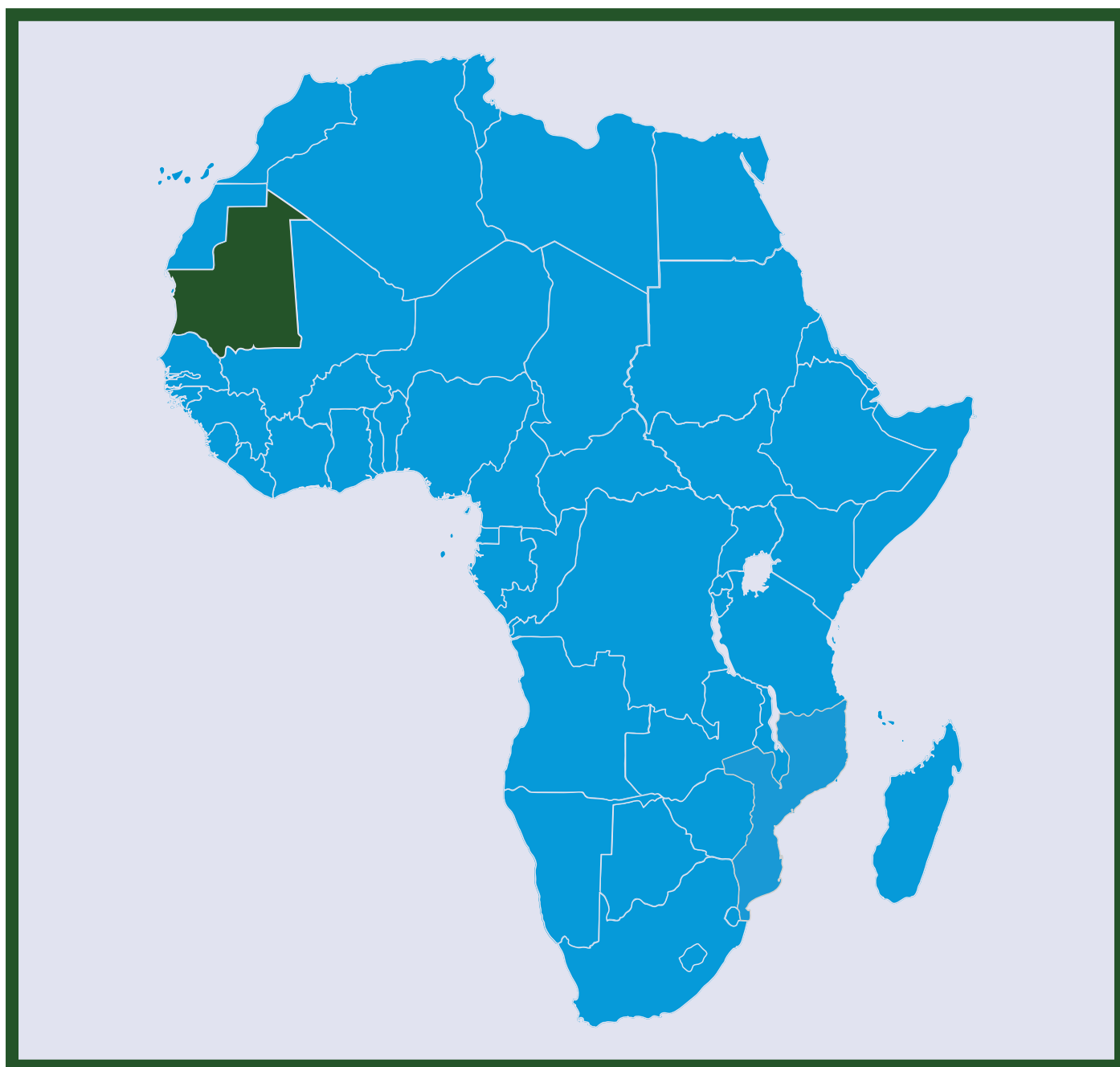


Mini-Grid Market Opportunity Assessment: Mauritania

Green Mini-Grid Market Development Programme:
Sustainable Energy Fund for Africa & African Development Bank

October 2019





The Sustainable Energy Fund for Africa (SEFA) is a multi-donor trust fund administered by the African Development Bank to support small- and medium-scale Renewable Energy (RE) and Energy Efficiency (EE) projects in Africa. SEFA supports private sector led economic growth initiatives under three financing windows: project preparation, equity investments and enabling environment support.



The SEforAll Africa Hub has the mission to facilitate the implementation of the SEforAll initiative in Africa. It is part of a regional hubs network established with the multilateral development banks. The Africa Hub promotes African ownership, inclusiveness and a comprehensive approach to the initiative's implementation. Its main activities include provision of guidance for the SEforAll country action processes globally and in Africa, delivering of technical assistance to partner countries, networking and communication, and mobilisation of financing.



The African Development Bank Group is Africa's premier development finance institution. It comprises three distinct entities: the African Development Bank (AfDB), the African Development Fund (ADF) and the Nigeria Trust Fund (NTF). On the ground in 41 African countries with an external office in Japan, the Bank contributes to the economic development and the social progress of its 54 regional member states.



The Carbon Trust wrote this report based on an impartial analysis of primary and secondary sources. The Carbon Trust's mission is to accelerate the move to a sustainable, low carbon economy. It is a world leading expert on carbon reduction and clean technology. As a not-for-dividend group, it advises governments and companies around the world, reinvesting profits into its low carbon mission.

The Carbon Trust would like to thank the following organisations whom made this report possible: Direction d'Electricité Mauritanienne, former Agence de Promotion d'Acces Universel aux Services (APAUS), Agence de Développement pour l'Electrification Rurale (ADER), European Union (EU), Agence Française de Développement (AFD), United Nations Development Programme (UNDP), SOMELEC, GRET, Winch Energy, Sot MAT, MTK-Services, Geniservices, Matrasco, Macoger, Cogér, Technosystems.

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PREFACE

This paper, part of the Green Mini-Grid Market Development Programme (GMG MDP) document series, assesses the green mini-grid market in Mauritania. Green-mini grids include 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 often results in significant financial losses for the utility, needed to sell power at prices significantly below the cost of production and delivery. It also 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, with 69 percent of the population in urban areas 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. In addition to unfriendly policy and regulatory frameworks, barriers to growth of the private mini-grids sector 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 African Development Bank (AfDB) designed and launched Phase 1 of the GMG MDP in 2015 with grant funding from the AfDB’s Sustainable Energy Fund for Africa (SEFA). 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 Department for International Development (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 implemented by the World Bank’s Energy Sector Management Assistance Program (ESMAP).

Phase 2 of the GMG MDP, greater in scope and scale as compared to Phase 1, was launched in November 2017 for 2.5 years. It is being funded almost exclusively by SEFA, a multi-donor trust fund administered by the African Development Bank to support small- and medium-scale Renewable Energy (RE) and Energy Efficiency (EE) projects in Africa. SEFA supports private-sector led economic growth initiatives under three financing windows: project preparation, equity investments and enabling environment support

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

The goals of the GMG 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 at the request of the AfDB. It was written by and Sophie Bordat and reviewed by Benjamin Curnier of the Carbon Trust. The Carbon Trust is a mission-driven organisation helping businesses, governments and the public sector accelerate the move to a low carbon economy.

The content of this report was reviewed by Brendan Coleman of the AfDB’s GMG MDP and cleared by Dr Daniel-Alexander Schroth, Advisor to the Vice President for Power, Energy, Climate and Green Growth at the African Development Bank.

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LIST OF ACRONYMS

| | |
|----------|---|
| ADER | Agence de Développement d'Electrification Rurale (ADER – Development Agency of Rural Electrification) |
| AFD | Agence Francaise de Développement (French Development Agency) |
| AfDB | African Development Bank |
| ADFES | Abu Dhabi Fund for Economic and Social Development |
| APAUS | Agence de Promotion d'Acces Universelle aux Services (Agency for Promoting Universal Access to Services) |
| CAPEX | Capital Expenditure |
| ECOWAS | Economic Community of West African States |
| EPC | Engineering Procurement and Construction |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GMG | Green Mini-Grid |
| HV | High Voltage |
| INDC | Intended National Determined Contributions |
| IPP | Independent Power Producer |
| LV | Low Voltage |
| MPME | Ministère du Pétrole, des Mines et de l'Energie (Ministry of Petroleum, Mines and Energy) |
| MV | Medium Voltage |
| OMVS | Organisation pour la Mise en Valeur du fleuve Sénégal (Senegal River Basin Development Organisation) |
| OPEX | Operational expenditure |
| PPA | Power Purchase Agreement |
| PPP | Public-Private Partnership |
| SCAPP | Stratégie de Croissance Accélérée et de Prospérité Partagée (Strategy for Accelerated Growth and Shared Prosperity) |
| SEFA | AfDB's Sustainable Energy Fund for Africa |
| SEforALL | Sustainable Energy for All |
| SHS | Solar Home System |
| SSA | Sub-Saharan Africa |
| UNDP | United Nations Development Programme |



EXECUTIVE SUMMARY

This country report is one of a series of country reports under the Market Intelligence business line of the African Development Bank's Green Mini-Grid Market Development Programme (GMG MDP). The MDP has the ultimate objective of fostering access to electricity across Africa by promoting the development of green mini-grids where they represent a technically and economically better option than the extension of the main grid. The Market Intelligence business line aims to provide comparable, actionable data on the potential for GMGs across countries in Sub-Saharan Africa (SSA). This report provides an analysis for Mauritania. Previous country reports can be downloaded from the GMG Help Desk (<http://greenminigrid.se4all-africa.org>).

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. Assessing the potential for mini-grids is challenging as such analysis requires plenty of 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.

Mauritania has an estimated population of 4.3 million and a landmass of 1,030,700 km², implying only 3.9 inhabitants per km², ranking the country as the fourth least densely populated in Africa (World Bank, World Bank Data, 2019). Despite being characterised as being composed of a population of nomadic tradition, the spread between urban and rural population in the country is uneven with 60% of Mauritania's population concentrated in urban areas. In fact, Mauritania has the second highest urbanisation rate (c.60%) on the continent and is expected to become predominantly urban country by 2025 (World Bank, 2018). The country is divided in 13 administrative regions with most of the population concentrated in the southern border with Senegal. The country's physical geography is primarily desert with the Sahara and the Sahel characterised by hot temperatures and dry air. However, as the climate is changing, Mauritania is increasingly affected by more frequent and more severe flooding.

In 2016, the Government of Mauritania established the *The Stratégie de Croissance Accélérée et de Prospérité Partagée* (SCAPP- Strategy for Accelerated Growth and Shared Prosperity 2016 to 2030) to foster economic prosperity focusing on infrastructure with an energy window to boost agro-pastoral and fishing communities. Mauritania's Gross Domestic Product (GDP) reached US\$5.4bn in 2018, a growth increase of c.2-4% over the last two to three years. Mauritania, however, faces a number of challenges that could undermine economic growth. The economy is highly dependent on international commodity prices and is not resilient enough to external shocks such as oil price fluctuations.

The average energy consumption per capita in Mauritania is small, averaging at ~0.3 toe/year compared to an average of ~0.5toe/year in the rest of Africa, and a world average of ~1.2 toe/year. The energy sector, more specifically the electricity sector, is largely dependent of thermal energy. However, since 2013 the country has increased the penetration of renewable energy in the energy mix and today renewables contribution represent 37% of electricity generation.

In terms of rural electrification, Mauritania has the objective to supply 40% of the rural population by 2030 as opposed to the current rate of 3%. The SCAPP and Master Plan both prioritise grid extension and reinforcement to supply more than 2,600 rural communities. However, Mauritania counts over 3,000 rural communities with populations varying between 200 and 2,000 that would benefit from mini-grid systems. There is currently no rural electrification plan or roadmap to identify priority areas for the Government or SOMELEC.

Mauritania's power sector is characterised by having one main national utility SOMELEC created in 2001 with the enactment of the Electricity Code. Like in most neighbouring West African countries, SOMELEC is the only national power utility authorised to distribute and sell electricity to consumers. SOMELEC is responsible for providing electricity to urban centres, areas located near its networks and local capital districts called Moughataas. There are also three Independent Power Producers in Mauritania allowed to consume their own production for their mining operations.

In terms of rural provision, the country counts six *delegataires* (also known as concessionaires) who were granted a licence from the Autorité de Régulation Multisectorielle (ARM – Multisectoral Regulatory Authority) to manage diesel and hybrid mini-grids.

The power sector's strategic policies and regulatory framework are out of date but currently being revised.

Mauritania's power sector is regulated by the 2001 Electricity Code which created the ARM and the now abolished agency in charge of rural electrification, Agence de Promotion d'Accès Universel aux Services (APAUS – Agency of Universal Access to Services). The code authorised the entry of the private sector into power generation in addition to creating a sector regulator. However, ARM only oversees and regulates concessionaires' operations and tariffs, while the Government directly regulates SOMELEC. In addition, current urban/rural on and off-grid tariffs have not been re-evaluated since 2007. The 2011 Production and Transmission Master Plan is the only existing document that has strategic and technical priorities to improve and expand the electricity system. This Master Plan is the only electrification plan available in the country that covers urban and rural areas with a focus on grid extension. There is no plan which provides integrated analysis of various technology options for electrification such as mini-grids or standalone systems.

A new Electricity Code is currently being elaborated by the UNDP in order to re-evaluate the role of ARM and harmonise the current on and off-grid tariffs split with a uniform tariff system. The code will also integrate renewable energy, and re-align the code with the new 2017 Public-Private Partnership Law that enacts public service delegation contracts allowing private operators to fully manage a concession on behalf of the Government. In addition, the EU and Agence Française de Développement (AFD) are providing technical assistance to restructure the current rural electrification framework and support SOMELEC in improving its human resources and commercial capabilities.

The political and regulatory framework for the off-grid sector is challenging in Mauritania. There is a lack of clarity in terms of roles and responsibilities for rural electrification in the country. In 2018, APAUS, the former agency responsible for rural electrification, was abolished as it was operating across several sectors, which raised concerns around how APAUS and the Agence d'Électrification Rurale (ADER – Rural Electrification Agency, a non-for profit independent organisation funded by the AFD) mandates differ. Both APAUS and ADER were running mini-grid tenders in hand with ARM for selecting operators. Since the abolition of APAUS, rural electrification responsibilities were transferred to SOMELEC. Without clear indication on governance structures, the sector has frozen, particularly since early 2018. Major transformations should be happening by early 2020, as AFD and the EU have been conducting studies to improve licensing and governing processes for rural electrification. EU-TAF as part of Rim-dir project and AFD's delegation contribution, has conducted a study to identify potential scenarios for governance structures applicable in Mauritania to develop mini-grids. Preliminary responses from the Government favour a scenario where SOMELEC will be the entity responsible for running tenders to select and grant licences to concessionaires, whilst ARM would maintain a pure regulatory role.

Other physical challenges constrain the development of mini-grids. Considering Mauritania's size, climate and lack of road infrastructure, being able to access remote areas is a challenging task. During country interviews, SOMELEC shared its reluctance to install mini-grids in remote areas. The cost of operating and maintaining systems is considered unaffordable. In addition to this, it's important to note that Mauritania is composed of a diverse ethnic population not always willing to share infrastructure among different groupings.

Our analysis estimates that 55% of the non-electrified population (2.2 million people) would be best served by mini-grid solutions in Mauritania. A further 629,000 people (16% of the non-electrified population) will be best served by solar home systems (SHS) and 1.2 million people (39% of the non-electrified population) will be best served by grid extension. To understand the mini-grid potential in Mauritania we have identified numbers of potential mini-grid customers, based on population (or household) density and proximity to the grid. Mauritania's land area was segmented into three area categories — grid extension, mini-grid and standalone system (SHS). Those best served by mini-grids are those outside of a 15km 'grid extensions buffer zone', and in areas where there is sufficient population density to justify this type of solution. Based on intended grid expansion to 2025, our analysis estimates that 1,503,000 people would be best served by mini-grid solutions, corresponding to 35% of the non-electrified population.

In summary, this report estimates an annual mini-grid market size of \$30 million in Mauritania, based on an average tariff of \$0.14/kWh (pre-harmonisation), and average per capita annual consumption of 98.4kWh (based on an average monthly consumption varying between 8kWh and 74kWh). This implies per capita annual electricity expenditure of \$13.78 within the population best served by mini-grids.

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

The African Development Bank's (AfDB) Green Mini-Grids Market Development Programme (GMG MDP) aims to foster access to electricity across Africa. The MDP assists 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 Sub-Saharan Africa (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 a series of country reports of the MDP's Market Intelligence business line, each of which provides an analysis of the GMG potential per country. These reports provide comparable, actionable data on the GMG potential across countries in SSA. GMG Opportunity Assessments for other countries can be downloaded from the GMG Help Desk (<http://greenminigrid.se4all-africa.org>).

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

The development of clean energy mini-grids is also the primary objective of the Mini-Grid Partnership, for which the Bank is playing a lead role for Africa. The Partnership seeks to galvanise action on the barriers facing the sector, with the engagement of public, private and civil society expertise and resources. The Mini-Grid Partnership (formerly the Clean Mini-Grids HIO), including the co-ordination group, secretariat and wider membership, is the established forum for discussion and co-ordination of the efforts of development partners to advance the adoption of GMGs. The MDP was designed from the beginning to be integrated and closely co-ordinated with the activities carried out in the framework of the Partnership.

2. COUNTRY OVERVIEW

2.1 COUNTRY OVERVIEW



Figure 1. Mauritania administrative division

Mauritania has a population of 4.3 million and a landmass of 1,030,700km², implying only 3.9 inhabitants per km², ranking the country as the fourth least densely populated in Africa (World Bank, World Bank Data, 2019). Mauritania is considered as both part of the North African's Maghreb and West Africa's Sahel. It is a coastal country surrounded by Western Sahara, Algeria, Mali and Senegal as shown in figure 1. Sixty percent of Mauritania's population lives in urban areas mostly in Nouakchott (968,000 inhabitants) the capital city, and Nouadhibou (c.100,000 people). In fact, Mauritania has the second highest urbanisation rate on the continent and is expected to become predominantly urban country by 2025 (World Bank, 2018). The majority of the population is located in the southern region of the country along the Senegal River.

Similar to other West African countries context, Mauritania's demography is composed of a young population with almost 60% of the population being under 25 years old (CIA, 2019). Mauritania's young population is vital to the development potential of the country. However, literacy rates and schooling opportunities remain low with only 50% of the population knowing how to read and write.

The nation is divided in 13 administrative regions, 46 Moughataas and 216 communes. Moughataas are large capital districts with administrative centres located in different regions. Overall, Mauritania counts more than 10,000 localities with populations varying from a 50 people up to over 100,000 spread across the country. Localities are any small town, commune or village with a smaller concentration of people than in large or capital cities.

Average Monthly Temperature and Rainfall of Mauritania for 1991-2016

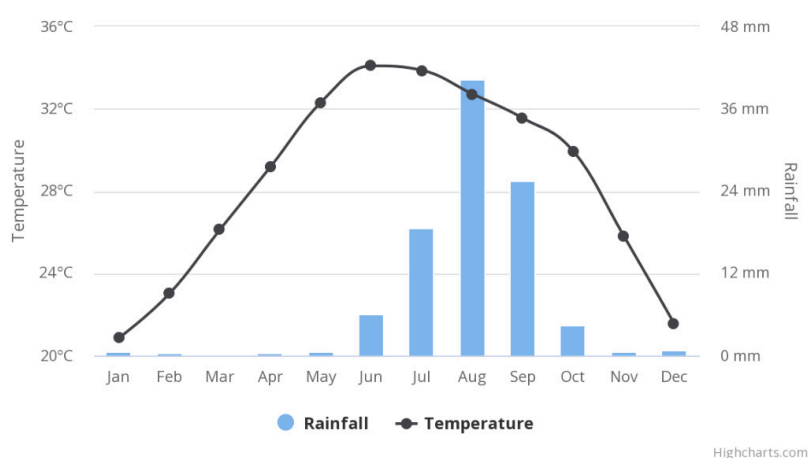


Figure 2. Average monthly temperature and rainfall Mauritania for 1991 to 2016

Mauritania is a very dry country and is divided into two major climatic zones; the Sahara and the Sahel. The coastline for both climatic zone is characterised by high humidity; while the inland areas have large temperature differences and extremely dry air with low rainfall and high evaporation (Climate Change Knowledge Portal, 2019). Temperature averages vary from 19 to 23 degrees in winter and reach, on average, 40 degrees in most of the regions in summer. Annual precipitation is scarce and reaches between 150mm to 600mm in the Sahelian region, whereas only 50mm to 150mm falls in the Sahara area.

Mauritania is considered highly vulnerable to climate change impacts with increasing risks of flooding, droughts and water scarcity. Mauritania's landscape is mostly composed of desert and vast areas of arable land notably in the southern border of the country, 40% of Mauritania's land is characterised as agricultural land. With increasing temperatures Mauritania is also exposed to increased risk of coastal flooding due to sea level rises. Heavy rainfall interspersed with increased aridity is also causing greater risk for river flooding on the Senegal River in the southern region. Variability of runoff and river flows with increased temperatures is resulting in greater evaporation of surface waters causing competition over reduced water resources (Climate Change Knowledge Portal, 2019).

From an infrastructure perspective, Mauritania's road network is extremely limited and considered to be in poor condition, particularly in the countryside. Long distances and the desert climate makes maintenance expensive and difficult. There are approximately 12,000km of roads, of which only 3,000km are paved, slightly less than its neighbouring countries such as Senegal that has 14,500km of roads and 4,500km of which are paved (Republique Islamique de Mauritanie, 2010). Lack of quality infrastructure exacerbates challenges related to isolation faced by many rural and remote localities, given limited access to economic opportunities, infrastructure and services.

The telecommunications sector in Mauritania is reasonably developed, with a penetration rate of mobile cellular of 110% reached in 2013 (World Bank Blogs, 2013). There are three main operators providing services such as fixed telephony, GSM and internet standard mobile telephony, data transmission. Despite high mobile penetration levels, mobile money is not yet developed in the country. The three main operators are international companies with Mauritel being partially owned by the Moroccan group Maroc Telecom; Mattel by Tunisian Telecom and Chinguitel from Sudanese investments.

Military leaders have headed the presidency of Mauritania since its independence. Mauritania was ruled by the French Colonial Empire from 1920 until its independence in 1960. Up until the 2009 democratic election of President Mohamed Ould Abdel Aziz, every head of state was a military officer who had assumed leadership through a coup d'état. The current president is Mohamed Ould Ghazouani, also a military leader that succeeded the former president.

The party system is dominated by the president's party l'Union pour la République. Mauritania is a constitutional republic with the executive branch composed of a president and prime minister; the legislative branch is made of a one Chamber Parliament and the National Assembly with 157 members.

Mauritania's nominal Gross Domestic Product (GDP) was US\$5.4bn in 2018 marked by a growing economy, according to figures from the World Bank (Bank, 2018). The economy has shown growth of 2 to 4% in the last few years, registering 3.6% in 2018, an increase from 1.4% the previous year. The main driver of growth since 2015 has been the recovery of iron ore and copper prices and increasing private sector consumption (World Bank, 2018). In the context of the sub-region, Mauritania's growth rate in 2018 was similar to the rest of West Africa.

Nevertheless, given the population growth rate of about 3% p.a, the pace of economic growth remains slow with real per capita income rising at only 0.8% in 2018. The same year, inflation increased to 3.1% on average mostly due to food price increases (IMF, 2019). Country debt levels remain a real challenge with an external debt-to-GDP ratio of 103.7% in 2018 (Afdb, 2019). However, efforts to rebalance the country's fiscal deficit have been successful to some degree; the country recorded a fiscal surplus of 1.5% in 2018 compared to a deficit of 0.2% of GDP in 2017 (World Bank, 2018). Despite high urbanisation rates, tax receipts-to-GDP ratio of about 15% remain low.

The main sectors contributing to 75% of GDP are oil, mining and fishery, despite only employing 3% of the population (BTI, 2018). Likewise, extractive commodities make up about three-quarters of Mauritania's total exports, subjecting the economy to price variability in world commodity markets (CIA, 2018). Mauritania also benefits from its rich fishing coastal waters that account for about 15% of budget revenues and 45% of foreign currency earnings. Mauritania processes more than 1,500,000 tonnes of fish per year but the sector is at risk of over-exploitation by foreign and national fleets. The substantial informal economy is dominated by the agricultural sector, which is the largest employer.

Mauritania's economy is structured by social and ethnic connections. The country is strongly reliant on remittances from its diaspora as well as from international officials and private aid. The economy has been described as having strong oligopolistic tendency with a small number of businessmen and their families controlling most of the large firms in banking, fishery, public infrastructure, and construction, import-export of consumer goods, foodstuff, and so forth.

Mauritania remains one of the poorest countries in the region and globally. Like its Sahelian neighbours, Mauritania is among the poorest of African countries and labelled as a 'low human development country' with a Human Development Index of 0.506 ranking the country as 156th in the world. Poverty rate is high at 22.1% and 55.6% of the population lives in multidimensional poverty, which in addition to low income encompasses various deprivations experienced by poor people in their daily lives such as lack of access to services, infrastructure, education or food (BTI, 2018).

Mauritania's economic development priorities, as laid out in policy, seeks to expand exploitation of the country's natural resources, notably in mining and gas, fisheries and agro-pastoral resources by promoting private sector-led diversification and sustainable job creation. The *Stratégie de Croissance Accélérée et de Prospérité Partagée* (SCAPP- Strategy for Accelerated Growth and Shared Prosperity 2016 to 2030) details these priorities as a means to economic prosperity to meet the need of a growing and increasingly urban population, but also increased resilience to the impacts of climate change. The SCAPP details major development projects focusing on infrastructure and construction across nine objectives clustered around three focus areas as shown in Table 1. The World Bank Group, under its Country Partnership Framework, will support the realisation of SCAPP having committed c.\$500m in funding over a six-year timeframe for investment, as well as technical support to improvements for economic governance; revenue mobilisation and public spending (World Bank, 2018).

Table 1. SCAPP focus areas and objectives

| Promote Economic Transition for Diversification and Resilient growth | Build Human Capital for Inclusive Growth | Strengthen Economic Governance and Private Sector-Led Growth |
|--|---|---|
| <ul style="list-style-type: none"> • Increase production in the fisheries sector • Increase agriculture and livestock production in the face of climate change • Promote the development of productive cities and adjacent territories in the context of decentralisation | <ul style="list-style-type: none"> • Increase coverage of social safety net system • Increase access to, and quality of, general education • Improve employability for youth and women • Improve access to maternal and child health care | <ul style="list-style-type: none"> • Strengthen fiscal management • Improve private sector participation in economic activities |

Mauritania's economy and safety are affected by neighbouring political and social unrest, most notably at Mauritania's eastern and southern borders where conflicts in Mali have the potential to spill over into the country. Additionally, already impoverished bordering regions such as Hodh al Gharby are hosting increasing numbers of Malian refugees, up to 50,000 in 2018 (BTI, 2018). This protracted refugee situation has put a further strain on the already scarce resources in the area, eroding the resilience capacity of host communities living around the camp.

2.2 OVERVIEW OF THE ENERGY SECTOR

2.2.1 ENERGY MIX, EMISSIONS AND TRENDS

The average energy consumption per capita in Mauritania is 0.3 toe/year; one of the lowest in the world. In comparison, per capita average energy consumption in Mozambique is 0.41 toe/year, 2.66 toe/year in South Africa and 3.84 toe/year in France.

Approximately 66% of energy consumed in Mauritania is supplied through firewood, while petroleum products and renewable energy represent only 33% and 1% of consumption respectively. The majority of energy is consumed in the domestic sector, with fuelwood and charcoal used predominantly for household cooking. Mauritania mostly extracts and exports its crude oil to neighbouring countries.

In 2015, total electricity production was 111,197 toe dominated by heavy fuel oil sources (EU, 2015). In 2016, about 73% of the country's power generation came from heavy fuel oil plants and low-efficiency generators running on diesel fuel, with the remaining 37% produced by renewable sources including two hydropower plants from the OMVS (Organisation pour la Mise en Valeur du fleuve Senegal) system. OMVS is an organisation between four state members: Guinee, Mali, Mauritania and Senegal, and aims to interconnect all four countries' networks as well as bring joint efforts to utilise the potential for hydroelectric development on the Senegalese river

Mauritania is a least developed country with non-significant greenhouse gas emissions, as stated in its Intended Nationally Determined Contribution (INDC). The country's NDC reported its 2012 per capita emissions had reached 2.1 tco₂e and estimated total emissions were at 7,071 Ggco₂e, similar to Senegal per capita emissions estimated at 2.37 tco₂e (USAID, 2016). The Government's stated intentions are to reduce emissions by 22% by 2030 to remove 4.2 mto₂e emissions across four major sectors; energy, industrial processes, agriculture and forestry, and waste. The most ambitious reduction contribution targets are in energy, and agriculture and forestry sectors, where the Government wants to reduce by 38% and 61% respectively. To reach its ambitious GHG emission reduction targets, Mauritania estimates needing US\$9.3 billion of which 88% would be funding through international aid. The funds would be used to operate energy efficiency projects as well as increasing renewables contribution to the energy system.

2.2.2 KEY ENERGY AND ELECTRICITY SECTOR STAKEHOLDERS

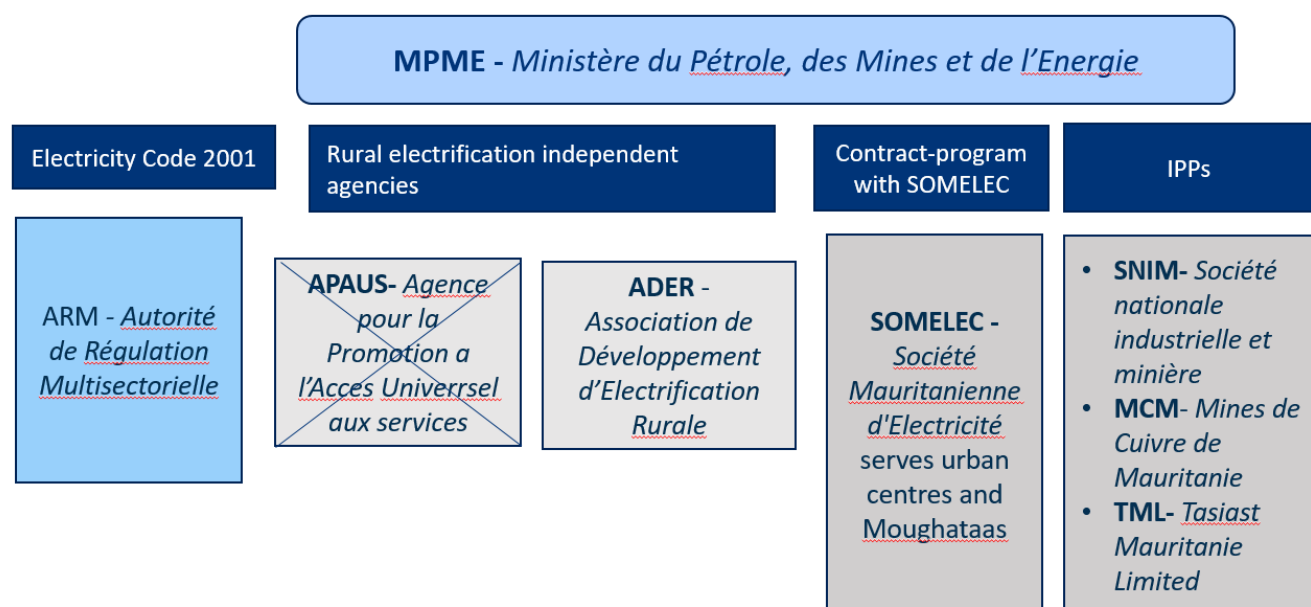


Figure 3. Energy and Power sector stakeholders

Several public and independent organisations are involved in Mauritania's energy sector. At a governmental and overarching level, the Ministère du Pétrole, des Mines et de l'Énergie (MPME) is the ministry responsible for energy planning and policy. The MPME is the key institution driving energy, power and electrification policy, more often basing these on presidential mandates. From an electrification perspective MPME can delegate its powers to agencies, such as the rural electrification agency, especially in the context of launching calls for mini-grid projects. The ministry includes a department of electricity and energy management that supervises the national utility SOMELEC to direct and plan the power sector. A Directorate General of Hydrocarbons also sits within the ministry and is responsible for granting and monitoring operating licences and distributing petroleum products.

The Autorité de Regulation Multisectorielle (ARM- *Multisectoral Regulation Authority*) regulates activities in water, electricity, telecommunications and postal services sectors. The authority was established in 2001 by the then new Electricity Code with the aim of introducing the basis of a liberalised market with a regulator in charge of oversight. In the context of energy, ARM's principal mission is to oversee the delivery of off-grid energy services through licensing,

regulating of prices, approving subsidies, and ensuring quality of service delivery from concessionaires – also referred to as *délégataires*. ARM is also mandated to conduct calls for proposals, and to grant and manage licences to selected concessionaires. Currently the role of ARM is being revised as part of the UNDP project of updating the Electricity Code (discussed later). It is also important to note that for historical reasons, SOMELEC, the national utility providing electricity services in all urban centres and Moughataas of the country is not regulated by the ARM. Indeed SOMELEC is not subject to any regulatory body.

The national utility SOMELEC was also set up in 2001 after the split of SONELEC with the view to liberalise the electricity markets. SONELEC was originally a company in charge of both electricity and water management in Mauritania, it was split into SOMELEC and the water company SNDE. SOMELEC is a 100% publicly funded state-owned company responsible for the generation, transport, distribution and sale of electricity in urban and suburban areas, as well as managing remote or isolated networks in regional capitals (Moughataas). It also manages solar and wind power plants connected to the grid. Since the abolition of the Agence de Promotion d'Accès Universel aux Services (APAUS- *Agency for the Promotion of Universal Access to Basic Services*) it has also been given the temporary role of implementing rural electrification objectives until such a time as clearer governance structures are confirmed. With this comes the mandate to launch tenders for electrification projects in both on and off-grid areas, and select developers for these projects.

Mauritania had until recently two independent agencies involved in rural electrification. APAUS was a multi-sectoral public entity with a mandate to improve access to services in water, energy and telecommunications. Created in 2001 it worked predominantly on the design and development of projects, most often funded by international donors and implemented by the private sector. APAUS was abolished in 2018, and Mauritania is currently reviewing rural electrification governance with the support of EU, UNDP and AFD (Agence Française de Développement).

The APAUS also oversaw the management of the Fond d'Accès Universel aux Services (FAUS- Fund for Universal Access to Services) whose aim is to cover the shortfall between the cost of operations and revenue generated, considering the concessionaires' margin also. This consists in covering the difference between revenue based on the regulated off-grid tariff, and the cost to operate the mini-grids. The FAUS is funded via a 3% tax on revenues from the telecommunications industry. Approximately 1% goes to rural electrification in the form of subsidy. Since 2018, FAUS is now managed by the Ministry of Finances and Economic Affairs.

ADER (Agence de Développement d'Électrification Rurale – Agency for the Development of Rural Electrification) is the specific rural electrification agency. It is a non-governmental and not-for-profit association still in place to carry out rural electrification actions under the supervision of the MPME. It was also created in 2001 by the French Development Agency to support the bank in the implementation of rural electrification projects. ADER was previously mainly involved in the distribution of PV kits, it then received similar responsibilities to APAUS in selecting off-grid developers. The organisation has also focused on organising training on off-grid technologies and management to service providers. The agency is dependent on donor funding and has not been very active in rural electrification projects in the past four years. Currently, ADER has shifted its work towards conducting a study on battery recycling in Nouakchott financed by the EU.

2.2.3 GOVERNMENT ENERGY POLICIES, STRATEGIES, TARGETS, ROADMAPS, PLANS AND PROGRAMMES

There is a limited set of energy policy and strategy documents in Mauritania. The ones that are currently active include the **Electricity Code 2001** which aimed to liberalise the electricity sector by unbundling the former SONELEC to create the SOMELEC, as well as enacting a regulatory body. The **Production and Transmission 2011 Master Plan**, which mostly focuses on interconnecting and expanding the current network. It identifies opportunities for increasing local production and which transmission and distribution lines to reinforce. Finally the **Stratégie Nationale de Croissance Accélérée et de Prospérité Partagée 2016-2030 (SCAPP - Strategy for National Growth and Shared Prosperity)** outlines the strategic vision of improving energy access of agro-pastoral and fishing communities to boost the country's economy.

The 2011 master plan is the only technical document setting priorities for the power sector based on four main focus areas:

- Increase installed capacity sourced by local resources (mainly natural gas)
- Develop transmission lines and interconnections with bordering countries
- Increase renewables contribution into the energy mix
- Install off-grid solutions in remote areas

In addition to these documents, IRENA has supported with the elaboration of a strategy for the promotion of renewable energy in 2014. It provides recommendations in terms of institutional and regulatory frameworks to increase renewables contribution in Mauritania. Suggestions include revising the legal framework to enhance the role of regulatory agencies, creating a renewable energy unit and also modernising the country's legislative and regulatory frameworks to enable investment in energy production at large scale.

The only legal framework of the power sector is the outdated law of 2001, this law regulates production, transmission, distribution and sales of electricity for any installation of above 23kW. This law liberalised the electricity sector to specifically allow Independent Power Producers (IPPs) to produce electricity. However, the law at the time did not specifically entertain the possibility of Public-Private Partnerships (PPP)¹ nor any scope for private sector involvement in electrification through unsolicited applications. There is currently no market structure in place or subsidy mechanism that would support private sector project development. Calls for proposals are the only enabling system for private sector contribution in the sector. This has more specifically been the case for off-grid activities for which operators have signed a management contract with the Government to operate sites as detailed in section 2.4 of this report. Mining companies are the only IPPs operating in Mauritania which have been permitted to produce their own power.

Several development agencies and international donors are supporting Mauritania in reviewing current governance framework.

Through its Technical Assistance Facility (TAF), the EU has also been supporting MPME by conducting a review of the institutional framework for electricity due by the end of 2019. The latest recommendations that have been provided to the Government include 1) unbundling SOMELEC into power generation, transmission, and distribution entities, and ultimately privatising the whole sector in the medium term (five to 10 years); 2) creating a rural electrification directorate within SOMELEC to administer rural electrification; 3) restructure SOMELEC's staffing to reduce over-staffing, and 4) prioritise the reduction of commercial and technical losses (together representing c.30%) (European Union, 2018).

The recommendations made by the EU have yet to be adopted. The timing of the recommendations just prior to the recent presidential elections means that these weren't considered at the time. The EU is hopeful of recommencing conversations now that the new administration is in place since June 2019. Secondly, the recommendations around unbundling are likely to be politically sensitive, since for the last few years SOMELEC has become financially viable and is now a considerable contributor to the state treasury.

UNDP has also been working on updating the 2001 electricity code as well as finalising a tariff study to harmonise current on and off-grid tariff mechanisms. One of the reasons that the Electricity Code is being revised is that it does not permit the participation of the private sector beyond IPPs, and hence is in contradiction with the newer 2017 law on PPPs. The updated PPP law reforms procedures for identifying projects, attributing licences and selecting service operators, it allows unsolicited projects offered by the private sector to provide public services. In addition, if the Electricity Code were to be aligned with the new PPP law, it will require removing ARM's role as central licence attributor, instead

¹ This report refers to Public-Private Partnership as a collaboration between a government agency and a private-sector company to finance, build and operate infrastructure projects. This collaboration implies that there is a financing mechanism for which asset ownership divided between the Government and private company is well defined.

only acting as a regulator. As a result, despite interest from the private sector to invest and intervene in the off-grid sector there is no enabling mechanism to support this. UNDP is also reviewing current off and on-grid tariffs of which the latter are significantly cheaper, as discussed later in this report.

To support the UNDP and EU's objectives AFD has also been active in providing technical assistance to restructure and improve SOMELEC's staffing and commercial losses. Further detail on these activities are described in section [2.4.1 Energy Access Policy and Planning](#).

2.3. OVERVIEW OF THE POWER SECTOR

As of 2016, the installed electricity generation capacity in Mauritania was 583MW, consisting of 37% renewable sources and 63% fossil fuel-based sources (SE4ALL, 2017). Of 37% of renewables penetration, 16% is from solar and wind against only 29% renewables contribution in 2014 (SE4ALL, 2017). Motivations to increase renewables penetration were mostly because there was an opportunity for the utility to reduce its operation costs and commercial losses while using the country's clean natural resources. Mauritania has continued its efforts in increasing renewables contribution with the development of future renewable projects such as wind installations close to Nouadhibou and 50MW solar in Nouakchott. Currently the majority of the country's power generation is from large thermal plants with an installed capacity varying between 22MW and 180MW. The country has one national utility, SOMELEC, and three independent power producers (IPPs) TMSL, MCM and SNIM that generate power for their mining companies. Of these companies only SNIM is authorised to sell excess power to the utility.

583MW installed capacity is both on and off-grid (table 2). Mauritania is composed of one interconnected system, large isolated grids also considered as on-grid systems, and diesel and hybrid mini-grids. 513MW are on-grid of which 188MW are from and for existing mining companies. Overall, the off-grid installed capacity to date is 70MW, of which 85% is from the 60 SOMELEC's mini-grids, and the remaining 10MW from 22 mini-grids operated by *délégataires* that were granted a seven-year licence by ARM to operate the grids.

Table 2. Generation plants Mauritania

| Plant | Installed capacity (MW) | Power source | Operator |
|-----------------------|-------------------------|-------------------------|--------------|
| Arafat | 42 | Thermal | SOMELEC |
| Wharf | 36 | Thermal | |
| Nouadhibou | 22 | Thermal | |
| DUALE | 180 | Thermal | |
| Tasiast - IPP | 188 | Thermal | TML |
| Akjoujt - IPP | | Thermal | MCM |
| Zouerate- IPP | | Thermal, solar and wind | SNIM |
| 42 SOMELEC mini-grids | 60 | Diesel & hybrid | SOMELEC |
| 22 ARM mini-grids | 10 | Diesel & hybrid | Délégataires |
| Nouakchott solar | 15 | Solar | SOMELEC |
| Nouakchott wind | 30 | Wind | SOMELEC |
| TOTAL | 583 MW | | |

Since 2013, Mauritania's power sector has been able to improve its production to meet peak demand. Introducing renewables into the generation mix has enabled the country to shift from under-capacity to over-capacity. In 2013, peak demand was at 100MW with only 89.9MW available installed capacity, while in 2017 total installed capacity within the interconnected system was up to 225MW (this includes Nouakchott's solar and wind plants) for a peak demand of 113MW as shown in Table 2. In addition to the installed capacity of the interconnected system, Mauritania's installed capacity made available on the other large isolated systems totals 78MW excluding IPPs. With increased capacity, SOMELEC has been able to export excesses to Senegal and Mali.

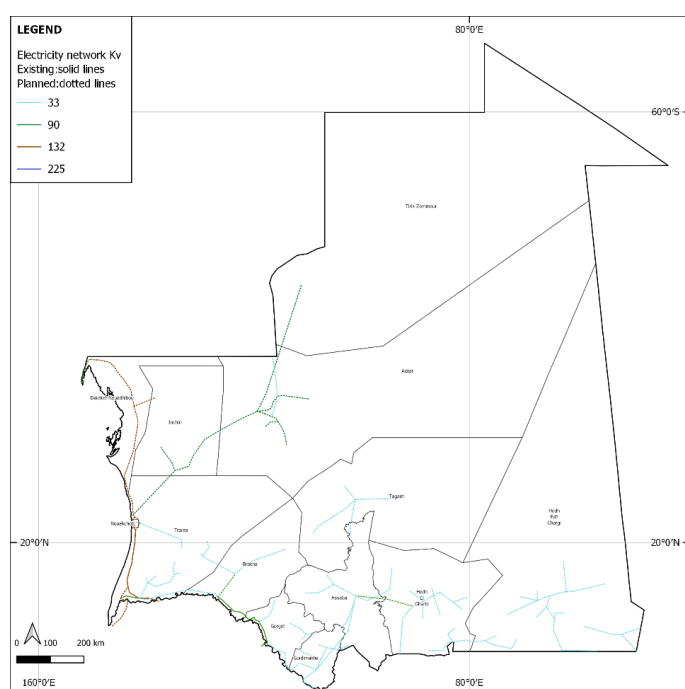
Mauritania is also building a new 50MW solar plant in Nouakchott. US\$53 million were co-invested between the Arab Fund for Economic and Social Development (AESD) and Mauritania's government to construct the plant by the end 2019/early 2020. Other renewable projects in the pipeline include the construction of a 100MW wind farm funded by AESD at a cost of \$120 million close to Nouadhibou. There is also a future hydroelectric project to be constructed by the Senegalese OMVS (Organisation pour la Mise en Valeur du fleuve Senegal) with an installed capacity of 140MW to be shared with other OMVS country members. Furthermore, off-grid hybrid technologies will also be deployed through international donors contribution to electrify agricultural and fishing communities. This includes funding from the EU, UNDP, GEF and Abu Dhabi Fund for Development (ADFD), more detail is provided in section 2.4.1.

Mauritania has an electrification rate of 42%, unevenly distributed between urban areas (76%) and rural areas (3%) (Ministere de l'Economie et des Finances, 2016). Reaching rural areas is a particularly challenging task due to accessibility issues especially in remote communities of fewer than 500 people in the middle of the desert with poor road infrastructure in place. Connecting these communities through traditional grid infrastructure is extremely expensive.

The majority of the electrified population receives their service from SOMELEC, the on-grid and urban national utility, either through the main grid, or in some cases through mini-grids. SOMELEC is responsible for supplying all urban centres of the country.

Since 2012, SOMELEC has also been involved in rural electrification by taking over the management of mini-grids located in Moughataas. Historically, SOMELEC's mandate was the provision of electricity services in urban environments, most notably in localities with at least 2,600 people (MPME, 2013). In the larger cities, this meant developing and running traditional grids, but in some of the smaller areas, SOMELEC runs isolated grids with fossil fuel-based generation, including with diesel generators. In 2012, SOMELEC's perimeter was expanded to include all administrative towns, or district capitals, called Moughataa, including those with fewer than 2,600 people or located in rural areas. This means that they took over a number of délégataire run sites.

SOMELEC's electrification efforts are predominantly funded through donors, including installing systems in rural areas. In addition, the utility has approximately €10 million p.a. national budget allocated to rural electrification that can be used to top up donor funding. Since 2015, SOMELEC claims not to have requested any government subsidy thanks to its increased penetration of renewables. In fact, it was able to contribute €12 million to the Treasury because of its electricity cost reduction.



The grid covers the south-east region of the country and is interconnected to the OMVS system. The 225kV line connects Dagana in Senegal to Nouakchott, as shown in Figure 4. A second 90kV line connects Selibaby to Bakel in Senegal. In terms of distribution network, there are 15kV and 30kV lines in Nouakchott. The 15kV line is in poor condition; in 2017 there were 99 power outages or 62 hours of interrupted service in the affected zone (SE4ALL, 2017). Additionally, most of the distribution sub-stations in Nouakchott are congested. The cost to reinforce and expand the network to unconnected peri-urban areas was recently estimated by the German consulting company INTEC to require €31 million by 2020.

Mauritania's Production and Transmission Master Plan focuses on expanding transmission and distribution lines to ultimately interconnect all existing systems.

Figure 4. Existing and planned grid

Current grid extension projects described in the master plan have been prioritised and laid out in the SCAPP (Ministere de l'Economie et des Finances, 2016), SCAPP's overall strategic ambition in terms of electricity for the country is to (SE4ALL, 2017):

- (1) Achieve the development of renewable energy projects with support of government funding
- (2) Connect to the grid localities with more than 200 inhabitants when it would be more economically feasible
- (3) Hybridise and connect all diesel mini-grids and plants situated in the eastern end of the country
- (4) Keep mini-grids located in the north as isolated and hybridise the systems

Three large grid extension projects have been designed to connect main urban centres to the Nouakchott power plant or to the Senegalese system OMVS covering the bordering south side of the country (Ministere de l'Economie et des Finances, 2016). Further in 2016, Mauritania was undertaking 13 transmission and distribution lines extension projects to interconnect main power plants or large isolated power systems (Ministere de l'Economie et des Finances, 2016).

The interconnection approach has also been integrated in future mini-grid projects. The SCAPP also has an ambition to power rural areas, particularly where fishing communities are located. Current mini-grid projects developed by the EU or UNDP have been designed with a long-term vision of interconnecting these systems. However, further clarification on the conditions and process for interconnection is required.

In 2017, SOMELEC was lacking technical and financial capacity to manage its operations. In terms of human resources, 30% of the company's staff was within the commercial department responsible for collecting public funds. Additionally, according to the EU-TAF study, the organisation does not have a department responsible for studies and planning which makes it difficult for SOMELEC to have future visibility. In terms of finances, from 2015 to 2017 SOMELEC was in deficit and lacked transparency in terms of financial management. As a result the company was constantly in debt despite falling international oil prices that helped reduce production cost. SOMELEC's financial challenges are exacerbated by management inefficiencies and lack of human resources capacity coupled with commercial and technical losses. However, with the increasing renewable penetration SOMELEC has recently been able to slowly revert its loss making trend. Distribution losses have also negatively impacted the company's revenue, the ratio between the total energy billed and the total energy produced decreased by 8% in 2016 (from 77.05% to 70.90%). SOMELEC has also not been able to tap into potential revenue in meeting connections demand. In November 2016, of 1,158 demands of connections to low voltage distribution network only 602 were realised (SE4ALL, 2017).

SOMELEC's tariffs have remained low and unchanged since 2007. SOMELEC's domestic tariff are set at US\$0.08/kWh for all domestic consumption in rural or urban areas. Tariffs in Mauritania are structured by two elements, fixed network charge and the price per kWh consumed. With the increasing contribution of renewable energy, the production cost per kWh has decreased, however current tariffs remain too low to guarantee financial stability. SOMELEC tariffs are lower than the ones fixed for concessionaires operating in the rural electrification space as explained in section 2.4.3. In terms of subsidies, SOMELEC claims having received its last subsidy from the Government in 2015 to an amount of MRU 61 (~US\$16.7million), this was driven predominantly by the reduction in cost of electricity.

Table 3. SOMELEC tariffs

| Categories | Consumption (kWh/month) | Fixed premium (MRU/month) | Price per kWh (MRU/kWh) |
|------------|-------------------------|---------------------------|-------------------------|
| Category 1 | If <25 | 72.42 (*\$1.9) | 3.07 (*\$0.08) |
| Category 2 | If >=25 : 0-100 | 72.42 (*\$1.9) | 3.07 (*\$0.08) |
| Category 3 | If productive | 1039,73 (*\$29.27) | 4,13 (*\$0.11) |

*Exchange rate of 28/08/2019: MRU 1 = US\$ 0.027

2.4 OVERVIEW OF THE OFF-GRID SECTOR

ENERGY ACCESS POLICY AND PLANNING

A number of institutions are involved in rural electrification. While the main mandate for energy access policy and planning lies with the MPME, implementation is spread between a number of governmental agencies, including the state-owned utility SOMELEC, APAUS (now-defunct), ADER, and ARM. In addition, a number of donors are active, most notably UNDP, the EU and AFD.

In terms of dictating energy access policy, the mandate for electrification, both on and off-grid, remains with the MPME. In 2013, MPME adopted the Plan Directeur de Production & Transmission à l'Horizon 2030 (*Production and Transmission Master Plan*), developed by Gopa Intec a German international energy consultancy. This plan, although now widely accepted to be out of date, is the only electrification plan currently available and provides recommendations on electrification through both on and off-grid technologies. The plan sets a 100% coverage and connection rate for the urban environment by 2020, and a 40% coverage (as opposed to connection), rate in the rural market.

Mauritania counts 3,209 rural localities of which less than 3% are electrified, the master plan does not indicate which areas it prioritises. However, it suggests electrifying localities with fewer than 2,600 people with mini-grids. The plan sets threshold requirements for electrifying localities, mainly through grid extension. As Mauritania is a vast and sparsely populated country, the plan specifies that localities with a population above 4,000 people should be connected to the main grid. Those between 2,600 and 4,000 people should be electrified with isolated grid-scale systems, when connection to the main grid is not economically feasible (MPME, 2013). For localities with fewer than 2,600 people, the plan suggests that these should be powered by isolated mini-grids. However, there is no indication which localities should be electrified by which approach.

More recently, the Government has updated its country development strategy; *Stratégie Nationale de Croissance Accélérée et de Prospérité Partagée 2016 to 2030* (SCAPP - Strategy for National Growth and Shared Prosperity). This details the country's aims to boost primary GDP sectors (agro-pastoral and fishing) through a variety of measures, including through improved access to energy. Given these sectors represented 31% of the country's GDP in 2016, the strategy seeks to enhance socioeconomic development by driving growth of agricultural and fishing production through improved access to infrastructure and electricity, especially at a community level. **The strategy has set its targets of reaching 40% of electrification in rural areas to 2030, and 95% in urban environments** against 3% and 76% achieved respectively in 2018.

One of the main challenges about the lack of clarity around electrification planning, is that it remains easily exposed to political interference. This is particularly the case during pre-election periods when politicians intervene in the prioritisation of new areas to electrify.

APAUS was responsible for developing 25 mini-grids of which 20 are diesel and five that have been hybridised. Historically, mini-grids were funded by donors who relied on APAUS's ability to manage the whole development process. This was done mostly with Engineering Procurement and Construction (EPC) contracts whereby APAUS would recruit engineering consultants to design installations. Once the mini-grid was commissioned, the identification of a *délégataire* (approved service providers, or concessionaires) was handed over to the Autorité de Régulation Multisectorielle (ARM). Since 2007, ARM has been in charge of opening calls for proposals to select the *délégataire* contracted for a management contract of seven years, now reduced to five. The selection was based on the provision of a *cahier des charges* (technical specifications) with a service proposition requiring the smallest subsidy. Today, of the 25 mini-grids developed by APAUS, SOMELEC took over the management of 13 mini-grids and the remaining 12 are managed by *délégataires* under contract with ARM.

ADER led the development of 15 mini-grids of which six have been hybridised and nine remain diesel only. Five of the 15 mini-grids were transferred to SOMELEC in 2012, when the utility started its involvement in rural electrification. All of ADER's mini-grids development projects were funded by AFD or the EU among other donors and the Mauritanian Government. Similar to APAUS, ADER was responsible for conducting feasibility studies to identify where to locate

installations as well as launching calls for proposals to recruit mini-grid developers. Once installed, the recruitment process of a *délégataire* was then likewise handed over to ARM which let five-year contracts for operation and maintenance. *Délégataires* managing systems installed through ADER are also eligible for FAUS subsidy.

Additionally, ADER also guarantees continuity of service to *délégataires*. This involves regular checking of site metrics as provided by operators. All systems developed under ADER's authority must be compliant with European electrical standards to ensure high quality and reliable installations.

In total, SOMELEC operates 42 mini-grids today of which 13 were taken over from APAUS and five from ADER that were installed in Moughataas. *Délégataires* whose mini-grids were transferred to SOMELEC were compensated according to their management contract agreements (20% of remaining expected revenue for the years lost).

Stakeholder interviews confirmed SOMELEC's unwillingness to run remote mini-grids. Installing and operating diesel mini-grids in the middle of the Mauritanian desert is very expensive for the utility. Difficult accessibility due to poor transport infrastructure coupled with the small number of inhabitants paying for SOMELEC's low tariff means these sites are invariably loss-making. During an in-country interview with the utility, SOMELEC openly shared its lack of interest in investing in far remote areas and operating systems installed there.

The Autorité de Régulation Multisectorielle (ARM – Multi-sectoral Regulation Authority) regulates the management of off-grid electrification activities outside of SOMELEC. Also established in 2001, ARM is responsible for the regulation of activities in water, electricity, telecommunications and postal services. In terms of electricity, the authority is only in charge of delegated service operators and issuing production licences for non-SOMELEC entities.

Opportunities for concessionaires to operate networks outside of urban areas has been in place since 2007. As explained above, calls are launched by the ARM, applications are evaluated and selected based on the smallest subsidy required. ARM's obligations as the regulator include regular inspection of sites and operations, checking that the applicable tariff has been properly applied (e.g. through checking of billing), receiving and reviewing concessionaires reports on operations, and approving the subsidy on a quarterly basis. When value added services are offered to consumers with installed systems, ARM allows operators to freely offer services, with the exception of where this strays into regulated territory (e.g. in telecommunications for which a licence is needed in terms of providing a service).

Today, ARM oversees 22 mini-grids that are operated by six *délégataires*. Twelve and ten of these systems were respectively developed under APAUS and ADER supervision. Additionally, 13 mini-grids originally contracted as concessions were transferred to SOMELEC after 2012. To date, six of the 22 ARM systems have been hybridised. Hybridisation was initiated in 2014 but the process has been relatively unsuccessful due to poor design, resulting in government frustration over lost potential cost and subsidy reduction.

As explained in Section 2.2, concessionaires operating mini-grids under licence from ARM receive the FAUS subsidy to cover costs of operation. The subsidy covers diesel, and maintenance, and small equipment renewal. Through its data, ARM has been able to establish that the subsidy it pays is surprisingly close to the tax on diesel. Therefore, ARM hypothesises that the subsidy could be largely eliminated should mini-grids be exempt from diesel tax, especially considering SOMELEC doesn't pay tax on the diesel it purchases.

In 2018, the MPME decided to close APAUS, under the stated aim of reducing institutional overlaps and duplication of efforts in both energy, water and telecoms areas. Furthermore, there were concerns about the quality of service provision under APAUS projects, especially where hybridisation was attempted. Many were unsuccessful as systems did not allow for simultaneous operation with diesel and solar, therefore, mini-grids were operated 100% on diesel. Since APAUS' abolition, the bulk of its activities have been temporarily divided between the MPME, the Ministry of Finances and Economic Affairs and SOMELEC. As a result, rural electrification activities have largely stagnated in the past year due to a lack of ownership of projects and activities. As an example, the operation of the FAUS was handed over to the Ministry of Finance, but since then payments to *délégataires* have been delayed. The sector reports continued substantial uncertainties about how the sector will function in the future.

Following EU-TAF's study, SOMELEC is being considered as the most relevant institution to take over APAUS's responsibility in orchestrating the off-grid sector. The study concluded that SOMELEC was best placed to deliver a private sector focused approach to rural electrification. The rural electrification directorate within the company would be the centre for managing concessions who would work in rural areas, currently outside SOMELEC's mandate. The conditions and expectations for this are still to be determined and confirmed, although the recommended governance structure would be similar to the one applied for the Rim-dir project described later in this section in Figure 5.

Going forward ARM would like to propose the launching of a call for PPP structures to hybridise the mini-grids park, such is the potential for cost saving from hybridising existing diesel mini-grids. One concessionaire had offered to finance the retrofit itself, although this hasn't progressed given the electricity code doesn't permit private sector financing yet. Further, the concession contract would have to be amended to include compensation for the investment in the case of contract cessation, which, likewise, isn't permitted.

All rural electrification projects must go through the call for proposal process, meaning there is presently no formal process in place to allow non-solicited projects to join the market. There has only been one project conducted without formal solicitation which was set up by Winch Energy, which received a government exemption to set up a solar platform pilot project in a rural village. The exemption for the case of Winch Energy is due to the fact there is no government financing (capex or subsidy) involved and the organisation was responsible for finding 100% of the financing. However, this has resulted in a challenging circumstance for Winch Energy as it is struggling to cover its financing costs. At present, despite numerous stakeholders working on clarifying the regulatory environment including how the private sector can be involved, there doesn't appear to be any future process for opening the market to non-solicited projects, or integrating a formal process that would receive spontaneous proposals.

The Government has been working with several international agencies, including AFD, UNDP and the EU on a number of projects and initiatives in an effort to restructure the electricity sector in general, and bring some much-needed clarity to rural electrification. UNDP, as part of its GEF funded country programme on renewable energy is providing support to update the Electricity Code, most notably to consider the latest thinking around renewables, and align it with other regulation, e.g. the latest PPP law. The aim is to have the updated Electricity Code ready for parliament to approve the new code in 2019. Through its study, UNDP has identified the main focus areas to be updated including:

1. Include renewable technologies in the updated version of the Electricity Code;
2. Align the Electricity Code to the latest updates on the PPP law to allow private sector participation in the commercialisation of electricity;
3. Harmonise rural tariffs with SOMELEC tariffs;
4. Restructure the call for proposals mechanism for rural electrification;
5. Determine electrification zones to be electrified with mini-grids

UNDP is also conducting a study to map how rural and urban tariffs could be aligned. Currently, tariffs in rural areas are more expensive than in SOMELEC's perimeter causing political issues among beneficiaries. The main problem is that SOMELEC tariffs are too low and for *délégataires* to be able to offer lower tariffs, a cross-subsidy mechanism would be required. This mechanism would help the poorest communities in rural areas to afford electricity. The UNDP study focuses on evaluating current tariff levels and structures as well as analysing Mauritians willingness and ability to pay to finally propose a new structure that would suggest a solution to the current discrepancies between rural and urban tariffs.

Today we estimate that there are approximately 64 mini-grids in total across the country. Of these APAUS originally developed 25 but 13 were passed over to SOMELEC, while the remaining 12 are managed by *délégataires* who report on their operations to ARM. Of these mini-grids, only five have been hybridised. Likewise, ADER has developed 15 mini-grids, of which six have subsequently been hybridised. Today 10 of all ADER's mini-grids are still operated by *délégataires* and the remaining five are being operated by SOMELEC. Of the 42 currently operated by SOMELEC, 11 are hybridised systems. The figure below gives a graphic visualisation of the different mini-grid splits.

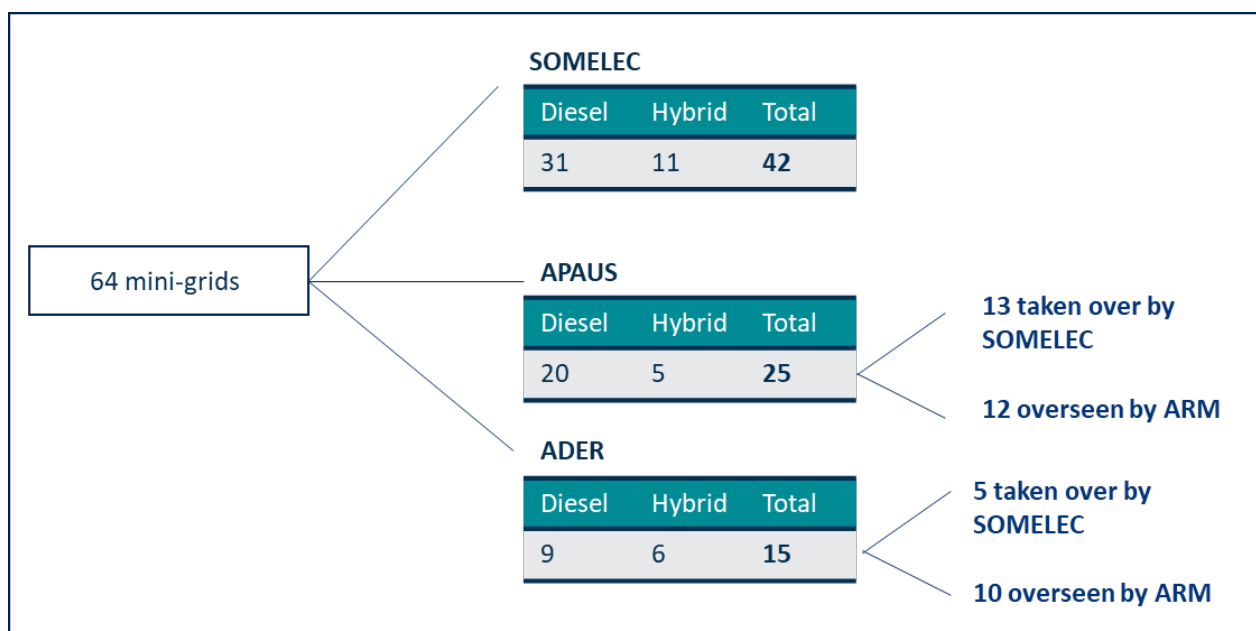


Figure 5. Mini-grids governance split

In addition to the development of diesel and hybrid mini-grids, there have also been several initiatives using solar platforms or SHS. As with mini-grids, nearly all the installations of solar platforms have been done with external funding. Solar platforms systems are kit-based systems consisting of a solar generator, some battery storage, and a range of bespoke productive use technologies including grain mills, hairdressing, ice-making, puncture repair, etc. The main implementer of the solar platforms was the French NGO GRET, through the PERIB (2008 to 2010) and ERUDI (2011 to 2018) programmes, both funded by the EU. In the first instance, 24 projects were set up, with a community-based operating model to collect revenues and manage maintenance. In the second, a further 79 villages were electrified. These conversely had managers to operate them, with the management licence awarded by the APAUS after GRET had completed the installation. It's widely expected that not many of these platforms today are still operating. Going forwards, it is unlikely that further projects of either SHS or solar platforms will be implemented as these are considered locally to be 'pre-electrification' methods that do not provide the level of service desired by either the recipients, or the Government.

Solar-home-system distribution has mostly been conducted by ADER. Approximately 15,000 kits have been distributed by the organisation with leasing programmes. SHS have been financed by beneficiaries who were able to pay for the kits over a period of two years. The mechanism involved contracting an operator that would be in charge of managing leasing contracts with beneficiaries and collecting payments from users. After two years, beneficiaries could also sign an extended maintenance contract with the local operator.

In terms of future mini-grids, the largest initiative at present is the EU funded RIM-DIR project to electrify agro-pastoral communities in the south-east of the country. Rim-DIR (Republique Islamique de la Mauritanie, Development des Infrastructures Rurales – Islamic Republic of Mauritania, Development of Rural Infrastructures) is a EUR35m project to support agro-pastoral development in three southern regions of the country where potential for socioeconomic development has been identified by the EU (European Union, 2018). The overall programme is part of a wider collection of three projects – RIM RAP, RIM DIR and RIM FIL- all of which share the objective of supporting rural agricultural development. RIM DIR's objective is to bring enhanced agricultural practices to the region, and to facilitate this it has an electrification component built in, representing EUR8m of the EUR35m grant. The RIM DIR element has been given over to AFD (electrification component only), and to ENABEL (Belgian aid) to develop, with AFD contributing a further EUR4m to the project.

RIM Dir plans to reach 18,000 subscribers of which 5,400 will be through mini-grids operating under a PPP framework, the first seen in rural electrification projects. The project will cover seven zones with one or two operators managing mini-grids to be selected through a call for tenders by end of 2019. This call will be organised by SOMELEC, in

partnership with ARM and the PPP department of the ministry of finances and economic affairs. Of the seven zones the EU and AFD will manage two to four zones and one to three zones will be managed by the World Bank, following the same process. The selection of seven priority zones were identified through a pre-feasibility study led by Burgeap that looked at the potential for economic development and where installations required the smallest subsidy. However, the exact number of mini-grids to be installed has not been firmly determined yet. This project is innovative as it is the first time that concessionaires will contribute 10% of CAPEX in installation and the operation of the equipment to be run as a concession for 15 to 20 years (European Union, 2018). The remaining 90% will be subsidised by the EU from the aforementioned grant. The selection of operators will be based on those proposing the highest level of renewables penetration in their installation (currently expected at around 95%), and requiring the lowest amount of subsidy. Further potential developers will have to propose technical and management related solutions, including for the first time productive use technologies. The hope is that more innovative propositions are offered to improve mini-grid performance. As an example, currently there appears to be hardly any battery storage used in Mauritanian grids, but again AFD is expecting to also see more storage proposed as installation to complement the large renewable penetrations.

The complications brought about by the loss of the APAUS, the apparent contradictions of the PPP law and the electricity code, and the desire to bring in the private sector as investors has meant that the AFD has also conducted a relatively in-depth study to clarify the potential management structure for the operation of the mini-grids. Although focused on one case, it is hoped that this judicial and institutional review can support the ministry with development of the overall framework for private sector participation in the market. The study proposed a number of operating scenarios to the ministry, including direct ministry operation, SOMELEC operation, and others.

The ministry chose to have SOMELEC manage the development and operation of the RIM DIR mini-grids, albeit with the participation of *délégataires* contracting to SOMELEC. This is despite SOMELEC not being mandated nor regulated to operate rural electrification projects. As shown in Figure 6 SOMELEC would be responsible for contracting *délégataires*, and receive technical assistance to project manage these new contracts under a PPP framework. Additionally, the PPP unit within the Ministry of Finance and Economics affairs with technical assistance support (MEF in figure 6) will assist in securing and transferring allocation of FAUS subsidy and cross-subsidies through a special reserve account. In this scenario, SOMELEC will also ensure asset management and equipment renewal. It would also receive project implementation and management support from external consultancy.

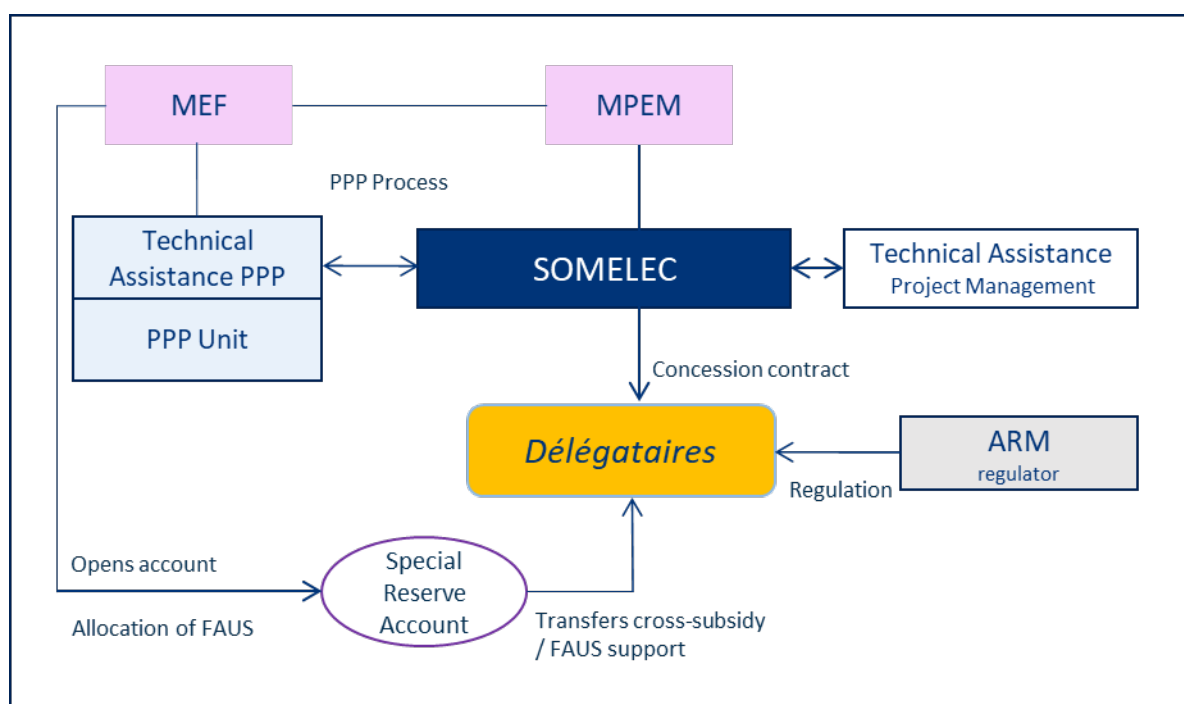


Figure 6. Rim-dir rural electrification institutional framework scenario 4 - Somelec operator (AFD, 2018)

In order to capacitate SOMELEC, AFD is providing technical assistance to improve the institutional set up and enhance greater ability to operate rural electrification. This includes appointing a rural electrification manager to sit within the future Rural Electrification Directorate within SOMELEC. Additionally, AFD is working on another project with a EUR12 million budget to improve SOMELEC's capacity in terms of technical knowledge, administration and managerial skills. This project will resurrect SOMELEC's presently defunct *Ecole des metiers* to provide managerial and technical skills training needed for electrification, including in rural contexts. In the longer term, the school will provide full time and professional programmes to be opened to the public and benefit other stakeholders to build a stronger market.

UNDP is also co-ordinating another mini-grid project targeting coastal fishing communities, in which four villages will be electrified through hybrid wind mini-grids on the coast of the country. The objective of this US\$6.7 million project is to provide improved infrastructure for fishing communities to support economic scale up, and in addition to the electrification, will provide fish processing equipment, including refrigeration. The project also aims to identify a business model that can be replicated to other regions of the country. \$1.7 million are funded by UNDP and GEF for soft support and \$5 million are funded by the Abu Dhabi Fund for Development (ADFD) for the installation of the pilot technologies. Finally, the Ministry of Energy is committed with in-kind support i.e. desks, buildings, staff, etc.

LICENSING AND EXISTING MINI-GRIDS

All mini-grid operators must have production and distribution licences, which are issued by ARM. The 22 mini-grids not operated by SOMELEC are operated by six *délégataires* and regulated by ARM. Production licences are subject to a minimum threshold, presently 23KW. Distribution licences have no threshold. No licences are available for transmission (this is only done by SOMELEC, which in any case is not subject to regulation). Licences are awarded at the same time as *délégataires* are awarded the right to exploit a particular site, following a call issued by the ARM.

Production and distribution licences for mini-grids are linked to the management contract term, initially seven years, and now five years. However, in the context of rim-dir project licensing process and length of concessions are being revised and will be granted for 15 to 20 years. Historically, awarding of the management contract has not been a particularly transparent process and stakeholders in the sector claim not to always understand why certain players are awarded the contracts, especially when they may not be the most competent or offering the least expensive option. Note that participation in tenders requires a relatively expensive participation fee.

Currently all operators need a licence to sell electricity in Mauritania, which means individual auto producers cannot reinject surpluses from their home systems into the grid. There is no mechanism in place for this to happen.

MINI-GRID TARIFFS

Mini-grid tariffs for concessionaires operating outside SOMELEC's perimeter are regulated, and set by ARM, in agreement with the ministry. At present, these are effectively 40% higher than the utility's tariffs. Tariffs are set by the Ministry of Energy and the ARM regulatory body and are standardised across all concessions. Presently, tariffs are set at US\$0.14/kWh for domestic consumption below 25kWh per month compared to SOMELEC's domestic tariff of US\$0.08/kWh per month for all domestic consumption in rural or urban areas. It should be noted that current rates have not been reviewed since 2007. In addition to the variable rate per kWh consumed, tariffs also have a fixed monthly fee.

The Government also mandates SOMELEC's fee rate which can be charged to customers. As it is fixed at a low rate, SOMELEC has welcomed the switch to renewables to allow the company to reduce cost instead of increase revenues through higher tariffs. Additionally, operating networks that cover wider zones and populations has allowed the utility to generate economies of scale as opposed to mini-grid operators.

The difference between SOMELEC and *délégataires*' tariffs is causing discontent in the areas where the two regimes border. Rural populations neighbouring urban centres or Moughataas are increasingly aware of the difference in tariffs paid. This can lead to discontent in those areas, meaning a refusal to pay, or requests for SOMELEC to take over. This is exacerbated by the fact that SOMELEC claims to provide a 24-hour service, whereas *délégataires* may not be able to provide this same level of service (i.e. a number of hours in the day rather than 24).

Table 4. Somelec and délégataires tariffs (UNDP, 2018)

| Domestic on-and off-grid tariffs (SOMELEC) for 2kVA subscription | | Domestic Off-grid tariff (concessions) | | | | | |
|--|-------------------------|--|-------------------------|----------------------------------|---------------------------------------|----------------------------------|-------------------------|
| | | Low rate <25 kWh /month | | Middle rate 25-120 kWh per month | | Higher rate 25-120 kWh per month | |
| Fixed premium (MRU) | Price per kWh (MRU/kWh) | Fixed premium (MRU) | Price per kWh (MRU/kWh) | Fixed premium (MRU) | Price per kWh (MRU/kWh) premium (MRU) | Fixed premium (MRU) | Price per kWh (MRU/kWh) |
| 72.42 (*\$1.9) | 3.07 (*\$0.08) | 70 (*\$1.88) | 5.1 (*\$0.14) | 182.5 (*\$4.9) | 8.1 (*\$0.22) | 761.3 (*\$20.5) | 9 (*\$0.24) |

*Exchange rate of 28/08/2019: MRU 1 = US\$ 0.027

To overcome this issue, ARM and other organisations have recommended harmonising all tariffs to SOMELEC's offer. ARM has suggested that government tariffs for the off-grid sector should be aligned with SOMELEC's, especially since it estimates that properly hybridising mini-grids would at the same time reduce the subsidy levels required for operation. To date, the ministry has not considered the hybridising possibility, however, more recently UNDP's off-grid tariff study made the same recommendation, and therefore it is hoped that such a decision could be introduced in the future.

UNDP's tariff study has recommended that SOMELEC tariffs might also need to be revised if there is to be any market subsidising. The main challenge that Mauritania has in terms of rural electrification is that approximately 70% of rural beneficiaries consume less than 15kWh per month. As a result the cost of supplying communities in remote areas with poor transport infrastructure and challenging landscapes – such as in the middle of the desert - is very expensive. Therefore, using SOMELEC tariffs will not cover high operational costs. In addition to recommending a tariff review to permit for cross-subsidisation, the study also recommends hybridising rural systems and identifying opportunities for economic development to increase communities opportunities and ability to pay for a service. Offering added value services to installations to drive demand for instance, can also contribute to increased electricity demand for business opportunities.

SUBSIDIES AND INCENTIVES

FAUS is the only current subsidy meant to support with mini-grids OPEX (capex being historically largely covered by donors). The FAUS is credited by a 3% tax on revenues from the telecommunications industry, in turn 1.5% is returned to the telecoms industry, and the remainder is for rural water and energy provision. Approximately 1% goes to rural electrification in the form of subsidy for concessionaire run mini-grids. It covers the difference between revenue based on the regulated off-grid tariff, and the cost to operate the mini-grids, and mostly covers diesel, and maintenance, and small equipment renewal. Through its data, ARM has been able to establish that the subsidy it pays is surprisingly close to the tax value paid on the diesel. Therefore ARM hypothesises that the subsidy could be largely eliminated should the tax payment be removed, especially considering SOMELEC doesn't pay tax on the diesel it purchases. Since the abolition of APAUS, the FAUS is now administered by the Ministry of Finance and Economic Affairs. But in the current transition period that rural electrification sector is facing in Mauritania, this has resulted in delays in payments to *délégataires* of up to three to six months.

There remains considerable uncertainty about potential financial mechanisms for future mini-grid installations. As it progresses the development of Rim-DIR project, the EU is examining the potential for various sustainable financial mechanisms in future such as capex subsidies, or using results based financing (i.e. capex subsidy of per connection made). The intention for the moment is that the first mini-grids to be developed under the project will be subsidised with a 90% CAPEX subsidy through the donor, and the 10% equity will be covered by the selected operator. All mini-grids will also be eligible for receiving FAUS subsidy, currently managed by the Ministry of Finance and Economic affairs.

Clarification on tax and import duty exemptions for renewable products must be provided. During in-country interviews mini-grid developers reported importing their solar products with tax and import duty exemptions. Yet no official documentation has been able to confirm this incentive.

POWER PURCHASE AGREEMENTS

Current legislation only makes provision of PPAs on a case-by-case basis. There is no framework in place for PPA adapted to renewable energy provision. Mining companies are the only independent power producers in Mauritania but are not all allowed to feed the main grid with their own production. SNIM's plant in Nouahdibou is the only exemption; the company sells part of its generation to the national utility. Organisations have highlighted and suggested developing a standardised PPA that would outline main terms, conditions and state guarantees needed. This would clarify the main clauses for producers and provide the authorities in charge of negotiations with a stable basis for their work that is accepted by all parties (IRENA, 2015).

ARRIVAL OF THE GRID

Should a concession run mini-grid become interconnected to the main grid, it is likely that SOMELEC will take over the operation of the system and provide compensation of at least 20% of revenue for the remaining years of the concession agreement. Currently, there are no clear rules regarding operation modalities for mini-grids that become interconnected to the main grid. In the context of the Rim-dir project, it is likely that the same agreement applies as when SOMELEC has taken over operation of other mini-grids, meaning a 20% revenue compensation is provided.

TECHNICAL RULES

Mauritania today does not have standards or codes for off-grid systems. However, all mini-grids developed through the APAUS and ADER were required to be compliant with EU quality standards.

MOBILE SERVICES

Mauritania has mobile network coverage across populated areas, but mobile payment services for general services, including electricity, have not been developed yet. The main mobile service providers are Mauritanian companies: Mauritel, Mattel and Chinguitel. Coverage aligns with densely populated areas such as urban areas and main road networks. Mauritania has four million active mobile phone subscribers with a penetration rate of 92 per 100 inhabitants (World Bank, 2019). The number of internet users in the country is estimated at 0.81 million, representing approximately 18% of the population (Hootsuite, 2019).

Pre-payment meters have not been deployed across the country. Existing and planned electrification projects are made with traditional meters, there is currently no ambition nor belief in the benefits of installing pre-payment meters. SOMELEC piloted an unsuccessful trial in Nouakchott where customers with pre-payment systems still managed to circumvent the meters without paying their bills.

Digital payment in Mauritania is at a very rudimentary stage. Payment is dominated by cash. There is currently no framework for mobile money, nor any strategy for the development of electronic payments (Initiative, 2016).

BARRIERS TO MINI-GRID DEPLOYMENT

The biggest barrier to rural electrification today remains the lack of governance framework, and an absence of institutional clarity for implementation. Despite having ambitious targets, the country unfortunately does not have any clear plans for rural electrification. Indeed, the latest electrification plans are widely accepted as being out of date, meaning these no longer influence geographical expansion. Further, with the closure of APAUS, the Government has no implementation mechanism either, which has effectively stopped the development of future projects. Additionally, regulatory contradictions, e.g. between the newest PPP law and the Electricity Code, further slow development. Those projects that are in process, e.g. RIM-DIR have now moved across to SOMELEC, who many regard as the natural home for rural electrification in future, but who is itself open about the fact that it remains unattached to that market. Attempts by those donors working in-country to provide support in clarifying the situation are struggling to gain traction. This is partially explained by the fact that private sector development in the off-grid space is not a political priority for the country thus far.

Mauritania rural areas are characterised with very low population densities. Servicing these customers is therefore relatively costly and damages the business case for provision of electrification of services. Low population densities means economies of scale are lacking, compounded by relatively low consumption levels in rural populations, and low ability to pay. This is further exacerbated by high distribution costs given high distances, and poor infrastructure. SOMELEC is relatively open about its lack of motivation to intervene directly in remote communities given these projects represent significant financial losses for the utility.

That being said, Mauritania already has a well-established culture of needing to explicitly subsidise both capex and opex for rural electrification, which should hopefully be taken forward as the country turns to renewables for off-grid electrification. An absence of either capex or opex subsidies going forward would jeopardise future electrification efforts due to projects being financially unsustainable. It is a useful data point that Winch Energy, having elected to overcome the regulatory barriers by developing a project outside of the established call for proposals process (by obtaining an exemption), has struggled with the viability of its project.

Given the institutional situation and its political history, there is a complete absence of a culture of private sector for public services, including in energy. Mauritania's history in permitting private sector investment in energy projects is non-existent, and all energy and renewable energy projects have been financed by DFIs. This lack of appetite, coupled with high cost of capital and limited experience presents as a barrier for financial institutions to participate in the sector (Power Africa, 2018).

Misalignment of tariffs between SOMELEC and off-grid concessionaires creates political tension. Rural tariffs are considerably more expensive than SOMELEC's tariffs which generates conflicts within bordering localities.

Finally, Mauritania's rural population is characterised as nomadic, with strong cultural and ethnical ties. Through in-country interviews with sectoral stakeholders, developers highlighted cultural and local perceptions as barriers for the implementation of off-grid technologies. Rural communities are nomadic, traditional and therefore conservative populations who can be sceptical of the introduction of new technologies. Furthermore, Mauritania's population is composed of several ethnic minorities with strong sociopolitical divides that filter down to every day interactions (BTI, 2018). This can even hinder development initiatives, especially where infrastructure might need to be shared. For example, where different ethnic groups live within a same village, installations of water pumps have only been used by the minority group living nearest to the technology, even though it was planned for a wider population. Hence, perceptions and cultural differences within rural areas must be acknowledged prior to the installation to optimise its use.

3. GREEN MINI-GRID POTENTIAL

Estimating the potential for mini-grids is a challenging task that requires robust data and/or assumptions. Some physical factors, such as resource availability and geographic features, can be collected remotely through satellite data, but other factors require availability of local datasets and surveys. Certain non-physical factors, such as demand and consumption patterns, require precise settlement-level data to be collected. This data is often unavailable, out of date, or highly resource intensive to obtain. In addition, opportunity assessments rely upon criteria that differ depending on the approach of the implementing agency. For example, a private developer might consider purely financial metrics, whereas a community scheme might focus on quality of services provided. Given these constraints, the opportunity assessment in this report is designed to be of relevance to all mini-grid stakeholders but will not address the individual needs of all.

This chapter aims to give mini-grid stakeholders an understanding of the size of the opportunity for green mini-grids in Mauritania. Market size estimates are calculated based on a number of considerations: (1) **physical opportunity size** according to GIS datasets (population density, load centres, existing grid, etc); (2) **existing electricity expenditure** by rural households; (3) **maximum customer affordability** and willingness to pay, and (4) **tariffs** currently allowed in-country. Comparisons will be made between an existing market size, based on affordability and in-country tariff limitations, and the theoretical market size based on cost-reflective tariffs². The difference between current and theoretical market size will allow an approximation of any subsidy requirement for opening the market (in percentage terms).

3.1 DATA AVAILABILITY

In Mauritania, population density data can be sourced from WorldPop³ and information on population distribution across the country was provided by an external consultant working on the Rim-Dir project. WorldPop data estimates numbers of people per grid square, with national totals adjusted to match UN population division estimates.

The electricity transmission network map of Mauritania was sourced from the West African Power Pool (WAPP) GIS database. This dataset is distributed by ECREEE providing details on the existing and planned transmission grid network (medium and high voltage lines) in the whole Economic Community of West African States (ECOWAS) region and some countries in West Africa. Grid extension populations within the 15km buffer of the current grid were based on a combination of high voltage (HV) line data (obtained from the IFC GIS data: [electricity transmission and distribution grid maps](#)) and satellite mapping of night lights. Off-grid populations are those outside of these areas.

3.2 ASSESSING MINI-GRID POTENTIAL: METHODOLOGY

The first step in understanding mini-grid potential in Mauritania is to identify numbers of potential mini-grid customers, based on population (or household) density and proximity to the grid. To do this, the country's land area is segmented into three area categories — grid extension, mini-grid and standalone system (SHS) — based on distance between the existing transmission and distribution network and the population.

- Grid extension areas: defined as areas within 15km of the grid

² Cost-reflective tariffs are assumed to be \$0.4/kWh across SSA, based on cash flow modelling for typical mini-grids seen across SSA and elsewhere in the world. It should be noted that \$0.4/kWh may be conservative in some markets, particularly those that face supply chain challenges.

³ www.worldpop.org.uk

- Mini-grid areas: defined as areas further than 15km from the grid⁴, with household density greater than 50 households per km²
- Standalone system (SHS) areas: defined as areas further than 15km from the grid, with household density less than 50 households per km²

To understand where these different areas lie, the national grid is inferred using a combination of high voltage (HV) line GIS data and satellite mapping of night lights, buffered by 15km to produce the grid-extension area⁵. Potential off-grid populations are outside of this grid extension area, with mini-grid populations identified based on population density greater than 50 households per km².

Once mini-grid population sizes are established, mini-grid market sizes can be estimated by multiplying the number of potential mini-grid customers by likely electricity expenditure (either per capita or by household). This report uses four different electricity expenditure scenarios:

1. **Existing rural household expenditure on electricity based on the World Bank Global Consumption Database** (World Bank, n.d.). This approach assumes that 60% of rural household energy expenditure is on electricity, and that household revenue comprises 60% of the total revenue of a mini-grid (when including revenue from businesses, public sector buildings and industrial users).
2. **Existing rural household expenditure on electricity based on other literature and sources.** This may be based on international or local studies, or local stakeholder interviews (in theory, this should yield similar results to scenario (1) above, although this may not be the case in practice).
3. **Potential rural household expenditure on electricity, estimated based on a bottom-up calculation of what would be required to deliver SEforALL Tier 2/3 energy access nationwide, and an average allowable tariff currently used in-country.** This approach assumes that the average rural household's electricity use would be approximately 2.2kWh/day; according to the SEforALL Multi-Tier Framework, this represents a supply level between Tier 3 (1kWh per day) and Tier 4 (3.4kWh per day), which allows for electrical lighting, air circulation, television and phone charging (Tier 2 level), plus additional appliances that can allow for productive uses.
4. **Potential rural household expenditure on electricity, estimated on a bottom-up calculation of what would be required to deliver SEforALL Tier 2/3 energy access nationwide, and a flat tariff of \$0.4/kWh.** This tariff has been chosen as the minimum tariff needed for private developers to recover their costs. Such a rate is assumed to be one which in many contexts in Sub-Saharan Africa, and in other developing countries, is cost reflective. It has been used to allow comparisons across countries in terms of market size, but also to highlight the shortfall between feasible tariffs, and often-cost-reflective tariffs.

Results from these four scenarios are discussed in the results section that follows.

-
- 4 While we have assumed GMG populations are those beyond 15km of the grid, some developers may also wish to consider regions already serviced by the grid. In some areas currently reached by the grid, mini-grid market potential exists due to both high main grid connection costs, as well as its lack of reliability due to the ageing grid network. The possibility of mini-grids in proximity to the main grid is not considered in our analysis due to its high dependence on the business model used and local demographics.
 - 5 Using this combination of night lights and HV line datasets provides a more comprehensive picture of current electrification than using HV lines alone. Although HV grid line data is commonly available for countries in Sub-Saharan Africa, these lines provide a limited view of electrified areas, since medium voltage (MV) lines are often used to reach towns at distances exceeding 15km. This analysis therefore infers the position of the MV lines from satellite data of night-time light emissions, pre-processed to provide yearly average datasets from which noise and cloud cover have been removed.

3.3 ASSESSING MINI-GRID POTENTIAL: RESULTS

Mauritania generally does not have an interconnected grid across the country with only one main 225kV interconnected line that extends from Nouakchott down to Senegal. In the future, Mauritania is planning on installing distribution lines around existing and future lines in different zones of the country with a future ambition of interconnecting them as shown in figure 7.

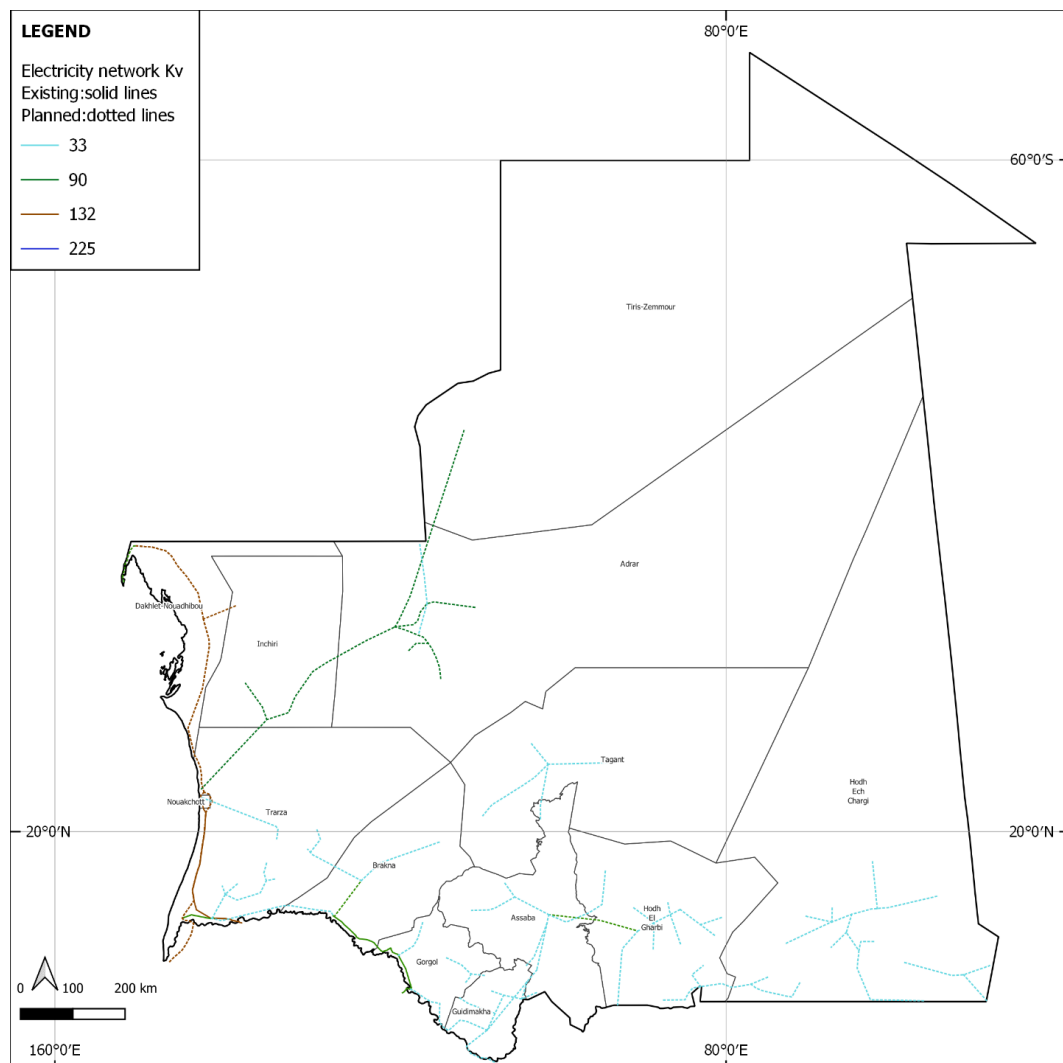


Figure 7. Mauritania transmission and distribution network

By inferring the presence of the transmission and distribution lines using night lights, and overlaying population density (figure 7) onto the resultant map, we can identify those areas best served by mini-grids (figure 8).

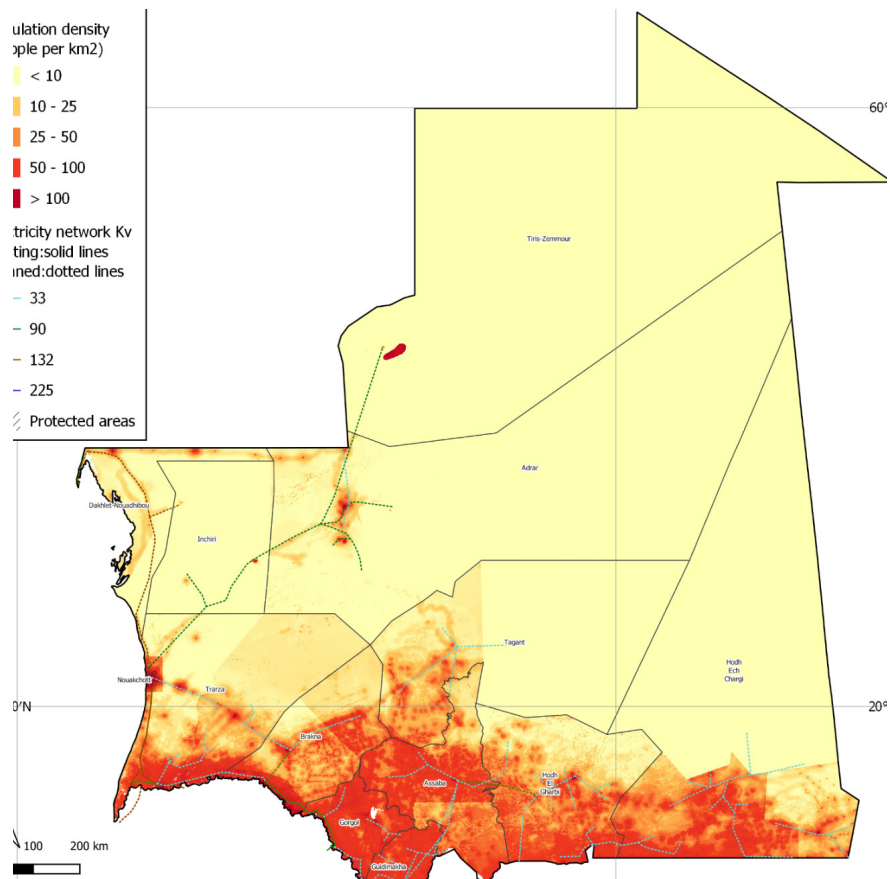


Figure 8. Population density in Mauritania

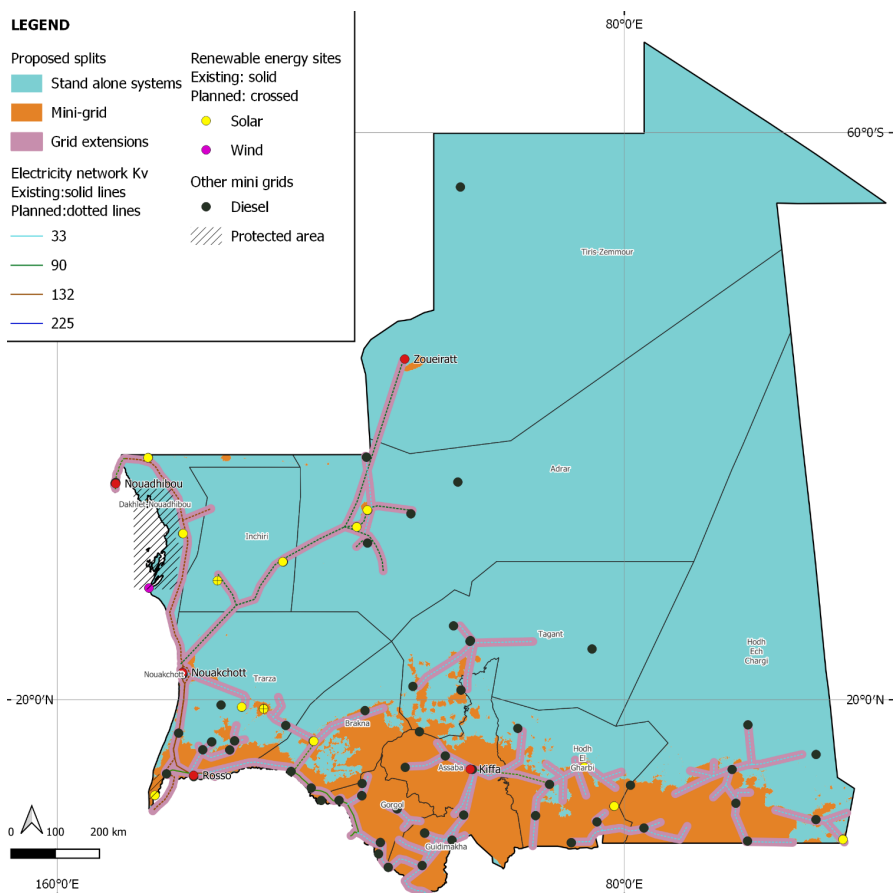


Figure 9. Regions best served by grid extension, mini-grid and standalone systems (Carbon Trust analysis)

Our analysis estimates that 2.2 million people (55% of the non-electrified population) will be best served by mini-grid solutions in Mauritania. A further 629,000 people (16% of the non-electrified population) will be best served by solar home systems (SHS) and 1.2 million people (39% of the non-electrified population) will be best served by grid extension, based on proximity to the existing grid. This calculation is based on the current grid coverage only⁶; any planned grid extensions will reduce the estimated market size.

The Mauritania mini-grid market is mostly on the southern border with Senegal due to their low electrification rates (i.e. 3% on average), limited grid coverage, and population densities high enough to support mini-grids. Our analysis shows that the mini-grid market potential is spread among the following five main regions - Assaba, Hodh Ech Chargi, Gorgol, Guidimakha, Trazra. The number of people that will be best served by mini grids respectively in each region is 344,820; 337,019; 282,467; 264,707 and 261,855, corresponding to around 85% of the population on average in each region. The provinces with the largest percentage of the population best served by SHS technologies are Tagant and Inchiri located in the Sahara, corresponding to 99% and 75% of the population respectively in each region.

Population sizes best served by either grid extension, mini-grid or SHS are shown by province in Table 5:

Table 5. Suitable electrification solutions per region in Mauritania (Carbon Trust analysis)

| State | Current grid network | | | | | Planned grid network to 2030 | | | |
|---------------------|----------------------|------------------------|--------------|------------|---------------------------------|------------------------------|--------------|------------|---------------------------------|
| | Electrification rate | Population (thousands) | | | Mini-Grid Market (\$,thousands) | Population (thousands) | | | Mini-Grid Market (\$,thousands) |
| | | < 15km of grid | Mini-Grid | SHS | | < 15km of grid | Mini-Grid | SHS | |
| Adrar | | 19 | 6 | 85 | 83 | 38 | 2 | 71 | 22 |
| Assaba | | 7 | 344 | 36 | 4,750 | 77 | 280 | 32 | 3,851 |
| Brakna | | 115 | 213 | 63 | 2,940 | 113 | 219 | 61 | 3,023 |
| Drakhlet-Nouadhibou | | 66 | 11 | 36 | 155 | 83 | 3 | 27 | 54 |
| Gorgol | | 98 | 282 | 1 | 3,891 | 125 | 255 | 2 | 3,509 |
| Guidimakha | | 12 | 265 | 2 | 3,646 | 140 | 140 | 1 | 1,930 |
| Hodh Ech Chargi | | 12 | 337 | 98 | 4,643 | 127 | 232 | 88 | 3,192 |
| Hodh Ech Gharbi | | 17 | 239 | 74 | 3,290 | 105 | 165 | 61 | 2,271 |
| Inchiri | | 1 | 0.07 | 15 | 0.9 | 3 | 0 | 13 | 0 |
| Nouakchott | | 717 | 154 | 0.3 | 2,118 | 868 | 0.8 | 0.03 | 11 |
| Tagant | | 3 | 41 | 80 | 573 | 16 | 37 | 70 | 510 |
| Tiris-Zemmour | | 0 | 54 | 12 | 780 | 2 | 52 | 12 | 721 |
| Trarza | | 119 | 262 | 125 | 3,607 | 282 | 117 | 108 | 1,612 |
| Total | 42% | 1,187 | 2,209 | 629 | \$ 30,438 | 1,980 | 1,503 | 547 | \$20,708 |

In terms of potential revenue, the size of the market based on 2.2 million potential customers varies according to the four electricity expenditure scenarios described in section 3.2:

6 High voltage lines plus lights seen from satellite, which are used to infer the presence of medium and low voltage lines (**note:** this method may camouflage a significant existing off-grid contribution from diesel gensets, meaning that this mini-grid market size result is likely to be conservative; further studies in-country are required)

1. **Existing rural household expenditure on electricity from the World Bank Global Consumption Database:** According to this database, average rural household spend on energy consumption in Mauritania is US\$11.3 annually. To convert this to expenditure on electricity, we use two assumptions: (1) that around 60% of household energy spend is on electricity, and (2) that household spending comprises 60% of the total revenue of a mini-grid (when including revenue from businesses and community buildings). Given that the average number of persons per household in Mauritania is five, this translates to per capita electricity expenditure of approximately \$1.4 annually, or an overall **market size of \$3 million annually** (assuming 2.2 million customers). Based on grid expansion projections to 2030, this market size will drop to \$2 million (assuming 1.2 million customers).
2. **Existing rural household expenditure on electricity based on other reports/literature:** This assumes a national average **per capita annual spend on electricity of \$13.78**. This expenditure is calculated by multiplying the per capita annual electricity consumption with the average tariff. In Mauritania, the per capita average annual electricity consumption is 98.4kWh based on recent estimates of average monthly household consumption varying between 8 to 74kWh according to a study on tariffs conducted by UNDP. The current average off-grid tariff is at \$0.14, as a result we can estimate a **market size of \$30 million annually**. However, Mauritania has planned to harmonise its tariffs before 2020 and this could have an impact on the estimated market size.
3. **Potential rural household expenditure on electricity, estimated on a bottom-up calculation of what would be required to deliver SEforALL Tier 2/3 energy access nationwide, and an average allowable tariff currently used in-country:** Annual cost of electricity from a mini-grid was estimated on forward-looking household electricity consumption of 2.2kWh per day, representing an annual per capita electricity demand of 160Wh (five people per household). Based on this assumption of growing demand the **estimated market size reaches around \$50 million annually** and \$34 million with projected grid extension plans to 2030.
4. **Potential rural household expenditure on electricity, estimated on a bottom-up calculation of what would be required to deliver SEforALL Tier 2/3 energy access nationwide, and a flat tariff of \$0.4/kWh:** This tariff is assumed to be cost reflective. Based on annual electricity demand of 160kWh per capita, a tariff of \$0.4/kWh gives an average annual electricity expenditure of \$64.24 per capita: an **overall annual mini-grid market size of \$142 million** given a mini-grid population of 2.2 million. However, estimating a tariff of \$0.4/kWh does not reflect the current market conditions of Mauritania with low tariffs and a population with a limited ability to pay for its electricity.

A summary of these four market size estimates is shown in Table 6.

Table 6. Market size estimates for the four scenarios

| Scenario | Estimated per capita annual costs for GMG | Market Size given current GMG population | Market Size of GMG population (given planned grid extension) |
|------------------------------------|---|--|--|
| 1 World Bank Database | \$1.36 | \$3m | \$2m |
| 2 Other Reports | \$13.78 | \$30m | \$21m |
| 3 'Bottom-up' + existing tariff | \$22.5 | \$50m | \$34 m |
| 4 'Bottom-up' + theoretical tariff | \$64.24 | \$142m | \$97m |

Scenario (1) yields underestimated results because the high household size is diluting the household spend and market size. Scenario (2) is based on current tariffs and indicative household energy spend estimated by UNDP, yet it is useful as it separates out rural and urban energy spend, and has been selected as the more likely estimate of mini-grid market size in Mauritania. Scenario (3) is based on national tariffs in Mauritania and on demand levels observed elsewhere in SSA. Finally, scenario (4) is based on a theoretical higher tariff than currently available and demand levels observed in SSA.

In summary, this report estimates an annual mini-grid market size of \$30 million in Mauritania, based on an average tariff of \$0.14/kWh, and average per capita annual consumption of 98.4kWh (based on an average monthly consumption varying between 8kWh and 74kWh). This implies per capita annual electricity expenditure of \$13.78 within the population best served by mini-grids. Based on an estimated cost-reflective tariff of \$0.4/kWh across SSA, it is therefore estimated that **65% of project costs would need to be covered by a subsidy** to open up the mini-grid market to developers (lifetime project costs – with subsidy covering both CAPEX and OPEX).

3.4 RENEWABLE ENERGY POTENTIAL FOR MINI-GRIDS

3.4.1 HYDRO

Mauritania's hydropower resources are concentrated around the Senegal River where current projects are shared with neighbouring countries. As a member of the OMVS, the country currently shares two hydro plants with Senegal, Mali and Guinea. The main hydropower plant, the Manantali plant, is on the Senegal River near the border with Mali. This plant was developed within the OMVS framework. The hydropower plant has a capacity of 200MW, generating ~740GWh per year (UNDP, 2016). 30MW of this capacity is made available to Mauritania. The Félou dam is the second hydropower plant shared by OMVS members of which 18MW are made available to Mauritania (IRENA, 2015). Looking forward, additional OMVS dams in Gouina and Goubassi are expected to be completed by 2020, coupled with interconnection projects to distribute electricity produced to OMVS members.

Mauritania has limited small hydropower potential that could serve small communities. Most communities being concentrated in the South end of the country, the extent of the resources has not been well assessed so far. However, according to IRENA's Renewables Readiness Assessment, studies and measurements of technical and economic potential could lead to a joint irrigation and power generation operation project.

3.4.2 BIOMASS

In 2015, it was estimated that Mauritania had an energy potential generated from agricultural waste of 3.7GWh (IRENA, 2015). Agricultural waste in the country totalled over 500,000 tonnes/year. Yet, the country's primary energy needs are met through the use of traditional biomass, primarily for cooking food.

Typha charcoal could be used and reduce pressure on forest resources. Since early 2000, the use of wood decreased and charcoal increased, as a result the use of traditional biomass combined with the effects of drought and fire have severely reduced the vegetation cover. In 2015, a typha carbonisation programme was tested in Rosso to replace wood charcoal. Results showed the value of the programme in restoring biodiversity around Rosso. A feasibility study is also underway to potentially create a gasification/waste incineration plant in Nouakchott to produce 10 to 20MW by IPPs, yet this was not materialised at the time this report was written in 2019 (IRENA, 2015).

3.4.3 SOLAR

Mauritania receives large amounts of sunshine with an average radiation on a horizontal surface of 4.9 to 6.5kWh/m²/day. This is much larger compared to large European solar markets such as Germany, which has a horizontal irradiation of 2.9kWh/m²/day (Fraunhofer ISE, 2019). The highest global horizontal irradiation is found in the North of Mauritania which is a highly exposed hot and dry desert climate.

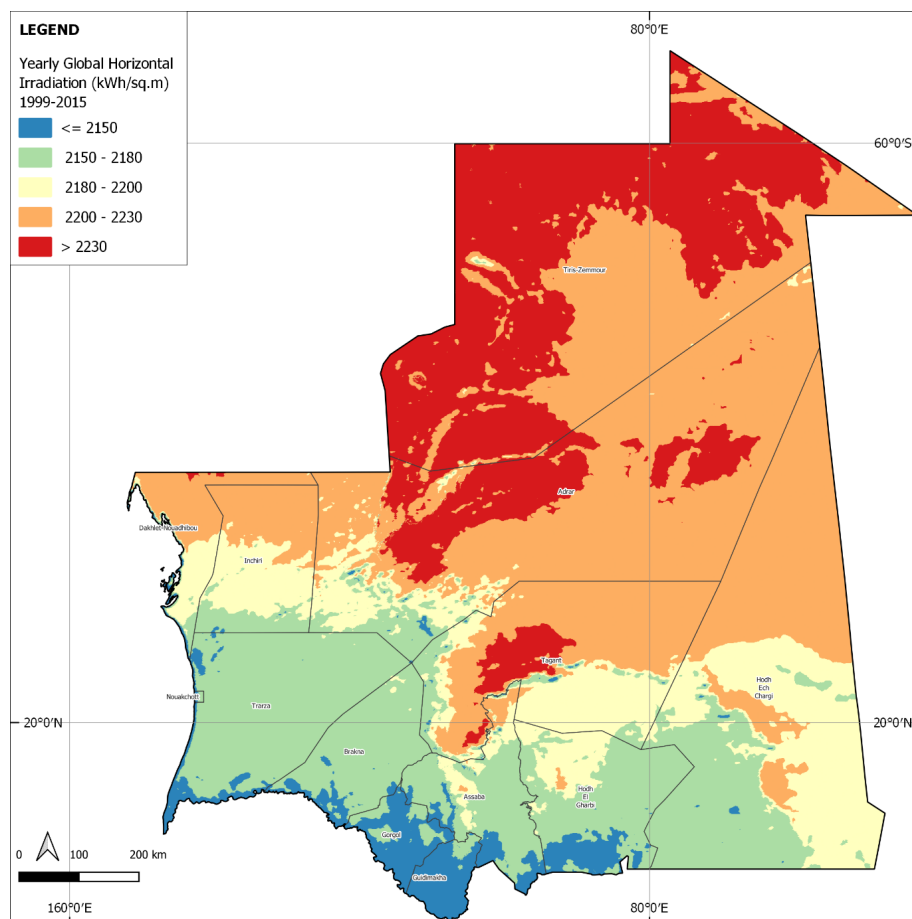


Figure 10. Mauritania's yearly global horizontal irradiation

Despite Nouakchott's large solar plant most solar applications have been off-grid. Nouakchott has the largest solar installation with a capacity of 15MW inaugurated in 2013. There are plans to extend it to 50MW under a joint investment from the Arab Fund for Economic and Social Development and Mauritania's government. In terms of off-grid applications, hybridisation activities have been conducted since 2012 and roughly five mini-grid systems are solar hybridised. The other 13 localities powered with diesel sources are planned to be hybridised with solar technology under a \$US10 million plan funded by the United Arab Emirates.

Despite the solar potential in Mauritania, IRENA recognises several challenges. These include the difficulty to prove that savings are feasible because of the existing tariff system and lack of information regarding true costs of generating electricity savings. There is also a need for better control of hybridisation that has been failing at several occasions.

3.4.4 WIND

Global satellite measurements show that Mauritania is well resourced for wind power. The northern coastal area shows wind speeds of between 8.3m/s and 8.7m/s (IRENA, 2015). However moving south, values drop gradually and inland wind patterns are more difficult to establish.

4. DIRECTORY

4.1 ENERGY SECTOR POLICIES AND REGULATORY FRAMEWORKS DIRECTORY

Law 2001-19 – Established the Electricity Code. The code enacted the multi-sectoral regulatory body ARM to oversee the power sector. This authority was mainly responsible for overseeing rural electrification concessions, granting licences for operation and regulating tariffs. The purpose of this code was to open the power sector to private participation by liberalising power generation. It regulates production, transmission, distribution and sales of electricity beyond 23kW. By the end of 2019, the 2001 Electricity Code should be updated to include renewable energies and to restructure concession granting process and governance.

Law 2001-06 – Created APAUS. APAUS was created to be the formal government agency responsible for universal access to services including electricity. This agency was abolished in 2018 and was established to recruit mini-grid developers to build systems in rural areas.

Decree 2002-88/PM 2001 - Creation of SOMELEC. This decree unbundled the former water and power management company SONELEC into SOMELEC and SNDE to respectively operate in the power and water sector. SOMELEC is a publicly-funded entity operating Mauritania's grids and power plants, apart from those operated by IPPs.

Plan de Production et Transport 2012 - Production and Transmission Master Plan 2012. This master plan was designed by the Belgium GOPA-Intec Internal Energy Consultants to provide a technical plan for the country's grid extension and increased production. The master plan suggests that communities with less than 2,600 people living far from the grid should be electrified with mini-grids, however it does not expand on where or how to electrify these communities. Instead it focuses on current and future grids.

Stratégie de Croissance Accélérée et de Prospérité Partagée (SCAPP - Strategy for Accelerated Growth and Shared Prosperity 2016 to 2030) is the country's strategy to foster economic prosperity. It includes infrastructure development with an energy window to boost agro-pastoral and fishing communities. SCAPP's overall strategic ambition in terms of electricity for the country is to (SE4ALL, 2017):

- Achieve the development of renewable energy projects with support of government funding
- Connect to the grid localities with more than 200 inhabitants when it would be more economically feasible
- Hybridise and connect all diesel mini-grids and plants situated in the eastern end of the country
- Keep mini-grids located in the north as isolated and hybridise the systems

4.2 DATA SOURCES DIRECTORY

This methodology was developed during the first phase of this project, the Green Mini-Grids Market Development Programme - Market Intelligence business line, which is also available via the African Development Bank. The two methodology papers are published on the AfDB's [Green Mini-Grid Help Desk](#).

This analysis, the results of which are provided in Section 3, 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 2025. The GIS sources used in this analysis are detailed below.

1. Electricity transmission network (medium and high voltage)

File Name: transmissiongridmauritania.geojson

Source Age: 2017

File type: Geojson, line

Description: A geojson of the electricity transmission network of Mauritania

Projected co-ordinate system: WGS_1984 (EPSG: 4326)

Source: 1) ECREEE transmission network for West Africa, online at ECOWREX; 2) Plan data collected and prepared for a project of the World Bank Group in April 2014, digitised from a PDF map.

Link: <https://energydata.info/dataset/mauritania-electricity-transmission-network-2017>

2. Mauritania Renewable energy power plants

File Name: cuserswb491917documentsshpafrpowerstations

Source Age: 2012

File type: ESRI Shapefile, points

Description: A Geojson of power plants in Mauritania

Projected co-ordinate system: WGS_1984 (EPSG: 4326)

Source: unknown source

Link: <https://energydata.info/dataset/africa-power-stations-2012> OR <https://energydata.info/dataset/mauritania-electricity-transmission-network-2017>

3. Operational Clean Energy Mini-grids

File Name: MRT_renewable_mini_grid

Source Age: August 2019

File type: ESRI Shapefile, point

Description: A shapefile of operational mini-grids in Mauritania

Projected co-ordinate system: WGS84 (EPSG: 3857)

Source: RIMDIR, 2018 ; Rapport annuel de l'autorité de Régulation, 2017

4. Night lights

File Name: SVDNB_npp_20190401-20190430_75N060W_vcmcfg_v10_c201905191000.avg_rade9h.tif

Source Age: 2019

File type: Raster

Description: Night lights data, annual average for 2019. Adjusted to remove clouds, outlier lights and data noise

Projected co-ordinate system: WGS_1984 (EPSG: 4326)

Data Source: Earth Observations Grou at NOAA

Spatial Resolution: 15 arc seconds

Link: <https://energydata.info/dataset/world-night-light-annual-composite-2015>

5. Woldpop Population Density

File Name: MRT_pph_v2b_2015_UNAdj.tif

Source Age: 2015

File type: Raster

Description: 2015 estimates of numbers of people per grid square, with national totals adjusted to match UN population division estimates (<http://esa.un.org/wpp/>).

Projected co-ordinate system: WGS_1984 (EPSG: 4326)

Data Source: World Pop data portal

Spatial Resolution: 100m

Link: http://www.worldpop.org.uk/data/data_sources/

6. Mauritania Administrative Boundaries (State and Local Government Area levels)

File Name: MRT_admbnda_adm1_1m_WFP

Source Age: 2017

File type: ESRI Shapefile, points

Description: Shapefiles of State and Local Government Area boundaries

Projected co-ordinate system: WGS_1984 (EPSG: 4326)

Source: World Food Programme and OCHA

Link: <https://data.humdata.org/dataset/mauritania-administrative-boundaries>

7. Wind

File Name: MRT_wind.tif

Source Age: 2015

File type: Raster

Description: Mean wind speed at 100m height

Co-ordinate system: WGS_1984 (EPSG: 4326)

Source: DTU, IRENA

Link: <https://irena.masdar.ac.ae/gallery/#map/1693>

8. Solar

File Name: MRT_GHI.tif

Source Age: 2015

File type: Raster

Description: Annual total Global Horizontal Irradiation (GHI) (kWh/sqm) averaged over 1994-2015

Co-ordinate system: WGS_1984 (EPSG: 4326)

Source: DTU, IRENA

Link: <https://globalsolaratlas.info/downloads/mauritania>

4.3 STAKEHOLDER DIRECTORY

4.3.1 GOVERNMENT AND AGENCIES

Ministère du Pétrole, des Mines et de l'Energie (MPME, Ministry of Petroleum, Mines and Energy)

Contact: Email: contact.mpemi@gmail.com

Link: <http://www.petrole.gov.mr/spip.php?article5>

Telephone: [\(00222\) 45259515](tel:0022245259515)

Brief description: Under the authority of the Prime Minister and the Minister of Petroleum, Mines and Energy prepares and implements the policy in terms of energy production and distribution. The ministry mandates SOMELEC electrification priorities as well as off and on-grid tariffs.

Agence de Développement d'Electrification Rurale (ADER, Rural Electrification Development Agency)

Contact: Email: ader@ader.mg

Telephone: +261 332353794

Link: <https://ader.mg>

Brief description: The Mauritanian Rural Electrification Development Agency was created in 2001 by the French Development Agency to support the organisation in implementing rural electrification projects. ADER is a not-for-profit independent association. The main task is to conduct and to support development programmes aimed at rural electrification. The organisation has been involved in recruiting 15 mini-grid developers that have installed systems across the country. The process has been structured through calls for proposals funded by international donors or national government. In the past few years the organisation has no longer been active in the rural electrification space.

Autorité de Régulation Multisectorielle (ARM, Multi-Sectoral Regulatory Authority)

Contact: Email: ader@ader.mg
Telephone: +261 332353794
Link: <https://ader.mg>

Brief description: The ARM was created in 2001 under the Electricity Code with the main objective to regulate the power sector. ARM mission in terms of rural electrification is to oversee the selection and granting of licences to délégataires managing mini-grids in the country. It also approves and regulates off-grid tariffs. The organisation's role within the off-grid sector is currently being reviewed for potential restructure. ARM is currently overseeing 22 mini-grid concessions.

SOMELEC

Contact: Email: somelec@somelec.mr
Telephone: +222 45256783
Link: <http://www.somelec.mr/>

Brief description: SOMELEC is the publicly owned utility created in 2001 under the Electricity Code to operate Mauritania's power plants and grids. Since 2012, SOMELEC has been involved in rural electrification projects by taking over all mini-grids installed in Moughataas. Since the abolition of APAUS in 2018, the utility has replaced the organisation in its role for managing rural electrification and selecting mini-grid developers during the transition period. However, SOMELEC's main role and interest is in current grid projects and it is reluctant to rural electrification intervention.

4.3.2 MINI-GRID PRACTITIONERS AND PRODUCT DEVELOPERS

Compagnie Générale des Energies Renouvelables (COGER, General Company for Renewable Energy)

Contact: Email: b.lebatt@gmail.com
Telephone: +22234224444

Brief description: COGER is one of the oldest renewables companies in the country and started its operations in 2002. The core of the company's work is to install renewable technologies for irrigation and rural electrification projects. In terms of rural electrification, the company has been involved in several projects to install and manage several technologies. Through ADER, COGER has installed c.12k solar kits. The company has also installed 12 mini-grids through calls from ADER funded by the EU or Mauritania's government, none of these are operated by the company. Finally, COGER has also installed 100 solar platforms through several projects including the latest one launched by GRET to install 72 solar platforms. Out of 72 platforms installed, COGER manages 57 installations which involves operating and maintaining the systems.

Matrasco

Contact: Email: brahimmatrasco@yahoo.fr
Telephone: +222 22087201

Brief description: Matrasco is a Mauritanian company involved in rural electrification and water infrastructure projects. The company has been involved in installing mini-grids and managing the exploitation of a couple of systems until installations were taken over by SOMELEC due to the location of mini-grids in Moughataas. Matrasco claims to have installed over 20 mini-grids with a low voltage network and a warrantee of 12 months post installation. Currently the company is no longer involved in mini-grid projects and has not been a délégataire since 2013.

Other key mini-grid developers that were not interviewed during the country visit phase of the research include: CDS Eau & énergie and SOT MAT.

4.3.3 BILATERAL AND MULTILATERAL DONOR ORGANISATIONS

Agence Française de Développement (AFD)

Contact: **Email:** afdnouakchott@adf.fr
Telephone: +222 45252525
Link: <https://www.afd.fr/fr/notre-agence-en-mauritanie>

Brief description: AFD's country office was established in 1978 and is a key correspondent for the Mauritanian authorities. It mobilises its entire range of financial tools to finance projects that contribute to sustainable and environmentally friendly growth, with a concern for reducing inequalities. In Mauritania, the AFD has mainly been focusing on facilitating access to essential services including water and sanitation and electricity, and focusing on the country's agricultural potential. Since 2013, it has been providing technical and financial support to SOMELEC to restructure the electricity and rural electrification sectors.

European Union (EU)

Contact: **Email:** delegation-mauritania@eeas.europa.eu
Telephone: +222 45252724
Link: https://eeas.europa.eu/delegations/mauritania/area/projects_fr

Brief description: The EU delegation based in Mauritania is responsible for representing and defending EU interests in the country. It supports the country in ensuring security and contributing to sustainable socioeconomic development. The main contribution of the EU in rural electrification has been providing technical and financial support in restructuring the rural electrification sector in hand with AFD's work.

United Nations Development Programme (UNDP)

Contact: **Email:** registry.mr@undp.org
Telephone: +222 45252616
Link: <http://www.mr.undp.org/>

Brief description: UNDP's main support in Mauritania is around promoting good governance, sustainable development and reducing inequalities to reinforce the poorest community's resilience. Within the power sector UNDP has invested in rural electrification projects, but is also currently finalising Mauritania's Electricity Code update which includes reviewing the country's electricity tariffs.

BIBLIOGRAPHY

- AFD.** (2018). *Note d'analyse et de présentation du nouveau dispositif institutionnel et contractuel transitoire proposé.*
- Afdb.** (2019, September 10). *Mauritania Economic Outlook* . Récupéré sur <https://www.afdb.org/en/countries/mauritania/mauritania-economic-outlook>
- Amnesty International.** (2018). *A sword hanging over our heads.*
- Bank, W.** (2018). *World Bank Data*. Récupéré sur <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=MR>
- BTI.** (2018). *BTI 2018 Country Report Mauritania.*
- CIA.** (2019, June 06). *Mauritania Factcheet* . Récupéré sur <https://www.cia.gov/library/publications/the-world-factbook/geos/mr.html>
- Climate Change Knowledge Portal.** (2019, June 6). Récupéré sur <https://climateknowledgeportal.worldbank.org/country/mauritania/climate-data-historical>
- EU.** (2015). *Fiche Energie Mauritanie* .
- European Union.** (2018). *Rim-DIR, volet B Etude technique, économique et financière - rapport final.*
- Hootsuite.** (2019, July 1). *Digital, 2018 Mauritanias*. Récupéré sur <https://fr.slideshare.net/DataReportal/digital-2018-mauritania-january-2018>
- IMF.** (2017). *World Economic Outlook Database*. Récupéré sur <http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx>
- IMF.** (2019). *Islamic Republic of Mauritania Third Review under the extended credit facility arrangement.*
- Initiative, F.** (2016). *Modernization of the Payment systems Infrastructure in Mauritania.*
Récupéré sur <https://www.youtube.com/watch?v=V8RTGhe4nzU&list=PLFYwaKvaxFhctzg9QXTEkzoIMk4KPVV0f&index=252>
- IRENA.** (2015). *Mauritania Renewables Readiness Assessment.*
- Ministere de l'Economie et des Finances.** (2016). *Stratégie nationale de croissance accélérée et de la prospérité partagée 2016 to 2030.*
- MPME.** (2013). *Plan Directeur de Production et Transport de l'Energie Electrique en Mauritanie entre 2011 et 2030 Rapport final.*
- Power Africa.** (2018). *Mauritania Power Africa Fact Sheet*. Récupéré sur <https://www.usaid.gov/powerafrica/mauritania>
- Republique Islamique de Mauritanie.** (2010). *Presentation du secteur de l'Equipement et des Transports.*

- SEforALL.** (2017). *Réformes institutionnelles du secteur de l'énergie Mauritanie.*
- UNDP.** (2016). *World Small Hydropower Development Report 2016 - Senegal.* Récupéré sur http://www.smallhydroworld.org/fileadmin/user_upload/pdf/2016/Africa_Western/WSHPDR_2016_Senegal.pdf
- UNDP.** (2018). *Etude tarifaire pour la délégation de service public d'électricité (DPSE) - rapport provisoire.*
- World Bank.** (s.d.). Récupéré sur <http://datatopics.worldbank.org/consumption/sector/Energy>
- World Bank.** (2018). *Country Partnership Framework for the Islamic Republic of Mauritania FY18-Fy23.*
- World Bank.** (2019, June 6). Récupéré sur World Bank Data: <https://data.worldbank.org/country/mauritania>
- World Bank.** (2019, July 01). *Mobile Cellular subscriptions Mauritania* . Récupéré sur <https://data.worldbank.org/indicator/IT.CEL.SETS?end=2017&locations=MR&start=1960&view=chart>
- World Bank Blogs.** (2013, July 12). Récupéré sur <https://blogs.worldbank.org/digital-development/mauritania-ramps-broadband-internet-stimulating-private-investment>
- World Data Info.** (s.d.). *Energy consumption in Mauritania.* Récupéré sur <https://www.worlddata.info/africa/mauritania/energy-consumption.php>

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