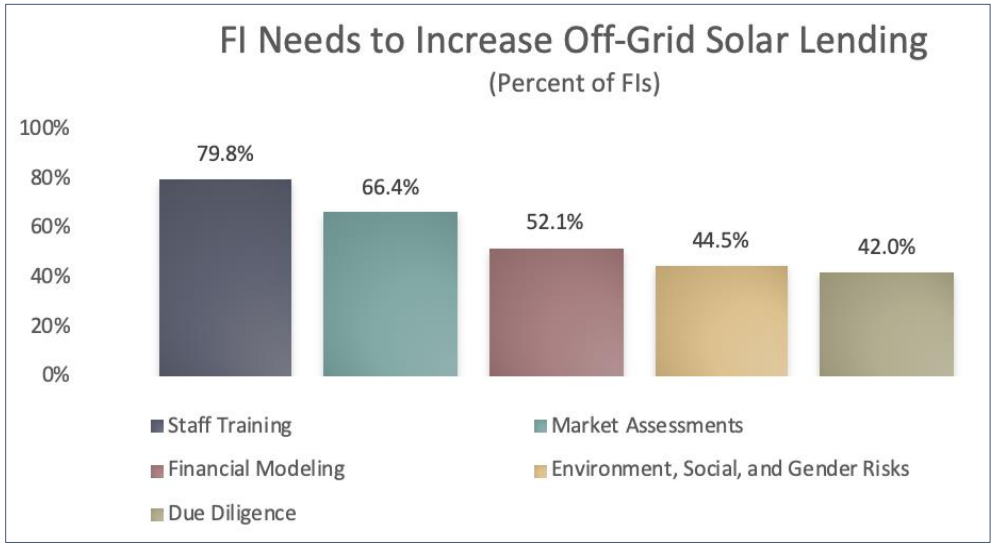
Key findings from the Task 3 FI survey activity are presented below. The results are based on feedback from a total of 121 FIs (including commercial banks, microfinance institutions and other non-bank FIs) that were interviewed across the 19 ROGEP countries. This summary only focuses on responses from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



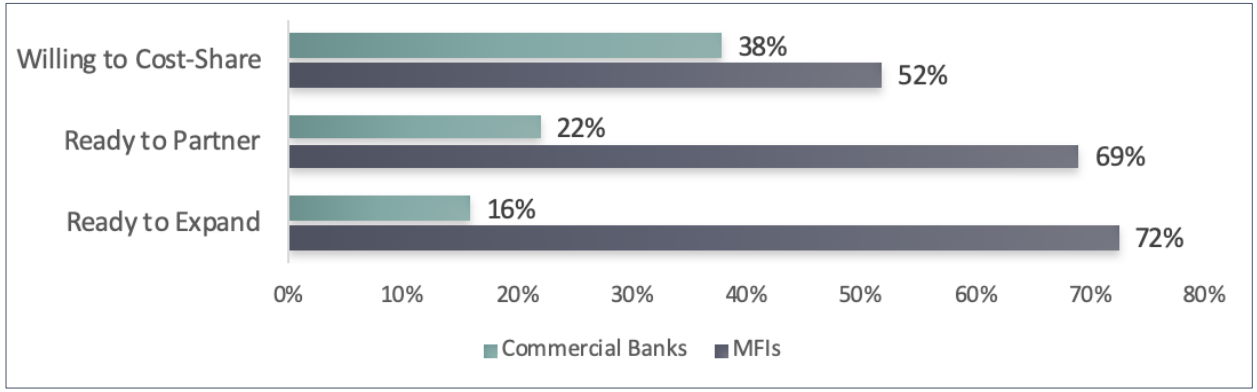
According to the survey, there is strong financial-sector interest across ROGEP countries to finance renewable energy projects, especially in off-grid solar. Commercial banks and MFIs identified loan guarantees as the most important measure that could improve their capacity to lend to the renewable energy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



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



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



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

ANNEX 1: TASK 1 METHODOLOGY

STATE OF ENERGY ACCESS AND ENABLING MARKET ENVIRONMENT

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

GIS DATA ANALYSIS APPROACH / METHODOLOGY

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

The main steps of the GIS analysis are as follows:
(i) Categorization/definition of settlements: scenario 2023;
(ii) Categorization/definition of settlements: scenario 2030;
(iii) Definition of un-electrified settlements within grid areas; and
(iv) Determination of population per settlement

1.1. Categorization/definition of settlements: Scenario 2023

1.1.1. *Electrification by grid extension* – settlements which are located within 5 km of the current electrical grid network[247] (according to WAPP densification plans).

1.1.2. *Electrification by mini-grid* – settlements that:
- Are located within 15 km of areas that have a high night-lights value (above 50/225 on grayscale raster)[248] and outside the buffer area established for the electrification by grid extension
- Are located within areas that have a population density of more than 350 people per km^2 (as defined by Eurostat for rural areas)[249], plus an additional 50 people per km^2 for greater feasibility of mini-grids[250] and are within 1 km[251] of a social facility (education center or health facility) and existing mini-grids of 2018.

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

1.2. Categorization/definition of settlements: Scenario 2030

1.2.1. *Electrification by grid extension* – settlements which are located within 50 km of the current electrical grid network (according to Electricité de Guinée (EDG) in a personal interview) or within 20 km of planned future line extensions[252]

[247] NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)
[248] The 50/225 classification represents the areas emitting light of the country with reduction of scattering light. The classification was first introduced in the USAID report ZAMBIA ELECTRIFICATION GEOSPATIAL MODEL and evaluated in cross-checks throughout the country. USAID: https://pdf.usaid.gov/pdf_docs/PA00T2JC.pdf
[249] http://ec.europa.eu/eurostat/web/rural-development/methodology accessed on 8/8/2018.
[250] Identified in discussions with different international mini-grid developer.
[251] Preferred maximum distance for mini-grids from discussions with different international developer.
[252] NOTE: Low-voltage distribution lines were not considered in this analysis (data was unavailable)

1.2.2. *Electrification by mini-grid* – settlements that:
- Were defined as mini-grid settlements in scenario 2023
- Are located within 1 km of the above mini-grid settlements, which is the preferred distance of mini-grid developers for their grid according to discussions with several international developers.
- Are located within 15 km of economic growth centers – airports and urban areas; average worker distance in Africa is 10 km, a distance of 5 km is added to include the growth of businesses in the periphery of the growth centers.[253]

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

1.3. Definition of un-electrified settlements within grid areas

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

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

1.4. Determination of population per settlement

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

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

"New data sources and recent methodological advances made by the WorldPop program now provide high resolution, open and contemporary data on human population distributions, allowing accurate measurement of local population distributions, compositions, characteristics, growth and dynamics, across national and regional scales. Statistical assessments suggest that the resultant maps are consistently more accurate than existing population map products, as well as the simple gridding of census data." [254]

A Voronoi polygon analysis[255] was used to create boundaries for each settlement. These boundaries were then used in combination with a population density layer to estimate total settlement population of the given year. The current annual national population growth rate of 2.6%[256] was applied to the geospatial analysis to project populations for scenario 2023 and 2030 analyses.

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

2. Summary of Key Datasets

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

Overview of Key Datasets of the Least-Cost Electrification Analysis								
Dataset	Description	Criteria used by technology						Source and Year
		Scenario 2023			Scenario 2030			
		On-grid	Mini-grid	Off-grid	On-grid	Mini-grid	Off-grid	
Electricity grid network (current)	Current national grid network (HV & MV lines)	≤ 20km distance	≥ 20km distance	≥ 20km distance	≤ 50km distance	≥ 50km distance	≥ 50km distance	SIE, 2018[257]
Electricity grid network (planned)	Future network planned to be built (HV lines)	Not considered	Not considered	Not considered	≤ 20km distance	≥ 20km distance	≥ 20km distance	SIE, 2018[258]
Mini-grids	Existing mini-grids in 2018	Not considered	≤ 1km distance	≥ 1km distance	Not considered	≤ 1km distance from all identified mini-grids in Scenario 2023	≥ 1km distance from all identified mini-grids in Scenario 2023	ECOWREX, 2018[259]
Night-lights	Night-time light emissions used to identify electrified areas	Not considered	≤ 15km distance	≥ 15km distance	Not considered	Not considered	Not considered	NASA Earth Observatory, 2016
Population density	Population distribution in people per km^2.	≥ 350 people per km^2 [260]	≥ 350 people per km^2	≤ 350 people per km^2	Not considered	Not considered	Not considered	WorldPop, 2014
Settlements	Settlement layer giving location of settlements across Guinea (cities, towns, villages)	Used	Used	Used	Used	Used	Used	SIE, 2018[261]

[257] Data shared in geospatial format by SIE Guinea.
[258] Ibid.
[259] http://www.ecowrex.org/mapView/index.php?lang=eng
[260] Based on Eurostat definition plus an additional 50 people per km2 for greater feasibility of mini-grids as identified in discussions with different international mini-grid developer. Source: http://ec.europa.eu/eurostat/web/rural-development/methodology
[261] Data collected in July 2018; the date of producing the data is unknown

Social facility: education centers	Primary schools; Indicator of active local economy	Not considered	≤ 1km distance[262]	≥ 1km distance	Not considered	Not considered	Not considered	USAID, 2015[263]
Social facility: health centers	Hospitals and health centers as collected by the Standby Task Force; Indicator of active local economy	Not considered	≤ 1km distance[264]	≥ 1km distance	Not considered	Not considered	Not considered	Humanitarian Data Exchange (HDX), 2015
Growth center: airport, urban areas	Economic growth centers for the analysis up to 2030; Urban areas as defined by Electricity Demand	Not used	Not used	Not used	Not considered	≤ 15km distance	≥ 15km distance	airports: SIE, 2018 urban areas: ECOWREX website, 2015[265]

[262] Preferred maximum distance for mini-grids from discussions with different international developer.
[263] https://catalog.data.gov/dataset/guinea-wadc00257-cod-primary-schools
[264] Preferred maximum distance for mini-grids from discussions with different international developer.
[265] http://www.ecowrex.org/mapView/index.php?lang=eng

ANNEX 2: TASK 2 METHODOLOGY

OFF-GRID SOLAR PV MARKET ASSESSMENT METHODOLOGY

Focus Group Discussions (FGDs) were held in Conakry, Kindia and Labé 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,[266] multiplied by electricity access rates from the International Energy Agency (IEA),[267] 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.

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

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

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

1.2 Household energy expenditure and potential savings

1.2.1 Current household expenditure on energy-related items (believed to be candidates for replacement with solar products) was estimated using information from the Focus Group Discussions (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 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 TV	-	-	1	-
Small Generator	-	-	-	1

- Numbers of units of torch lights/lanterns, cell phones, dc radio, dc TV 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 Guinea, 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%	15%
Fourth 20%	90%
Third 20%	95%
Second 20%	100%
Lowest 20%	100%

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

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

Average rural household expenditure on energy varies considerably. A study from Sierra Leone found that the "cost of lighting, on average, occupied between 10-15% of household incomes. Households using generators were found to spend a greater proportion of their income (upward of 20%) on lighting."[268] Other research has shown household energy spending between 6-12% for low income segments in sub-Saharan Africa.[269] 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:

[268] 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).
[269] 10% is an acceptable figure for lighting and cell phone charging costs for low income groups. See: https://www.brookings.edu/blog/africa-in-focus/2017/03/17/figures-of-the-week-benefits-of-off-grid-electricity-solutions/

- **Tier 0**: Assumed to be an absolute energy poor household, relying solely on kerosene and charcoal both for cooking and lighting.
- **Tier 1**: The household was assumed to have access to 1 torch light/lantern powered by dry cells, charging services for a phone charged on average 8 times a month.
- **Tier 1.5**: The household was assumed to have access to 1 torch light and 1 lantern each powered by dry cells, one regular cell phone charged on average 8 times a month, and a radio powered by dry cells (assume access to 2 low quality cells) replaced 4 times a month.
- **Tier 2**: The household was assumed to have access to 1 torch light and 2 lanterns each powered by dry cells, one regular cell phone charged on average 8 times a month, and one smart phone charged on average 16 times a month, a DC TV powered by lead acid battery recharged once per week.
- **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 Guinea, 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 30% p.a., based on the interest rate charged on housing loans by COFINA, a Microfinance Institution in Guinea.[270]

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

1. The GIS analysis[271] estimates that by 2023, 35.5% of the population will be grid connected, 15.5% will be connected by mini-grids while 48.9% of the population will be connected by off-grid stand-alone solutions. By 2030, the GIS analysis estimates that 82.8% of the population will be grid connected, 2.6% will be connected by mini-grids while only 14.6% 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

[270] http://housingfinanceafrica.org/app/uploads/Guinea-Housing-Investment-Landscapes-Final-October-2018.pdf
[271] See Annex 1 for GIS methodology

priority due to their relatively higher power demand and ability to pay for power consumption. Hence, the highest quintile was assumed to have only 1% off-grid households, while the second highest quintile was assumed to have 2% off-grid households with the third quintile having 43% off-grid households. It is also assumed that almost all households in the bottom two quintiles remain off-grid. These assumptions have been made such that the total number of off-grid households assumed is equal to the GIS data 2023 estimate.

- Similarly, in the 2030 scenario, it was assumed that the higher income quintiles will be prioritized for electrification, based on economic considerations, above the lower quintiles. Hence, the highest four quintiles were assumed to have only 1%, 2%, 3%, and 4% off-grid households respectively, while the lowest quintile was assumed to have 63% off-grid households. These assumptions have been made such that the total number of off-grid households assumed is equal to the GIS data 2030 estimate.

Quintile	% Off-Grid (2023)	% Off-Grid (2030)
Highest 20%	1%	1%
Fourth 20%	2%	2%
Third 20%	43%	3%
Second 20%	99%	4%
Lowest 20%	100%	63%

2. Inflation rates for Guinea: According to the IMF World Economic Outlook data, inflation in Guinea is estimated to be at 7.8% 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 1.078.

3. Based on a 2.6% population growth rate from the World Bank[272] and the population density dataset used in the study, the estimated total population will be 15,009,964 in 2023 and 17,964,336 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 44.0% in 2023 and 84.3% in 2030.

5. To estimate GDP, it was assumed that the current annual GDP growth rate of 6.4% will be maintained through 2023 and 2030:

Parameter	2023	2030
Population	15,009,963.55 (GIS estimate)	17,964,335.74 (GIS estimate)
GDP (constant 2010 USD)	$15,808,973,186	$24,405,912,986

6. According to the Lighting Global Off-Grid Solar Market Trends Report 2018,[273] 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,

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

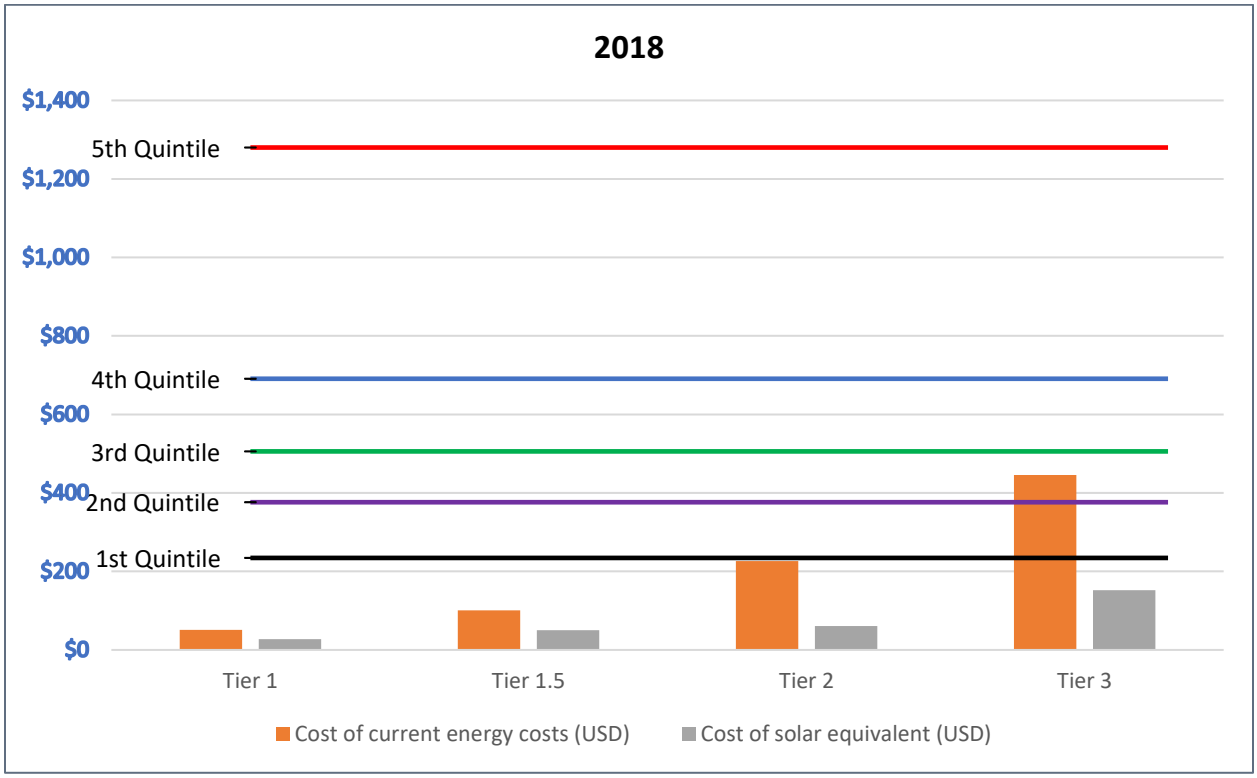
[273] "Off-Grid Solar Market Trends Report 2018," Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, (January 2018): https://www.lightingafrica.org/wp-content/uploads/2018/02/2018_Off_Grid_Solar_Market_Trends_Report_Full.pdf

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 Guinea will stagnate at the current rate of 30% or possibly decline.

Household Cost Savings and Affordability Calculation

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



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

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

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

2. INSTITUTIONAL DEMAND

2.1 Country Categorization

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

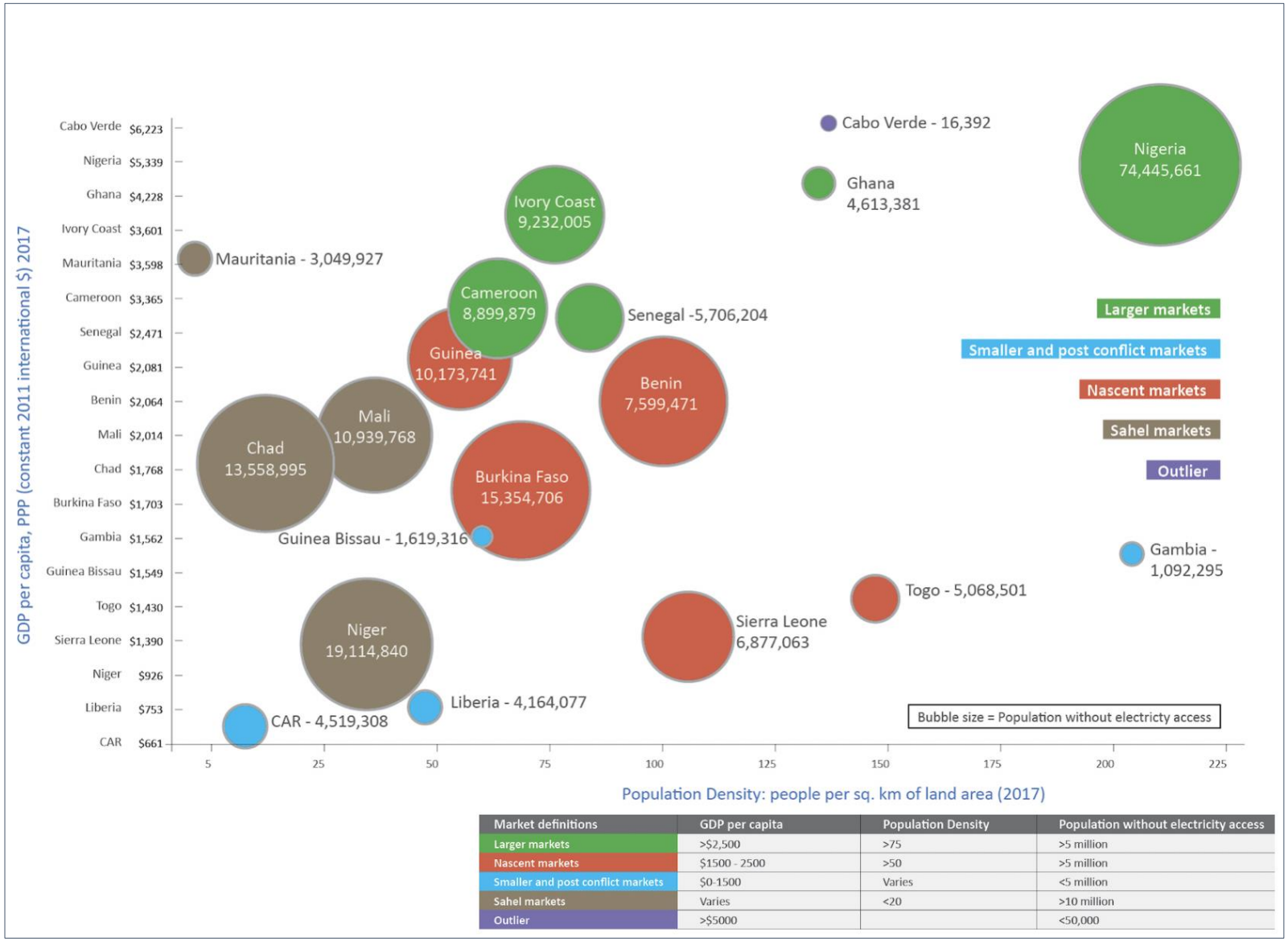
Country Categorization by Income and Population Density			
Category 1: Low-income / low population density	**Category 2:** Low-income / high population density	**Category 3:** High-income/ low population density	**Category 4:** High-income / high population density
Niger Burkina Faso Chad Mali Guinea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

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

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

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

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



Market definitions	GDP per capita	Population Density	Population without electricity access
Larger markets	>$2,500	>75	>5 million
Nascent markets	$1500 - 2500	>50	>5 million
Smaller and post conflict markets	$0-1500	Varies	<5 million
Sahel markets	Varies	<20	>10 million
Outlier	>$5000		<50,000

Source: African Solar Designs analysis

2.2 Energy Needs by Institutional Market Segment

Institutional Sector	Description	Rating (W)	Time of use (hrs)	Total Wh/day	Total Load	Recommended system (W)
Water Pumping						
Low power		1,500	6	9,000		1,500
Medium power		4,000	6	24,000		4,000
High power		10,000	6	60,000		10,000
Healthcare						
HC1 Health post	Lighting	30	8	240		
	Communication	20	8	160		
	ICT	100	8	800	1,200	250
HC2 Basic healthcare facility	Lighting	200	8	1,600		
	Maternity	200	4	800		
	Vaccine refrigeration	100	8	800		
	Communication	100	4	400		
	Medical exams	200	2	400		
	ICT	200	8	1,600		
	Staff housing	50	8	400	6,000	1,500
HC3 Enhanced healthcare facility	Lighting	400	8	3,200		
	Communication	200	8	1,600		
	Medical exams	600	2	1,200		
	ICT	300	8	2,400		
	Maternity	600	4	2,400		
	Laboratory	1,000	2	2,000		
	Sterilization	1,200	1	1,200		
	Vaccine refrigeration	150	8	1,200		
	Staff housing	200	8	1,600	16,800	4,200
Education						
Primary school	Communication	20	8	160		
	Lighting	80	8	640		
	ICT	100	8	800		
	Staff house	50	8	400	2,000	500
Secondary school	Communication	20	8	160		
	Lighting	240	8	1,920		
	ICT	400	8	3,200		
	Laboratory use	100	8	800		
	Staff house	200	8	1,600	7,680	1,920
Public Lighting						
Street lighting	Lights	200	8	1,600	1,600	500

Source: The estimates in the table above are based on data obtained from local experts, interviews with solar industry stakeholders and corroborated by secondary desk research.

CALCULATIONS: Rating of systems is based on data for sizes of the appliances from a 2016 GIZ solar PV catalogue.[274] The solar PV sizing factor is based on the peak sun hours available across most of Africa.

[274] "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[275]	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

[275] 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	X		X		=	Estimated Annualized Off-Grid Solar Market Potential for Healthcare Sector
HC 1		Cost per tier 3 system ($625)		Divided by system lifetime of 5 years		
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	X		X		=	Estimated Annualized Off-Grid Solar Market Potential for Education Sector
Primary		Size of solar system in Watts (500W)		Cost per watt ($3) divided by system lifetime of 20 years		
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

GUINEA			
Water Supply	**Healthcare**	**Education**	**Public Lighting**
Per capita assumption	GIS data	GIS data	Per capita assumption

Data was collected on the total number of off-grid institutions by institutional market segment for Guinea from a combination of available GIS data, local expert input, 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:[276]

- Primary school: Per capita calculation using the off-grid population that is 0-14 years
- Secondary school: Per capita calculation using the off-grid population that is 15-19 years

Public lighting: Using population figures by region, and assuming that the population per market center was 5,000 people, the number of market centers was calculated. An assumption of two [2] public lighting points per market center was used in the calculation. No data on street lighting was included, as it was assumed that street lighting projects are linked to road infrastructure rather than institutions.

2.5 Ability to Pay Analysis (Strongest Potential Market Segment)

Data was not available to estimate the monthly energy expenditures of institutional users. Secondary data was available through government and donor program annual budgets for public services but was not comprehensive. A rudimentary analysis was undertaken based on these funding sources and compared to the total solar product market estimate for each institutional market segment in order to discuss the realistic potential market outlook based on the ability to pay. Due to a lack of data, the analysis was not able to take into account other potential sources of funding, such as funds pooled at the national or local level, fees for services etc.

[276] 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[277]	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)[278]	X 25%	=	Smallholder Irrigation Potential (hectare)[279]	Divided by 0.3[280]	=	Estimated No. of Smallholder Farms Suitable for Solar Irrigation	X	$650 (cost of solar pumping kit)[281]	Divided by 6 year (life of system)	=	Estimated Annualized Off-Grid Solar Market Potential for irrigation

Methodology for identifying areas suitable for irrigation activities on farms:

The areas for potential irrigation activities were calculated using the visible cropland[282] adjacent to permanent surface water sources. As identified by experts in a study in Zambia[283] and based on other expert consultations, beyond a 5 km distance from surface water, the returns are not economically feasible. **Figure 31** is a map of the cropland within a 5 km distance from permanent surface water.

[277] "MSME Finance Gap," SME Finance Forum: https://www.smefinanceforum.org/data-sites/msme-finance-gap
[278] AQUASTAT – Food and Agriculture Organization: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en
[279] 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
[280] 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/
[281] 120W solar pumping kit: https://futurepump.com/futures-bright-farmers-kenya/
[282] "Prototype Land Cover Map over Africa at 20m Released," Esa, (February 2018): https://www.esa-landcover-cci.org/?q=node/187
[283] "Zambia Electrification Geospatial Model," USAID and Power Africa, (April 2018): https://pdf.usaid.gov/pdf_docs/PA00T2JC.pdf

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.

Value-Added PUE Applications – Solar Milling													
Cereals, roots tuber crops (tons)[284]	X	70%[285]	X	50%[286]	=	Smallholder Milling Potential (tons)	Divided by 2 tons per day X 70% capacity factor[287]	=	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[288]	X	5,500 W[289]	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).

[284] Food and Agriculture Organization: http://www.fao.org/faostat/en/#data/RF
[285] Assumption that 70% of crops are milled
[286] Assumption that 50% of milled crops are processed at smallholder farmer level
[287] 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/
[288] https://www.citypopulation.de
[289] 5.5kW solar powered refrigeration system – *See*: https://www.deutschland.de/en/solar-powered-coldhubs-nigeria

Mobile Phone Charging Enterprises							
# of Mobile Phone Subscribers in 2017[290]	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

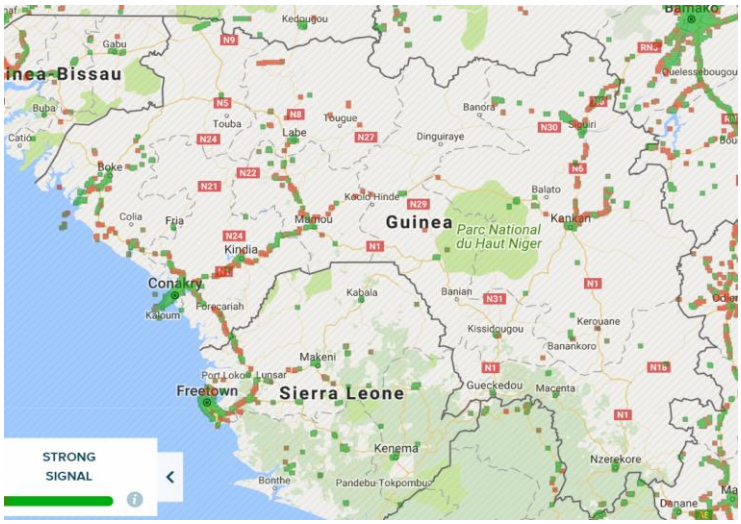
* Indicative Costs for Phone Charging Appliances[291]

Charging Stations	Cost (USD)	Manufacturer
Charging ECOBOXX Qube (sizes - 50) 5Wp panel	$83	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Charging ECOBOXX Qube (sizes - 90) 10Wp panel	$205	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Charging ECOBOXX Qube (sizes - 160) 2*10Wp panel	$209	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station ECOBOXX 300	$681	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station ECOBOXX 600	$965	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable Charging Station ECOBOXX 1500	$1,532	EcoBoxx/ Sungrid Group (PTY) LTD South Africa
Portable charging station BOSS Kit Portable	$3,025	Phaesun GmbH
Charging Sundaya Charging Station	$193	Sundaya
Average Cost	**$862**	

Source: GIZ and African Solar Designs analysis

Identifying areas of phone network coverage

The mobile phone network geographic coverage was mapped across each country (**Figure 33**). The source for this data is GSMA, which gives a radius ranging between 2-30 km. The radius is affected by a number of variables including tower height, power output, frequencies in use, and antenna type. Since this does not indicate the quality of network, the data was compared with data from OpenSignal, which tracks the signal from users registered on the platform.



Green: Strong Signal (>-85dBm)
Red: Weak Signal (<-99dBm)
Source: Open Data Signal

[290] "The Mobile Economy, Sub-Saharan Africa," GSMA Intelligence, (2017): https://www.gsmaintelligence.com/research/?file=7bf3592e6d750144e58d9dcfac6adfab&download

[291] "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 Conakry, Kindia and Labé in June 2018
- Survey of 14 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 Guinea is included below:

1	ARD Equipment
2	Batanko & Frères
3	BB et Fils
4	Bilaré Solar Technologies
5	Cebel Solaire
6	Doumbouya Solar Electric
7	EAK Energy
8	EG Fimme
9	EDPD
10	Elsa
11	Ets Bah Mamadou Bhoye & Fils
12	Ets Kamab
14	JSF
15	Kamab
16	M-Power Engineering
17	Optimum Energy
18	Rkomp
19	Satech Guinée
20	Sines
21	SODEPER
22	SOGER-Guinée
23	Société JSF Energy de Guinée
24	Solar Attitude
25	Solar Guinée
26	Solec Energy
27	2HK Energie
28	Volt In Motion
29	Yandalux /BMCIP
30	Woco Solar

Source: ECREEE, Focus Group Discussions; Stakeholder interviews

ANNEX 3: TASK 3 METHODOLOGY

FINANCIAL INSTITUTION ASSESSMENT

Data collection under Task 3 included a combination of desk research, collaboration with local experts, and extensive stakeholder engagement with key officials and representatives from local and regional commercial banks, microfinance institutions and other development banks and agencies in Guinea. 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.[292]

The questionnaire that was administered to FIs in the country and across the ROGEP region is included below.[293] 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?

[292] The results of this assessment and corresponding recommendations were prepared for ECREEE in a separate, confidential report.
[293] The survey was adapted based on the type of FI that was being interviewed (commercial banks, MFIs, Regional Development Banks)

- Is the bank interested to explore a credit line with ROGEP? What size of credit line would the bank be 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.[294] 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.[295]

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.[296] 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.[297] 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.[298]

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).[299] 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).

[294] "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

[295] 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

[296] "Situation Analysis of Energy and Gender Issues in ECOWAS Member States," ECREEE and National Renewable Energy Laboratory, (2015): https://www.seforall.org/sites/default/files/Situation-Analysis-of-Energy-and-Gender-Issues.pdf

[297] Ibid.

[298] "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/

[299] "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 in Conakry, Kindia and Labé to share their insights and inform the overall market study. A gender questionnaire was also distributed to key stakeholders in Guinea 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

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[300] (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 (existence of 'gender units' in public agencies and/or 'gender audits' in energy sector?

2. Gender Profile

2.1 The state of gender equality in Guinea

Structural inequalities and gender discrimination against women and girls persist in Guinea, as inclusive participation remains an ongoing challenge. The gender assessment found that while there have been modest improvements in recent years to certain social indicators such as access to education and healthcare services, gender disparities still exist across the economy, particularly in access to resources, higher education, land ownership, and inheritance systems, political power and decision-making. These findings are largely supported by UNDP Human Development Index (HDI) rankings, as Guinea is in the low human development category in the global index.[301]

2.2 Gender and Poverty

Despite improvements over the course of the last two decades, poverty remains widespread in Guinea, particularly in rural areas where a large share of the country's poor population lives. It is estimated that more than 50% of the population lives below the poverty line, with less than 2 USD of income per day.[302] According to UNDP statistics, 69% of the labor force is considered working poor at PPP USD 3.10/day.[303] Although women's level of participation in the economy is growing, they still lag behind men.

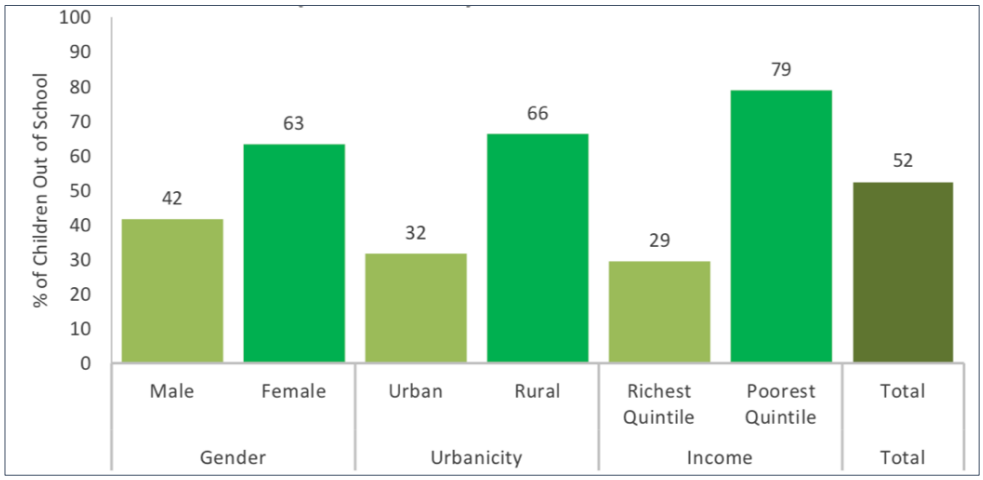
2.3 Gender, Human Capital and Economic Empowerment

2.3.1 Education, Skills Development and Training

Guinea has achieved gender parity in rates of access to primary education. Despite this progress, female access to and rates of enrollment in higher education in Guinea remain low compared to men. In 2014, 63% of female youth of secondary school age (13-19) were out of school compared to 42% of male youth the same age.[304] This trend remains consistent in literacy rates among Guinea's youth and adult populations, as just 12% of the country's female adult population is literate, compared to 37% of the adult male population.[305]

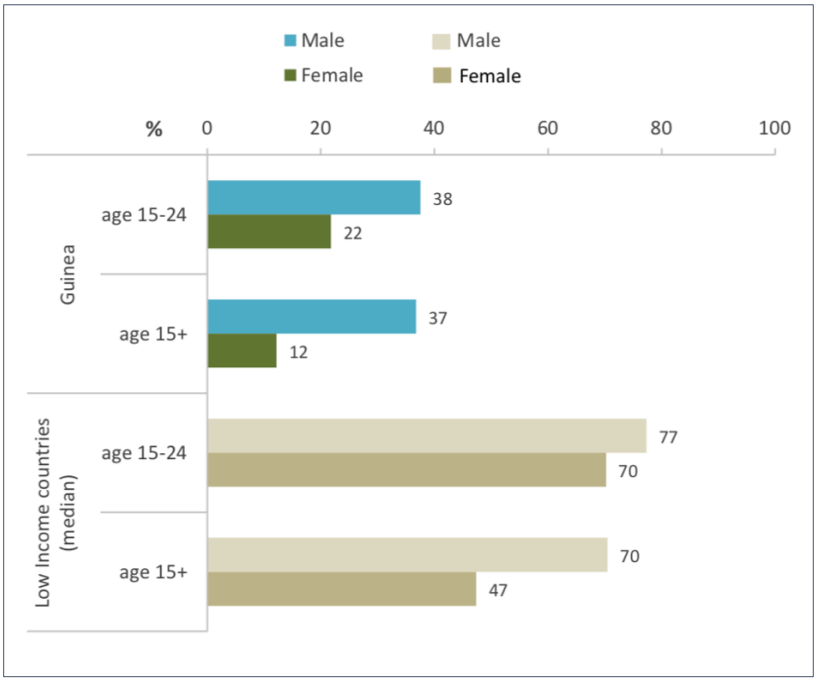
[300] **Gender mainstreaming**: The process of ensuring that women and men have equal access to and control over resources, development benefits and decision-making, at all stages of development process, projects, programs or policy.
[301] "Human Development Indices and Indicators: 2018 Statistical Update," UN Development Programme, (2018): http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf
[302] "Evaluation et Analyse des Gaps par rapport aux objectifs de SEforALL," UNDP and SEforALL, (July 2014): https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_RAGAs/Guinea_RAGA_FR_Released.pdf
[303] "UN Human Development Indicators: Guinea," UN Development Programme, (2018): http://hdr.undp.org/en/countries/profiles/GIN
[304] "Guinea: National Education Profile, 2014 Update," Education Policy and Data Center, (2014): https://www.epdc.org/sites/default/files/documents/EPDC%20NEP_Guinea.pdf
[305] Ibid.

Percentage of Children of Secondary School Age (13-19) Out of School



Source: UNESCO Institute for Statistics

Literacy Rate Among Youth and Adult Population

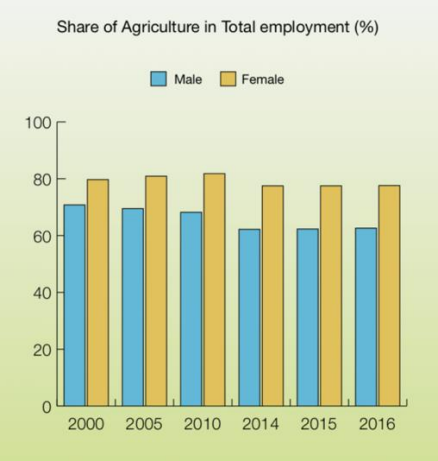


Source: Education and Policy Data Center

According to the UN, as of 2017, only 20% of women in Guinea had an account at a financial institution or with a mobile money service provider.[306] This can be attributed to the country's elevated levels of poverty, low or irregular sources of income, low rates of financial literacy, and a perceived lack of need. This is also a result of the fact that most banks are focused on serving the formal sector, while many women

[306] "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

remain engaged in informal economic activities – especially subsistence agriculture, which has employed close to 80% of the country's female labor force since 2000.[307]



Source: African Development Bank

2.3.2 Fertility Rates and Reproductive Health

Guinea's healthcare system was devastated by the 2014 Ebola Crisis. Weak surveillance systems and poor public health infrastructure contributed to the outbreak and its spread to neighboring countries.

As of 2017, the fertility rate in Guinea was about five children per woman. The country has an extremely high maternal mortality rate; for every 100,000 live births, 679 women die from pregnancy related causes. As of 2017, 27.6 % of women had an unmet need for family planning.[308]

2.3.3 Participation and Decision-Making

Socio-cultural perspectives in Guinea remain male-dominated, as conventional gender roles continue to hold women back. This is reflected in household decision-making, which often plays a role in restricting the rights and empowerment of women. These dynamics are also present in the rates of representation of women in the labor market as well as in leadership positions in business and government. As of 2018, women hold 21.9% of the country's seats in parliament.[309]

As of 2018, among 33 senior executives in the Ministry of Energy, only two were women. The disparity is less within the Guinea Renewable Energy Division, where 11 out of 50 positions are held by women.[310]

[307] "Indicators on Gender, Poverty the Environment and Progress toward the Sustainable Development Goals in African Countries," African Development Bank, (2017): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/GENDER_Poverty_and_Environmental_Indicators_on_African_Countries-2017.pdf

[308] "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

[309] Ibid.

[310] Stakeholder interviews, 2018.

2.4 Gender Policy, Institutional and Legal Framework in Guinea

2.4.1 Gender Mainstreaming Initiatives by the Government

While Guinea's legal framework is structured to protect the rights of women, discriminatory practices still exist in many areas surrounding the social and economic empowerment of women, especially in the domains of family and inheritance. The situation is worse in rural areas where these dynamics tend to be defined by customary and religious practices, and where few women are aware of the legal rights that are in place to protect them. To address these issues, the GoG adopted gender mainstreaming as a pathway to achieve not only equality between the sexes, but also to address poverty reduction, economic growth, and sustainable development.

Guinea's policy framework for promoting gender equality and women's empowerment is guided mainly by a National Policy on Gender was adopted in 2011. The GoG has signed on to key international and regional framework agreements protecting women's rights (see **Section 1.2.2.5**). The Government has also enacted 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. Guinea's Strategic Poverty Reduction Document (DSRP) identifies education as a priority sector and aims to achieve gender parity at all levels.

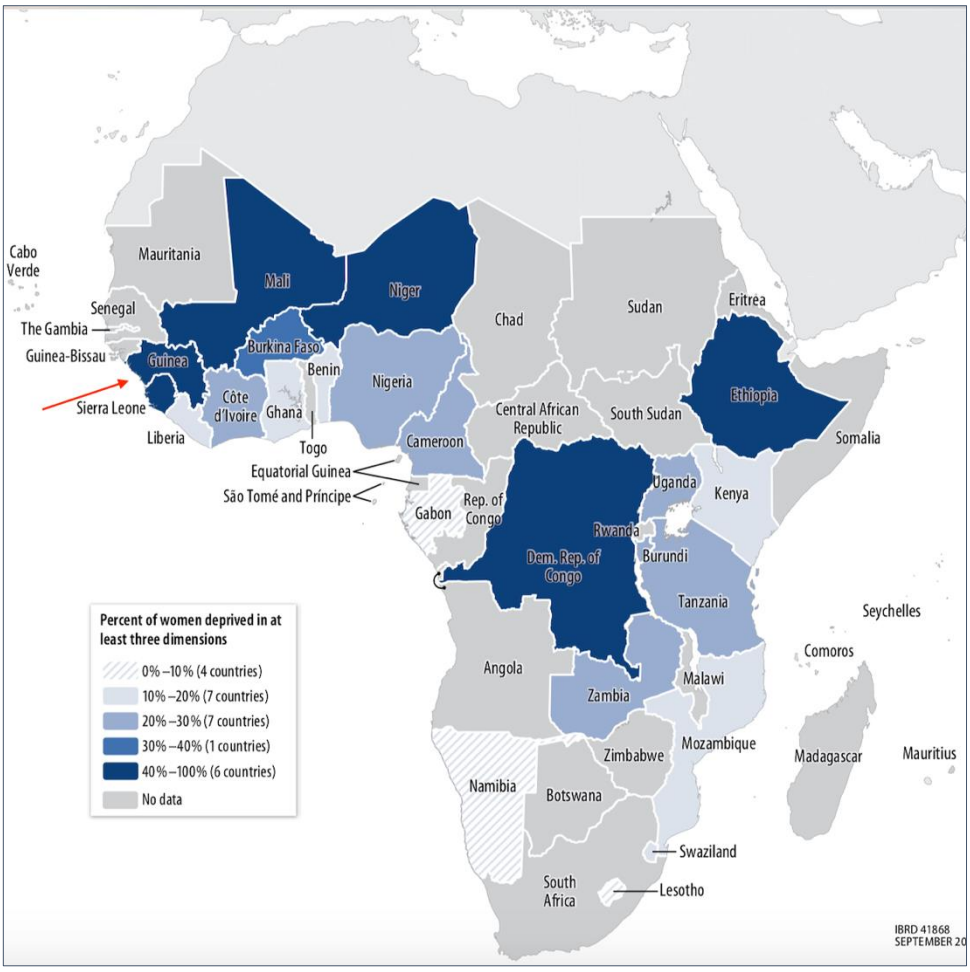
The Ministry of Social Action, Women Advancement and Childhood (Ministère de l'Action Sociale, de la Promotion féminine et de l'Enfance) is mandated to coordinate the country's gender mainstreaming activities.

2.4.2 Gaps in the Gender Policy/Legal Framework

Despite the Government's policy initiatives and legislative reforms, gender inequality remains an ongoing challenge across the country's political, economic and socio-cultural landscape, as women still face many barriers to inclusive participation. Women are often curtailed in their access to information and decision-making. Moreover, Guinea's legal system includes a Constitution and Civil law system based on the French model and consists of statutory, customary, and religious laws, all three of which are applied, creating confusion that undermines the rights of women.

While multiple deprivation characterizes life for a sizable share of African women, rates are significantly higher in West Africa and the Sahel – with Guinea ranking among the six worst nations in Africa.

Socioeconomic Deprivation of Women in Africa[311]



Source: The World Bank Group: Poverty in a Rising Africa

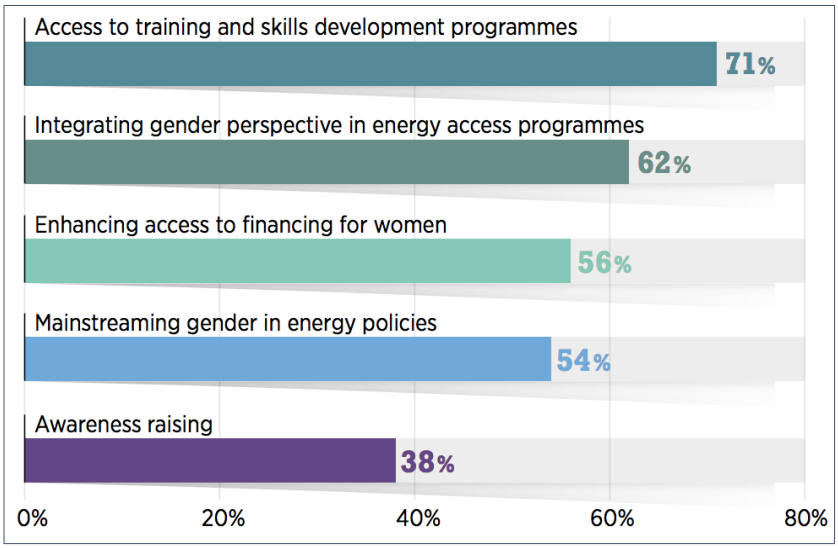
2.5 Summary of Recommendations

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.[312]

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.[313]

[311] "Poverty in a Rising Africa: Africa Poverty Report," The World Bank Group, (2016): https://www.un.org/africarenewal/sites/www.un.org.africarenewal/files/Poverty%20in%20a%20Rising%20Africa%20Overview.pdf
[312] "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
[313] 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 Guinea's energy sector:[314]

- Take measures to close the gender gap in access to education, particularly in higher levels of education
- Implement a quota system to increase the number of women employed in government's energy ministry and ensure that women are part of decision-making processes in the energy sector
- Implement policy and budgetary measures to support programs that aim to raise awareness and promote opportunities for women as energy customers, suppliers, financiers, and educators
- Commission studies to collect, synthesize and publish gender-specific/sex-disaggregated data on women's energy access and usage to inform (i) public policy development to improve rates of access for women; and (ii) private sector on potential customer needs (e.g. clean cooking technologies, productive use of energy applications etc.)
- Undertake a "gender audit" of the energy sector and develop a gender action plan to inform long-term policy objectives targeting gaps in the existing framework and promoting inclusive participation (e.g. by adding gender categories to policies and projects and accounting for gender impacts in strategic planning).
- Establish a Gender Focal Point or Unit within key national and local institutions in order to administer targeted gender policies and programs
- Raise awareness / provide training and technical support to private sector businesses / SMEs on (i) the benefits of gender inclusion and in viewing business decisions through a gender lens; (ii) the value of gender-disaggregated data; and (iii) how to develop and implement gender strategies to encourage inclusive participation.[315]

[314] **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

[315] "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, Alkaly Mohamed T. Condé (fourth from left) with ROGEP focus group participants in Conakry, Guinea, in June 2018.

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, 2015, "Central Africa Regional Integration Strategy Paper," https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/RISP%20CENTRAL%20AFRICA-ECCAS%20English%20FINAL.pdf

African Development Bank Group, 2017, "225kV Guinea Mali Electricity Interconnection Project," https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Multinational_-_225_KV_Guinea-Mali_Electricity_Interconnection_Project.pdf

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

African Development Bank Group, 2017, "Situation of the Sub-Electricity Sector in Guinea, Annex I.1, 225 kV Guinea-Mali Electricity Interconnection Project," https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Multinational_-_225_KV_Guinea-Mali_Electricity_Interconnection_Project.pdf

African Economic Outlook, African Development Bank, 2018, "Guinea Economic Outlook," https://www.afdb.org/en/countries/west-africa/guinea/guinea-economic-outlook/

Banque Centrale De La République de Guinée, 2018, "Bulletin des Statistiques Monétaires, Financières et de Balance des Paiements de la Guinée – 2017," https://www.bcrg-guinee.org/publications/publication-annuelle/782-bulletin-des-statistiques-monetaire-et-exterieures-2017

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, 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

Brown, F., 2018, "France's Orange enters African off-grid solar market," PV Magazine, https://www.pv-magazine.com/2018/03/28/frances-orange-enters-african-off-grid-solar-market/

Castalia Strategic Advisors, 2017, "Programme d'électrification de la Guinée: Prospectus d'Investissement."

Comité Consultatif de Guinée, 2017, "Projet: Programme National d'Amélioration d'Accès à l'Électricité en Guinée," https://groupe-consultatif-guinee.com/pndes-content/uploads/2017/10/Fiche-MOE-Programme-National-damelioration-de-lacces-a-lelectricite.pdf

Dahlberg Advisors, Lighting Global, GOGLA and World Bank ESMAP, 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., 2017, "The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution," World Bank, 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 Centre for Renewable Energy and Energy Efficiency, 2016, "Termes de référence pour l'élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement de capacité en planification de l'AGER," http://www.ecreee.org/sites/default/files/procurment/attachments/tors_ager_pner_.pdf

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

ECOWAS Centre for Renewable Energy and Energy Efficiency, I2D, 2017, "Élaboration du PNER sur l'horizon 2030, des deux PPER et renforcement des capacités en planification de l'AGER : Rapport Final Volume 2.

Electricité de Guinée, 2016, "Rapport annuel 2016," https://www.sieguinee-dne.org/images/RAPPORT_ANNUEL_EDG_2016_partie1.pdf

Embassy of Guinea in New Delhi, 2018, "Doing Business in Africa – Investing Guinea," http://www.ambaguinee-inde.org/pdf/guinea-brochure-2018.pdf

Entrepreneurs du Monde, 2018, "Wakili: A Social Microfinance in Guinea," https://www.entrepreneursdumonde.org/en/program/wakili-social-microfinance-guinea/

ESI Africa, 2017, "Guinea seeks to extend Conakry electricity grids," https://www.esi-africa.com/guinea-extend-conakry-electricity-grids/

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/

European Investment Bank, 2018, "Banking in Africa: Delivering on Financial Inclusion, Supporting Financial Stability," http://www.eib.org/en/infocentre/publications/all/economic-report-banking-in-africa-delivering-on-financial-inclusion-supporting-financial-stability.htm

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

Food and Agriculture Organization, "Family Farming Knowledge Platform, Smallholders DataPortrait," http://www.fao.org/family-farming/data-sources/dataportrait/farm-size/en/

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

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

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

GSMA and Ernst and Young, 2018, "Reforming mobile sector taxation in Guinea: Unlocking socio-economic gains from mobile connectivity," https://www.gsma.com/publicpolicy/wp-content/uploads/2018/05/GSMA-Guinea-taxation-report-EN.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, 2015, "Public Private Partnership Stories," https://www.ifc.org/wps/wcm/connect/5110ac804bf90737871cdf7cbf6249b9/Guinea+Power_PPP+Stories_Final_9+March+2016.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, Country Report No. 18/234 July 2018, "Guinea: First Review of the Arrangement Under the Three-Year Extended Credit Facility, Financing Assurances Review," https://www.imf.org/en/Publications/CR/Issues/2018/07/20/Guinea-First-Review-of-the-Arrangement-Under-the-Three-Year-Extended-Credit-Facility-46109

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

Ngounou, B., 2018, "Orange to deploy its new solar energy service in rural areas," Afrik21: Green Economy and Sustainable Growth in Africa, https://www.afrik21.africa/en/guinea-orange-to-deploy-its-new-solar-energy-service-in-rural-areas/

Republic of Guinea, 2017, "National Economic and Social Development Plan," https://groupe-consultatif-guinee.com/pndes-content/uploads/2017/11/Condense_ENGVersion_DEF_08112017_19h30.compressed.pdf
SEforALL-Africa, 2018, "Guinea at a Glance," https://www.se4all-africa.org/seforall-in-africa/country-data/guinea/

Rewald, R., 2017, "Energy and Women and Girls: Analyzing the needs, uses, and impacts of energy on women and girls in the developing world," Oxfam, https://www.oxfamamerica.org/static/media/files/energy-women-girls.pdf

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 and Shell Foundation, https://static.globalinnovationexchange.org/s3fs-public/asset/document/SOGE%20YIR_FINAL.pdf?uwUDTyB3ghxOrV2gqvsO_r0L5OhWPZZb

Siedek, M., 2015, "How does Ebola impact microfinance in Guinea, Liberia, and Sierra Leone?," http://hannahsiedek.com/how-does-ebola-impact-microfinance-in-guinea-liberia-and-sierra-leone/

Takouleu, J. 2019, "Guinea: World Bank and AFD grant $106 million for electrification projects," Afrik 21: Green Economy and Sustainable Growth in Africa, https://www.afrik21.africa/en/guinea-world-bank-and-afd-grant-106-million-for-electrification-projects/

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

United Nations Development Programme, 2015, "Gender Inequality Index," http://hdr.undp.org/en/composite/GII

United Nations Development Programme, 2018, "Human Development Indices and Indicators: 2018 Statistical Update," http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf

United Nations Development Programme and Sustainable Energy for All, 2014, "Evaluation et Analyse des Gaps par rapport aux objectifs de SEforALL," https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_RAGAs/Guinea_RAGA_FR_Released.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 Educational, Scientific and Cultural Organization Institute for Statistics, 2018, "Guinea Participation in Education," http://uis.unesco.org/en/country/bf?theme=education-and-literacy

UN 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, August 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

United States Agency for International Development, Climate Economic Analysis for Development, Investment and Resilience (CEADIR), June 2018, "Market Assessment Report on Clean Energy: Guinea," https://www.climatelinks.org/resources/renewable-energy-lending-west-africa

United States Agency for International Development (USAID), "LandLinks, Guinea Profile," https://land-links.org/country-profile/guinea/#land

U.S. Export.gov, "Guinea: Agriculture, Best Prospects," https://www.export.gov/article?id=Guinea-Agriculture

West African Monetary Agency, August 2017, "Financial Sector Developments and Stability in ECOWAS 2016 Report," http://amao-wama.org/publications/financial-stability-2016-report/;

World Bank, 2011, "Lessons Learned in the Development of Smallholder Private Irrigation for High Value Crops in West Africa," http://siteresources.worldbank.org/INTARD/Resources/West_Africa_web_fc.pdf

World Bank, 2014, "Power Sector recovery Project," http://projects.worldbank.org/P146696?lang=en

World Bank, 2015, "Decentralized Rural Electrification Project: Final Assessment Review," http://documents.banquemondiale.org/curated/fr/598521467986262235/pdf/ICRR14655-P074288-Box393183B-PUBLIC.pdf

World Bank, 2016, "World Development Indicators, Population," https://data.worldbank.org/indicator/SP.POP.TOTL

World Bank, 2017, "Sahel "Irrigation Initiative Support Project," http://documents.worldbank.org/curated/en/515131512702151121/pdf/WESTERN-AFRICA-PADnew-11142017.pdf

World Bank, 2017, "WAPP Integration and Technical Assistance Project in the Support of the First Phase of the CLSG Power System Re-Development Sub-Program of the WAPP APL Program," http://documents.worldbank.org/curated/en/369271509740134599/pdf/Sierra-Leone-Liberia-WAPP-PAD2375-PUBLIC.pdf

World Bank, 2018, "Additional Credit for the Power Sector Recovery Project, Guinea," http://documents.worldbank.org/curated/en/172941521424821535/pdf/GUINEA-POWER-SECTOR1-PAD-02272018.pdf

World Bank, 2018, "Guinea-Mali Interconnection Project: Combined Project Information Documents / Integrated Safeguards Datasheet," http://documents.worldbank.org/curated/en/515871527263469191/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Guinea-Mali-Interconnection-Project-P166042.pdf

World Bank, 2018, "Interest Rate Caps, The theory and the Practice," http://documents.worldbank.org/curated/en/244551522770775674/pdf/WPS8398.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 Guinea: Overcoming Growth Stagnation to Reduce Poverty, Systematic Country Diagnostic," http://documents.worldbank.org/curated/en/830641522072107327/pdf/Guinea-SCD-final-03222018.pdf