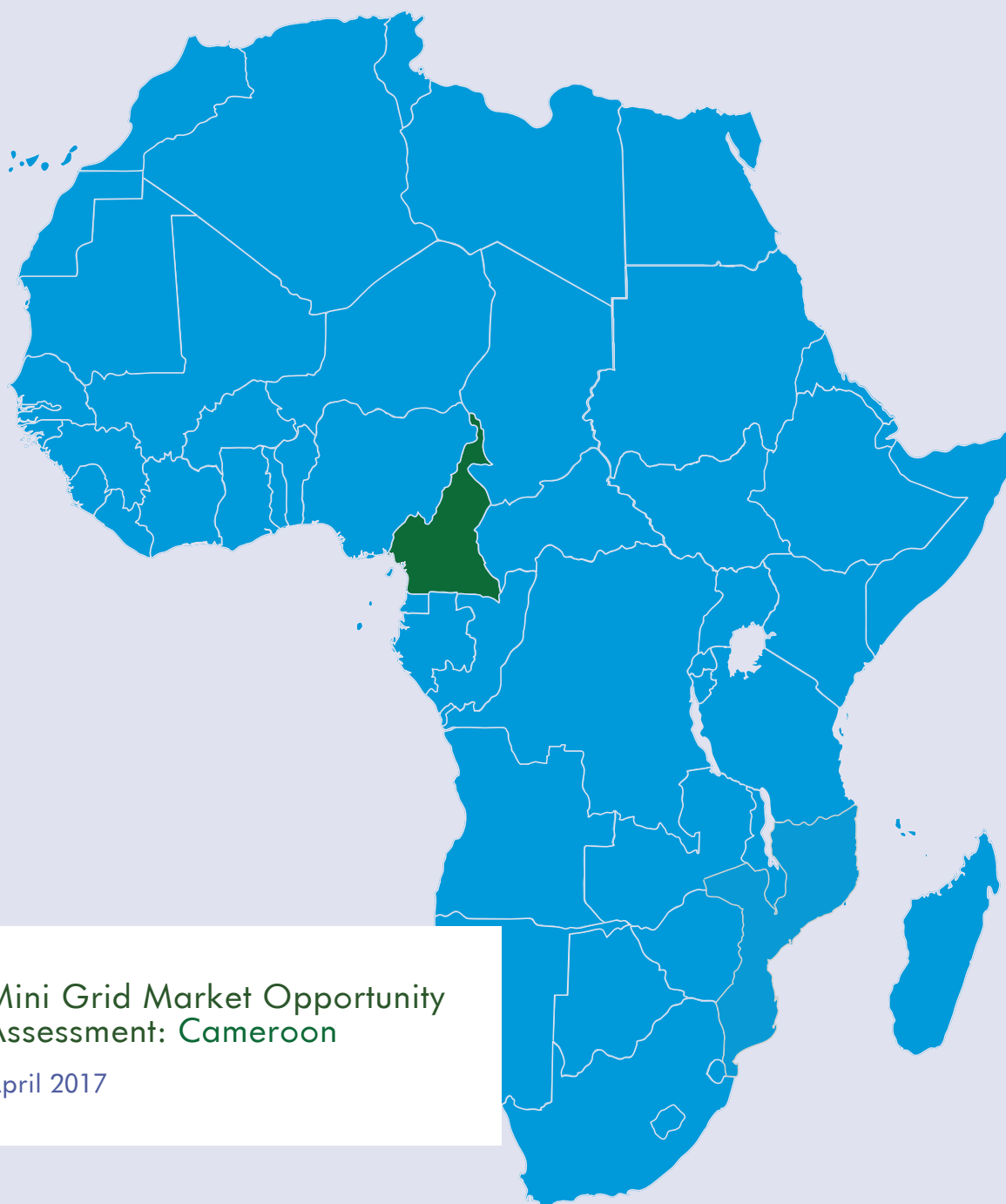


Green Mini Grid Market Development Programme

SEforALL Africa Hub
African Development Bank



Mini Grid Market Opportunity
Assessment: Cameroon

April 2017



Prepared by



PREFACE

This paper, and subsequent papers in the Green Mini-Grid Market Development Programme (GMG MDP) document series, is a market assessment for green mini-grids for rural electrification in Cameroon. These are mini-grids powered by renewable energy resources – solar radiation, wind, hydropower or biomass – either exclusively, or in combination with diesel generation.

Mini-grids are not a new phenomenon in Africa. Almost all national utilities own and operate diesel-powered generating facilities not connected to the main grid, which supply electricity to secondary towns and larger villages. This solution to rural electrification inevitably results in significant financial losses for the utility as it is required to sell power at prices significantly below the cost of production and delivery. Moreover, it leaves the most remote towns and villages unelectrified.

The latest Sustainable Energy for All (SEforALL) Global Tracking Framework estimates that the urban-to-rural divide in access to electricity in Africa is as high as 450 percent given that 69 percent of the population in urban areas is electrified compared to only 15 percent in rural areas.

There are three principal options for providing new connections to currently unserved populations in Africa, namely: extension of the national grid; installation of separate “mini-grids” to operate independently from the main grid; and stand-alone generating systems that supply individual consumers. The most cost-effective approach for powering mini-grids is to use renewable energy sources, which are widely available across Africa.

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

In response to these challenges, the SEforALL Africa Hub at the African Development Bank designed and launched Phase 1 of the GMG MDP in 2015, with grant funding from the AfDB's Sustainable Energy Fund for Africa (SEFA).¹ The GMG MDP is a pan-African platform that addresses the technical, policy, financial and market barriers confronting the emerging GMG sector. It is part of a larger DFID-funded GMG Africa Programme, which also includes GMG initiatives in Kenya and Tanzania; country-specific GMG policy development through SEFA; and an action learning and exchange component being implemented through the World Bank's Energy Sector Management Assistance Program (ESMAP).

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

The goals of the green mini-grids programme are central to AfDB's mission of spurring sustainable economic development, social progress and poverty reduction in its regional member countries. Off-grid and mini-grid solutions are a key component of the AfDB's New Deal on Energy for Africa, launched by the Bank's president in January 2016. The New Deal, a transformative, partnership-driven effort, aspires to achieve universal access to energy in Africa by 2025.

This report was prepared by the Carbon Trust, United Nations Environment Programme (UNEP) and ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) at the request of the AfDB. It was written by Marcos Sampablo, Guy Henley and Juliana Meng of Carbon Trust and Eugene Ochieng of UNEP. Carbon Trust is a mission-driven organization helping businesses, governments and the public sector to accelerate the move to a low carbon economy. UNEP is a leading global environmental authority.

The content of this report was reviewed by Jeff Felten of the AfDB's GMG team and cleared by Dr. Daniel-Alexander Schroth, SEforAll Africa Hub Coordinator at the AfDB. The report was edited by Kimberlee Brown.

1 The SEforALL Africa Hub partnership includes the African Union Commission (AUC), the New Partnership for Africa's Development (NEPAD), the United Nations Development Programme (UNDP), and the Regional Economic Communities (RECs), which are represented on a rotating basis. <http://www.se4all-africa.org>

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List of Acronyms

| | |
|----------|---|
| AER | Rural Electrification Agency/Agence d'Électrification Rurale du Cameroun |
| ARSEL | Electricity Sector Regulatory Agency/Agence de Régulation du Secteur de l'Electricité |
| CCCE | Electricity Consumers Consultative Committee/Consultatif des Consommateurs de l'Electricité |
| CDMT | Mid-Term Expenditure Framework 2015-2017/Cadre de Dépenses à Moyen Terme |
| CEMAC | Economic and Monetary Community of Central Africa/ La Communauté Économique et Monétaire des Etats de l'Afrique Centrale |
| DSCE | Growth and Employment Strategy Document 2010-2020/Document de Stratégie Pour La Croissance et L'emploi |
| ECCAS | Economic Community of Central African States/ Communauté économique des États de l'Afrique centrale |
| ECREEE | ECOWAS Centre for Renewable Energy and Energy Efficiency/ Centre pour les Energies Renouvelables et l'Efficacité Énergétique de la CEDEAO |
| EDC | Electricity Development Corporation |
| ENEO | Energy of Cameroon Eneo Cameroon S.A |
| FEICOM | Special Council Support Fund For Mutual Assistance/Fonds Special d'équipement et d'intervention Intercommunale |
| GESP | Growth and Employment Strategy Paper 2010-2020 |
| GIS | Geographic Information System |
| MINEE | Ministry of Water Resources and Energy/Ministère de l'Eau et de l'Energie |
| MINEPAT | Ministry of Economy, Planning and Regional Development/Ministère de l'Economie, de la Planification et de l'Aménagement du Territoire |
| PANERP | National Energy Action Plan for Poverty Reduction/ Plan d'Action National Energie pour la Reduction de la Pauvrete |
| PDER | Rural Electrification Master Plan/Plan Directeur d'Électrification Rurale |
| PNDP | National Program for Participatory Development/Programme National de Développement Participatif |
| PRERETD | Reinforcement and Extension of Electrical Transport and Distribution Networks Project/Projet de Renforcement et d'Extension des Reseaux Electriques de Transport et de Distribution |
| PERPREN | Electrification Project for 16 villages in rural and peri urban areas in 10 communes in Cameroon's Far North Region/Projet d'Électrification de 16 villages en zones Rurale et Périurbaine dans 10 Communes de la Région de l'Extrême Nord, Cameroun |
| PLAN VER | Decentralized Electricity Production and Enhancement of Rural Electrification for Cameroon's Rural Agricultural Development/Production décentralisée d'électricité et Valorisation de l'Électrification Rurale pour l'Agriculture et le Développement Rural au Cameroun |
| PV | Photovoltaic |



EXECUTIVE SUMMARY

This country report is one of five pilot country reports in the first phase of the Market Intelligence business line of the African Development Bank's Green Mini-Grid Market Development Programme (MDP). The MDP programme has the ultimate objective of fostering access to electricity across Africa by promoting the development of green mini-grids where they are technically and economically a better option than the extension of the main grid. The Market Intelligence business line targets the provision of comparable, actionable data on the potential for GMGs between countries in Sub-Saharan Africa. This report provides an analysis for Cameroon.

This report's methodology combines a high-level opportunity assessment with practical knowledge and information targeted at mini-grid practitioners. Information provided covers key stakeholders, raw data on physical and non-physical factors and a policy and regulatory analysis. The potential for mini-grids is a challenging analysis, requiring substantial data and assumptions. A thorough assessment must include a number of criteria that are driven by the particular business model and approach of the implementing agency for each case. This report therefore aims to capture available data and highlight general assessments that would be relevant to most mini-grid stakeholders. Raw data is provided with this report so stakeholders may further conduct their own specific analysis.

The Republic of Cameroon has a population of 22 million and borders the Central African Republic, Nigeria, Chad, Republic of Congo, Gabon and Equatorial Guinea. Since 2010, Cameroon's GDP has grown at an average of 5% per year and GDP per capita is estimated at US\$1,407. The country is split into ten regions. The Centre region has the highest population (19%), while the South has the smallest (3%). The majority (60%) of the population live in rural areas. The Far North has the largest rural population. The region represents 18% of the total population, of which an estimated 88% live in rural areas and 74% live below the poverty line (estimated at 339,715 FCFA/year²).

Cameroon's short-term energy objective (to 2020) is to increase electrification rates and ensure a reliable supply of electricity to meet increasing demand. Generation capacity is estimated at 1.3GW, of which 732MW is from hydropower. The Cameroonian energy sector is faced with a number of challenges including: inadequate production capacity due to delays in investment and an ageing transmission and distribution network; low electrification rates due to insufficient resources allocated to rural electrification and high connection costs; high electricity distribution losses; restricted technical and financial capacities of institutional actors; the absence of appropriate instruments to attract private investors; and the lack of planning and feed-in tariff regimes for renewable-based energy production.

The key energy sector institutions are the Ministry of Water Resources and Energy (MINEE), Electricity Sector Regulatory Agency (ARSEL), and national utility Energy of Cameroon (ENEO). The institutional landscape is relatively crowded and complex. The national energy policy is implemented by the MINEE. ENEO holds a monopoly concession on distribution and possesses the majority of generation capacity in the country. The Electricity Development Corporation (EDC) also holds generation and infrastructure responsibilities. The Rural Electrification Agency (AER) is in operation, but its current level of engagement is minimal as the majority of rural electrification projects are led by the MINEE, EDC and decentralised authorities.

National grid coverage is relatively broad, with 74% of the population living in a population centre connected to a power grid. About 86% of the population live within 15km of the power network. The grid network in Cameroon is divided into three non-interconnected grids: The northern network (RIN), the southern network (RIS), and the eastern network (RIE). The grid suffers from considerable losses and investment is required to replace the ageing network.

Nevertheless, the national household electrification rate stands at only 23%.³ Significant resources are required to increase rural electrification rates. Cameroon suffers from low household electrification rates with only 23% of the population subscribed to the national utility ENEO. Meanwhile, only 3,700 of the 14,207 localities within ENEO's concession area are connected to the maximum demand voltage line or to an isolated power plant.

2 INS ECAM IV, 2015

3 PDER and MINEE Annual Statistics 2015

Mini-grids are an attractive mechanism to electrify rural populations in Cameroon due to the country's abundance of renewable resources; however an improved enabling environment is necessary to attract increased financing for the sector. Cameroon has substantial solar, biomass, and small hydro resources. Given the poor reach and discontinuity of the three grid networks in the north, east, and south, in addition to the significant resources required to extend these, mini-grid solutions are therefore a viable solution to support Cameroon's electrification and development targets. However, an improved legislative framework and increased financing for projects and key institutions is required.

Based on current grid coverage, our geo-spatial analysis estimates that 14% of the population (3 million people) could be best served by mini-grid solutions. In terms of population, the largest markets are found in the Far North, North, and Adamaou regions, where 921,000, 732,000 and 723,000 people could be best served by off-grid solutions.

Our analysis estimates a current annual household market size of US\$144 million based on an annual per capita energy expenditure of FCFA 28,606 (approximately US\$46).⁴ Taking into consideration grid extension projects that have secured financing or are under development, the market size falls to 1.7 million people and US\$80 million. Further taking into account planned expansion of the grid up to 2035, the market drops to just 100,000 people and US\$4 million. These final figures reflect the strong focus on grid extension of existing electrification plans. The market size may be larger than this as modern decentralized solutions are also feasible in yet-to-be electrified (due to limitations of the national power network assets) areas within proximity to the grid.

The legal framework in Cameroon enables the development of independent mini-grids, but priority has been given to grid extension. While the regulatory framework permits independent generation and distribution, the opportunity for green mini-grids is limited by a policy focus on grid extension and regulatory limitations. Distribution of electricity is monopolised by the national utility ENEO, whose concession covers over 70% of the communes. The legislative framework limits the capacity of independent power distribution to 100kW and 1MW in rural areas. In addition, the Rural Electrification Master Plan heavily prioritises grid extension to achieve energy access targets.

However, the grid extension plans are ambitious in scope and the Rural Electrification Master Plan (PDER) identifies a role for green mini-grids. Mini-grids present the possibility to leverage Cameroon's renewable energy sources to electrify population centres that are too far from the current grid. The PDER sets an objective to achieve 20,000 connections through green mini-grids by 2020. Following techno-economic analysis, the PDER prioritises 27 solar, biomass, and small hydro mini-grids sites (30kW to 2.4MW in capacity) across the country, representing a total investment of FCFA 137 billion. The government is starting to deploy hydro and solar based mini-grids. However, no independently operated green mini-grids exist today in Cameroon. There may be the opportunity to substitute ageing thermal powered mini-grids run by the national utility with renewable energy sources.

⁴ Based on World Bank Global Consumption Database statistics



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

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

- Establishing a comparable, actionable understanding of the GMG market opportunity in SSA;
- Promoting the linkages between communities, public institutions, developers, financiers, and technology providers required for successful mini-grid development;
- Strengthening capacity of developers to develop and operationalise GMG business models;
- Promoting a sound policy and regulatory environment; and
- Engaging project financiers and supporting the development of suitable financial solutions.

This country report is one of five pilot country reports in the first phase of the Market Intelligence business line of the MDP, providing an analysis of the potential for GMGs per country. Successive phases of the MDP will include additional countries to provide comparable, actionable data on the potential for GMGs across countries in Sub-Saharan Africa.

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

The development of green mini-grids is promoted by the Clean Energy Mini-Grids Partnership under the SEforALL Initiative. The African Development Bank is playing a lead role for Africa. The partnership will galvanize action on the barriers facing the sector, with the engagement of public, private and civil society expertise and resources. The Clean Energy Mini-Grids Partnership, including the coordination group, secretariat and wider membership, is the established forum for discussion and coordination of the efforts of development partners to advance the adoption of GMGs. The MDP is designed from the beginning to be integrated and closely coordinated with the activities carried out in the framework of the partnership.



2. COUNTRY OVERVIEW

The Republic of Cameroon, in Central Africa, has a population of 22 million and borders the Central African Republic, Nigeria, Chad, Republic of the Congo, Gabon and Equatorial Guinea. The country is split into 10 regions: Centre (capital, Yaoundé), South, Littoral (capital, Douala), Northwest, Southwest, West, Adamawa, North, Far North, and East. These regions are divided into 58 departments and 360 districts. The Centre region has the highest population (19%), while the South has the smallest (3%). The majority (60%) of the population live in rural areas, with the largest concentrations in the northern regions. The two main cities, Douala and Yaoundé, are both located in the southern area and are similar in size. Douala is the economical capital with around 20% of the country's population. Yaoundé is the second largest city and the political capital of the country. The city is experiencing high urban expansion due to the concentration of the administrative structures, universities and diplomatic services. The country is characterized by great ethnic, religious and linguistic diversity, with over 230 ethnicities and 240 dialects. French and English are the official languages.

Cameroon's diverse geography naturally divides the country into four distinct regions. Bordering the Atlantic Ocean and including Douala Bay lie the Coastal Plains. The South Cameroon Plateau is found southeast of the Sanaga River, which is covered with equatorial forests. Meanwhile, the Centre and West Highlands arch is characterized by mountain chains and volcanic peaks such as the Mount Cameroon (4,070m) and the Mount Oku (3,008m). Lastly, the Far North consists of the Savanna Plain and slopes down to the Lake Chad Basin. Forests cover 40% of the country's surface.

Cameroon is a multiparty democracy and one of the most stable countries in the region. The presidential party, Cameroon People's Democratic Movement (CPDM), is the dominant political party and possesses a strong majority at the National Assembly. Women play an important part of society and held 31% of the seats in the national parliament in 2016. President Paul Biya has been in power since 1982. Under his rule the country has benefited from stability, enabling the development of critical infrastructure.⁵ Nevertheless, the country still suffers from weak governance that hinders its capacity to attract investment. The World Bank's 2017 Doing Business report ranked Cameroon's economy at 166 out 190.

Since 2010 Cameroon's GDP has been growing at an average of 5% per year and GDP per capita is estimated at US\$1,407. The country has a relatively resilient economy and is a front-runner in the Economic and Monetary Community of Central Africa (CEMAC) region. Cameroon is part of CEMAC and the Economic Community of Central African States (ECCAS), and accounts for 39% of the region's GDP. Like other countries in the block it uses Central African CFA currency (FCFA), which is pegged to the Euro. Services are the largest contributor to the economy (48.7% of gross value added, GVA), followed by industry (28.5% of GVA) and agriculture (22.8% of GVA).⁶ Petroleum products account for a significant portion of its exports (approximately 37%). Coffee, timber and cocoa are also important export commodities. Cameroon's economy is much less dependent than its neighbouring CEMAC countries on petroleum, which accounts for only 8% towards its total budget. Key trading partners include the EU and China.⁷

Poverty levels remain high with 24% of the population living on less than US\$2 per day.⁸ This figure has remained unchanged since 2001. The country's literacy rate is 75% for the population aged 15 years and older and 84% for the youth population between 15 and 24 years.⁹ Development challenges include: limited access to electricity and potable water; limited availability of healthcare services; and increased insecurity due to the presence of Boko Haram's threat in the north, in addition to the crisis in Central African Republic. To address these challenges, the government drafted the Growth and Employment Strategy Paper 2010 – 2020 (GESP) and the National Energy Action Plan for Poverty Reduction (PANERP). The latter places energy access as the foundation for Cameroon's economic and social development.

5 CIA World Factbook, 2017

6 World Bank Databank, 2017

7 MINEE Annual Statistics, 2015

8 World Bank, 2014

9 UNESCO Statistic Database

3. GREEN MINI-GRID POTENTIAL

3.1 INTRODUCTION

The national electrification rate is low and significant disparities exist between regions. The national electrification rate stands at 23%, with 32% in the south and 7% in the north areas.¹⁰ The grid is relatively extended, with 74% of the population living in population centres connected to a power grid, and with about 86% of the population living within 15km of the power network. Nevertheless, only 26% (3,700) of the 14,207 localities within Energy of Cameroon's (ENEO's) concession are connected to the maximum demand voltage line or to an isolated power plant.

Significant renewable energy potential, notably in the form of hydro, solar and biomass exists. The country has one of the highest hydropower potentials in Africa estimated at 20GW. Hydropower is the main source of electricity with 732MW of installed capacity out of a total of 1,354MW.¹¹ Approximately 260 small hydro (representing approximately 360MW) and 30 biomass (representing approximately 35MW) sites have been identified across a number of studies, with many of these identified as suitable for green mini-grids.¹² In addition, there is also good potential for solar power. Solar irradiation is estimated at an annual average of 4.9 KWh/m²/day, with particularly strong levels in the north of Cameroon (5.7 -6 KWh/m²/day).

The legal framework in Cameroon enables the development of independent mini-grids, but priority has been given to grid extension. The new 2011 Electricity Law opens the doors to independent power producers and distributors to operate in Cameroon. Nevertheless, a comprehensive regulatory framework needs to be developed. Green mini-grids play a relatively minor role in the electrification plans of Cameroon. The Rural Electrification Master Plan (PDER) sets 2035 targets for 54% of households to be electrified and 85% of population centres to be connected to the grid (covering 98% of the total population) at an estimated cost of FCFA 805 billion, to be achieved predominantly through grid extension. The PDER has set a target of only 20,000 off-grid mini-grid connections by 2020.

The first pilot green-mini grid projects are starting to be developed and recent studies have identified a pipeline of potential sites for future development. An ambitious government-led solar mini-grid programme in partnership with Chinese company, Huawei, aims to electrify 1000 rural population centres. A first phase aims to electrify 350 centres by the end of 2017.¹³ In addition, the first independently developed rural hydropower mini-grid—the 1.4 MW Mbakaou Carrierre—led by IED-Invest and due to be operational in 2018 is in the final stages of securing the required permissions and agreements from ARSEL and ENEO. Initial plans included independent operation of the distribution assets, although they will now reportedly be transferred to the national utility, ENEO.

3.2 ASSESSMENT BACKGROUND

Estimating the potential for mini-grids is a challenging task involving a plethora of data and assumptions. Certain physical factors, such as resource availability and geographic features, can be collected remotely through satellite data, but other factors require the availability of local datasets and surveys. Some non-physical factors such as demand and consumption patterns require collection of precise settlement-level data. This data is often unavailable, outdated, or is highly resource-intensive to obtain. An opportunity assessment using this data should include a number of criteria that are driven by the particular business model and approach required of the end user. For instance, a private developer may consider purely financial metrics, whereas developers of a community scheme may focus more on service level provided.

10 PDER and MINEE Annual Statistics 2015

11 In 2014, hydropower represented 59% of electricity production (4,425GWh out of a total of 7,688GWh).

12 Of the hydro sites identified in the 2015 Investelec study, it was estimated that 31.5% (approximately 78MW) could serve mini-grids, primarily in the north. Of the biomass sites, an estimated 51% (approximately 19MW) were identified as suitable for isolated production, with the greatest potential in the east.

13 For more information on the first phases see: <https://www.voltatic.com/2016/12/cameroun-huawei-demarre-son-projet-delectrification-solaire-dans-1000-villages/>

The detailed assessment in this report cannot address the needs of all stakeholders for which it is intended. This report therefore aims to capture available data, and highlight general assessments that would be relevant to most mini-grid stakeholders. Raw data is provided with this report to allow stakeholders to conduct their own more specific analyses.

Data used within this analysis has been compiled from a number of sources, including the Ministry of Water Resources and Energy (MINEE), the National Institute of Statistics (INS), the 2016 Rural Master Electrification Plan (PDER) and the EU-funded 2015 Investelec project. Publically available data on access to energy and renewable energy sources is limited. This report relies on data included in the 2016 Rural Electrification Master Plan, shared with the authors of this report by MINEE and the consulting company, Innovation Energie Developpement (IED). The Rural Electrification Master Plan is the most recent dataset and has identified and compiled detailed information on almost 300 small hydropower sites and 35 biomass sites. Making this geographic information system (GIS) data and other information held by public institutions more broadly available to stakeholders and the public at large would facilitate project identification and development. An opportunity exists to produce a detailed renewable energy atlas based on existing information.

This high-level analysis defines grid and off-grid areas based on their distance from the power network. Grid regions are defined as areas within 15km of the grid. Off-grid population centres are then mapped, enabling an analysis of the potential for mini-grid projects. Analysis has been conducted using both the current power network and planned power network up to 2035.

3.3 MINI-GRID POTENTIAL ASSESSMENT

National grid coverage is relatively broad, with 74% of the population living in a population centre connected to a power grid, and with about 86% of the population living within 15km of the power network. Nevertheless, the national electrification rate stands at only 23% (32% in the south and 7% in the north) and only 3,700 of the 14,207 localities within ENEO's concession area are connected to the maximum demand voltage line or to an isolated power plant.¹⁴ The grid network in Cameroon is divided into three non-interconnected grids; the northern network (RIN), the southern network (RIS), and the eastern network (RIE). The majority of grid infrastructure is focused in the north, south, and southwest of Cameroon. The southern network is significantly larger than the others in terms of capacity and serves the two largest cities: Doula and Yaoundé. The eastern network is the smallest in terms of absolute size and population served.¹⁵

Based on current grid coverage, this analysis estimates that 3 million people could be served by independent mini-grid solutions. This represents 14% of the total population, a smaller share than in other Sub-Saharan countries given the government's policy focus on grid extension. Nonetheless, this figure provides the first approximation of the total market size taking into account a percentage of households likely best served by standalone systems. Figure 1 shows the distribution of population centres located further than 15km from the existing power grid. These population centres are grouped by population size, using the thresholds of 1,000 and 5,000 people. In terms of population, the largest markets are found in the Far North, North, and Adamaou regions, where 921,000, 732,000 and 723,000 people could be best served by off-grid solutions. Overall, these results are consistent with those of the more detailed PDER study.

Based on the government's projected long-term grid extension plans, the estimated market size for mini-grids is significantly smaller. Taking into account grid extension projects that have secured financing, or are under development, the market size falls to 1.7 million people. And, when considering the planned expansion of the grid up to 2035, the market drops to just 100,000 people. Nevertheless, the planned extensions are highly ambitious in their scope and will require significant capital investment estimated at FCFA 650 billion (US\$1.08 billion). Mini-grids may therefore be well placed to serve rural populations that are not forecasted to be connected to the grid in the short to medium terms until the grid arrives, at which point they could be connected.

14 PDER and MINEE Annual Statistics 2015

15 Ibid.

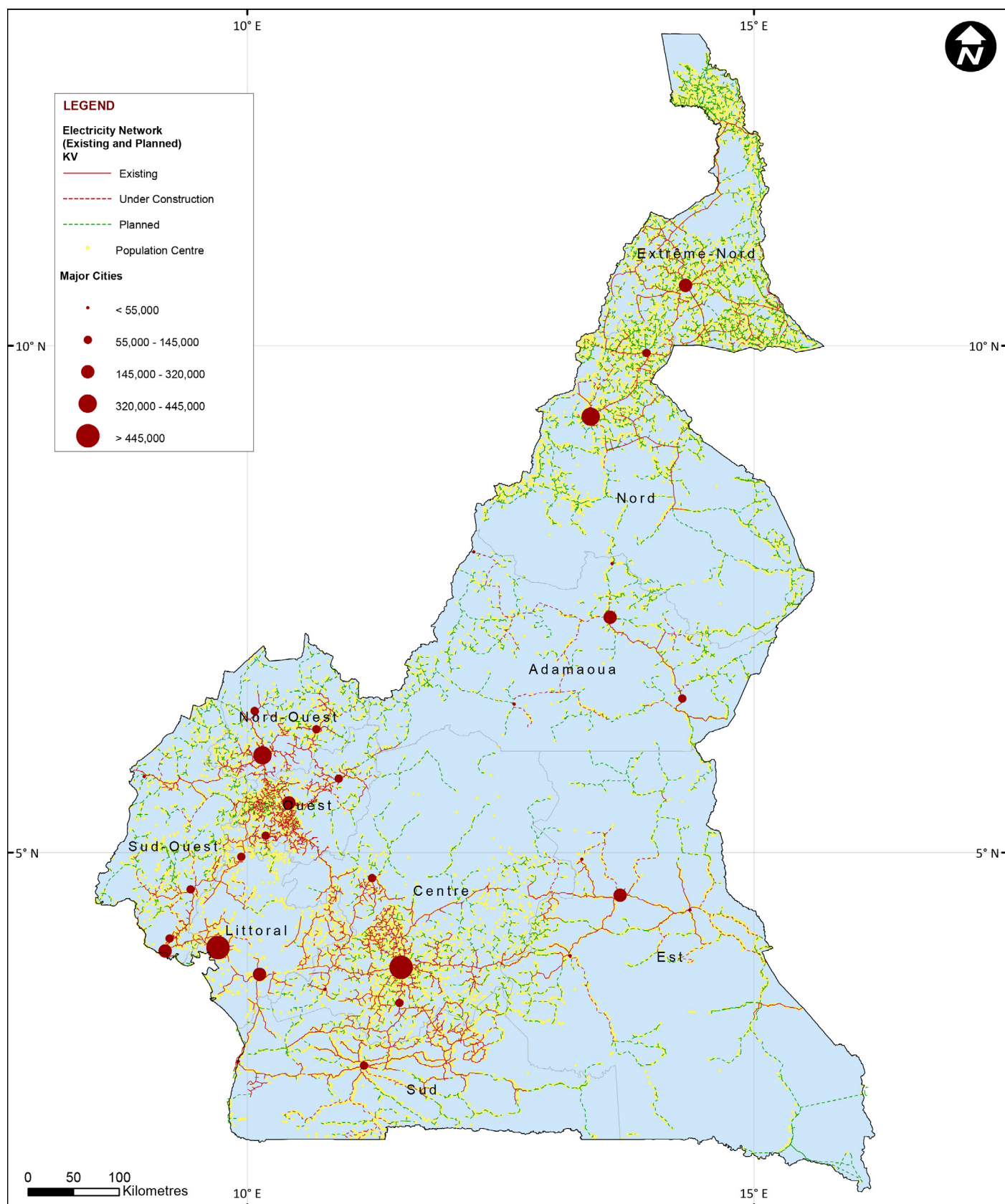
This analysis estimates an annual household market size of US\$144 million based on an annual per capita energy expenditure of FCFA 28,606 (approximately US\$46) and the current grid network.¹⁶ This scenario assumes that the entire population residing 15km outside of the current grid could be connected to mini-grids. In reality, the market size may be even larger as modern decentralized solutions are often also feasible in areas within grid proximity where population centres close to the grid are not yet electrified due to limitations of the national power network assets. The same analysis, conducted assuming the grid under construction scenario, yields an annual market size of US\$80 million. Finally, using the PDER projected grid coverage of 2035, the annual market size estimate falls to US\$4.5 million. The results of this analysis are shown in Table 1.

Given the strong renewable energy potential of Cameroon, grid-connected mini-grids could have significant potential, but would require policy changes. Grid-connected mini-grids have been favoured in some countries to accelerate the process of rural electrification. In Burkina Faso, for instance, local cooperatives can purchase power in bulk from the utility and distribute it locally. In Tanzania, companies like Mwenga Hydro produce electricity and distribute it throughout a rural concession. They are also connected to the grid so they may sell any excess power to the utility. These models strive to remove the national utility's burden of investing in distribution and, in the case of Tanzania, promoting the development of renewable energy sites by private developers. In Cameroon, some 300 mini-hydro, 35 biomass, and a selection of solar sites were identified and assessed in the PDER. Out of these, 12 hydro, 7 biomass, and 8 solar powered mini-grid projects (representing a combined total of 28MW of installed generation capacity and 1,200km of MV overhead lines), were prioritised at an estimated total cost of FCFA 137 billion. The PDER prioritises biomass and hydro mini-grids and foresees these to be grid connected post 2020. Nevertheless, the current regulatory framework limits the potential of grid-connected mini-grids. ENEO owns a concession for distribution to over 70% of the communes utilizing the existing grid. The regulatory framework allows for independent power producers to supply power to the grid, but limits distribution to 100kW in urban areas and 1MW in rural areas within ENEO's concession. ENEO is mandated by law to purchase excess energy from independent power producers (IPPs), however this is conditioned on the IPP successfully obtaining authorisation from the regulator and negotiating purchase agreements with ENEO. The first green mini-grids are emerging, but these have taken many years to develop due to the complex institutional and regulatory landscape.



¹⁶ World Bank Global Consumption Database. The data is from 2010 in USD. We applied nominal 2010-2016 GDP growth rates from the IMF to bring to a 2016 approximation.

Figure 1. Population centres and existing electricity grid with planned network up to 2035



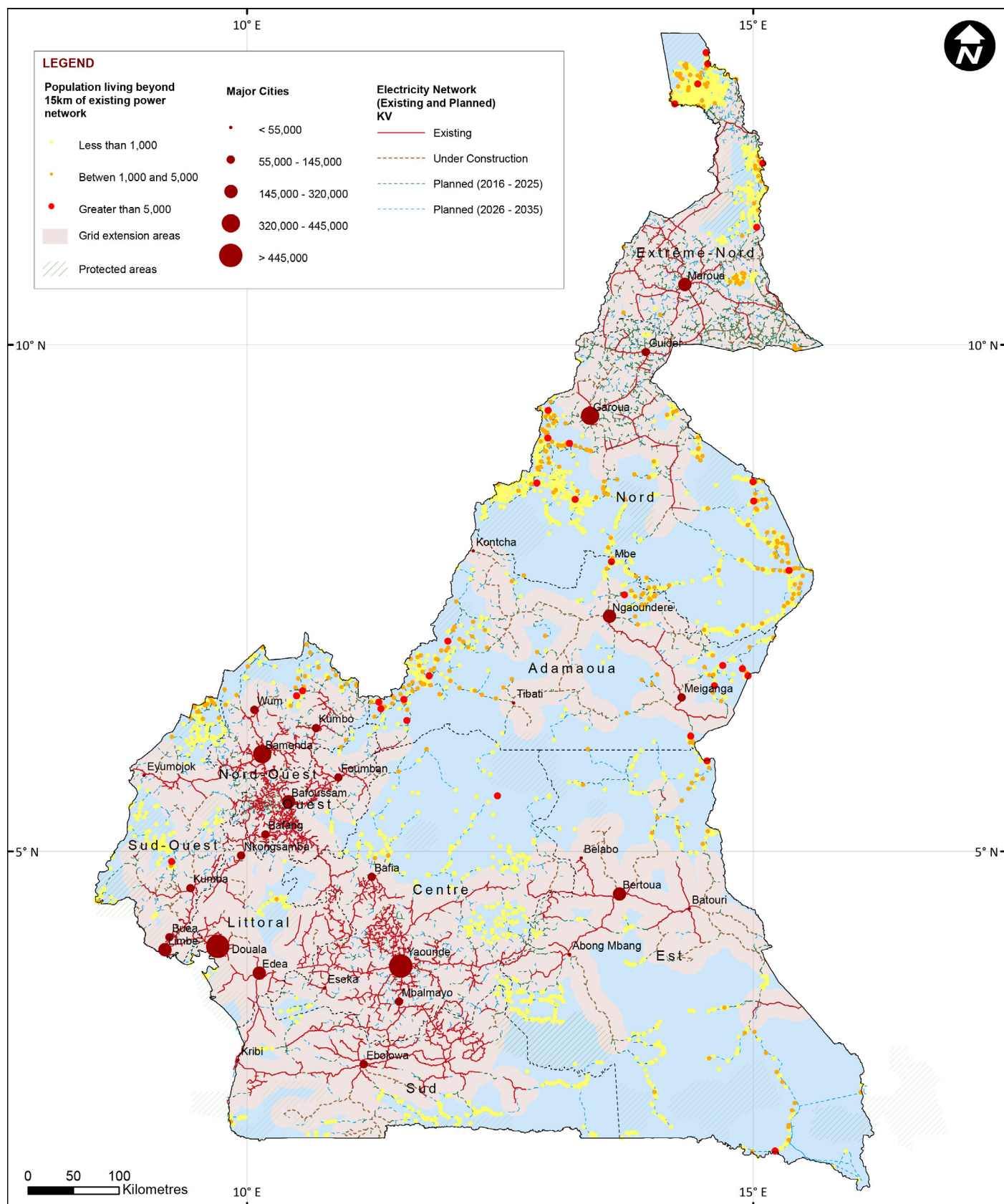
Source: Carbon Trust analysis based on PDER data

Table 1. Estimated annual household market size for off-grid solutions assuming three scenarios and a population split between grid extension and off-grid regions¹⁷

| Region | Grid Extension | Mini-Grid | | | |
|---|-------------------|-----------------------------------|---|-------------------------------|--|
| | Population | Population less than 1,000 people | Population greater than or equal to 1,000 and less than 5,000 | Population greater than 5,000 | Estimated Annual Off-Grid Market Size (US\$) |
| Scenario 1. Existing grid only | | | | | |
| Adamaoua | 460,649 | 144,360 | 282,299 | 297,255 | 33,370,711 |
| Centre | 4,012,226 | 47,154 | 12,551 | 7,037 | 3,076,647 |
| East | 543,577 | 133,740 | 73,048 | 73,382 | 12,915,170 |
| Far North | 3,047,245 | 300,349 | 336,690 | 284,345 | 42,473,608 |
| Littoral | 3,360,092 | 1,571 | 3,502 | - | 233,853 |
| North | 1,830,289 | 283,957 | 285,091 | 162,995 | 33,745,439 |
| NorthWest | 1,732,015 | 33,676 | 78,835 | 22,982 | 6,245,905 |
| West | 1,828,078 | 5,394 | 6,131 | - | 531,275 |
| South | 642,754 | 79,213 | 6,549 | 14,537 | 4,623,545 |
| Southwest | 1,311,445 | 77,050 | 65,208 | 20,732 | 7,513,451 |
| TOTAL | 18,768,370 | 1,106,464 | 1,149,904 | 883,265 | 144,729,603 |
| Scenario 2. Existing grid and networks under development | | | | | |
| Adamaoua | 790,740 | 80,398 | 177,253 | 136,172 | 18,154,302 |
| Centre | 4,021,012 | 41,493 | 9,426 | 7,037 | 2,671,634 |
| East | 659,121 | 71,501 | 42,681 | 50,444 | 7,588,866 |
| Far North | 3,605,384 | 172,902 | 112,010 | 82,155 | 16,920,914 |
| Littoral | 3,361,526 | 1,205 | 3,502 | - | 216,981 |
| North | 1,995,715 | 224,523 | 230,612 | 112,326 | 26,158,600 |
| Northwest | 1,790,976 | 21,111 | 41,331 | 14,090 | 3,527,943 |
| West | 1,835,851 | 3,752 | - | - | 172,958 |
| South | 708,279 | 32,947 | 1,827 | - | 1,602,999 |
| Southwest | 1,406,114 | 37,768 | 25,551 | 5,240 | 3,160,407 |
| TOTAL | 20,174,718 | 687,600 | 644,193 | 407,464 | 80,175,605 |
| Scenario 3. Existing grid, networks under development, and planned extensions up to 2035 | | | | | |
| Adamaoua | 1,173,299 | 2,561 | 8,703 | 7,842 | 880,741 |
| Centre | 4,071,304 | 6,429 | 1,235 | - | 353,292 |
| East | 778,775 | 13,055 | 24,075 | - | 1,711,605 |
| Far North | 3,968,629 | - | - | - | - |
| Littoral | 3,361,243 | 420 | 3,502 | - | 180,795 |
| North | 2,537,158 | 14,382 | 10,792 | - | 1,160,461 |
| Northwest | 1,865,828 | - | 1,680 | - | 77,444 |
| West | 1,839,603 | - | - | - | - |
| South | 738,122 | 4,931 | - | - | 227,307 |
| Southwest | 1,474,435 | - | - | - | - |
| TOTAL | 21,808,396 | 41,778 | 49,987 | 7,842 | 4,591,645 |

¹⁷ Total market size is estimated from the household energy market size. This assumes that 60% of household energy spend is on electricity, and that household spending comprises 60% of the total revenue of a mini-grid (when including revenue from businesses, public sector buildings and industrial users).

Figure 2. Distribution and population of settlements farther than 15km from current grid



Source: Carbon Trust analysis based on PDER data

3.4 RENEWABLE ENERGY POTENTIAL FOR MINI-GRIDS

HYDRO

Cameroon has an estimated 20GW of hydropower potential, among the greatest in Africa. Only 732MW (<5% of total potential) of hydropower capacity has been developed across three sites: Lagdo (72MW) in the north, and Songloulou (384MW) and Edea (265MW) in the south. Three projects are under construction, including Mekin (15MW), Lom Pangar (30MW) and Menve'ele (211MW). Projects in planning stages expected to be online in the next ten years include: Menchum (84MW), Bini Warak (60MW), Nachtigal Amont (390MW), Makay (400MW), Mbinjal (83MW), Mandourou (70MW), and Colomines (12MW).

Sixty-seven out of 270 small hydro sites identified in the PDER—with a total generation potential of 317MW—lie within 10km of a mini-grid population centre. Mini-hydro represents the greatest potential in Cameroon and can be used to power mini-grids, feed directly into the grid, and substitute thermal production centres. The PDER consolidated and reviewed data on small hydropower sites from several previous studies.¹⁸ Out of a total of 270 sites with a total power potential of 701MW, 67 sites (with a potential of 317MW) are suitably located to serve population centres identified as mini-grid candidates. The greatest potential for hydro mini-grids is in Cameroon's North and Adamaoua regions.

Table 2. Small hydro sites within a 10km buffer of mini-grid candidate population centres

| Province | Number of sites | Hydro Potential (MW) |
|--------------|-----------------|----------------------|
| Adamaoua | 20 | 81.86 |
| East | 8 | 66.00 |
| Littoral | 2 | 1.88 |
| North | 29 | 108.39 |
| Northwest | 5 | 51.84 |
| West | 1 | 0.60 |
| Southwest | 2 | 6.57 |
| TOTAL | 67 | 317.14 |

A number of projects to rehabilitate small and micro hydro-electrical plants are already under consideration or development. The PDER has identified 12 projects for isolated mini-grids. These are on average 2MW in capacity and are 7km away from the grid, with a combined total capacity of 24MW and an average levelized cost of electricity (LCOE) of 205 FCFA/KWh. Separately, the 2015 Investelec project identified 23 priority hydro projects at an estimated cost of FCFA 71 billion. The ERD RUMPI 2.9MW small hydro generation project on the Uve River in the southwest, and the Mbakaou Carriere' 1.4MW hydro-based mini-grid project in the western Djerem region are nearing completion (see Section 4.4 for more detail). In addition, a number of other identified sites are in preliminary planning phases, including, Yoké (1,500 kW), Malalé (720 kW), Luermannfalls (300 kW), Bare Bakem (50 kW), Kekem (60 kW), Koutaba (65 kW), and Foubot (65 kW), although the funding and operating structure of these projects requires further clarification. Additional programmes identified include a Swiss-funded micro hydro-based decentralised rural electrification project, an AER initiative that aims to develop three mini-hydro sites of approximately 5 MW each (currently in the feasibility assessment stage) in the east of Cameroon in the Messmock, Lomie, and Messamena localities, an Action for Equitable, Integrated & Sustainable Development (ADEID) hydro programme funded by the EU that seeks to develop four micro hydro sites listed above, and a United Nations Industrial Development Organization-Global Environmental Facility mini hydro project which will deploy 2.8MW of mini-hydro and biomass power in collaboration with ENEO¹⁹.

18 Including: JICA-EDF, 1996; Sonel, 1999; JICA, 1999; EED, 2014

19 AER website 2017. http://www.aer.cm/front-page?set_language=fr

BIOMASS

Cameroon's biomass capacity derived from its forest foliage, palm oil, rice, and sugar waste has the potential to generate an additional 700GWh for the national grid. The Rural Electrification Master Plan estimates a potential of 1000GWh, 700GWh of which could be injected into the power network. Agro industries producing wood, sugar, palm oil and rice are the main producers of feasible biomass. Forest residue generates up to 500,000 m³ tonnes of material with a potential generation of 720GW. As a result, 80 sawmill sites have been identified in the south and southwest regions, areas poorly served by the grid network. The sugar cane industry is growing and has a potential of 200GWh of electricity production. The palm oil industry, also rapidly growing, produced 270,000 tonnes in 2014 and its residue could generate an estimated 121GWh of electricity. Meanwhile, the country's rice production is centred on five plantations with a total production of 100,000 tonnes. Its biomass residue potential is 22,000 tonnes, representing 12GWh of potential electricity generation. It is estimated that production will increase to 180,000 tonnes by 2018.

Table 3. Overview of biomass sources in Cameroon

| | Wood | Sugar Production | Palm Oil | Rice Production |
|--|--|--------------------------------|--|--------------------------------|
| Production Unit | m ³ dry wood | Tonne of sugar cane | Tonne of fresh fruit bunch (FFB) | Tonne of paddy rice |
| Production reference | 6 million m ³ of dry wood | 2 million tonnes of sugar cane | 1.5 million of FFB | 100,000 tonnes of paddy rice |
| Waste output | 0.5m ³ residue / m ³ of dry wood | 290kg/ tonne of sugar cane | 210kg of shell fibre/ tonne of fruit and 230kg of cobs/ tonne of fruit | 220kg / tonne of paddy rice |
| Potential for electricity production | 120 KWh/m ³ of dry wood | 100KWh/tonne of sugar cane | 3-45 KWh/tonne of FFB | 90-120 KWH/tonne of paddy rice |
| Total potential electricity production (GWh) | 720 | 200 | 121 | 12 |
| Useable electricity (GWh) | 480 | 140 | 83 | 8 |

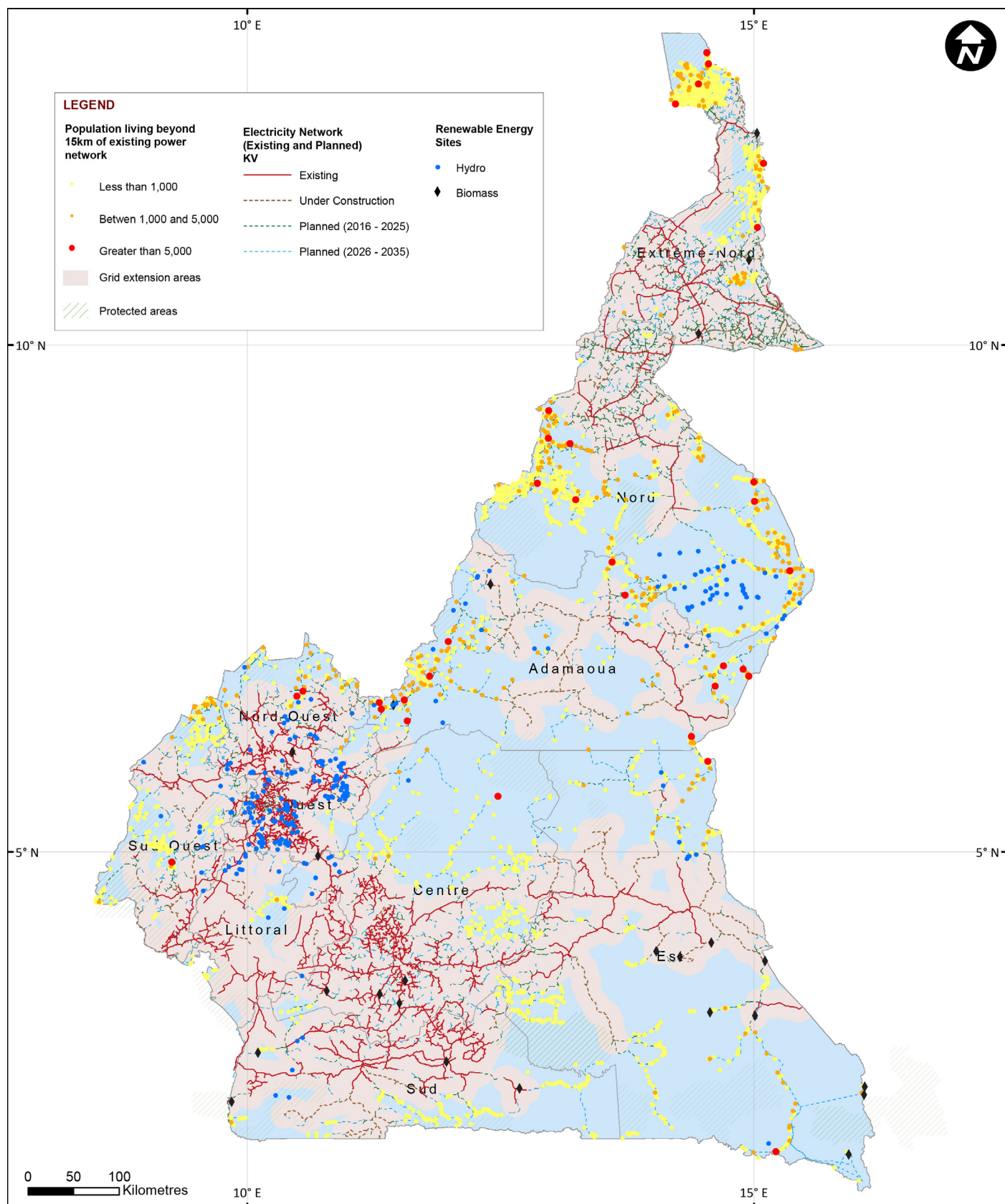
Source: PDER, 2016

This analysis suggests nine biomass sites totalling 20MW could power independent and grid connected mini-grids situated within 10km of a mini-grid population centre. Using data sets from the PDER, nine sites (totalling 20MW) were identified to be suitably located to serve population centres identified as mini-grid candidates. The greatest potential was found in the east of Cameroon. These results were achieved by mapping known biomass sites and applying a 10km buffer around target mini-grid population centres to reveal those sites that fell within this radius. (See Table 4 below.) Following technical analysis of seven biomass sites, the PDER estimates small scale biomass sites (> 100Kw) to have a LCOE of 200-300 FCFA/KWh. Separately, the Investelec study identified nine, out of a total of 25 sites, that could be developed, predominantly focused in the east of Cameroon, at an estimated cost of FCFA 12 billion. However, the development of biomass powered mini-grids could be hampered by the lack of commercially available biomass to power technologies.

Table 4. Biomass sites within a 10km buffer of population centres smaller than 5,000 inhabitants

| Province | Number of sites | Biomass potential (MW) |
|----------|-----------------|------------------------|
| Adamaoua | 2 | 0.132 |
| East | 6 | 15.659 |
| South | 1 | 3.862 |

Figure 3. Overlapping small hydro and biomass sites suitable for grid extension and mini-grid systems



Source: Carbon Trust analysis based on PDER data

SOLAR

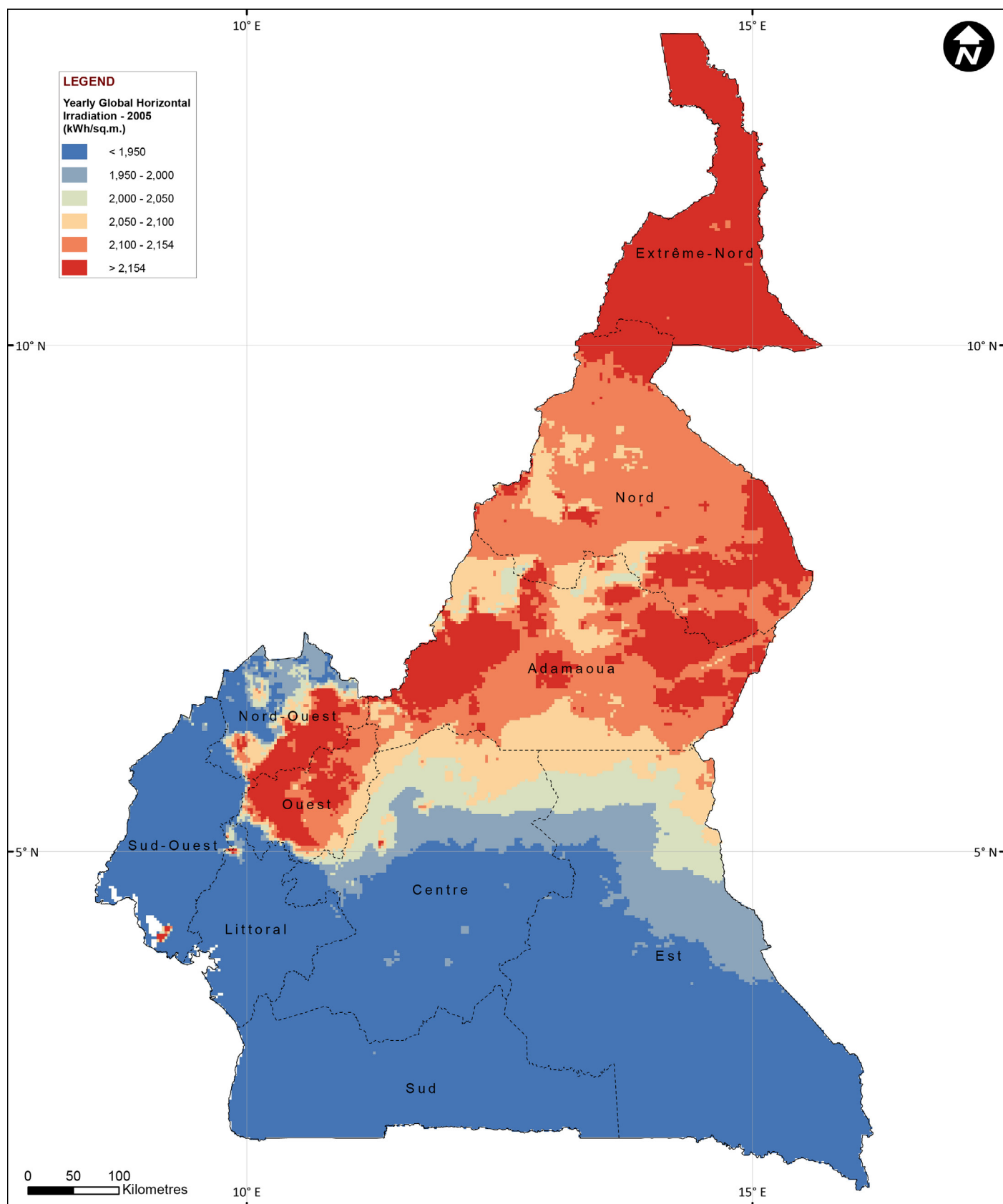
There is strong solar potential in Cameroon. Across Cameroon there is an estimated annual average of 4.9 KWh/m²/day, with an estimated 5.7 - 6 KWh/m²/day in the north and 4KWh/m²/day in the south. A recent study by the University of Dschang, identified photovoltaic systems to be among the most economical options for villages in the northern region for distances that were greater than 9-33.5km from the existing grid. In the PDER, solar-hybrid systems are identified as the most viable option where hydro and biomass sources do not exist, although in reality they could be more widely deployed.

Cameroon's first utility scale solar power project is in the initial stages of development, which will help reinforce the solar market and build much needed capacity within the sector. A 72MW solar plant in Mbalmayo is being developed by JCM Greenquest, with capital support being provided by the Dutch development bank FMO, and a US\$700,000 grant from the AfDB's Sustainable Energy Fund for Africa (SEFA). In addition, a number of other projects are being considered.

Off-grid solar energy solutions are only in the pilot stage in Cameroon, but possess strong potential. Despite considerable potential for solar power in Cameroon, to date, this resource has not been significantly capitalised upon. However, the sector is gaining traction with a number of on-grid and off-grid developments. Solar projects could act as standalone mini-grids and/or feed into the three principle grids. The government and the Chinese technology firm, Huawei, are starting implementation of a solar mini-grid rural electrification programme that aims to electrify 1,000 localities covering 75,000 households. It targets electrifying areas that are unlikely to be connected to the grid in the short to medium term (see section 4.4 for more information).



Figure 4. Yearly global horizontal irradiation

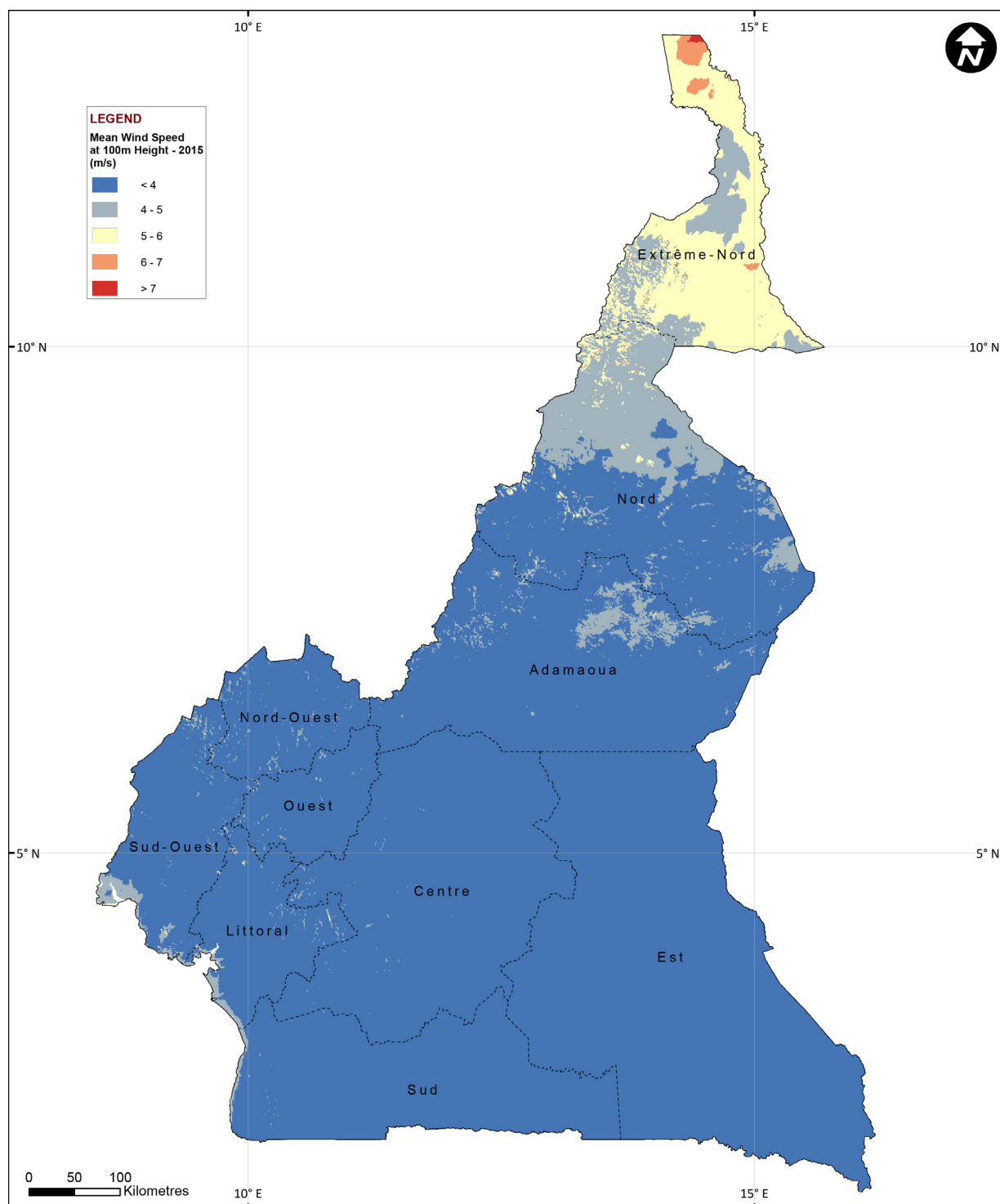


Source: Carbon Trust analysis based on DTU, IRENA data

WIND

Wind energy has not been widely developed in Cameroon due to the low wind speeds found across most of the country. With a few exceptions, Cameroon does not have large wind potential. Researchers and international data suggest that wind speeds (at a height of 80m/s) vary between 3.0m/s in the south to 5.0-5.5m/s in the north. The areas of Kaele Kousseri, the mountains of Bamboutos, and the region of Adamaoua have been identified as sites with strong potential. Wind technologies are generally still in the experimental stage in Cameroon and universities such as the University of Dschang and the Institut Supérieur du Sahel are piloting a few micro wind projects. However, the feasibility study for a 40MW on the Bamboutos Mountains in the West has been validated and the project is reportedly under development.

Figure 5. Mean wind speed in Cameroon



Source: Carbon Trust analysis based on DTU, IRENA data

4. OVERVIEW OF THE ENERGY SECTOR

4.1 CURRENT CONTEXT AND OVERVIEW OF RESPONSIBILITIES

The national energy policy is implemented by the Ministry of Water Resources and Energy (MINEE). Within the MINEE, the Department of Renewable Energy and Energy Management (DERME) is mandated to support the development of renewable energy including the conception of policies and strategies, the identification of renewable energy resources, the transfer of technologies and the promotion of renewable energy within the country. ARSEL, the electricity regulatory agency, is responsible for the regulation, control and monitoring of the activities of the operators in the electricity sector. The Electricity Development Corporation (EDC), a public institution, was created to operate and manage publicly owned electricity infrastructures, support and implement infrastructure projects and participate in the development and promotion of private and public investments in the electricity sector. ENEO, the national utility, is responsible for the distribution of electricity and is an important producer of energy. The government is in the process of establishing a state owned transmission system operator, Sonatrel, which is due to be operational in 2017/2018.

The Vision 2035 and the Growth and Employment Strategy Document (DSCE 2010-2020) underpin Cameroon's energy policy. The country's energy strategy aims to: ensure an efficient, reliable, clean supply of energy that meets the country's demand; develop and guarantee long-term access to modern energy services; and ensure energy is a contributor to Cameroon's global industrial competitiveness. These objectives are being delivered through a number of plans including the Development Plan for the Electricity Sector Horizon 2035 (PDSE), the Rural Electrification Master Plan (PDER), and the National Energy Plan for the Reduction of Poverty (PANERP). These documents highlight the need to increase Cameroon's large-scale hydro and fossil fuel generation capacity, extend the power grid to meet electrification targets and increase the share of renewables.

Cameroon's energy sector has been undergoing a long and gradual process of liberalization. The sector has been undergoing a step-by-step transformation since the late 1990s. In 1998, to improve governance and efficiency of the power sector, the government introduced the electricity law that led to the privatisation of the state-owned utility AES-Sonel in 2001, following a 51% acquisition by the American firm AES. In 2014, British private equity firm Actis took over AES shares and the corporation was renamed to ENEO Cameroon S.A. ENEO's share structure is now 56% owned by Actis, and 44% owned by the government of Cameroon. Despite the privatisation of the utility in 2001, it continues to face a steep challenge to increase its customer base, improve the availability and maintenance of its assets and reduce high levels of commercial losses. In 2011, a new law mandated the separation of the generation, transmission and distribution segments to foster competition in the sector. It accomplished this by: restricting ENEO's generation to 1,000MW; transferring water storage concessions from ENEO to EDC; mandating the creation of a state run system operator, SONATREL (Société Nationale de Transport d'Electricité), which is due to be fully operational in 2018; establishing penalties charges in the event ENEO fails to meet agreed performance targets; and establishing the framework for independent power producers and small scale distributors outside of ENEO's concession.²⁰²¹

However, ENEO still dominates the generation market and holds a monopoly on distribution. ENEO is still the principal electricity producer with an estimated 968MW of production capacity. Liberalisation acts have had limited impact with only a few IPP's created, notably the KPDC 216MW natural gas plant and the DPDC 88MW HFO plant. ENEO's generation facilities include 13 grid power plants and 26 remote thermal power plants powering local mini-grids. Furthermore, it holds exclusivity over its distribution concession, which covers over 70% of the communes in Cameroon. With ambitious and grid-centred plans for rural electrification it is foreseen that ENEO will increase its concession and remain the principal distributor of electricity, leaving limited room for independently operated mini-grids.

20 World Bank, Project Information Document PIDISDSC16563, 2016

21 Government of Cameroon, New Electricity Law, 2011

The Rural Electrification Agency was created in 1999 with the mandate to accelerate rural electrification, but impact has been limited. The Rural Electrification Agency (AER), as denoted through the Article 62 in the 2011 law, is responsible for overseeing rural electrification. However, in practise, the roles and responsibilities are distributed, and at times duplicated across centralised and decentralised actors making the institutional landscape complex. Between 2002 and 2012, 1,600 population centres were electrified, the majority under the leadership of MINEE and EDC. Since 2013, an increasing number of projects are being undertaken by the EDC and decentralised authorities with support from Special Council Support Fund for Mutual Assistance (FEICOM) and the National Programme for Participative Development (PNDP). The Rural Energy Fund (FER) was created in 2009 and falls under the remit of the AER. However, due to the lack of funding it has had limited impact to date. The government is reportedly examining options to streamline and better define responsibilities. It is envisaged the AER will have a more important role in the future.

Household connection rates in Cameroon remain low (26%) and significant resources are required to increase electrification rates. Electrification rates in rural areas in the north are particularly low with connection rates to ENEO estimated as low as 6%.²² The PDER estimates that 9,806 localities have no access to electricity, representing 36% of the population (approximately 8.4 million people) and 69% of Cameroon's localities. Out of the 9,806 non-electrified localities, approximately 70% of them are home to less than 500 inhabitants, making isolated mini-grids a likely and most suitable option. Depending upon the length of the required grid extensions, mini-grids may be the least cost option to best serve certain low-density populations, especially those in the north. Pipeline projects geared toward increasing extra production capacity are mainly focused on the southern and eastern regions, further reinforcing the business case for mini-grids in other rural areas.

Table 5. Percentage of households in Cameroon connected to the low voltage network by region

| Adamaoua | Centre | East | Far North | Littoral |
|----------|-----------|------|-----------|-----------|
| 15% | 32% | 15% | 6% | 43% |
| North | Northwest | West | South | Southwest |
| 6% | 19% | 38% | 26% | 25% |

Source: PDER, 2016

4.2 POWER NETWORK AND INFRASTRUCTURE

Cameroon possesses 1.3GW of installed power capacity, based on large-scale hydropower and hydrocarbon plants.²³ In 2014, total electricity production reached 7,700GWh. Hydropower accounted for 57.56% of this production and thermal stations for an additional 42.4%. Other renewable sources accounted for only 0.06% of total production.²⁴ The country's hydropower is derived from three principal sites that account for 732MW of installed capacity. Between 2010 and 2014 production capacity grew by approximately 350MW, notably due to the start of operations of the Kribi Gas Power Plant (216MW) in 2013 and of the 100MW diesel Emergency Thermal Programme (PTU). ENEO currently operates 17 grid-connected thermal units and 26 isolated sites, however many of these sites are ageing and availability is in decline. ENEO is reportedly transferring the management of major hydro concessions to the EDC, which is also overseeing the construction of the Lom Pangar Dam and providing technical assistance for hydro development on the Sanaga river.

To meet increased demand, the government has prioritised new large-scale hydropower and thermal generation plants. In order to meet increasing domestic and industrial demand, the government has set a target to increase production to 3,000MW by 2020. It aims to achieve this through increased investment in large hydropower and thermal projects.

22 Access to energy figures quoted in numerous Cameroonian and international reports (estimated to be between 48-74%) are misleading as these simply reflect the percentage of the population that live in a population centre that have a connection point to the power network. This is not a measure of the rate of household electrification.

23 Estimates in literature vary between 1.25 and 1.45GW

24 MINEE Situation Énergétique du Cameroun 2015 (p.77). Noting large hydro is not classified as a 'renewable' source in Cameroon.

Cameroon has a particularly strong hydro resource in the Sanga Basin and natural gas and petroleum reserves in the Rio del Rey and Kribi Doula Campo Basins (estimated to hold 154 billion m³ of natural gas and 221 MMbbl of petroleum).²⁵ The government, with support of international stakeholders, is currently developing a large number of hydropower projects that will help increase and regulate supply across the country.

Cameroon has three main grids: the southern, the eastern and the northern grids. The three grids are independent of each other and operate in isolation. The southern network, which includes the cities of Douala and Yaoundé, far exceeds the others in terms of capacity and energy flows.²⁶ The lack of interconnection between the three networks greatly reduces the flexibility required to effectively manage supply and demand. Historically, ENEO was fully responsible for these networks. However, responsibility for high voltage transmission lines (225kV, 110kV, and 90kV lines) will be handed over to SONATREL—the transmission system operator (TSO)—once fully operational. ENEO will remain responsible for distribution, including for the medium and low voltage lines, which comprise 30kV, 15kV, and 0.22kV lines.

Despite growth between 2010 and 2014, the power network suffers from underinvestment. Efforts are underway to further expand and reinforce the grid. Between 2010 and 2014, the transmission and distribution grid grew (in km) by approximately 15% and 30%, respectively. However, capital investments have been insufficient and increased resources are required to further extend its reach, replace ageing assets, connect new households and reduce losses.²⁷ Cameroon has approximately ten electrical outages per month, which last an average of two hours each.²⁸ Losses have increased on an annual basis from 2005 to 2010. Distribution losses are estimated at 31% (1,271GWh) and transmission losses are estimated at 6% (295GWh). Commercial losses are significant, estimated at 14% in 2014, impacting ENEO's earnings.²⁹ The ratio between electricity sold and electricity distributed reduced from 78% in 2006 to 69% in 2014.

Sector priorities include the need to bolster generation and rehabilitate and modernize existing transmission infrastructure. To improve the quality of power supply and reduce energy losses, the government has prioritized the reinforcement and replacement of transmission and distribution capacity.³⁰ The government, following a study on each of the three grids, estimated the investment required at US\$1.64 billion.³¹ The government's Mid-Term Expenditure Framework 2015-2017 (CDMT) for the development of transmission equipment is structured around five projects. The country expects to reinforce and stabilise the power network in both Yaoundé and Douala cities. The western region is currently facing power supply overload that the CDMT also plans to address. Additionally, the CDMT integrates two international interconnection projects: the Cameroon-Nigeria interconnection of 400kV (Yola) and the Chad-Cameroon interconnection (Ngdéré-Maroua-Mora-Kousseri-Ndjaména).

4.3 SUPPORT FOR RENEWABLE ENERGY

The government is currently prioritising large-scale hydropower projects. However, Cameroon's first large-scale wind and solar farms are being developed. The government, in collaboration with international donors, is currently developing a number of large-scale renewable projects, including a 72MW solar power plant in Mbalmayo and a 40MW wind generation plant on the Bamboutos Mountains, with the possibility to expand this to 80MW. In addition, a number of smaller scale hydro and solar programmes are in initial phases. More information on these is provided in Section 3.

As part of its Nationally Determined Contributions (NDC), the government has committed to 25% of renewable energy by 2035. Renewable energy currently contributes less than 1% towards Cameroon's energy mix. The government through its NDC, PDSE, and PDER policy documents has highlighted its intention to increase the share of renewable

25 MINEE Situation Energétique du Cameroun 2015

26 In 2014, 5,698GWh was injected into the southern grid, compared to 329GWh and 56GWh into the northern and eastern grids.

27 To date, total clean energy investments have been scarce with only US\$100 million between 2011 and 2015 (Climate Scope 2016 estimate).

28 World Energy Outlook 2015. Chapter 2.

29 ENEO analysis suggests 15% of losses arise for commercial reasons (e.g. poor or lack of billing and illegal connections) and 15% due to technical losses. Separately, non-distributed energy was estimated at 73GWh in 2014 (e.g. load shedding, programmed disruptions and other incidents).

30 According to the MINEE, load shedding has increased since 2010 highlighting the limited capacity of the networks.

31 \$0,0016/FCFA. www.xe.com/currencyconverter. 02.2017

production in Cameroon to 25% by 2035. This objective is expected to be included in the renewable energy law that is being drafted. It targets 25% of renewable production out of total of 6000MW by 2035, including 11% from micro-hydro (660MW), 7% from biomass (420MW), 6% from solar (360MW) and 1% from wind (60MW).

A Master Plan for the Development of Renewable Energy in Cameroon is currently being developed. The plan is being developed by the Ministry of Water Resources and Energy, with financial and technical support provided by the Korean International Cooperation Agency, KOICA. The project has three key aims. Firstly, to identify high potential sites for the development of renewable energy. Secondly, it will seek to establish a viable master plan for the sector, including the exploitation and distribution of renewable energy in Cameroon. Thirdly, it will work to increase the capacity of Cameroonian officials.³²

There is not a dedicated law for the renewable energy sector. However, the adopted 2011 law that regulates the power sector does consider power generation from renewable energy sources. It gives certain priorities to decentralized renewable energy production. For example, it establishes the obligation for the power utility to buy power surplus from small-scale renewable energy producers and foresees fiscal incentives and tax exemptions to renewable energy products and services.

There is currently no feed-in-tariff framework or revenue-based incentive mechanism for renewable energy. Currently, import duties and VAT incentives are the only existing renewable-specific support mechanisms. Renewable energy must therefore compete on a cost basis with domestic fossil fuel production and foreign imports. The government is reportedly considering approaches to develop a comprehensive framework for small-scale producers and distributors.

4.4 OFF-GRID DEVELOPMENTS AND SUPPORT FOR ENERGY ACCESS

Household electrification rates remain low despite a high percentage of the country's population residing in localities that are connected to the grid. The current national household electrification rate is estimated at 23%, with a low of 6% in the North region and a high of 43% in the Littoral region. This contrasts to the percentage of the population living in population centres that have a connection to the power network, which currently stands at 74% (commonly denoted as the access rate in Cameroonian policy documents).³³ In addition, while ENEO's concession covers 70% of the communes, only 31% of population centres possess a grid connection. Nevertheless, between 2013 and 2016, 780 population centres were electrified up from 1,600 between 2001 and 2012. Historically MINEE was the entity responsible for these projects, but the AER, EDC, PNDP, and FEICOM are now playing increasingly important roles.³⁴

The Rural Electrification Master Plan sets out a roadmap to increase household electrification rates to 54% and the number of population centres connected to the grid to 85% by 2035. Most notably, the plan foresees household electrification rates in the northern regions increase from 7% today to 45% in 2035, a substantive and challenging increase. In addition, it aims to increase the number of population centres with a connection point to the grid to 85% by 2035, up from 31% today. This is forecasted to cover 98% of the population by 2035. Although the potential to increase energy access by extending the existing grid and connecting households currently living within villages connected to the grid is high, policy changes and increased funding commitments will be required. The PDER 2016 defines a clear grid extension plan and includes expected results for each five-year phase. By the end of phase 4, all localities with over 150 inhabitants are expected to be electrified. It estimates the cost of extending the grid will amount to FCFA 559 billion (Central African CFA franc) over 20 years. The majority of investment will be focused on the northern region (64%), with smaller investments in the south (28%) and east (8%). In addition, this will entail FCFA 55 billion for feasibility and technical studies and the supervision of the work, and approximately FCFA 36 billion of accompanying measures and compensation for environmental and social impacts.

32 [AllAfrica.com](http://allafrica.com/stories/201504100856.html). 2015. Cameroon: National Renewable Energy Master Plan Under Preparation. Available here: <http://allafrica.com/stories/201504100856.html>

33 PDER, 2016

34 MWH 2016. CW98.201508 Cameroon Stocktaking Report

Table 6. Expected results by phase, Rural Electrification Master Plan (PDER)

| | 2015 | Phase 1 (2016–2020) | Phase 2 (2021 – 2025) | Phase 3 (2026 – 2030) | Phase 4 (2031 – 2035) |
|--|------|---------------------|-----------------------|-----------------------|-----------------------|
| National electrification rate | 23% | 32% | 41% | 48% | 54% |
| Electrification rate in the southern region | 32% | 39% | 46% | 53% | 59% |
| Electrification rate in the northern region | 7% | 21% | 30% | 39% | 45% |
| National grid coverage rate | 31% | 44% | 64% | 75% | 85% |
| National population energy access rate | 74% | 85% | 94% | 98% | 99% |
| Number of electrified localities at end of phase | | 6,772 | 9,525 | 11,097 | 12,526 |
| Number of localities to be connected per phase | | 2,065 | 2,753 | 1,572 | 1,429 |
| Total electrified population at end of phase (in millions) | | 20.3 | 24.6 | 28 | 31.1 |
| Population electrified per phase (in millions) | | 2.9 | 2.4 | 1.1 | 0.5 |
| Number of additional connections | | 179,222 | 222,694 | 195,198 | 181,243 |

Source: Adapted from the PDER, 2016

The PDER foresees a small, but important role for mini-grids in electrifying population centres that will not be grid connected in the short to medium terms. It identifies 27 mini-grids powered by small hydro, biomass, and solar. The PDER foresees the development of 12 mini-grids powered by hydro with a combined capacity of 24.5MW, 7 mini-grids powered by biomass plants with a combined capacity of 2.5MW and 8 mini-grids powered by hybrid solar and diesel systems with a combined capacity of 550kW. Additional details are provided in Table 7 below. The role out of 27 mini-grids is estimated to cost FCFA 154 billion, including FCFA 137 billion in capital expenditure, and FCFA 17 million for feasibility studies and supervision.

Table 7. Mini-grid characteristics, Rural Electrification Master Plan (PDER)

| Generation source | Number of sites | Total capacity | Projected LCOE(FCFA/ KWh) | Population in connected villages | Number of forecasted clients | MV lines (KM) | Estimated cost (FCFA) |
|-------------------|-----------------|----------------|---------------------------|----------------------------------|------------------------------|---------------|-----------------------|
| Hydro | 12 | 24.5 MW | 138-291 | 374,416 | 59,142 | 903 | 124.5bn |
| Biomass | 7 | 2.5 MW | 200-300 | 74,939 | 7,763 | 264 | 11.9bn |
| Solar-Diesel | 8 | 557 kW | 400-850 | 14,582 | 1,208 | NA | 2.4bn |

Source: Adapted from the PDER, 2016

The main international donors supporting rural electrification include the African Development Bank, the World Bank, the Islamic Development Bank, European Union, and Japan International Cooperation Agency (JICA). Additional support is being provided for off-grid projects by actors such as the Agence Francaise de Development (AfD), Korea International Cooperation Agency (KOICA) and German development bank, KfW. The Rural Electrification Project

and the Reinforcement and Extension of Transport and Distribution Electrical Networks Project (PRERETD) are the principal mechanisms targeting rural electrification through the extension of the grid. In 2016, the MINEE in collaboration with the Islamic Development Bank, launched Phase II of the Rural Electrification Project. The first phase resulted in the electrification of 3,935 households across 33 population centres. The second phase aims to support the connection of an additional 102 population centres across the country. Funding commitments for the second phase include FCFA 12.2 billion from the Islamic Development Bank, FCFA 8.45 billion from OPEC, FCFA 6.31 billion from the Arab Bank for Economic Development in Africa (BADEA), and FCFA 1.35 billion from the government of Cameroon.³⁵ In addition, the PRERETD includes grid investments in eight out of ten regions of the country. The project is financed by the African Development Fund, the African Development Bank, JICA and the Cameroonian government and plans to extend the low voltage, medium voltage and high voltage networks. The EU is funding a number of grid extension projects including the PERPREN Monts Mandara project in the Extreme North region targeting the electrification of 44 villages at an estimated cost of EUR 10 million. The AfD and KfW are supporting rural electrification through the PNDP programme by working closely with decentralised authorities including FEICOM. In addition, a number of other projects are reportedly being developed including: a UNIDO and GEF funded biogas, small hydro and solar programme that aims to electrify 7,000 households; a domestic biogas programme in partnership with Netherlands Development Organisation (SNV); and a German solar mini-grid programme.

While the policy focus is on grid extension, the first government led mini-grids are being deployed. A solar mini-grid programme developed by the MINEE and Chinese telecom company, Huawei, (with financing from EximBank in China) aims to electrify 1,000 population centres. In 2015, the first phase secured a FCFA 46 billion loan, with the Cameroonian government contributing an additional FCFA 7 billion. The programme is in its initial phase, targeting 350 population centres. The forecasted mean generation capacity is 50-80kW per site, aimed at supporting 150 households. A prepayment smart metering system will be utilised to avoid the need for extensive monitoring of meters and subsequent billing. The selection of sites is based on three principal criteria: distance to the grid; potential to stimulate economic activity; and presence of a stable population. The final consumer tariff is still under consideration, although a universal programme tariff of 100 FCFA/kWh has reportedly been discussed. Huawei is undertaking engineering, procurement, and construction of the programme. Operational responsibility of the assets will reportedly be transferred to a separate state-led entity, which is in the process of being incorporated. The AER is now in the process of training personnel to ensure suitable capabilities for operations and maintenance.

In addition, the Cameroonian government, with financing from the EU Energy Facility, is in the final stages of developing a 2.9MW hydro plant and an associated distribution network aimed at powering the Big Masaka and neighbouring villages. The project is also developing an underground cable to connect to an existing switchyard to sell excess power to ENEO through a nearby existing 30kV line. The operation of the plant will reportedly be transferred to the local municipality which will partner with a private entity, chosen as the result of a competitive tender held by ARSEL. The responsibility for the distribution of electricity will be handed over to ENEO. The project is part of a wider programme financed through the government of Cameroon and a EUR6.6 million EU grant, for a reported total of EUR16.8 million. The project is promoted by the AER, MINEE, and ARSEL.³⁶

The first independently developed mini-grid is due to be operationalised in 2018. Although distribution operational responsibility will be reportedly handed over to ENEO. The 1.4MW Mbakaou Carriere mini-hydro project (expandable to 2.8MW) in the western Djerem region is forecasted to be completed in 2018. IED-Invest, the project lead, has recently finalised licensing agreements with ARSEL and purchase agreements with ENEO. It is the first private independent operator to achieve an IPP license. The project has mobilised EUR4.8 million from IED-Invest and a EUR2.5 million grant from the EU, which will go toward building the hydro plant and a 70km medium and low voltage distribution network. It was

35 Actu Cameroun. « Cameroun : 8,5 milliards de FCFA du Fonds de l'OPEP pour le secteur de l'électricité » 1 April 2017. <https://actu cameroun.com/2017/04/01/cameroun-85-milliards-de-fcfa-du-fonds-de-lopep-pour-le-secteur-de-l-electricite/>

36 <http://database.energyfacilitymonitoring.eu/acpeu/project/4291/>

initially planned that IED would operate both the hydro plant and the distribution of electricity to nearby villages.³⁷ However, ENEO will now reportedly be handed over responsibility for the operation of the distribution segment. Once completed, it will connect 2,800 households across eight localities.

4.5 CHALLENGES TO INCREASING THE UPTAKE OF GREEN MINI-GRIDS

Mini-grids are not prioritized in energy policy despite an increase in activity in recent years. Energy generation and access policies are focused on large-scale hydropower and hydrocarbon developments. Power regulatory policy is focused on the creation of the TSO, SONATREL, while rural electrification policy is focused on grid extension. Nevertheless, the government is in the initial stages of piloting green mini-grid solutions. However, it should be noted that the government's green mini-grid aspirations are limited. The PDER foresees just 20,000 mini-grid-based connections by 2020.

The legal framework limits the potential of independent mini-grids. ENEO holds a monopoly in distribution rights across more than 70% of Cameroon's communes, although the law foresees the possibility of allowing independent distributors of electricity with a maximum capacity of 100kW in these areas. In rural areas, the maximum installed capacity of independent power distributors is capped at 1MW. ENEO is obligated through the 2011 law to connect and purchase excess renewable energy generation from small installations. However, there is no framework for agreeing terms.

In addition, a comprehensive inventory of exploitable sites has not been completed. While some data sets exist, the breadth of these vary per technology area. For example, small hydro sites are relatively well documented but there is limited information on the location of suitable solar, biomass, and wind sites. There is also a lack of reliable data on the characteristics of identified sites, including production capacity and investment costs.

The government will need to increase current support for energy access if it wants to meet the national electrification targets set by Vision 2035 and the PDER. Between 2001 and 2012 an estimated 1,600 localities were electrified.³⁸ At this rate and without further support, it will take Cameroon 75 years, not the projected 20 years, to reach its global electrification target. Based on an assessment of 543 localities, the costs of electrifying one locality can vary significantly. For the 2008-2012 period, the average cost per locality to the AER was FCFA 102 million compared to FCFA 26.3 million for the PNDP.³⁹



37 IED Invest

38 ARSEL 2013. Etude sur l'évolution du périmètre de la concession d'AES-SONEL

39 MWH 2016. CW98.201508 Cameroon Stocktaking Report

5. REGULATORY FRAMEWORK FOR MINI-GRIDS

5.1 REGULATORY AND POLICY ENVIRONMENT: KEY TAKEAWAYS

Table 8. Summary of Cameroon's regulatory and policy environment

| | Enabling Factors for the development of clean energy mini-grids | Limiting Factors for the development of clean energy mini-grids |
|---|--|--|
| National planning and institutional setting | <ul style="list-style-type: none"> Key policy documents (e.g. Vision 2035, PDER, PDSE, DSCE) make commitments to clean rural electrification, including a 2035 target for 98% of population centres to have a point of access to the power grid. Law N°2011/022 of 14 December 2011 enables independent mini-grids to operate and connect to the grid. Law N°2013/004 of 18 April 2013 prioritises renewable energy. A dedicated Rural Electrification Agency (AER) responsible for rural electrification and a Rural Energy Fund (FER) exist. | <ul style="list-style-type: none"> Energy access strategies prioritize grid extensions over the deployment of mini-grids. ENEO, the privatized national utility, owns a distribution concession covering most of the country, limiting the opportunity for mini-grids. |
| Data availability | <ul style="list-style-type: none"> The key laws are available online from ARSEL, the MINEE, and select ministries. | <ul style="list-style-type: none"> Many relevant documents and data sets exist but are not publically available. The websites of some agencies are non-operational, or have limited functionality. A GIS platform is available, however it is outdated, has limited use, and does not allow download of key data. |
| Licensing | <ul style="list-style-type: none"> Independent power distributors and generators are foreseen by the regulatory framework. | <ul style="list-style-type: none"> All independent power distribution projects require an authorisation from ARSEL. The size of mini-grid projects is capped at 100kW in general and at 1MW in rural electrification. |
| Tariffs | <ul style="list-style-type: none"> Public tariffs are reviewed every five years, providing a good level of visibility for developers. | <ul style="list-style-type: none"> The social tariff of 50 FCFA/KWh sets a hard to meet benchmark for mini-grid developers. The government is subsidizing power tariffs through direct budget transfers to the utility. Mini-grid developers can propose tariffs, but these are reviewed and determined by ARSEL on a cost-plus basis. In practice, as is the case with ENEO, political reasons may push ARSEL to keep electricity tariffs low. |
| Subsidies and incentives | <ul style="list-style-type: none"> Law N°2013/004 of 18 April 2013 establishes private investment incentives, e.g. VAT and customs duties exemptions, tax credits, easier administrative processes may be applicable. Reduced licensing requirements have been put in place for small clean generation projects. | <ul style="list-style-type: none"> The Rural Electrification Fund, managed by AER, has been set up to provide funding to private mini-grids, but budget and impact have been limited. |
| Power purchase agreements | <ul style="list-style-type: none"> The 2011 Electricity Law defines the obligation to purchase renewable energy supply. A few small-scale renewable energy Power Purchase Agreements (PPAs) are being negotiated. | <ul style="list-style-type: none"> No standard PPAs and related feed-in-tariffs exist for renewable energy projects. PPAs need to be negotiated on a case-by-case basis. |
| Arrival of the grid | <ul style="list-style-type: none"> Plans for grid extension between 2016-2035 are available providing long-term visibility for investors. | <ul style="list-style-type: none"> There are no protection laws in place for developers when the grid arrives. |

| | Enabling Factors for the development of clean energy mini-grids | Limiting Factors for the development of clean energy mini-grids |
|---------------------|---|---|
| Arrival of the grid | <ul style="list-style-type: none"> Plans for grid extension between 2016-2035 are available providing long-term visibility for investors. | <ul style="list-style-type: none"> There are no protection laws in place for developers when the grid arrives. |
| Technical rules | <ul style="list-style-type: none"> Mini-grid projects must follow the rules for the distribution of electricity set out within the Order N°00000013/MINEE dated 26 Jan 2009. | <ul style="list-style-type: none"> No technical standards for mini-grids exist. |
| Mobile services | <ul style="list-style-type: none"> The sector is liberalised with high coverage (75% of Cameroonians have mobile cellular subscriptions), and good competition. Multiple mobile payment systems exist, including one operated by ENEO. Mobile money services are being tested in the Huawei Solar Mini-Grid Programme. | <ul style="list-style-type: none"> Persisting dysfunctions such as cut-offs for non-payment after paying with mobile services. Unreliable network services. |

5.2 MINI-GRID POLICY AND REGULATORY ENVIRONMENT

NATIONAL PLANNING AND INSTITUTIONAL SETTING

The main authority in the energy sector is the Ministry of Water Resources and Energy (MINEE). MINEE is responsible for all energy policy and grants concessions and licenses. ARSEL, the national regulator, is responsible for the regulation, control and monitoring of activities in the electricity sector. ARSEL issues authorisations and declarations. The Rural Electrification Agency (AER) was established in 1999. It is responsible for the elaboration of rural electrification policies and providing operators and users with technical and financial assistance. A Rural Energy Fund (FER), created in 2009, is in operation and can provide funding for high priority rural electrification projects. However, it has had limited impact to date. Rural electrification decisions are being increasingly devolved to local authorities that can receive support from FEICOM, an entity empowered to provide financial support to local councils.

Cameroon has been liberalising its energy market for over a decade. Cameroon began reforming its power sector almost two decades ago with the introduction of the Law N° 98/022 of 24 December 1998, which is aimed at restructuring the electricity industry and creating a dynamic power sector. The power utility has been privatized and the power sector unbundled. The generation segment has been opened to independent power producers and SONTATREL, a newly created state-run transmission system operator, is now in the process of assuming the responsibility to manage the transmission network.

ENEO, the national utility, holds a concession for power distribution in most of the country, but independent power distributors are foreseen beyond this area. ENEO's distribution network reaches 70% of Cameroon's communes. Nevertheless, with one million connections, the utility serves less than 25% of the population. The 2011 Law allows the development of small-scale mini-grids in areas not covered by ENEO subject to previous authorization from ARSEL. The existing laws are reportedly being clarified and possibly amended to better allow for the operation of mini-grids.

The Vision 2035 and the Growth and Employment Strategy Document (DSCE 2010-2020) underpin Cameroon's energy policy and promote rural electrification. These key policy documents are operationalised through a number of plans and entities including the Energy Sector Development Plan Horizon 2035 (PDSE); the Rural Electrification Master Plan 2016 (PDER); and the National Energy Action Plan for Poverty Reduction (PANERP). The PDSE is the core document that lays out the electricity strategy for Cameroon, and is largely based on increasing large hydropower. The PDER provides the strategy for improved rural electrification, including the promotion of increased small-scale renewables. It was originally devised in 2001, and refreshed in 2015/2016 as part of the Development of the Energy Sector Project (PSDEN). A Renewable Energy Master Plan is under development.

Despite an enabling institutional environment, several barriers exist to the development of mini-grid solutions. Although the policy framework allows for independent mini-grids, the Rural Electrification Master Plan, developed by MINEE and now under the control of AER, places a heavy emphasis on the extension of the grid and the development of large hydro and thermal power plants. Also, public funding is scarce and overlap exists in the remits of a number of key institutional players, which makes navigating the public sector difficult for independent and external parties.

DATA AVAILABILITY

Lack of information within the public domain creates unnecessary barriers for mini-grid developers. Legal documents are available on ARSEL's website. However, despite the creation of energy sector and rural electrification studies and plans, they are not widely available within the public domain. Key documents which do not feature on government webpages include the Rural Electrification Master Plan (PDER), the Energy Sector Development Plan Horizon 2035 (PDSE), the MINEE Annual Statistics report, and the latest population census.

Existing GIS data is not made publicly available to mini-grid developers. The only publicly available information, which is out of date and has limited functionality, can be found here: <http://www.mng-cameroon.org/SIG/default.asp>. More current data exists covering the grid network (current and planned), population centres, and a portfolio of renewable energy sites. This data, which was funded by the World Bank, has been kindly shared with the authors of this study by the Ministry of Water Resources and Energy and IED, but is not readily available to interested parties. The limited availability of comprehensive and up-to-date geospatial data does not facilitate initial site assessments for local stakeholders, and can discourage international stakeholders from investing in the sector.

LICENCING

The size of mini-grid projects is capped at 100kW in general and at 1MW for rural electrification. Mini-grid developers must obtain an authorisation from the regulator, ARSEL. Although ENEO holds a concession for power distribution, the Electricity Law of 2011 foresees the possibility of authorisations being granted to independent power distributors when the existing electricity service is limited or non-existent. Authorisations are limited to distribution projects with an installed power capacity no bigger than 100kW in general, and not bigger than 1MW in rural electrification projects.

Small-scale renewable energy independent power producers must obtain a license and an authorisation from ARSEL. In general, independent power producers must obtain a license from ARSEL for the sale of electricity. Renewable energy generation projects associated with rural electrification projects are subject to authorisation from ARSEL, but exempt from any tendering process and benefit from special fiscal incentives. The Electricity Law defines renewable energy projects as those based on the following technologies: solar, wind, hydro (up to 5MW), biomass, geothermal and marine. According to the 2011 Electricity Law, ENEO is obliged to buy surplus power from decentralised renewable energy plants, but this is conditional upon its ability to obtain the corresponding license and authorisation. The Mbakaou Carriere project, led by IED-Invest, will be the first private independent operator to successfully obtain an IPP agreement with ENEO.

A detailed project description needs to be provided when requesting a license or an authorisation. The Decree N°00000193/A/MINEE of 28 April 2014, lays out the provisions and fees for licences, and authorisations. A request must include the:

- Purpose of the business;
- Social and economic case for the request;
- Nationality and domicile of the business, and of key management personnel;
- Technical and financial capacity of the firm;
- Approval from the relevant authority in cases where construction is in an environmentally-protected area;
- Comprehensive technical study and its associated documents (e.g. energy sources used, maps, construction plans, etc.); and
- Study on tariffs, with its associated calculations.

TARIFFS

National electricity tariffs are fixed by the regulator ARSEL and kept below cost. ARSEL applies revenue-cap principles to establish power tariffs for low voltage and medium voltage customers. A social tariff of 50 FCFA/kWh (US\$0.082/kWh) for a monthly consumption of up to 110kWh exists. The current average tariff is 78FCFA/kWh (US\$0.135/kWh). These tariffs are not cost-reflective. The government of Cameroon has decided not to fully pass on the increase in generation costs to consumers due to political and social reasons. Instead, the government is making direct annual contributions of US\$30 million to ENEO.⁴⁰

ARSEL reviews tariffs for mini-grids on a cost-plus basis. Although in principle mini-grid operators can establish their own electricity tariffs, ARSEL has the authority to review and adjust them following cost-plus principles. Informal thermal-based mini-grids are reportedly charging tariffs of 250 to 600 FCFA/kWh across the country. The first solar-based mini-grids promoted by Huawei and described in Section 4 are reportedly applying a tariff between 100-150 FCFA/kWh.

SUBSIDIES AND INCENTIVES

A Rural Electrification Fund has been set up to provide funding to public and private sponsored rural electrification projects, but has felt short of its ambitions. A Rural Electrification Fund was set up in 2011 with the objective of providing financial and technical support to rural electrification projects, including mini-grids, promoted by either the public or private sectors. The Fund had the ambition to provide investment subsidies of up to 70% for rural electrification projects. However, in practise it has fallen short of its aims and objectives largely due to its lack of funding and capacity.

There are few fiscal incentives for renewable energy projects. Companies operating in Cameroon are subject to several taxes, including a tax on corporate profits (33%), a tax on personal income (ranging from 11-38%), value-added tax (19.25%), social security contributions (11.2%), custom duties (5-30%), and property taxes (0.1%). The Electricity Law 2011 foresees special incentives for renewable energy projects. Law no. 2011/020 grants VAT exemptions for solar and wind generation equipment. The 2013 Private Investment Law grants additional special incentives to companies in priority sectors, including the energy sector.

POWER PURCHASE AGREEMENTS

Renewable energy power producers are granted the right to connect to the power grid, but no standard terms exist. Law N°2011/022 of 14 December 2011 grants the right for independent renewable power producers to connect renewable energy power centrals to the grid—including small-hydropower stations below 5MW—and establishes the obligation for the network operator to purchase the electricity supplied. Nevertheless, the relevant regulatory framework has not been further developed. No standard PPAs and feed-in-tariffs exist. Thus, PPAs need to be negotiated on a case-by-case basis. The 1.4MW Mbakaou Carriere mini hydro project is in the final stages of securing a PPA, following a lengthy process. The plant is planned to be operational in 2018.

ARRIVAL OF THE GRID

The 2016 PDER defined a clear and ambitious grid extension plan. The five-year grid extension plan is expected to provide the required visibility to mini-grid developers. The PDER roadmap highlights ambitions for 70% of population centres to have an electricity connection for the period 2016-2020, 90% for 2021-2025, 95% for 2026-2030 and 98% for 2031-2035. During the first five-year phase, grid extension will only be considered for localities within 20km of the main grid. The selection criteria will then be 50km for phase 2 and 100km for phase 3. During phase 4, the government expects to electrify all localities of over 150 inhabitants. However, only a portion of the plans have secured financing.

There are limited provisions to protect mini-grid developers when the grid arrives. Mini-grid projects must be granted a previous authorization from ARSEL. The authorization must state the length of its validity period, normally ranging between 15 to 20 years.

40 IBRD. 2016. Project Appraisal Document PAD1777

TECHNICAL RULES

ARSEL has defined technical and service standards for distribution by ENEO. In the absence of other specifications mini-grid developers must adhere to the ‘Regulation of Services for Public Distribution of Electricity.’ Developers are required to adhere to the high level distribution standards (covering voltage, frequency, and harmonics, etc.) established in Order N°00000013/MINEE dated 26 January 2009 - a document created to define the operational expectations for AES-Sonnel (ENEO).⁴¹ However, these standards are inadequate to small modern mini-grids.

MOBILE SERVICES

The telecom sector was liberalised in 1998. Four companies: Orange, MTN, CAMTEL and Nextel are in operation. Between 2004 and 2015, cell phone penetration rate increased from 9.8% to 75%. In addition to MTN's "Mobile Money" and Orange's "Orange Money" for mobile electricity bill payments, ENEO and Societe General Cameroon operate "Monifone"—the country's third largest mobile payment system. Although ENEO has estimated that around 25% of its subscribers have registered to a mobile payment system, only one fourth of those subscribers are using the services to make regular payments. This is due to persisting dysfunctions such as cut-offs for non-payment after paying with mobile services. However, the introduction of mobile payments has beneficial impacts on urban populations that still have parents living in rural areas and could be utilised in future mini-grid systems.

The PDER and the Solar Huawei Programme have identified prepaid metering services via mobile phones as a practical mechanism in Cameroon. These systems have already been tested in Cameroon and will help to reduce commercial losses and reduce capital expenditure payback periods. However, mini-grid operators will need to ensure that regular inspections are still undertaken by billing and maintenance teams. In addition, ensuring a supply chain will be essential to ensuring sales points are accessible in the vicinity of the mini-grid.

5.3 ENERGY SECTOR POLICY AND REGULATORY FRAMEWORK

Key energy policies for the development of green mini-grids include Law N°2011/022 of 14 December 2011, which enables the modernisation and development of the energy sector; Law N°2013/004 of 18 April 2013, which establishes private investment incentives for designated priority sectors, including energy; and Decree N°00000193/A/MINEE of 28 April 2014, which lays out the provisions and fees for concessions, licences, authorisations, and declarations for independent producers. These and other relevant documents are described below.

DECREE N° 2000/464 PM of 30 June 2000

<http://www.arsel-cm.org/decret-30-juin-2000-secteur-electricite.pdf>

The decree governing the activities of the electricity sector builds upon the application of certain provisions of law N°98/022 on the electricity sector. It lays out the procedures for granting, renewing, revising, suspending and withdrawing concessions, licenses and authorizations for the production, transmission, distribution and sale of electricity.

LAW N° 2006/012 of 29 December 2006

<http://www.cvuc-uccc.com/minat/textes/7.pdf>

The 2006 law defines partnership contracts between the private and the public sector such as public private partnerships (PPP) in large-scale projects.

LAW N° 2008/009 of 16 July 2008

http://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/ppp_testdumb/documents/loi_n_2008_009_du_16_juillet_2008.pdf

The 2008 law establishes the fiscal, financial and accounting conditions applicable to partnership contracts.

⁴¹ See: 'Arrete N°00000013/MINEE DU 26 JAN 2009 portant approbation du Règlement du Service de distribution publique d'électricité de la société AESSONEL' <http://www.arsel-cm.org/reglement-de-service-electricite.pdf>

DECREE N°2009/409 of 10 December 2009

<http://opencamer.blogspot.co.uk/2013/09/decret-n-2009409-du-10-decembre-2009.html>

The 2009 decree approved the creation, organisation and operation of the Rural Energy Fund (ERF), which aims to support rural electrification objectives.

DECREE N°00013/MINEE of 26 January 2009

<http://www.arsel-cm.org/reglement-de-service-electricite.pdf>

The decree approved the regulation of distribution services provided by AES-Sonel's (ENEO) for public electricity distribution. The accompanying « ARRETE N°00000013/MINEE DU 26 JAN 2009 portant approbation du Règlement du Service de distribution publique d'électricité de la société AES-SONEL » defines technical and service distribution standards for the national utility.

ELECTRICITY LAW N°2011/022 of 14 December 2011

http://www.arsel-cm.org/loi_regissant_le_secteur_de_lelectricite_au_cameroun.pdf

The 2011 'New Electricity Law' replaced Law N°98/022 of 24 December 1998. It is currently the key policy for the electricity sector in Cameroon. It defines the organization of the electricity sector into three separate segments including generation, transmission and distribution. It defines the administrative requirements for operators in each of these segments. The law includes specific provisions supporting rural electrification and renewable energy sources.

DECREE N°2012/2806/PM of 24 September 2012

<http://www.arsel-cm.org/decret-n2012-2806-pm.pdf>

The 2012 decree further develops certain elements of electricity sector law N°2011/022. It provides details on the award, renewal, revision, suspension and withdrawal of concessions, licences and authorisations for power generation and distribution.

DECREE N°2012/501 of 07 November 2012

<http://www.atangana-eteme-emeran.com/spip.php?article13597>

The 2012 decree created the « Direction des Energies Renouvelables et de la Maîtrise de l'Energie » (DERME) within the MINEE. Its mission is to support the development of renewable energy including the conception of policies and strategies, the identification of renewable energy resources, the transfer of technologies and the promotion of renewable energy within the country.

DECREE N°2013/203 of 28 June 2013

<http://www.arsel-cm.org/decret-du-28-juin2013-portant-organisation-fonctionnement-ARSEL.pdf>

This 2013 decree defines the organisation and functioning of the Electricity Sector Regulatory Agency (ARSEL). It establishes ARSEL as a public administration with a legal identity and with financial independence. Its mission is to regulate, control and monitor the activities of power operators in the electricity sector.

DECREE N°2013/204 of 28 June 2013

<http://www.atangana-eteme-emeran.com/spip.php?article23879>

This 2013 decree defines the organisation and operation of the Rural Electrification Agency (AER). It establishes the AER as a public administration with a legal identity and with financial independence. Its mission is to promote and develop rural electrification throughout the country.

DECREE N°00000193/A/MINEE of 28 April 2014

No link is publically available.

The 2014 decree provides specifications on the documents that need to be included in the application file for concessions, licences, authorisations, declarations, as well as associated fees.

5.4 INVESTMENT INCENTIVE POLICIES

LAW N°2011/022 of 14 December 2011

The 2011 law foresees the introduction of fiscal incentives for renewable energies. It also creates the obligation for the power utility to connect to the grid and purchase power produced from any renewable energy producer - Chapter 2, Section 1, Article 66.

ORDER N°001/MINFI/CAB of 30 January 2012

https://garoua.eregulations.org/media/Circulaire_LF_2012_d%C3%A9finitive.pdf

This order includes VAT exemptions for solar and wind energy equipment.

LAW N°2013/004 of 18 April 2013

<http://www.arsel-cm.org/loi18avril2013.pdf>

This law establishes renewable energies as a priority sector. The renewable energy sector will benefit from broad private investment incentives, as well as investment incentives specific to its sector.

- Implementation phase: Tax and custom incentives during the implementation phase which cannot exceed five years after the delivery of the agreement – Titre 2, Chapter 1, Article 6
- Operation phase: Tax and custom incentives during the operation phase which cannot exceed ten years – Titre 2, Chapter 1, Article 7
- Tax credit: Investors will benefit from tax credits if it meets one of the following criteria: hires five graduates per year with higher education; decreases pollution; develops cultural, sports or social activities; or develops public interest activities in rural areas - Titre 2, Chapter 1, Article 8
- Administration processes: Investors will benefit from easier access to financial and local currency services, as well as visa facilities – Titre 3, Chapter 1, Article 12-13

ORDER N°00366/MINFI/SG/DGI/DGD of 9 November 2013

<http://www.minfi.gov.cm/index.php/facilites-aux-entreprises/330-arrete-n-366-minfi-sg-dgi-dgd-du-19-nov-2013-precisant-les-modalites-de-mise-en-oeuvre-des-avantages-fiscaux-et-douaniers-de-la-loi-n-2013-004-du-18-avril-2013-fixant-les-incitations-a-l-investissement-prive-en-republique-du-cameroun>

Provides precisions on the application methods of the tax and customs incentives included in Law N°2013/004 of 18 April 2013.

ORDER N°0000031/MINFI/SG/DG/DGD of 17 July 2013

http://www.conferenceinvestiraucameroun.com/confcameroun-content/uploads/2015/06/Order-no-0000031-17-July_2014en.pdf

This order amends some of the provisions included in Order N°00366/MINFI/SG/DGI/DGD of 9 November 2013 on the application methods of the tax and customs incentives included in Law N°2013/004 of 18 April 2013.

5.5 RECOMMENDATIONS

Cameroon requires additional resources and improvements in the regulatory and institutional landscape to encourage mini-grid development. The planning, consenting, and development stages for mini-grids can be lengthy and are shrouded by significant uncertainty. In particular this is caused by the lack of clarity surrounding the process to negotiate terms with ENEO and which government agencies to interact with. While the 2011 law enables the development of independent distributors and generators and contains connection and excess renewable supply purchase obligations, the formulation of the clauses, which are written as general principles and not accompanied by detailed implementation guidelines increases uncertainty. In addition, provisions for independent distribution are very small (i.e. 100kw-1MW) and are limited to areas outside of the ENEO concession, limiting opportunities for independent green mini-grids. Lastly, the national electricity tariffs are not cost-reflective making it hard for mini-grids to attract investors.

Given the country's low electrification rates and renewable energy potential there is a substantial opportunity to capitalise on mini-grid development. However, a number of incremental improvements and initiatives are needed to accelerate the development of green mini-grids. Encouragingly the 2011 law has already set legal precedent for independent generation and distribution. Improvements and clarifications to the text would encourage private investment in green mini-grids. In addition, streamlining institutional roles and responsibilities, increasing public funding, and improving the availability of site information (e.g. though improved GIS datasets) would reduce uncertainty and lower risk. The following high level recommendations to promote green mini-grids and private operators are highlighted below. These include the need to:

Policy and national electrification planning

- Review mini-grid policy and regulatory requirements. For example, in rural areas, eliminate the need for an authorization for mini-grid companies below a certain capacity to operate.
- Review the cap on the maximum distribution capacity allowed for mini-grids in the 2011 law.
- Consider policy approaches to replace ageing and expensive isolated thermal power generators with modern hybrid mini-grid systems.
- Develop standard feed-in-tariffs and purchase agreement frameworks for renewable energy projects in rural areas.
- Develop a transparent planning process to provide clarity over the current and future boundary between grid and off-grid areas.
- Consider implementing protection measures for independent distributors to safeguard against the arrival of the national grid.
- Streamline and better define roles and responsibilities across the main institutional actors involved in rural electrification and decentralised energy.
- Consider a roll-out of pre-paid metres to limit commercial losses in the distribution of electricity.

Capacity and market development

- Increase training capabilities for key institutional actors. This could potentially include financial management, low-level system maintenance and broader project management skills.
- Continue to support technical universities and power market-related training programmes. For example, this may include further support for operation and maintenance training programmes that are underway through the MINEE/Huawei solar mini-grid programme.
- Update the GIS platform, providing additional information and increasing functionality. Maps and data on the power network, population centres, renewable energy sources, amongst other items should be publicly available.
- Ensure existing plans and policy documents are made publicly available. A centralised website that contains all policy and planning information would be beneficial for prospective investors.

Financing

- Increase resources for key rural electrification agencies and governmental departments. This could involve transmitting additional responsibilities to the Rural Electrification Agency and increasing funds for the Rural Energy Fund.
- Consider phasing out the subsidisation of the social tariff of 50 FCFA/KWh. This will improve the financial resilience of ENEO and increase the willingness to pay for green mini-grid tariffs.
- Strengthen the national financing strategy for renewable energy and further focus the energy sector strategy on solar, small hydro, and biomass technologies to best enable effective decarbonisation of the energy mix.

The Green Mini-Grids Market Development Programme could support the mini-grid sector in Cameroon through a number of initiatives. Of primary consideration to the programme is supporting the government in its transition towards implementation of clean energy mini-grids (solar, biomass, and solar technologies) as part of the national (and rural) electrification strategy. International donors are supporting rural electrification through the extension of the main grid, for example through the Rural Electrification Project Phase II, the PRERETD, PERPREN, and PLAN VER programmes. Increased government and donor finance could be directed towards green mini-grids. The GMG MDP could provide policy and institutional support such as the development and dissemination of GIS-based data, increased planning support, as well as knowledge transfer and capacity development for financiers and supply chains. A number of potential initiatives include:

- Supporting the review and improvement of the existing regulatory framework for mini-grids to reduce the requirements on small mini-grid projects. This could focus on improving the 2011 Electricity Law and developing bespoke mini-grid frameworks.
- Facilitating a series of capacity building programmes for public-private partnerships and mini-grid operators in collaboration with decentralised authorities.
- Supporting the development of GIS-based spatial planning processes, including working with local authorities to make more GIS data available. Financing the refresh and open-source publication of existing GIS datasets.
- Supporting the trial of comprehensive mobile and mobile money services coverage map for Cameroon through the Huawei solar mini-grid programme.
- Working with financial institutions and other stakeholders to reduce investment risk.

6. MAIN STAKEHOLDERS

There are a large number of public stakeholders in the energy sector in Cameroon. Stakeholder feedback suggests there is overlap in secondary agency remits. Encouragingly this is reportedly in the process of being reviewed and refined. There is growing interest from the private sector in Cameroon's energy market, although this interest is primarily focused on larger grid-based generation capacity (both renewable and fossil fuel based). The basis for mini-grids is starting to emerge and is expected to be reinforced with the forecasted growth in mini-grids outlined in the Rural Electrification Master Plan. However, considerable effort through government and international stakeholders is still required to support the growth of this emerging market. A brief summary on the key stakeholders is available below.

6.1 GOVERNMENT AND AGENCIES

MINISTRY OF WATER RESOURCES AND ENERGY (MINEE)

Contact: Massoma Bille (DERME Director)
Email: massomabille@yahoo.fr
Website Link : <http://www.mng-cameroon.org/>

The MINEE establishes, executes, and oversees policy in water and energy. In addition, it sets the incentive framework, grants production and distribution concessions and licenses, promotes and establishes strategies for renewable energy. Basile Atangana Kouna, is the current Minister for the MINEE. Following Decree N°2012/501 of the 7th of November 2012, the government created a division within the MINEE responsible for renewables energy (DERME). DERME seeks to develop sector specific policies, undertake applied research and ensure technology transfer in renewable technologies. It further leads on the promotion, development and extension of renewable energies. In addition, the MINEE holds responsibility for the Energy Sector Development Plan (PDSE), runs a data management team, and has recently released a number of annual energy reports on Cameroon.

ARSEL

Contact: Fotso Kangmogne (oversees development politics and programmes for ARSEL)
Email: fokadoch@yahoo.com
Website Link: <http://www.arsel-cm.org/>

ARSEL is the energy regulator in Cameroon. It was created in 1999 to regulate activities across the energy sector and to ensure the adequate supply and protection of consumers. It establishes and approves tariffs, monitors the financial strength of the sector, signs-off on authorisations and declarations, and collaborates with the MINEE on concessions and licenses.

RURAL ELECTRIFICATION AGENCY (AER)

Contact: Issa Oumaraou (Advisor to the Director General)
Email : oums252@yahoo.fr
Website Link: <http://www.aer.cm/>

The AER was created in 1999 to promote and facilitate rural electrification across Cameroon. It provides users and operators with technical support, and where required, financing to support the growth of rural electrification. In addition, it conducts feasibility studies and provides capacity building to rural populations and local councils. The capacity and mission

of the AER was established by Article 62 in the 2011/022 law. It now holds responsibility for the Rural Electrification Master Plan (PDER). In reality, overlap in mandates currently exists with other actors such as FEICOM, PNDP, EDC, and local councils. Work is underway to ensure the AER holds a clear mandate and the required resources to appropriately carry out its objectives. Stakeholder feedback suggests that the AER requires additional resources and should focus on enabling small generation project development through the integration of private sector, rural populations and councils.

The AER manages the Rural Energy Fund (FER). The FER was established in 2009, but only operationalised in 2011. Its main objective is to support projects that contribute to rural electrification. It can support up to 70% of the costs of selected projects. However, to date, it has largely been underutilised with key financial support provided by the MINEE, EDC, and FEICOM.

ELECTRICITY DEVELOPMENT CORPORATION (EDC)

Contact: Dr. Théodore NSANGO (Managing Director)

Email: info@edc-cameroon.org

Website Link: <http://www.edc-cameroon.org/>

The Electricity Development Corporation was established in 2006 to manage public electricity assets for the state. It also contributes to sectoral and project studies. Increasingly generation responsibilities are being handed over to EDC including major hydro projects. While the EDC has some responsibilities related to rural electrification, stakeholder feedback suggests it should transfer this responsibility to other organisations such as the AER.

NATIONAL SOCIETY FOR THE TRANSPORT OF ELECTRICITY (SONATREL)

Contact: Mbemi Nyankga (Managing Director)

Website Link: <http://sonatrel-cmr.cm/>

SONATREL was created in 2015 and is the designated transmission system operator (TSO) in Cameroon. Its creation has been heavily supported by the World Bank through loans and the provision of technical assistance and it is due to go into operation in 2017/18. It is 100% state owned, and currently runs as a monopoly. Interface with the current institutional actors in the energy sector still requires clarification.

FEICOM

Contact: Philippe Camille Akoa (Director General)

Website Link: www.feicom.cm

FEICOM, the Special Council Support Fund for Mutual Assistance, is a Cameroonian finance and development fund whose mandate is to provide financial and technical assistance to local governments to promote economic development. FEICOM interacts heavily with international donors and is reportedly able to enter into public private partnerships. FEICOM was created in 1977 and sits under the Ministry of Territorial Administration and Decentralisation. Recently, FEICOM has benefited from financial support from KfW and plans are under development to secure further funding from the AfD.

Additional public based mechanisms and institutions exist to support rural electrification and may as well play an important role in mini-grids. These include:

- MINEPAT: The Ministry of Economy, Planning and Regional Development (MINEPAT) is able to channel support from bilateral and multilaterals to provide concession loans, trade credits, subsidised loans, and grants.

- CCCE: Electricity Consumers Consultative Committee (CCCE) is an association of electricity consumers created by ARSEL in 2009. Its main objective is to ensure the protection of consumers.

6.2 PRIVATE SECTOR OPERATORS AND MINI-GRID PRACTITIONERS

ENEO CAMEROON S.A.

Contact: Joel Nana Kontchou (CEO)

Email: contact@eneo.cm

Website Link: <https://www.eneocameroon.cm/index.php/en/>

ENEO is the power utility in Cameroon. It is responsible for distribution and holds the majority of energy production responsibilities, although these have been capped at 1000MW. ENEO was also responsible for transmission before these were transferred to SONATREL. ENEO has a long history in the Cameroonian energy market. It was created in 1974 operating under the name SONEL, and has since merged with a number of entities, including ENELCAM, EDC, and POWERCAM. Rebranded as ENEO Cameroon S.A. in 2014, the Cameroonian government currently holds a 44% share, with 56% held by Actis, the British private equity firm. ENEO currently has a production capacity of 968MW, consisting of 39 production centres, 13 of which are connected to the grid and 26 operate in isolation. 74% of ENEO's production capacity is derived from hydro sources.

IED – INNOVATION ENERGIE DÉVELOPPEMENT / SUBSIDIARY : EED – ETUDE ENGINEERING DÉVELOPPEMENT

Contact: Hugo Yvanoff

Email: h.yvanoff@ied-sa.fr

Based in France, IED is an independent consulting and engineering firm specialised in the provision of sustainable energy services. EED is a subsidiary of IED created in 2005 and based in Cameroon. EED is specialised in the provision of market study and capacity building services in the energy, water and sustainable territorial development sectors. Projects implemented by IED and EED include:

- IEDINVEST- Design studies and civil works for the 1.4MW hydro-based mini-grid project Mbakaou Carrierre project
- EED – Study of power demand and diagnosis of Mbang region power network to inform SFID (Société Forestière et Industrielle de la Doumé) co-generation project
- IED – Detailed technical and economic feasibility study for grid-tied solar PV power plants (25+5 MWp PV) in Eastern and Northern interconnected grids in Cameroon, and 4 solar PV/Diesel hybrid systems (totalling 750 kWp PV) – 2015
- IED – Training program in the rural electrification sector – 2016

HUAWEI TECHNOLOGIES

Contact: Ni Zheng

Link: <http://www.huawei.com/cm/about-huawei/contact-us/>

Huawei is a leading global information and communications technology (ICT) solutions provider with a local office in Yaoundé. Huawei projects in Cameroon include the installation of solar lighting on the University of Yaoundé II campus and the financing of the electrification of Ngang village in Nkol-Afamba. Huawei and the MINEE are in the initial stages of implementing an ambitious solar mini-grid rural electrification programme. The first phase aims to support the electrification of 350 localities for a total budget of US\$85 million (US\$11 million by the government of Cameroon and US\$74 million by Huawei).

HYSACAM

Contact : Michel Ngapanoun (Director)

Email: contact@hysacam-proprete.com

Link: <https://www.hysacam-proprete.com/>

Created in 1969, the company specialises in waste management of cities in Cameroon including Douala and Yaoundé. In 2011, Hysacam inaugurated in Yaoundé - Nkolfoulou the first biogas capture and treatment plant in Central Africa. In 2014, the company also inaugurated a biogas capture and treatment plant in Douala. They are currently in the process of implementing pilot projects to generate power from these plants.

IDRATEL ENERGY CAMEROON

Contact: Tabe James Orock (CEO)

Email: tabe_james@yahoo.com

In collaboration with the MINEE, IDRATEL is working on the implementation of Cameroon's power generation strategy. Product offerings include the construction of mini-hydro plants, installation of solar PV plants (for capacities between 3 and 9MW) and solar lighting, implementation of solar kits, and installation of wind power plants.

CAMSOLAR – CAMEROON SOLAR ENERGY COMPANY

Contact: James Tataw (CEO)

Email: camsolar@hotmail.com

Link: <http://www.camsolenergy.com/index.html>

A Cameroonian-based company that provides solar systems. The company has designed and built various categories of solar home systems to meet the demand of off-grid electricity in rural areas. CAMSOLAR also features a selection of solar components, design and install resources and a portfolio of best-in-breed LED lighting products, refrigerators, pumps, motors, battery chargers, tools, etc.

YANDALUX CAMEROUN SARL

Contact: E-Mail : cameroun@yandalux.com

Link: http://www.yandalux.com/index_fr.html

YANDALUX Cameroun SARL is the Cameroon branch of Yandalux GmbH, a German based company that provides independent solar solutions including on-grid hybrid systems, mini-grids, solar home systems, solar thermal and solar lighting. To date it has generated approximately 20MW of power around the world.

SCHNEIDER ELECTRIC CAMEROUN

Contact: Link: <http://www.schneider-electric.cm/fr/>

Schneider provides off-grid solutions for Cameroon's rural electrification, including solar home systems, lighting and other electrical equipment.

HES - HAUTE ENERGY SYSTEMS

Contact: Email : info@camhes.com

Link: <http://www.camhes.com/>

HES is specialised in hi-tech electrical engineering. The company provides solar home system consultancy, design and installation services for individuals, corporate organisations, communities, NGOs and government agencies.

MAGYUSAMA TECHNOLOGIES

Contact : Email : maguysama@free.fr

Link: <http://www.maguysama.com>

Created in 2003, Magyusama Technologies provides and installs renewable energy power generation systems such as solar panels, street lighting and micro-hydropower.

ERC - ENERGIE RENOUVELABLE CAMEROUN

Contact: Email: energierenouveableducameroun@yahoo.fr

Link: <http://www.erc.cm>

ERC operates in the solar energy sector. It develops and builds solar home systems and provides power kits and pumps. The company also installs electrical equipment including lighting and pumps.

CANOPY

Contact : Email : cameroun@canopy-energy.com

Link: <http://canopy-energy.com/fr/canopy-energies/>

Created in 2008, Canopy is a company specialised in renewable energy and energy efficiency. Headquartered in France, the company has an office in Yaoundé. It provides development, construction and distribution of solar solutions, including solar lighting, power plants between 20kWc and 5MWc and individual solar equipment.

Below is a non-exhaustive list of additional practitioners that also operate in Cameroon:

- African Energy - <http://www.africanenergy.com>
- Hero Technologies - <http://www.herotechno.com>
- Julius Kewir Tangka - <http://www.juliustangka.org/>
- Orirudev - <http://www.hedon.info/orirudev#Introduction>
- REI (Renewable Energy Innovators) - http://www.rei-cameroon.com/Home_Page.html
- TACEM (TransAfrica Construction and Energy Management) - <http://www.tcecs.com/>
- REPMA Cameroon - <http://repma.webs.com/>

- Tunach Engineering Group Plc
- SafeNet Cameroon

6.3 BILATERAL AND MULTILATERAL DONOR ORGANISATIONS

Cameroon is a member of a number of international bodies, including the 'Pool Energetique de l'Afrique Centrale (P.E.A.C), the African Energy Commission (AFREC), and the World Energy Council (WEC). There is a strong presence of international organisations in Cameroon. This includes a number of stakeholders highlighted below. Their roles vary from supporting studies in the energy sector, to providing project finance and technical assistance. The largest contributors to the energy sector in the last five years have been the World Bank Group, the French Development Agency (Afd), European Union, African Development Bank, and the Korean International Cooperation Agency (KOICA).

WORLD BANK GROUP

Contact: Stephan Garnier, Lead Energy Specialist

Email: sgarnier@worldbank.org

Link: <http://www.worldbank.org/en/country/cameroon>

The World Bank has an active presence in Cameroon and is currently supporting the creation of SONATREL the state run TSO, the Director Plan for Rural Electrification and associate projects (for example electrification in the Northern regions), and a number of large-scale hydro projects including the Lom Pangar Dam, Song Loulou Hydro Plant, and Nachtigal Hydro Plant. The World Bank deploys a range of support mechanisms including risk guarantees, loans, feasibility studies and technical assistance. The World Bank Group is not active in the mini-grid domain.

AFDB - AFRICAN DEVELOPMENT BANK

Contact: Dr. Succès MASRA, Principal Energy Economist & Financial Analyst

Email: s.masra@afdb.org

Website Link (english) : <https://www.afdb.org/en/countries/central-africa/cameroon/>

Website Link (français) : <https://www.afdb.org/fr/countries/central-africa/cameroon/>

The AfDB plays an active role in Cameroon's energy and power market. It supports a number of hydro and fossil fuel projects to enhance energy security and support development. These include, among others, the Lom Pangar and Nachtigal hydro projects, the Kirbi extension and Dibamaba project. The AfDB also plays an active role in supporting rural electrification through the PRERETD programme (a programme looking to reinforce transmission and distribution networks), interconnections studies (e.g. between Chad and Cameroon), capacity support for government agencies, and renewable energy studies. The AfDB provides loans, credit and risk guarantees, technical assistance, and equity, and manages the Sustainable Energy Fund for Africa (SEFA). The majority of its projects are focused on the public sector (54%), with the rest divided between the private sector and public multinationals. It is not currently actively pursuing green mini-grid programmes, however its recently launched New Deal on Energy for Africa aims to increase access to energy across the continent.

EUROPEAN UNION/DELEGATION

Contact: Jordi Cadilla Falco, Infrastructure Programmes Manager – Energy Focal Point

Email: Jordi.CADILLA-FALCO@eeas.europa.eu

Website Link: http://ec.europa.eu/europeaid/countries/cameroon_en

The European Union is represented in Cameroon by its locally based delegation. Relations between the European Union and Cameroon go back several decades, and focus on supporting good governance and economic and institutional reforms, trade and regional integration, and infrastructure, communications and transport. It is currently focused on supporting two core areas: governance and rural development. Recently they have funded a number of small hydro generation and mini-grid focused projects through its Energy Facility mechanism (funded through the 9th and 10th FED), including: The 'ERD-Rumpi' 2.9MW hydro based mini grid project in the southwest; the 'Mbakou Carriere' 1.4MW hydro based mini-grid project in the western Djerem region; support for two micro hydro based grids in the west of Cameroon under the 'Decentralised renewable energy sources for poverty alleviation and environmental protection in rural areas' project; support for two hydro based mini-grids in the centre region under the PLAN VER (Production décentralisée d'électricité et Valorisation de l'Electrification Rurale). They are reportedly examining options to support the development of a renewable atlas and opportunities to deploy alternative financing.

AFD – AGENCE FRANÇAISE DE DÉVELOPPEMENT

Contact: Christian Yoka, Director AfD Cameroon,

Email: afdyounde@afd.fr

Website Link: <http://www.afd.fr/home/pays/afrique/geo-af/cameroun>

Cameroon is one of the greatest beneficiaries of AfD funding. On average, AfD commitments in the country have represented US\$230.78 million per year since 2002. Intervention areas include agriculture, forest, infrastructure, education, health and energy. The AfD is a key supporter of the PNDP programme, which supports rural electrification. PROPARCO (Société de Promotion et de Participation pour la Coopération Economique), a subsidiary of AfD dedicated to the private sector, granted a credit of US\$30 million to the Cameroonian power utility in 2006. More recently, AfD has been financing the Lom Pangar Hydropower Project with a total budget of US\$300 million (AfD US\$60 million) to increase power generation from the Sanaga Basin.

FMO - DUTCH DEVELOPMENT AGENCY

Contact: South Africa Office

Email: joburg-office@fmo.nl

Website Link: <https://www.fmo.nl/>

Through the Access to Energy Fund, the FMO is providing a convertible grant of around US\$1 million to a 72MWp solar power plant in Cameroon. The project is being implemented by the JCM Greenquest Solar Corporation SA (JGSC), a company wholly owned by the Canadian investment fund, JCM International Solar Development Fund. FMO has also invested EUR18 million in the Kribi Power Development Company to support the development, construction and operation of a new natural gas-fired power plant and transmission line. In March 2016, FMO published a call for proposals to support on-grid projects. Although the first call did not prioritize Cameroon, a second call is expected in the short-term.

KOICA – KOREA INTERNATIONAL COOPERATION AGENCY

Contact: Kim Tae Young, KOICA Resident Representative

Link: http://www.koica.go.kr/english/aid/industry_energy/index.html

Priorities of KOICA assistance programmes in Africa are health, education and rural development to meet basic human needs and improve basic infrastructure. In Cameroon, KOICA is providing US\$2 million financing for the development of the Master Plan for the Development of Renewable Energy. Activities include assessment of development potential, establishment of the master plan, training of government officials and organisation of joint workshops.

JICA – JAPANESE INTERNATIONAL COOPERATION AGENCY

Contact: Umemoto Shinji, JICA Resident Representative to Cameroon

Email: ca-abe-mip@jica.go.jp

Link: <https://www.jica.go.jp/cameroon/english/index.html>

JICA assistance to Cameroon focuses on the development of human resources through education, economic growth through the support of SMEs and agriculture and rural development. JICA is currently financing, with the AfDB and the government of Cameroon, the development of the PRERETD (Projet de Renforcement et d'Extension des Reseaux Electriques de Transport et de Distribution), which aims to support the development of the transmission and distribution network in eight out of the ten regions in the country.

UNIDO – UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Contact: Maxime KAMDEM, National Coordinator

Email: kamdem_maxime@yahoo.fr

Website Link: <http://www.unido.org/office/cameroon.html>

Since 1986, UNIDO has implemented 129 projects in Cameroon for a total budget of US\$27,692,572. In partnership with GEF, UNIDO is currently funding the Promoting Integrated Biomass and Small Hydro Solutions for Productive Uses Project for the electrification of rural areas in West littoral. With a budget of a US\$10 million, the objective of the project is the electrification of 7,000 households using solar and mini-hydropower generation. Other projects under development include a solar power generation programme for the electrification of 1,000 localities and initiatives for the development of hydro and biogas power generation. A new UNIDO cooperation framework was established in 2014 with a budget of EUR19.8 million to support the following priority areas: elaboration of the industrialisation strategy and implementation of the Development of a Competitive Cameroonian Economy Programme (PACOM); support for the implementation of the Trade and Economic Integration of CEMAC Countries Programme (PACIE); poverty reduction through the development of value chains and implementation of (agro-) industrial parks; and environment and energy efficiency.

UNDP – United Nations Development Programme

Contact: Dr. Marie Laure Nyemeck Mpeck, Programme Coordinator

Email: marie-laure.mpeck@undp.org

Link: <http://www.cm.undp.org/content/cameroon/fr/home/operations/projects/overview.html>

UNDP, in partnership with GEF, World Bank and Barefoot College, has been supporting environmental issues in Cameroon through the GEF Small Grants Programme. This includes a programme to support off-grid rooftop solar energy systems in the Muyengue Trouble village in the Southwest of Cameroon. In total, 1,000 people have benefited from domestic electrification through the project.

6.4 OTHER RELEVANT ORGANISATIONS AND INITIATIVES

NATIONAL PROGRAMME FOR PARTICIPATORY DEVELOPMENT (PNDP)

Contact: Marie Madeleine, National Coordinator

The National Programme for Participatory Development (PNDP) is an important support programme for rural electrification projects in Cameroon. The PNDP provides technical and financial support to municipalities, trainings of elected officials, development of communal development plans and the realization of micro-projects deemed priorities by the populations and their elected representatives. The ultimate objective is to provide municipalities with the financial and technical management capacities to control their development and thus prepare for the decentralization promoted by the Cameroonian government. The programme is supported by, among others, the AfD, World Bank, GEF, and KfW.

UNIVERSITY OF NGAOUNDÉRI – INSTITUT UNIVERSITAIRE DE TECHNOLOGIE (IUT)

Contact: Dr. Ruben MOUANGUE, Professor of electrical engineering

Email: r_mouangue@yahoo.fr

Link: <http://iut.univ-ndere.cm/index.php?rubrique=2&porte=1&LANG=FR>

The Institut Universitaire de Technologie (IUT) of the University of Ngaoundéri is a technical higher education institution and located in the Adamaoua region. It prepares students for high-level technician positions in areas such as industrial technologies, process engineering and computer science. Since 2008, 534 students have graduated from the IUT in thermal and power engineering.

UNIVERSITY OF DOUALA – INSTITUT UNIVERSITAIRE DE TECHNOLOGIE (IUT)

Contact: Dr. Louis MONKAM, Head of Thermal and Electrical Engineering Department

Email: monkam@yahoo.com

Link: <http://www.iut-douala.cm/>

The Institut Universitaire de Technologie (IUT) of the University of Douala is a technical higher education institution. In two years, students can obtain the DUT (Diplôme Universitaire de Technologie). Sectors covered by the IUT include industrial and maintenance engineering, mechanical engineering, thermal and electrical engineering, railway engineering, metallurgical engineering and mining engineering.

UNIVERSITY OF MAROUA - INSTITUT SUPÉRIEUR DU SAHEL (ISS)

Contact: Professor Raidandi DANWE, Director of ISS

Email: institutsupsahel.uma@gmail.com

Link: <http://www.univ-maroua.cm/fr/ecole/institut-superieur-du-sahel>

The ISS was established in January 2010. It trains engineers in ten sectors that enhance know-how in management of natural resources and endogenous development. Its specific missions include the provision of higher education in renewable energy, in agriculture and water and in environmental protection, the improvement of recycling processes in public and private services and the development of art professions. Admissions are based on entry exams, or for professionals, through the submission of an application.

UNIVERSITY OF YAOUNDE 1 - ÉCOLE NATIONALE SUPÉRIEURE POLYTECHNIQUE DE YAOUNDE

Contact : NA

The Ecole Nationale Supérieure Polytechnique de Yaoundé seeks to train engineers and strengthen research for the development of Cameroon. The school focuses on training civil, computer, electrical, industrial, telecommunication, and mechanical engineers. It has trained more than 3,300 engineers.

ADEID - ACTION POUR UN DÉVELOPPEMENT EQUITABLE INTÉGRÉ ET DURABLE

Contact: Email: adeid_mountain@yahoo.fr

ADEID is a small-scale NGO working towards sustainable development goals and supports initiatives that develop local resources and products. The organisation is also involved in developing projects with the aim to facilitate access to energy in rural areas of Cameroon. Activities include the construction of 12 micro hydropower plants, biogas plants, solar as well as wind energy systems in some communities in West, Littoral, Northwest and Southwest Regions.

7. ANNEX. OBJECTIVES, SCOPE AND METHODOLOGY OF THE MARKET ASSESSMENT

7.1 OBJECTIVES OF THE MARKET ASSESSMENT

The objective of the Green Mini-Grids Africa Market Development Programme is to support the scale-up of investments in commercially viable GMG projects through a broad range of interventions aimed at improving the enabling environment. The project seeks to remove or reduce market barriers at regional scale and strengthen the ecosystem for the emergence of a thriving GMG sector in Sub-Saharan Africa – contributing significantly to the objectives of the SEforALL. The Programme's Market Intelligence business line supports activities that foster the ability of project developers, investors and public entities in: identifying market opportunities for GMGs; facilitating a coherent national approach; and supporting linkages between central authorities, local/national businesses, investors and communities with demand for power.

7.2 SCOPE OF THE MARKET ASSESSMENT

This report is one of five country reports that comprise the third deliverable for this project. All published deliverables will be available through the African Development Bank and other dissemination channels. As written in the original terms of reference, the project had three main deliverables:

D1 - An evaluation of the methodologies and best practices available for assessing GMG potential; D1 will analyse the methodologies currently utilised to assess the GMG potential with top-down approaches. The assessment will include data requirements, software requirements, robustness, handling of data paucity, quality of outputs, facility of use, openness of the system, interoperability with other planning tools, cost and any other specific strength or weakness. The Output of the D1 will be a report accompanied by an executive summary and a presentation or infographics.

D2 - Creation or choice of an opportunity assessment methodology in order to generate comparable data across countries, to the extent that is possible; On the basis of the methodological analysis made in D1, the consultant will present a methodology able to generate comparable data across countries. The methodology shall generate quality outputs, be robust, scalable, preferably based on open source or commonly used software and need only limited training. The output of the D2 will be a methodological paper or report and a presentation. If any new software tool will be developed to implement this methodology, it will have to be disseminated as open source.

D3 - The publication of country-level analysis on mini-grid market opportunities, initially focussing on at least five countries in SSA that are prioritising GMGs, generated with the above methodology. AfDB will provide the country list and will support the consultant to get access to country institutions, notably the SEforALL focal points, and national sources of data to apply the methodology. The D3 output will be a report with the assessment for the five countries.

7.3 METHODOLOGY

This methodology was developed during the second phase of the project, the Green Mini-Grid Market Development Program - Market Intelligence business line, which is also available via the African Development Bank.

Formulation of the Cameroon Report: A number of recent energy initiatives have been undertaken by the government and civil society at large in Cameroon. This report therefore draws upon these and onsite stakeholder interviews carried out in December in 2016. In particular, the report draws upon the findings of the: PDER (2016); Invest-Elec (2015); PDSE (2015); MINEE Annuaire (2015); and wider reports and factsheets provided by the European Delegation, UNIDO, World Bank, and AfDB.

This analysis, for which its results are provided in Section 2, considers the potential for mini-grids by segmenting the countries into two areas, grid and off-grid areas. This split is based on the distance of 15km from the power network. We have used the planned power network for up to 2035. The GIS sources used in this analysis are detailed below.

POPULATION CENTRES

Source: PDER, 2016

EXISTING AND PLANNED POWER GRID

Source: PDER, 2016

PROTECTED AREAS

Source: PDER, 2016

LAKES AND WETLANDS

Source: NA

IDENTIFIED RENEWABLE SOURCES AND PROJECTS

Source: PDER, 2016; Investelec, 2015; MINEE data; IED data

MEAN AVERAGE WIND SPEED

Source: DTU/IRENA, 2005

ANNUAL GLOBAL HORIZONTAL IRRADIATION

Source: DTU/IRENA, 2015

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