Ministry of Foreign Affairs

# Scoping study Renewable Energy Senegal

*Commissioned by the Netherlands Enterprise Agency*

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Ministerie van Economische Zaken en Klimaat

Ambassade des Pays Bas au Sénégal

PROMOTION OF PARTNERSHIP BETWEEN SENEGAL AND THE NETHERLANDS ON RENEWABLE ENERGIES AND ENERGY EFFICIENCY

*Scoping Study Renewable Energy Senegal*

# *Identification of partnership opportunities between Senegal and the Netherlands*

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Commissioned by Netherlands Enterprise Agency (RVO)

# Final Report

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Demba Diop
Durgerdamstraat 19
1507 JL Zaandam, The Netherlands
Phone: + 31 615106015
ddiop@antenna.nl

EPM Consulting

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## Abbreviations

| | |
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| AEME | Agency for the Economy and Control of Energy |
| AFD | French Development Agency |
| ANER | National Renewable Energies Agency |
| ANSD | National Agency for Statistics and Demography |
| ASER | Senegalese Agency for Rural Electrification |
| ADB | African development bank |
| EIB | European Investment Bank |
| BT | Low tension |
| ECOWAS | Economic Community of West African States |
| CRSE | Electricity Sector Regulatory Commission |
| CMS | Credit Mutuel du Senegal |
| ECREEE | Ecowas Center for Renewable Energy and Energy Efficiency |
| EE | Energetic efficiency |
| ERIL | Local Initiative Rural Electrification Project |
| IRON | Rural Electrification Fund |
| FONGIP | Priority Investment Guarantee Fund |
| FONSIS | Sovereign Fund for Strategic Investments |
| GHG | Greenhouse gas |
| GIZ | Gesellschaft für Internationale Zusammenarbeit |
| GW | Giga Watt, 106 kW, power measurement unit |
| GWh | Giga Watt Hour, energy measurement unit corresponding to 106 kWh |
| HT | High tension |
| IPP | Independent Power Producer |
| KFW | Kreditanstalt für Wiederaufbau |
| kV | kilo Volt |
| LBC | Low Consumption Lamp |
| LED | Light Emitting Diode |
| LPDSE | Energy Sector Development Policy Letter |
| MT | Medium voltage |
| MW | Mega Watt, 103 kW, power measurement unit |
| OMVG | Organization for the Development of the Gambia River |
| OMVS | Organization for the Development of the Senegal River |
| PERACOD | Program to promote renewable energies, energy efficiency and access to energy services |
| SME | Small and medium enterprises |
| PPER | Priority Rural Electrification Program |
| PSE | Emerging Senegal Plan |
| RI | Interconnected Network |
| RVO | Netherland Enterprise Development Agency (Ministry of the Economy) |
| SENELEC | National Electricity Company of Senegal |

# 1. EXECUTIVE SUMMARY

This study on the Renewable Energy sector of Senegal is commissioned by the Government of the Netherlands (RVO and the Netherlands Embassy in Senegal) to identify niches and opportunities for partnerships and business between the two countries to promote access to sustainable energy in Senegal.

Indeed, Senegal is considering universal electrification by 2025. In 2018, the overall access was 57%; meaning 90% in urban areas and 40% in rural areas. By 2020, rural electrification attained 53% from 8% in 2008 due to massive investment. A robust and ambitious electrification program with a penetration rate of 30% of renewable energy is currently being implemented by the Government with the support of several technical and financial partners including USAID, the EU, the World Bank, the ADB and several European countries.

The aim of this study was to define the place and role of the Netherlands in the promotion of electrification by renewable energy to contribute to the ambitions of the Senegalese Government. In this context marked by a massive interest of the development partners, it was opportune to investigate which roles and positions the Netherlands can play in the Senegalese renewable energy and energy efficiency market by taking into consideration the specificities, singularity and unique characteristics of the Netherlands potential contribution. Indeed, the Netherlands has a large array of expertise, technologies and adequate financial instruments to promote various forms of energy access in Senegal in segments relating to (i) off-grid and rural electrification market, (iii) productive use in the water-agriculture-energy nexus and (iii) energy efficiency policies, best practices and technologies.

The off-grid market in Senegal is quite attractive as the country has good experience and tract record in this field over the last decade. The country has evolved as the regional leader in terms of number of mini grids installed per capita. It mainly consists of the deployment of standalone systems and solar powered mini grids through various innovative payment systems to collect the revenues justifying the investments. However, the off-grid sector will represent only about 7% of the investment needs for reaching universal access to electricity by 2024 as the choice of the Government is to extend the grid due to investment costs consideration. Indeed, on the long run, various studies concluded that it is cheaper and more reliable to extend the grid given the spatial and human settlement configuration of the country.

Productive use in the water − agriculture- energy nexus is the most attractive segment for Netherland's intervention in Senegal. It includes a vast array of concepts and applications. In Senegal, the identified needs related to the improvement of the value chain in the specific horticulture sector where the Netherlands is already well represented through the provision of farm inputs and equipment, the production and export of various fruits and vegetables to the Netherlands. Concepts and applications such as solar powered cold storage, water pumping, irrigation, drying and local processing are highly needed to unlock the potential of the sector and create massive jobs.

In the Senegalese context, Energy Efficiency is a key niche as the electricity that is generated at high cost is not well used. Therefore, Energy Efficiency can be the cheapest way to make electricity available to the populations and businesses in Senegal through the reduction of the losses and waste during electricity generation, transmission and consumption. The Netherlands can transfer adapted "best practices" that will make more power available for productive uses while reducing the cost of electricity and its environmental impacts in Senegal. This niche addresses various technologies, processes and applications to curb the use of electricity for the household appliances, industrial processes and machineries, public lighting and cooling of buildings while maintain high standard electricity services. The Netherlands transfer to Senegal could involve: (i) the development

of standards and labelling for appliances, (ii) training in various areas for low carbon industrial production processes, transport, buildings and eco-design, (iii) efficient lighting.

In terms of structure, the report is articulated around the following segments. Chapter 1 presents the geopolitical context of Senegal. Chapter 2 provides a deep analysis of the energy sector. Chapter 3 outlines what the Netherlands could offer to promote renewable energy and energy efficiency in Senegal. Chapter 4 gives an overall overview of the renewable energy market in Senegal with a description of the potential of each of the market niches. Chapter 5 analyses the level of familiarity of the Netherlands companies and public institutions with the Senegalese RE and EE market and the willingness to explore it. Chapter 6 analyses the partnership niches between Senegalese and Dutch public and private institutions. Chapter 7 presents an overview of the contents of the received project ideas presented by the Senegalese actors. Chapter 8 presents the analysis of the results of the survey among the Netherlands entities. Chapter 9 presents the 6 priority projects, at the rate of 2 projects per niche, that RVO and the Embassy of the Netherlands could facilitate. Chapter 10 is related to the lessons learned and conclusions of the study with few recommendations.

In terms of outcomes, the study revealed contrasting results. On one hand there is a massive interest from the Senegalese public and private institutions to partner with the Netherlands in all the three selected niches, especially in the productive use and energy efficiency subsectors. About 57 requests for cooperation with Netherlands entities were collected under the form of project sheets amounting to a total need for investment above €400 million. On the other side, little interest was shown by Netherlands companies as only 7 companies over the 44 of the contacted companies provided some answers. The timing of the survey in the holyday's months of July and August and the growing RE market of the Netherlands may explain the lack of answers from the Netherlands companies.

The high interest from Senegal relates mainly to technology transfer, training and projects finance. By training is meant the development or upgrading of the skills of technicians in the various technological and managerial aspects of renewable energy project development, design, implementation, operation and maintenance. Technology transfer corresponds to the need for accessing the latest innovative processes and technologies and its familiarisation. Almost all requests included access to finance whether though private investment or the RVO financial instruments.

The analysis of the 57 project sheets allowed a selection of 6 priority projects that could be supported by the Dutch cooperation with the various instruments of RVO and the Dutch Embassy in Senegal. The study identified that productive use to support the specific horticultural sector is the most suitable niche for Netherland's intervention in the renewable energy of Senegal followed by Energy Efficiency. The selection process considered the level of maturity of the proposals, their potential impacts and the likelihood of the Netherlands private and public sector to respond to it.

The study concludes that the Senegalese renewable energy and energy efficiency market is quite large and is already attractive to foreign investors and providers of technologies and services. According to ASER's planning, 8,445 of the 13,819 localities to be electrified (i.e., 61%) will be electrified by extension of the network, against 7% by solar powered mini-grid and 32% by individual photovoltaic system. The estimated investment to reach universal electrification by 2024 amounts to € 1 billion of which most will be allocated to grid extension and about €160 million to mini grid. The combined needs for investment including productive use and energy efficiency that was expressed by the Senegalese public and private institutions surveyed during the underlined study amounted to EURO

420 million. However, this market is quite large, even much larger than the Government investment plan of €1 billion due the flexibility that standalone systems can provide for productive use and its decreasing price.

In terms of recommendations, the study reveals the need for the Senegalese Government to create a more attractive investment climate for the sector to leverage more foreign investment; specially for the mini grid sector. The concession and ERILS systems should be reformed to accommodate more flexibility and openness to innovation while reducing bureaucracy and cutting down the time consuming and lengthy procedures for licensing.

The Netherlands could possibly cooperate with the concessionaire holders to supplement the investment needs and position the Dutch providers of technologies and services. In particular, the 4 concessions which are operated by Senelec can be interesting considering the need for investment estimated at €80,000,000 for which the EU is committed to provide a grant of €20,000,000 under a blending scheme to complete a €60,000,000 loan that should come from one or more EU country members to complete the financial needs. RVO could reach out to the EU Delegation in Dakar to be part of the financial consortium in which AFD (France) and the European Investment Bank (EIB) have shown interest. Such option will reduce risk and lower drastically the transaction costs.

The study revealed that some of the financial instruments of the Dutch International Cooperation are particularly suitable for financing Productive Use and ERILs by enabling consortiums of Senegalese and Dutch companies to implement rural electrification projects. The role of RVO, though its various instruments, is to facilitates activities such as matchmaking, market soundings, study tours, feasibility studies, training and investments in production and distribution infrastructure such as mini grid and standalone systems including the needs for productive uses in terms of solar powered water pumping, cold storage, drying and local processing.

Finally, B2B activities could be organised by RVO and the Netherlands Embassy in Dakar to promote 6 selected proposal ideas. RVO has a long experience and proven tools to make the matchmaking between Senegalese and Netherlands entities successful.

About EPM Consulting

Mr. Demba Fall DIOP (Senegalese and Dutch national) is an expert in the field of Economy, Energy and Environment to promote growth and equity in Africa. He holds a DEUG in economy from University of Maine (France) and a MBA from the University of Wales (UK). Mr Diop has about 30 years of experience in the formulation, development, implementation, evaluation and monitoring of energy access and renewable energy programmes including rural electrification projects, utility scale projects, bioenergy programmes, Wind Park and solar project in sub-Saharan Africa. Concrete experience are the development of renewal energy projects to improve access for rural and peri urban populations in several countries including Senegal. Mr Diop has an extensive records in the formulation and implantation of regional and national energy policies for the Africa Union, UNECA, NEPAD, UNDP, UNCDF, the EU (Aidco, BizClim, ProInvest, CDE), ECOWAS, UEMOA, ECREEE, IGAD, PEAC, CEMA, the government of Togo, Niger, Guinee, Nigeria, Ghana, Senegal a.o. His expertise in the energy sector focuses on energy access, renewable energy and private sector participation. As private investor, Mr Diop developed the Dakar Abattoir waste to energy plant that is operational since 2014 and initiated the St Louis Wind park (50 MW) an the 20 MW Fass solar project that are under development in Senegal. Mr Diop is a board member of CLASP (US based NGO promoting energy efficiency worldwide), the President of the Senegalese Association for Renewable Energy (ASERA) and member of the board of WAIO.

# 2. METHODOLOGY

In the inception phase, a series of tools has been developed to facilitate optimal communication on the scope of the project and to collect the necessary information relating to priority needs and niches to be explored through fruitful partnerships between Dutch companies and institutions and Senegalese one. These tools consisted of the preparation of: (i) a brochure explaining the objectives of the project and the expected results; (ii) an interview guide for physical meetings; (iii) a questionnaire by each type of actor whether institutional or private; (iv) a template or canvas for the presentation of the project ideas sheet with the view of standardizing the information to be collected to ease its analysis.

Subsequently, a list of Senegalese and Dutch public and private institutions, representative of the various identified niches in the two countries was established. About eighty (80) Senegalese institutions (i.e., 4 concessionaires and 37 ERILS; 26 private operators, and 12 public institutions and NGOs) and forty-four (44) of their Dutch counterparts were contacted by email. These messages were followed by several reminders to enable the collection of the needed information. Consequently, a series of ten (10) virtual meetings were organized in Senegal with government institutions (MPE, AEME, ANER, CRSE) and employers' organizations (COPERES and ADEPME) followed by many individual meetings with private companies. From the Netherlands companies, only 7 answers were received. This amount is too low to gain quantitative and qualitative insights on the interest of the Netherlands companies and public institutions on the Senegalese renewable energy sector.

From the information collected by questionnaires and project sheets, a data base was created to process all data in order to collect essential statistics, trends in areas of interest, expressed needs and related constraints and limitations. From these data, a series of analyses were carried out by cross-checking and extrapolation to allow the characterization of the niches in terms of potentials, needs and constraints. This analysis also made it possible to map out a table of the different actors and stakeholders according to their identities and roles. The results of these surveys and the preliminary conclusions enabled to identify and characterize the challenges of the sector which at the same time constitute opportunities for partnership with Dutch public and private institutions.

# 3. CONTEXT

## 3.1 GEOGRAPHY AND DEMOGRAPHY

Senegal is the westernmost country in mainland Africa with a total area of 196,700 km2 and an estimated population of 16,209,125 inhabitants in 2019. Senegal has a coastline


of over 700 km and is bordered by the Mauritania to the north, Mali to the east, Guinea to the south-east and Guinea-Bissau to the south-west. Senegal also borders with and surrounds The Gambia.

According to the 2013 Population Census, the share of the rural population of Senegal accounts for about 55% of the total population, which represents 7.4 million peoples, distributed over more than 14,000 villages and 7,000 hamlets.

## 3.2 OVERVIEW OF THE COUNTRY POLICY AND ECONOMY

Senegal benefits from a favourable geographical position and a good dynamic of infrastructure development, a stable political and macroeconomic environment, and good governance. On the economic side, Senegal has experienced a strong economic growth rate which was over 6% per year before the advent of Covid 19. This recent economic growth was driven in part by the primary sector (15% of GDP, 60 % of the working population) and the good performance of agriculture and fishing. The secondary sector (21% of GDP) is mainly linked to the mining, agri-food and construction industries and has generally slowed down despite the sustained growth in the construction, chemicals and energy sectors. Finally, the tertiary sector (64% of GDP) continues to show rapid growth thanks to the expansion of the transport, telecommunications and service sectors. The inflation rate was under control at 0.5% in 2018.Growth prospects remains generally

positive, in favour of the start of oil and gas production scheduled for 2023 and major infrastructure investments targeted by the Plan Senegal Emergent (PSE),

## 3.3 THE BUSINESS ENVIRONMENT

Senegal has good political stability, good governance, a stable and promising macroeconomic context, a commitment and reforms for the establishment of a favourable framework for investments. The country has a well-developed legal framework for the protection of property rights, and is a signatory to international conventions on environmental protection, human rights, trade, copyright, etc. The Senegalese Agency for the Promotion of Investment (APIX) has implemented a series of reforms to considerably reduce delays in administrative procedures. In addition, the Government has given priority to efforts to fight corruption, increase transparency and improve governance (ranked 10th on the Mo Ibrahim Index of Governance in Africa, 2018).

### Plan Senegal Emergent (PSE)

Senegal is aiming for middle-income country status by 2035 and has, to this end, adopted an ambitious program, the PSE, which emphasizes the diversification of economy and boosts exports. The economic, social and environment policies of Senegal are embedded in the PSE (Plan Senegal Emergent) which is articulated around three (3) priority axes: (i) encourage the transformation of the structure of the economy in the sense of supporting a strong dynamic and sustainable growth; (ii) expand access to social services and social coverage and preserve the conditions for sustainable development; (iii) meet the requirements of good governance, through the strengthening of institutions and the promotion of peace, security and African integration.

In this dynamic towards emergence, the PSE has identified the energy sector as a major pillar for the development of the economy and the reduction of social and territorial inequalities. Thereby, to translate Senegal's ambition to guarantee broad and reliable access to cheap energy, the PSE has set itself the following objectives: (i) availability of sustainable energy in quantity and quality sufficient; (ii) develop one of the lowest electricity prices in the sub-region (between 60 and 80 FCFA / kWh) to support the country's competitiveness; (iii) universal access to electricity; and (iv) eliminate power cuts and associated losses. The second phase of the PSE covering the period 2019 - 2023 revolves around the implementation of 30 structuring energy projects for an investment estimated at 1,175,459,000,000 FCFA or 1,794,590,000 EURO to reach a level of access to electricity by 85% in 2023 with a renewable energy penetration level of 29%[1].

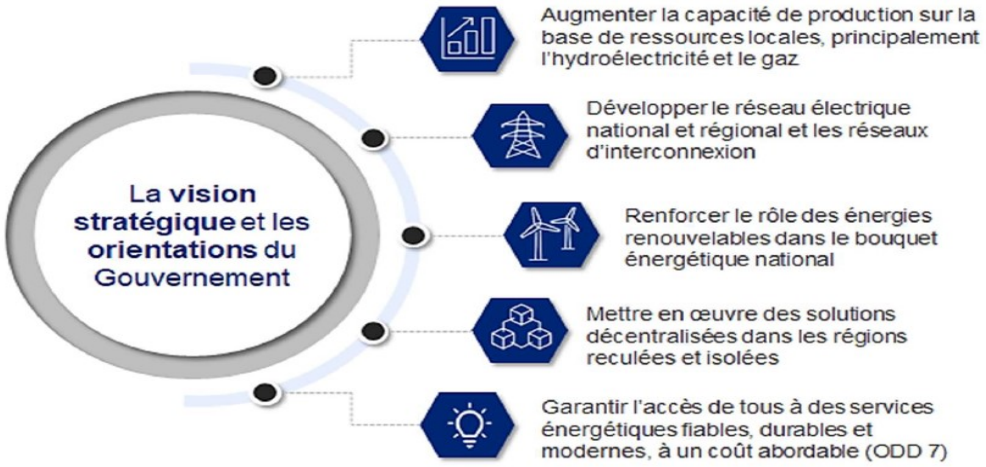
[1] PSE phase 2, 2018

# 4. OVERVIEW OF THE ENERGY LANDSCAPE

## 4.1 VISION AND INSTITUTIONAL FRAMEWORK

### 4.1.1 Strategic vision and orientations of the Government

Senegal envisages universal access to electricity by 2025 through the 5 pillars described in the following figure.



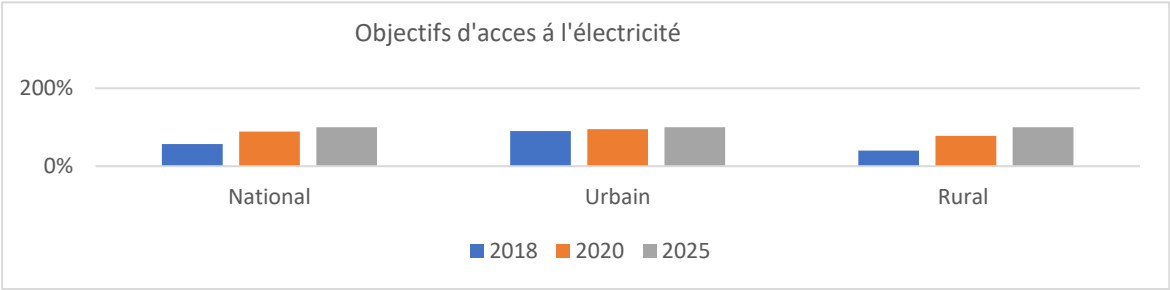

### 4.1.2 Objectives of universal access to electricity by 2025

Due to the efforts made in recent years, Senegal is well positioned to achieve universal access to electricity by 2030 in accordance with the objectives of the SDGs. In 2018, access to electrification was around 57% nationally, i.e., 90% in urban areas and 40% in rural areas. Against this benchmark, the Government has put in place an action plan to achieve universal access by 2025 as illustrated in the table and graph above.

Tables 1: electrification objectives

| | 2018 | 2020 | 2025 |
|---|---|---|---|
| National | 57% | 89% | 100% |
| Urban | 90% | 95% | 100% |
| Rural | 40% | 78% | 100% |

Graph 1: electrification objectives




It should be noted that the level of access to electricity in rural areas in 2020 was only around 50% against a target of 78%. Lack of investment is the most obvious reason for not achieving the goals set for 2020. Also, the heavy bureaucratic procedure of the

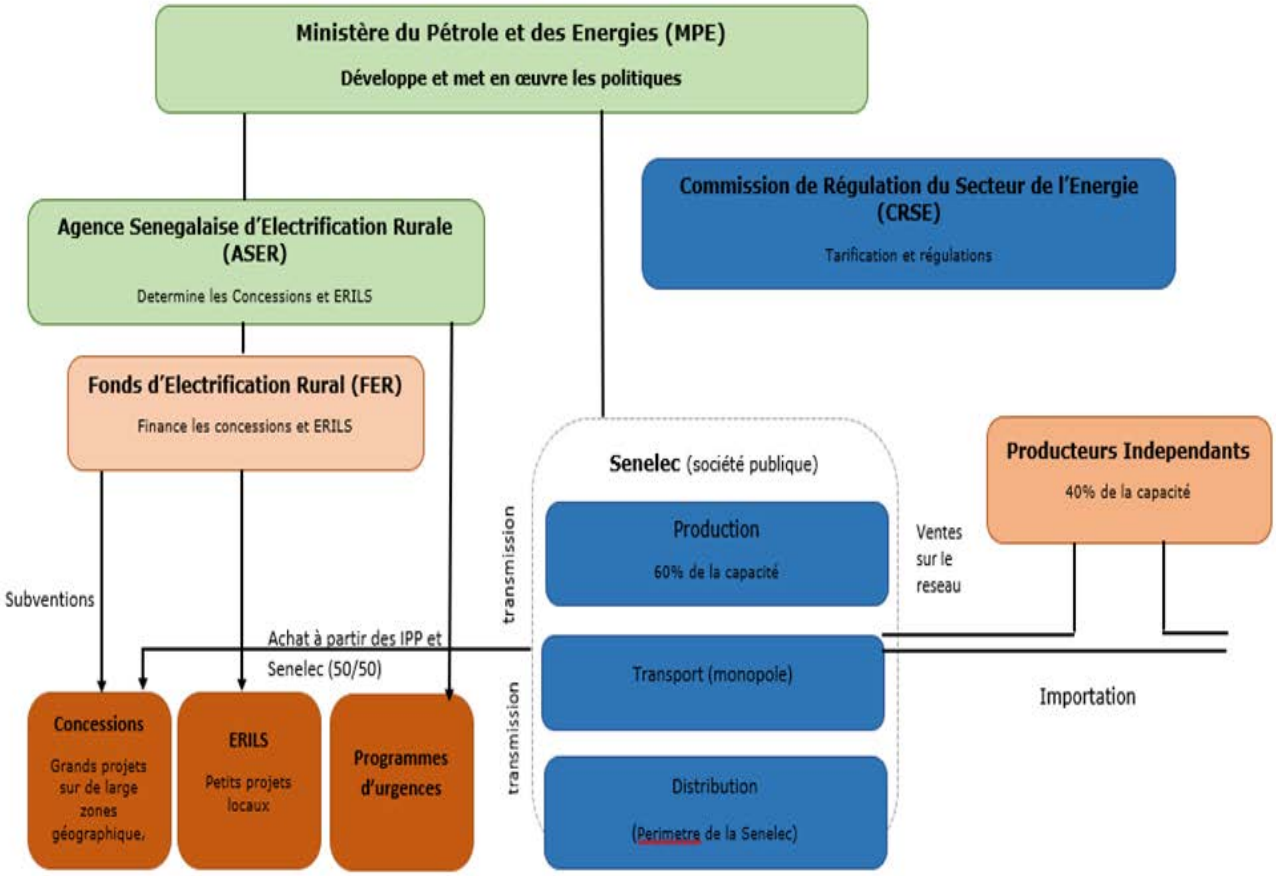
Senegalese rural electrification model is a key root for the delays and barriers for investing in the sector. The model needs to be simplified to allow more spontaneous offer from private sector. According to many studies, the rural electrification agency (ASER) should be reformed to increase its performance and impulse a new dynamic of achievement by adapting its strategy and modus operandus to absorb technological breakthroughs and innovative market approaches to reach the last miles. Equally the concession system has shown its limits by its inability to reach the last miles.

In terms of financing, the Government intends to involve more the private sector and its international cooperation partners. To this end, a round table for the financing of the universal access to electricity of the country was organized in April 2021 to engage partners in achieving the SDGs in terms of access to electricity by 2024. The round table, held in April 2021, yielded commitments from the private sector and development partners that is far above the investment needs for reaching universal access by 2024. The main challenge for the Government of Senegal will be to transform those commitments into effective financing transactions by providing the required documentations and guarantees.

### 4.1.3 Organization of the sector

The Senegalese electricity sector is organized vertically under the direction of the Ministry in charge of energy (MPE) as shown in the figure below with two distinct main sub-sectors representing the rural and urban electrification perimeters.

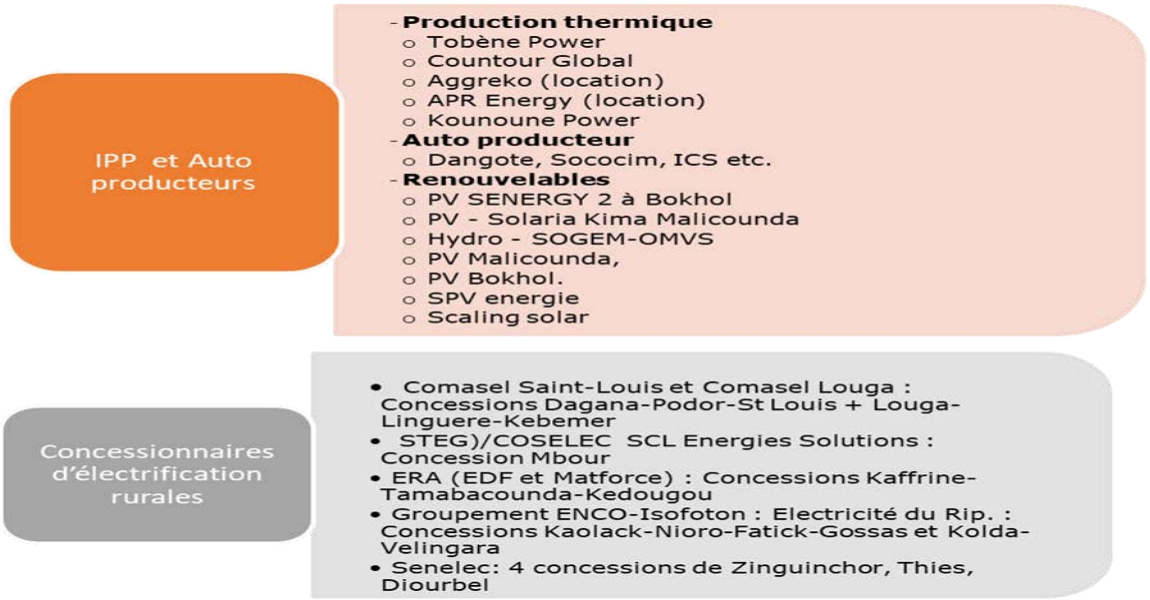
Fig1: Presentation of the Senegalese electricity landscape



### 4.1.4 Private actors and investors

Since the liberalization of the energy sector (1999), the private sector has taken on a role in the financing and production of electricity.

Table 2 List of different IPPs and concessionaires




IPPs represent now more than half of the country's electricity production. More recently, there is a remarkable presence of the national private sector in the IPPs scheme and rural electrification concessions under the local content policy.

## 4.2 ELECTRICITY GENERATION FOR THE NETWORK

### 4.2.1 The On grid installed capacity

The total installed generation capacity in Senegal in 2019 was around 1,431.89 MW, mainly made up of thermal power plants based on HFO (Heavy Fuel Oil) partly owned by Senelec (442 MW) and independent private producers (IPP) for the remaining capacity. A coal-fired power station (Sendou) has been commissioned by Senelec and is expected to supply 115 MW to the Senelec network. 75 MW of gas turbines are also operational and used mainly as backup power stations for peak management. At the end of 2019, a barge was added to these plants with a contractual capacity of 120 MW, initially supplied with liquid fuel and LNG from 2020. Currently a 300 MW gas powered plant is under construction.

For the non-interconnected network, Senelec has power plants supplying the towns of Ziguinchor and Tambacounda. Senelec has also developed a network of isolated small diesel power plants to meet the demand of small towns and villages spread between the regions of Kaolack, Tambacounda, Kolda and Ziguinchor and Kédougou,. These plants have reduced profitability and very high production costs.

### 4.2.2 Grid connected renewable energies IPPs

The Renewable energy sub-sector represents a considerable stake in achieving the objective of improving energy independence and security in Senegal. The national strategy for the diversification of energy sources is being implemented through the connection to the network of 168MW of solar PV, 150 MW of wind turbines and 75MW of hydroelectricity at the end of 2019, i.e., 22% of total electricity production from the country. In addition, there are isolated systems installed by public and private institutions. The original target of 20% RE penetration set in 2013 have been reaching. The new target is set at 30% by 2030. However, the country is facing serious constraints to integrate RE sources into the network. This explain why all new IPP should include storage facilities. The Independent producers are listed in the following table,

Table 3: overview of RE based Independent Producers

| Name of the project / initiative / Project leader | Institution | Temporary horizon |
|---|---|---|
| Production projects | | |
| Sarreole I (production) - Wind power 50 MW | Private | 2018 |
| Sarreole II (production) - Wind power 50 MW | Private | 2019 |
| Sarreole III (production) - Wind power 50 MW | Private | 2020 |
| KfW (production) - PV Dias 15 MW | KfW | 2019 |
| Energy Resources (production) - PV Kahone 20 MW | Private | 2018 |
| Eximag (production) - PV Sakal 20MW | Private | 2018 |
| Senergy I (production) - PV Santhiou 29.5 MW | Private | 2017 |
| Tenergie (production) - PV Merina Dakhar 29MW | Private | 2017 |
| IPP tender via Scaling Solar - 75 MW | Public (CRSE) | 2021? |

With regard to solar energy, the situation in 2017 is as shown in the table below.

Table 4: Solar capacity on the IR installed at the end of 2017

| Solar capacity on the integrated network at the end of 2017 | Installed capacity (MW) |
|---|---|
| CICAD PV plant | 0.12 |
| Mekhé PV plant | 30 |
| TenMérina PV plant | 30 |
| Malicounda PV plant | 22 |
| Bokhol PV plant | 20 |
| Ndioum Regional Hospital | 0.1 |
| Diourbel regional hospital | 0.125 |
| Tambacounda Regional Hospital | 0.2 |
| Thiès regional hospital | 0.175 |
| TOTAL | 102.72 |

*Sources: Senelec 2017 energy movement report and 2018 UEMOA conventions audit report*

The forecasted solar power generated capacity on the integrated grid by 2023, through the development of 11 solar power plants, amounts to 333 MW as shown in the table below.

Table 5: Solar capacity forecast over time (2023)

| Project | Power (MW) | Operating year |
|---|---|---|
| Solar installed | 40 | End of 2016 |
| Solar IPP1 | 29 | 2017 |
| Solar IPP2 | 29 | 2017 |
| Solar IPP3 | 20 | 2017 |
| Solar scaling 1 | 30 | 2018 |
| Solar scaling 2 | 30 | 2018 |
| Solar scaling 3 | 40 | 2019 |
| Diass | 25 | 2019 |
| Solar new 1 | 30 | 2021 |
| Solar new 2 | 30 | 2022 |
| Solar new 3 | 30 | 2023 |
| Total | 333 | |

*Source : UFC-MCA, VF-PP1. For wind power, a power of 158.7 MW is envisaged, as shown in the table below.*

Hydroelectricity

Senegal receives 66 MW from the hydropower plants of Manantali which has a capacity of 200 MW and 15 MW from the Felou hydro plant (60 MW) located respectively in Mali and Guinee within the framework of the Organization for the Development of the River Senegal (OMVS).

### 4.2.3 Cost of electric power production in Senegal

The use of petroleum products, mainly imported, results in a production cost per kWh output close to 80 FCFA / kWh ($ 0.13 / kWh), representing one of the highest production costs in the sub-Saharan region.

The Senegalese Government, within the framework of the Plan Senegal Emergent (PSE), aims to reduce the production cost of electricity to a range between 60 and 70 FCFA / kWh by 2025 (between 0.10 and 0.12 $ / kWh). This political motivated vision should go along with strong measures to enable IPP with incentives for building strong business cases while protecting the consumers capacity to afford electricity services. For this, the production mix will be strengthened by integrating less expensive production systems with the implementation of the "gas-to-power" strategy based on the use of natural gas from domestic fields (from 2023), solar and wind power plants, import of hydroelectricity electricity from the region (OMVG, OMVS). The massive discovery of natural gas resources in the country of which the first production is expected by 2023 will enable to dramatically reduce the cost of electricity production by eliminating the import of expensive fuels to generate electricity. The gas-to-power strategy of the Government is expected to be the base load for the electricity systems of Senegal and will enable more RE sources as the network will gain more density and stability.

The reduction of generating costs will not only allow to serve rural areas through grid extension, but also represents an essential instrument to minimize, or even eliminate the government subsidy for the sector. It will improve the competitiveness of Senegalese companies since energy is one of the main factors of production. The cost of electricity represents currently up to 25% of the average production cost of the Senegalese industry according to UNIDO and from 15 to 30% of the agri processing industry according to a survey that was performed during the underlined study.

# 5. ANALYSIS OF THE NETHERLANDS POTENTIAL OFFER

## 5.1 INTERNATIONAL COOPERATION

It is recognised that the overall development of the country will depend strongly on the availability of affordable energy and increasingly from renewable sources and less polluting sources as natural gas. More electricity generating facilities need to be made available to power the industry, enable to add value locally agricultural products and mining resources and ease the condition of living of the population on all manners. In the context of Senegal, access to electricity is recognised as a must to reduce poverty and increase social cohesion.

Therefore, the energy sector of Senegal has attracted in recent years many donors and development partners. The total financing from the Development Partners in the sector (2012 - 2018) is estimated at USD 1,284,481,600[2]. The role and overall portfolio of donor and donor projects in the energy sector in Senegal are summarized in the table Overview of the project portfolio in the energy sector in Senegal in Annexes 3.

As a result of the recent round table on the financing of electrification in Senegal, international cooperation will continue to play an important role in the electricity sector in Senegal through adequate financing to develop the business environment but also loans and substantial grants to increase production, storage, transport and distribution.

In recent years, thanks to the potential of renewable energy to eradicate poverty and fight against climate change, there has been an increased interest from technical and financial partners (PTFs) in the electrification sector. Almost all the TFPs engaged in Senegal have programs related to access to electricity and renewable energy in particular.

According to their identities and centres of interest, the PTFs claim to intervene in a concerted manner in the sector. USAID, the largest player in the energy sector in Senegal with an envelope of USD 600 million, focuses its intervention above all on the development of natural gas and related major infrastructures. The EU with a portfolio of over EUR 300 million mainly finances the rural electrification sector. The EU intervention is mainly directed to solar technology and mini grid development. Chinese and Indian cooperation, through their respective Exim banks, are mainly focused on electricity transmission and distribution lines. The African Development Bank, the Islamic Development Bank, the World Bank, AFD (Proparco) and BOAD finances mainly IPPs and rural electrification concessions.

## 5.2 DEFINITION OF THE ROLE AND PLACE OF THE NETHERLANDS

The present study seeks to identify the priority areas of cooperation where the Dutch private sector and cooperation can bring the maximum impacts. The objective is to identify what the Netherlands (public and private sector) can offer in terms of financial instruments, services, knowledge and technologies to meet the needs of private and public actors in Senegal. In other words, what are the activities that can best bring out the specific Dutch technical and financial expertise in the Senegalese renewable energy sector?. What types of projects will optimise the attributes and characteristics of the Dutch expertise and supply in terms of access to sustainable energy?
The Dutch cooperation has been already funding various projects in Senegal:

- Funding of solar and wind IPPs (Taiba Wind Farm) by the FMO

[2] mission to identify and formulate a program in the energy sector in the Republic of Senegal, 11 ED F, December 2019.

- Solar electrification of rural health centres (RVO / ORIO),
- The transformation of waste from the Dakar slaughterhouse into electricity (RVO / PSI),
- Funding of ERILs by Senter Novem / Daey Ouwens, Endev.
- Acquisition of 1000 solar kits for rural electrification.

However, the involvement of Dutch companies in electrification projects in Senegal is still limited compared to the German, Indian, Chinese, French and American private sector for example. Likewise, within the framework of cooperation with Senegal, the financial resources that can be deployed by the Netherlands in the field of electrification are less important than these countries given the context of their cooperation with Senegal.

What differentiates the interventions of the various development partners of Senegal, of which the Netherlands, relate to the financing opportunities and modalities for projects because from the point of view of technological approach and know-how, practically all the partners are equal. The nature of the knowhow, technical and financial resources and instruments that the Netherlands can offer to the Senegalese renewable energy market is quite distinct to the other development partners. Unlike the bilateral cooperation from the US, Germany, France, China, India and multilateral institution (WB, AfDB), the Netherlands development cooperation instruments with Senegal are not suited for large infrastructural projects like the financing of electricity concessions requesting large among of investment. The involvement of the Netherlands in large projects can be made possible only under the form of co-financing or though multilateral instruments such as ENDEV and specialised windows managed by the WB or AfDB.

As an illustration, France, due to their strong presence (Embassy, AFD and Proparco), can combine loan, subsidies and strong political ties and lobbies to position their companies on major works. The USA, with their US$600 million grant to the sector, positions easily its private sector for the implementation of related projects. By financing the electrification of 300 villages through GiZ, German know-how and private sector are now well positioned in Senegal.

It is clear that the Netherlands Government financial instruments and tools for electrification cannot compete with Germany, France, USA or China. However, some of the RVO and of FMO instruments can make a difference in certain segments of the Senegalese electrification market and promote Netherlands companies and institutions to develop winning partnerships. The productive use in the horticulture sector where the Netherland is strongly present in Senegal is a typical segment where the Netherlands can singularise itself.

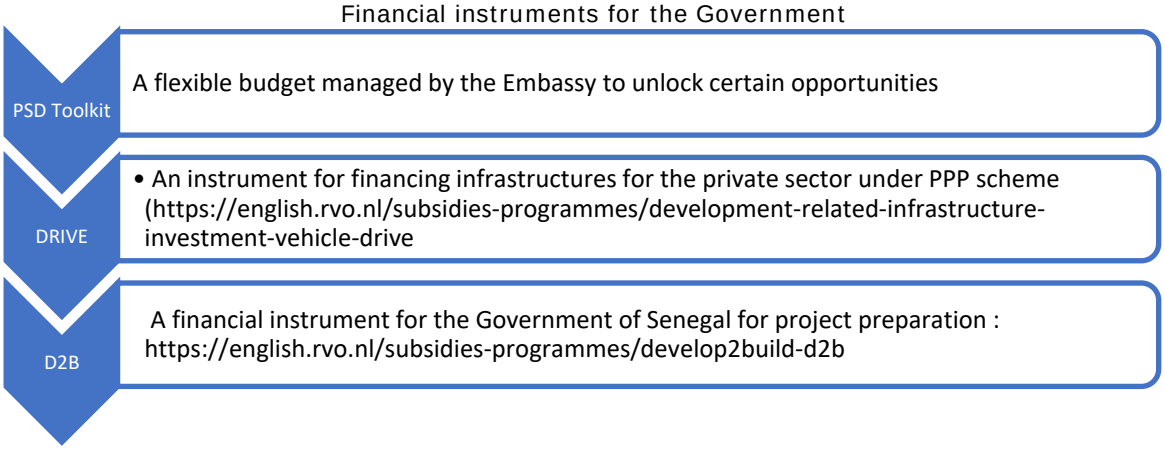
It is important to note that to date, the various Dutch financing instruments and tools are underutilized in Senegalese energy market. The financial support instruments of RVO could leverage greater involvement of NL companies and institutions in the renewable energy market of Senegal; specially in the selected niches outlined in this study; namely: (i) the off grid and rural electrification, (ii) productive uses, (iii) energy efficiency. Bioelectricity, although it has potential in Senegal (waste to energy for example), is not yet competitive in the context of Senegal due to the absence of government support and logistics related to the feedstocks. Therefore, this niche has not be addressed as part of this study.

## Short overview of the NL financial tool for the RE market of Senegal

As earlier stated, the Netherlands development cooperation has instruments and programs to support private sector development (PSD) in developing countries that are relevant to the Senegalese renewable energy sector. The PSD is mainly based on two pillars: 1) improving the business climate and 2) supporting small businesses (Dutch and local).

For the improvement of the business climate in Senegal the PSD can help to improve the legislation and the regulations (for example fiscal reform), to support governmental institutions, develop infrastructures projects, strengthens the financial sector and the access to markets. PSD programs and instruments are implemented by RVO, international organizations or the private sector. The relevant instruments for Senegal are the following:

Financial instruments for the Government




For supporting Dutch and Senegalese SMEs in the renewable energy sector, there are mainly six relevant instruments implemented by RVO and Invest International that can be leveraged:

1. DGGF - the financing of investments, exports or imports ( https://english.rvo.nl/subsidies-programmes/dutch-good-growth-fund-dggf gold https://www.dggf.nl/
2. DHI - support for demonstration, feasibility studies and investment preparation (: https://english.rvo.nl/subsidies-programmes/dhi)
3. Impact Cluster (PSD Toolkit) - a grant to expand the possibilities of developing PSD in a particular sub-sector or value chain.
4. Partners for International Business - support PPP between companies and knowledge institutes ( https://english.rvo.nl/subsidies-programmes/partners-international-business-pib )
5. Starters International Business - issues vouchers for various activities ( https://english.rvo.nl/subsidies-programmes/sib
6. Business Partner Support - partner search ( https://english.rvo.nl/information/going-international/business-research-tools/business-partner-support)

For Senegalese companies, there could be financing opportunities through local investment funds in which the Government of the Netherlands has invested; to know:

1. DGGF (https://english.dggf.nl/finance-opportunities/financing-local-smes).
2. SDG 7 RBF program ( https://english.rvo.nl/subsidies-programmes/sdg-results-access-renewable-energy-sdg-7) also offers opportunities for Senegalese companies

Besides RVO, there are other Dutch partners who can support the partnership between Dutch and Senegalese companies. It's about:

1. FMO (https://www.fmo.nl/),
2. PUM (https://www.pum.nl/en)
3. DECP (https://www.decp.nl/).

RVO also organizes (virtual) trade missions, matchmaking and stands at trade fairs.

## 5.3 POTENTIAL OFFER OF THE DUTCH PRIVATE SECTOR

The Netherlands has a dynamic and internationally recognized private sector specialized in renewable energy; specially in East Africa. In areas of innovative and front-line technologies such as PayGo systems, some Dutch companies have played a pioneering role in the rapid development of the rural electrification market in countries such as Kenya, Uganda, Tanzania. Dutch companies have contributed to the development of these flexible technologies that can be adapted to all kinds of needs (lighting, domestic appliances, productive use) but also affordable to all budgets according to the needs.

Netherlands companies have also made an appreciable contribution to the financing of sustainable energy access projects in the remote areas segment. The development of micro-credit and prepayment systems tailored to users' needs have made it possible to serve poor and isolated populations. Dutch companies could thus complete the potential contribution of the financial instruments of Dutch cooperation in Senegal. Some of these instruments require the involvement of Dutch companies. However, an awareness campaign to raise their interest will be necessary to lift the multiple barriers (language, unknown context, lack of familiarity).

This study concluded that the main renewable niches where the NL companies could play a significant role are the (i) productive use of energy in the nexus water-agriculture-energy, (ii) off rid sector and (iii) energy efficiency. The next chapter is presenting in detail these niches.

# 6. THE SENEGALESE RENEWABLE ENERGY MARKET

## 6.1 OVERVIEW

### 6.1.1 The 2025 vision for rural electrification

As part of the PSE, the Government of Senegal has the objective of providing to all its citizens with safe access to reliable electricity, in quantity, quality and at an affordable price by 2025. One of the first components of this ambition is to raise the electrification rate from 76%[3] in 2019 to 100% in 2025 through major investments in the sector, particularly targeting rural areas where only 53.9% of the population would benefit from access to electricity at the end of 2020. Therefore, the Government of Senegal has defined an "Operational Plan for Universal Access" which presents the national strategy for electrifying the 13,819 non-electrified localities in rural areas, representing approximately 3 million inhabitants; and peri-urban areas, representing a potential of 420,321 subscribers for Senelec. Investments are of the order of 660 billion FCFA (approximately 1 billion EURO) for rural areas and 72.875 billion CFA francs (111 million EURO) for urban areas.

Table 6 Investment needs in the period 2021 - 2025

| Electrification investment needs | FCFA | EURO |
|---|---|---|
| Rural areas (networks and non-networks) | 660,000,000,000 | 1,009,000,000 |
| Peri-urban areas | 72,875,000,000 | 111,000,000 |
| Total | 713,875,000,000 | 1,120,000,000 |

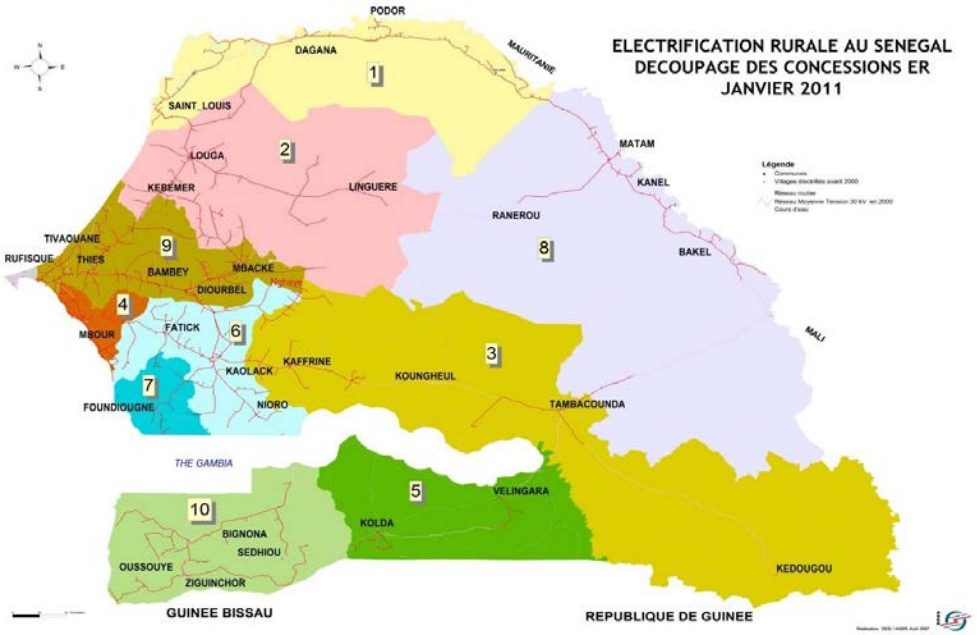
Source: Electricity sector financing round table.

An overview of the projects presented at the table is appended

### 6.1.2 Rural electrification concessions

To facilitate access to electricity in rural areas, the territory has been divided into ten concessions to be electrified.

Figure 3: Breakdown of rural electrification concessions in Senegal




[3] According to the presentation of the Ministry in charge of energy during the April 2021 round table for financing universal electricition

These concessions have all been distributed to private companies to ensure investments with the Government and the operation of energy services. Six concessions have been awarded, following international tendering process, to private operators: COMASEL (ONE, for two concessions), SCL Energie Solutions (STEG and COLSELEC, for one concession), ERA (EDF and Matforce, for one concession) and ENCO (Senegalese-Spanish consortium, two concessions). In December 2018, Senelec's perimeter was extended to the four remaining concessions, i.e., 18 departments.

The ASER system of concession enabled to increase the level of rural electrification from 8% in 1999 to 50 to 53% by 2020. This is a good leap over 20 years but it could have been greater by reforming the system to adapt it to the actual breakthrough in term of technology and delivery models.

The Netherlands could possibly cooperate with the concessionaire holders to supplement the investment needs and position the Dutch providers of technologies and services. In particular, the 4 concessions which are operated by Senelec can be interesting considering the need for investment estimated at €80,000,000.
RVO could team up with the EU Delegation in Dakar that is already committed to finance the Senelec concessions under a blending instrument in which the EU will donate €20,000,000 to complete a € 60,000,000 loan from one or more of the EU country members to complete the financial needs.

### 6.1.3 Regulatory instruments

Within the concessions, the PPER and ERIL are the two other instruments used to involve private sector players. These instruments mainly target the supply of electricity to households, administrative and social services with little regard for productive uses. In areas not covered by PPER, Local Initiative Rural Electrification (ERIL) projects can be developed and exploited by independent services providers. In practice, ERIL projects have so far been developed mainly through programs funded by development partners. The framework currently governing these projects is under review with the aim of attracting private investments in this type of project.

Some of the financial instruments of the Dutch International Cooperation are particularly suitable for financing ERILs by allowing a consortium of Senegalese and Dutch companies to implement rural electrification projects in partnership with the populations. The role of RVO, though its various instruments, is to facilitates activities such as matchmaking, market soundings, feasibility studies, training and investments in production and distribution infrastructure such as mini grid and standalone systems; including the needs for productive uses.

Note: sale of solar kits and other individual autonomous electrical systems is free of exercise throughout Senegal, subject to the provisions in force.

A summary of these frameworks is provided in the table below.

| | PPER Concession | ERIL Concession |
|---|---|---|
| Goal | 1. Focused on the electrification of consumers and households.<br>• Measures or statistics include villages and electrified consumers | 1. Focused on the electrification of consumers and households<br>2. Measures include villages and electrified consumers<br>• ERILs are the main framework used for the development of micro networks |
| Geographies | 1. There are ten concessions including 4 for Senelec.<br>• The provision of services is limited to the rural areas of the concession not served by SENELEC | 1. The concession area is a village area (or a group of villages)<br>2. The villages are in areas that are not expected to be reached by the network or the concessions for the next three years.<br>• Services to be provided within the perimeter, including areas connected to the micro-grid or not connected |
| Technologies | 1. PPERs take a technology neutral approach<br>  | 1. Connection to the grid is technically feasible, although unlikely<br>2. ERILs follow a technologically neutral approach<br>  |
| Cut | 1. The geographic area covers tens of thousands of consumers<br>• Connection targets range from 11,800 to 19,000 per concessionaire, but are below target today | 1. Rules limit ERILs to 200 households<br>2. There are around 10 ERILs operating in 300 villages[4]<br>• ERILs provide services to around 9,000 households |
| Model | 1. PPERs are heavily subsidized,<br>2. Tariffs are set by concession (until harmonization is implemented)<br>• Investments include foreign shareholdings | 1. ERILs are heavily subsidized (Capex and Opex)<br>2. Tariffs are set by concession and the methodology is not clear<br>• The structure involves private management but little private investment |

Sources: Overview of Senegal's off-grid market, USAID, 2018

### 6.1.4 The limits of the concession system

The results obtained from the concession policy, at the end of the priority rural electrification programs (PPER), did not meet initial expectations[5]. Progress has in fact been made in only four concessions: Dagana-Podor-Saint Louis (54% of the target), Louga-Linguère-Kébémer (68% of the target), Kaffrine-Tambacounda-Kédougou (52%) and Mbour (68% of the target). The limited results can be explained by the technological and organizational choices (preference to grid extension requiring heavy upfront investment) in some case, the difficulties of accessing finance, as well as the connection costs and high tariffs compared to those of Senelec. In November 2018, the decision to harmonize the tariffs between Senelec and the concessions was taken by the Government, making it therefore possible to substantially increase the connection rate in the concessions as the price will be more affordable to the population

In terms of solutions, the harmonization of tariffs through a subsidy from the Government of Senegal and its development partners make it possible to increase the number of rural customers. Indeed, the mobilization of investments for electrification infrastructure depends directly on the solvency of users and therefore on their ability to pay for services. As the cost are more affordable, more people in rural areas are inclined to subscribe to electricity services. The Netherlands could support holders of concessions and ERILS to increase production and distribution capacities. The support could be through the financing of solar mini grid for instance by following the German (GiZ) model that enabled

[4] We could not have enough information to assess the performance of ERILs
[5] Investment prospectus Roundtable financing of electrification, April 2021

to electrify 300 villages.

### 6.1.5 Emergency programs

For the purpose of accelerating the electrification rate within the concessions, initiatives are being developed in parallel with the concessionaire programs, through emergency electrification programs executed by ASER, PUDC, PUMA, Senelec including off-grid projects financed by development partners. The works carried out in these projects and programs are transferred to the concessionaires for operation and maintenance.

### 6.1.6 Off-grid regulation

The Government of Senegal recognizes the potential of off-grid electrification technologies (mini-grids, stand-alone solar systems) to accelerate access to electricity in rural areas. This sector is already dynamic in Senegal and provides access to electricity to around 7% of the population. This dynamism is the result of actions carried out by small and medium-sized enterprises which operate in this market with innovative approaches.

In order to promote the dissemination of these technologies, the Ministry in charge of Energy set up in August 2018 a consultation framework for off-grid electrification. This framework covers activities aimed at facilitating communication, coordination and synergies between initiatives. It is also working to put in place an institutional and regulatory framework favourable to the development of this market and conducive to the mobilization of financing.

#### Solar Home Systems

Sales of assets (panels, batteries, lamps, etc.) are not counted or recognized as a mode of electrification by the government. Consequently, the government has not yet regulated this market, particularly in terms of product quality. The general rule is that electric utilities are generally included in electrification statistics, while asset sales are not considered in the electrification statistics, therefore creating some market distortion.

In fact, within the context of the current regulation, SHS distributors are operating illegally within a designated concession and competing with SHS offers from the official service provides. However, these facts are tolerated by both government authorities and the concessions holders as it is impossible to deny a household to acquire as SHS or lease it. In fact, Service providers SHS are not considered as energy distribution services.

### 6.1.7 The size of the rural electrification market

According to ASER's planning, 8,445 of the 13,819 localities to be electrified (i.e., 61%) will be electrified by extension of the network, against 7% by solar powered mini- grid and 32% by Solar Home systems.

Table 7: Estimation of the number of electrical systems to be put in place by 2025[6]

| Regions | PV mini-grid | Autonomous PV | Network | Grand total |
|---|---|---|---|---|
| DAKAR | 0 | 0 | 3 | 3 |
| DIOURBEL | 0 | 459 | 903 | 1362 |

[6] Investment Propectus, Round Table on the financing of electrification, April 2021

| | | | | |
|---|---|---|---|---|
| FATICK | 0 | 255 | 868 | 1123 |
| KAFFRINE | 46 | 252 | 698 | 996 |
| KAOLACK | 0 | 183 | 704 | 887 |
| KEDOUGOU | 77 | 117 | 127 | 321 |
| KOLDA | 124 | 457 | 779 | 1360 |
| LOUGA | 126 | 805 | 1347 | 2278 |
| MATAM | 176 | 256 | 228 | 660 |
| SAINT LOUIS | 174 | 394 | 590 | 1158 |
| SEDHIOU | 19 | 174 | 342 | 535 |
| TAMBACOUNDA | 268 | 473 | 522 | 1263 |
| THIES | 0 | 402 | 1133 | 1535 |
| ZIGUINCHOR | 9 | 128 | 201 | 338 |
| GENERAL TOTAL | 1019 | 4355 | 8,445 | 13 819 |
| DIVISION | 7% | 32% | 61% | 100% |

The table below summarizes the populations to be served in each region.

Table 8 Populations to be served by 2025 depending on the technology[7]

| Regions | PV mini-grid | SHS | Grid Extension | Grand total |
|---|---|---|---|---|
| **DAKAR** | 0 | 85 | 2,063 | **2 148** |
| **DIOURBEL** | 0 | 24 167 | 250 169 | **274 335** |
| **FATICK** | 0 | 15 088 | 280,497 | **295,585** |
| **KAFFRINE** | 11,126 | 13 891 | 280,224 | **305,241** |
| **KAOLACK** | 0 | 10,163 | 246,920 | **257,083** |
| **KEDOUGOU** | 20 177 | 6 251 | 50 683 | **77 111** |
| **KOLDA** | 29,749 | 25 250 | 206,543 | **261,542** |
| **LOUGA** | 27,272 | 42,890 | 333 235 | **403,397** |
| **MATAM** | 37,725 | 13 073 | 63,771 | **114,568** |
| **SAINT LOUIS** | 36,410 | 20,531 | 149,844 | **206 785** |
| **SEDHIOU** | 3,637 | 9,196 | 104,282 | **117 115** |
| **TAMBACOUNDA** | 67,580 | 22 684 | 151 766 | **242,030** |
| **THIES** | 0 | 20,864 | 357,459 | **378,323** |
| **ZIGUINCHOR** | 1,523 | 5 953 | 55,196 | **62 672** |
| **GENERAL TOTAL** | **235 199** | **230,085** | **2,532,652** | **2 997 937** |
| **DIVISION** | **8%** | **8%** | **84%** | **100%** |

About 84% of the household will be electrified with grid extension and 8% respectively by mini grid and SHS

### 6.1.7 Financing needs in the rural area

[7] Investment Propectus, Round Table on the financing of electrification, April 2021

The total cost of the investment to electrify localities not covered by current projects is estimated at CFAF 643 billion. The extension of the MV and LV networks will be requiring 495 billion FCFA to build more than 1078 km of lines and associated connections. The cost of the mini grid installation to electrify 1,019 localities is estimated at 105 billion FCFA. Autonomous solar systems, which will have to be deployed for the benefit of 30,000 households spread over 4,356 small villages, call for a financing need of Fcfa 21 billion, while the densification phase, giving access to electricity to more than 45,000 households, calls for a need of Fcfa8 billion .

To these investment costs are added the costs of preparing the program (implementation studies) and operating and maintenance estimated at 2.6% of the amount of the project. This brings the overall total cost of the program to Fcfa 660 billion. The table below provide an overview of the financing needs for each component.

Table 9 - Breakdown of investments

| Items | Financing requirement (millions Fcfa) |
|---|---|
| Preparation and Studies (Detailed Studies, Program Management, Technical Assistance) | 16,085 |
| Capacity building | 867 |
| CAPEX | 643,401 |
| MT backbones | 14,101 |
| Connection to the MV network | 495,092 |
| - MV Extension (Power Supply, Transformer Substations) | 318,662 |
| - LV networks | 131,838 |
| - Connections | 18,608 |
| - Indoor installations | 25,984 |
| PV mini-grid | 105,337 |
| - Energy production (Equipment, control, Civil Engineering) | 84,603 |
| - LV network | 15,908 |
| - Connections | 2,015 |
| - Indoor installations | 2,811 |
| Autonomous PV System (SHS) | 21,063 |
| - Energy production (Equipment, Supports) | 12,739 |
| - Indoor installations | 3,204 |
| - Public lighting | 5,121 |
| Densification phase | 7,807 |
| - Indoor installations | 3,090 |
| - Connections | 4,717 |
| TOTAL | 660,353 |

The existing Netherlands instruments are suitable for undertaking specific projects such as feasibility studies, investment preparation, match making and technology transfer in the off grid and productive use sector through B2B and PPP schemes.

## 6.2 PRODUCTIVE USES

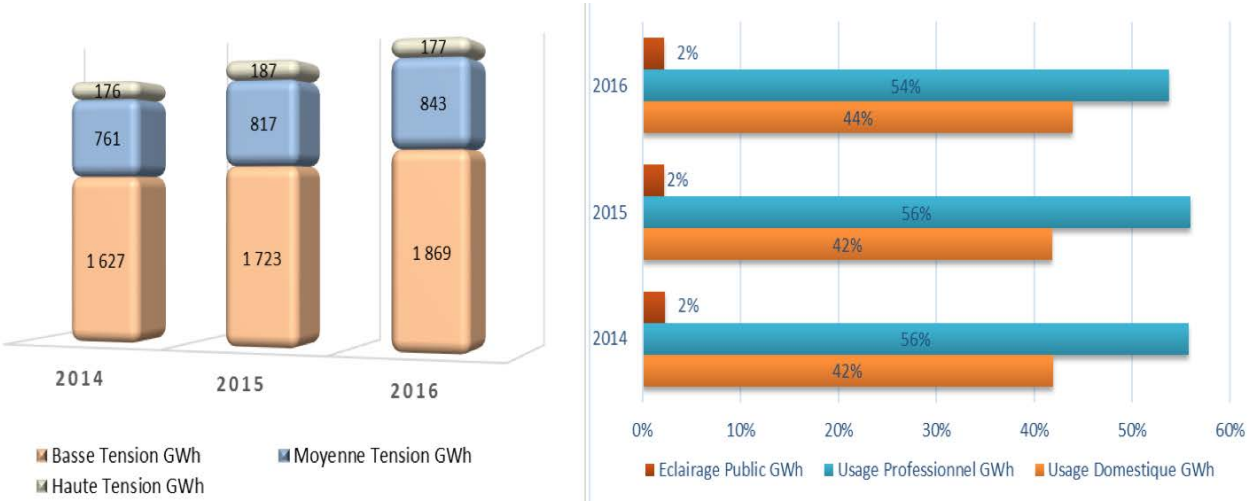
### 6.2.1 Analysis of electricity consumption in Senegal

Electricity is an expensive input for Senegalese small and medium enterprises. Energy services represent 17 to 30% of production costs in Senegal with an average of 25% among SMEs (UNIDO). These costs are high compared to OECD countries or Southeast Asia.

The high cost of electricity partly explains the fact that the Senegalese economy is still largely dominated by informal activities characterized by low mechanization and the intense use of human force by farmers and artisans to obtain meagre outputs. Therefore, the need for mechanization to improve productivity is largely hampered by the non-availability of electricity in sufficient quantity and quality and at an affordable cost.

Consumption by domestic customers and professional and industrial customers represents 44% and 54% respectively, while public lighting uses the remaining 2%[8]. The graph below highlights the electricity consumption curves in Senegal in the periods 2014 - 2016;

Figure 4: Profile of electricity consumption




Given the electricity generation deficit of Senelec and the limited coverage of the grid, electricity from solar solutions is becoming an attractive option for SMEs and households to access sustainable energy at a more affordable cost.

### 6.2.2 Lower costs of solar solutions

As the price of solar PV equipment decreases, more and more businesses and households are looking for solar solutions to reduce the cost of electricity and stabilize the availability of energy. Therefore, for the sake of profitability, Senegalese SMEs are seeking alternatives for more affordable services as compared to the average Senelec tariff (0.18 € / kWh).

### 6.2.3 Scope of productive uses

[8] Sire CRSE

The productive uses of energy cover practically all areas of economic activities in Senegal; including agriculture, mining, industry, crafts, transport, commerce and services. The increased availability of energy solutions of renewable origin, their flexibility and above all the continuous drop in costs opens a wide range of applications to improve the technical, economic, financial and environmental performance of Senegalese artisans, farmers, micro-enterprises and SMEs. In particular, mini grid and solar stand-alone solutions are particularly suitable for solving various needs due to their flexibility in terms of size, availability, costs and ease of deployment.

In this context, several studies have been carried out in Senegal to promote the productive uses of energy. PERACOD recommends that solar refrigeration to preserve agricultural and fishery products, solar pumping for agriculture as well as the solar mill are priority areas for the creation of income in Senegal. The other areas of activity were not covered by the PERACOD study, but the needs relate equally to local processing of products and post-harvest handling (cleaning, drying, packaging for instance). Solar rooftop is an application that can be promoted for many types of needs for parking, industry, trade, services and household needs.

### 6.2.4 Boost agricultural development

The Senegalese agriculture has recorded good performance for the last ten years[9] according to government statistics. These statistics advocate that food self-sufficiency is within reach. If constraints such as access to sustainable energy which hamper the optimization of its potential are removed, the sector can reduce unemployment, limit rural exodus and boost growth.

The FAO recommends that good policy choices can boost agricultural performance by up to 20%. In this context, the option that makes agriculture the engine of the Plan Senegal Emergent (PSE), a benchmark for national economic and social policy in the medium and long term, could be relevant. The various actions to modernize the sector have resulted in clear improvements in yields according to the website of the Ministry of Agriculture which informs that with regard to rice, peanuts, horticultural products, cereals, Senegal is close to achieve self-sufficiency. The contribution of agriculture to GDP increased from 7% by 2012 to 12% in 2020. However, given its potential, the sector can serve the national economy more effectively.

<u>Water, productivity, mechanization and land</u>

The constraints of Senegalese agriculture are of several types.

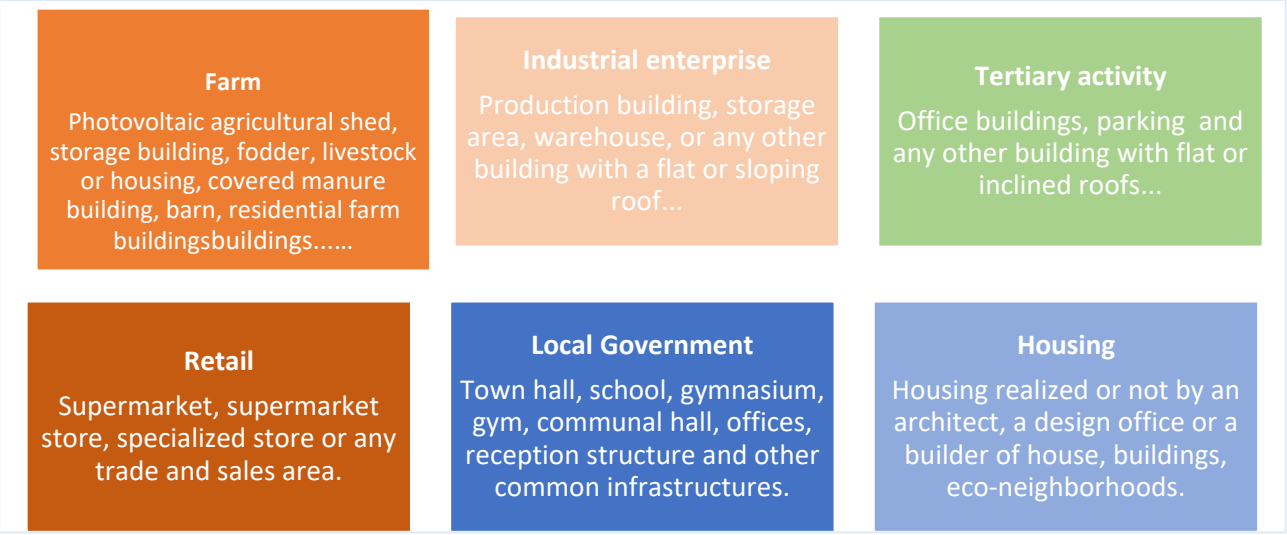
- The first would be the availability of water for irrigation because the sector cannot depend on climatic hazards in a Sahelian context characterized by irregular rain patterns. In addition, the outputs of irrigated agriculture in the Sahel are significantly better than rainfed agriculture according to the FAO.
- Another constraint to be removed is linked to agricultural intensification, which consists of increasing yields and, above all, increasing agricultural productivity through mechanization.
- A third barrier consists of reducing post-harvest losses through the development of cold chains, solar drying, processing and storage facilities. Senegal still records significant post-harvest losses, of the order of 20 to 40% depending on the sector, especially for horticultural products such as mangoes, tomatoes, onions, potatoes, etc. The main challenge is the availability of electricity, especially in the remote areas, to conserve or transform locally what is produced. Solar rooftop could be an indicated option for covering such need in the absence of grid electricity. This implies the need to promote an industry for processing agricultural products through the availability of sustainable energy on production sites. The direct effects would be to increase

[9] Click here to Read or Reread: Focus on the agricultural sector (1/2): How is the face of Senegalese agriculture changing

production, create local added value (job creation, income, imports, etc.). If rural productions are optimized in the direction of transformation, this will result in more jobs. Since GDP is the sum of added values, the starting point for reducing poverty and unemployment in Senegal seems to be the development of agriculture through the mobilization of renewable energy to facilitate mechanization and the processing industry. Due to the high cost of diesel, solar solutions have become more affordable for the preservation and processing of agricultural products.

### 6.2.5 Solar roof for productive uses

There are solar roofs of all sizes, shapes and in all sectors. They are designed from an existing building or structure or to be constructed. For example, solar roofs can be installed in:




An existing building can be transformed into a photovoltaic building provided that its roof has sufficient capacity. In other words, it must be able to support the weight of the solar panels (around 14Kg / m²).

Auto-consumption with the sale of surplus in the long term

In Senegal, auto -consumption is an interesting choice if the electricity needs are regular or constant because of the high costs of electricity from the Senelec network. Auto-consumption from solar roofs is therefore a suitable solution for all type of activities. The operation of the auto-consumption of a photovoltaic building can be described as follows:

- Photovoltaic solar panels generate electricity during the day. This instantly powers all or part of the electrical equipment (over the sun) so as to reduce or even eliminate the need for Senelec and therefore minimize the costs of electricity.
- When energy needs are greater than the energy produced by the solar installation, the Senelec network takes over (at night, for example).
- In the event of production exceeding needs, the surplus electricity that is not consumed could be sold to Senelec when the network is more sophisticated (smart grid) and the Senegalese regulation allows it. The purchase price of solar electricity must however be regulated in Senegal by the CRSE.

Solar rooftop remains an untapped niche in Senegal.

The use of solar photovoltaic installations could also reduce the use of expensive small diesel generators to face the impact of power outages. However, the decision to use solar

rooftop will be determined by the credit facilities and financing conditions to acquire the solar installations, the savings in energy costs (return on investments), the quality of the system (guarantee) and the seller's reputation (track record, trust). Among these constraints, the real bottleneck would be the mobilization of investment costs for the equipment. Solar rooftop would be recommended especially in the industrial zone of Dakar where hundreds of companies are potential targets.

In the absence of leasing or other forms of innovative financing, solar rooftop remain still inaccessible to most companies who are struggling to raise the necessary financing.

## 6.3 ENERGY EFFICIENCY

### 6.3.1 Background

Energy efficiency, through the reduction of losses and inefficient uses, leads to additional and immediate availability of electricity. As a result, energy efficiency, in the Senegalese context marked by insufficient production capacity, would be the cheapest way to make electricity available to populations and businesses.

In fact, due to the lack of optimal maintenance and the obsolescence of part of the transmission network, losses during the transmission of electricity are estimated at more than 20%. The massive use of second-hand and low-quality equipment and materials for which the purchase price is attractive at first glance, leads to high electricity consumption in relation to the services provided. Finally, both households and SMEs pay more for the service provided because of the excessive need for electricity to produce the required service.

### 6.3.2 Institutional framework for energy efficiency

Senegal is pursuing an ambitious objective in the field of energy efficiency with the establishment of the National Agency for Energy Efficiency (ANEE, created in 2011), which in 2013 became the Agency for the Energy Efficiency and Energy Management (AEME). The AEME is therefore responsible, among other things, for (i) evaluating and exploiting the potential for energy savings in the various sectors of activity, (ii) elaborating energy management strategies, (iii) drafting programs for energy management, (iv) leading and evaluating the implementation of energy saving and energy efficiency programs, (v) providing advice, technical and financial assistance for the rationalization of energy consumption, (vi) promoting standards and regulations concerning the rational use of energy and energy-saving equipment.

Therefore, the energy management policy of Senegal is based on the following four (4) key pillars that should be activated simultaneously to achieve the objectives of reducing energy consumption:

(i) governance arrangements;
(ii) economic and financial arrangements;
(iii) implementation arrangements and;
(iv) energy management action programs

To operationalize the various policies, Senegal has adopted instruments and measures including[10] :

1. Decree No. 2017-1411 of July 13, 2017, prohibiting the import, production and marketing in Senegal of incandescent lamps and promotion of energy-saving lamps, which repealed that of 2011;
2. New Urban Planning Code: consideration of energy efficiency;
3. Energy savings target of around 40% on electricity demand by 2020;

[10] PANEE, 2015

4. Capacity building, training and sensitization of stakeholders;
5. Public sector electricity expenditure monitoring and reduction;
6. Widespread use of energy saving lamps;
7. Standardization and labelling of energy equipment: draft standards already available.

However, labelling for domestic (electronic, air conditioning, water heaters, etc.) and industrial appliances has not yet been generalized and the ban on the massive importation of second-hand equipment is not yet effective.

### 6.3.3 Government objectives

The objectives in terms of energy efficiency are presented in the following table:

Table 10: Planning of energy efficiency targets

| | 2015 | 2020 | 2030 |
|---|---|---|---|
| Percentage of industries with energy efficiency measures | 15% | 50% | 100% |
| Percentage of new public buildings designed with EE measures | 2% | 14.5% | 40% |
| Network lighting penetration rate | 56.2% | 82% | 99% |
| Losses in the electricity sector | 21% | N / A | N / A |

*Source: AA SE4ALL 2015*

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### 6.3.4 The potential savings

A brief description of the energy efficiency potential in the country by sector or area is presented in the table below:

**Potential for energy savings in Senegal [11]**

| | |
|---|---|
| Energy savings in electricity | The energy consumption of Senegal's electricity sub-sector was approximately 2375 GWh in 2013; in the absence of a structured and sustained energy management strategy, it will continue to grow steadily to reach 6,567 GWh in 2030, an increase of 176%, at an average annual rate of 6.2% per year. The implementation of the various energy efficiency measures recommended in the electricity sector will allow a gain of 28% to 36% by 2030. |
| Energy savings in hydrocarbons (transport) | Senegal's consumption of hydrocarbons was around 982 ktep in 2013; in the absence of a structured and sustained energy management strategy, it will continue to grow steadily to reach 2,125 ktoe in 2030, an increase of 116%, at an average annual rate of 4.6% per year.<br>The implementation of various energy saving measures in the hydrocarbon sector will allow a gain of 10% to 18% by 2030. |
| Energy savings in household fuels | The consumption of domestic fuels in Senegal is around 1122 ktep in 2013; in the absence of a structured and sustained energy management strategy, it will continue to grow steadily to reach 2,370 ktep in 2030, an increase of 111%, at an average annual rate of 4.5% per year.<br>The implementation of the various energy saving measures in the domestic fuel sector will allow a gain of 25% to 40% by 2030. |

The implementation of the pilot program to replace incandescent lamps with low consumption lamps (LBCs) resulted in a decrease in demand of around 9 MW (2011). The generalization of the use of AMLs (approximately 4,432,000 units) will save approximately 88.1 MW (at least 44 billion FCFA on investments in power plants) and will considerably reduce both Senegal's oil bill and greenhouse gas emissions.

Table 11 Energy efficiency project in Senegal

[11] PANEE, 2015

| Name of project / initiative | Institution | Temporary horizon |
|---|---|---|
| Program to reduce public utility bills of the Administration | AEME | 2018-2019 |
| Project to install energy-saving lamps in administrations and public establishments with UEMOA | UEMOA | 2017 |
| Project to install energy-saving lamps for households, administrations, small professionals and public lighting | AEME | 2020 |
| Behaviour changes communication campaign project | | |
| Project to implement a regulation for the energy information label on household electrical appliances | AEME | |
| Etc.... | AEME | |
| Regional device labelling project | UEMOA | |
| Regional energy efficiency code project in buildings | UEMOA | |
| Credit line for EE / ENR projects SUNREF | AFD / EU | |
| Draft Minimum Energy Performance Standards (NMPE) | ECOWAS / ECREEE | In progress |
| Draft energy efficiency standards and labelling | AEME | In progress |
| The draft order for the application of the Senegalese construction code to take into account energy efficiency aspects in buildings | AEME / PNEEB / Typha | In progress |

*Source : National SE4Focal Point / EU TAF Expert team / ECREEE*

The Senegalese context characterised by (i) costly electricity generation from thermal sources mainly, (ii) rusting power generation equipment and obsolete process, (iii) weak electricity transmission grid, (iv) the massive use of cheap but low efficient household and industrial appliances and machineries and (v) limited awareness on EE policies and best practices by the population and the industry. Under such context, Energy Efficiency measures, designed to reduce losses and cut inefficiency uses, remain the cheapest way to make electricity available for the population and industry.

Netherland could help improve the awareness and policies. It will consist of helping to promote best practices in (i) standards and labelling of appliances and machineries, (ii) cleaner production in industry and mine to reduce energy uses, (iii) improved building codes and standards, (iv) efficient lighting, (v) decarbonisation of the transport, promoting (vi) eco design and (vii) awareness. The means of intervention could be through training, transfer of technologies and know-how via the cooperation between institutions, project finance.

# 7. ANALYSIS OF THE NICHES FOR PARTNERSHIPS

## 7.1 CHOICE OF NICHES

Through a preliminary documentary review, 5 niches to be studied were identified; namely: (i) the rural electrification market with a view of reaching the SDGs, (ii) the water-energy-agriculture nexus market, (iii) solar roofs for SMEs; (iv) modern bioenergy and (v) energy efficiency.

After several (in presence and virtual) meetings with the Senegalese actors and the Dutch Embassy and RVO, the niche relating to bioenergy was disregarded in order to better focus on those which seem to have more potential in the immediate term in terms of priority, maturity of projects proposed by Senegalese institutions, costs, speed in terms of implementation and impacts.

During the discussions related to the validation of the inception report, only three niches were retained; namely decentralized rural electrification, productive uses including solar roofs and energy efficiency. In fact, the water-energy-agriculture niches and that of solar rooftop were grouped together under the generic term "productive use" to reflect the content (the why) rather than the form (the how).

## 7.2 METHODOLOGICAL APPROACHES

Initially, a series of tools was developed to facilitate optimal communication on the scope of the project and to collect the necessary information relating to priority needs and niches to be explored through fruitful partnerships between Dutch and Senegalese companies and institutions. These tools consisted of :

(i) a brochure explaining the objectives of the project and the expected results;
(ii) an interview guide for physical meetings;
(iii) a questionnaire by type of actor;
(iv) a template or canvas for the presentation of the project sheet .

### Brochure

With the view of explaining the contours of the project, present the objectives and expected results, a brochure was produced in French and English to inform public and private actors and to raise their interests . This brochure was sent to about eighty Senegalese public and private institutions while the English version was distributed by email to 44 Dutch institutions and companies.

### Questionnaires

The questionnaire, designed in French and English, was intended to collect essential information on the views, constraints and needs of stakeholders in Senegal and the Netherlands to promote the development of RE and EE in Senegal. The use of this data made it possible to better characterize the niches and identify the priorities.

### Interview guide

The interview guide was designed for one-to-one meetings in order to collect useful information as standard. The content was a little similar to the questionnaires but adapted according to the interlocutor taking into account his nature and his concerns

### Template for project sheet presentation

The objective of the Template is to collect in a standard format project ideas that could be the subject to a partnership with the Netherlands. This Template made it possible to collect 57 project sheets, which testifies the interest of Senegalese public and private institutions in the process initiated by RVO and the Embassy of the Netherlands.

Series of face-to-face and virtual contacts and meetings

After designing the communication tools for the project, the first action was to establish a list of Senegalese and Dutch public and private institutions representative of the various niches identified in the two countries. About eighty (80) Senegalese institutions (i.e., 4 dealers and 37 Erils; 26 private operators, and 12 public institutions and NGOs) and about forty-four (44) of their Dutch counterparts were contacted by email. These mails were followed by several reminders to collect the required information.

Subsequently, a series of ten (10) virtual meetings were organized: two with (COPERES), a group meeting with (MPE, AEME, ANER, CRSE), two meetings with ADEPME, one with SENELEC, one with AGROSSED and one with SAHEL ENERGIE. These meetings were followed by other individual sessions with ANER and the Ministry of Petroleum and Energy to better sensitize the actors and inform them about the opportunities that can be offered by the Dutch Cooperation. Sites visits were also organized for certain institutions such as COMASEL, CMS. Regular telephone contacts and email exchanges were established, given the COVID context.

A visit to FIAN (Agricultural Fair) was also carried out on June 4, 2021. Given the considerable weight of the agricultural sector in this project, this visit was an opportunity to meet the main actors of the sector in Senegal and to present the project to them

Analysis of the data collected

From the information collected through the questionnaires and project sheets, an Excel file was created to process all the data in order to collect essential statistics, trends in areas of interest, expressed needs and related constraints and limitations.

From these data, a series of analyses were carried out by cross-checking and extrapolation to allow the characterization of the niches in terms of potential and need. The niches were analysed in terms of number of actors, the various needs expressed: regulatory, technical, financial, know-how. This analysis also made it possible to draw up a table of the different actors and stakeholders according to the following criteria:

- Identity: public or private, concessionaires, ERILS, equipment suppliers, investors,
- role: policy, regulation, investors, O&M.

The results of these surveys and the preliminary conclusions to identify and characterize the challenges of the sector constitute at the same time as many opportunities for potential partnership with Dutch public and private institutions for improving access to sustainable in Senegal.

## 7.3 THE NEEDS & CONSTRAINTS EXPRESSED BY THE INSTITUTIONS

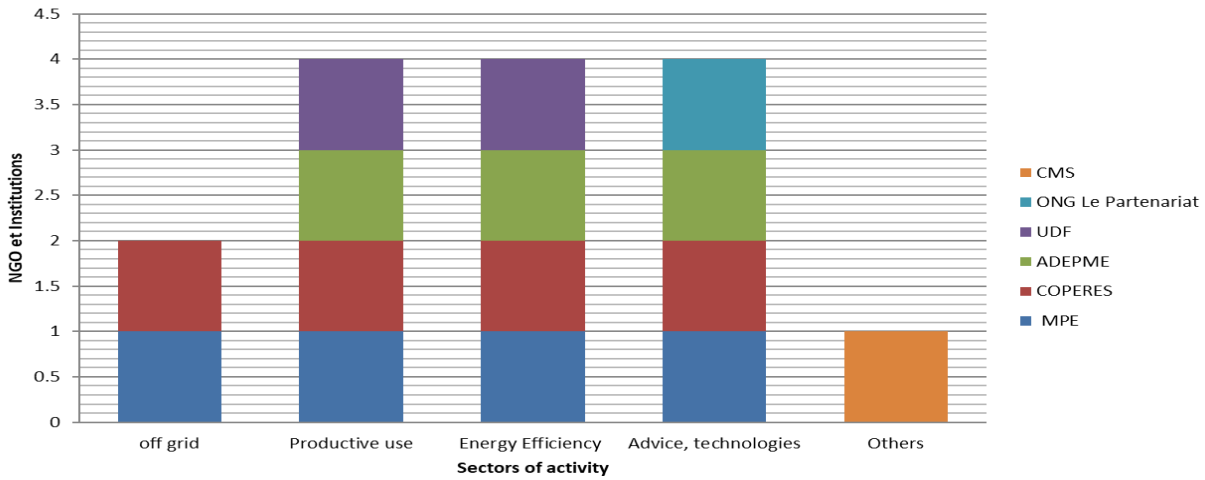
During the survey phase, twelve (12) key institutions were contacted and six (6) responded to the interview form 12. The data from the survey forms collected are analysed in this section.

### 7.3.1 Identification of activity sectors

The graph below describes the business sectors and the number of public institutions and NGOs that responded to the survey.

[12] It is when noted that institutions such as ASER, ASER and AEME preferred to present project sheets instead of responding to the survey form

Graph 5: Sectors of activity (surveyed public institutions and NGOs)



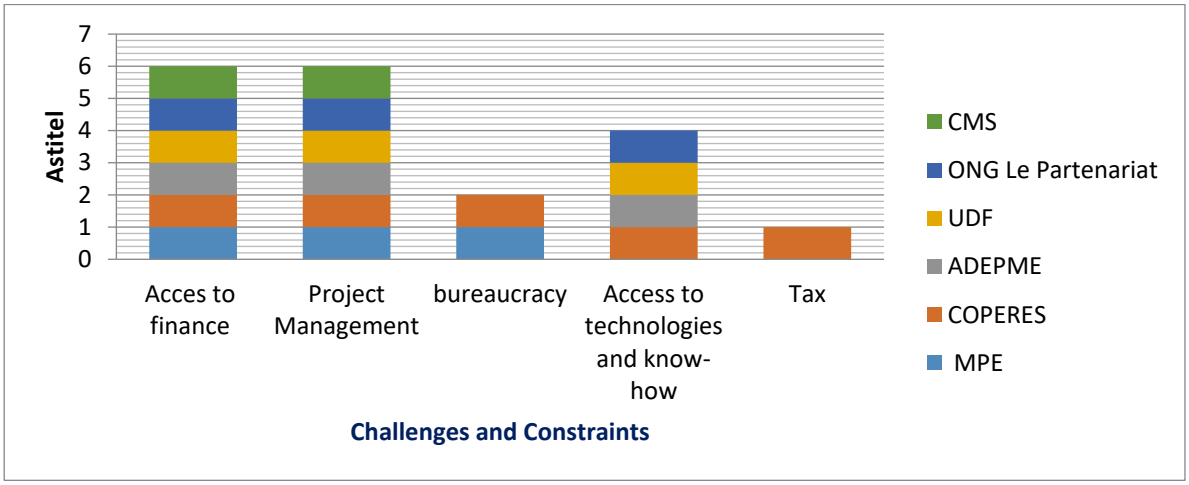

*Nota bene: the different colours has only the purpose to identify the sources of information.*

- The Ministry of Petroleum and Energy (MPE) is represented in all sectors of activity because it oversees the general policy of the energy sector in Senegal;
- The cooperative for the promotion of renewable energy (COPERES) is represented in all activity because it brings together a set of players in the renewable energy industries in Senegal;
- The agency for the promotion of small and medium-sized enterprises (ADEPME) is represented in four (4) sectors, namely productive uses, solar roofs, modern bioenergy, advice, technologies and services;
- The NGO UDF (Union for the Development of Fass Ngom) is represented in three (3) sectors: productive uses, solar roofs and modern bioenergy;
- The NGO The Partnership is represented in two sectors: bioenergy and advice, technologies and services;
- The CMS is represented in the segment other sectors, in particular the financing of renewable energy projects.

### 7.3.2 The typology of the challenges encountered

This graph represents on the y-axis the institutions and NGOs that responded to the survey and on the x-axis the various challenges encountered.

Graph 6: Types of challenges encountered by public institutions and NGOs



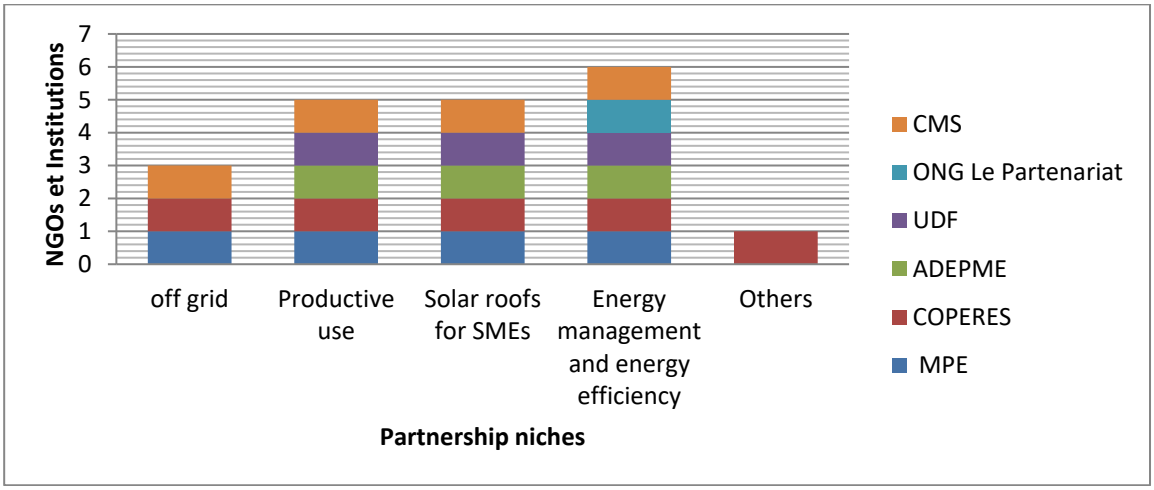

The surveyed institutions and NGOs encounter several challenges, including:

- The MPE: access to financing, monitoring and management of projects as well as heavy administrative costs and procedures.
- COPERES: all the challenges listed on the graph;
- ADEPME, UDF and NGO Partnership: access to financing, monitoring and management of projects, but also access to appropriate technologies and know-how;
- The CMS: access to funding and the management of projects.

### 7.3.3 Type of partnership with the Netherlands desired

The graph below describes the partnership niches desired with Dutch companies and institutions by the actors, institutions and NGOs surveyed.

Graph 7: Partnership niches desired by public institutions and NGOs




- The MPE, CMS and COPERES: all the niches mentioned in the graph;
- ADEPME and UDF: all niches other than off-grid and rural electrification;
- The NGO The Partnership: energy management and energy efficiency as well as modern bioenergy;

### 7.3.4 Specific expectations in terms of partnership

Ministry of Petroleum and Energy (MPE)

The expectations are diverse and varied: As part of the water-energy-agriculture nexus, the Ministry is promoting off-grid electrification projects (photovoltaic type) and pumping stations in the region of Saint-Louis as a respond to the high cost of electricity singled out as the main bottleneck for productivity, impacting therefore the socioeconomic life of the populations. Over the year, the cultivation period lasts only six (06) months because of the cost of electricity which is excessively expensive. Access to finance is difficult. However, with the support of Dutch cooperation, the Ministry intends to set up an adapted energy production system to improve productivity and allow an all-year cropping system.

Cooperative for the promotion of renewable energies (COPERES)

The main challenges raised relate to financing and cash flow difficulties.

Agency for the Promotion of Small and Medium-Sized Enterprises (ADEPME)

Expectations revolve around the following points:

1. Capacity building for SMEs through multiple training sessions on Renewable energies, Energy Efficiency, clean technologies, low-carbon activities, waste recovery with modern bioenergy.
2. Financing of SMEs through subsidies for the purchase of solar equipment for processing, drying and food preservation, solar roofs, to reduce the production costs of SMEs.

Union for the Development of Fass Ngom (UDF) -

This association seeks for technical and financial support to transform household waste into energy. It also seeks to support agricultural producers, in particular market gardeners for the acquisition of solar and wind energy supply systems for water wells and boreholes to boost agricultural production.

UDF is interested in technological innovations in the field of renewable energies that could be implemented. UDF mentions the need for benchmarking to visit and find out what is happening in the Netherlands.

CMS seeks funding for renewable energy projects.

### 7.3.5 Promising niches other than those already mentioned

The answers obtained from this question are as follows:

- MEPs: support for the electrification of health structures and schools by solar panels.
- COPERES: The Solar Home System (SHS), the solar pumping system and productive use (Post harvest).
- ADEPME: wastewater and faecal sludge treatment, sorting - recycling - reuse of agricultural waste; ecological packaging.
- UDF: Installation of biodigesters for biogas and biofertilizer fertilizer and solar pumping in rural areas.

## 7.4 CONCESSIONNAIRES AND ERILS HOLDERS

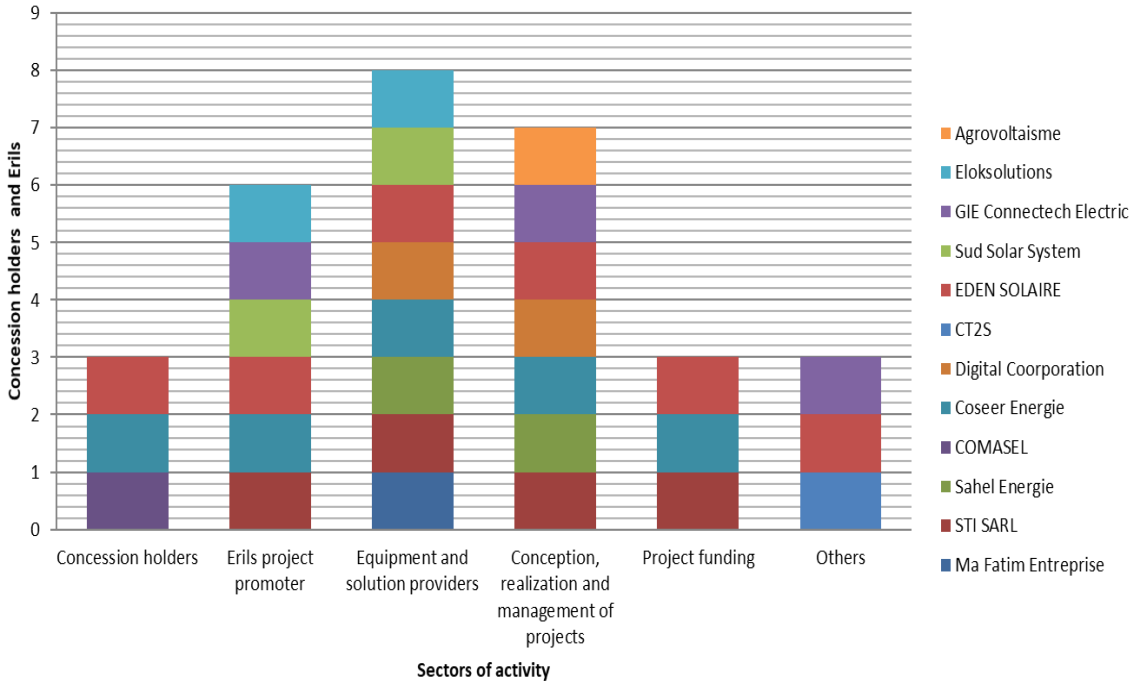
Concessionaires and ERILS are the two major players in rural electrification in Senegal. Indeed, Senegal is divided into ten (10) rural electrification concessions which are awarded to private companies to provide energy access services to households and businesses. However, for areas not yet electrified in each concession, the populations also have the right to take their own initiative in electrification, in partnership with a private operator other than the concessionaire (ERIL).

As part of this project, questionnaires were sent to the five (5) concessionaires including SENELEC and thirty-seven (37) ERILS, to collect useful information in relation to the various challenges and opportunities for partnership with companies and institutions in the Netherlands. Twelve (12) responses were obtained. The answers to the various questions are analysed in the following paragraphs.

### 7.4.1 Sector of activity

The answers to this question are shown in the graph below.

Graph 8: The sector in which the Concessionaires and Erils are involved

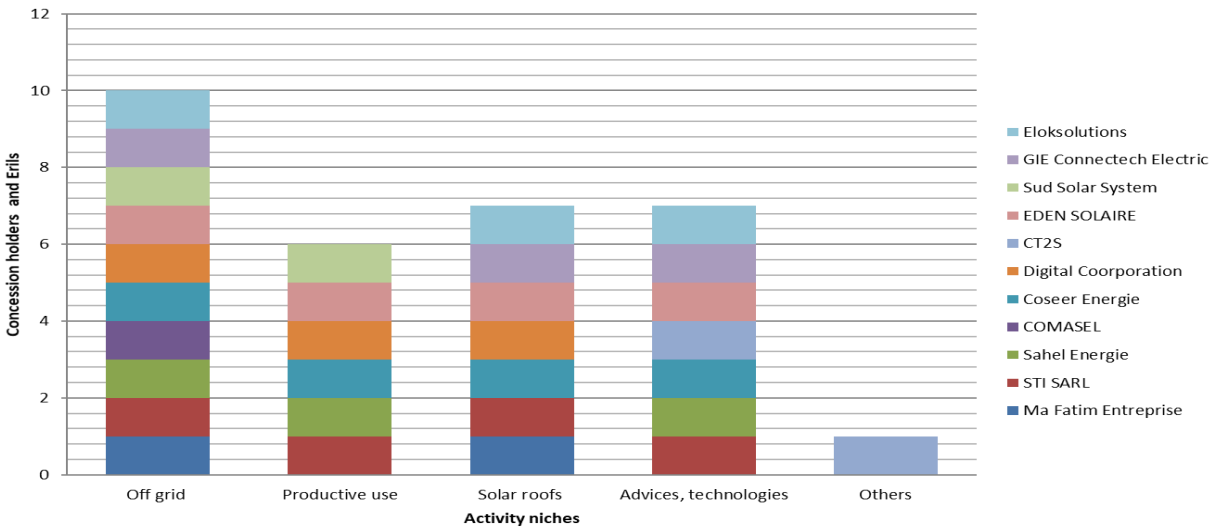



Most surveyed companies are considering themselves as Equipment and Services providers in the rural electricity market. The large majority of the surveyed are equally involved in the design, conception, implementation and management of rural electrification project. Only 3 actors are involved in project finance.

### 7.4.2 The different markets / niches

The following graphs describe the different markets where Concessionaires and ERILS holders are active or want to be active. In the first graph, the respondents are found on the abscissa and the markets on the ordinate. In the second graph there is a percentage distribution of the different niches.

Graph 9: Niche for Concession and ERILS holders

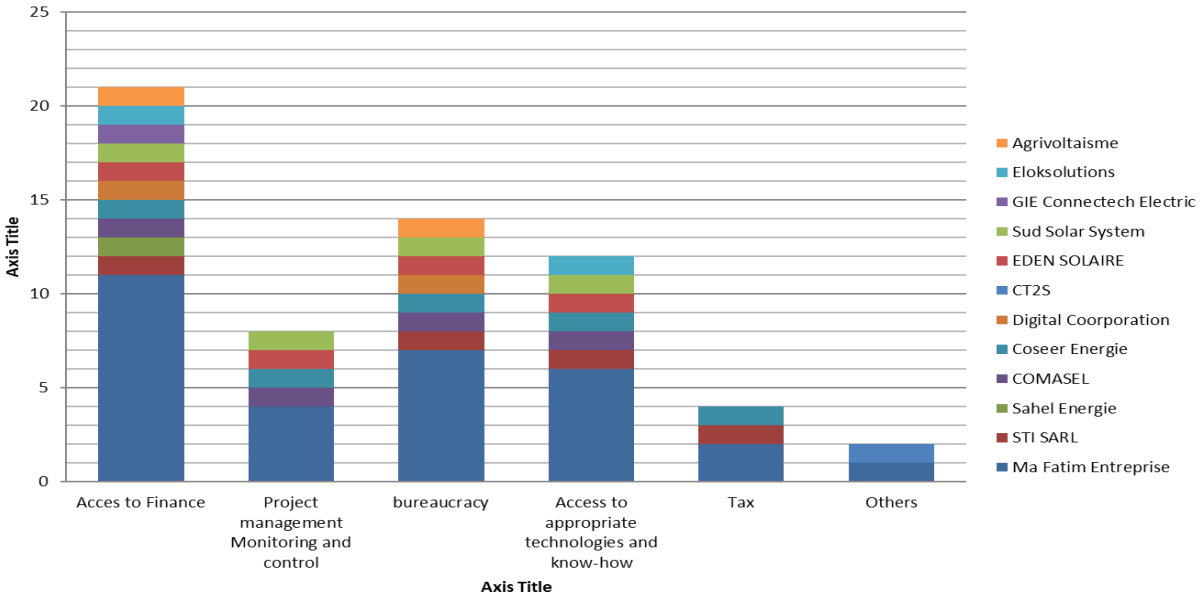



At the level of private operators, productive uses in general (water-energy-agriculture and solar roofing) represent 40% of the activities; followed by the off-grid electrification sector which is 29%. Advice and services represent 20% of activities.

### 7.4.3 The various challenges encountered

The graphs below explain the challenges encountered by concessions and ERILS in carrying out their activities.

Graph 10: challenges encountered by Concessions and ERILS holder

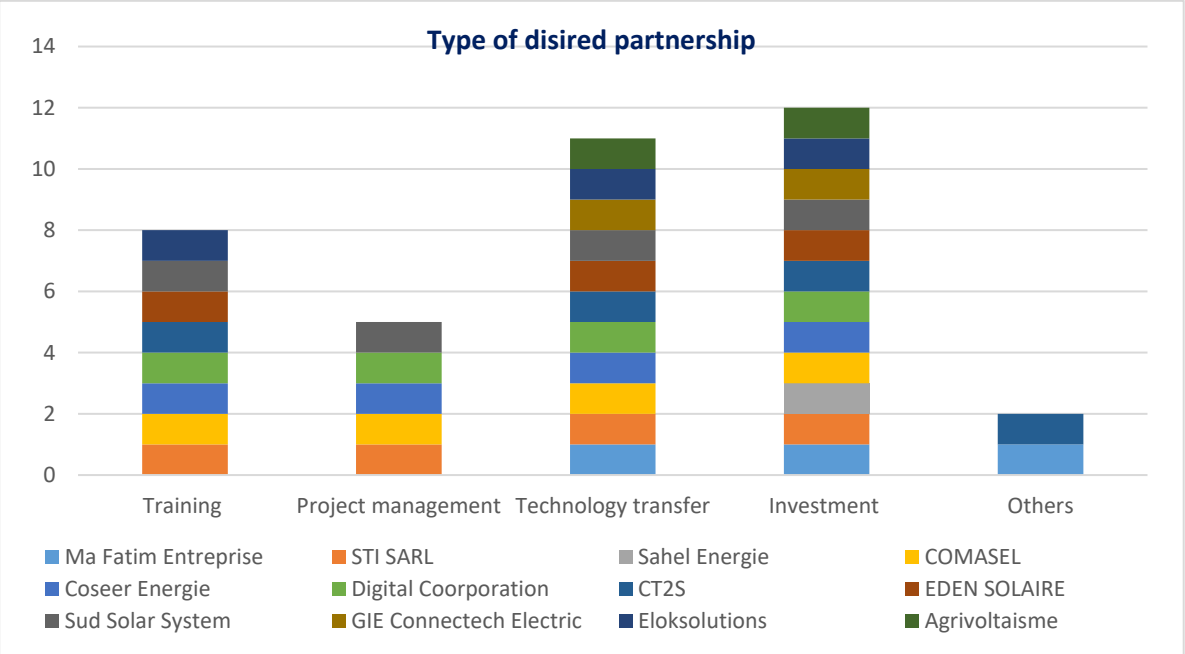


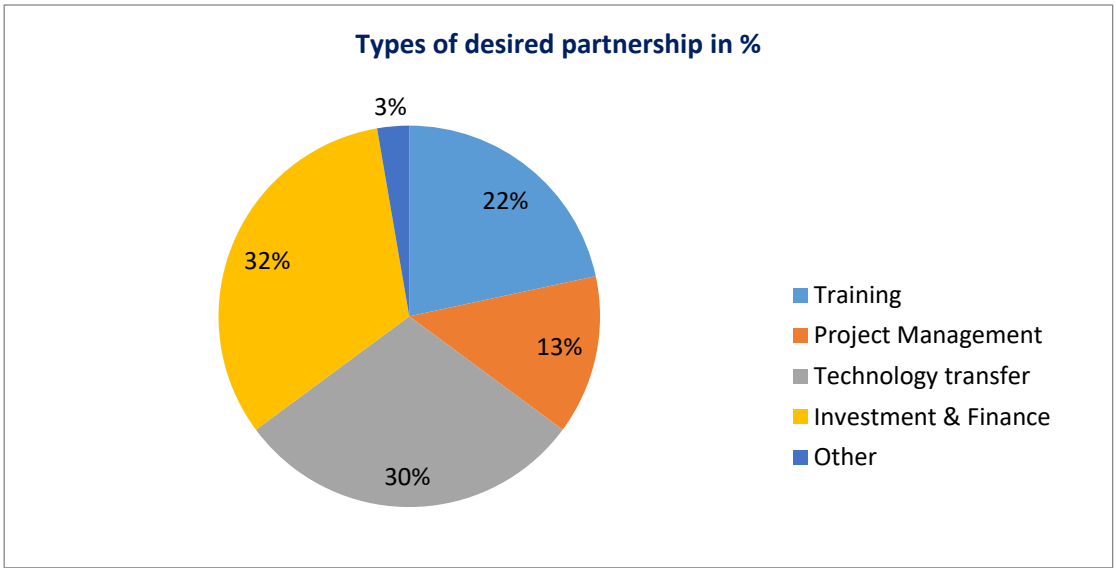

Access to Finance is the biggest challenges encountered by all the surveyed, followed by the bureaucracy. Access to appropriated technology is equally mentioned by many together with the need for capacity for management and monitoring project.

### 7.4.4 Type of desired partnerships

This graph points out to the types of partnerships the surveyed concessions and ERILS would like to develop with NL entities within the framework of this study.

Graph 11: Types of partnerships desired by Concessions and ERILS holders




About 32% of the surveyed requested investment and project financing; 28% for knowledge and technology transfer; 24% are seeking training/capacity building and 16% would like to development some relationship related to project management. Training and knowledge transfer relate to the familiarization with the technology (mainly solar mini grid) and specially the innovation that are on the market. Most of the interviewed companies expressed the need to upscale the skills of their technician and workers in the design, sizing, installation, operation and maintenance the solar systems

### 7.4.5 The specific expectations of Concessions and ERILS holders

In terms of specific expectations, the following needs were noted:

MY FATIM Companies would like:

- A partnership articulated through the representation of brand or innovative products;
- A joint venture to develop a project with added value;
- Participation in the financing of the development of the company in the renewable energy technology market to support agriculture and or the empowerment of women in rural areas.

SUD SOLAR SYSTEMS

- Training on new smart technologies associated with renewable energies, in particular "Pay as You Go" systems;
- Transfer of technology and know-how;
- Logistic support;
- Development and modernization of mini-grid and SHS;
- Research and development on energy efficiency and the lifespan of tubular lead acid batteries;
- Scientific, technical and financial partnership, training and transfer.

SOLAR EDEN:

- Biomass energy (converting of biomass to clean combustion) by Pyrolysis and Biogas for industrial application;
- Establishment of multifunctional platforms for sustainable energy solutions in artisanal fishing communities and in Agriculture;
- 100% solar solutions for cooling and air conditioning needs in the medical and residential sectors (self-consumption);
- Smart Energy Solutions to make Senegalese universities green and sustainable (Concept smart university).

AGRIVOLTAISM : a win-win partnership, namely a financial participation in the form of a subsidy and or loan for the start of a demonstration project of agrivoltaisme.

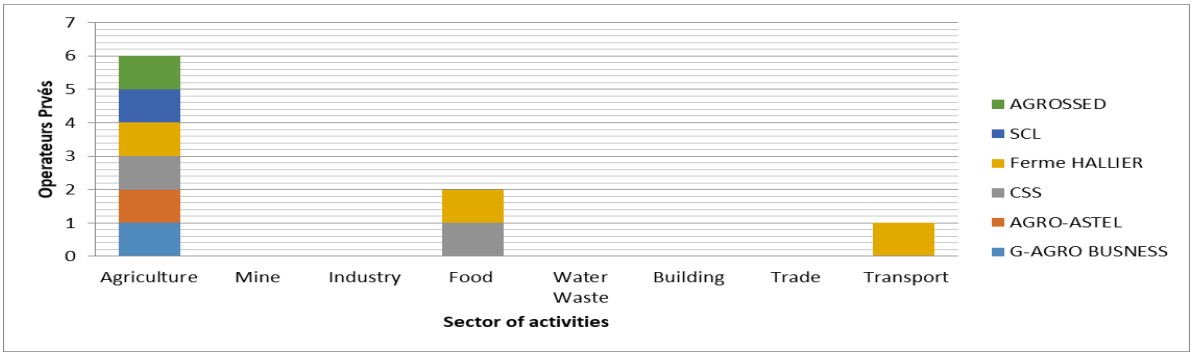
## 7.5 PRIVATE OPERATORS (POs)

Of the 57 POs surveyed, several preferred to send project sheets rather than answer the questionnaire; only six (6) responded to the survey form. These responses are discussed in the following paragraphs.

### 7.5.1 Business sectors

The graph below describes the different sectors of activity of the POs surveyed

Graph 12: sectors of activity of the surveyed private operators

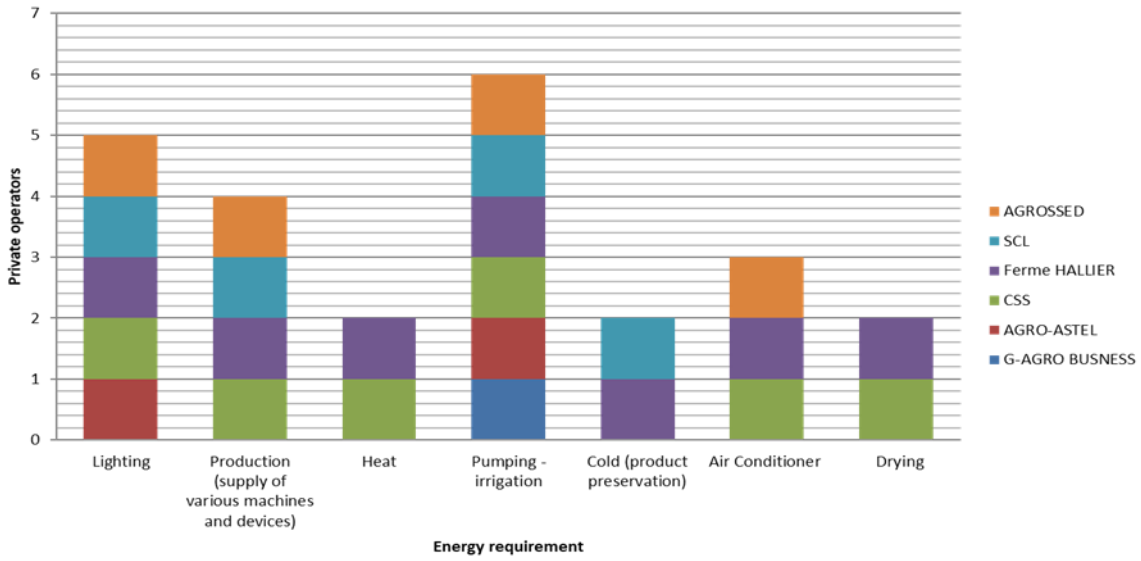



All six (6) private operators surveyed operate in the agriculture, forestry and fishing activity sector. CSS is also active in the food industry, while Ferme HALLIER is in the food industry.

### 7.5.2 Typology of PO energy needs

In the graph below, the energy needs of private operators are represented.

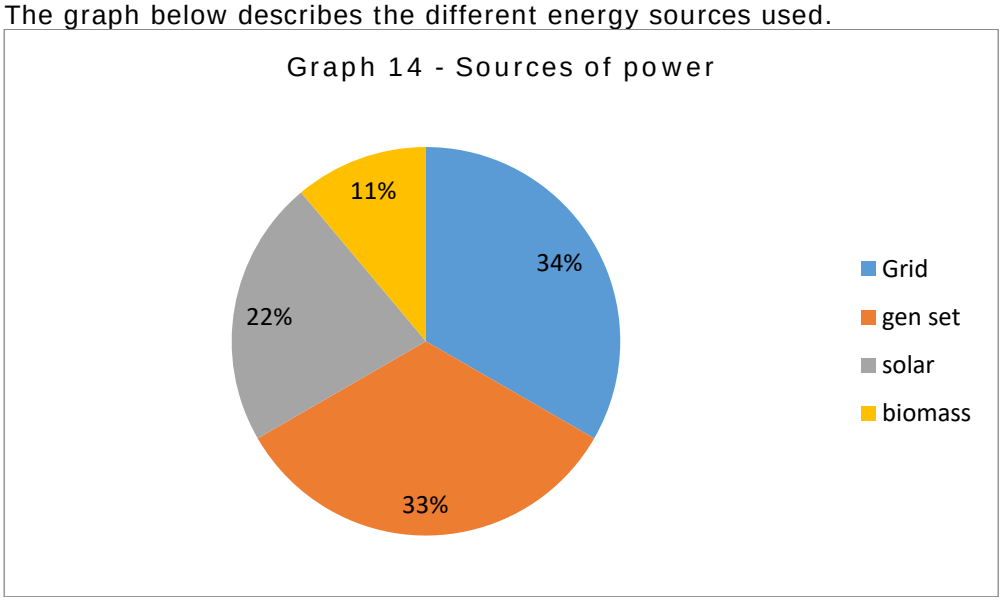
Graph 13: energy needs of private operators




The energy needs of private operators revolve around water pumping and irrigation as much of the surveyed operate in agriculture (horticulture) followed by need for lighting, processing of agriculture produce, air conditioning, drying and heat.

### 7.5.3 The energy sources used

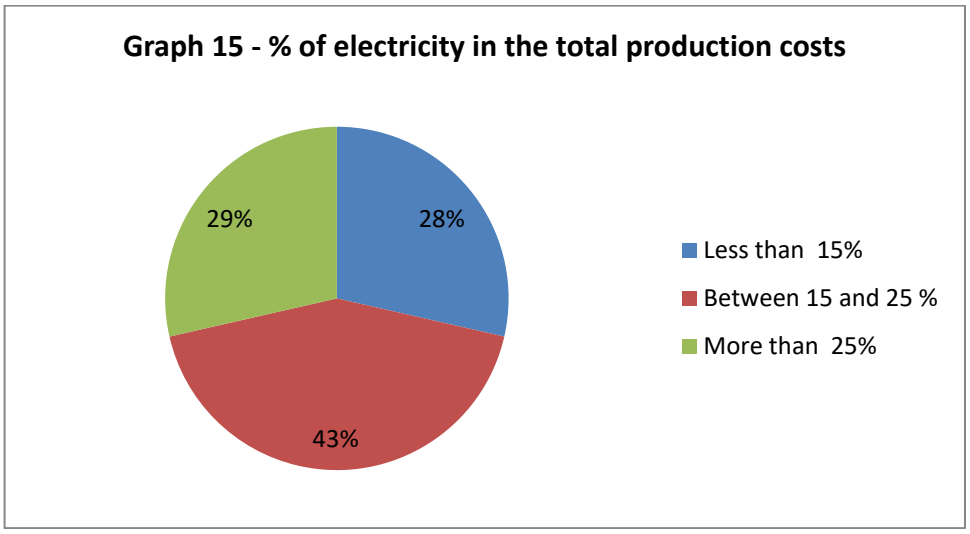
The graph below describes the different energy sources used.




Among the energy sources used by POs, 34% comes from the SENELEC network, 34% use small heavy fuel oil gen sets, 22% have an independent solar installation and 11% use Biomass.

### 7.5.4 The cost of electricity

The cost of electricity represents an important part of the production costs of Senegalese POs as illustrated in this graph.

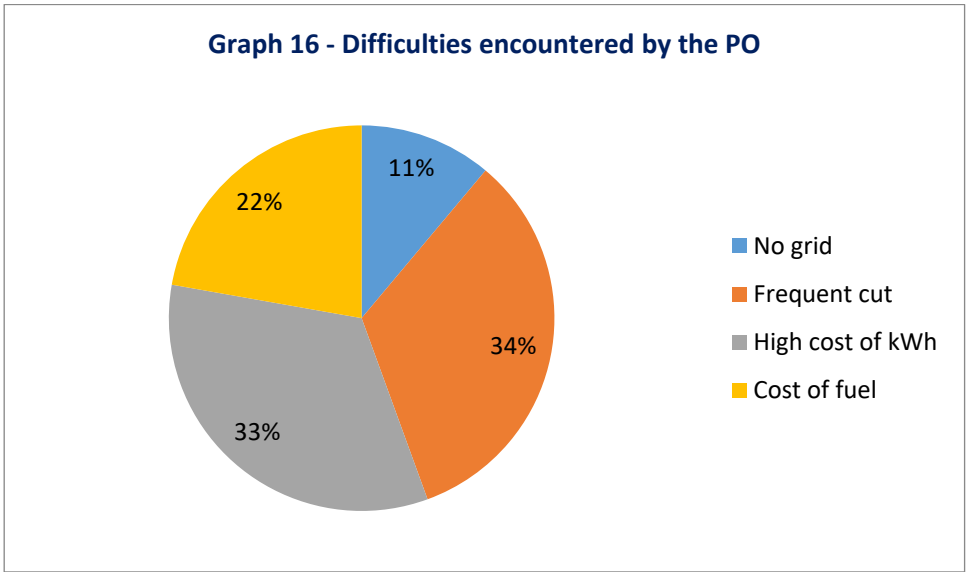



The cost of electricity represents between 15 and 20% for 43% of the surveyed, more and 25% for 29% of the sampling and less than 15% for 28 of interviewed private sector.

### 7.5.5 Difficulties in meeting energy needs

The graphs below describe the difficulties of the POs (private operators) surveyed to cover their energy needs. The first graph describes the types of difficulties per PO surveyed and the second graph describes the different difficulties in terms of percentage.

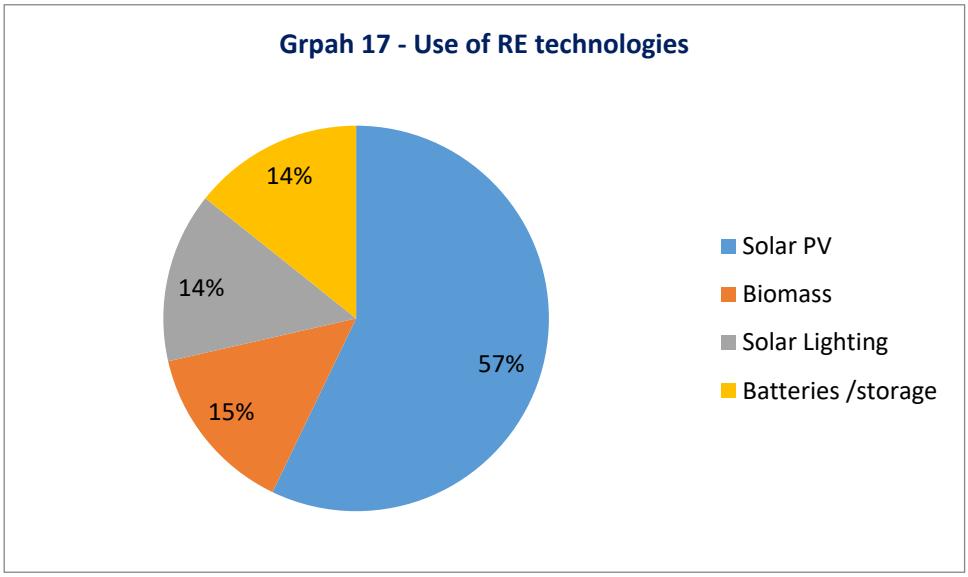
Graph 14: The difficulties encountered by private operators




34% of POs surveyed mentioned frequent cuts (network instability); 33% find it difficult to cover their energy needs due to the high cost; 22% of POs mention the cost of fuel to supply independent groups and 11% point to the lack of a network.

### 7.5.6 The use of renewable energies by POs

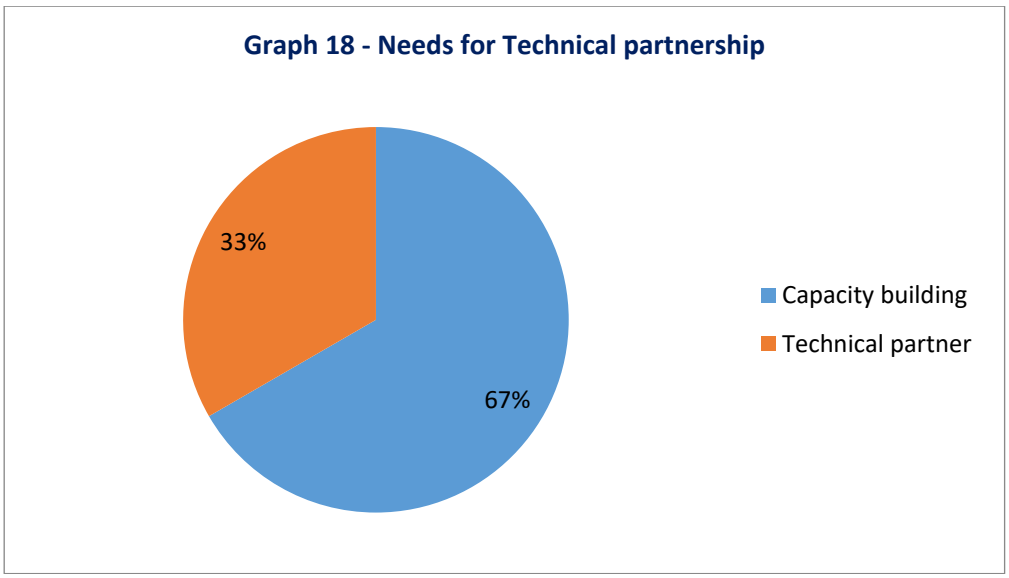
All the POs surveyed say they have set up projects or planning to use RE technologies.




About 57% of the surveyed private operators say they have set up photovoltaic solar projects (panels) and 15% of the projects are linked to biomass; 14% on independent solar lighting and storage batteries.

### 7.5.6 Renewable energy expertise needs

The six (6) respondents gave an unanimous answer, namely they need more expertise to undertake renewable energy projects.

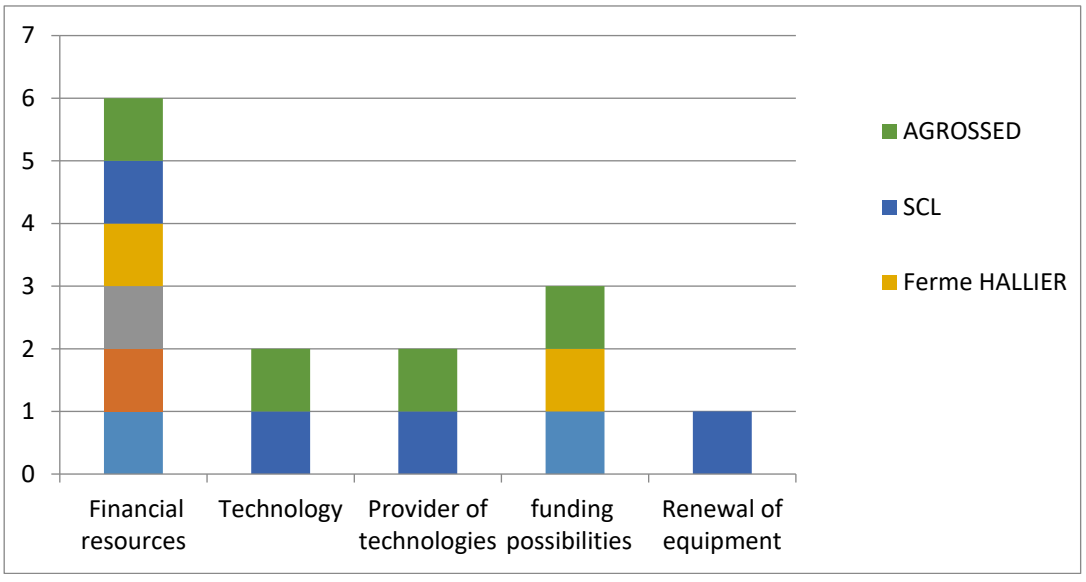



67% of the surveyed said they need training and supervision and 33% are looking for a technical partner. These entities are facing the need to uplift the technical and managerial expertise of their staffs in the subject of project design, conception, installation, operation, repair and maintenance.

### 7.5.7 Obstacles to planning a renewable energy project

Analysis of the data yielded the following observations.

Graph 19: Obstacles encountered by private operators

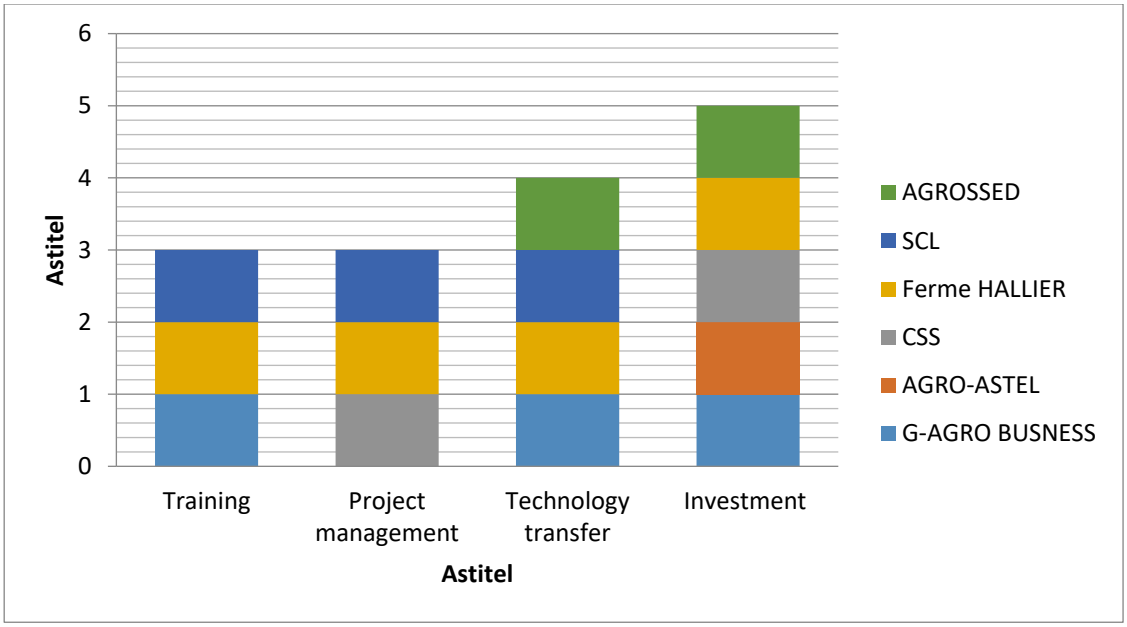


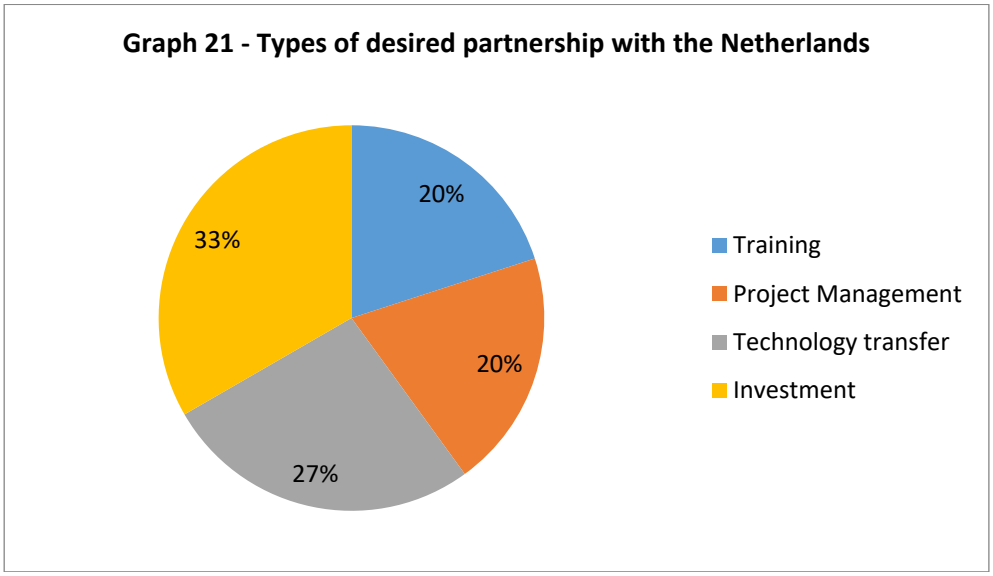

The obstacles that POs face in implementing renewable energy projects are mostly a lack of financial resources and familiarity with financial possibilities, but also a lack of knowledge about innovative technologies and the suppliers of these technologies.

### 7.5.8 The desired partnerships

The graphs below show the types of partnerships desired by the POs surveyed. For the first graph on the y-axis are the respondents and on the x-axis for each respondent the types of partnerships desired and for the second graph the distribution is given as a percentage.

Graph 20: Types of partnerships desired by private operators




As for the types of partnerships, investment and project financing are more in demand with 33% of respondents; followed by knowledge and technology transfer with 27%; Training and project management with 20% for each of the respondents.

# 8. ANALYSIS OF RECEIVED PROJECT SHEETS

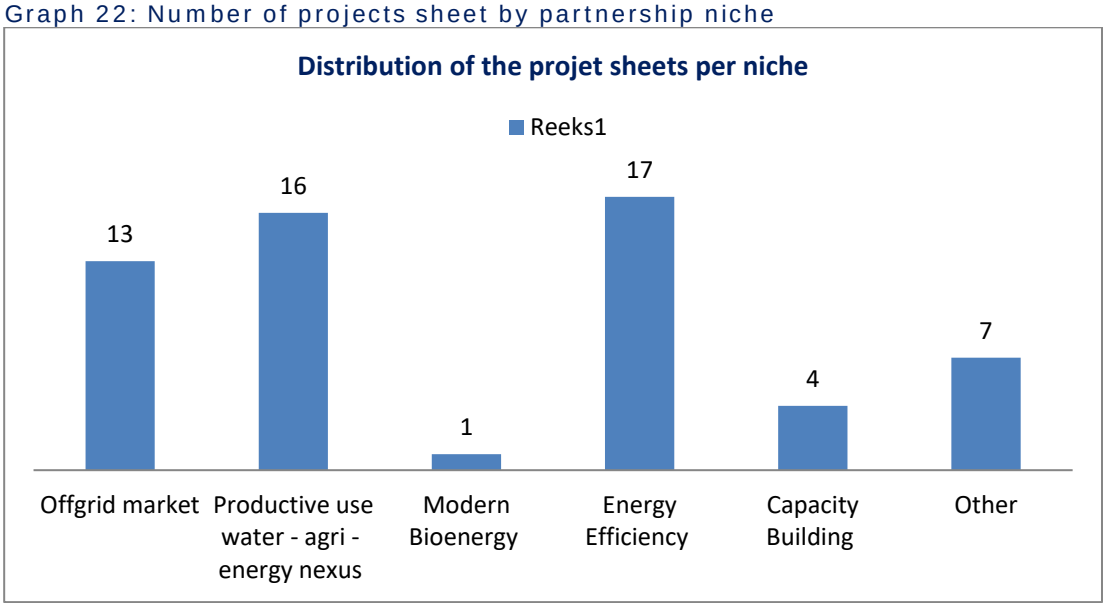
In the second phase of the renewable energy scoping study, virtual meetings were organized to present to the targeted organizations the possibilities of partnership with the support of the Embassy of the Netherlands in Senegal.

Subsequently, a project sheet template was sent to all organizations and fifty-seven (57) completed project sheets were collected. Thereafter a first global analysis of the results obtained was carried out, followed by a detailed analysis by actors.

## 8.1 ANALYSIS OF THE RESULTS OBTAINED

The graphs below describe the project sheets collected by Partnership niche for this study and for all the Institutions, Actors and NGOs; Concessions; ERILS and Private Operators.

Graph 22: Number of projects sheet by partnership niche




Thirteen (13) projects were collected on the off-grid and rural electrification market; fifteen (15) on productive uses, one (1) on modern bioenergy, seventeen (17) on energy efficiency and energy management, four (4) on technology and know-how transfers and seven (7) in niches other than renewable energies.

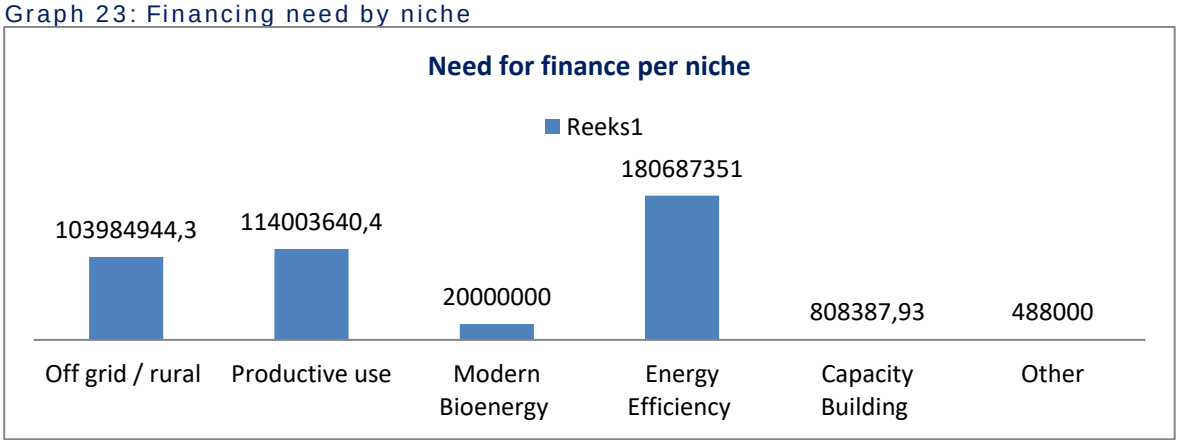
In terms of representativity per niche, 30% of the project sheets collected dealt with energy efficiency and energy management; 26% with productive uses and 23% with the off-grid and rural electrification market; 7% are related skills transfer and 2% with modern bioenergy; 12% of the received proposal did not relate to any of the sectors mentioned in the graph.

## 8.2 INVESTMENT NEEDS FOR THE IDENTIFIED PROJECTS

The total financing need identified from the project sheets collected as part of this study amounts to €419,893,660 or FCFA 275,030,347,712[13].

The graph below analyses the financing needs expressed by all the players by niche of partnerships selected.

Graph 23: Financing need by niche




- The financing need (FN) for energy efficiency is by far the most significant with €180 608 678.
- The FN for the off-grid and rural electrification market amount to €103,984,944.
- For productive uses the FN amounts to €114,003,944.
- The FN for modern bioenergy amount to €20,000,000.
- The Capacity Building niche totals a financing need of €808,387.
- The others amount to €488,000.

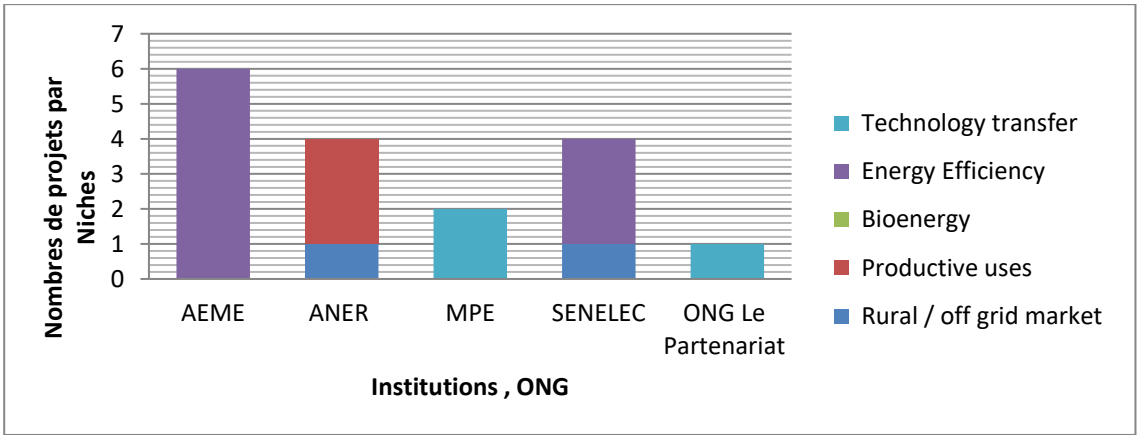
## 8.3 ANALYSIS OF RESULTS BY TYPE OF ACTORS

The different actors have submitted projects for the different niches. Below follows a detailed analysis.

### At the level of public institutions and NGOs

Institutions, actors and NGOs have submitted projects that are analysed in the graph below.

Graph 24: Projects collected by partnership niches for institutions and NGOs




[13] 1 Euro = 655 FCFA

- AEME has submitted six (6) projects concerning energy efficiency and energy management; ANER has submitted four (4) projects, three (3) on productive uses and one (1) on the off-grid and rural electrification market; the MEP has submitted two (2) projects on technology transfer.

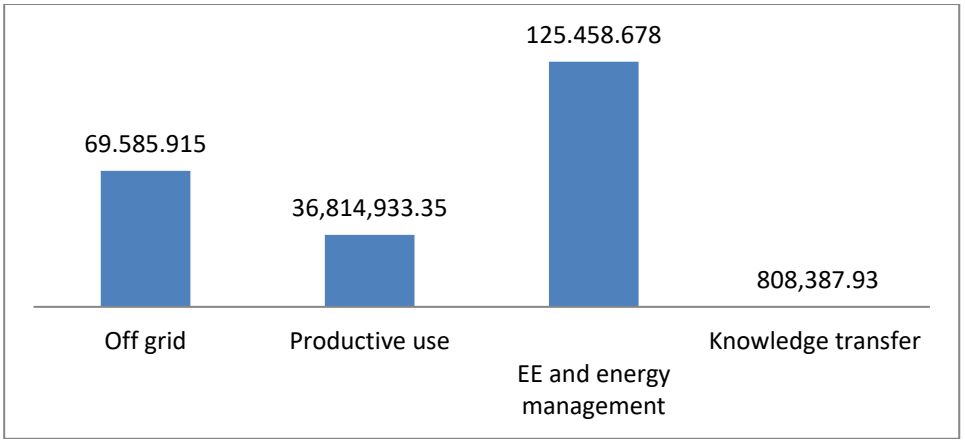
- SENELEC has submitted four (4) projects, three (3) on energy efficiency, including two (2) focused on training with the Professional Training and Development Center (CFPP) and one (1) project on the off-grid and rural electrification market.

- The NGO Le Partenariat submitted one (1) project on skills transfer.

### Financing needs of Public Institutions by Sector of activity

The graph below shows the financial needs for public institutions, Actors, NGOs by Partnership Niche.

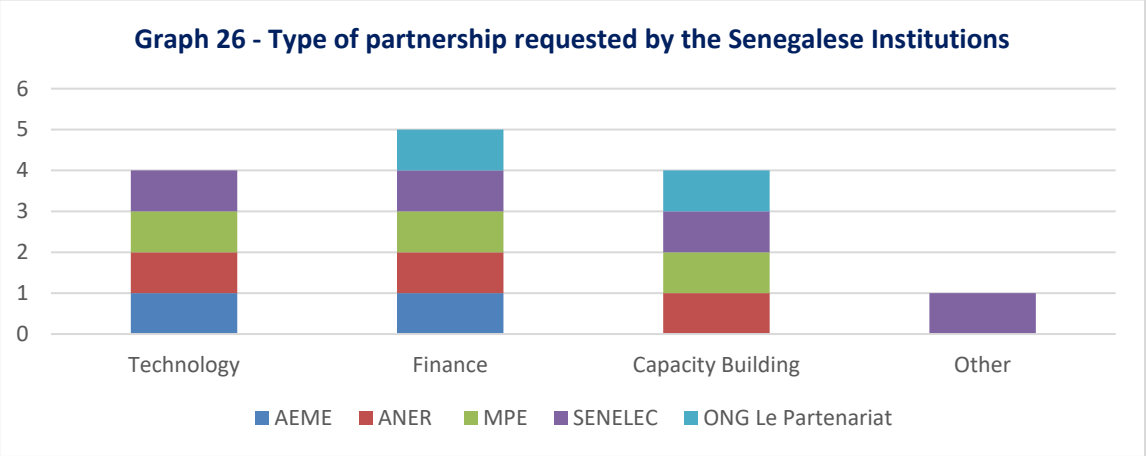
Graph 25: Funding needs by partnership niche of institutions and NGOs




- The financial need corresponding to the project sheets presented by the Institutions and NGOs in the off-grid and rural electrification market amount to €69,585,915;
- The financing requirement on the productive uses market amounts to €36,814,933;
- The financial needs expressed in the energy efficiency and energy management market amounts to €125,458,678;
- The financial need for capacity building is €808,387.

## 8.4 TYPES OF COLLABORATIONS ENVISIONED

The institutions and NGOs have specified the types of collaboration desired for each project submitted. They are summarized in the graph below.




The type of collaboration requested are mainly technical and financial; there are also training needs.

- AEME requests technical and financial collaboration for the projects submitted, as well as ANER and MPE, but who also want training;
- SENELEC wishes technical, financial and training collaboration but also collaboration specified in the following point.
- The NGO Le Partenariat wishes a financial partnership and training

Specific collaboration needs

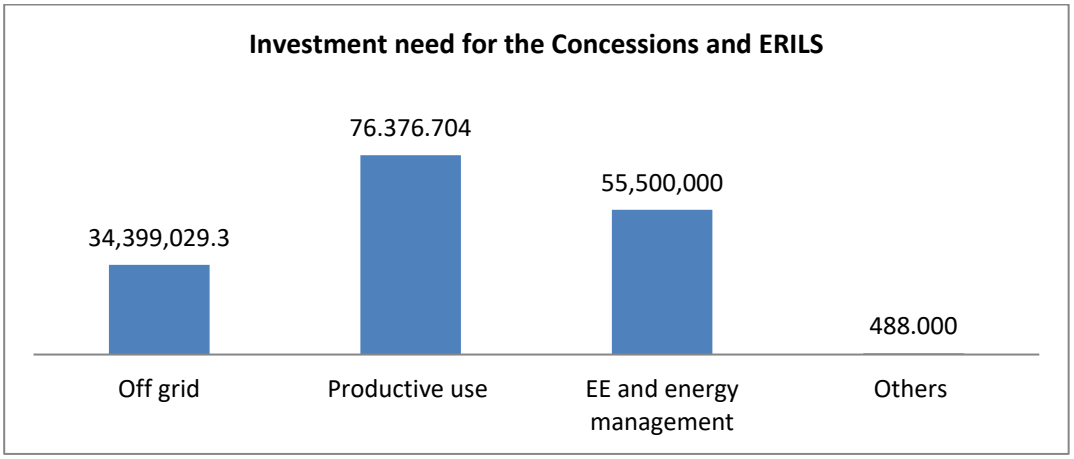
- develop tools and design training modules in the field of off-grid and rural electrification (Niche 1).
- develop training on solar pumping for the optimal water supply for the agriculture (Niche 2)
- develop training on the maintenance and performance monitoring of solar energy production facilities.
  The solar rooftop for health and education buildings in rural village, solar public lighting, refrigerated containers, solar mills will serve as practical applications for training (Niche 3).

## Concession and ERILS Holders

### Financing needs of Concessions and ERILS by Partnership Niche

The graph below describes the financial need of the Concessions and ERILS for each Niche of partnership.

Graph 27: Financing needs by partnership niche of concessionaires and ERILs




- The financing needs of concessionaires and ERILS on the off-grid and rural electrification market is €34,399,029;
- The needs for productive uses market are established at €76,376,704;
- The financing requirement on the bioenergy market is €20,000,000;
- The needs for energy efficiency (EE) are set at € 55,500,000;
- The other needs than those niches mentioned on the graph are € 488,000.

The types of collaborations specified

The concessionaires and ERILS have requested different types of partnerships through the projects they have submitted. Eden Solaire requested technical collaboration, training and another specified below; ERA Senegal requested a technical, financial and training partnership.

ERA SENEGAL wishes a partnership in the fields mentioned in the graph above but focused on:

- Satellite technologies (Earth observation, telecommunications and navigation)
- Social services activated by Internet (education, health);
- The manufacture of agri-food equipment (supply of equipment and support services);
- A technical training institute (electrical engineering, setting up of mini-networks, remote monitoring of equipment);
- Business development agencies (coordination of the national strategy combined with local development priorities, skills and training of rural entrepreneurs);
- Impact measurement, in particular carbon credits;
- Financial planning for operating the business model.

MY FATIM COMPANIES is interested in:

- A partnership articulated through the representation of brand or innovative products;
- A joint venture to develop a project with added value;
- Participation in financing the development of their business in the renewable energy sector, geared towards agriculture and / or the empowerment of working women in rural areas;

Sud Solar system would like, in addition, a partnership in social engineering.

EDEN SOLAIRE requested a grant to promote the climatic externalities of projects through green funds;

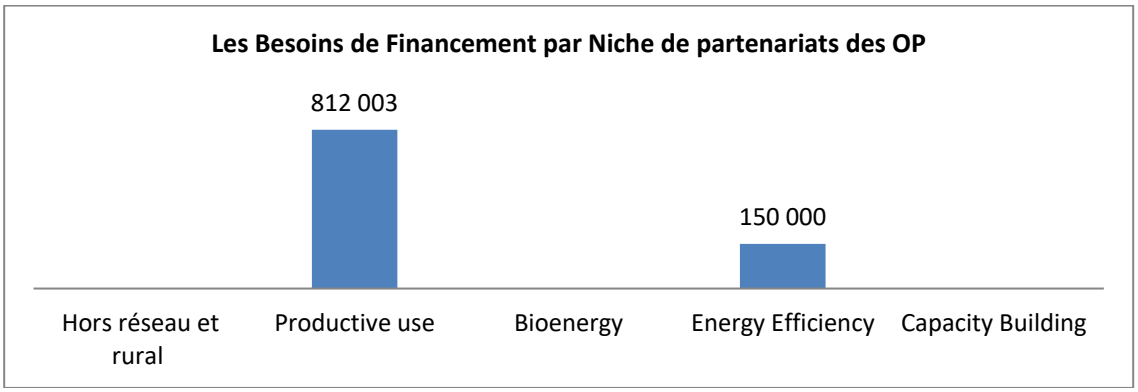
Solar Energy Senegal wishes to attract investors to increase its capital and long-term loans

## PRIVATE OPERATORS (PO)

### PO Niche financing needs

The graph below expresses the financing needs of POs by Niche of partnerships.

Graph 26: PO partnership financing needs by Niche

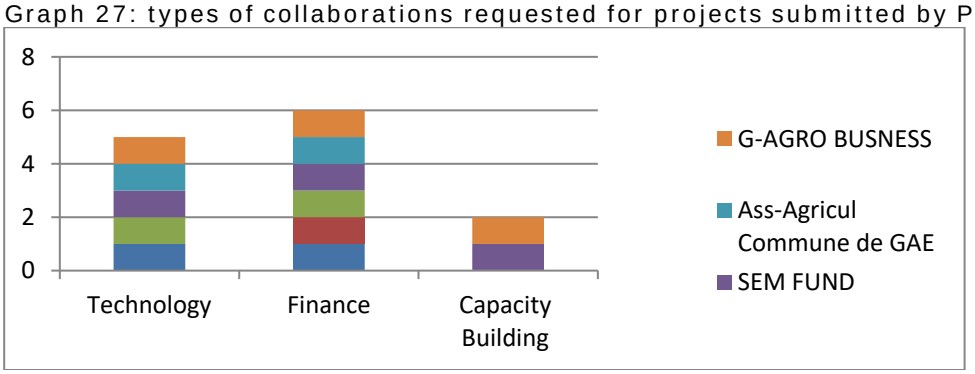



The identified financial needs for POs amount to €812,003 for the productive use projects and €150,000 for energy efficiency and energy management. It should be noted that the surveyed enterprises are mainly active in agriculture (horticulture) production.

### The types of collaboration requested by POs from the submitted projects

The graph below represents the private operators on the abscissa and the types of collaborations requested by the Private Operators for the projects submitted.

Graph 27: types of collaborations requested for projects submitted by POs




SEM FUND and G-AGRO BUSNESS have requested a technical, financial and training partnership; the HORTICULTURE Cluster requested a financial partnership. These companies are mainly based in the natural region called Les NIAYES, stretching from Saint Louis down south to Dakar and characterised by some type of Mediterranean climate. The Region is the centre of horticulture production of Senegal because of its soft climate and abundant underground waters.

# 9. POTENTIAL DUTCH INTEREST FOR PARTNERSHIP

## Introduction

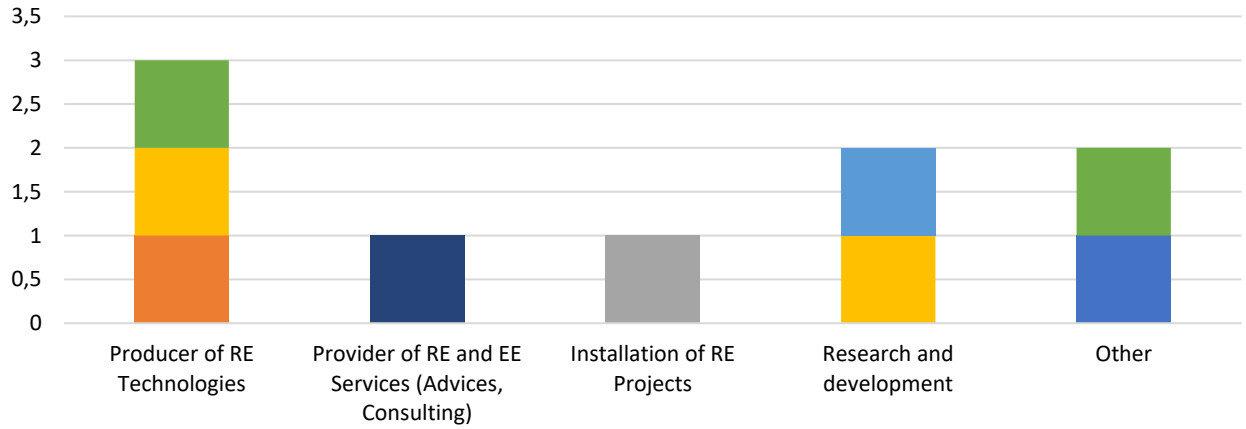
A long list of 40 NL private and public institutions were preidentified through different sources including personal contacts and internet search. A first round of contacts was initiated in July through sending a short questionnaire though email but it resulted to almost no answers because most of the email address were general mail (such as info@...,nl) due to the prevailing privacy law making the access to telephone numbers and personal emails more difficult. The holydays periods of July – August did also not help. Finally with the assistance of RVO, about 7 companies answered the questionnaire.

The result of the collected information is highlighted in this chapter to capture the various needs and constraints perceived by the Netherlands companies for entering the Senegalese EE and RE markets.

## What is your core business?

First, it was important to identify the profiles of companies that could be interested in the underlined market. The collected answers to these questions are presented in the figure below.

Graph 28 - The core business of the intitutions or compagnies surveyed



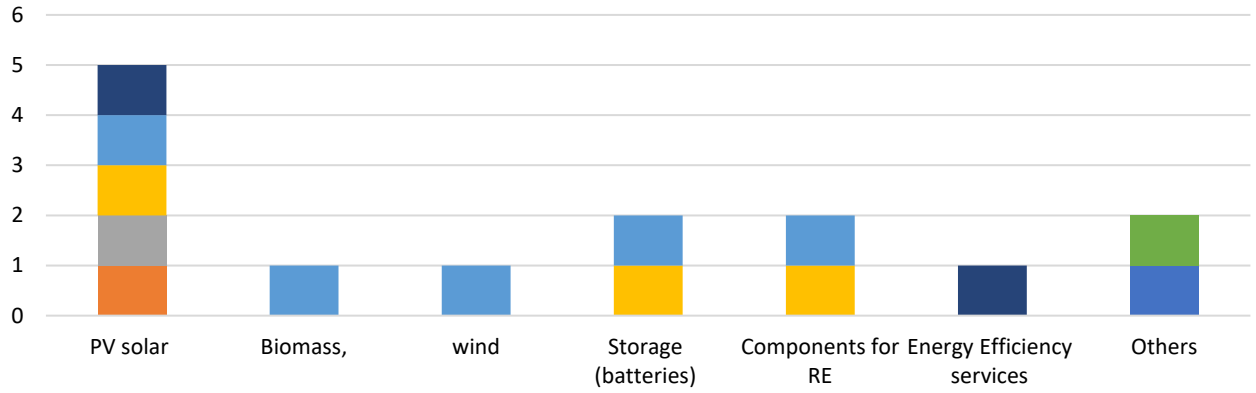

The main learning:

- Most of the interviewed companies are producers or providers of RE technologies.
- The second highest score was R&D's companies and institutions involved in policies development.
- Services providers (installation for instance) and consulting companies ranked third.
- Other include answers related to waste to energy; segment that is not included in the identified niches.

## What are your specialities?

This question aimed to capture the specifics technologies or services the interviewed companies are specialised in.

Graph 29 - The specialities of the institutions and compagnies surveyed



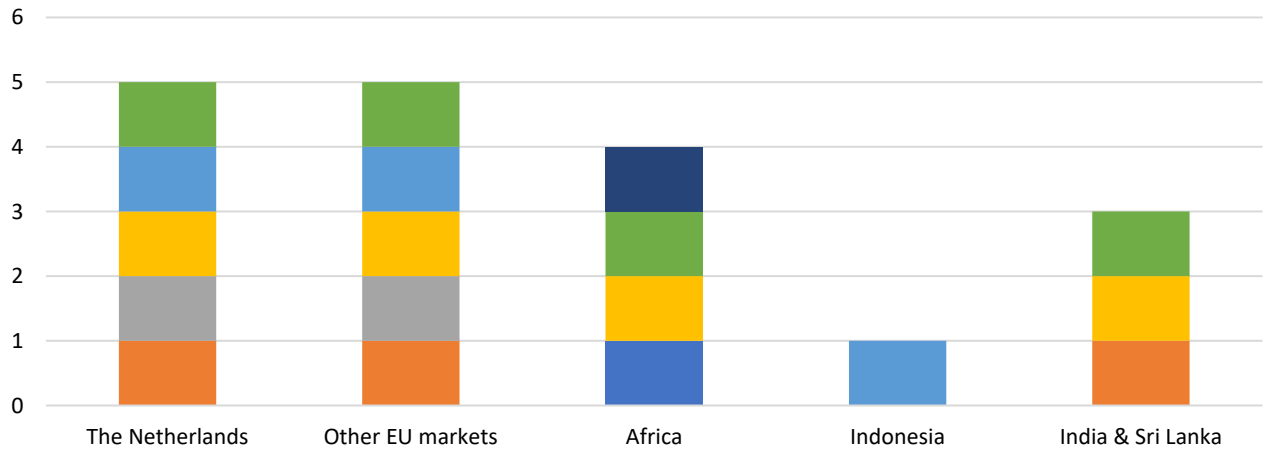

The learnings are presented as below:

- Over 70% of the interviewed companies are active in solar technologies and related services;
- Storage (Batteries) and Components for RE ranked second with 2 answers for each type of technology / services;
- Biomass, Wind and Energy efficiency accounted only for 1 response per technology;
- By others is meant waste to energy and circular economy.

## Which geographical markets are you already operating?

This question enabled to identify where (geographical areas) the interviewed companies are operating.

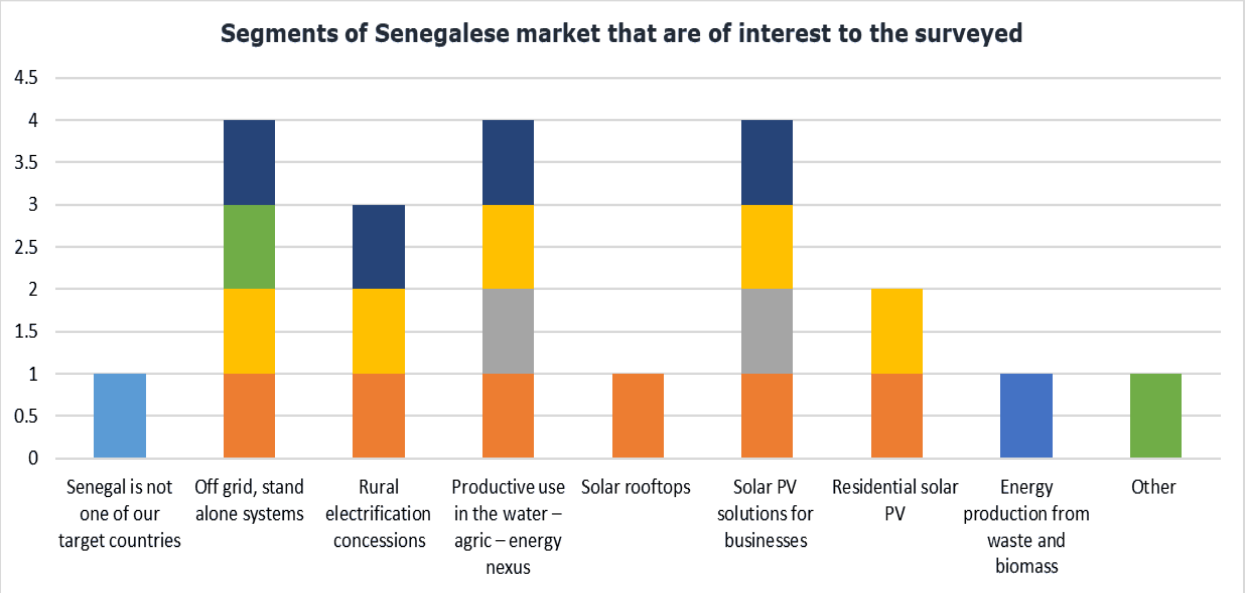
Graph 30 - The geographic market where the surveyed already operate




The geographical presence is presented below:

- 5 companies operate only in the NL or the EU.
- 4 companies are already operating in Afrique
- 3 companies are operating India/ Sri Lanka
- Only 1 company is active in Indonesia

## In which segment of Senegalese RE and EE market could you be interested?

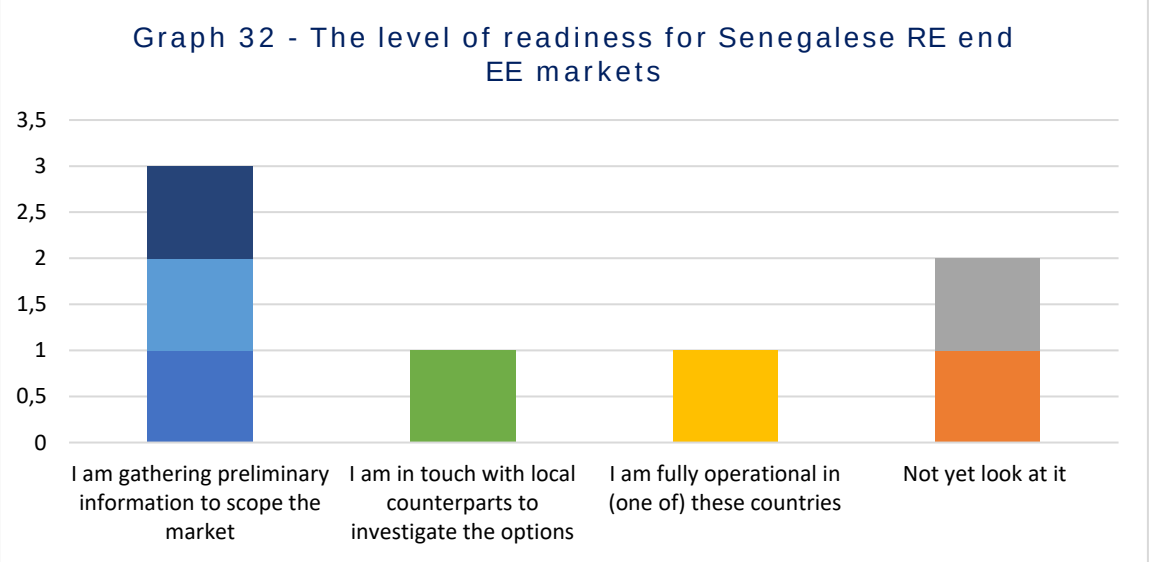



The following observations can be drawn from the collected answers:

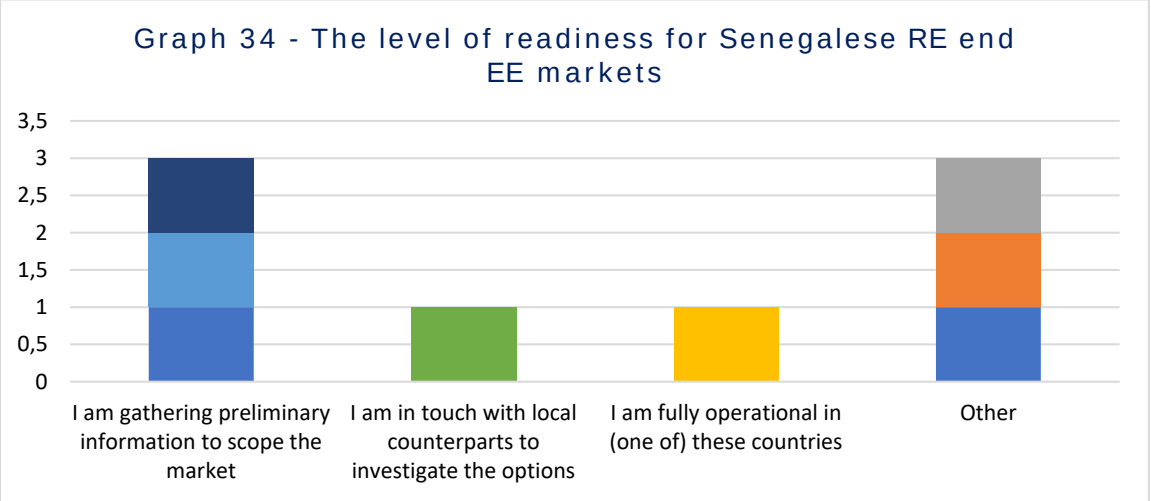
- About 88% of the surveyed companies are interested in the 3 segments related
  - Off grid,
  - Productive use in the water agriculture and energy nexus,
  - Solar PV solution for businesses,
- The Concession for rural electrification represents 66% of the shown interest,
- The Residential Solar PV market is credited for 44 % of the interest,
- Solar roofs tops, Waste to Energy, other (solar street lighting) and no interest represent each 1 answer.
-

What is your level of readiness for the Senegalese RE and EE market?

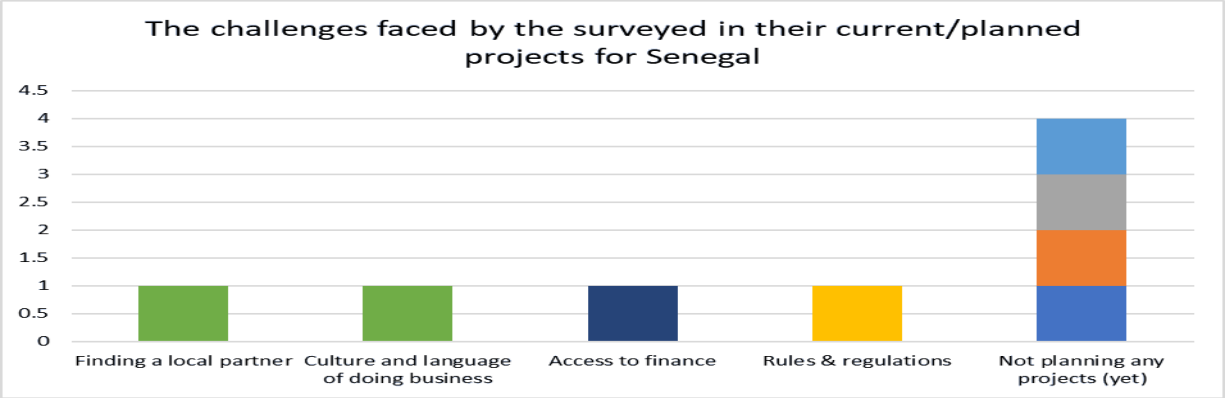
This question was intended to collect the current views and perception of the surveyed with regard their readiness for doing business in Senegal.




- 85% of the interviewed said they are gathering information to scope the market;
- About 30% are already in touch with local counterpart to investigate option;
- 30% are already operational in the Senegalese market;
- 60% declared to not yet have investigated this market.



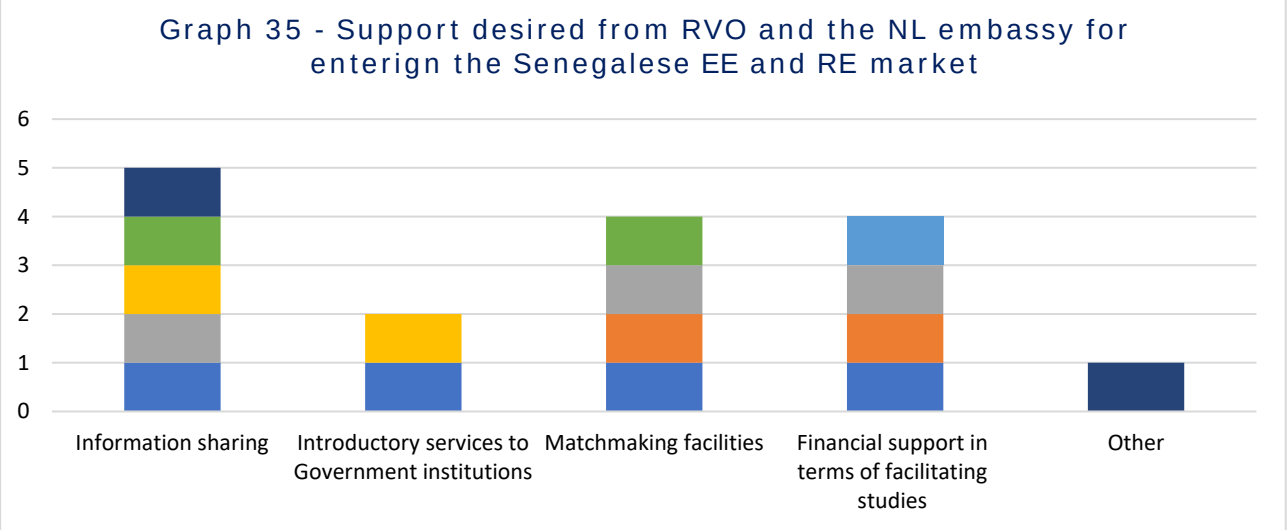

What challenges are you facing in your planned projects for Senegal ?




The answers are highlighted as follow:

- More than 88% of the surveyed said that they did not plan yet for Senegal;
- Finding a local partner: 20% of the answers;
- Culture, Language of doing business: 20%;
- Access to finance 20%;
- Rules and regulation: 20%.

How could RVO be of support for your activities and plan?




- 83% of the surveyed need more information on this market;
- 66% of the surveyed would like to benefit from a matchmaking facility approach;

- 66% of the surveyed would like to have some financial support for understating studies and market assessment;
- A 1/3rd of the surveyed are seeking for introductory services to Government institutions.

## Conclusion: contrasting results in terms of interest for partnerships

On one hand there is a massive interest from the Senegalese companies and institutions to partners with the Netherlands companies and institutions. This interest is reflected in the large number of partnerships leads (projects ideas) that were submitted amounting € 420 million.

On the other hand, little interest from the Netherlands private sector were collected while the same efforts as in Senegal has been deployed. The lack of interest from the Netherlands companies can be traced back to:

1. The lack of dedicated specific communication plan toward the Netherlands entities.
2. Lack of familiarity with the Senegalese market, where the use of French as official language can be perceived as a barrier as compared to East African countries.
3. The survey was carried out in the holyday's months of July and August where most activities are slowed down.
4. The growing solar market in the Netherlands implying that many companies are focused on the home market; more certain during these COVID pandemic times.

The main recommendations that can be made to balance the situation is to raise the interest of the Netherlands compagnies and position them to match the needs expressed from Senegal by implementing a dedicated communication plan.

# 10. PRESELECTED PROJECTS FROM SENEGAL

As discussed during the inception phase, 2 project's ideas were selected for each of the identified 3 niches. This chapter aims to highlight the most representative projects by selected niche as being the most promising in terms of maturity, possibility of effective implementation, socio-economic and environmental impacts. On each of the three selected niches, two project possibilities presenting the maturity of being supported by the Dutch cooperation (RVO and or Embassy) are presented.

The selection criteria were based on the level of readiness and likelihood of the project to meet the interest of the Netherlands institutions and companies. It also included the potential impacts in term of job creation, social and environmental benefits. Projects seeking to improve the horticulture sector, which is the privileged Netherland investment in Senegal, were somehow privileged. Also, the potential impact on gender equality was integrated in the selection process. The profile of the entities that requested the partnership were equally analysed although a certain level of risk should be tolerated given the potential innovation and impacts the project could leverage.

- The first selected project, with title "Realization of off grid solar installations for sustainable development and inclusive growth" aims to create about 200 businesses and 1,000 jobs through the productive use of solar energy while enabling safe access to electricity for 30,000 households with an investment of only €456,838. This project presents a high efficiency rate in term of job creation against the required investment cost.

- The second selected project, with the Title "Generation Smart Meter Assembly Plant" aims to reducing electricity bill by 60 % by integrating small solar powered electricity into the grid and higher efficiency of use of power. It aims also to increase the share of solar power in the grid at 40% while creating 25 jobs at the assembly plant and 1,500 indirect jobs (sales and maintenance). The investment is €485,967.

- The third selected project with the title "Diffusion of solar pumps for productive uses" aims to disseminate solar pumping and irrigation systems. It targets to disseminate 4,000 solar pumps as alternative for diesel to develop the agriculture sector, improve yields and create jobs. The project can be downscaled and implemented in smaller batches with several sources of finance.

- The fourth selected project with the Title "Solar cold storage for the preservation of horticultural products" aims to add value to horticulture produce and reduce post-harvest losses that can represent up to 40% of the harvested produces. This project will create many jobs in a sector representing already a good presence of Netherlands interest in Senegal.

- The fifth selected project with the title "Solar energy switch for public buildings" aims to switch the government owned buildings from the grid to independent solar solutions. It will enable more energy from the Grid to power the households and industry and reduce the cost of electricity for the Government. The project will be implemented by phases with the possibility of targeting different sources of finance.

- The sixth selected project with the Title "Improving energy efficiency in industry and the tertiary sector" aims to reduce electricity wastes and losses for the process industry and services and make more power available for other uses, reduce environmental impacts. The implementation of the project can be done per phase to suit the budget that will be made available.

Four of the six projects selected projects presented large budget, making it apparently hard to find partnership in the Netherlands. However, after discussion with the different promoters, it has been made clear that these 4 projects are scalable. It is possible to split them in different phases, making the budget more suitable for the Netherlands cooperation and private companies. In other words, rather 4000 solar pump which the total vision, one could start with 500 solar or lower. The same scalability applies to all the other 3 projects in this category; meaning the number of cold stores or buildings for improved energy efficiency.

As short presentation of the 6 selected projects are highlighted below.

### Rural and off-grid electrification market

## Project 1 - Development of small and medium-sized solar power plants equipped with hybrid technologies for remote and inaccessible villages

| | |
|---|---|
| Project title | Realization of off grid solar installations for sustainable development and inclusive growth |
| Developers | DIGITAL CORPORATION / COPERES |
| Amount of financing sought in Euro | € 456,838 |
| Main objective | Contribute to the creation of wealth and jobs through the deployment of autonomous solar systems |
| Specific objectives | • Improve rural, peri-urban and urban electrification by electrifying 30,000 households in 13 regions of Senegal;<br>• Ensure access to energy and water;<br>• Promote the creation of 200 businesses and 1,000 jobs for young people;<br>• Promote gender and lighten women's work. |
| Indicators and expected results (measurable and quantifiable) | ▪ 30,000 rural households have electricity for basic services (lighting, audio-visual, household appliances, agriculture, livestock, fishing);<br>▪ 200 SMEs / SMIs are created where 1,500 women work;<br>▪ 1,000 direct jobs for young people are created;<br>▪ 100 community infrastructures are electrified (schools, clinics, churches, mosques, youth centre, telecommunications, IT, commerce, etc.);<br>▪ 2,000 shops and businesses are electrified;<br>▪ 500 young technicians are trained in installation and maintenance of solar equipment;<br>▪ 5,000 women are initiated and trained in the use of solar energy and in household and income-generating activities<br>Localities 13 regions of Senegal: Diourbel, Fatick, Kaffrine, Kaolack, Kédougou, Kolda, Louga, Matam, Saint-Louis, Sédhiou, Tambacounda, Thiès and Ziguinchor<br><br>Target populations in urban areas: rural households, agricultural producers and industrial operators, women's groups, local communities, community infrastructure, State and public services, NGOs, local populations. |
| Potential interest of NL companies | ▪ Design of the system<br>▪ Supply of the technology: solar panel, inverters, batteries, etc<br>▪ Design and implementation of prepayments systems and remote supervision<br>▪ Training and supervision of work, etc |
| Funding possibilities from the Netherlands | ▪ Challenge Fund for youth employment |

| | |
|---|---|
| | ▪ DGGF- the financing of investments, exports or imports ( https://english.rvo.nl/subsidies-programmes/dutch-good-growth-fund-dggf gold https://www.dggf.nl/<br>▪ DHI - support for demonstration, feasibility studies and investment preparation (: https://english.rvo.nl/subsidies-programmes/dhi)<br>▪ Impact Cluster (PSD Toolkit) - a grant to expand the possibilities of developing PSD in a particular sub-sector or value chain.<br>▪ Business Partner Support - partner search ( https://english.rvo.nl/information/going-international/business-research-tools/business-partner-support)<br>▪ FMO (https://www.fmo.nl/),<br>▪ PUM (https://www.pum.nl/en)<br>▪ DECP (https://www.decp.nl/). |
| Risks analysis | ▪ The project is spread over vast territory including 13 Regions across Senegal. A pilot phase including only one Region would be recommended;<br>▪ The business model is not detailed on the project sheet nor the O&M modalities to ensure sustainability<br>▪ The ownership of the installation is not mentioned at this stage and the target group would be involved in the project. |

## Project 2 - 3rd Generation Smart Meter Assembly Plant

| | |
|---|---|
| Project title | 3rd Generation Smart Meter Assembly Plant. |
| Developers | Elok Solutions |
| Amount of financing sought in Euro | 485,967 Euros. |
| Main objective | Enabling the availability of electricity at a lower cost for SMe and households |
| Specific objectives | 1. Promote the energy mix with solar energy at home;<br>2. Promote a policy of energy saving control and the fight against Electrical Fraud by remote supervision of customers' electricity consumption;<br>3. Promote Electric Prepayment |
| Indicators and expected results (quantifiable) | • 60% reduction in electricity bills;<br>• Reduction of the government subsidy to the electricity sector to 100% within 5 years;<br>• Reduction of carbon emissions by 60% per year;<br>• Rational use of energy;<br>• Solar penetration rate of 20 to 40% within 5 years;<br>• Contribute to increasing the national electrification rate from 70 to 100% in 2035 (PSE reference).<br>• Reduction of 40,000 tonnes of CO2 emissions per year.<br>• Creation of 25 direct jobs for the assembly plant and 1,500 indirect jobs through rapid intervention centres and in the field of distribution and sales (in the 554 municipalities of SENEGAL). |
| Potential interest of NL companies | • Improvement of the designs<br>• Supply of the equipment and components for manufacturing of the meters<br>• Design and implementation of IT systems to manage the prepayments systems and remote supervision<br>• Training and supervision of work, |
| Funding possibilities from the Netherlands | ▪ DGGF - the financing of investments, exports or imports ( https://english.rvo.nl/subsidies-programmes/dutch-good-growth-fund-dggf gold https://www.dggf.nl/<br>▪ DHI - support for demonstration, feasibility studies and investment preparation (: https://english.rvo.nl/subsidies-programmes/dhi)<br>▪ Impact Cluster (PSD Toolkit) - a grant to expand the possibilities of developing PSD in a particular sub-sector or value chain.<br>▪ Starters International Business - issues vouchers for various activities ( https://english.rvo.nl/subsidies-programmes/sib<br>▪ Business Partner Support - partner search ( https://english.rvo.nl/information/going-international/business-research-tools/business-partner-support)<br>▪ FMO (https://www.fmo.nl/),<br>▪ PUM (https://www.pum.nl/en)<br>DECP (https://www.decp.nl/). |
| Risks analysis | ▪ This innovative and promising project is still a start up with the promoter having very little experience in managing a company;<br>▪ High competition with cheap Chinese made intelligent meters;<br>▪ A strong cooperation with the Utility and telephone providers will be needed to develop the market |

## Productive uses

## Project 3 - Diffusion of solar pumps for productive uses

| | |
|---|---|
| Project title | Diffusion of solar pumps for productive uses |
| Developer | ANER |
| Beneficiaries | Niayes Market Garden Unions Association (AUMN) |
| Amount of financing sought in Euro | €15,781,426.71 for 4000 solar pumps. This the project can be implemented by batches of 500 pumps requiring €1,972 665 per phase. Therefore, it is recommended to start a set of 500 pumps for roughly € 2 million investment and scale up the project with other follow up batches at a later stage. |
| Main objective | ▪ Develop institutional, technical and financial tools to support the installation of solar pumps in agriculture. |
| Specific objectives | ▪ Promote a more sustainable development of Senegalese agriculture through pumping and solar irrigation as a competitive alternative to diesel and gasoline. |
| Indicators and expected results (measurable and quantifiable) | ▪ Installation of 4,000 solar pumps<br>▪ Reduce operating costs<br>▪ Increase producers' incomes<br>▪ Set up a maintenance and servicing plan for the pumps for the sustainability of the installations<br>▪ Reduce greenhouse gas emissions |
| Potential interest of NL companies | ▪ Supply of the technology for water pumping and irrigation: solar panels, pumps, designs, drips systems, etc<br>▪ Training and supervision of work |
| Funding possibilities from the Netherlands | ▪ PSD Toolkit: a flexible budget managed by the NL Embassy to unlock certain opportunities.<br>▪ DRIVE: An instrument for financing infrastructures for the private sector under PPP scheme. (https://english.rvo.nl/subsidies-programmes/development-related-infrastructure-investment-vehicle-drive<br>▪ D2B: A financial instrument for the Government of Senegal for project preparation: https://english.rvo.nl/subsidies-programmes/develop2build-d2b. |
| Risks Analysis | ▪ The sustainability of the installations will require solid operation and maintenance strategies and practices to produce the expected long-term results.<br>▪ The roles of the beneficiaries and how they will be selected and capacitated is not clear at this stage. What would be their financial contribution to buy their full ownership.<br>▪ The cheap and non-labelled technology that is submerging the local market (mainly from China) should be avoided |

## Project 4 - Solar cold storage for the preservation of horticultural products

| | |
|---|---|
| Project title | Solar cold storage for the preservation of horticultural products |
| Developer | ANER |
| Beneficiaries | Niayes Market Garden Unions Association (AUMN) |
| Amount of financing sought in Euro | • €16,050,000 euros for the installation of 200 solar cold room.<br>• It is advisable to start by a bloc of 20 cold storerooms and scale up the project after few years of exploitation.<br>• The pilot phase (20 cold storage rooms) will require an investment of €1,605,000. |
| Main objective | Improvement of the income of market gardeners generated thanks to the availability of solar cooling technologies for the conservation of fruits and vegetables. |
| Specific objectives | • Increase the sales volume of local agricultural products;<br>• Reduce post-harvest losses which are around 40% on average in Senegal;<br>• Improve the cold chain and sanitary conditions for storing vegetables to create added value;<br>• Create the preconditions for the economic profitability of the system put in place in the long term. |
| Indicators and expected results (measurable and quantifiable) | • Development of technical and managerial capacities of beneficiaries;<br>• Installation of pilot phase of 20 solar cold rooms. |
| Potential interests for Netherlands companies | • Design of cold storage facilities<br>• Supply of technologies and equipment<br>• Supervision of work and training |
| Funding possibilities from the Netherlands | ▪ PSD Toolkit : a flexible budget managed by the NL Embassy to unlock certain opportunities.<br>▪ DRIVE: An instrument for financing infrastructures for the private sector under PPP scheme. (https://english.rvo.nl/subsidies-programmes/development-related-infrastructure-investment-vehicle-drive<br>• D2B: A financial instrument for the Government of Senegal for project preparation : https://english.rvo.nl/subsidies-programmes/develop2build-d2b. |
| Risks Analysis | ▪ The sustainability of the installations will require solid operation and maintenance strategies and practices to produce the expected long-term results.<br>▪ The roles of the beneficiaries and how they will be selected and capacitated is not clear at this stage. What would be their financial contribution to buy their full ownership.<br>• The ownership structure of the installation will need to be made clear |

## Energy Efficiency

## Project 5 – Solar Energy Switch For Public Buildings

| | |
|---|---|
| Project title | Solar Energy switch for Improvement for public buildings |
| Developers | National Agency for Renewable Energies (ANER)<br>Stakeholders: AEME / Ministry of Petroleum and Energy |
| Amount of financing sought in Euro | • €68,542,923 for the Government plans composed of several building<br>• It is recommended to start with few buildings and scale up the project with an initial budget of €5,000,000. |
| Main objective | The project consists of supplying electricity to public buildings from solar energy to guarantee the continuity of electricity and reduce their electricity bills. |
| Specific objectives | Reduce electricity bills for administration buildings,<br>• Relieve SENELEC to meet customer demand<br>• Diversify sources of energy production,<br>• Reduce imports of fossil fuels,<br>• Contribute to improving the security of supply of energy products,<br>• Contribute to the reduction of greenhouse gas emissions,<br>• Significantly reduce the electricity bills of targeted buildings |
| Indicators and expected results (measurable and quantifiable) | • The rate of reduction of energy expenditure in public buildings<br>• The rate of increase in the share of renewable energies in the energy mix<br>• The number of local jobs created for the maintenance of mini solar power plants<br>• The number of tonnes of CO2 avoided per year |
| Potential interest for Netherlands companies | • Project design per selected site<br>• Supply of expertise and training<br>• Supply of equipment |
| Funding possibilities from the Netherlands | ▪ PSD Toolkit : a flexible budget managed by the NL Embassy to unlock certain opportunities.<br>▪ DRIVE: An instrument for financing infrastructures for the private sector under PPP scheme. (https://english.rvo.nl/subsidies-programmes/development-related-infrastructure-investment-vehicle-drive<br>• D2B: A financial instrument for the Government of Senegal for project preparation: https://english.rvo.nl/subsidies-programmes/develop2build-d2b. |
| Risks Analysis | ▪ The sustainability of the installations will require solid operation and maintenance strategies and practices to produce the expected long-term results.<br>▪ The roles of the beneficiaries and how they will be selected and capacitated is not clear at this stage. What would be their financial contribution to buy their full ownership. |

## Project 6 - Improvement of energy efficiency in industry and the large tertiary sector by promoting the use of advanced technologies and systems, offering very high energy yields

| | |
|---|---|
| Project title | Improving energy efficiency in industry and the tertiary sector |
| Developers | AEME: Agency for the Economy and Control of Energy |
| Amount of financing sought in Euro | € 18,239,695 or FCFA 11,947 billion<br>€ 2,000,000 for the pilot phase |
| Main objective | Improve the energy efficiency of industrial installations and processes and the large tertiary sector Project Sub-objectives |
| Specific objectives | ▪ Carry out pilot energy efficiency programs in industries and the tertiary sector;<br>▪ Support industries to invest, based on successful examples, in energy efficiency - Set up an investment aid fund |
| Indicators and expected results (measurable and quantifiable) | Planned achievements:<br>▪ Installation of co and tri generation systems in ten industries;<br>▪ Installation of a cold storage system in a fishing industry; of GTC at the level of two large industrial sites; solar air conditioning at the level of a large industrial building; variable speed motor at an industry level; design of a 100% energy efficient building;<br>▪ Establishment of a system for measuring gains and monitoring / evaluation;<br>▪ Promotion of results and establishment of mechanisms for scaling up |
| Potential interest or role for Netherlands companies | ▪ Project design<br>▪ Training and transfer of knowledge<br>▪ Supply of energy efficient equipment<br>▪ Supervision of work |
| Funding possibilities from the Netherlands | ▪ PSD Toolkit: a flexible budget managed by the NL Embassy to unlock certain opportunities.<br>▪ DRIVE: An instrument for financing infrastructures for the private sector under PPP scheme. (https://english.rvo.nl/subsidies-programmes/development-related-infrastructure-investment-vehicle-drive<br>▪ D2B: A financial instrument for the Government of Senegal for project preparation: https://english.rvo.nl/subsidies-programmes/develop2build-d2b.<br>▪ DHI - support for demonstration, feasibility studies and investment preparation (: https://english.rvo.nl/subsidies-programmes/dhi)<br>▪ Impact Cluster (PSD Toolkit) - a grant to expand the possibilities of developing PSD in a particular sub-sector or value chain.<br>▪ FMO (https://www.fmo.nl/),<br>▪ PUM (https://www.pum.nl/en)<br>▪ DECP (https://www.decp.nl/). |
| Risks Analysis | ▪ The sustainability of the installations will require solid operation and maintenance strategies and practices to produce the expected long-term results.<br>▪ The roles of the beneficiaries and how they will be selected and capacitated is not clear at this stage. What would be their financial contribution to buy their full ownership. |

# 11. CONCLUSIONS

A dynamic electricity market

- The electricity market of Senegal is growing fast. The country is well on its way to reach universal access to electricity by 2025 as stipulated in the government plans. About €1 billion investment is needed to provide 100% to safe electricity by 2025. However, the bulk of the investment will be under the form of grid extension followed by off grid solutions (solar mini grid and standalone). The US, France, Germany, India, China and multilateral institutions are the main providers of finance and technology in the Senegalese the electrification market. The presence of the Netherlands in this market is quite timid and mostly embedded in the intervention of multilateral institutions such as the WB, EU and African Development Bank.
- The off-grid market of Senegal is dynamic with high perspectives as it will represent an appreciable share of the solutions envisioned by the Government to reach universal access to electricity by 2025. However, this market sector is not yet well regulated by the government. There is a need for an improved enabling environment by the removal of the restrictions and barriers that the private sector are facing to enter the market. The needed reforms include easing access to licence, lowering administrative procedures, providing fiscal incentive, adapting clear uniform technical standards, etc. Netherlands companies are not yet present in this market as compared to their stronger position in similar markets in East Africa.
- The portfolio of projects proposed to the Netherlands cooperation and private investors amount to € 400 million according to the collected projects fiches during the surveys performed during this study. Energy Efficiency has been the largest requests from the Senegalese side both in term of investment needs (€180 million) and number of project sheets received (17); followed by Productive Uses (€114 million for 15 projects) and Off Grid electrification (€104 for 13 projects).

Relevance of the selected niches

- Energy efficiency requests emanated mainly from Government institutions (AEME and ANER). Energy Efficiency policies, best practices and financing are highly needed for the reduction of losses during the transport of electricity, improved regulation for electrical appliance and machinery, construction (building) codes and standards, enhancement of industrial process. It seeks also to switch from electricity from grid (mainly thermal) to independent solar installations for the public buildings.
- Most of the requests from the private sector are related to productive use, more specifically in the horticulture sector. The needs for productive uses from renewable energy sources seems to be the most attractive segment for the Netherlands private sectors, specifically in the development of value chain of the agriculture and more precisely in the horticulture. Wind, solar and bioenergy solutions for water pumping and irrigation, cold storage, drying and various post-harvest technologies are all areas where the Netherlands companies have solid experience. The productive use segment will also strengthen the already existing Netherlands investments in the horticulture in Senegal.
- For the off-grid niche, the desired partnership related to access to Finance and Technology transfer. Most of the requests dealt with the development of mini grid for enabling access to electricity for remote villages.
- Most of the needs of the Senegalese private companies are related to access to finance for (33% of the requests), followed by technology transfer (27 %) while training and project management both represent 20%.

About the readiness of the Netherlands private sector

- The level of readiness of the Netherland institutions and private sector to enter the Senegalese RE and EEF market is very limited. About 80% of the surveyed companies have not yet considered investing in Senegal mainly by their lack of familiarity of this market.
- However, about 60% are willing to gather information to scope the market and requested the need for RVO to share information, organise matchmaking activities, arrange introduction services to relevant government institutions and provide financial support.

The place of the Netherlands in this market

- The Netherlands expertise is not suited for the very large-scale electrification projects, whether the concessions, the large IPPs or the development of the grid. Therefore, the study has investigated the niches matching the Netherlands identity in terms of expertise, interests and financial instruments to leverage partnership with the Senegalese entities.
- The identified niches relate to the off grid market, productive uses in the horticulture sector and energy efficiency. Theses niches match the traditional centre interest of the Netherlands cooperation and private sector in Senegal, especially in the development of the horticulture value chains.
- The most promising options for the Netherlands include solar or wind energy solutions for water pumping and irrigation, cold storage, solar drying and post-harvest processing and management.
- Finally, the wealth of experiences of the Netherlands in the Energy Efficiency segment could be exported to Senegal to help shape appropriate policies, best practices through knowledge transfer and project finance. The Netherlands could transfer its knowhow related to standards and labelling of appliance and machinery, energy efficient building codes, eco design, cleaner production in the industry and mining sector, improved mobility and transport by means of training, policy formulation and project finance.

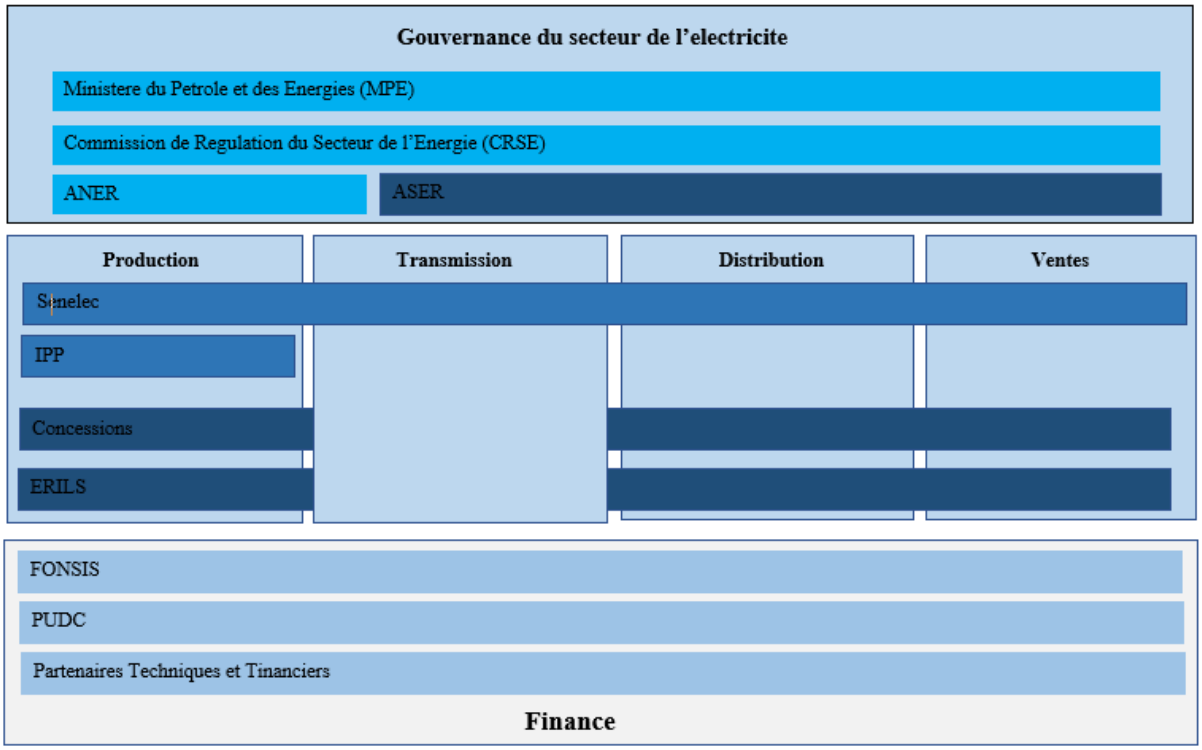
The way forward

Follow up for the pre-selected projects. The survey on the Senegalese public and private institutions enabled to collect about 57 project's ideas where partnership with the Netherlands is sought for. The portfolio includes various needs in terms of knowledge transfer, training, equipment and direct investments in renewable energy and energy efficiency. A screening and selection process enabled to select 6 projects that can be presented to the Netherlands private sector. The 6 projects represent 2 projects for each of the 3 niches.

Senelec concessions for rural electrification. The way forward would be to reach out to the EU Delegation in Dakar to be part of the consortium for financing these concessions under a blending instrument.

# ANNEXES

## Governance of the electricity sector




## Analysis of institutional actors and their attributions

The various public institutions and private companies in the electric power sector in Senegal are listed in the following table.

| | |
|---|---|
| Ministère du Pétrole et des Energies | •Le Ministère est chargé de formuler, de coordonner et de fixer des objectifs généraux, des politiques, des stratégies et des directives générales pour l'ensemble du secteur de l'énergie. Le Ministère élabore les politiques de promotion de la production d'électricité à partir de sources d'énergie renouvelables et joue un rôle clef dans la formulation de politiques et le suivi des décisions visant à promouvoir les applications décentralisées des énergies renouvelables, pour l'électrification hors réseau. |
| Commission de Régulation du Secteur de l'Électricité (CRSE) | •La CRSE est une autorité indépendante créée par la loi n° 98-29 du 14 avril 1998 relative au secteur de l'électricité. Le conseil d'administration de l'organisation est composé de trois membres, dont un président nommé par décret gouvernemental. L'octroi de licences, l'exploitation et la vente d'électricité sont réglementés par le CRSE, qui a également pour mandat d'approuver les tarifs de fourniture d'électricité, quelle que soit la taille de l'installation. Le CRSE définit les conditions tarifaires d'accès à l'électricité, qui constituent le cadre de référence pour l'harmonisation des tarifs, et assure l'application des dispositions contractuelles, en particulier celles relatives aux procédures de révision tarifaire périodique. Le CRSE est chargé d'assurer le développement rationnel de l'approvisionnement en électricité et l'équilibre économique et financier du secteur de l'électricité ; que la concurrence est réelle et équitable; préserver les conditions économiques nécessaires à la viabilité du secteur et aux intérêts des consommateurs. |
| Agence Sénégalaise de l'électrification rurale (ASER), | •L'agence gouvernementale en charge de l'électrification rurale. L'ASER a été créée en 1999 mais n'est devenue opérationnelle qu'en 2005. Il est financé par le gouvernement sénégalais et à l'international par les bailleurs de fonds. ASER s'occupe des concessions pour les zones rurales pour les investisseurs privés et finance 70% des projets. L'ASER s'appuie sur deux instruments principaux pour l'électrification rurale: l'attribution de concessions à grande échelle par le biais du Programme prioritaire d'électrification rurale (PPER) dans les villes et villages situés à proximité du réseau principal, où l'électrification est économiquement viable; et l'électrification rurale par l'initiative locale (ERIL) pour les communautés qui sont trop éloignées du réseau principal pour être connectées et où les responsables locaux expriment un besoin. L'approvisionnement en électricité urbaine est resté sous la responsabilité du SENELEC. |
| Agence Nationale des Énergies Renouvelables (ANER). | •Les missions de l'Agence Nationale pour les Energies Renouvelables (ANER) sont définies à l'article 2 du décret n°2013-684 du 17 Mai 2013 portant sa création, son organisation et son fonctionnement.<br>•Cet article stipule que l'ANER a pour mission de promouvoir l'utilisation des énergies renouvelables y compris la bioénergie, dans tous les secteurs d'activités. A ce titre, elle est chargée de :<br>•Réaliser des études prospectives et stratégiques pour le développement des énergies renouvelables ;<br>•Elaborer et exécuter des projets et programmes nationaux d'énergies renouvelables et d'assurer leur cohérence ; |
| Agence des économies et maîtrise de l'énergie (AEME). | •L'AEME, créée en juillet 2011, sert de bras opérationnel pour la mise en œuvre de la politique nationale de maitrise de l'énergie. Pour ce faire, elle s'appuie sur la promotion de l'efficacité énergétique, l'utilisation rationnelle de l'énergie et la diversification énergétique auprès de tous les consommateurs et pour tous les secteurs d'activités.<br>•L'AEME vise la réduction durable des consommations d'énergie nationale en mettant en place des bases solides avec une approche intégrée tenant compte des principales formes d'énergie utilisées que sont l'électricité, les combustibles domestiques et les produits pétroliers. |

| | |
|---|---|
| SENELEC | •La compagnie nationale d'électricité est une entreprise d'État, créée en 1983. La SENELEC est le concessionnaire du réseau de transport et de distribution au Sénégal ainsi que de l'achat et de la vente en gros d'électricité. La Senelec avait autrefois un monopole complet dans le secteur, mais plus pour l'électrification rurale depuis le transfert en 1999 à une agence dédiée à l'électrification rurale, créée sous le nom d'ASER (Agence Sénégalaise d'Électrification Rurale). La SENELEC a repris les 4 concessions du PPER non attribuées. |
| APIX | •L'Agence de Promotion des Investissements et Grands Travaux) : société à responsabilité limitée créée par le Gouvernement en 2000 pour promouvoir d'importants investissements dans les infrastructures. APIX prépare les documents d'appel d'offres, s'assure que le processus d'appel d'offres est mené de manière satisfaisante et transparente et assume la responsabilité de la gestion financière des projets. |
| PUDC | •Creee en 2016, le Programme d'urgence pour le développement communautaire (PUDC), pour mettre en œuvre le Plan Sénégal Émergent (Plan Sénégal Emergent). Le PUDC, avec l'appui technique du PNUD, contribue à la mise en place d'infrastructures et d'équipements socioéconomiques de base pour contribuer à l'amélioration durable des conditions de vie des populations des zones ciblées, en fournissant des services communautaires d'urgence (eau, forages hydrauliques, routes rurales et besoins en matériel de transformation agricole, santé, éducation, transport et services économiques, y compris l'électricité) à la population. Le PUDC représente un investissement de 113 milliards de francs CFA et prévoit l'électrification rurale de 325 villages. Il finance actuellement plusieurs projets d'électricité. |
| West Afican Power Pool (WAPP) | •Le WAPP assure un approvisionnement stable et fiable à des coûts d'électricité compétitifs dans la sous-région de l'Afrique de l'Ouest. Ainsi que la promotion et le développement des infrastructures de production et de transport de l'énergie électrique ainsi que la coordination des échanges d'énergie entre les différents États. |
| FONSIS | •FONSIS est le Fonds Souverain pour l'Investissement Stratégique (FONSIS), créé par la Loi 2012-34, promulguée le 31 décembre 2012. Avec cet instrument, l'Etat du Sénégal va augmenter ses investissements aux côtés du secteur privé. |
| FER | •Le Fonds d'électrification rurale (FER) créé par décret (n°2006-247 du 21 mars 2006. Cependant, le REF n'est pas totalement indépendant : la gestion des fonds est totalement intégrée dans la comptabilité ASER, et surtout, onze ans après sa création, elle n'a pas encore mis en place les instruments qui devraient accompagner les investissements privés. En particulier : un fonds de garantie, destiné à fournir une part du risque emprunteur aux banques à la demande des investisseurs privés, les encourageant ainsi à participer au financement du secteur de l'électrification rurale. |

Overview of the project portfolio in the energy sector

| Institutions | Funding | Financial partners | Projects | Sources and dates |
|---|---|---|---|---|
| MEPs | 21,713,000,000 F CFA | MCC | Improvement of the legal framework and capacity building of actors in the sector | VF-PP4 UFC-MCA-Senegal November 2017 |
| | US $ 29,000,000 | IDA | Institutional capacity building | VF_PP1, VF-PP2, VF-PP3, VF-PP4 UFC-MCA-Senegal November 2017 |
| | US $ 60,000,000 | World Bank | Improved governance and management of the energy sector | |
| | US $ 165,400,000 | AFD, BM, BID | Promotion of access to reliable, modern energy sources at reasonable cost | |
| | US $ 19,370,000 | GIZ | The Sustainable and Participatory Energy Management Project (PROGEDE II) | |
| SENELEC | 195,610,000,000 FCFA | MCC | Diversification of electricity production sources, fleet optimization and demand management | |
| | 124,500,000,000 CFA francs | MCC | Improving access to electricity in rural and peri-urban areas | |
| | 276,710,000,000 F CFA | MCC | Modernization and strengthening of networks | |
| | US $ 93,500,000 | World Bank | Energy sector support project | |
| | € 105,000,000 | AFD | The restructuring of Senelec and the production of electricity from a hydroelectric dam in Manantali | |
| | US $ 450,000 | USAID | Training and capacity building of Senelec on renewable energies | |
| | € 70,000,000 | KfW | Construction of a 15 MW solar power plant in Diass and a 2 MW hybrid power plant in the Saloum Islands | |
| | 5,000,000,000 CFA | JCA | Strengthening and rehabilitation of the energy transport network in the Dakar region | |
| | € 532,000,000 | OMVG | a) Sambangalou hydroelectric development<br>b) The hydroelectric development of Kaléta<br>c) The interconnection of the four national electricity grids | |
| | € 11,000,000 | AFD | Electricity production from a thermal power station (PROPARCO) | |
| | 18,000,000,000 CFA | LEKELA POWER, EKF | Construction of the Taïba Ndiaye wind power plant | |
| | 159,000,000 € | BM EU, EIB (Blending) | PASE II | Energy sector sheet EU August 2018 |
| | € 52,900,000 | EU, AFD (Blending) | Network modernization and ENR integration | Energy sector sheet - EU August 2018 |
| PN B | € 7,400,000 | EU | Support for SMEs / Biogas | Energy sector sheet - EU August 2018 |
| ARE | US $ 400,000 | EU | Electricity Code, and regulation of feed-in tariffs for ENERs | VF_PP1_Diversification-of production |
| AEME | US $ 100,000 | USAID | Communication campaign on energy | |

| | | | | |
|---|---|---|---|---|
| | | | efficiency | sources, fleet optimization and demand management UFC-MCA-Senegal November 2017 |
| ASER | US $ 450,000 | USAID | Management of the rural electrification program | |
| | € 6,400,000 | EU | PRODAPES | EU energy sector sheet August 2018 |
| | € 8,000,000 | EU | Electrification of development centers | EU energy sector sheet August 2018 |
| ECREEE | € 6,400,000 | EU | Sustainable development project by ENR | EU energy sector sheet August 2018 |
| ENDA Energy | € 5,200,000 | EU | PROGRES - milk | EU energy sector sheet August 2018 |
| City of Dakar | 700,000 € | EU | Territorial Climate Energy Plan (PCT) | EU energy sector sheet August 2018 |
| Town of Pikine | € 800,000 | EU | Energy climate change plan | Energy sector sheet EU August 2018 |
| Total financing in the sector (2012 - 2018): 1,284,481,600 EURO | | | | |

## PSE II energy project portfolio

The project portfolio provided for in the second phase of the PSE consists of 30 projects whose cost is estimated at 1,175,459,000,000 FCFA or 1,794,590,000 EURO. This portfolio as presented in the following table is largely dominated by the projects planned under the MCC and the Sambangalou dam.

| | DESCRIPTION | COST (million FCFA) |
|---|---|---|
| 1 | Second Compact MC Senegal / energy | 318,000 |
| 2 | OMVG energy project (Sambangalou dam) | 154,648 |
| 3 | Electricity sector support project (phase 1 and 2) | 88,446 |
| 4 | Electrification project of 300 villages | 78,700 |
| 5 | Construction project for the 225 kv Kolda - Tamba - Ziguinchor line | 73.210 |
| 6 | Electricity interconnection project between Senegal and Mauritania | 68.764 |
| 7 | Gouina hydroelectric development | 65,000 |
| 8 | OMVS electricity grid reinforcement and extension project (Manantali 2) | 58,395 |
| 9 | Electricity supply project for the city of Dakar (225 kv Kounoune-patte d'oie 30 km and Kaolack-Mbour links) | 48,493 |
| 10 | National Emergency Rural Electrification Program | 46,000 |

| | | |
|---|---|---|
| 11 | Senelec's electricity network strengthening and modernization project in support of the development of renewable energies and access to energy | 27,122 |
| 12 | Electricity Access Support Project (PAMACEL) | 23.825 |
| 13 | Project to promote energy efficiency and access to energy | 23,668 |
| 14 | Electrification project of 177 villages by mini solar photovoltaic plants | 22,668 |
| 15 | Densification of the region's electricity network in Dakar | 11.510 |
| 16 | Project to set up a photovoltaic power plant interconnected to the integrated special economic zone of Dakar | 8.510 |
| 17 | Solar rural electrification project | 6.801 |
| 18 | Rural electrification support project in Casamance (EU / BEI) | 6.700 |
| 19 | National biogas program | 6.542 |
| 20 | Rural electrification project: Matam - Ranérou- Goudiry | 5.378 |
| 21 | Solar energy empowerment program for infrastructure and public buildings (police stations, customs posts and gendarmeries) | 3,000 |
| 22 | Sustainable energy program / GiZ | 2,300 |
| 23 | Regional PROGEDE: management component of the domestic energy sector and fuelwood uses | 2,300 |
| 24 | Succeed Senegal / GiZ program | 2,200 |
| 25 | Rural electrification project of 218 villages | 2.061 |
| 26 | Coverage of energy supply for events | 1,800 |
| 27 | ORiO solaristion health infrastructure program | 1,660 |
| 28 | Project to build 53,000 indoor installations in rural areas | 1,600 |
| 29 | Sustainable energy program | 1.158 |
| 20 | Electrification project of 500 villages by mini solar grid | 15,000 |
| | TOTAL | 1,175,459 |

Sources: Presentation of the PSE, Paris December 2018

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Netherlands Enterprise Agency
Prinses Beatrixlaan 2
PO Box 93144 | 2509 AC The Hague
T +31 (0) 88 042 42 42
Contact us
www.rvo.nl

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