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The energy policy of the Republic of Senegal

Evaluation and Perspectives

Auteur : Ahmadou Saïd BA

23/01/2018

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2 ACRONYMS AND ABBREVIATIONS

HDI	Human Development Index
GII	Gender Inequality Index
GDP	Growth Domestic Product
SMEs	Small and Medium Enterprises
FDI	Foreign Direct Investment
PSE, ESP	Plan Sénégal Emergent, Emerging Senegal Plan
LDPSE	Lettre de Politique de Développement du Secteur de l’Energie
NICT	New Information and Communication Technologies
SONATEL	Société Nationale des Télécommunications
SENELEC	Société Nationale d’Electricité
WCR	Working Capital Requirement
PETROSEN	Société des Pétroles du Sénégal
COS-PETROGAZ	Comité d’Orientation Stratégique du Pétrole et du Gaz
GES-PETROGAZ	Gestion Exécutive et Stratégique du Pétrole et du Gaz
ERIL	Electrification Rurale d’Initiative Locale
PPP	Public Private Partnership
PSCs	Production Sharing Contracts
JOAs	Joint Operating Agreements
IPPs	Independent Power Producers
ESL	Energy Saving Lamps
IEPF	Institut de l’Energie et de l’Environnement de la Francophonie
MDE	Maîtrise de la Demande de l’Energie
SAR	Société Africaine de Raffinage
LV, MV, HV	Low Voltage, Medium Voltage, High Voltage
ECOWAS	Economic Community of the West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
UEMOA	Union Monétaire Ouest Africaine
WAPP	West African Power Pool the specialized agency of ECOWAS
OMVS	Organisation pour la Mise en Valeur du Fleuve Sénégal
OMVG	Organisation pour la Mise en Valeur du Fleuve Gambie
PROGEDE	Programme de Gestion Participative et Durable des Energies Traditionnelles et de Substitution
PERACOD	Programme pour la Promotion des Energies Renouvelables, de l’Electrification Rurale et de l’Approvisionnement Durable en Combustibles Domestiques
ASER	Agence Sénégalaise d’Electrification Rurale
PASER	Plan d’Actions Sénégalais d’Electrification Rurale
PANEE	Plan d’Actions National pour l’Efficacité Energétique
ANER	Agence Nationale des Energies Renouvelables
AEME	Agence pour l’Economie et la Maîtrise de l’Energie
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
GTL	Gas -To-Liquid
CCG	Combined Cycle Gas
MRV	Measurement, Reporting and Verification
Tcf	Trillion cubic feet
MMBbl	Million barrels
SOP	Start-Of-Production
REs	Renewable Energies

3 INTRODUCTION

Senegal is a developing country which, moreover, does not have significant natural resources, and which is located in the Sahel zone of the African continent. It is therefore a country which is not, so to speak, spoiled by nature.

Despite this state of facts, this country has been able to build and consolidate, since its accession to independence in 1960, a nation, as well as a stable and democratic state of law. It has not been subject to civil war or violent political conflict and has been resilient to all the droughts in the region, avoiding any humanitarian catastrophe.

At the economic level, it has also been able to adapt to the major crises of the second half of the 20th century, but also to the hard periods of structural adjustment, imposed by the IMF and which lasted about twenty years, as well as the devaluation of the CFA franc, whose value was halved in 1994. Since the beginning of the 2000s, the country has grown at an average rate of over 3% / year¹. Since 2014, average GDP growth has been above 6.5% / year with a stable outlook until 2022 according to the IMF.

In 2014, Senegal adopted an accelerated economic development plan called the “Plan Sénégal Emergent” (PSE), or Emerging Senegal Plan (ESP), which rightly relies on the development of the energy sector, among others. The country's energy policy has therefore been revised, in agreement with the ESP, to define a clear vision, with specific objectives and a well-developed strategy.

However, its energy consumption was only 0.27 toe, including 230 kWh of electricity², and generated 0.54 tCO₂ per capita in 2016³. These figures are obviously low and symptomatic of a low-energy economy, characteristic of a developing country. Nevertheless, Senegal's energy consumption has been growing rapidly at + 3.6% / year on average⁴, since 2000, due to the combined effects of economic and demographic growths. In addition, significant offshore oil and gas reserves have recently been discovered in the country, which first production is expected to start in 2021.

All of these elements raise a fundamental question: how can a developing country like Senegal, deprived of natural resources since always, succeed in supporting its economic emergence through an ambitious and low-emission energy policy while exploiting its new oil and gas resources?

The purpose of this study is therefore to analyze the relevance of Senegal's current energy policy with regards to its ambitions for economic emergence and vis-à-vis the main challenges facing the country like energy independence and security of supply in the face of growing demand, universal access to affordable electricity, and climate change.

To do this, the study was divided into 3 parts. The first presents an overview of the country, including its macroeconomic fundamentals. The second details its energy policy, including its objectives, the strategies deployed, and the institutional and regulatory frameworks that underpin it. The third is a detailed critical analysis of this policy, starting with an evaluation of the results and ending with suggestions for improvement.

4 COUNTRY CONTEXT

The Republic of Senegal is in the western-most part of Africa's Sahel region and has a national territory covering 196,722 km². Senegal borders Mauritania in the north, Mali in the east, Guinea to the southeast, and Guinea Bissau to the southwest. It also borders The Gambia, a sovereign enclave occupying a narrow sliver of land along the banks of the Gambia River and sharing a maritime border with Cape Verde.

¹ IMF data base

² <https://estore.enerdata.net/energy-market/senegal-energy-report-and-data.html>

³ <https://knoema.com/atlas/Senegal/CO2-emissions-per-capita>

⁴ <https://estore.enerdata.net/energy-market/senegal-energy-report-and-data.html>

4.1 POLITICAL OVERVIEW

Senegal is one of the most stable countries in Africa. As most African countries, Senegal gained independence in the early sixties. Since its independence from France in 1960, the country has considerably consolidated its democratic institutions.

Senegal was one of the first African countries to introduce a multi-party system, with the government recognizing opposition parties since 1974.

As a matter of facts, it had three peaceful political transitions, including two alternations, under four presidents: Leopold Sédar Senghor (1960–1980), Abdou Diouf (1981–2000), Abdoulaye Wade (2000–2012), and since March 2012, Macky Sall.

In March 2016, the Government adopted a package of 15 constitutional reforms following a national referendum, which strengthened the powers of the Parliament, shortened presidential terms from seven to five years, and set a limit of two terms. As a result, the next presidential election, after 2019, will be held in 2024. Today the country is firmly anchored in multi-party rule and counts around 250 political parties.

4.2 DEMOGRAPHY, HEALTH, EDUCATION AND EMPLOYMENT

Over the last decade, Senegal averaged an annual population growth rate of just under 3%, bringing its total population to 15.1 million by 2015, of which 44 percent live in urban areas. Senegal's mostly young population is estimated at 15.3 million in 2016.⁵ 23% of the population lives in the greater Dakar region (which makes up 0.3% of the territory), and 40% lives in other urban zones. People under the age of 24 represent more than 60% of the population. With a median age of 18.2 years, the population is young and is growing fast (2.9% per year). By 2030, Senegal is expected to be home to nearly 22 million people.

Health and education facilities as well as other public services such as access to drinking water are quite dense in the coastal areas, due to urbanization, but become scarce in rural areas.

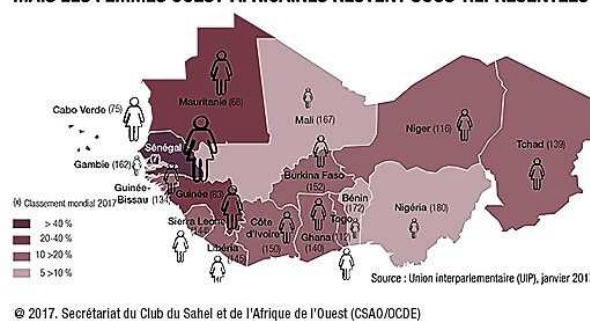
Senegal accomplished laudable progress in terms of access between 2000 and 2015. In elementary school, gross enrollment rates went from 67.2% to 84.6% and the gender parity index went from 0.87 to 1.1.⁶ However, despite progress over the years, Senegal's education system still faces significant issues and challenges. These include regional disparities in school enrollment and completion, low levels of learning achievement, low level enrollment in math and sciences disciplines and poor learning conditions. Lately, the government has prioritized these objectives to meet the goal of developing competent human resources in line with the requirements of sustainable development.

Young people represent 60% of job seekers. Efforts to change this situation are being made by the current government which has launched several initiatives to help the country provide trained and skilled workers for the labor market, concentrating on three priority industries of the Emerging Senegal Plan: horticulture, poultry farming, and tourism.

Senegal's HDI value for 2015 is 0.494, which put the country in the low human development category, positioning it at 162 out of 188 countries and territories. Between 1990 and 2015, Senegal's HDI value increased from 0.367 to 0.494, an increase of 34.6%.⁷ Nevertheless, like all averages, the HDI masks inequality in the distribution of human development across the population at the country level. Senegal has a GII value of 0.521, ranking it 120 out of 159 countries in the 2015 index.³

In Senegal, 42.7% of parliamentary seats are held by women, which calls the country at the 7th world rank just behind Sweden.⁸ Yet, 10.2% of adult women have reached at least a secondary level of education compared to 19.2% of their male counterparts.

FEMMES DANS LES PARLEMENTS : LE SÉNÉGAL SE CLASSE AU 7^E RANG MONDIAL MAIS LES FEMMES OUEST-AFRICAINES RESTENT SOUS-REPRÉSENTÉES



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Figure 4-1 : west africa 2017 GII ranking

⁵ World Bank 2016

⁶ Rapport national sur la situation de l'éducation au Sénégal, Août 2015

⁷ Human Development Report 2016

⁸ <http://www.oecd.org/swac/maps/50-Women-deputies.pdf>

4.3 THE ECONOMY OF SENEGAL

4.3.1 Macroeconomic outlook

Background: With its capital city of Dakar located on the western-most point of Africa, Senegal is a gateway to the continent. It is an open economy with major trade flows to Europe and India. Senegal's economy is largely natural resource-based. Key industries include the fishing sector, construction and mining, while tourism is a significant service sector and offshore oil and gas exploration is underway. Services account for 59% of GDP, industry for 24% and agriculture 17%. While agriculture accounts for 77% of labor force participation, it only accounts for 17% of GDP and agricultural products are among the country's main exports. For generations, coastal communities have relied on fishing for their livelihood of which 95% consists of artisanal fishing. Senegal's fishing industry remains one of the core contributors for the economy and it makes up 2,2% of the GDP, with more than 600,000 people working as fishermen.

The 1980s and early 1990s were marked by inconstant and unsustainable economic growth rates. Growth fluctuated with international raw-materials prices in imports and exports. In the 1990s the low level of GDP growth was due to a lack of investment and several imbalances, especially in terms of debt control and inflation variations.

Since the mid-1990s, Senegal has launched a radical economic reform program to strengthen its macroeconomic fundamentals. This reform took place concomitantly with the devaluation of Senegal's currency, the CFA franc, which was tied to the former French franc at a fixed rate. After the shock, prices initially jumped and the national inflation rate hit 32%, but with time the devaluation and reform program began to pay dividends. Thanks to the reforms, Senegal enjoyed a GDP growth rate of around 5% per year, over the 1995-2000 period, and inflation stabilized.

Macroeconomic performance: Economic growth in Senegal has peaked up since 2014. Over the course of 2015, Senegal's macroeconomic performance has been solid. Its GDP was USD 36.7 billion in 2015 with a growth rate of 6.5% – a rate not reached since 2003 - and have remained robust in 2016 as all components of demand have behaved strongly. GDP growth is projected to continue accelerating gradually to about 7% over 2017–2020⁹ as the primary sector continues its strong growth thanks mostly to agriculture and extractive industries, whilst services also achieve a growth rate over the average, notably due to commerce, transport, communication, and real estate. This performance in growth is remarkable, particularly when compared to other African economies, which have registered a marked deceleration due to a depressed global environment. As a result, Senegal registered the second fastest growing economy in West Africa, behind Côte d'Ivoire.



Figure 4-2: real GDP growth rate 1997-2022

GDP main contributors¹⁰: The sectoral analysis of GDP shows the predominance of the tertiary sector. Activities in the services sector accounted for nearly 60% of total value added between 2000 and 2015. The primary sector only accounted for 16% of GDP over the same period. The weight of the secondary sector in value added has been constant since 2000, at around 23%. Within the tertiary sector, trade (18%), post and telecommunications (9%), financial services (3%) and government services (9%) were the main drivers of growth.¹¹ Senegal's early bet on telecommunications infrastructure, with significant investments in terms of capacity and modernization, resulted in the country

⁹ IMF data base, 2017

¹⁰ The World Bank data base

¹¹ International Telecommunication Union (ITU), 2016

having well-established telecom infrastructure. To date, it ranks first in West Africa in terms of penetration and quality service growth. Also, Senegal has in the last ten years become a destination of choice for outsourcing of customer relationships and value-added IT services.

Thanks to public expenditure, Senegal has made significant progress in infrastructure, including transport, electricity, and water sectors. Senegal currently spends around US\$910m per year on infrastructure.

Senegal also has excellent telecommunications infrastructure. The country is connected to more than 40 countries around the world and is well integrated into the global network of submarine optic fiber cables. Cable, telex, fax, and internet services are available. There has been a boom of internet-related activities and services and in cellphone usage. The last years have witnessed spectacular growth of mobile telephone use from 1.5 million subscribers in 2005 to 15.3 million in 2016, when mobile penetration reached about 117% by mid2016.

Trade relations and foreign investment⁶: During the last ten years Senegal's exports of goods and commercial services have increased at an annual average rate of 6.4% and 5.5% respectively. Exports of goods have increased from US\$1.5bn in 2006 to US\$2.61bn in 2015, while exports of commercial services have increased from US\$0.8bn in 2006 to US\$1.3bn in 2014. Despite the growth in exports, Senegal's trade balance continues to record a deficit which reached US\$3bn in 2015 (22% of GDP). According to the UN ComTrade database 2017, in the last five years, Senegal's export growth mainly has been driven by phosphates and groundnut products.

Senegal's Investment Code includes guarantees for access to foreign exchange and repatriation of capital and earnings, though transactions are subject to procedural requirements of financial regulators. There are today no barriers to 100% ownership of businesses by foreign investors except in sectors that government and state-owned enterprises are active such as physical infrastructure including water, electricity distribution, and port services.

Since 2014, FDI inflows have been linked to the Emerging Senegal Plan (ESP) for the development of infrastructure, electricity, agriculture, drinking water and health.

Revenue collection⁶: The fiscal deficit has been declining steadily from 5.5% of GDP in 2013 and is projected to reach 4.2% of GDP in 2016. The current account deficit has narrowed and is projected to reach 6.5% of GDP in 2016, driven by lower oil prices and improved export performance.

Efforts to increase revenue collection and rationalize public consumption have helped control budget deficits. However, these efforts need to be pursued for a more transparent and fairer public-sector wage remuneration system and a more equitable and efficient collection of taxes, where tax expenditures are significantly reduced. Reforms to ensure everyone pays their fair share of taxes in a transparent system, should make it possible to raise more revenue, whilst removing tax disincentives facing SMEs and FDI in globally competitive activities.

4.3.2 The Emerging Senegal Plan (ESP)

Senegal adopted a new development model to accelerate its progress towards becoming an emerging economy. The ESP was developed to adopt a model focusing on accelerating the GDP growth rate and providing better living conditions for the population. It establishes the framework for the country's economic and social policy over the medium and long term and calls for Senegal to be an emerging market by 2035, as well as a business hub for the region. The main objectives are to obtain a GDP growth rate of 7-8%, create 600 000 formal jobs and reach a GDP per capita of US\$1 500 by 2035.¹²

The vision of the plan is based on three pillars:

- (i) a structural transformation of the economy through the consolidation of current engines of growth and the development of new sectors to create wealth, jobs, and social inclusion, with a strong capacity to export and attract investment;

¹² SEN-PPP Finance, 2015

- (ii) a significant improvement in the wellbeing of the population, a more sustained struggle against social inequality, while preserving the resource base and supporting the emergence of viable regions;
- (iii) the reinforcement of security, stability, governance, the protection of rights and liberties, and the consolidation of the rule of law to create better conditions for social peace and the fulfilment of potential.

The ESP will be implemented in three phases from 2014 until 2035. It also calls for continuing fiscal consolidation, increasing public savings to generate the fiscal space for higher public investment in human capital and public infrastructure, and envisages structural reforms to attract FDI, boost private investment and drive export diversification.

Growth acceleration will be driven by the implementation of flagship projects and multi-sector structural reforms. In this sense, the reforms will focus on four sectors, which have been identified as critical binding constraints to inclusive growth:

- (i) energy;
- (ii) agriculture and land;
- (iii) NICT;
- (iv) transport.

In terms of agriculture, despite a shortfall in rainfall in recent years, Senegal has significantly improved its results due to the selection of seeds and strong mechanization, which have had a positive impact on agricultural yields. Yields have seen a dramatic increase.

For the energy sector a 2015-25 production plan has been put in place according to long-term demand forecasts associated with a transmission system development program. The energy sector has made remarkable progress with an average cut-off time that has increased from 912 hours in 2011 to 72 hours in 2016. The implementation of a program to rehabilitate power stations over the 2014-15 period has resulted in a 52MW increase in electricity generation. The recently inaugurated *Tobène* Power plant adds another 96MW. The diversification of energy sources has also become a reality (*see chapter h.*).

For the transport sector, Senegal has built 1 520km and rehabilitated 4 015km of roads over the past four years. Senegal has expanded its highway system with the construction of the *Diarniadio* highway and a new 115km highway (the *Ila Touba* highway) is under construction. The government's objective is to equip Senegal with a 520km motorway network by 2025.

Senegal is also counting on the modernization of transport services through the development of a more modern public transport system. In rail transport, Senegal has recently launched its largest project since independence, the TER (Regional Express Train). This highspeed train of the latest generation aims to revolutionize the transport system. The train will connect Dakar to the new airport via 14 stations with a speed of 160km/h, for a load capacity of 115 000 people per day.

4.3.3 Oil & Gas discovery in Senegal

Senegal's energy sector enters a new area after recent findings of oil and gas. The Scottish operator, Cairn, has discovered two petroleum deposits SNE and FAN in 2014. As an outcome of the evaluation drilling carried out during 2015 and early 2016, recoverable reserves for the SNE and FAN deposit are estimated by the company between 350 million and 500 million barrels of oil.

This corresponds, to more than 65 000 barrels of oil per day – superior to the current daily production of a country like Cameroon, which is Africa's 12th largest oil producer. Moreover, US company KOSMOS has realized two discoveries of gas in 2016. The Guembeul-1 discovery in the block of St Louis is the largest gas field in West Africa. The well found 101 meters deep with estimated reserves at about 450 cubic meters. The *Coast of Cayar* discovery, which is located 65km north-west of Dakar, has estimated reserves of about 140 billion cubic meters.

The first gas production is anticipated to start in 2021, while the first oil production could take place between 2021 and 2023. Thanks to those new discoveries, the country could turn into the new energy hotspot of the continent.

4.3.4 Outlook for the future

Despite the country's recently improved economic performance, poverty remains high and predominantly rural. Most of the poor live in rural areas, where poverty is deeper and more severe, and live mainly off agriculture. In urban areas, the poor are mainly unemployed or working in the informal sector, typically in trade.

Moreover, the country still faces important infrastructure challenges, including improving road conditions, boosting air and rail traffic, updating electricity infrastructure, and boosting the pace of expansion of the water and sanitation network.

So far, the implementation of the first set of Emerging Senegal Plan (PSE) projects has helped move Senegal to a higher growth trend. Nevertheless, sustaining this growth over the medium term requires steadfast implementation of reforms that would enable SMEs to thrive and attract FDI for globally competitive production. Continued efforts to increase the competitiveness of the private sector, including through making tax collection more transparent, lowering electricity costs and improving service distribution, as well as creating an environment where SMEs and FDI can contribute to broad-based growth, will allow the private sector to take the reins of growth over the medium term.

4.4 LINK TO THE INTERNATIONAL COMMUNITY

Senegal is a respected and active member of the international community. The country has been a member of the United Nations since September 28, 1960. It is also a member country of the African Union (AU), the Economic Community of West African States (ECOWAS), the West African Economic and Monetary Union (WAEMU), and the Organization for the Harmonization of Business Law in Africa (OHBLA).

Otherwise, Senegal is party to all major treaties regarding financial, legal, labor, Human Rights and environmental issues, including treaties relative to the oil and gas sector. The most notable treaties cover the following scopes:

- **Human rights:** Universal Declaration of Human Rights, United Nations (UN) Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), the UN Convention on the Rights of the Child, and the African Charter of Human and Peoples' Rights;
- **Development goals:** The Sustainable Development Goals (SDGs);
- **Environment:** the UN Framework Convention on Climate Change (UNFCCC), the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands, the UN Convention to Combat Desertification (UNCCD), the Convention on the Illegal Trade in Endangered Species of Wild Fauna and Flora (CITES), the Basel Convention for Controlling Transboundary Movements of Hazardous Wastes and Their Disposal, the Stockholm Convention on Protecting Human Health and the Environment from Persistent Organic Pollutants, and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals & Pesticides in Int Trade '01;
- **Labor rights:** Senegal has ratified all eight of the International Labor Organization's (ILO's) fundamental conventions: Freedom of Association and Protection of the Right to Organize Convention, Right to Organize and Collective Bargaining Convention, Forced Labor Convention, Abolition of Forced Labor Convention, Equal Remuneration Convention, Discrimination (Employment and Occupation), the Minimum Age Convention and the Worst Forms of Child Labor Convention, and the International Convention on the Protection of the Rights of all Migrant Workers and Members of their Families.
- **Extractive resources:** Senegal applied to the Extractives Industry Transparency Initiative (EITI) in 2013. It published its first report about 2013 in October 2015 and is yet to be assessed based on the 2016 standard in order to become a fully EITI-Compliant Country.

- **International trade and investments:** the Cotonou Agreement on reciprocal duty-free access to EU markets for African, Caribbean and Pacific country export (EU-ACP), the African Intellectual Property Organization (OAPI), the International Center for the Settlement of Investment Disputes (ICSID), the Multilateral Investment Guarantee Agency (MIGA). Bilateral investment treaties are also in force with Australia, Denmark, Finland, France, Italy, Japan, Romania, South Korea, Spain, Switzerland, the Netherlands and the US. Tax treaties exist with France, Mali and the French-speaking African states of the Afro-Malagasy Organization (OCAM).

5 ENERGY POLICY

5.1 OVERVIEW OF THE NATIONAL ENERGY POLICY

5.1.1 Policy guidelines

The governing policy for the energy sector is the Letter of Policy Development of the Energy Sector (Lettre de Politique de Développement du Secteur de l'Énergie, LPDSE), which was first released in 1997 and subsequently updated in 2002, 2008, and 2012.

In 2008, the LPDSE explicitly acknowledged the importance of renewable energy and laid the groundwork for the passage of the Renewable Energy Law (2010), which regulates the RE sector. The Law covers tax relief, grid access, certificate of origin (to help RE producers to unlock incentives), and feed-in tariffs.

The policy framework for the oil and gas sector is set in the Energy Sector Development Policy Letter (LPDSE) adopted in October 2012, which has been integrated into the PSE. Most recently, the 2012-2017 LPDSE called for the creation of ANER, the operationalization of incentive schemes, investment opportunity identification and planning, and a study on the implementation of a feed-in tariff. Although still in its early stages, the RE policy environment is advancing.

The LPDSE outlines ambitious objectives for improving the sector's performance in the medium to long term. Overall, the objective of the policy is to improve the reliability and affordability of access to modern electricity services in a sustainable manner by:

- (i) ensuring energy security and increasing energy access for all;
- (ii) developing an energy mix combining thermal generation, bioenergy, and renewables and taking advantage of the opportunities flowing from regional interconnections to access low-cost hydropower;
- (iii) continuing and accelerating the liberalization of the energy sector by encouraging independent production and sector institutional reform;
- (iv) improving the competitiveness of the sector to lower the cost of energy and reduce sector subsidies;
- (v) strengthening sector regulation.

5.1.1.1 Electricity subsector

5.1.1.1.1 Power production plan

The objective pursued by the Government in the sub-sector is to ensure the availability of quantity and quality of electrical energy, competitive and produced from a variety of technologies including, notably, coal, gas, hydroelectricity to wind power and solar energy.

The Government considers that the construction of low-cost production facilities, such as this coal-fired power plant, is an essential step in achieving the short-term objectives of the PSE and the development of the country. In particular, there is an emblematic coal-fired power plant project in *Bargny*, near Dakar. The plant is currently under construction, and is scheduled to start in 2018, following a delay of one year. The installed capacity will be 125 MWe and could then increase to 250 MWe. The initial production would be 925 GWh / year, or more than a quarter of production in 2016. By itself, it would ensure sufficient production growth to the Senegalese population for more than two years. The cost of production would be much lower than the current cost. However, if it is deemed indispensable by the

Senegalese Government, it is badly fought by environmental defenders powerful enough to succeed in interventions with the African Development Bank (ADB), which is the main donor, and hand over in question its financing. The cost of the first 125 MWe is about 118 billion CFA francs, or 180 million euros.

To achieve these objectives, Senegal has been involved in setting up a favorable regulatory framework for financing the sector. The 2013-2017 Production Plan, adopted by the Government during the Council of Ministers meeting of 21 March 2013 held in *Matam*, outlines the following strategic steps:

- Government intends to promote a strong involvement of the private sector in the production and intends, for this purpose, to engage the IPPs and SENELEC to resolve disputes which could jeopardize partnership and which may have a negative impact on future independent production projects;
- The Government has therefore decided to step up the renovation of the transmission-distribution grids to deal with multiple incidents, particularly in the distribution and transmission networks, but also to the needs of grid extension;
- The Government has kicked-off the financial restructuring of SENELEC which includes various measures, namely (i) the elimination of the tariff gap, (ii) the recapitalization of SENELEC, (iii) debt restructuring, and (iv) implementation by SENELEC of an internal improvement plan (cost reduction, revenue improvement, overall efficiency improvement, WCR reduction).
- With the implementation of SENELEC's financial and operational restructuring plan and the completion of investments in intermediate production capacities, the Government intends to provide the means for a gradual decline in the subsidy as well as an action plan to compensate for the SENELEC's income projected reduction;
- At the same time, the government decided to sign a performance contract for 2013-2015 with SENELEC, setting the objectives and specifying the conditions for achieving the objectives that will be monitored through a set of performance indicators. This contract will be audited annually.
- In addition, in accordance with the guidelines set by the President of the Republic, the Government is studying the option of institutional restructuring of SENELEC which favors the liberalization of the production segment and the intervention of private producers. In this respect, the achievements of works for the subsidiarization of the activities carried out in 2009-2010 will be capitalized in particular: the accounting separation as envisaged by article 19 of the law of orientation of the sector of electricity, unbundling of the activities in two entities, the first in charge of Production and the second in charge of Transport and Distribution activities.

In the medium term, the construction of coal and natural gas power plants as well as the development of hydro-electric potential at the OMVS and OMVG level should allow a sustainable recovery of the sector through a substantial reduction in the price of electricity with the objective of having, as of 2018, reached a maximum production cost of between CFA 60 and 80 per kWh.

Current projects allow a projection to 2000 MW in 2020, as well as universal access to electricity in 2025 with an interim target of 60% of rural electrification in 2019. It is also expected, by 2019, a cumulative power of renewable energy of at least 405 MW, 150 of which in wind energy and the rest in solar, to be injected into the network.

5.1.1.1.2 Rural electrification

In view of the challenges of rural electrification, particularly in terms of social cohesion and balanced development of the country, the Government aimed to achieve the goal of a rural electrification rate of 60% by 2017 against 25,7% in 2012. PASER (Senegalese Rural Electrification Action Plan), the ambitious twenty-year program (2002-2022) for rural electrification is structured around 3 complementary programs.

The Rural Electrification Priority Program (PPER): The PPER coordinates the PNUER and rural electrification concessions. The National Emergency Rural Electrification Program (PNUER) aimed at an intermediate objective of 60% rural electrification rate in 2017, for an amount of 107 billion CFA francs (214 million USD) of which 23.4 billion CFA francs (46.8 million USD) dedicated to decentralized electrification by mini solar or hybrid grid. It is based on four components that will provide access to electricity for 1,330,000 inhabitants (intermediate objective in 2017): (i) Construction of 2,835 km of MV networks; (ii) Electrification of 2,794 villages near the MV network; (iii) Extension of low voltage (LV) networks of 560 already electrified villages (840 km of LV line); (iv) Decentralized electrification by solar or hybrid mini-grid of 392 villages. The above graph gives a snapshot of the country electrification plan between 2014 and 2017.

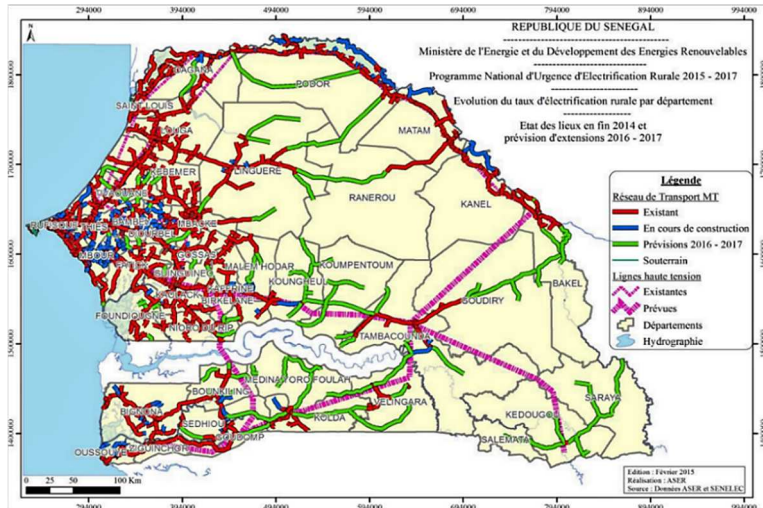


Figure 5-1 : électrification plan 2014-2017

The PPER consists also in granting concessions to private operators as follows: (i) Concession term: 25 years; and (ii) Operator commitment to connect a targeted number of households after 3 years. For the implementation of the PPER, Senegal has been divided into 10 zones (see opposite map) intended to be granted to private companies as operators of the regions to be electrified through a competitive bidding process.

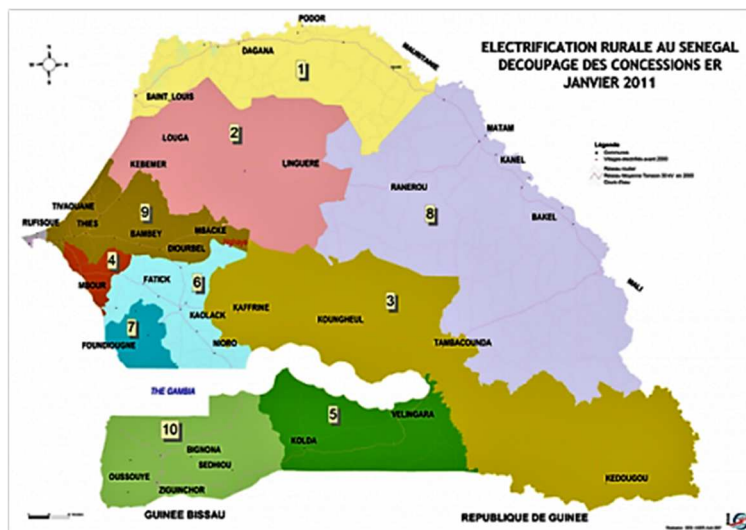


Figure 5-2 : rural concessions map

The public-private partnership was favored with private sector participation in rural electrification financing amounting to 49.15% of the total amount of planned investments. In fact, the financing plans for the 6 granted concessions registered, at the end of 2017, accounted for private sector contractual commitments of \$ 51 million out of the \$ 105 million corresponding to the overall investment.

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The Local Initiative Rural Electrification (ERIL): The ERIL which aims to provide access to energy to communities not benefiting from the network since the Government has recognized that large-scale expansion of the national grid will not meet the needs of rural areas. Therefore, the regulatory framework promotes electrification of remote areas through PPERs and off-grid Local Rural Electrification Initiatives according to the following modalities and characteristics:

- operators apply for a renewable contract under which a 15-year concession is issued by the Ministry of Energy and the Development of Renewable Energies;
- ASER only approves ERILs in areas that will be electrified in the next 3 years, according to the electrification plan of the PPER concession holder;
- applies to smaller projects compared to concessions (one or more villages) and target villages not taken into account by concessions;
- Solar technology is generally used (remote villages SENELEC's network);
- Investment subsidy provided by the State, if necessary.

ERIL-type programs aim at a relatively economic approach to rural electrification initiated by the community and / or the private sector: (i) They allow to feed a network by combining different sources of electricity (wind, solar, micro hydro-electric and biomass electricity) and to guarantee high energy security; (ii) As energy is generated and consumed locally, the long-distance transport losses are minimal, making the mini-grid a more efficient option for remote areas; (iii) Mini-grids make it easy to identify the operational, technical and administrative challenges that typically hinder the expansion of the core network. This approach (concept technological neutrality) has allowed a significant use of renewable energies, especially solar photovoltaic, very adapted to the geographical configuration of the rural areas of Senegal.

The Multisectoral Energy Program (PREM): The PREM which aims to broaden the social and economic benefits of electrification. In addition, the Government intends to improve good governance in the management of the Senegalese Rural Electrification Agency (ASER).

5.1.1.2 Renewable energy subsector

The renewable energy sub-sector is a significant challenge since the exploitation of national potential could make a significant contribution to achieving the objective of improving energy independence and security.

Today that the legal and regulatory framework is in the process of being fully in place with the implementation decrees already adopted, the Government sets itself the objective of achieving a rate of independence in commercial energy excluding biomass from at least 15% by 2025, thanks to the contribution of renewable energies and biofuels.

5.1.1.2.1 Renewable power

There exists a National Action Plan for Renewable Energies (PANER) which defines the targets for REs injected into the grid in 2025 and 2030 as follows:

- In 2025: (i) Power of 440 MW from different sources (PV and wind); (ii) Penetration rate of 30%; and (iii) No constraints to evacuate the total power according to the results of the integration study of the REs taking into account the planned network at this date.
- In 2030: (i) Power of 550 MW from different sources (PV and wind); (ii) Penetration rate of 30%; and (iii) Need to reinforce the 90 kV (*Cap-Des-Biches - Kounoune*) transmission network and the installation of a third 225/90 kV transformer of 200 MVA.

The Strategies for Achieving Consistent Targets are defined as follows:

- Implementation of the integration study of the REs in the network;
- Promotion of private electricity generation from renewable energy sources;
- Finalization of the legislative and regulatory framework on the REs (feed-in tariffs, taxation, etc.);
- Development of self-generation of electricity from renewable energies.

With respect to electricity, the objective is to achieve, by 2017, a rate of about 20% in the installed capacity, particularly through the projects selected by the Approval Committee set up by the Ministry of Energy and other mechanisms.

5.1.1.2.2 Domestic fuel

The objective of the Government in the sub-sector is to provide sustainable supply of urban and rural households with cooking energy, while ensuring the preservation of forest resources.

As part of the forest capital preservation policy, the participatory management strategy will be pursued, in particular with PERACOD and PROGEDE, which has just opened new zones, namely *Kaolack*, *Kaffrine* and *Matam*, after *Tambacounda* and *Kolda* today. in the consolidation and closure phases of the planning cycle. Thus, the exploitation of wood for charcoal production will always be limited exclusively to the developed zones.

PROGEDE II: Programme de Gestion Participative et Durable des Energies

Traditionnelles et de Substitution : The goal of PROGEDE is to contribute to the sustainable increase in the availability of diversified domestic fuels, as well as income for the communities concerned, while preserving forest ecosystems and taking into account gender. Its intervention zones were the eastern zone (*Tambacounda, Kédougou*), the southern zone (*Kolda, Sédhiou*) and the *Ferlo* center zone (*Kaolack, Fatick, Matam*). It comes in four components: (i) Institutional reform of the charcoal industry; (ii) Sustainable management of wood fuel supply; (iii) Promotion and diversification of modern domestic energies; and (iv) Institutional Arrangement for the implementation of the project. The results of PROGEDE 2 in 2015 were mainly: (i) The establishment of 23 CIVG (Inter Village Forest Management Committee); (ii) 997,263 ha of managed forest; and (iii) 23 GIEs created as part of the organization of local producers.

The Special Jatropha Biofuel Program: Despite its energy potential, *Jatropha*, an inedible product, may not be of interest to rural populations. The political options in Senegal preceded research on the conditions for setting up a genuine *Jatropha* sector, integrated into agriculture. Biofuel crops create a new modeling of space. The agrarian landscape is changing, as are the systems, with an association between food crops and energy crops. The development of biofuels has two major implications: complementarity with food crops, in the case of a continuous association, competition with these crops, when the revenues generated by biofuels impose a monoculture of rent. The likely weakening of traditional crops is leading to food insecurity, rising food prices and crisis among rural households. Therefore, the Senegalese government wants to rely on South-South cooperation to support the development of biofuels. Brazil, because of its experience in the production of biofuels, is thus a strategic partner of Senegal.

At the sub-regional level, UEMOA contributes to the development of the sector through the Regional Biomass Energy Program (see the map opposite¹³), by making available to the Government of Senegal an envelope of 98 million FCFA for the implementation of an "experimental unit of electricity production from biomass". However, the Biofuel program seems to consider only the upstream side of the sector. Downstream has not yet been the subject of any legislation. A Biofuels Guidance Law and implementing decrees are, however, being drafted.

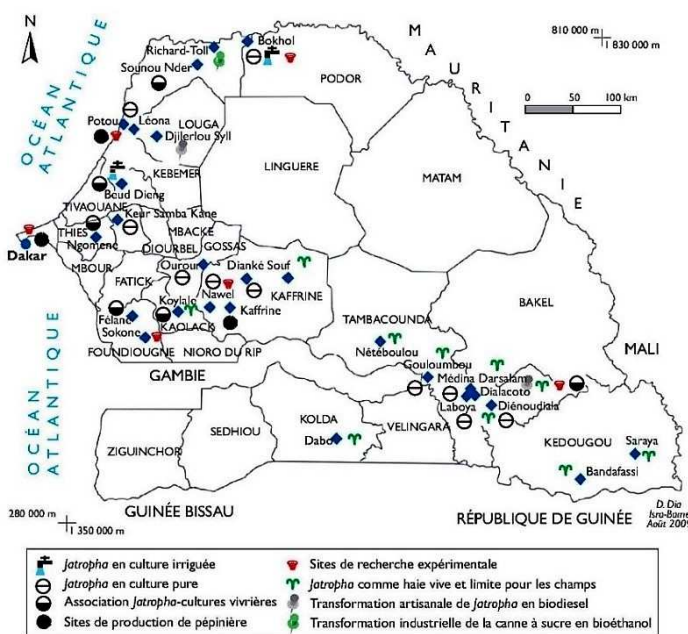


Figure 5-3 : biofuel cultures' map

PNB-SN II: National Biogas Program: Senegal's National Domestic Biogas Program (PNB-SN) conducted its first phase in 2010-2015. In terms of results, the GNP was able to achieve only about 1000 units in 5 years on a target of 8 000 bio-digesters. Although the targeted objectives in terms of the number of bio-digesters of this first phase allowed according to the coordinator of the program: (i) adapt and validate the model that has been introduced; (ii) make household bio digesters of larger sizes more suitable to Senegalese households; (iii) better understand the importance of agriculture and livestock in the biogas sector; (iv) Set up a biogas job with the training of masons, accessories manufacturers and (v) To put in place a strategy involving the various actors and parties stakeholders in the bio-digester sector.

For the second phase (2015-2019), a target of 10,000 bio-digesters is set for a budget of 10 billion funded by the state, the European Union and other partners. The program provides a grant of 80% and the beneficiary contributes building materials and participates in the implementation. It is currently in its second year of Phase 2 with production that has evolved significantly compared to the first phase.

¹³ IRD Éditions, 2012 *Jatropha curcas* L. au Sénégal

According to the coordinator, the latter is marked by a strong commitment of the State and the actors at the base, the diversification of the types of partners and a greater importance given to agriculture.

The PNB-SN aims since 2010 to provide a solution to the supply of households with alternative cooking fuel. This is a program that is in line with the ECREEE regional initiative for the promotion of clean cooking in October 2012 in Ghana, which aims to enable ECOWAS people to access sustainable energy and cooking equipment by 2030.

5.1.1.3 Energy efficiency subsector

Considering the weight of imports of petroleum products in the country's trade balance (40.4% of export earnings in 2010)¹⁴, the Government has taken full measure of the importance for Senegal to reduce the dependence of the country on imports for its supply and mitigate the oil bill by setting up an Agency for the Economy and Energy Management since 2011 (AEME). An action plan for energy efficiency has been set-up, including the establishment of a legislative and regulatory framework (energy efficiency standards and requirements, quality control, compulsory energy audit, etc.), mass distribution of ESL lamps, audits in the residential, commercial and industrial sectors, transport, standardization and labeling of household electrical and office equipment.

The National Action Plan for Energy Efficiency (PANEE) defines the following targets for Energy Efficiency¹⁵:

- In 2020: (i) Elimination of incandescent lamps and promotion of energy-saving lamps (LBC and LED); (ii) network lighting penetration rate equal to 82%; (iii) Off-grid lighting penetration rate of 1%; (iv) Number of devices with labels in effect equal to 4; (v) Percentage of Industries that applied efficiency measures equal to 20%; and (vi) Percentage of energy saving in the industry equal to 5%.
- By 2030: (i) network lighting penetration rate of 99%; (ii) Off-grid lighting penetration rate of 1%; (iii) Number of devices with labels in effect equal to 6; (iv) Percentage of Industries that have applied efficiency measures equal to 80%; and (v) Percentage of energy savings in industry equal to 25%.

The strategies to achieve these targets are:

- Prohibition of the manufacture, import and marketing of incandescent lamps;
- Generalization of the use of efficient lamps with the provision of 3,000,000 lamps to households;
- Raising public awareness of the benefits of efficient on-grid and off-grid lighting;
- Adoption of minimum energy performance standards for on-grid and off-grid lighting;
- Develop and adopt tax instruments to reduce the prices of efficient on-grid and off-grid lighting;
- Establishment of financing line for energy audits in industry.

In total, the Government aims, among other objectives, the reduction of 10 to 20% of the electricity bill by 2015 thanks to the ongoing program with the Institute of Energy and the Environment of La Francophonie (IEPF) and an energy saving of about 40% on the electrical demand in 2020 by implementing the measures listed in the Study of the Control of Electrical Demand (MDE). Indeed, it is accepted that "saving a kilowatt hour is more economical than producing a kilowatt hour".

5.1.1.4 Hydrocarbons subsector

The objectives pursued by the Government in the sub-sector consist in securing the country's supply, creating conditions for cost reduction and ensuring the quality of petroleum products as well as the safety conditions of the activities.

¹⁴ World bank data base

¹⁵ ECREEE - presentation_se4all_action_agenda_senegal.pdf

5.1.1.4.1 Upstream activities

The objective pursued is the intensification of the promotion of the Senegalese sedimentary basin, particularly in the deep offshore and the Paleozoic. The Government is keen to capitalize on the renewed interest of international oil companies for Senegal and intends to expedite the processing of requests currently underway. An evaluation study of the oil and gas potential of the Senegalese sedimentary basin was commissioned, including the estimation and classification of probable reserves, the certification of the hydrocarbon reserves highlighted, the production forecasts as well as the economic evaluation of potential deposits. Developments will also be made to the Petroleum Code and the model contracts with, notably, (i) the establishment of a regulation of petroleum operations, (ii) a simpler definition of the tax system under the new General Tax Code and (iii) setting certain parameters in the contract templates.

5.1.1.4.2 Downstream activities

Refining and import: The SAR, which has been mandated to supply fuel to SENELEC, is at the center of the energy sector's exit plan. The operation of the Company also appears crucial for the viability of independent distributors who, in the event of the refinery's shutdown, refuel with their competitors at disadvantageous conditions. At this level, the Government is evaluating the options for maintaining the refining activity taking into account the evolution of the national demand for petroleum products and the possibilities of supplying the sub-region from Senegal as well as the advantages of having a powerful refining tool. In addition, the evaluation will also consider previous and ongoing experiences with past public-private partnerships. In the meantime, the State is working to boost the implementation of an emergency program to eliminate the technical problems of the refinery which expose it to the risk of major incidents that could compromise the operation of the facilities. These are investments aimed at securing and reducing the cost of supplying petroleum products, namely the construction of a berth for 160.000 tons crude oil tankers, a sea-line and a berth for butaniers of 12 to 15 000 tons as well as the modernization of the import logistics currently source of additional costs related to the obsolescence.

Storage: The Government is concerned about the problem of adapting storage capacity to the changing needs for a constantly increasing demand and integrating security stocks. Thus, a re-evaluation of the storage situation was initiated to reconsider the decisions taken previously. The objective is to set up a truly independent repository open to new entrants in the import and distribution of petroleum products.

Distribution: In order to reinforce the conditions of competition, the criteria for the allocation of licenses, the problem of the barriers to the exercise of certain activities (Jet, lubricants), rules and standards to which any distributor should be subject will be reviewed, especially for infrastructure. The quality control of the products will be improved through the establishment of an independent laboratory. In the same vein, the Government is studying the possibility of disengaging from transport equalization.

Hedging: In order to optimize the cost of imports of petroleum products, the State set up a Steering Committee for hedging oil price hedging operations in order to have recommendations on the best means of to minimize the risks related to fluctuations in the price of oil.

Regulation: At the level of regulation, the development of the sub-sector requires the creation of a strong regulatory authority, capable of ensuring a transparent operation of the sub-sector. To this end, consultations will soon be opened for the establishment of a regulatory body for the energy sector, including the hydrocarbons dimension, in place of the one dealing solely with electricity.

5.1.1.5 Development of energy markets

The Senegalese energy market is composed of: (i) private industrial units; (ii) SENELEC; and (iii) independent power producers (IPPs).

In the segment of gaseous products, it was decided to reserve the use of gas obtained from national subsoil for SENELEC and independent power producers. These independent producers are required, whatever the source of the energy they produce, to supply their entire production to SENELEC.

To accomplish the tasks assigned to it under the concession contract and the specifications, SENELEC launches tenders at the auction, according to the provisions of an order made by the Minister of Energy to receive required supply offers from companies pursuing or contemplating engaging in an activity of production of electrical energy.

The CRSE monitors compliance with the principles of fairness, transparency and non-discrimination in appeal procedures, tendering and selection of supply offers. SENELEC concludes, after tendering, contracts for the purchase of electric energy.

5.1.1.6 Link to climate change policy¹⁶

Senegal's INDC, on mitigation, aims to implement specific activities that have an impact on reducing GHG emissions, both on the basis of national resources (objectives of unconditional contribution) and support of the international community (conditional contribution objectives) in relation to its capabilities. These activities cover three gases: carbon dioxide (CO₂), methane (CH₄) and nitrous oxides (N₂O).

Activities that generate GHG emission reductions will be realized in the following subsectors: (1) energy, through electricity generation, energy efficiency and transportation, (2) agriculture forestry and other land use (AFAT) through manure management, rice cultivation, agricultural soils, organic fertilizers, forest land and plantations, (3) industry and (4) waste management by the treatment of solid waste, industrial, domestic and commercial wastewater.

Under the unconditional option (INDC), emission reductions from their expected path are 3%, 4% and 5% respectively in 2020, 2025 and 2030.

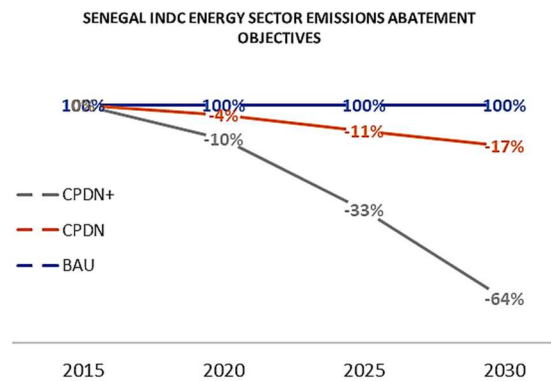


Figure 5-5 : emissions abatement objectives

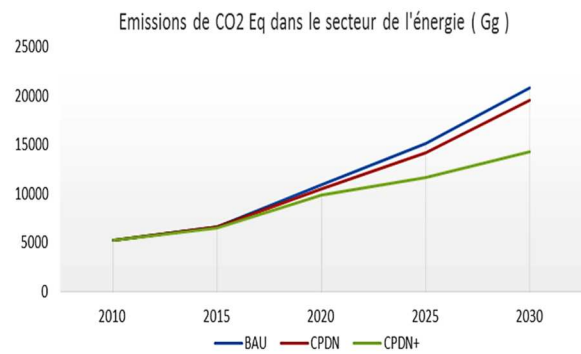


Figure 5-4 : CO₂ emissions forecast 2010-2030

With the conditional option (INDC+), the expected emissions reductions are in the order of 7%, 15% and 21% over the same years.

The contribution of the energy sector has been broken down into 3 sub-sectors: (i) electricity and domestic fuel; (ii) energy efficiency; and (iii) transport. However, most of the emissions reduction policy in the sector is based on the introduction of renewable energies in electricity production by 30% by 2030. The graphs above and opposite show the reduction commitments of the corresponding emissions, according to the scenarios CPDN and CPDN+.

5.1.1.7 Monitoring and Evaluation

In addition, it is important to note that to ensure the success of the new energy policy, the Government has set up a monitoring and evaluation system for major energy projects through an inter-ministerial committee chaired by the Prime Minister.

¹⁶ CONTRIBUTION PREVUE DETERMINEE AU NIVEAU NATIONAL (CPDN) – Sep, 2015
<http://www4.unfccc.int/submissions/INDC/Published%20Documents/Senegal/1/CPDN%20-%20S%C3%A9n%C3%A9gal.pdf>

5.1.2 Institutional framework¹⁷

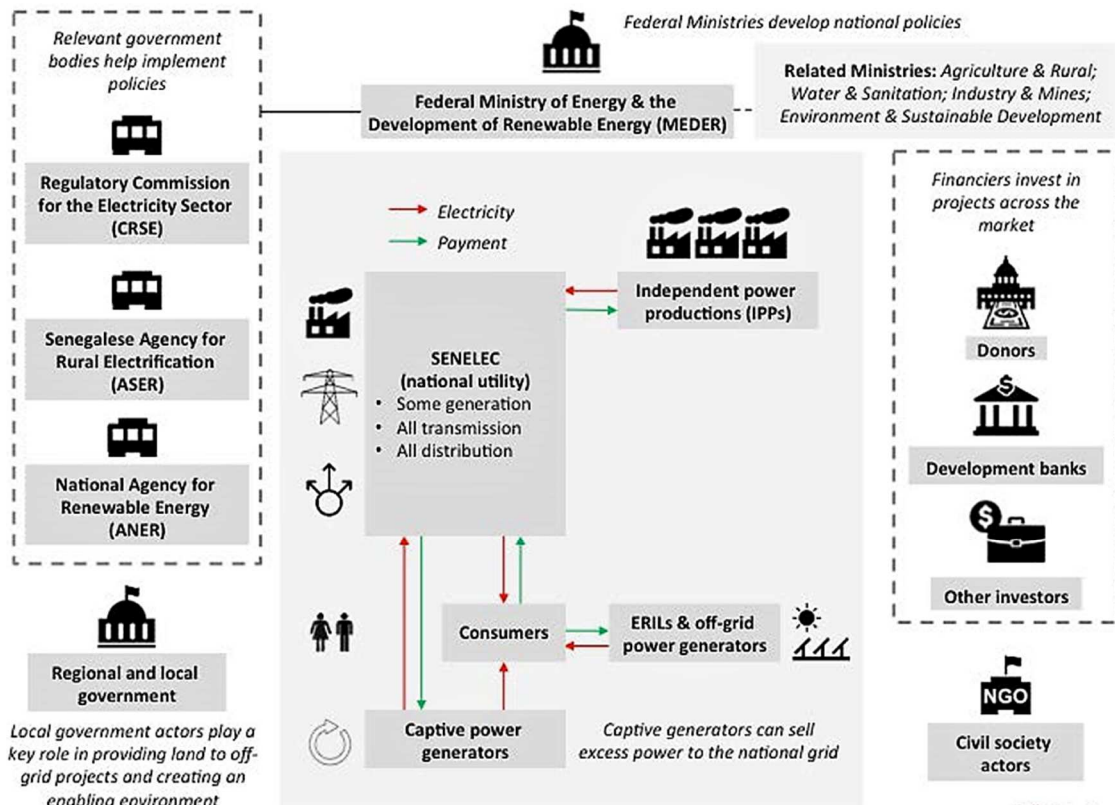


Figure 5-6 : institutional framework map

5.1.2.1 Electricity subsector¹⁸

Tableau 5-1: Electricity subsector key stakeholders

MEDER (Ministre de l'Énergie et du Développement des Énergies Renouvelables)	Ministry of Energy and the Development of Renewable Energies that oversees the energy sector, including the renewable sub-sector. Within the Ministry, DRE relates to the Renewable Energy Development department and DE, the Electricity department.
CRSE (Commission de Régulation du Secteur de l'Électricité)	Regulator that oversees licensing, operation, and sales of electricity. This includes setting tariffs (regardless of the size of the project) and monitoring concession contracts.
SENELEC (Société Nationale d'Électricité)	SENELEC is the vertically-integrated national utility created in the 1998 power sector reforms. It is the largest electricity generator, and the only concessionaire for on-grid transmission and distribution. It has a monopoly over the purchase and sale of wholesale electricity.
ASER (Agence Sénégalaise d'Électrification Rurale)	Established by Law 98-29, ASER is an independent agency responsible for providing electricity companies and individuals with the technical and financial assistance needed to support rural electrification initiatives. ASER is developing the electrification programs decided on the basis of the rural electrification plan defined by the Minister in charge of Energy.

¹⁷ The World Bank - Supporting Gas Project Negotiations and Enhancing Institutional Capacities - Mar 21, 2017

¹⁸ Dalberg off-grid policy – May, 2017

ANER (Agence Nationale pour les Energies Renouvelables)	Government agency established by the 2012-2017 LPDSE, and created in 2013, to promote and develop renewable energies in all forms: solar, wind, biomass, hydropower, and tidal. ANER has focused more on SHS and public areas electrification given ASER's focus on village-level mini-grids.
AEME (Agence Nationale pour l'Economie et la Maitrise de l'Energie)	AEME participates in the implementation of policies in the areas of energy, environment and sustainable development. It provides companies, local authorities, public authorities and the general public with expertise and advice. It helps finance and implement projects in the areas of sustainable energy usage and energy efficiency.

5.1.2.2 Renewable energy subsector¹⁹

Tableau 5-2: Renewable energy subsector key stakeholders

MEDD (Ministère de l'Environnement et du Développement Durable)	Article 1 of Decree No. 2014-880 of 22 July 2014 summarizes the attributions of the MEDD: The MEDD prepares and implements the policy defined by the Head of State in terms of environmental monitoring, pollution control and protection of nature, fauna and flora.
CERER (Centre d'Etudes et de Recherches sur les Energies Renouvelables)	Center located at the University Cheikh Anta Diop of Dakar that focuses on renewable energy research. This includes studies on RE potential across the country, solar, wind and thermal energy pilot projects, and socioeconomic research related to energy access.
PROGEDE (Programme de Gestion Durable et Participative des Energies Traditionnelles et de Substitution)	The objective of PROGEDE is to contribute to the domestic supply of household fuels, in a regular and sustainable way, preserving the environment and offering wider possibilities of choice and comfort to consumers.
PERACOD (Programme pour la Promotion des Energies Renouvelables, de l'Electrification Rurale et de l'Approvisionnement Durable en Combustibles Domestiques)	PERACOD is implemented by GIZ, a German technical cooperation organization. The objective of PERACOD is to contribute to the sustainable improvement of the rural population's access to energy services. The focus is on renewable energies, especially on solar systems and the sustainable use of non-fossil fuels.

5.1.2.3 Hydrocarbons subsector²⁰

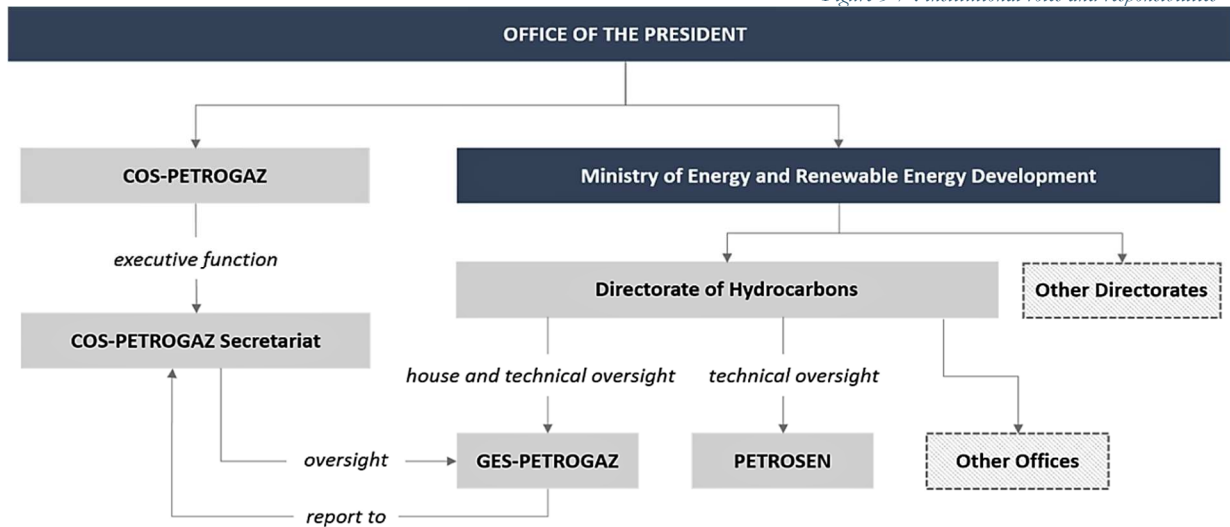
Until the creation of the Strategic Petroleum and Gas Steering and Development Monitoring Committee (COS-PETROGAZ) in 2016, the Ministry of Energy and Development of Renewable Energy (Ministère de l'Energie, du Développement des Energies Renouvelables, MEDER) was the only entity responsible for the oil and gas sector. The upstream oil and gas arms of MEDER are the Directorate of Hydrocarbons (DH) and the National Oil Corporation of Senegal (PETROSEN), which was created in May 1981 with a state participation of 99 percent. MEDER ensures the implementation of the laws promulgated by the President of Senegal with respect to both onshore and offshore oil and gas exploration and production activities, hydrocarbon imports, exports, and marketing as well as crude oil refining, transportation, storage, and petroleum products distribution.

¹⁹ ENDA Energie - Étude sur la situation de base des énergies renouvelables et de l'efficacité énergétique au Sénégal -Nov, 2016

²⁰ The World Bank - Supporting Gas Project Negotiations and Enhancing Institutional Capacities - Mar 21, 2017

Institutional roles and responsibilities in the upstream oil and gas sector are as follow:

Figure 5-7 : institutional roles and responsibilities



President of the Republic: Under the Petroleum Code, the President’s role in the oil and gas sector consists in: (i) Awarding and renewing exploration licenses or authorizations (by decree); (ii) Awarding temporary production authorizations (by decree); (iii) Awarding and renewing concessions or authorizations (by decree); and (iv) Approving oil and gas exploration and production contracts, including PSCs (by decree).

Ministry of Energy: The Ministry is the supervising entity responsible for the implementation and monitoring of the Government’s policy for the oil and gas sector.

PETROSEN: PETROSEN is a public limited company created in 1981 operating under the technical supervision of the Ministry of Energy. It is an instrument of Senegal’s implementation of oil and gas policy. As defined by the Petroleum Code (No. 98-05 of January 8, 1998) and its implementing decree (No. 98-810 of October 6, 1998), PETROSEN is active in the upstream, midstream, and downstream oil and gas sectors. In upstream oil and gas, its mission is to evaluate the country’s hydrocarbon resources, promote the development of these resources by international oil companies, oversee petroleum development, and monitor contract compliance. PETROSEN is thus in charge of the preparation and negotiation of all petroleum conventions and PSCs, which are signed by MEDER and the petroleum companies. PETROSEN is entitled to a contributing participating interest in any exploitation project in a range of 10 percent up to the maximum rate stipulated in the conventions or PSCs (generally 20 percent). To that end, it is a signatory to all Joint Operating Agreements (JOAs) contracted with the petroleum companies. In the downstream oil and gas sector, PETROSEN is a strategic stakeholder in the refinery process.

COS-PETROGAZ: In October 2016, the Government of Senegal established by decree the COS-PETROGAZ to provide strategic guidance as well as define and oversee policies regarding hydrocarbon development. COS-PETROGAZ is embedded within the Office of the President of Senegal. Specifically, its key roles and responsibilities include: (i) defining, overseeing, monitoring, and verifying the implementation of the national oil and gas policy; (ii) implementing strategies and programs for the promotion and development of hydrocarbon projects; (iii) approving oil and gas studies pertaining to reserves assessment and development; (iv) approving strategies submitted by private operators; (v) approving action plans for the creation of an entity devoted to research and training in the oil and gas sectors; (vi) approving local content and policy for oil and gas development; (vii) mobilizing funds from ministries, public entities, and donors for the promotion of oil and gas projects; and (viii) ensuring that good governance practices are followed in the development of the hydrocarbon sector. COS-PETROGAZ has been effective since December 2016. It is headed by the President of Senegal, and includes key cabinet members, including MEDER. It is managed by a Secretariat created in November 2016 and composed of a Permanent Secretary and an Adjunct Secretary, who have already been appointed. COS-PETROGAZ is expected to meet every quarter or at the President’s request.

GES-PETROGAZ: The October 2016 Decree also created a project implementation unit, Unité d'Exécution et de Gestion (GES-PETROGAZ), housed in the MEDER. The latter takes charge of the day to day coordination and management of all technical assistance project activities in the oil and gas sector, as well as the implementation of all relevant decisions by the MEDER and COS-PETROGAZ.

5.1.3 Legal & regulatory framework²¹

5.1.3.1 *The regulators*

The regulators of the energy sector in Senegal are: (i) the Minister of Energy; (ii) the Electricity Sector Regulatory Commission (CRSE), which is an independent authority responsible for regulating the production, transmission, distribution and sale of electricity; and (iii) the National Committee for Hydrocarbons, created by Act No. 98-31 of 14 April 1998 on import, refining, storage, transport and distribution of hydrocarbon, which is a consultative organ. The regulators are different for each segment of the energy sector: (i) the CRSE deals with the electricity segment; and (ii) the National Committee for Hydrocarbons deals with the oil and gas segment.

Minister of Energy: The Minister of Energy develops and proposes general policy and standards for the electricity sector to the President of the Republic. He also grants licenses and concessions provided by the Energy Act and has the power to remove them. The Ministry of Renewable Energy is responsible for framing policies for the promotion of electricity generation from renewable energy sources and thus plays a key role in formulating policies and monitoring decisions taken in consultation with the Ministry of Energy and other relevant stakeholders for promoting decentralized renewable energy applications.

Electricity Commission: The Electricity Commission has, as part of its regulatory mission, a number of main responsibilities that include advisory functions and decision-making powers. In its advisory functions, it contributes to the development of national strategies related to the electricity sector: (i) advising the Minister of Energy on all legislative and regulatory plans for the electricity sector; and (ii) offering to the Minister of Energy orders related especially to the rights and obligations of companies, third party access to the network and business relationships with their customers.

The Commission also has powers to take individual decisions in the energy sector. Thus, it has the skills to: (i) examine applications for a license or concession; (ii) ensure compliance with the terms of the licenses and concessions; (iii) make changes to general licenses, concessions or their specifications; (iv) ensure compliance with technical standards; (v) ensure compliance with competition in the sector; (vi) determine the structure and composition of tariffs; and (vii) apply, if necessary, sanctions to operators for breaches of duty. Eventually, the Commission also has broad powers of investigation in the sector.

National Committee for Hydrocarbons: The National Committee for Hydrocarbons gives opinions and recommendations relating to the hydrocarbon sector on the request of the Minister of Energy and Mines. It suggests law modifications, gives opinions on license requests and suggests sanctions against license holders violating their obligations. It also conducts periodic consultations with operators, consumers and the other institutions of the hydrocarbon sector; analyses and evaluates the impact of the liberalization rules on the performances of the sector; and follows the evolution of prices.

5.1.3.2 *Regulated activities*²²

In the oil and gas segment, approvals are granted to undertake the following petroleum operations: (i) prospecting; (ii) exploration of hydrocarbons; (iii) temporary exploitation; and (iv) exploitation of hydrocarbons.

²¹ The Energy Regulation and Markets Review - Edition 6 – July, 2017 – Editor: The Law reviews

²² The Energy Regulation and Markets Review - Edition 6 – July, 2017 – Editor: The Law reviews

In the electricity segment, approvals are required from the Minister of Energy on a proposal from the commission of electricity regulation to conduct the following activities: (i) the production and sale of electric energy; (ii) the distribution of electric energy; and (iii) the sale of electric power industry.

Furthermore, only the National Electricity Company of Senegal (SENELEC) is entitled to exercise a wholesale purchasing activity, and transport and sell wholesale electric power throughout the national territory for a period to be defined by a concession contract with the Minister for Energy. It also owns about half of the generation capacity, with the remainder being owned by independent power producers (IPPs) that generate electricity and sell it exclusively to SENELEC.

Senegal was among the first countries in Sub-Saharan Africa to introduce private sector participation in the power sector in the late 1990s. The first IPP was GTI, a 52MW combined cycle oil-fired power plant commissioned in 2000. The second IPP was *Kounoune*, a 67.5MW power plant commissioned in 2008. The track record of IPPs in the country has been mixed, mainly due to variations in the quality of fuel delivered, grid instability and other technical difficulties that have reduced electricity output from these plants. Some of these issues have been resolved and the Government of Senegal remains committed to relying on private sector investment to bridge the generation gap.

SENELEC is the concessionaire for the transmission and distribution network in Senegal (with the exception of *Manantali* interconnection) and operates in a monopoly condition for the purchase and sale of wholesale power.

In the electricity sector, the Minister of Energy grants licenses or concessions based on proposals from the CRSE. The process for obtaining licenses other than those relating to independent production of electricity or concessions is as follows: (i) the applicant addresses his or her request for a license or concession to the Minister of Energy. A copy of this application is also addressed to the President of the Regulatory Commission of Electricity Sector; and (ii) the Minister of Energy sends the file to the CRSE for its opinion.

5.1.3.3 Ownership and market access restrictions

There is no discrimination against businesses conducted or owned by foreign investors. In fact, there are no barriers regarding 100 per cent ownership of businesses by foreign investors in most sectors, including the hydrocarbon sector. Article 5 of the Petroleum Code provides expressly that the state may authorize a company to undertake petroleum operation irrespective of its nationality.

In the electricity segment, there are limitations on cross equity participation between the various activities in the electricity segment, that cannot exceed a certain threshold.

5.1.3.3.1 Transmission, transport and distribution services

Vertical integration and unbundling: Under Senegalese law, the activities of production and distribution of electricity are regulated. To promote fair competition between different actors in the electricity sector, equity investments among different segments of the industry are controlled. The holder of a distribution concession, except SENELEC, cannot acquire, directly or indirectly, an interest in the share capital of a production license holder or the latter in the capital of the first, except where: (i) the capacity of production facilities of the production license holder does not exceed 15 per cent of the total production capacity of electric power in the territory of Senegal, this threshold could not be exceeded thereafter; or (ii) such facilities use the following sources of energy: solar wind and tidal power.

Any acquisition must be brought to the attention of the Commission. However, the production, transmission and distribution of electricity by power plants and transmission and distribution networks, including backup facilities, are free provided that they are issued by a company or household for own consumption or to those of its affiliated companies, since such power stations or networks are established within private property without encroaching on the domain of the state or the national field.

As part of a concession or a service contract, the right to operate a hydrocarbon deposit entitles the holder to the right to transport, according to the stipulations of the agreement or service contract, the product resulting from its operations to the storage points for processing, loading or consumption.

Hydrocarbon transportation rights may be transferred to third parties, individually or jointly, by any holder of exclusive rights to operate under the conditions set out in the agreement or service contract.

Transmission/transportation and distribution access: Companies holding a production license for electricity shall submit to the Regulatory Commission, upon signature, grid connection contracts they conclude with holders of transmission or distribution concessions. It is prohibited for providers of service to grant exclusivity or preferential access. A company performing transmission or distribution of electric energy cannot deny access to electricity producers if their request is normal and made in good faith, nor can they apply discriminatory prices. Only differences between producers on an objective basis can justify differences in tariffs.

Rates: Tariff conditions are defined in the specifications annexed to licenses or concessions. They are determined on a capped price basis and not on the cost of the service. They are applicable for a determined period previously defined in the said specifications. The holder of a license or concession is authorized to vary the rates charged to consumers within the limits of the defined capped price. The Minister of Energy and the CRSE set the fares and allow income levels they consider sufficient to allow the license or concession holder, operating efficiently, to obtain a normal rate of return relative to a base charge fee.

5.1.3.3.2 Energy markets

Energy market rules and regulation: Pursuant to the energy law texts, SENELEC alone may exercise a wholesale buying activity, transportation and wholesale of electricity throughout the national territory for a period defined by a concession contract signed with the Minister of Energy and by the specifications attached to it.

During the period referred to, SENELEC has the quality of a single buyer of electricity. Under the Electricity Act, SENELEC is granted, for a period, the monopoly of wholesale buying and transport.

However, a large place is given to the private sector both in production and in distribution and sale of electrical energy. The graph opposite shows the current and forecasted shares of the power generation market based on committed current committed contracts.²³

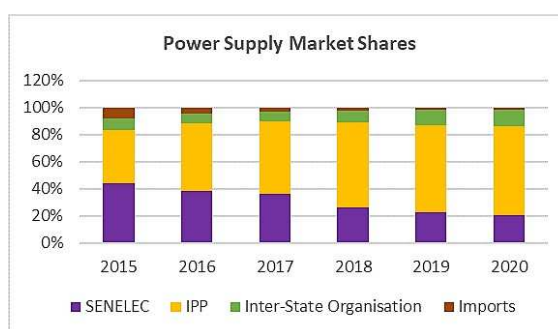


Figure 5-8 : power supply market shares

Regarding the oil and gas segment, the hydrocarbon deposits carriers may be required, under conditions laid down in their agreement or service contract, to assign priority products of their operations to cover the domestic consumption needs of the country. In this case, the transfer price should reflect the international market price. After meeting the domestic needs of the country, the farmers' production share can be exported freely and free of all duties and export taxes.

Contracts for sale of energy: Any company planning to sell electricity must obtain a license for this purpose from the Minister for Energy. Attached to the license are specifications that determine the territorial scope where appropriate, the duration and the public service obligations that are imposed on the incumbent. It indicates the type and consumption of electrical energy customers that the owner can service.

5.1.3.4 Renewable energy and conservation

The regulatory framework in Senegal comes in the form of decrees that are promulgated periodically. The two most important and recent decrees for implementing the Law on Renewable Energy were issued in December 2011. They lay down the purchase and remuneration conditions for electricity generated by renewable energy plants, the conditions for the connection of these plants to the grid and the

²³ SENELEC data

conditions for purchase and remuneration of surplus electricity from captive power plants generating electricity from renewables. However, reduced taxes and customs duties applicable to renewable energy equipment are only considered on a case-by-case basis.

The implementing decrees of the Renewable Energy Law are as follows:

- Decree No. 2011-2013 provides conditions of power purchase and remuneration for electricity generated by renewable energy plants and the conditions of their connection to the grid. It also provides the formula for the avoided cost, which serves as a reference for calculating the power purchase price cap. It also contains elaboration on renewable power purchase obligation and feed-in tariffs for different renewable energy technologies.
- Decree No. 2011-2014 provides the conditions of power purchase of surplus renewable energy-based electricity from self-producers. It has fixed the maximum intake from renewable energy sources. It has also determined the purchase price, conditions of purchase of surplus energy, connection to the grid, etc.
- Law No. 2010-22 of 15 December 2010 of the biofuel sector - this law on the orientation of the biofuels sector, was adopted in 2010 with the aim of creating favorable conditions for the development of the biofuels sector and providing answers to the problems of economic growth, based on a policy of energy self-sufficiency through the development of biofuels. The law therefore covers all components of the biofuels sector including production, processing, storage, transport, marketing and distribution.

5.2 THE ENERGY DEMAND AND SUPPLY STATUS²⁴

The supply of primary energy is characterized by the prevalence of fossil fuels and biomass. In 2013, coal, hydro-electricity and natural gas account altogether for 8% whereas the contribution of renewable energies remains very small. Senegal was independent on average at about 48%. The rate has slightly improved since then considering the recent start of renewable energy production plants. However, this relatively high energy independence rate is mainly related to biomass energy consumption. In fact, the modern energy independence rate (i.e. excluding biomass) is very low (2%) on average.

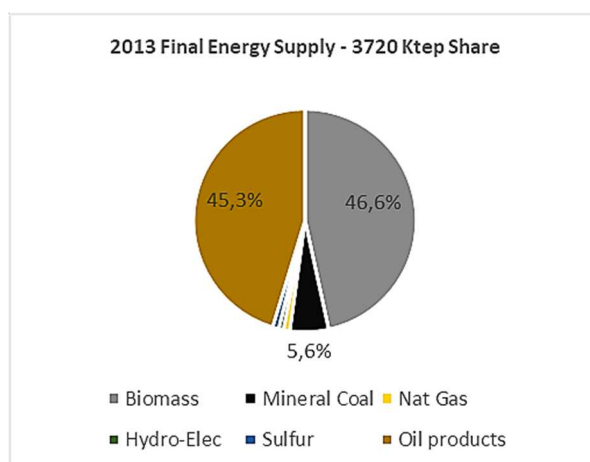


Figure 5-9 : final energy supply

Senegal's per capita energy consumption in 2016 was 0.27 toe, including approximately 230 kWh of electricity. The country's total energy consumption is growing rapidly (+3.6%/year, on average, since 2000).²⁵

Actually, 90% of Senegal's energy (excluding biomass) comes from imported heavy fuel. Thus, it is simultaneously committed to shifting from a diesel-based power generation to cheaper energy sources. In addition, Senegal has embarked on an aggressive effort to produce significant quantities of biofuels, initially to run electricity generation units, and has projects using sugarcane-based ethanol.

²⁴ Rapport SIE Sénégal 2014

²⁵ <https://estore.enerdata.net/energy-market/senegal-energy-report-and-data.html>

The final consumption is dominated by biomass and oil products and the relatively low power consumption reflects the equally low national electrification rate of 60%. In Senegal, households use energy mainly for cooking, lighting, refrigeration and ventilation. Firewood is the main energy resource used in the Senegalese households (450 ktoe/year since 2000). It is followed by charcoal which exceeds 200 ktoe. LPG is in third position and rapidly growing owing to the financial incentives introduced by the government (LPG subsidy). Electricity and kerosene contribute to a lesser extent to the households needs.

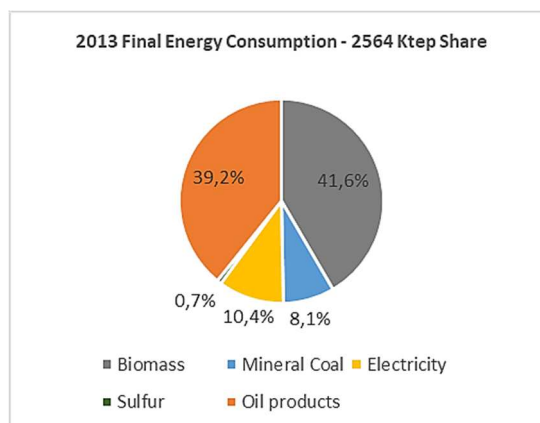


Figure 5-10 : final energy consumption per source

The consumption of mineral coal (coal) is due exclusively to the SOCOCIM and CIMENT DU SAHEL cement plants which use it in their kilns for cooking clinker. Imported crude oil is processed and refined by Senegal's only refinery, Société Africaine de Raffinage (SAR). Refined oil products are also imported directly, as SAR's processing capacity covers less than 40% of the market.

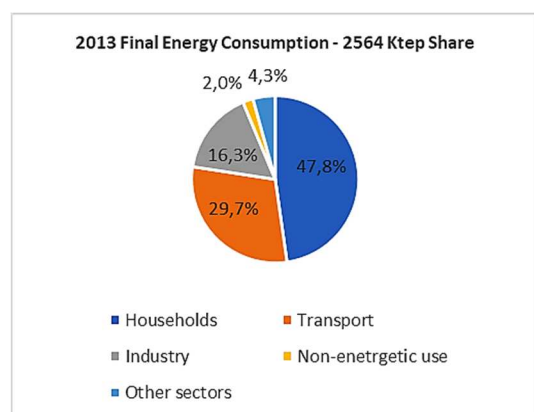


Figure 5-12 : final energy consumption per sector

of most of the transport vehicles (taxis and public transport vans) exceeds 10 years (see figure 5-15 below). In 2012, the newly elected president pushed the extension of the age limit for the importation of used vehicles, from 5 to 8 years, by the parliament. This is a situation that has worsened since then.

The residential sector is the first final consumer before the transport and industry sectors, which characterizes simultaneously the low industrialization level of the country and the prevalence of biomass in the household's consumption pattern.

Transportation in Senegal is the second largest energy consumption sectors (30% of the final energy consumed in 2013)²⁶. The calculated mean weighted energy efficiency of the transport sector is around 14.70%²⁷, essentially because of the obsolete nature of vehicles in use (cars, trucks, etc.). Indeed, the average age

Age	<5ans	>5 et <10	>10 et <15	>15 et <20	>20
Senegal	8.9%	8.1%	22.4%	30.4%	30.3%
Dakar	10.5%	9.4%	23.2%	29.0%	27.9%
Rest of the country	2.8%	4.8%	22.3%	32.6%	37.4%

Figure 5-11 : distribution of motorized vehicles by age

The graph below completes the energy usage distribution of the sector.²⁸

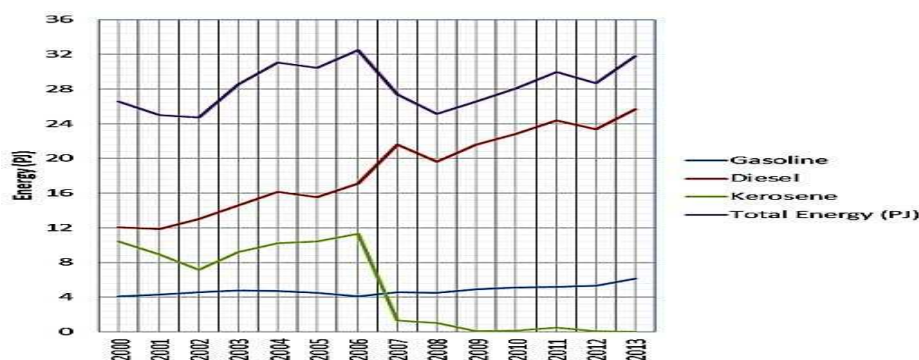


Figure 5-13 : transportation fuel market shares

²⁶ Rapport SIE Sénégal 2014

²⁷ <http://www.aimspress.com/article/10.3934/energy.2017.6.912/pdf>

²⁸ <http://www.aimspress.com/article/10.3934/energy.2017.6.912/pdf>

5.2.1 Electricity subsector²⁹

5.2.1.1 Power supply and consumption

The production capacity of 843 MW installed in 2015 including 489 MW by thermal power plants managed by SENELEC public limited company with majority government.

Thanks to the IPPs, the country installed capacity has increased to 1000 MW in 2016 and 1100 MW in 2017. The graph below gives the predicted power generation market shares based on the committed capacity infrastructure implementations.

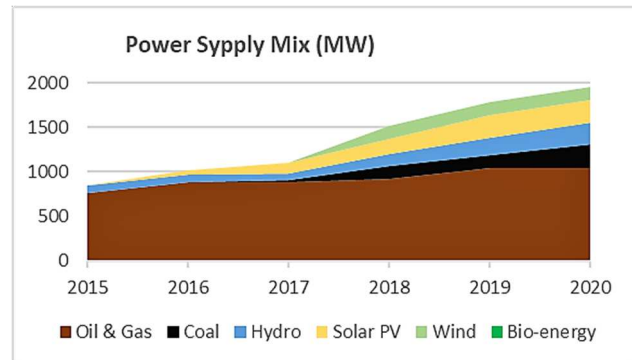


Figure 5-14 : power supply mix

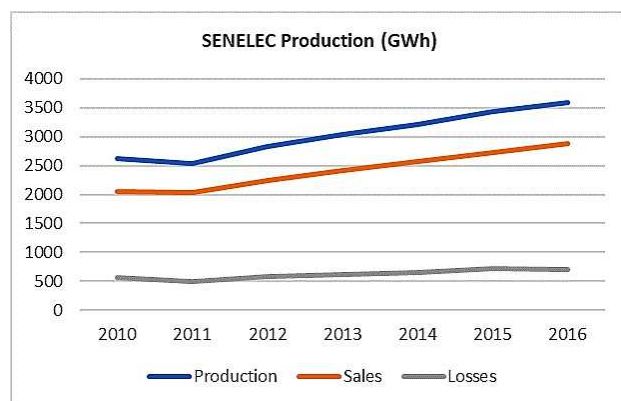


Figure 5-15 : SENELEC production losses

The difference between production and sales has remained constant between 2010 and 2016 representing about 20% of the total production of SENELEC (see graph opposite). These losses are explained mainly by the obsolescence of the grid which had not been subject of a systematic renovation until 2016.

5.2.1.2 Structure of the power consumption

The consumption of domestic customers and professional and industrial customers supplied with LV, MV and HV grew in almost the same proportions. Thus, the structure of consumption in 2015 and 2016 remains the same as in previous years. In 2016, professional uses accounted for 54% of consumption, while domestic and public lighting accounted for 44% and 2% respectively. The national electrification rate was 60% in 2016, with a marked imbalance between urban areas and rural areas (see map opposite).

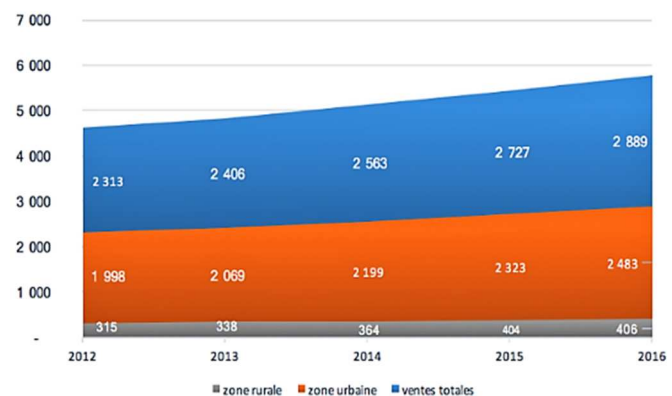


Figure 5-16: rural versus urban areas consumption in 2016 (GWh)

5.2.1.3 Power affordability and tariffs

Senegalese laws and regulations closely regulate SENELEC's finances and tariffs. The public company must respect a maximum allowable income. It can receive compensation from the State "for maintaining the tariffs in force". The Maximum Allowable Income is calculated according to the formulas of the level of a master's degree in mathematics, or even an aggregation, and the decision-making processes are worthy of the elaboration of a European directive, that is to say, not particularly light. The reality is much simpler: the rates are stable, in current currency, for several years.

²⁹ CRSE, SENELEC

For families and small businesses, it has been 123 Francs CFA per kWh from 2010 to the end of 2016, or 19 cents. As the CFA Franc is linked to the euro, inflation is low. In fact, in constant currency, electricity tariffs have dropped by 1 to 2% per year. For Senegalese, these rates are extremely high. Admittedly, they are lower compared to Europe, and even to France (22 cents per kWh in 2016 - see Eurostat), but the standard of living being tens of times lower, the price of electricity makes its use very expensive for almost all families. Hence massive current flows evaluated at the beginning of 2017 at 7% of billed electricity. For companies (average and high-voltage deliveries), they did not change much either. For high voltage, so for the industry, it was, in 2015 and 2016, on average 85 CFA francs per kWh, or 13 cents, a little lower than the French price for small industry. Unfortunately, this slight price advantage was canceled by the impact of the cuts.

The President of Senegal announced on January 1, 2017, a reduction of electricity tariffs for households by 10%. On March 1st, the President of the Regulatory Commission indicated that it would be 15% for annual consumption below 150 kWh, 11% for 150 to 250kWh and 4% beyond. Future declines are expected by the government as new generation means come on stream from 2018 to 2020.

5.2.2 Renewable energy subsector

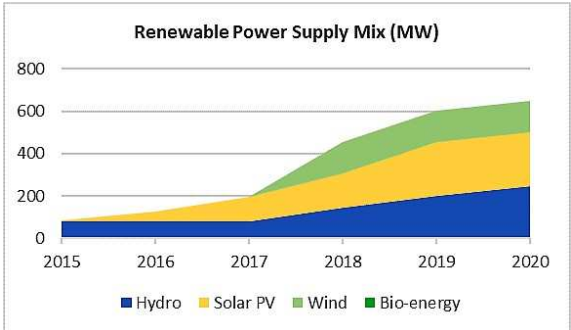


Figure 5-17 : renewable power supply mix

Based on the installed and committed projects, the share of renewable energy in the total power generation capacity will evolve from 10% of hydro, 0,4% of solar PV and 0% of wind in 2015 to 13% of hydro, 13% of solar PV and 8% of wind power in 2020, whilst the total capacity will be multiplied by 2,3 up to 2 GW in the same period.

5.2.2.1 Solar power

The solar resources in Senegal are characterized by 3,000 hours of sunshine per year, and average overall daily solar irradiation of 5.8 kWh / m2 / day. Until now, these resources have been harnessed through photovoltaic and thermal solar systems. Photovoltaic solar systems have seen the most sustained development in Senegal. It has been the subject of significant development in various fields (telecommunications, water pumping and centralized and decentralized electricity generation). The first facilities were set up in the 1980s. In 2007 the total installed capacity was 2 MWp. In two years, between 2016 and 2017, it rose to 113 MWp. Current projects should take the total installed capacity up to 255 MWp by 2020.

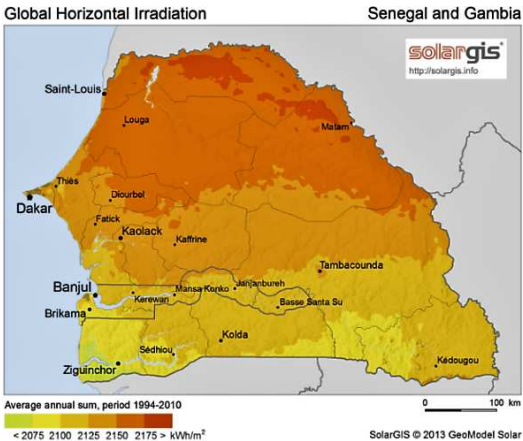


Figure 5-18: solar irradiation

5.2.2.2 Wind Power

Wind power could be an interesting field to develop for electricity generation, in particular on the northeastern coast of the country, the Grande Côte, from Dakar to Saint Louis. The potential exists on this strip of 200km long and 50km wide and where market gardening activities are concentrated.

Recent measurements conducted between 30 m and 40 m in height have revealed the existence of speeds of more than 6 m/s. Although several projects and programs have been implemented since the 80s, the wind power sector remains underdeveloped, and the total installed power which is truly

operational at present does not exceed 0.5 MW throughout the country. However, the sector offers interesting prospects given the wind data recorded by private developers on the north coast, and especially given the development of technology over recent years.

According to certain estimates wind power could account for as much as 70% of Senegal's renewable energy generation capacity. A first on-grid project called SAREOLE was launched in 2016. It should deliver 150 MW of power in 3 phases: 50MW in 2018 (*Sareole I*), 50 MW in 2019 (*Sareole II*) and 50 MW in 2020 (*Sareole III*).

5.2.2.3 Hydroelectricity

The studies conducted by the Organisation pour la Mise en Valeur du Fleuve Sénégal (OMVS – Organization for the Development of the Senegal River) and the Organisation pour la Mise en Valeur du Fleuve Gambie (OMVG – Organization for the Development of the Gambia River), have shown the existence of several sites with a potential estimated capacity of 1,400 MW on the Senegal and Gambia Rivers, as well as their tributaries. The harnessing of this considerable potential is planned under the aegis of these two sub-regional organizations. The OMVS has identified about ten sites ready to accommodate dams for a hydroelectric potential estimated at about 4,000 GWh per year. A series of projects have been launched by the OMVS and OMVG that will take the Senegal's share from 81 MW in 2017 to 256 MW in 2020.

5.2.2.4 Bioenergy³⁰

All in all, it remains extremely difficult to collect reliable production and consumptions figures on this sector. Biofuels are a relatively new element in Senegal's energy and agricultural policies.

However, agricultural and animal residues represent a very interesting energy potential, but they are either under-exploited or simply wasted. Only few industries, mainly agro-industries like SONACOS (vegetable oil production) and CSS (sugar cane company), use agricultural residues (peanut shells, bagasse, etc...) for co-generation. With this in mind, the Government launched in 2007 the special biofuels program based mainly on the promotion of *Jatropha curcas* L (for the production of oil) and sugar cane (for the production of ethanol).

In addition, the biomass sector presents proven prospects for the production of biogas, in particular from: (i) animal waste, with an estimated potential of 32,000 tons of dry matter per day (ENDA report - March 2005); (ii) industrial waste from the abattoirs managed by the SOGAS (Société de Gestion des Abattoirs du Sénégal – Senegalese abattoir management company); (iii) in a year, the potential production of biogas from abattoir waste could reach 53 toe for solid waste and 70 toe for liquid waste; (iv) household waste, with an estimated potential biogas production of 41.4 million m³ per year in urban areas, equivalent to 23,000 toe, if we consider that one ton of dry matter would produce 180 m³ of biogas; and (v) human waste (faeces and urine).

For several decades Senegal can boast considerable knowledge in the use of biomass as an energy source in agri-food industries to meet a large part of their electricity and heating consumption. Notably, groundnut shells and palm husks used by the "SUNEOR Group", the bagasse used by the Senegalese Sugar Company (CSS), and the cotton stalks used by the textile fibers development company (SODEFITEX).

5.2.3 Energy efficiency in the households' subsector

In the household sector there is significant energy efficiency potential for both cooking fuels and electricity uses. The energy efficiency options can be differentiated according to the income levels of the households as follows: wealthy households and poor-rural households.

³⁰ PROGEDE 2 and PERACOD sites ; IRD Éditions,2012 *Jatropha curcas* L. au Sénégal

5.2.3.1 Wealthy households

They use increasingly more modern and cleaner fuels and devices such as LPG and improved stoves for their cooking needs. This is in fact the main reason behind the success of the introduction of LPG in Senegal. Indeed, the LPG subsidy program has more benefited rich households who have enough financial resources to purchase modern LPG stoves and LPG cylinders. The transition of wealthy households to LPG and the introduction of more efficient biomass stoves have all contributed to biomass energy efficiency. Substitution from traditional cooking equipment to improved stoves increases energy efficiency from 15% to 40%.

In the electricity sector, there is strong energy efficiency potential through the introduction of low energy bulbs in wealthy households. Accordingly, SENELEC has developed a pilot energy efficiency project covering 688 households to evaluate its feasibility on a larger scale. This will help assess the effectiveness of this measure in improving energy service quality (reduction of power outages caused by peak demand that often cannot be met) and in decreasing households' electric bills.

5.2.3.2 Poor and rural households

They still use biomass (wood and charcoal) to satisfy their cooking needs. The three-stone stove, with an efficiency of 0.1%, remains the most used cooking device in poor urban and rural areas. Improved stoves, with an energy efficiency of up to 40%, make a weak penetration in those areas because of the high upfront prices and the lack of organization and financing mechanisms to make them affordable to all. In addition, despite the subsidy, access to LPG by poor has remained low because of various barriers such as financial capacities to purchase LPG devices and lack of distribution outlets at decentralized level to meet the demand of the scattered habitat in rural areas. The development of domestic biogas, as cooking energy efficiency option, has experienced a low progress. Several initiatives were launched but their impacts have remained weak. In the electricity sector, a Clean Development Mechanism (CDM) energy efficiency project (Senegal Rural Lighting Efficiency project) is being developed by ASER with support from the World Bank.

The ASER Rural Energy Efficient Lighting Program is a component of a rural electrification plan that will provide communities (around 365,000 rural households within five years corresponding to about 1,500,000 CFL lamps) with affordable access to power.

5.2.4 Oil & Gas subsector

Senegal has been attracting the attention of oil and gas companies for more than 60 years. Despite the fact that nearly 140 offshore wells have been drilled since the 1950s, proven reserves have remained very limited until recently. The country's hopes for the evolution of production levels seemed, at best, slim. This changed dramatically when Cairn Energy simultaneously announced two exploration successes in late 2014, complemented by KOSMOS ENERGY's announcement of two gas discoveries in the first quarter of 2016. The map opposite provides an overview of the current offshore wells.³¹

Thanks to continuous promotional efforts over the last decades, the Ministry of Energy, supported by PETROSEN, the Senegalese national oil company, has succeeded in attracting oil companies, initially small and then larger, especially since the promulgation of the 1998 Act, specifically designed to make

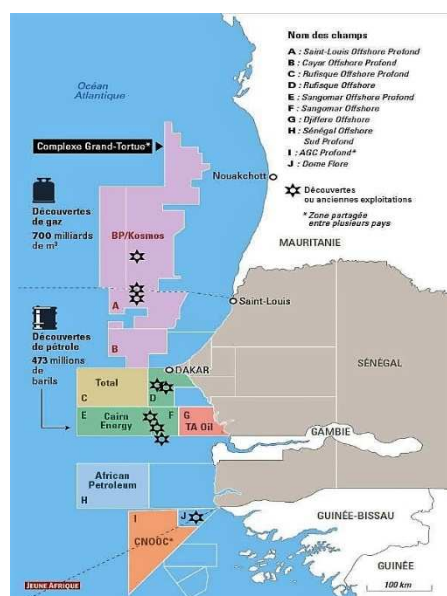


Figure 5-19 : oil & gas fields

³¹ Jeune Afrique magazine

exploration and exploitation more attractive and to pay more attention to environmental problems.

In the entire basin, only *Gadiaga Field No. 2 of the Tamma onshore block* was in production in 2014, with small reserves (363 million m³) and natural gas production of 41 million m³. In recent years, all gas sold has been delivered by pipeline to SOCOCIM, a cement producer, and SENELEC.

5.2.4.1 Current development activities

The table bellows is an overview of current oil and gas discoveries in the Senegal and Mauritania's waters.

Tableau 5-3: Current Oil & Gas development activities

N°	Block	Well	Operator	Partner	Oil & Gas content	Phase	Remark
1	Sangomar	FAN-1	Cairn Energy PLC (40%)	Woodside (35%), FAR (15%), Petrosen (10%)	Oil: 330MMBbl	Field Appraisal	Well depth 1430m
2	Sangomar	SNE-1	Cairn Energy PLC (40%)	Woodside (35%), FAR (15%), Petrosen (10%)	Oil: 900MMBbl Gas several Tcf gas	Field Appraisal	Well depth 1000m
3	Tortue & Teranga	Gueumbeul wells 1 & 2	Kosmos (60%)	Timis (30%) Petrosen (10%)	Gas: 15Tcf	Field Appraisal	Well depth 5000m Field inter connection Mauritania and Senegal
4	Grand Tortue	Teranga 1	Kosmos (28%)	BP (62%) Petrosen (10%)	Gas: 50Tcf	Field Appraisal	Extending from Marsouin in Mauritania

At the time being, the reserves of the region, established by the geologists of these companies, are mainly gas with 700 billion cubic meters at *Grand Tortue*, the largest deposit in West Africa. Pockets of 473 MMBbl of crude oil were also found. Dakar should produce from 2021 its first barrels of black gold, with an average of 100,000 to 120,000 barrels per day (b/d) forecasted by CAIRN ENERGY. In addition, KOSMOS and BP have launched a first LNG plant on a floating barge at the Senegal-Mauritanian maritime border, 8 km from Saint-Louis. It could begin in 2022, with a production of 227 billion cubic meters over 30 years.

On the Deep Offshore *Sangomar block*, an SNE Discovery Assessment Campaign is still in progress, including 3D seismic analysis in 2015 and four delineation drilling (SNE-2, SNE-3, BEL-1 and SNE-4) in 2016. Other appraisal work was completed in 2017, including well testing. This campaign confirmed the high quality of the crude oil, the productivity of the wells as well as the probable development plan of the project (Floating Production Storage and Offloading - FPSO). Currently, the planned schedule for the project is as follows: FID in early 2019 and First Oil in 2021/2023.

In May 2016, *Teranga-1* was successfully drilled in Senegal. Given the large size of the resources and low-price trends of the international LNG market, the operator is willing to develop the resource in stages. The first phase would be a low-cost solution to establish Senegal and Mauritania as producing countries in a timely manner. An innovative LNG concept floating near the coast (FLNG) is thus part of the preliminary and screening studies. BP plans to drill four more wells and will then decide on a project development concept this year targeting a final investment decision (FID) by the end of 2018, in the hope of the first production in 2021/22 and an expansion in 2025/2026. The fact that the petroleum systems straddle the border between Senegal and Mauritania is a complicating factor which hampers the development of reserves and requires a cross-border unitization deal as well as operations involving

cooperation and agreement from both countries. However, these problems are attenuated by the fact that KOSMOS and BP hold rights in the contiguous blocks on either side of the border. Luckily, Senegal and Mauritania are willing to resolve the problem amicably and have reached a memorandum of understanding (MOU) on the subject.

5.2.4.2 Other exploration activities

T5 Oil & Gas, obtained a 10,000-square-mile production sharing agreement in the *Louga onshore block* following the acquisition of *Blackstairs Energy* Senegal. Two main exploration areas have been identified on the block that could contain about 1 Tcf of gas and more than 150 MMBbl of oil, according to T5. The ongoing second exploration period that expires in July 2018 requires the drilling of an exploration well. If successful, the third exploration period s until July 2020 and would necessitate the drilling of two additional wells.

Oryx Petroleum conducts a variety of exploration activities in the blocks of *AGC Central*. The light oil reserves identified in the AGC Central licensing area are initially estimated at a total of 367 MMBbl. The drilling of an exploration well is planned for early 2018. In the *AGC Shallow block*, Oryx identified three structures for potential light oil exploration, initially estimated to contain a total of 192 MMBbl. Oryx plans to drill a well in early 2018 to meet its drilling commitment for the first phase of exploration.

In May 2017, TOTAL signed two exploration agreements with the Republic of Senegal concerning deep and ultra-deep offshore zones. The exploration and production sharing contract for the *Rufisque Offshore Deep block*, covering an area of 10,357 km², provides 90% for TOTAL, the remaining 10% being held by PETROSEN. In addition, Total will evaluate the exploration potential of Senegal's very deep offshore.

6 POLICY ANALYSIS

6.1 SECURITY, SUSTAINABILITY AND AFFORDABILITY STATUS

The oil bill is paid in foreign currency, which unbalances the macroeconomic aggregates. The Senegalese oil bill rose from FCFA 185 billion in 2000 to FCFA 327 billion in 2005, and FCFA 353 billion in 2006. Eighty percent (80%) of electricity production came from thermal power plants in 2017.³²

The country faces a chronic dependency on foreign energy which accounts for nearly 52% of the energy supply if biomass production is included and for around 98% if without biomass.

The energy sector is characterized by a structural vulnerability due mainly to its strong dependency on foreign imports and the reduction of its supply to two main sources: oil and biomass. Therefore, this nearly dual structure (imported oil and biomass) bears potential risks for energy shortages and makes it difficult for Senegal to put in place a sustainable and cost-effective energy supply system or strategy.

Three preponderant sectors of the economy use a great part of the total oil supply:

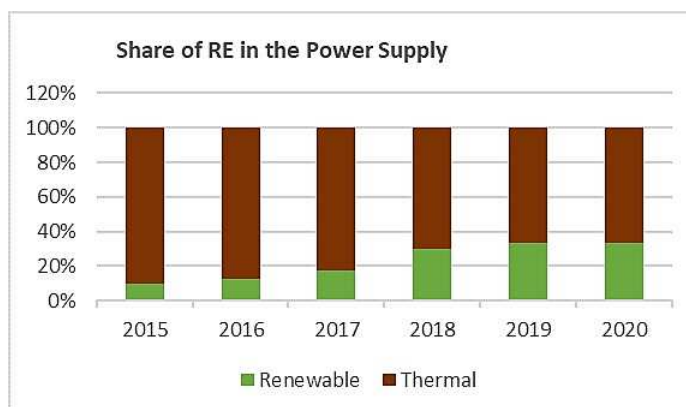


Figure 6-1 : share of REs in the national power supply

³² SENELEC

- the transportation and manufacturing industries which account respectively for 30% and 16% of national consumption. In those industries, energy expenses represent a significant part of production costs. Hence, the ability of these sectors to maintain high productivity and remain competitive is heavily affected by the volatility in the price of oil and its derived products;
- the household sector which accounts for 48% of the total energy consumption. Domestic fuels (wood and charcoal) account for 76% of the household consumption, oil products 17% and electricity 7%.³³ Thus, this sector is highly vulnerable to biomass shortages. This risk is aggravated by the permanent threat of drought, as well as deforestation caused by the lack of an integrated management strategy for natural resources. The growing use of LPG by households represents an additional cost for the government which is subsidizing it.

This situation results in two kinds of vulnerabilities, notably:

- an economic and financial insecurity caused by soaring oil prices and the linked oil bill burden that negatively impact the balance of payments;
- an environmental insecurity due to the massive harvesting of forest resources, mainly to meet the needs of the households, small and medium-size companies and the craft industry. Recent estimates indicate that 77.667 ha of forest have already disappeared, due to an abusive exploitation of resources to meet energy needs³⁴, which has serious implications on the biodiversity of forest ecosystems.

In summary, the energy security situation of Senegal is characterized by:

- a high dependence on oil imports;
- prevalence of thermal sources for power generation;
- the low storage capacity for imported energy and absence of strategic storage capacities;
- prevalence of biomass in the total energy volume;
- low energy efficiency in production, distribution and consumption sectors;
- a gap between energy supply and demand;
- relative low use of renewable energy with regards to the country's potential, mainly solar PV, thermal solar energy, modern biomass and hydroelectricity for power production;
- climate hazards risks leading to insufficient hydro power production;
- but also
- population growth creating growing demand;
- important energy policy projects necessitating capacity building;
- a commitment to sub-regional cooperation.

6.2 POLICY ASSESSMENT

Senegal's score against the World Bank's Energy Sector Management Assistance Program (ESMAP) – Regulatory Indicators for Sustainable Energy (RISE) indicator reflects fairly well the country's performance with regard to its energy policy and regulatory frameworks. The RISE assesses countries' policy and regulatory support for each of the three pillars of sustainable energy: access to modern energy, energy efficiency, and renewable energy. The Country overall score is 48 with the following breakdown: 69 on Energy Access, 54 on Renewable Energy and 19 on Energy Efficiency. The next 2 provide respectively snapshots of the country's global and regional positions in 2016

The next 3 sub-chapters provide a more detailed understanding of the evaluation parameters, thus highlights the country's policy support shortcomings accordingly.³⁵

³³ Rapport SIE Sénégal 2014

³⁴ Direction de l'Énergie, 2006

³⁵ The World Bank Group RISE data base

6.2.1 Energy access

ith regards to the Senegal's 2012 LDPSE goal to reach universal access to electricity by 2025 with an intermediary step of 60% rural electrification in 2019, the result is somehow mixed. In effect, the existing regulatory framework has highlighted several shortfalls as outlined by the map opposite.

Also, even though no clear data is available on rural electrification since the end of 2016, the figures in the below would indicate that the objective of 2017 wasn't met.³⁶

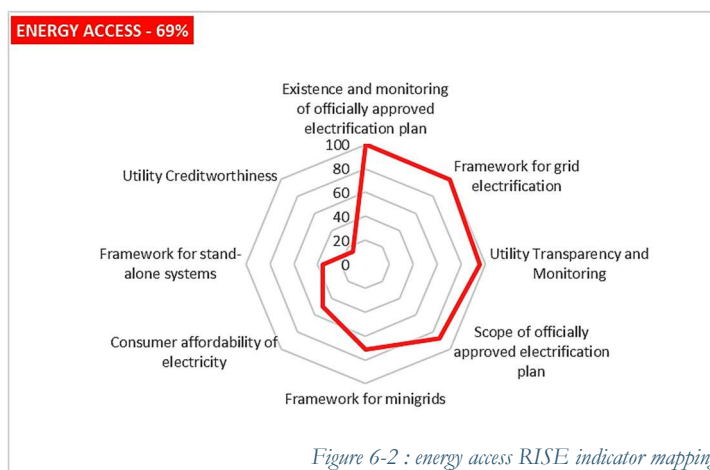


Figure 6-2 : energy access RISE indicator mapping

Tableau 6 1: Rural electrification achievements 2012 - 2016

	2012	2015	2016	Evolution
Electrified villages	1,648	2,840	3173	+72%
Electrified rural households	170,000	216,000	-	+27%
Rural Electrification rate	24%	31,5%	-	+7,5%

6.2.1.1 Evaluation of the system of concessions

Since the division, 6 of the 10 concessions have been awarded: (1) *St. Louis, Dagana* (COMASEL); (2) *Podor, Louga, Linguère* (COMASEL); (3) *Kaffrine, Tambacounda, Kedougou* (ERA); (4) *Mbour* (STL); (5) *Kolda, Velingara* (ENCO); and (6) *Kaolack, Nioro, Fatick, Gossas* (ENCO).

However, several years after the signing of the concession contracts with MEDER, considerable delays were observed in the implementation. Only two of the operators (COMASEL and ERA) made significant progress by connecting to the grid or providing decentralized solar or hybrid systems.

At the end of 2015, only 5,679 households (5% of the target) and 710 villages had been electrified (49% of the target) compared to a target of end-2017 which consisted of a connection of 106,601 households across the country. electrification of 1,443 villages of which 862 by network and 581 by solar way.³⁷

Root causes

- Long process of granting and enforcing concessions (2 years);
- Low acceptance by the population of the pricing system;
- Coexistence in the same municipality of villages with SENELEC tariffs and operator tariffs for rural electrification;
- Non-payment of public lighting bills by a large number of municipalities;
- Difficulties to mobilize additional concessional financing for the 4 concessions not yet allocated.

6.2.1.2 Evaluation of the ERIL system

By the end of 2015, 44 ERIL projects had been awarded with 150 electrified villages and 7,116 households connected to a target of 8,883 households (80% of target) if PERACOD mini-grids are accounted.³⁸

Root causes

³⁶ ECREEE - Expérience du Sénégal sur les Concessions d'Electrification Rurale – Abuja – July 19, 2017

³⁷ ECREEE - Expérience du Sénégal sur les Concessions d'Electrification Rurale – Abuja – July 19, 2017

³⁸ ECREEE - Expérience du Sénégal sur les Concessions d'Electrification Rurale – Abuja – July 19, 2017

- Difficulties in obtaining exemption certificates allowing operators to benefit from the provisions of the ASER Tax Convention
- Low profitability of exploitation linked to the authorized size of ERILs that cannot exceed 200 households

Thus, for both models (Concessions and ERIL), these delays are mainly due to:

- Institutional overlaps, long and complex administrative procedures;
- A business model that makes investments difficult to make profitable;
- No policy related to grid interactivity (e.g., what would happen when the national grid arrives) creates uncertainty for off-grid projects;
- A tariff model often beyond the reach of poor households;
- Mini-grid operators usually struggle to secure loans from commercial banks because they aren't contracted by the government and generally lack collateral otherwise

Indeed, there is currently a profound difference between the prices applied in urban and rural areas. In rural areas, the cost of electricity is, in fact, two or three times more expensive than in urban areas. The difference in electricity tariffs is explained by the reform of the energy sector. Indeed, in urban areas, SENELEC is responsible for the distribution of electricity, while in rural areas it is entrusted to a concessionaire, or private operator, selected by call for tenders by the Senegalese Electrification Agency (ASER).

From a regulatory point of view, the law requires the regulator to ensure each operator, a rate of return on investment allowing it to cover its operating and maintenance expenses, depreciation and taxes. Now, in the structuring of tariffs, urban consumers pay only electric power, while in rural areas, the consumer not only pays electricity, but in addition, it supports the cost of connection that the private concessionaire has the obligation to carry out with all the interior amenities. This leads to raising the cost of electricity in rural areas. As a result, the technical and economic conditions of electrification vary from one concession to another which, of course, induces a heterogeneity of the applicable tariffs. This heterogeneity of the electricity tariff system raises many complaints from users.³⁹ This is most likely why, judging these tariffs excessive, many people in rural areas refuse to subscribe.

6.2.2 Renewable energies

The penetration of renewable energies in the energy supply scheme of Senegal has become a reality since the latest revision of the energy policy. However, few shortcomings can be observed (see figure 6-3) that would deserve improvement measures.

Bioenergy: Despite the will of the Government, a legislative framework has not been able to underpin the activities of production, processing and marketing from the start of the program. In all the links of the chain, dysfunctions subsist. To date, it remains difficult to assess the actual contribution of bioenergy to domestic production as well as the success rate of the biofuel production plans.

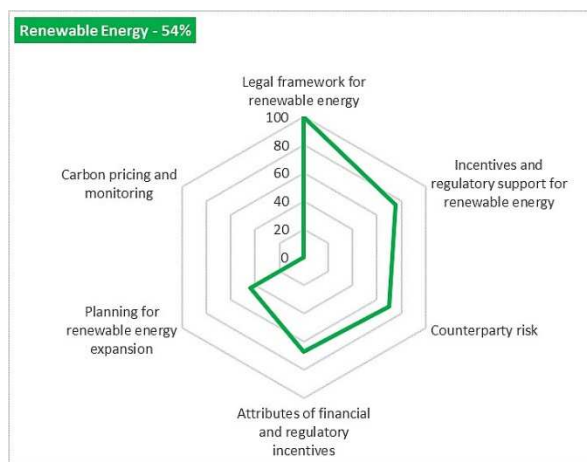


Figure 6-3 : renewable energy RLSE indicator mapping

Renewable Power (Solar, Wind): The target of 20% renewable energy in the electricity mix in 2017 was reached after commissioning, on January 18, 2018, the 30 MWp Ten Merina solar power plant located in the commune of *Merina Dakhar*. The addition of the other projects in the bidding phase also seems to

³⁹ LE SOLEIL journal – March 1, 2017

indicate that the target of 30% renewable energy in the electricity mix is likely to be reached before term (2025). Nevertheless, an assessment of the recent accomplishments should be launched very short term prior to pursuing the deployment strategy:

- What load can the national grid actually handle?
- To which extent can the national grid successfully connect to renewable sources of energy?
- What's the actual efficient output of the 140 MWp on-grid solar PV capacity installed between 2012 and January 2018 in terms of energy delivered (Watt-Hour per day, month, year)?

Economic and financial model: Innovative and sustainable incentivization, tariff schemes, perceived risk reduction and access to funding of local investors by local financial institutions are policy elements that still need clarification in the regulatory framework since, for now, they're treated on a case by case basis.

6.2.3 Energy efficiency

Although it's fair to acknowledge the fact that, in the case of Senegal, speaking about energy efficiency measures seems unrealistic because the per capita energy consumption remains very low, (0.27 toe for the total final energy and 230 kWh/capita for electricity in 2016)⁴⁰, it is nevertheless important to remind that these low per capita figures reflect the fact that a large part of the country total population does not have access to conventional energy (electricity and oil products). In fact, the per capita energy consumption becomes important when we consider only that part of the population that is actually supplied with conventional energy. Moreover, a long-term perspective should also consider the country's +3,6%/year growth rate of total energy consumption which will be accelerated by the ongoing electrification programs.

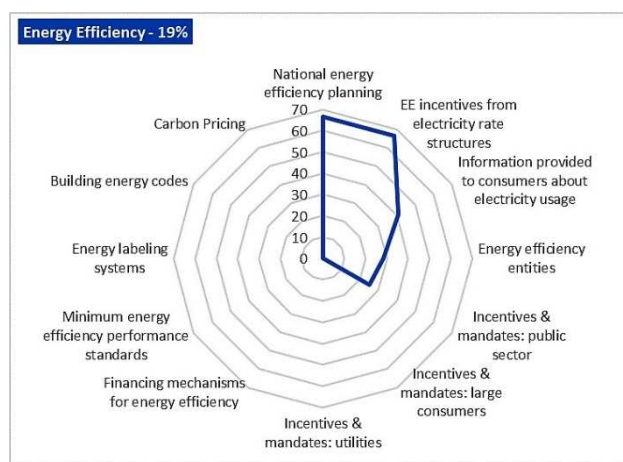


Figure 6-4 : energy efficiency RIASE indicator mapping

Despite many statements by public authorities and initiatives to develop energy efficiency, the process has not yet reached a significant scale due to a series of barriers (see figure 6-4). Even though no official measurements of progress are available to date, one can be skeptical on the achievement of the country's goal to reach 40% energy-saving on the electrical demand by 2020.

Indeed, the main barrier to improving energy efficiency in Senegal is linked to the financial capacity of household and private sectors. Because of the lack of financial means, Senegal is using less efficient equipment particularly in the household, transportation and the administration sectors. Most of such equipment, which can be obsolete, second-handed or of low technology is less efficient than the latest models. The financial problems are compounded by the lack of local awareness and interest. As of now, there is no large-scale communication and outreach program to sensitize the population about energy efficiency.

Another barrier comes from the lack of appropriate legal and regulatory framework aimed at the private sector and consumers, for instance fiscal and customs duties reduction as well as other tax exemptions for private investors.

⁴⁰ Enerdata – Senegal Energy Report – December 2017

6.3 SWOT ANALYSIS

Tableau 6-1: Policy strengths & weaknesses

STRENGTHS	WEAKNESSES
A comprehensive energy policy fully integrated in the 20-years well designed Emerging Senegal Plan (PSE 2014-2035)	Hydrocarbons subsector
Durable peace and stability	Unavailability of oil & gas resources
Installed and anchored democracy	Lack of storage capacity
Dynamic, engaged and involved civil society	Monopoly of the refinery company (SAR)
International openness: Senegal is respected and its voice is audible in the international community	Lack of refinery capacity
Signatory of all key international treaties	Inflexibility of the SAR refinery plant: processing limited to a single crude oil
Member of the Extractives International Transparency Initiative (EITI)	Lack of incentives for storage facilities investment
Favourable geographic location	Electricity sub-sector
	Mixed success of the ERIL program due to inappropriate incentives
	Very slow regional interconnection process of the WAPP
	Renewable energy sub-sector
	No or unclear household auto-consumption policy in place
	Insufficient promotion of RE usage at household level (Agricultural products conservation, livestock and fishing, Grain milling, Water heating, Water pumping and drinking water)
	Energy Efficiency Policy
	Lack of application and appropriate control of new norms and standards
	Lack of incentives to compensate for low financial capacity of final consumers
	Lack of local awareness and interest
	No holistic SMART CITY policy
	No policy aimed at the Transport Sector
	Governance, Policy framework and Implementation
	Complex institutional and regulatory ecosystem with too many stakeholders
	Competing programmes
	Weak or little execution of MRV instruments in the policy framework
	Scarcity and fragmentation of the data
	Lack of technology transfer plans in each energy policy sector

Tableau 6-2: Policy opportunities & threats

OPPORTUNITIES	THREATS
Under-exploited energy efficiency potential	Delays in the power supply infrastructure development
Unexploited ESCO potential	Delays in the ERIL program due to inappropriate incentives to drive the uptake
SMART CITIES through "Leapfrogging"	Policy focuses on Supply. Demand is not well addressed in the electrification plan.
Oil & Gas Production Resources	Oil price shocks
Under-exploited biomass potential	Climate hazards risks leading to insufficient biofuel production
Under-exploited own and neighborhood hydro potential	Climate hazards risks leading to insufficient hydro power production
Incipient regional interconnection	Dutch disease subsequent to the oil & gas SOP
Development and implementation of a comprehensive technology transfer plan	Resource curse subsequent to the oil & gas SOP
	Environmental impact of the <i>Sendou</i> 250 MW coal plant
	Public health impact due to traditional usage of biomass by households
	Public health impact due to local pollution based on transport sector fundamental trends

6.4 IMPROVEMENT OPPORTUNITIES

For the case of Senegal where energy supply relies on imported fossil fuels and decreasing forest resources, and where the technical efficiency of the energy system is low, and the storage capacity is insufficient, the appropriate definition of the Energy Security concept aiming to meet the growing energy needs in a sustainable manner and at affordable prices encompasses numerous aspects that are addressed in following sub-chapters.

6.4.1 Energy supply mix

In terms of energy sources diversification, all the following improvements are reasonably achievable in short to mid runs.

Biofuels for transport and residential sectors:

- The food security objectives recommend a diversified agriculture, but the choice of techniques, as part of the implementation of agricultural programs, should follow certain rules: adaptation to the physical context, profitability for the benefit of small producers, management of productive resources, sustainability of production systems. This framework should take into account the economic integration imperatives aimed at the common agricultural policy of WAEMU and ECOWAS, notably, with the establishment of a common market;
- The special program "Biofuels", as an innovation in the agricultural sub-sector, should be introduced in association with traditional crops. For this, a rigorous regulation, which establishes quotas on the areas to be sown between energy and traditional crops, should be applied to any new actor who would like to enter the sector. This quota system has the advantage of upgrading the status of the peasant, favoring the "win-win" partnership between foreign investors and local producers. Since land management is a transferred competence, quota control can be delegated to local governments;
- To reconcile food security and energy security, two schemes are recommended for the transformation of *Jatropha* seeds into biodiesel:
 - at the micro scale, the installation of small and medium processing units (as in the context of multifunctional platforms existing in some countries of the sub-region) would enable rural

populations to meet certain energy needs for the operation of drilling, mills, motor pumps for irrigation around retention ponds, artificial lakes and other wells. This oil production could also contribute to powering the generators for rural electrification, supplementing the energy supply provided by ASER and SENELEC;

- at the macro scale, the industrial processing of Jatropha oil could help to reduce the energy bill, by introducing legislation encouraging, in the medium term, the gradual incorporation of biodiesel or bioethanol into the transport sector, as this has the advantage of reducing greenhouse gas emissions into the environment. The involvement of the private sector in this downstream segment could produce positive externalities in terms of jobs and investment;
- The marketing component, still absent from the "Biofuels" program, requires state support for the sustainability of the sector and the accessibility of biodiesel and bioethanol to consumers. Government intervention would, for example, involve the establishment of consumer price subsidy mechanisms, the financing of which could even come from taxes levied in the oil and gas sector. However, priority should be given to meeting national needs rather than exporting.

Domestic fuel portfolio:

- Conduct an in-depth analysis of the household energy sector to determine the appropriate domestic energy taking into consideration technical, financial, geographical distribution, demography growth and market aspects to elaborate a comprehensive action plan in order to secure domestic fuels supply (for cooking, heating, etc.);
- Include more alternatives sources as biomass energy remains one of the critical vulnerability issues in a dual context dominated by biomass and LPG as main domestic fuels. As a matter of facts, sustainability of both fuels is threatened by external issues such as Climate Change (drought, desertification) and international market fluctuations. In this regard, main options to be actively promoted, to reduce local emissions and enhance affordability, are: (i) solar ovens; (ii) solar heating; (iii) solar parables; (iv) pumping wind turbines for irrigation; (v) biogas from methanation; and (vi) biofuels from Jatropha;
- Continue the PROGEDE program after June 30, 2018 with a PROGEDE III program.

Power generation mix:

- Conduct the transformation of current diesel power plants into natural gas combined cycle generators after the SOP of offshore resources to reduce cost through additional productivity gains and increase affordability to end-users as well as emissions;
- Develop further the sub-regional interconnection through the OMVS, the OMVG, and the West African Power Pool (WAPP) frameworks for electricity generation from hydropower sources, given the huge hydro potential of the region, particularly in Guinea.

6.4.2 Rural Electrification

Current efforts to increase private sector participation in electricity production and distribution should be pushed further to increase efficiency and affordability for all stakeholders. In this regard, it is crucial to remove the constraints and difficulties noted in the implementation of the rural electrification concession approach in order to catch up the significant delay in the implementation of the current concessions (6) and to finalize the process of awarding the remaining concessions (4).

In particular, it is essential to develop a price-system that allows for harmonized and socially acceptable tariffs guaranteeing sufficient income for private concessionaires operating in rural areas. But to do this, it is necessary to conduct extensive consultations with dealers to propose contractual changes and a compensation mechanism. Indeed, based on the price applied by SENELEC to its users equipped with prepayment systems, a study has shown that the need for compensation for energy pricing is of the order of 19.3 billion CFA (29,4 million euros) on first three years.⁴¹

In summary, the main questions that require clear answers are as follows:

⁴¹ LE SOLEIL journal – March 1, 2017

- **Feed-in tariff:** at what price should mini-grids sell electricity to SENELEC, if/when the national grid arrives? If so, what is the grid interactivity policy? How to make off-grid projects attractive to investors and affordable for SENELEC?
- **Financing:** what are the appropriate risk management instruments to secure investors?
- **Subsidies:** to what level should the government subsidize rural electrification projects? How can it do so most effectively?
- **End user tariffs:** What is the optimal tariff policy for off-grid projects? How can off-grid tariffs be harmonized with on-grid prices? Should there be one national tariff for on-grid and off-grid projects? If so, should the government cover the losses of off-grid projects as it does for SENELEC? How would that compensation be funded?

To resolve these questions, it appears necessary to:

- Conduct a research on existing financing instruments and tariff cross-subsidization mechanisms around the globe;
- Develop clear technical standards for grid compatibility;
- Diagnose the grid to assess its capacity and the possibility for interconnection with renewable sources.

6.4.3 Energy efficiency

Address the Energy Efficiency Policy shortcomings through residential level auto-consumption policy implementation, leveraging of the existing high-quality telecommunication network, specific regulation enforcement, specific financial support and communication. In this regard, the following improvements would be necessary.

- **Residential level auto-consumption policy:** should be considered as an important part of Demand Side Management (DSM), in particular, in urban areas which constitute the majority of the demand and where on-grid connection is the standard, through: (i) a clearer regulation of auto-consumption (excess generation resale, residential buildings, etc.); and (ii) a voluntary incentivization of residential auto-consumption (buildings, households) based on smart meters supply by the SENELEC and attractive surplus sale tariffs;
- **Leverage the existing high-quality telecommunication network:** the current deployment of the optic fiber in each region combined with the existing 4G mobile technology in the country enables to target an “Energy management leapfrogging” at short term and reasonable cost through the elaboration of a holistic SMART CITY plan to be fully integrated into the national energy policy with the collaboration of collectivities, as well as local and international private sectors. The plan should to include: (i) DSM with Mobile Technology Support (consumption monitoring, metering and prepaid supply management, etc...) which is particularly suitable for remote areas; (ii) public buildings management (schools, universities, hospitals, administrative buildings, airports, etc...) in urban zones; and (iii) street lighting management in urban zones and rural areas combined with a systematic solar-LED street lighting deployment (progressive replacement of existing systems whenever applicable and new instalments wherever applicable);
- **Specific regulation enforcement:** (i) enforcement and control of the real application of current legal and regulatory frameworks; (ii) set-up constraining standards on lighting bulbs imports; and (iii) set-up revised housing and buildings construction norms;
- **Financial support:** an indirect subsidization via tax instruments (import customs, VAT, fiscal incentives) to stimulate a broad-base access to low consumption features and equipment;
- **Communicate to educate:** a much more intensive sensitization of the population and private consumers on the stakes and interest of energy efficiency.

6.4.4 Oil & Gas subsector

6.4.4.1 Storage

Although the government has been keen to the enhancement of storage capacities to secure a regular supply of oil products, it seems that the notion of strategic security storage is not yet a priority.

Thus, the installation of strategic storage capacity to allow oil product supply during shocks as long as it will be a predominant primary energy resource for the country, appears to be more than ever a security of supply priority. In particular, the following measures are to be considered in this regard:

- creation of a fund to secure petroleum products imports;
- preserving the refinery plant with the increase of the government stake in SAR capital;
- support to the construction of independent storages facilities;
- expanding and modernizing SAR refining plant from 1.2 million de tons to 3 million tons per year.

6.4.4.2 Appropriate leveraging of future resources

According to the simulations of the Ministry of Economy, Finance and Planning, an efficient use of the financial resources generated by oil and gas would help Senegal to follow a stable and better economic development trajectory than that proposed in the paper PSE, with, in particular:

- an average annual growth over the period 2022-2035, projected at 7.5% by the PES and which could reach 8.6% with a production of 50,000 barrels per day, 9.11% for a production between 50,000 and 100,000 barrels / day and 9.4% above 100,000 barrels / day;
- an average job creation of more than 211,000 a year by a combination of PES / Oil and Gas Resources (RPG) resources and additional jobs of 18.4% for industry and 47.8% for services;
- a proportion of populations living below the poverty line from 20% (PSE) to 14.8% (PSE-RPG);
- a change in the human development index from 0.7% (PSE) to 0.85%.

Nevertheless, almost 80% of resource-driven countries have below-average levels of per capita income, and studies have shown that low-income countries are more vulnerable to the so-called “resource curse” challenges.⁴² Well-known potential risks for resource-wealthy countries encompass: (i) democracy and social problems; (ii) violent conflicts; (iii) inefficient public spending and borrowing; (iv) patriarchy and gender-based challenges; (v) limited government capture of benefits; and (vi) weaker institutional development.

6.4.4.2.1 Specific risks and threats

More specifically, the future exploitation of Senegal's oil and gas resources calls for vigilance and the adoption of appropriate strategies to prevent the risks described in the next three sub-chapters.

The resource curse: The term “resource curse”, eloquently illustrated by the image below, includes the important social, economic and political challenges that are specific to countries which are wealthy in oil, gas and minerals.⁴³

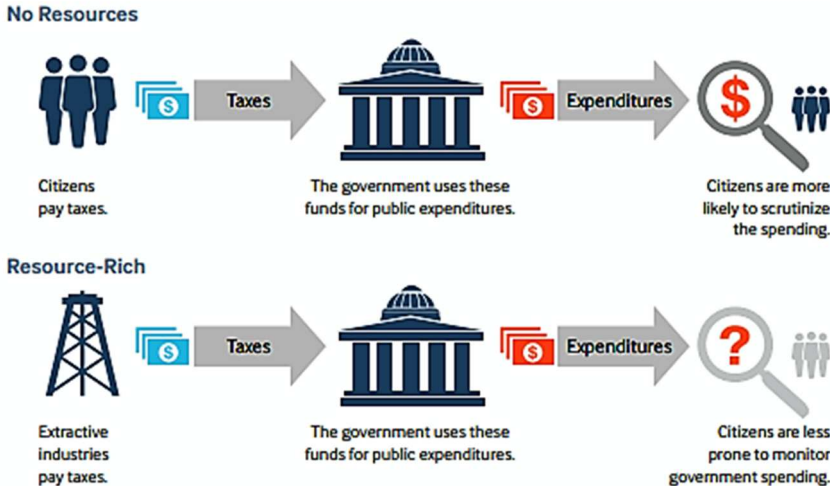


Figure 6-5 : illustration of the resource curse process

⁴² McKinsey Global Institute, December 2013

⁴³ Natural Resource Governance Institute

The Dutch disease: The term was invented in 1977 by The Economist to describe the declining process of the manufacturing sector in the Netherlands subsequent to the discovery of the Groningen gas field in 1959. The phenomenon is well described by the figure below.⁴⁴

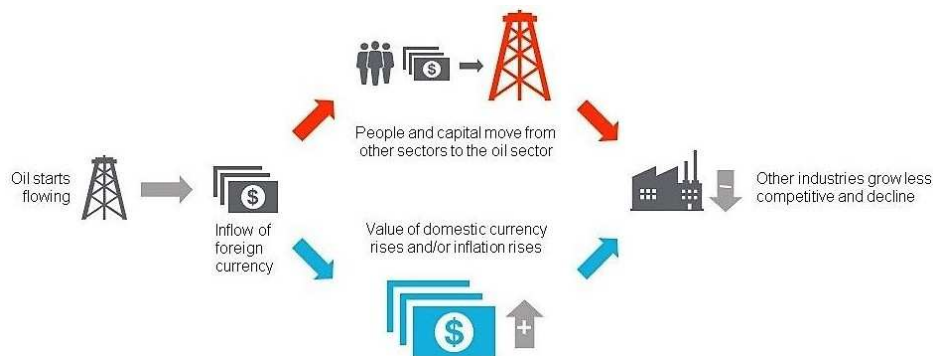


Figure 6-6 : illustration of the dutch disease process

Environmental risks: Exploration and exploitation of oil and gas natural resources can generate positive economic outcomes. However, they also come with serious challenges along the life cycle. Indeed, environmental impacts linked to petroleum activities can be generally summarized into two categories: (i) ecosystems, and (ii) human, socio-economic and cultural.

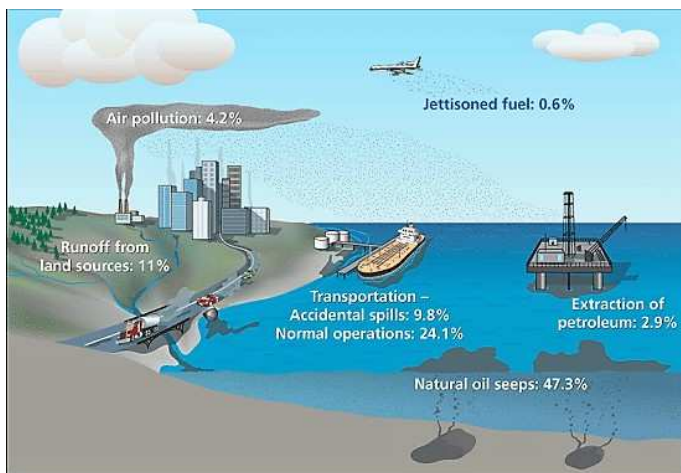


Figure 6-7 : emissions from petroleum activities

In effect, sources of emissions tied to oil development activities, as described by the images opposite,⁴⁵ can be wrapped as follows (UNEP E&P Forum, 1997): (i) Flaring, venting and purging of gases; (ii) Combustion processes from diesel engines and gas turbines; (iii) Fugitive gases from loading operations and losses from process equipment; (iv) Airborne particulate from burning sources such as well testing and soil disturbance during construction and vehicular traffic.

The principal emissions of gas flaring contain toxic from methane and benzene. They also engender carbon dioxide, carbon monoxide, volatile organic carbons, sulfur dioxide, nitrogen sulfide and nitrogen oxide. Some of these gases participate to global warming, others to the constitution of acid rain, which is noxious to soil.

Discharges from oil and gas platforms comprise sanitary and domestic wastes, spills and leakages, sewerage, produced and process water. These discharges result from the drilling of wells and, afterwards, from the production of crude oil. The content of produced water is potentially toxic to marine waters. Offshore oil drilling rigs and coastal storage, Oil tankers and underwater pipelines can release crude oil into the ocean by accident. Over time, the petroleum industry has experimented oil spills that has caused ecological disasters, needless to remind that hundreds of thousands of Senegalese live from fishing.

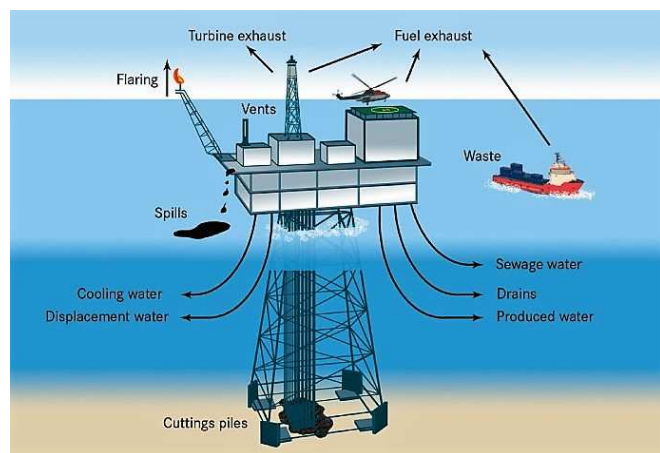


Figure 6-8 : discharges from petroleum activities

⁴⁴ Natural Resource Governance Institute

⁴⁵ <http://assignmenttask.com> and <http://www.who.edu/oilinocan/>

6.4.4.2.2 Specific recommendations

An abrupt and high increase in natural resource revenues can impact other important sectors of the national economy, notably the manufacturing or, in the case of Senegal, the agriculture sector, by provoking inflation or exchange rate appreciation and displacing labor and capital from the non-petroleum sector to the petroleum sector. These effects can be mitigated only if the country has the capacity to transform resource revenue inflows into palpable investments, such as agriculture, infrastructure and power. In doing so, Senegalese government should use future oil & gas resource revenues to make investments in the economy that create non-petroleum resource sector growth.

6.4.4.2.2.1 Top-ten priority actions

The hydrocarbon sector could generate huge positive effects by enhanced revenues and the opportunity to create local employment possibilities, directly as well as indirectly through the linked industries. However, a high consideration should be given to the fact that the oil and gas sector is a component of the broader national socio-economic configuration only. The suggested 10 priority actions would, hence, be the following ones:

- (i) re-enforcement of local content policies throughout the sector supply value chain (see image opposite⁴⁶);
- (ii) development of a local education sector dedicated to the oil and gas industries;
- (iii) partnering with the universities and institutes providing world class training in petroleum industry matters;
- (iv) promotion of investments in the agricultural sector;
- (v) long term value creation of fertilizer income;
- (vi) introduction of small-scale LNG as energy source for power generation and local industry in Senegal;
- (vii) introduction of small-scale LNG as fuel for the transport sector;
- (viii) creation of a sovereign fund for the future generations;
- (ix) development of further institutional capacity building post-FID.

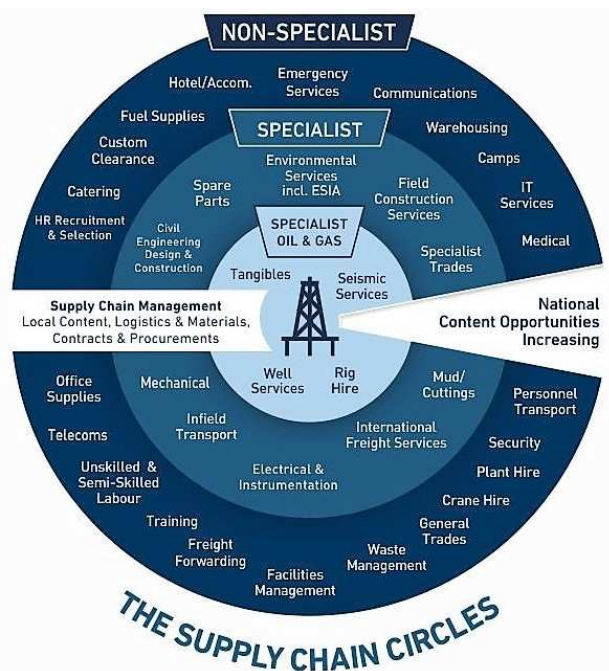


Figure 6-9 : supply chain circles

6.4.4.2.2.2 Strategic downstream options

6.4.4.2.2.2.1 Ground for analysis

The LNG option: "The gas market is growing by 2% a year, and within it the LNG by 5%. These are therefore very attractive markets, while oil only grows by 1% every year," said Laurent Vivier, Total Gas Manager in an interview with "Jeune Afrique" magazine in November 2017. According to a study by BP, gas consumption will jump between 2015 and 2035 by 77% in Asia-Pacific, 28% in North America and 80% in Africa, even if the continent will represent in twenty years only 5, 1% of global gas consumption (3.9% today).

Presented as a clean energy for electrification, especially with respect to coal, "conventional" natural gas - unlike shale gas, extracted by hydraulic fracturing - appears for many electric companies and governments as an alternative route to be favored. With these appetizing trade prospects, the attitude of the oil companies towards gas has changed profoundly, especially since developing important gas projects also allows them to benefit from less volatile prices than those of oil.

⁴⁶ <https://www.tulloil.com/suppliers/sustainable-supply-chain>

Also, by developing LNG production, Senegal could offer a new outlet to its deposits, which are mainly export-oriented. It will then be possible to create a short circuit of LNG supply in Senegal for the countries of the sub-region. Provided that the states agree to make this market attractive from the point of view of companies by lowering the customs barriers. Indeed, some countries in the sub-region that do not have large gas reserves can also hope, through LNG import and regasification terminals, to develop their electricity sector. The map opposite shows well that Dakar is strategically located on the crossroads of global shipping and regional trucking routes. Thus, the country has the potential to serve as a key link for global and west African trade. Moreover, it could particularly become the main provider of gas-based energies to landlocked ECOWAS countries like Mali, Guinea, Burkina Faso and Niger. It would therefore make sense to look closer at the relevancy, feasibilities and prerequisites of a scenario where the demand from the latter countries would constitute an outlet for the Senegalese future gas production.



Figure 6-10: oil & gas potential shipping routes

The Fertilizer option: Senegal disposes of phosphate rock that is extracted from the subsoil and shipped abroad for sales with very little value added into the process. The transformation of the natural gas into ammonia, and from there into urea and/or methanol, could be a better option than the processing, shipping and sales of LNG, considering the likely overcapacity of LNG in the world market for the next 5 to 7 years. It is estimated that the profit gained per energy unit (\$/MMBTU) commercialized in the form of ammonia, urea and methanol will be some 4 to 6 times higher than the feasible profit per energy unit of LNG.

Senegal produces currently some 800 kilo tons of rock phosphate per year partly used to feed a phosphoric-acid and sulfuric acid plant. However, the phosphate rock in Senegal contains a high cadmium rate. Given the global objective to reduce the Cadmium (and other heavy metals) in the agriculture fields, this element will most likely become an important constraint on phosphate rock producers.

Eventually, depending on studies, there seem to be a shared view of a peak phosphorus production somewhere between 2034 and 2075. For now, unlike oil, there is no known alternative for the element phosphorus in the agriculture. Thus, it's worth raising the strategic question, whether to encourage rock phosphate production or to reduce it until times of global scarcity and, in the meantime, produce fertilizers based on natural gas.

6.4.4.2.2.2.2 Downstream options

Considering the specificities of the Senegalese development stage, economy and geographic location, the following strategic options seem to be the most relevant in terms of post-FID contract negotiation and downstream resource potential optimization:

Tableau 6-3: Recommended downstream options

Option	Sector	Rationale
1	LNG for export and domestic markets	-Offshore gas development won't be carried out without LNG -Long term contracts will enable large investments and give visibility to the government -Domestic LNG opportunities can be developed resting on LNG-export facilities
2	Pipeline-based gas distribution	-Relatively low operational costs -Favors the formation of industrial hubs across the country -Fuel supply for industry, transport, commercial and residential sectors

Option	Sector	Rationale
3	Fertilizer plants (Ammonia, Urea)	-Supports the Senegal's export of phosphor -Reduces the current fertilizer imports -High international demand -Become the distribution center for West-Africa
4	GTL (Methanol, Fischer Tropsch)	-Methanol is part of the highest added value to natural gas as a base material for a broad range of products in almost all areas
5	LPG	-Reduces dependence on imported refined products -Replaces fuels used in domestic sectors (wood and coal) -Eases the penetration of natural gas to pipeline free areas
6	Gas power plants	-Rising demand of power -Availability and reliability of power favors industrialization and rural electrification -From small size to large CCG plants
7	Gas exportation to ECOWAS countries	Mali, Guinea, Burkina Faso and Niger are landlocked and have no hydrocarbon resources.
8	Oil for export	-Crude oil is easier to store, transport, and sell at the world spot market. -Less investment in costly infrastructure -Less dependent on long term off-take agreements

6.4.4.2.2.3 Environmental risk prevention

Offshore upstream operations that can generate environmental challenges encompass seismic acquisition, drilling and development as well as production and transportation activities. The Senegal's 1998 Petroleum Code which is being reviewed should reinforce the environmental provisions through the introduction of a Strategic Environmental Assessment (SEA). The goal should be to make sure that strategic planning and decision-making processes shall be more transparent, inclusive and will take environmental, social and economic impacts into consideration.

6.4.5 Governance and Management

Overlapping of government bodies: many government bodies play a role in the growth and success of the rural electrification sector, including: MEDER, SENELEC, ASER, ANER, and CRSE. Each of them has a specific mandate, but they often overlap with each other. Hence, it would be more efficient to create a national government energy access coordination platform. This platform could then provide a clear declination of each government entity's current and future activities dedicated to electricity access. It could also map the national grid, extension plans, the location of IPPs and auto-producers selling power to SENELEC, as well as ongoing and future mini-grid projects. That set-up would promote higher transparency in the sector and help policymakers in a more efficient planning of the efforts. To make sure that the platform doesn't become simply consultative, it would be key to ensure that it is supported by a firm leadership and clear accountability system in place.

Fragmented and incomplete data: data is currently sprinkled across different entities (ASER, SENELEC, CRSE, ANER, AEME, NGOs, etc.). As a result, the flow of information across entities is little and that further accentuates the coordination and communication difficulties. On top of that, the access to reliable and adequate data is proving quite laborious. Thus, at least, the SIE (Energy Information System of Senegal), which used to be managed by the Direction of Energy of MEDER but is in a lethargic state since 2015, date of the publication of its last annual report, should be re-launched.

Management: Several shortcomings related to the non-application of the MRV (Monitoring, Reporting and Verification) mechanisms included in the Senegal's energy policy impede the effective implementation of the strategies. Others are related to management. Notably, the answers to the following questions should be given first priority:

- What are lessons learned (failure and success factors) from previous projects (e.g., PERACOD, PROGEDE, ERIL, etc.)?

- What have rural electrification plans achieved so far?
- Why are some concessionaires struggling to meet their commitments in rural areas?
- How many mini-grids exist and what is their total capacity and performance, to date?
- How to empower ASER, ANER, AEME and CRSE to fulfill their mandates given the SENELEC monopoly?

Therefore, for the sake of a good management system and strategy implementation monitoring, much more importance and diligence should be given to data collection, progress measurement review and the necessary subsequent adjustment plans. In this regard, given the high importance of renewable energy in the power supply and emissions reduction strategy of Senegal, the three verification first steps could be to: (i) map existing mini-grids and establish a specific monitoring system; (ii) conduct a grid diagnostic to assess the capacity of the current grid and its ability to interconnect efficiently with renewable energy sources; and (iii) assess the effective energy output of the 120 Mwc solar PV plants recently connected to the national grid prior to pursuing new installations.

Governance: In the annual CPI (Corruption Perception Index) ranking of Transparency International, Senegal ranks 64th / 176 behind Italy, Saudi Arabia and before South Africa, Ghana and Brazil. Even though the country has made sensible progress since 2011 (112th / 182)⁴⁷, the level of CPI indicates that there is still significant room for improvement.

In fact, Senegal has several entities which mandates include fighting against corruption potentially involving state bodies and agencies: the IGE (State General Inspection), the State Court of Auditors and the OFNAC (National Office for Combating Fraud and Corruption). These entities have proven to have all the competence and probity required to conduct their missions effectively. Nevertheless, recent experience has taught that political interference can hinder the prosecution of offenders or, sometimes, prevent further investigation.

In any case, resolving governance weaknesses remains eminently a political leadership issue.

7 CONCLUSION

The energy supply of Senegal - excluding biomass - is heavily dependent on fossil imports even though it will, most likely, have raised the share of renewable energy in its power supply mix to thirty percent (30%) by 2025, while having almost doubled its total available power capacity between 2016 and 2020, thanks to its very proactive energy supply diversification policy. In doing so, the country will also exceed its energy-related INDC goals. However, it seems feasible and relevant to build an even more ambitious renewable energy share of the energy mix to reduce further Senegal's energy dependency - excluding biomass - since the huge solar PV potential of the country can be leveraged further, its wind energy possibilities remain under-exploited, its bioenergy strategy is suffering from a deficient execution and the energy efficiency policy is still quite weak.

In its quest for universal access to electricity, Senegal has put in place a pioneering system in rural electrification through concessions and local initiative projects (ERIL). However, while it is a fact that rural electrification is progressing, for the last ten years, the projects that carry it face a sustainability problem which is a hindrance to the attainment of its electrification rate objective by 2025.

In this respect, a tariff system is still to be developed which makes it possible to have harmonized and socially acceptable tariffs guaranteeing sufficient income for private concessionaires operating in rural areas. But to do this, it is necessary to conduct extensive consultations with stakeholders to propose appropriate contractual changes and a compensation mechanism.

The discovered natural resources may enhance the acceleration of economic growth and allow long-term expectations to materialize by prompting Senegal into a freshly industrializing middle-income country by 2030. Petroleum exploitation activities, however, also expose the country to outstanding

⁴⁷ <https://www.transparency.org>

governance, environmental and social challenges, especially to build inclusive growth through effective alleviation of poverty across the country.

The Government of Senegal has designed an institutional framework with all relevant bodies required to oversee the negotiations of its oil and gas development projects. During the negotiations that will lead to the Final Investments Decisions (FIDs), the Government will need to reinforce this institutional framework so that to bring it up to the relevant level to oversee effective development, production, and commercialization. In the same vein, it will be of the utmost importance to elaborate a strategy for future oil and gas revenue management, as well as local content, technology transfer, specific education capacity and downstream industry development to take the-most of the opportunity.

In this perspective, the revenues expected from the oil & gas resources exploitation should not be considered as the basement of the future national energy mix, but rather be regarded as opportunities to accelerate the implementation of a long-term sustainable energy policy as well as reduce its financing costs. At best, the gas reserve should be considered as a transitional oil replacement resource towards a longer-term carbon neutral energy mix situation.

The detailed evaluation of Senegal's energy policy has highlighted some pitfalls in implementation due mainly to governance and management issues. In effect, there exists a disconnect between policy intention and reality on the ground, and the lack of data to track progress is one symptom of the defective monitoring, reporting and evaluation mechanism (MRV). Moreover, few gaps would need to be filled to make the institutional and regulatory frameworks very efficient, notably, in terms of coordination and transparency between the different key bodies in charge of the sector. Eventually, clearer and more supportive regulatory frameworks for renewable power generation would reduce opportunity costs, be more efficient than a case-by-case support and, in fine, create the basements of a more attractive environment for investment.

In summary, Senegal has developed over time a consistent and comprehensive energy policy, which has been benefiting from the dynamic of the execution of the Emerging Senegal Plan (ESP) since 2014. By 2030, the country has a real potential to reach universal access to affordable electricity, become energy-independent – excluding biomass – and have a well-balanced energy mix. However, keeping in mind demography, economic growth and climate change challenges before the country, a real demand side management (DSM) strategy, underlaid by a strengthened energy efficiency policy, combined with the decarbonation of the transport and households' sectors through bioenergy, could be a relevant roadmap to meet durably the country's energy demand.

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