Senegal 2023

Energy Policy Review

International Energy Agency

INTERNATIONAL ENERGY AGENCY

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Executive summary

The development of Senegal's energy sector is at the heart of the country's strategy for sustainable and economic development and aspiration to become an emerging economy by 2035 under the *Plan Sénégal Émergent (PSE).* With strong institutions and a clearly articulated vision to pursue sustainable development goals, Senegal is well positioned to fulfil these ambitions and continue its pathway towards economic growth and development.

Since the launch of the PSE, Senegal has adopted reforms designed to attract foreign direct investment (FDI) and encourage higher levels of private sector participation, leveraging significant support by the development finance institutions (DFIs), such as the Scaling Solar Programme of the World Bank. The stability of the country's institutions has enabled the energy sector to attract FDI for its development, although more would be needed to meet Senegal's ambitions. In order to achieve universal access to modern energy, to spur industrialisation and consolidate a low-carbon, resilient and sustainable energy system, Senegal has recently joined the ranks of countries (South Africa, Indonesia, Viet Nam) having entered a Just Energy Transition Partnership (JETP). Signed with partners from France, Germany, the European Union, the United Kingdom and Canada, the JETP agrees to mobilise up to EUR 2.5 billion over a three to five year-period to support Senegal in achieving its ambitions.

Senegal is a strong supporter of the UNFCCC Conference of the Parties (COP) process, with a focus mostly on developing clean power, reducing methane emissions, enabling climate resilience and just and implementing equitable energy transitions, notably for developing economies. It chaired the group of climate negotiators from the least developed countries (LDCs), and is a strong advocate for increased mobilisation of climate finance. In 2020, the government presented a comprehensive and ambitious Nationally Determined Contribution (NDC) which contains concrete clean energy targets for the coming decade, including for renewables, energy efficiency and clean energy technology deployment. In 2023, Senegal has already met the unconditional renewable targets under the NDC. The government is working on a long-term low-carbon development strategy with international partners.

Over the past four years, the government's energy strategy, the *Lettre de politique de développement du secteur énergétique (LPDSE 2019-2023)* has focused on securing low-cost energy supply, access to more reliable, sustainable and lower cost electricity, access to modern cooking fuels and stronger rules for financing, governance and regulation in the sector.

The IEA energy policy review comes at a time when Senegal is taking stock of progress made within the framework of its LPDSE 2019-2023 and designing the energy strategy for the next five years. A new LPDSE is under preparation for 2024-2028 with a consultation launched in July 2023.

The IEA confirms that Senegal has taken significant steps towards its objectives. In 2022, 75% of Senegal's population had access to electricity (urban 97%, rural 55%)[1], one of the highest rates in sub-Saharan Africa (SSA). In 2022, almost 30% (5 million) of the population had access to clean cooking fuels and equipment, although this was mostly in urban areas, where over 50% have access and where LPG (liquefied petroleum gas) is primarily used, while only 7% had access in rural settlements.

Due to strong demographic growth, the number of people still relying on traditional biomass for cooking has increased faster than the total population, doubling from 6.5 million in 2000 to 12.5 million today. To cope with these demographic trends, it will be critical in the next LPDSE to prioritise clean cooking programmes overall and electricity access in rural areas, in particular. Noteworthy experience for Senegal comes from success stories from Indonesia and India in Asia and in Africa, from South Africa, Nigeria, Sudan, and Kenya, where new clean cooking strategies have been implemented over the past five years. The significant progress in providing clean cooking in these countries has largely been driven by the adoption of LPG.

The power sector is the key enabler for Senegal's sustainable development. The country's electricity mix is dominated by heavy fuel oil (HFO), which accounted for 70%[2] of total electricity generation in 2022. In recent years, renewable energy has overtaken coal, with wind and solar power accounting for 21% of generation in 2022. Senegal already has 0.4 GW of total renewable energy installed capacity and has recently pledged to increase the share to 40% by 2030 within the framework of the JETP, whose funding to be mobilised can be a key enabler for Senegal to also meet its conditional targets under the NDC. The JETP also recognised the importance of Senegal's gas production opportunities and the role of gas in the country's economic development and energy transition.

Senegal is currently working on a ten-year Integrated Low-Cost Plan (*Plan Intégré à Moindre Coût* PIMC). The government has already set out a gas-to-power strategy to switch from HFO to natural gas use in power generation. The retirement of old HFO plants would significantly reduce the cost of electricity and the country's energy-related emissions. Since most of the HFO is imported today, this switch will also reduce the import bill and increase energy security.

A comprehensive clean power strategy is needed to synchronise the closure of the oldest HFO plants with the construction of gas-fired power plants to support power system flexibility, while adding renewable energy to the system. This strategy should be based on the outcome of the PIMC, using international best practices. Senegal's power sector transition needs a clear strategy, which includes the full implementation of the power sector reforms, the expansion of the electricity network, the creation of renewable energy zones and auctions, as well as increased balancing power at the domestic and regional levels within the West African Power Pool. Such a strategy will be critical to provide a long-term policy signal to investors.

While public finance will continue to play an important role, Senegal's energy sector will also need to mobilise more private sector investment. Access to finance for renewable projects is available, mostly from international banks and development finance institutions

[1] The latest data shared by the MPE for access to electricity rates for 2021 slightly differ from IEA statistics due to methodological considerations: national: 85%, urban: 94% and rural: 58.2%.

[2] The hydroelectric contributions (66 MW) of the Manantali dam in Mali, which covers part of Senegal's electricity needs, are not included in the IEA data on electricity generation because of the statistical methods used.

(DFI). Gas-related projects are currently more difficult to finance, since most DFIs no longer support such projects and commercial investors may not find attractive risk-adjusted returns for regulated assets like pipeline gas.

The natural resource sector is at the heart of Senegal's development strategy. The country is set to become an oil and gas producer in 2024, leveraging its significant offshore reserves. In 2020, the African continent for nearly 3% of cumulative global emissions, with Senegal representing only 0.03% of global energy-related emissions. IEA analysis has shown that the impact on global emissions from development of natural gas resources on the continent would be negligible and only raise cumulative emissions to 3.5% by 2030.

At the COP26 in Glasgow, Senegal joined the Global Methane Pledge to act on methane emissions. The Petroleum Code requires companies to take necessary measures to prevent and combat environmental pollution, in accordance with international industry practice and applicable national legislation. The development of a National Methane Roadmap is envisaged, with the support of the Climate and Clean Air Coalition. Reducing operational emissions from oil and gas production is a cost-effective measure. It will not only increase government revenues, but support ambitions to use gas to boost domestic energy access and reduce health and environmental impacts on local communities.

To ensure the distribution of revenues from the development of these resources, the government has set up a Stabilisation Fund and an Intergenerational Fund. The funds will enable Senegal to leverage hydrocarbon revenues to finance sustainable economic growth, mitigate the impact of international price volatility on the Senegal's State Budget and prepare for a low-carbon and resilient energy system.

Energy efficiency is a critical topic for a country that highly values energy access and is making great progress in achieving universal access to electricity. Strong policies fostering energy efficiency can contribute to important savings, which are particularly relevant for the segments of the population that face affordability issues. Given the country's current energy mix, efficiency can also critically contribute to lower greenhouse gas emissions, which is why the Government of Senegal included energy efficiency ambitions in the NDC of 2020.

Progress has been achieved thanks to Senegal's energy efficiency agency AEME, which was set up in 2011. AEME's strategy identified important savings potential in hydrocarbons, electricity and domestic fuel sectors (18%, 36% and 40%, respectively). It develops and implements several programmes and actions, including sensitisation campaigns to incentivise the population to adopt energy-efficient measures. To fully implement the work underway and achieve greater savings results, the government needs to bolster the financial and human resources of AEME and create a strong governance to support synergies across the energy agencies.

One positive step is the establishment of a super ESCO with FONSIS and AEME, building on the results of the World Bank study on strategies for financing energy efficiency in the public sector (lighting, universities, hospitals). Using economies of scale, Senegal will be able to improve the efficiency in the residential and services sectors, which have seen a decline in energy efficiency improvements in the past decade. The Ecofridges programme is another leading example of how the public sector can support upgrades in domestic appliances and equipment. However, the current loan programme only offers support to the households that can afford to do so. Most of the vulnerable consumers would benefit

from a grant programme. Work on implementing existing and strengthening energy efficiency standards under the UEMOA Directives should be prioritised.

Energy efficiency also includes efficiency of fossil fuel subsidies. In the future, domestic oil and gas prices are expected to decrease with the start-up of oil and gas production. The design of the Stabilisation Fund is important in this context to avoid overcompensation (subsidising all citizens rather than the vulnerable ones) and driving up government debt during very high oil prices. Senegal needs to carefully manage its exposure to today's high oil price volatility by reducing fossil fuel subsidies and focusing on risk management. In 2022, Senegal spent almost 4% of its gross domestic product (GDP) on energy subsidies. The government pledge to reduce this share to 1% by 2025 is a major and welcome reform commitment. The roadmap in place guides the implementation in the coming years.

The IEA applauds Senegal's energy policy approach and the active work and plan under way. As input to the LPDSE 2024-2028, the IEA offers a few key actionable recommendations. First, the government needs to prioritise actions to complete universal access to energy, support system integration of higher shares of variable renewables through a clean power strategy and the development of a natural gas market and related infrastructure. The governance of the agencies entrusted with the energy sector implementation and their funding is going to be an important lever to complete the reforms and create more efficiency and synergies.

Key recommendations

For the LDPSE 2024-2028 the government of Senegal should focus on actions to:

Strategy

- Close the gap and achieve universal access to electricity through better co-ordination of players, focusing on the last mile and enhancing the quality of supply. Prioritise the roll-out of clean cooking programmes, using LPG and renewables technologies and fuels to make faster progress.
- Accelerate renewable development for a more low-emission, affordable and reliable supply and design a power sector strategy for the substitution of heavy fuel oil in electricity production based on integrated system planning, investment in gas peaking plants and a high degree of collaboration among all electricity sector stakeholders.
- Ensure the effective application of the new electricity and gas codes with a view to promoting investment in the energy sector, particularly in renewable energies.
- Intensify efforts to attract a diversified set of financial resources, working with donors and the private sector, by developing a plan for long-term energy investments. As part of the plan, quantify investment in the necessary oil and gas infrastructure that is adequate to underpin the country's development and supports the greater penetration of renewable energy across the energy sector.

Institutional framework

- Ensure better co-ordination of the actions taken in the energy sector by the various stakeholders around the MEP.
- Bring together the agencies responsible for energy management and renewable energies and possibly the rural electrification agency within a single agency, with a view to strengthening the synergy of their actions, pooling their means of intervention and increasing their impact, particularly in rural areas.

Regional co-operation

- Intensify regional co-operation, particularly in the field of electricity grid interconnections, energy efficiency and renewable energy standards, strategies for access to electricity and clean cooking technologies.
- Scale up energy efficiency programmes that have been successful in the appliances/lighting/cooling sectors and can be leveraged in industry and transport sectors.
- Develop and implement Minimum Energy Performance Standards (MEPS) for appliances that are aligned with major exporting countries, drawing on examples of standards and labelling programmes in Ghana and other countries in the subregion.

Training, skills and employment

- Continue and strengthen the energy data collection and use and the national training and skills development effort, particularly at the level of technicians and engineers, in the field of renewable energies and energy efficiency.

1. General energy policy

Key data (2021)

TES: 212 PJ; +23% since 2011

TES by source: oil 49%, bioenergy and waste 39%, coal 10.3%, solar 1.6%, electricity imports 0.5%, heat 0.2%, natural gas 0.1%

GDP per capita at current USD (2022)*: 1 599

Energy intensity per capita (TES/capita): 12.342 GJ/capita (IEA average: 166.7 GJ/capita); -6% since 2011

Energy intensity per GDP (TES/GDP): 3.59 MJ per 2015 USD PPP (IEA average: 3.7 MJ/USD); -25% since 2011

TFEC: 134 PJ; +20% since 2011

Access rate to electricity: 75% (urban 97%, rural 55%); +34% since 2005, +18% since 2011

Access rate to clean cooking: 29% (urban 52%, rural 6%); -9% since 2005, -3% since 2011

TFEC by sector: buildings 47%, transport 34%, industry 19%

* World Bank

Source: IEA (2023), World Energy Balances

Country overview

Senegal is a country in West Africa (hereinafter “the subregion”) that borders Guinea, Guinea-Bissau, Mali, Mauritania and The Gambia. The capital city, Dakar, is a peninsula facing the Atlantic Ocean, where most of the country’s economic activity takes place. Coastal regions are densely populated compared to inland territories. Most parts of the country experience a semi-arid to a tropical climate ranging from 20°C in the cold season to 40°C or higher in the hot season.

The population of Senegal reached 17 million in 2022, with a growth rate of 2.7% per year over the period from 2010 to 2023, thanks to a fertility rate of 4.7 births per woman . Senegal has a very young population: the median age is 19.4. The pyramid-shaped demographic distribution has 50% of the population below 18 years old.

Senegal is an ethnically diverse nation. The Wolof account for 43% of the population, followed by the Fula and Toucouleur (24%); Serer (15%); Jola (4%); Mandinka (3%); and others, including the Bassari, Maures and Soninke.

Economy

The development of the power sector is a priority of the government's Plan for an Emerging Senegal (Plan Sénégal Émergent [PSE], proposed in 2012 and adopted in 2014), which aims to make Senegal an emerging economy by 2035. Senegal's industry sector consists mainly of food processing, mining, cement production, fertiliser, refined petroleum, chemicals and textiles.

Senegal's exports are mostly raw or semi-processed products, including seafood; iron ore; gold; oily seeds; cotton, textile, agricultural products; and other minerals like zinc, uranium and phosphoric acid. Senegal's imports depend highly upon petroleum products and energy-intensive manufactured goods, such as vehicles. Its economy is vulnerable to price spikes of imported products, including crude oil, and is impacted by delays in governance reforms and climate change. Irregular rainfall and extreme weather events affect the country's largest industry sector, agriculture, and its infrastructure. The global financial crisis of 2008-2009 hit Senegal because of the vulnerability of its industrial sector. 39% of the population lives in poverty and 75% of households suffer chronic poverty.

Economic growth is very diverse across subregions and countries in Africa. According to World Bank data from 2023, the GDP growth of Western and Central Africa is estimated to decline to 3.4% in 2023 from 3.7% in 2022, while that of Eastern and Southern Africa is estimated to decline to 3.0% in 2023, from 3.5% in 2022. Senegal's economy has been growing for 20 years, with an average growth rate of 5.1% over the past decade, with rates over 6% from 2014 to 2018. The rate only slowed down in conjunction with the recent global economic crisis following the Covid-19 pandemic and the global energy crisis. The inflation rate in Senegal was 1% in 2019 before the pandemic but rose to 9.7% in 2022. In 2023, the International Monetary Fund's latest review showed that real GDP growth in 2022 was 4.7%, reflecting a disappointing harvest season and a contraction in industrial production. Economic activity is projected to rebound in 2023, albeit at a slower pace than initially envisaged, while inflation is expected to decline. The medium-term outlook remains favourable and would benefit from both the start of oil and gas production (see Chapter 8) and the implementation of structural reforms to strengthen private sector participation in economic activity in the context of Phase 3 of the PSE.

At the regional level, Senegal is part of the Economic Community of West Africa (ECOWAS) and the West African Economic and Monetary Union (WAEMU). The WAEMU was created in 1994, bringing together Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo. Among WAEMU countries, economic collaboration includes trade and environmental protection with common standards, rules and regulations as well as action plans (for instance, for energy efficiency).

Senegal uses the *Communauté Financière Africaine* (CFA) franc as currency, which is managed and emitted by the Central Bank of West African States. The currency is also shared by six other countries as *Coopération Financière en Afrique* (CEMAC space), representing altogether a combined population of 150 million people. The CFA franc (FCFA) has a fixed parity with the euro (EUR 1 = FCFA 655.957) and is guaranteed by the French Treasury.

Political structure

Senegal is a presidential democratic republic. The Head of State, Mr Macky Sall, in office since 2012, holds the executive power. The Prime Minister, n Amadou Ba, is the head of

the government. Senegal has a unicameral national assembly with 165 seats. In 2016, a constitutional amendment reduced the presidential term from seven to five years and prohibited former presidents from running for a third term. President Mr Macky Sall was re-elected in February 2019. Provincial and city-level local elections were held in 2022, with the Benno Bokk Yakaar coalition winning in 10 cities out of 14, but losing in the capital city of Dakar.

The President's Cabinet, led by the Director of the Cabinet, consists of ministers, ministerial advisers, goodwill ambassadors, special and technical advisers, and project officers. There are five offices of the President of the Republic, including the Strategic Orientation Committee for Oil and Gas (COS-PETROGAZ). Among the ministries, the Ministry of Petroleum and Energies (*Ministère du Pétrole et des Énergies*, MPE) manages the government's policy on electricity generation, oil and gas, renewable energies and clean cooking.

Institutional framework for energy policy

Senegal has a strong institutional framework of energy policy decision making, led by the MPE, in co-operation with other ministries, and implemented through a range of national agencies and companies which are under the MPE's technical supervision.

The **MPE** is responsible for regulating, controlling and directing the production, transport and distribution of electricity. It implements the government's policy on energy savings and renewable energy, collects and disseminates scientific and technical information, ensures the supply of hydrocarbons and energy, and supports universal access to electricity and rural electrification programmes.

The **Ministry of Environment, Sustainable Development and Ecological Transition** (*Ministère de l'Environnement, du Développement Durable et de la Transition Ecologique*, MEDDTE) is tasked with achieving the goals outlined in the Environmental and Sustainable Development Policy Letter. It aims to promote economic and social development through sustainable practices while ensuring the rational management of natural resources and the environment.

The **Commission for the Regulation of the Energy Sector** (*Commission de Régulation du Secteur de l'Énergie*, CRSE) is an independent organisation responsible for regulating the production, transport, distribution and sale of energy in accordance with legal and regulatory provisions. It has decision-making powers such as examining licence requests, ensuring compliance with regulations and imposing sanctions on non-compliant operators.

In Senegal, the **Standards Association of Senegal** (*Association Sénégalaise de Normalisation*) applies, promotes and develops both international and domestic standards for electrotechnical equipment, namely solar photovoltaics (PV) and thermal solar. Relevant standards include the measurement of current-voltage characteristics, PV solar modules, PV terrestrial systems and stationary lead-acid batteries.

The **Senegalese Rural Electrification Agency** (*Agence Sénégalaise pour l'Électrification Rurale*, ASER) provides technical and financial assistance to electricity companies and individuals for rural electrification initiatives. It develops electrification programmes based on rural electrification plans defined by the minister in charge of energy and organises calls for new distribution concessions in rural areas.

The **National Agency for Renewable Energies** (*Agence Nationale des Énergies Renouvelables*, ANER) promotes the use of renewable energies and is responsible for identifying and exploiting economically feasible sources of renewable energy, and conducting studies for the development of renewable energies.

The national **Agency for the Energy Savings and Management** (*Agence pour les Économies d'Énergies et la Maîtrise de l'Énergie*, AEME) provides expertise and advice on energy, environmental and sustainable development policies. It contributes to financing and implementing sustainable energy use and efficiency projects.

The **National Electricity Company of Senegal** (*Société Nationale d'Électricité du Sénégal*, Senelec) is the historical operator in the Senegalese electricity sector, responsible for the production, purchasing, transportation, distribution and sale of electricity. In 1998, it underwent a significant change in its legal status, becoming a public limited company acting as a public service concessionaire. Independent power producers (IPPs) play an important role in Senegal's energy sector. They include operator companies such as Senergy, Contour Global and Melec PowerGen, which own and operate solar, wind and hydroelectric power plants. Following the adoption of the new Electricity Code (Law No. 2021-31 of 9 July 2021), SENELEC was restructured and transformed into a holding company with a number of subsidiaries, respectively in charge of production, transmission, and distribution/sale of electricity.

The national oil company, **PETROSEN**, is responsible for promoting, researching and exploiting hydrocarbon resources, as well as refining, storing, marketing, distributing and transporting petroleum products, along with associated industrial activities. It prepares and negotiates all agreements and contracts related to petroleum. In 2019, PETROSEN was restructured and transformed into a holding structure with subsidiaries respectively in charge of the upstream segment (exploration and production, PETROSEN E&P) and of the downstream segment (refining, import/export and distribution, PETROSEN Trading & Services).

Created in 2014 as a public investment fund, the **Souverain Strategic Investments Fund** (*Fonds Souverain d'Investissements Stratégiques*, FONSIS) supports public-private partnerships and state investment in strategic projects/sectors in support of the PSE.

Senegal is committed to regional energy co-operation and is a member of various organisations to develop hydroelectricity resources (see Chapter 5 on renewables). The government has signed a Millennium Challenge Corporation compact, which aims to improve the transmission network and increase electricity access in rural areas while improving the governance and financial viability of the sector.

Energy data and statistics

The MPE is the main source of data and has several directorates, including the directorate of electricity, the directorate of hydrocarbons, the directorate of strategy and regulation, the Directorate for Planning, Studies and Energy Information Systems and the Directorate of Renewables Energies Development. The MPE also contributes to tracking progress every year under the Presidential PSE joint indicators group. The Energy Information System (SIE) is maintained by the MEP and is used to compile the country's energy accounts and calculate electricity coverage and access rates. The Directorate for Planning, Studies and Energy Information Systems co-ordinates the SIE and ensures the collection, analysis and publication of the main energy balances.

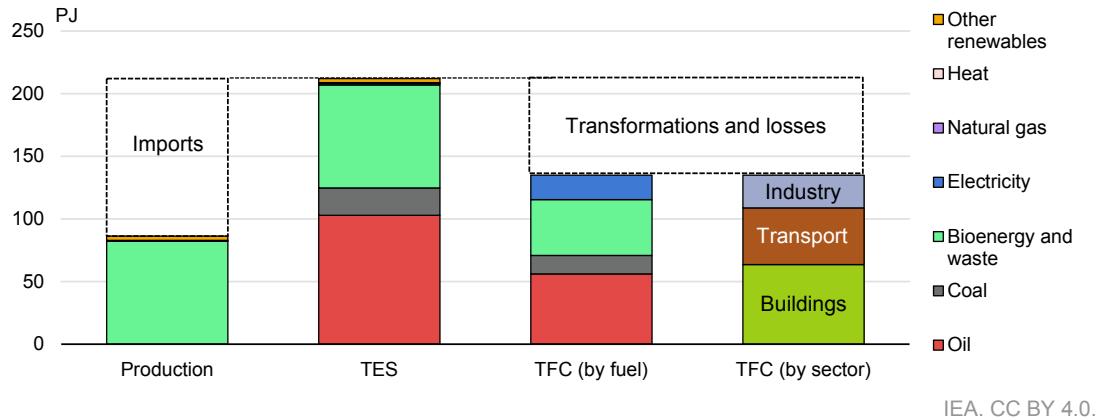
The MPE provides technical supervision to other entities such as the ASER, the AEME, ANER, Senelec, PETROSEN, the African Refining Company (*Société Africaine de Raffinage*, SAR) and the CRSE.

There is a national Statistical Law in place which explicitly cites energy. There is also a ministerial order governing statistical activities at the MPE level. The MPE co-ordinates with the National Agency of Statistics and Demography to produce energy statistics, in particular on households.

Energy supply and demand

In 2021, Senegal's domestic production of energy covered 41% of total energy supply (TES) and relied on imported fossil fuels to cover the rest (Figure 1.1). Biofuels and waste were the largest sources of energy production (82 petajoules [PJ]), followed by solar and wind (3.4 PJ in 2021), heat (0.4 PJ), and natural gas (0.3 PJ). Senegal imported all its coal (22 PJ) and oil needs (103 PJ), which accounted for 49% of TES. In 2021, total final consumption (TFC) was dominated by oil (41%), followed by biofuels and waste (33%), electricity (14%), and coal (12%). The buildings sector (in particular residential) had the highest demand in TFC (64 PJ), followed by transport (45 PJ) and industry (26 PJ).

Figure 1.1 Overview of energy production, supply and demand in Senegal, 2021

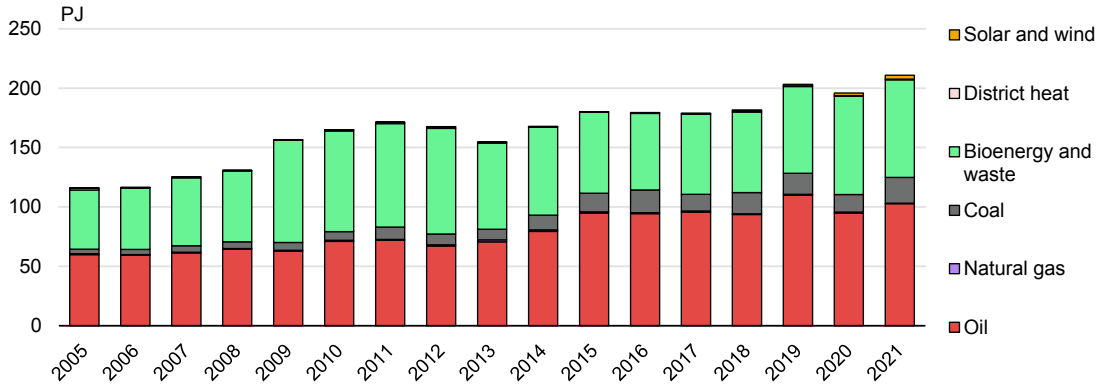


Note: Natural gas and heat are not visible at this scale. Other renewables are solar and wind.
Source: IEA (2023), World Energy Balances.

Senegal's TES has increased by 23%, growing from 172 PJ in 2011 to 212 PJ in 2021 (Figure 1.2). Covid-19 lockdown measures suspended economic activities and led to the drop in TES in 2020.

In 2021, Senegal's TES rebounded strongly to a peak of 212 PJ as the economy started to recover from the pandemic. Fossil fuels accounted for 59% of Senegal's energy supply in 2021, a higher share than in 2011 (+10%): in 2021, oil dominated TES (49%), followed by bioenergy and waste (39%), coal (10.3%), solar and wind (1.6%), district heat (0.2%), and natural gas (0.1%). Bioenergy and waste have increased by 65% since 2005, from 50 PJ to 82 PJ. From 2011 to 2021, the share of coal more than doubled, from 10 PJ to 22 PJ, and solar energy only entered TES in 2017.

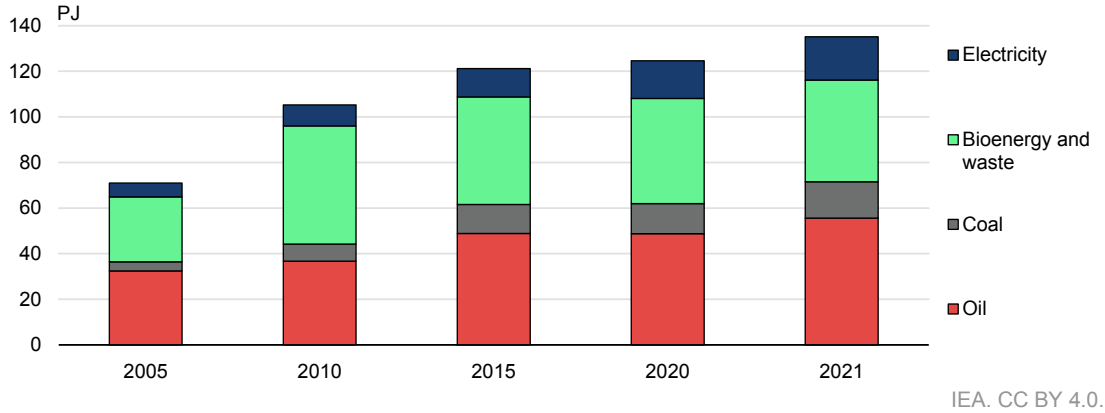
Figure 1.2 Total energy supply by source in Senegal, 2005-2021



Note: Natural gas is not visible at this scale and was equal to 0.25 PJ in 2021.
Source: IEA (2023), World Energy Balances.

Total final energy consumption (TFEC) increased by 88% from 2005 to 2021 (72 PJ to 135 PJ) (Figure 1.3). In 2021, the share of oil in TFEC was the highest at 41%, followed by bioenergy and waste (33%), electricity (14%), and coal (12%). Since 2005, the end-use of electricity has increased by 211% and that of coal by 305%.

Figure 1.3 Total final energy consumption by source in Senegal, 2005-2021

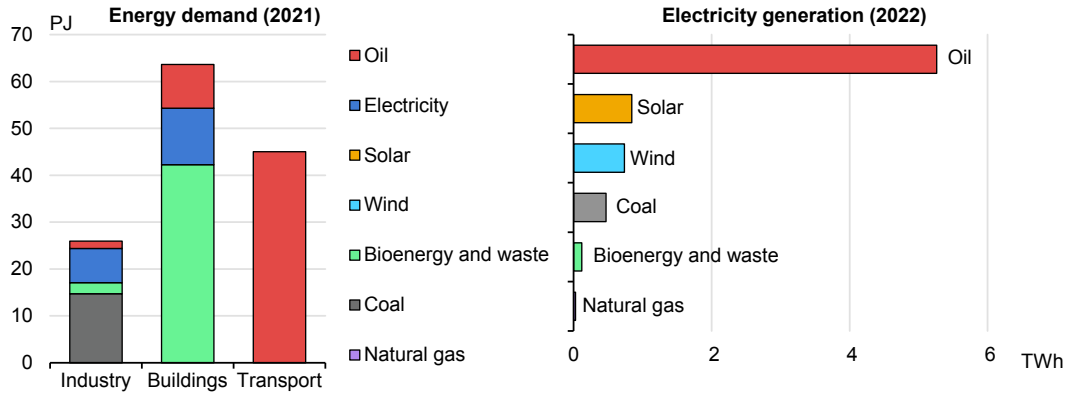


Source: IEA (2023), World Energy Balances.

In 2021, the buildings sector (including residential) accounted for the largest share of Senegal's TFEC (47%), followed by transport (33%) and industry (20%) (Figure 1.4). The most electrified sector was industry, as electricity accounted for 26% of the sector's demand. Industry was also the only sector of the economy to consume coal, which covered 61% of the sector's needs. Buildings mainly relied on bioenergy and waste (66%), exclusively consumed in residential buildings, as well as on electricity (19%), and oil (15%). Senegal's transport sector was entirely reliant on oil in 2021.

In 2022, oil contributed the most to Senegal's electricity generation mix, accounting for 70% of total electricity generation (5.2 terawatt hours [TWh]). Solar (11%) was the second most used source of electricity generation, followed by wind (9.8%), coal (6.3%), bioenergy and waste (1.6%), and natural gas (0.4%).

Figure 1.4 Energy demand per sector and per fuel in 2021, and electricity generation by fuel in 2022 in Senegal



Note: Hydropower contributions (66 MW) from the Manantali Dam in Mali which generates some of Senegal's electricity needs are not included in the IEA data for electricity generation due to statistical methodologies.

Source: IEA (2023), World Energy Balances.

Energy strategy and policies

Senegal's energy and climate policy forms an integral part of its overarching sustainable development strategy: the **Plan for an Emerging Senegal (PSE)**, adopted in 2014. The PSE promotes an economic policy framework for Senegal to lift its population out of poverty by 2035. It is implemented through five-year action plans prepared by the respective ministries and focuses on three strategic areas: 1) structural transformation of the economy and growth; 2) human capital, social protection and sustainable development; and 3) governance, institutions, peace and security.

The institutional framework enabling the implementation of the PSE is made up of the Strategic Orientation Committee, which is under the authority of the President of the Republic; a Steering Committee, chaired by the prime Minister; and an Operational Office, in charge of tracking the PSE.

Achieving universal electricity access remains a key policy priority. Under the PSE, the government set a target of achieving 60% rural electrification by 2020 and universal access by 2025. The plan includes governmental programmes which promote the development of renewable energy and energy efficiency to achieve the objective of reducing oil prices and energy dependence. The implementation of the programmes has helped Senegal save FCFA 3 billion per year over the last three years.

In 2020, Senegal submitted the **Nationally Determined Contribution (NDC)** with strong objectives for the development of the sustainable energy sector.

The **Energy Sector Development Policy Letter** (*Lettre de politique du development du secteur de l'énergie*, LPDSE) for the horizon 2019-23 is Senegal's energy strategy and reference framework for the sector's orientations, objectives and actions. It is a five-year document which is accompanied by an action plan and a monitoring and evaluation mechanism. The LPDSE has pursued four key objectives:

1. reinforce the country's production and supply of energy in sufficient quantity and at the lowest cost

2. access to electricity with quality and continuity of service at a lower cost and in a sustainable manner
3. access to modern cooking fuels for the population
4. strengthening financing, governance, regulation, and monitoring and evaluation.

A key focus of Senegal's energy policy is realising universal access to energy. The country has a target for universal electrification by 2025. By 2022, the electricity access rate will be 75% (97% in urban areas, 55% in rural areas[1]).Senegal's per capita electricity consumption is lower than the sub-Saharan African average. The government wants to achieve universal access by reforming the electricity market to increase private sector participation. Energy policies and regulations encourage private electricity generation through IPPs, which in 2022 accounted for 64% of Senegal's installed capacity (1139 MW out of a total of 1789 MW).

A new LPDSE is under preparation for 2024-28, with a consultation launched in July 2023. The next LPDSE aims to strengthen key energy policies which facilitate further the participation of IPPs, reform institutions and market regulations for a competitive electricity generation market.

Towards a people-centred transition

Senegal is firmly committed to international discussions on an inclusive and just energy transition. The Minister of Petroleum and Energies is a member of the IEA Global Commission on People-Centred Transitions, which set out several recommendations to help guide just transition policy frameworks (Figure 1.5).

At COP26, Senegal signed the Global Coal to Clean Power Transition Statement, committing to ensuring a just transition away from coal use. It is also working on developing a roadmap for a just transition as part of the Climate Action for Jobs Initiative. Senegal has been working on policies and plans related to the green economy and green jobs for close to a decade. Its 2015-2020 National Strategy for the Promotion of Green Jobs created 2 000 jobs and won an international award for its public policy.

Reforming fossil fuel subsidies while aiding vulnerable parts of the population in their transition is becoming a priority. The government has announced plans to reduce energy subsidies to 1% of GDP and remove them by 2025 while diversifying its energy sources to meet growing demand and reduce costs. The government plans to achieve this by revising electricity tariffs, providing cash transfers and promoting renewable energy resources. Savings from the energy sector will be used to fund projects mitigating rising energy prices for the socially vulnerable.

In 2022, Senegal spent more than 4% of its annual GDP on energy subsidies, or about FCFA 750 billion (USD 1.2 billion) on energy subsidies. This amount reached FCFA 800 billion (USD 1.3 billion) in 2023 (around 5% of Senegal's GDP), of which 65% were in petroleum products and 35% in the electricity sector. In 2023, subsidies for the electricity sector cost Senegal FCFA 280 billion (USD 458 million), while subsidies for

[1] The latest data shared by the MPE for access to electricity rates for 2021 slightly differ from IEA statistics due to methodological considerations: national: 85%, urban: 94% and rural: 58.2%.

petroleum products cost FCFA 525 billion (USD 859 million), for a grand total of FCFA 800 billion (USD 1.3 billion) in 2023.

To manage the distribution of the country's future oil and gas revenues, Senegal has adopted a law on the distribution and management of revenues from the exploitation of hydrocarbons (Law No. 2022-09 of 19 April 2022). This law creates two funds: the Stabilisation Fund, whose purpose is to protect the State Budget from fluctuations in global oil and gas prices, and the Intergenerational Fund managed by FONSIS, whose purpose is to save part of the revenues for future generations.

Figure 1.5 Principles for just energy transitions

DECENT JOBS AND WORKER PROTECTION

1	Design transitions to maximise the creation of decent jobs.
2	Develop tailored government support for communities and workers and focus on skills and training.
3	Use social dialogue, robust stakeholder and policy co-ordination to deliver better outcomes

SOCIAL AND ECONOMIC DEVELOPMENT

4	Ensure that policies enhance social and economic development, and improve quality of life for all
5	Prioritise universal clean energy access and eliminating of energy poverty
6	Maintain and enhance energy security, affordability and resilience

EQUITY, SOCIAL INCLUSION AND FAIRNESS

7	Incorporate gender, equality and social inclusion considerations in all policies
8	Ensure the fair distribution of clean energy benefits and avoid the risk of disproportionate negative impacts on vulnerable populations
9	Integrate the voices of younger generations in decision making

PEOPLE AS ACTIVE PARTICIPANTS

10	Involve the public through participation and communication
11	Use insights from behavioural science to design effective behaviour change policies
12	Enhance impact through international collaboration and the exchange best practice

Source: IEA (2021), Recommendations of the Global Commission on People-Centred Clean Energy Transitions.

Assessment

Senegal's overall sustainable development strategy is set out in the PSE and is broken down into five-year action plans by the various ministries.

Since the adoption of the PSE, Senegal has attached increasing importance to objectives relating to a just and inclusive energy transition and sustainable development. At COP26,

the country signed the Declaration on the Transition from Coal to Clean Electricity and the Global Methane Commitment. Senegal has adopted an environmentally friendly energy strategy and approved its NDC in 2020, which contributes to the fight against climate change and meets the commitments of the Paris Agreement.

The IEA congratulates the Senegalese authorities on the clarity of its policy objectives and the considerable progress already made, particularly in terms of access to energy and the development of renewable energies. The stability of the country's institutions and energy resources constitute an exceptional asset for ensuring its economic and social development for the benefit of all citizens.

The LPDSE for the period 2019-23, within the context of the PSE, constitutes the reference framework for Senegal's energy strategy. The Letter is accompanied by an action plan and an evaluation mechanism. Its main guidelines include the objective of universal access to electricity by 2025, the development of access to clean cooking fuels, the development of national oil and gas resources, the substitution of gas for oil in electricity production, and the deployment of renewable energy.

A new Letter for the period 2024-28 is currently being prepared, with a consultation under way in the fourth quarter of 2023 and final release for the first quarter of 2024. The development of the country's gas resources, even if they are mainly for export, is an opportunity to replace HFO with natural gas massively and rapidly to lower the cost of producing electricity and reduce oil imports and the electricity sector's carbon footprint. A new energy strategy incorporating the medium and long term will be used to set targets for Senegal's energy system with a view to reducing carbon emissions, in line with the United Nations' climate objectives. In this context, the government intends to involve all stakeholders in the development of this strategy.

To manage revenues from oil and gas, the new law on the distribution and management of oil and gas revenues provides for full budgeting and the creation of an Intergenerational Fund and a Stabilisation Fund. Senegal could use part of its hydrocarbon revenues to finance a transition to renewable energies and promote energy efficiency.

It is important to emphasise that Senegal has set itself the target of reducing energy subsidies, and in particular subsidies for petroleum products, which accounted for a very high proportion of the national budget in 2022, representing more than 4% of annual GDP (or 20% of tax revenues). The Senegalese government has set a target of reducing this percentage to 1% by 2025.

Senegal is involved in a number of regional organisations, notably the Economic Community of West African States, including the West African Power Pool (*Système d'Échanges d'Énergie Électrique Ouest Africain*, WAPP). Regional co-operation should be stepped up with the development of resources and in view of the shared objectives of the countries in the subregion in terms of sustainable development and the development of renewable energies. In particular, the prospects for full operationalisation of the WAPP offer opportunities for independent producers and for Senelec to benefit from a wider market. As Senegal is an example of political and security stability in the region, participation in the regional electricity market will open up more opportunities for investors in Senegal.

Institutionally, the MPE is responsible for energy policy; regulating the production, transport and distribution of the various energy sources; developing national resources;

and promoting universal access to electricity. The CRSE, created by the Law of 9 July 2021, is the independent authority responsible for regulating the electricity, gas and petroleum products markets.

The MPE relies on state-owned companies in the sector: PETROSEN for oil and gas production, SAR for oil products refining and Senelec for electricity production and distribution. It oversees several agencies: the ANER, the AEME and the ASER. The review notes an insufficient co-ordination and communication between these structures, which operate in the same areas. There is no clear demarcation between the AEME's and the ANER's areas of intervention, which sometimes carry out similar activities. Improved communication and co-ordination would enhance the synergies and impact of the work of the agencies.

With anelectricity code in 2021 and a gas code in 2020, Senegal has made significant efforts to promote the reform of the electricity and gas markets. It is now important to focus on the effective application of these reforms so that Senegal remains attractive to international investors.

In co-operation with the IEA, Senegal has significantly improved its energy statistics in recent years. Energy balances have become more comprehensive in recent years (currently available balances are 2021). All fuels are covered in the energy balance, allowing a comprehensive picture to be drawn of the energy situation in Senegal. Data collection methods and frequency and surveys could be improved, notably in the transport sector and biomass collection. The ministry in charge of energy is responsible for producing energy market data through its various sectoral departments and contributes to the annual monitoring of PSE indicators. Progress remains to be made, particularly in the renewable energies, energy efficiency and biomass sectors, and on the demand side in the transport sector. A more precise understanding of energy supply and demand by sector is essential if Senegal's new energy policy objectives are to be defined as effectively as possible.

Recommendations

Strategy

- Close the gap and achieve the national universal access to electricity goal through better co-ordination, with a particular emphasis on the last mile and enhancing the quality of supply for existing consumers.
- Accelerate the substitution of heavy fuel oil with natural gas in electricity production with a view to lowering costs and reducing oil imports and the electricity sector's carbon footprint.
- Ensure the effective application of the new electricity and gas codes with a view to promoting investment in the energy sector, particularly in renewable energies.
- Define a long-term low-carbon energy strategy that integrates the development of oil and gas resources in the short and medium term to promote the development of the national economy, the country's energy autonomy and universal access to electricity.

Institutional framework

- Ensure better co-ordination of the actions taken in the energy sector by the various stakeholders around the Ministry of Petroleum and Energies.
- Bring together under one entity the agencies responsible for energy management and renewable energies and possibly the rural electrification agency, with a view to strengthening the synergy of their actions, pooling their means of intervention and increasing their impact, particularly in rural areas.

Regional co-operation

- Intensify regional co-operation, particularly in the field of electricity grid interconnections, energy efficiency and renewable energy standards, strategies for access to electricity, and clean cooking technologies.

Training and employment

- Continue and strengthen energy data collection and use and the national training and skills development effort, particularly at the level of technicians and engineers, in the field of renewable energies and energy efficiency.

2. Energy, climate change and the environment

Key data (2021)

GHG emissions (2020):* 30.3 Mt CO_2-eq vs. 12.4 Mt CO_2-eq in 1990

Energy-related GHG emissions by fuel: 10.1 Mt CO_2-eq (oil 76%, coal 21%, natural gas 0.1%, other 3.5%)

Energy-related GHG emissions by sector: electricity and heat generation 41%, transport 33%, industry 16%, buildings 9%

Energy-related CO_2 emissions per GDP:** 0.398 kg CO_2/USD
(IEA average: 0.175 kg CO2/USD)

Energy-related CO_2 emissions per capita: 0.572 t CO_2/capita
(IEA average 7.823 t CO_2/capita)

* World Bank (2023).

** Gross domestic product in 2015 prices and purchasing power parity (PPP).

Source: IEA (2023), Greenhouse Gas Emissions from Energy

Overview

Senegal has signed several international agreements related to climate change. The government signed, when it was adopted, the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and ratified it in 1994, a year before it entered into force. After ratifying the 1997 Kyoto Protocol in 2001, Senegal signed and ratified the Paris Agreement in 2016. Senegal is a non-Annex I country and, as a developing nation, will need to manage growing energy demand and related emissions.

Senegal integrates its climate action commitments with developmental targets, considering the importance of international support to assist climate efforts. Climate policy forms part of the Plan for an Emerging Senegal, which sets out Senegal's national sustainable development objectives for 2035.

The first Intended Nationally Determined Contribution (INDC) submitted to the UNFCCC in 2015 in the context of the Paris Agreement outlines sectoral mitigation and adaptation measures. In 2020, Senegal updated its INDC to an enhanced NDC to account for the latest population, economic and energy resource developments. The NDC was validated by the President of the Republic of Senegal.

On the mitigation side, the government targets reductions in greenhouse gas (GHG) emissions by 5% and 7% (unconditional goal) and 23% and 29% (conditional on external support) by 2025 and 2030, respectively, focusing on actions in the energy sector. Senegal also set out detailed objectives for adaptation in its NDC to strengthen networks for observing and collecting climate, ocean and coastal data; the resilience of ecosystems and production activities; and to ensure the health, well-being and protection of populations against the risks and disasters associated with extreme weather events and other impacts of climate change.

Climate institutional governance

The MEDDTE is tasked with achieving the goals outlined in the Environmental and Sustainable Development Policy Letter 2016-2020. The Letter aims to promote economic and social development through sustainable practices while ensuring the rational management of natural resources and the environment.

The MEDDTE is the focal point for activities relating to commitments made under the UNFCCC. Its Department of the environment and classified establishments is the Designated National Authority for the Clean Development Mechanism and the focal point for the Green Climate Fund (GCF). The National Agency for Civil Aviation and Meteorology is the focal point for the Intergovernmental Panel on Climate Change. The Centre for Renewable Energy Studies and Research at the Cheikh Anta Diop University is the designated national authority for technology transfers.

By presidential decree, Senegal created a National Committee on Climate Change (*Comité National sur le Changement Climatique*, COMNACC) and regional climate committees. The COMNACC is also in charge of managing and monitoring the implementation of climate policies.

Box 2.1 Senegal's contribution to international climate change negotiations

Senegal is a strong supporter of the COP process, particularly focusing on clean power, reducing methane emissions, increasing climate finance, climate resilience, and the just and equitable energy transition, notably for developing economies. The Ministry of Environment and Sustainable Development chaired the group of climate negotiators from least developed countries in the period 2022-2023.

In 2019, Senegal joined the Climate Ambition Alliance - an initiative of the COP25 hosted by Chile - which agreed to work to meet the global net-zero emissions by 2050 target at the COP. Senegal submitted an updated strengthened Nationally Determined Contribution in 2020 as a result of its COP commitment under the Alliance. At COP26, Senegal signed the Global Coal to Clean Power Transition Statement, committing to ensuring a just transition away from coal use. It is also working on developing a roadmap for a just transition as part of the Climate Action for Jobs Initiative. By COP27, Senegal signed up to the Global Methane Pledge in 2022, joining 130 governments that are collectively targeting a reduction in methane emissions of at least 30% by 2030 across all sectors. On that occasion, Senegal joined Spain, together with leaders from over 25 countries and 20 organisations, to launch the International Drought Resilience Alliance to accelerate action against droughts and help countries be better prepared for future droughts.

Climate change mitigation policies

Senegal has not legislated its NDC-related climate targets. To implement its NDC, the government plans to use increased carbon sequestration in the agriculture and forestry sectors, to use renewable energies, to strengthen energy efficiency notably in industrial processes, and to improve waste management.

Senegal's Environment Code (Law No. 2001-01 of 15 January 2001) does not cover GHG emissions mitigation or climate change in general. A new Environment Code is under preparation and should be published in 2023. It is expected to include rules on gas flaring and venting of methane emissions.

Senegal has presented three National Communications (1997, 2010 and 2015) to the UNFCCC, each with an inventory of GHG emissions as well as mitigation measures and adaptation actions. A new National Communication is under preparation.

The Climate Action Tracker considers Senegal's climate governance performance very good in terms of political commitment and stakeholder engagement but raises the weakness of the institutional framework for delivering on its climate goals. Senegal could benefit from a dedicated authority with an explicit mandate to provide climate- or energy transition-related advice to the government. A dedicated climate change strategy or policy roadmap to 2050 would enable the government to better articulate the development goals.

Long-term energy and climate scenarios

In 2022, the government worked on a long-term low-carbon development strategy. The MPE and the MEDDTE jointly developed 2050 pathways in collaboration with the think tanks ENDA (Senegal) and the Institute for Sustainable Development and International Relations (France), supported by the French Development Agency. The government also prepared sectoral assessments, for instance a strategy for financing the NDC implementation in the industry sector.

Targets and objectives

In 2020, Senegal presented an NDC, updating its 2015 INDC. The NDC sets out a political strategy for the country's main CO_2-emitting sectors: transport, waste, energy, industry, forestry and agriculture.

The transition from the INDC to the NDC responded mainly to the need to update the data (sectoral, macroeconomic, demographic, etc.) used during the preparation of the INDC. It also integrates essential components such as measurement, notification and verification, capacity building, and technology transfer needs important for successful implementation of the NDC. The NDC also anticipates future emissions from the major new oil and gas developments, which were expected to start production in 2022.

The NDC identifies the main GHG-emitting sectors – transport, waste, energy, industry, forestry and agriculture; and gives priority to activities to adapt and control the impacts of climate change, coastal erosion, agriculture, fisheries, livestock, health, biodiversity and floods.

As with many non-Annex I countries, Senegal's NDC defines conditional and unconditional emissions reduction targets, the conditional ones depending on the level of international aid available for its climate action. The NDC includes an unconditional objective (referred to as NDC), to be accomplished with the country's means, and a conditional objective (referred to as NDC+), which will be accomplished if the international community supports Senegal's climate change targets and goals. Support is required in the form of finance or technology transfer. To note that emissions are expected to grow in all scenarios (BAU, NDC and NDC+) and whenever an emission reduction target is mentioned in the NDC and NDC+ scenarios, it refers to a comparative reduction against the BAU scenario.

- Under the NDC (the unconditional objective), Senegal aims to cut its total business-as-usual emissions by 5.1% by 2025 and 7.0% by 2030. The reduction targets for energy-related emissions are 8.0% by 2025 and 6.9% by 2030.
- Under the conditional NDC+, Senegal adopted stronger GHG emissions reduction targets for 2025 and 2030, respectively 24% and 30%, with respect to the BAU scenario, provided international support, notably financial aid. Senegal's reduction target for energy-related emissions would target 27% and 32% by 2025 and 2030, respectively, with respect to the BAU scenario.

According to the government's estimates, the implementation of the NDC will require a total investment of USD 13 billion.

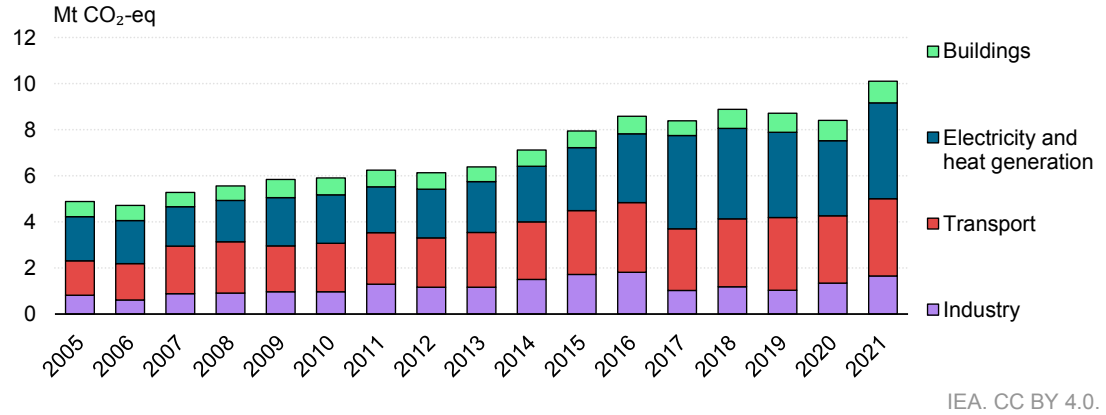
Senegal's greenhouse gas emissions and recent trends

Because of its growing economy and population, Senegal's overall GHG emissions have steadily increased since 1990. Exceptions to the trend occurred in 2020, as the economy slowed down due to the Covid-19 pandemic (Figure 2.1). According to the latest available World Bank data, Senegal's total GHG emissions were 30.3 million tonnes of carbon dioxide equivalent (Mt CO_2-eq) in 2020, a tripling of emissions from 12.4 Mt CO_2-eq in 1990.

In 2021, Senegal's total energy-related GHG emissions were 10.1 Mt CO_2-eq, half of which from electricity generation. From 2012 to 2019, the sector's emissions increased by 75%, mainly due to the increasing use of HFO. In 2019, the latest year with a sector breakdown, energy-related GHG emissions (including electricity generation, transport, industry and buildings) accounted for 48% of total emissions, followed by agriculture (33%), industrial processes (11%) and waste (8%).

The second-largest sector in energy-related emissions in Senegal is transport, with total emissions of 3.4 Mt CO_2-eq in 2021. Over the 2011-21 period, transport emissions grew by 50%. Over the same period, building sector emissions increased by 29%, reaching 0.9 Mt CO_2-eq in 2021. Emissions from the industry sector fluctuated between 1.0 Mt CO_2-eq and 1.8 Mt CO_2-eq over the decade and stood at 1.7 Mt CO_2-eq in 2021.

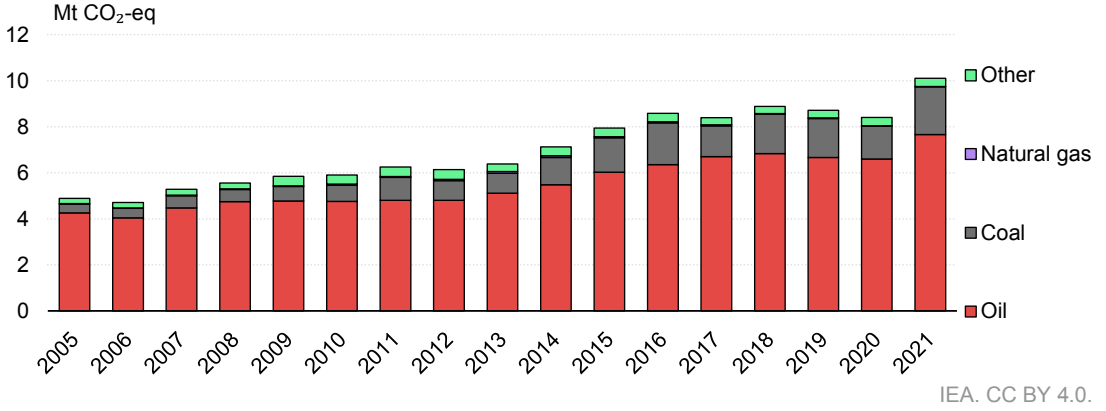
Figure 2.1 Energy-related greenhouse gas emissions by sector in Senegal, 2005-2021



Source: IEA (2023), Greenhouse Gas Emissions from Energy.

Oil use (mainly for electricity and heat generation and the transport sector) was responsible for 7.7 Mt CO_2-eq in 2021, almost 76% of the total energy-related emissions in 2021 (Figure 2.2). Oil emissions reached a high in 2021, as did emissions from coal (2.1 Mt CO_2-eq). Coal emissions more than doubled between 2011 and 2021.

Figure 2.2 Energy-related greenhouse gas emissions by energy source in Senegal, 2005-2021

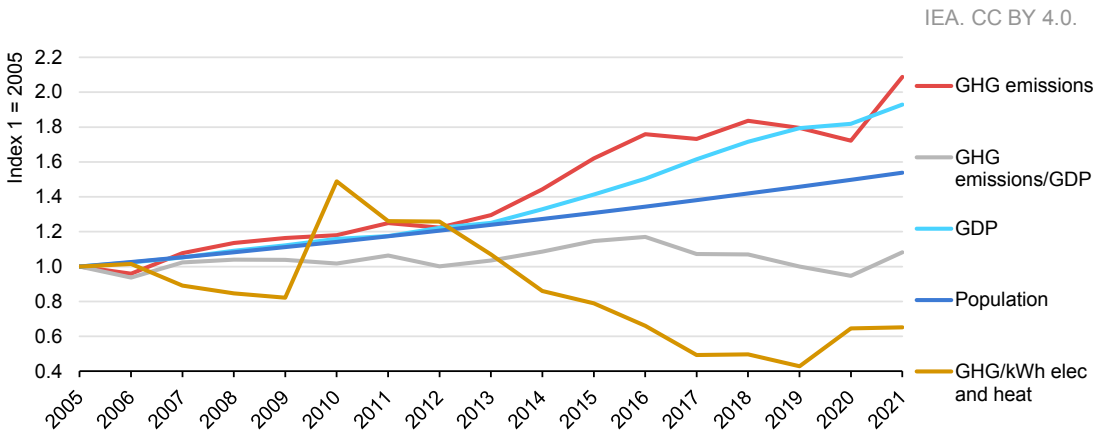


Source: IEA (2023), Greenhouse Gas Emissions from Energy.

From 2005 to 2021, Senegal's GDP increased by 93% while the population grew by 54% (Figure 2.3). A period of stabilised emissions growth (2015-18) has ended as GHG emissions rebounded strongly after the drop related to the Covid-19 pandemic. This rebound is linked to the country's economic recovery following the end of the acute period of the pandemic.

In 2021, CO_2 emissions per unit of GDP in Senegal were 0.4 kilogrammes of carbon dioxide per USD (kg CO_2/USD), which is slightly higher than the IEA average of 0.21 kg CO_2/USD. Conversely, CO_2 emissions per capita are much lower than in advanced economies. In 2021, Senegal recorded 0.6 tonnes carbon dioxide (t CO_2) per capita, well below the IEA average of 8 t CO_2 per capita.

Figure 2.3 Energy-related greenhouse gas emissions and main drivers in Senegal, 2005-2021

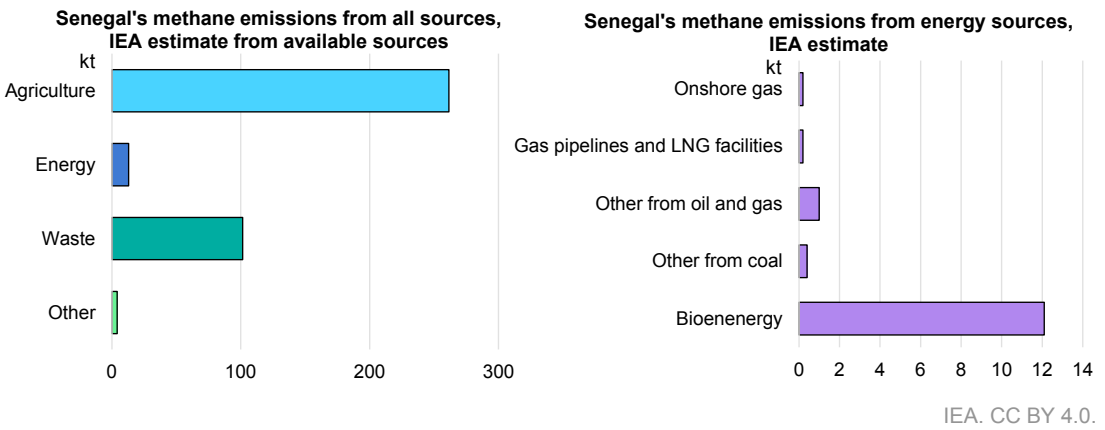


Source: IEA (2023), Greenhouse Gas Emissions from Energy.

Methane emissions

Senegal's methane emissions were 380 kilotonnes (kt) (from 2019 to 2021). Methane emissions mainly stem from agriculture activities; only 3% were from the energy sector. Most of Senegal's energy-related methane emissions are from bioenergy, according to the 2023 IEA Methane Tracker (Figure 2.4). Senegal signed up to the Global Methane Pledge in 2022, joining 130 governments that are collectively targeting a reduction in methane emissions of at least 30% by 2030 across all sectors.

Figure 2.4 Estimates of average yearly methane emissions by source in Senegal, 2019-2022

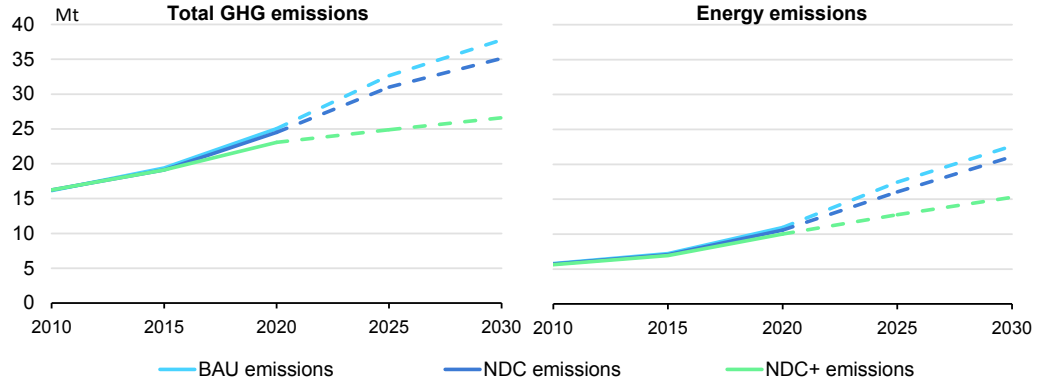


Source: IEA (2023), Global Methane Tracker.

Progress towards targets and gap

Senegal is expected to see total GHG emissions and energy emissions to continue rising fast in the business-as-usual scenario (Figure 2.5). Reaching the unconditional goal of the NDC can partly mitigate this accelerated growth, while the conditional NDC would be able to plateau energy sector emissions by 2030.

Figure 2.5 Total and energy greenhouse gas emissions under the business-as-usual scenario and the Nationally Determined Contributions, 2010-2030



Note: BAU = business-as-usual.

Source: UNFCCC (2020), Senegal's Nationally Determined Contribution, as modified by the IEA.

Table 2.1 Senegal's targets and objectives for 2030 for the energy sector

Sector	NDC scenario	NDC+ scenario
Power generation	- Cumulative installed capacity of solar (235 MW), wind (150 MW), hydro (314 MW) - Grid integration of 699 MW of renewable energy - 13.68% of non-hydro renewables in power generation by 2019 - 6.18 MW of solar PV in non-connected rural areas	- Cumulative installed capacity of solar (335 MW), wind (250 MW), biomass (50 MW), cost for concentrating solar (50 MW) - Grid integration of 999 MW of renewable energy - 18% of non-hydro renewables in power generation by 2022 - Fuel switching from heavy fuel oil and coal to gas with a total of 600 MW of gas-fired capacity - Full rural electrification by 2025 with mini-grids for 2 292 municipalities and 4 356 solar home systems
Clean cooking	- Conversion of 800 000 households per year by 2030 - Installation of 27 000 biodigesters by 2030 - Liquefied petroleum gas policy and bio-coal	- Conversion of 1.5 million households per year by 2030 - Installation of 48 000 biodigesters by 2030 - Promotion of bio-coal
Energy efficiency	- Targeted energy savings of 627 028 GWh by 2030 - Reduction of electricity consumption in 2030 by 126.8 MW	- Targeted energy savings of 3 402 GWh - Reduction of electricity demand in 2030 of 800 MW, corresponding to 48.9% from the peak demand expected in 2030

Sector	NDC scenario	NDC+ scenario
Industry	- Development of agricultural value chains and manufacturing - Better valorisation and exploitation of minerals (phosphates, zircon, iron and gold)	- Improved regulation (audits, energy supply evaluation, checks, etc.) - Environmental and efficiency upgrades of enterprises - Waste management in agriculture industries - Energy intensity improvements in the cement industry (use of natural gas)
Transport	- Reduction of air pollution - Diversification of transport modes (rail and maritime)	- Expansion of sustainable public transport (bus rapid transit, regional express train) - Introduction of hybrid vehicles and biofuels for urban transportation

Source: UNFCCC (2020), Senegal's Nationally Determined Contribution, as modified by the IEA.

The NDC+ scenario reinforced the targets of the overarching PSE and the Letter for the Development of the Energy Sector (2013-2018) with regard to the power sector, fossil fuels, energy access, energy efficiency and clean cooking. The NDC set out several quantitative targets in this regard; however, often with different time horizons and granular manners.

Adaptation and resilience to climate change

The 2018 Intergovernmental Panel on Climate Change report and its special chapter on Africa highlighted that the Western Sahel region will be subject to drier weather conditions with lower precipitation over the next half of the century. Consequences of climate change in Senegal are further outlined in the country's NDC, notably less rainfall, increased average temperatures, sea level rise, disruption of arable soil and ecosystem vulnerability. Northern regions of Senegal (such as the Saint-Louis region) are more affected by extreme droughts.

The NDC contains adaptation measures that aim to increase the resilience of ecosystems and ensure the population is protected against climate risks, with a focus on strengthening climate, ocean and coastal observation and data collection. The following adaptation measures are planned, and most of them perfectly align with mitigation measures:

- energy-efficient infrastructure using traditional architecture and local materials and plants
- phasing out the use of refrigerants
- expanding renewable energy: solar, hydro
- energy efficiency audit and promotion of efficient lightbulbs
- integrating waste management facilities for organic waste (composting) and energy from waste (anaerobic digestion for biogas production) and wastewater management
- promoting clean cookstove and sustainable charcoal
- integrated transport and promoting hybrid vehicles

- agriculture: assisted natural regeneration practices for cultivated land, manure composting and biogas generation
- forestry: increasing forest coverage and reducing the deforestation rate by 25% between 2010 and 2030, restoring mangroves, and reducing bushfires by 90%.

The necessary investments for the mitigation efforts are estimated in the NDC at a total of between USD 8.7 billion and USD 5.3 billion conditional and USD 3.4 billion unconditional. Adaptation action requires USD 4.3 billion, of which USD 1.4 billion are unconditional and USD 2.9 billion are conditional.

The water-energy-food nexus is central importance in the Sahel, including Senegal. The combined effect of economic and demographic growth is expected to significantly increase electricity and water needs. The growing energy demand will increase pressure on water resources in certain areas (which are already characterised by water scarcity), competing directly with other sectors (e.g. agriculture, urban supply) and triggering potential conflicts among water users.

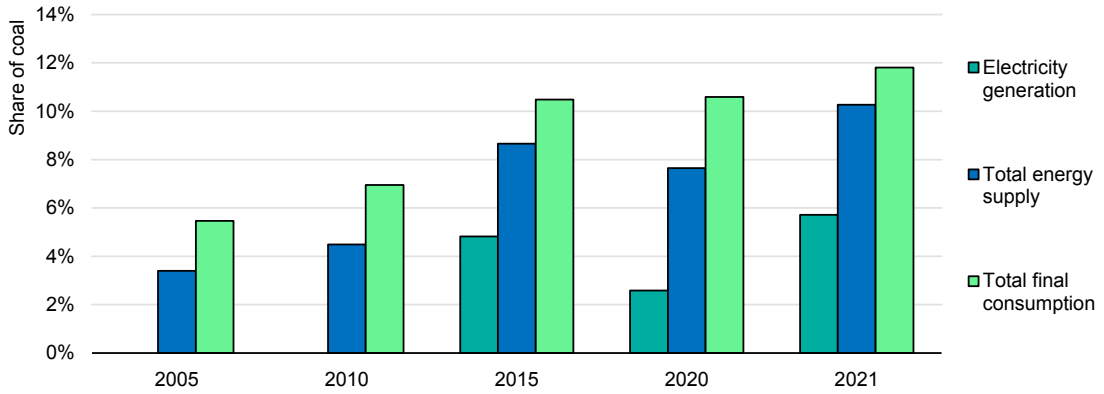
Water availability and water temperature have an effect on cooling systems, which can constrain the operation of power plants. In this context, energy supply disruptions due to droughts frequently lead to negative economic and health aftermaths in African countries, affecting the energy mix, operational costs, CO_2 emissions and water consumption for energy generation.

Coal transition

Senegal does not produce coal; all of its supply is imported. According to the IEA Coal Transition Exposure Index, Senegal's energy transition has to face several country-specific issues related to the role of coal consumption in industry but also in power generation.

Coal accounts for 10% of TES, 5.7% of electricity generation and 12% in TFC, mostly driven by needs in industry. However, Senegal's energy demand is still on the rise, as economic development drives up energy consumption. To satisfy rising future energy demand, clean energies need to expand rapidly so that coal use not only stops increasing, but also eventually decreases. The share of coal in TES has been increasing since 2005 (3.4%), being notably high in 2016 (11%) and 2021 (10%) (Figure 2.6). The share of coal in Senegal's energy demand has increased since 2005, from 5.5% to 12% in 2021. Coal in TES and electricity generation decreased in 2020 due to the temporary closure of the biggest coal plant. Coal started to be used for electricity generation in 2014; use was the highest in 2019 (15%) before dropping to 5.7% in 2021.

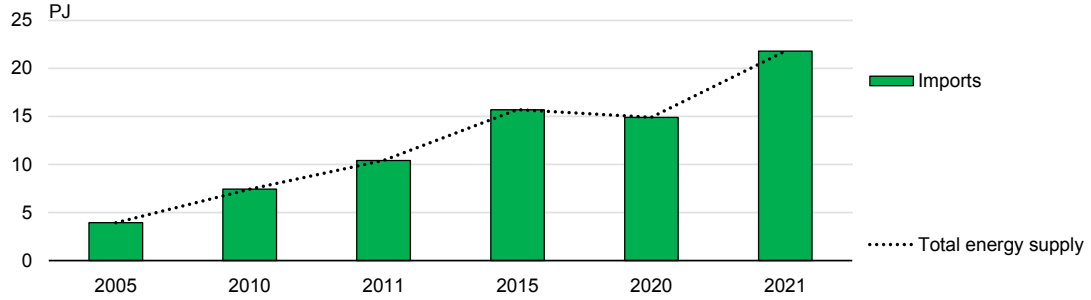
Figure 2.6 Shares of coal in Senegal's energy sector, 2005-2021



Source: IEA (2023), World Energy Balances.

TES from coal came entirely from imports, which are on the rise. The supply of coal grew more than fivefold between 2005 and 2021, from 3.9 PJ to 22 PJ (Figure 2.7). The supply of coal dropped slightly to 15 PJ as a result of the Covid-19 pandemic in 2020 and due to the temporary shutdown of a power plant.

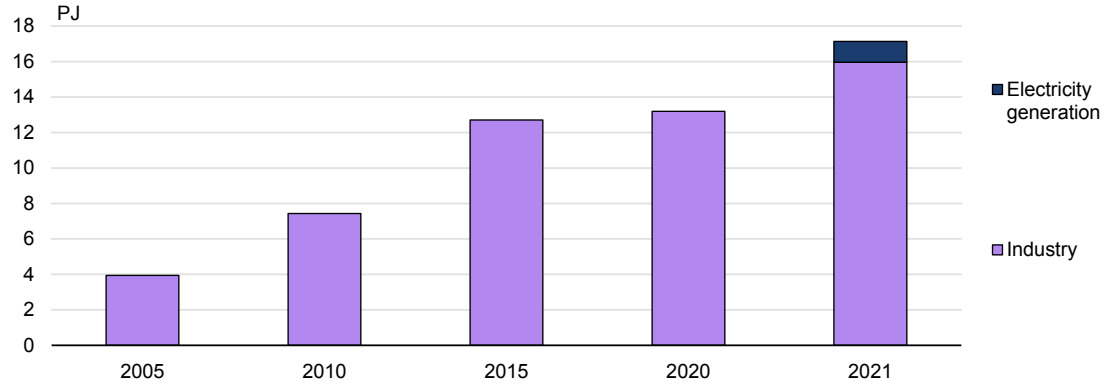
Figure 2.7 Coal supply by source in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

From 2005 to 2021, coal was only used in the industry sector in Senegal, except in 2018, 2019 and 2021, when it was also used for electricity generation (Figure 2.8). Demand for coal in the industry sector was 3.9 PJ in 2005, increasing to almost 13 PJ in 2015 and 16 PJ in 2021.

Figure 2.8 Coal demand by sector in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

Climate finance and projects

Senegal is deploying efforts to attract increasing climate finance directed to the sub-Saharan African region, notably from the Green Climate Fund. The MEDDTE's Senegal Country Program includes priority projects and programmes to be submitted to the GCF for funding by 2025 and 2030.

The GCF supports 13 approved projects for a total budget of USD 176 million, with a strong focus on climate resilience, agriculture and universal energy access. Senegal's *Centre de Suivi Écologique*, *Banque Agricole* and Attijariwafa Bank (AWB, Morocco) are accredited to the GCF to implement operations in Senegal, while accreditation is pending for the public funds, the Priority Investments Guarantee Fund (FONGIP) and FONSIS.

Senegal has a portfolio of 20 projects registered under the Clean Development Mechanism (Programme of Activities), particularly in the fields of renewable energies and some linked to energy efficiency. Standardised baselines have been developed for improved stoves (wood and charcoal) and efficient charcoal production, which were approved by the UNFCCC. Nationally appropriate mitigation actions were validated in the areas of household biogas, off-grid PV and energy-saving lamps.

Under the World Bank's Partnership for Market Readiness, Senegal has prepared an initial proposal for approval, which will contribute to and accelerate low-carbon development and support country efforts through the deployment of national carbon pricing instruments and participation in international carbon markets. The government is developing the second phase of the study on the carbon tax.

Senegal participates in the World Bank Standardized Crediting Framework Initiative, which provides a framework for decentralised governance that will allow initiating a new dynamic to promote better management of the carbon market. The Standardized Crediting Framework provides for a set of flexible procedures and guidelines administered and managed by the public authorities, with a view to contributing to the implementation of the Paris Agreement under Article 6. A ministerial decree confirming the functioning of the Standardized Crediting Framework has been put in place, supported by a steering committee and a technical committee; the administration is managed by the Directorate of

the Environment and Classified Establishments. A pilot phase was successfully carried out in the rural electrification sub-sector. This system must be sustainable to take into account all sectors included in the NDC.

Box 2.2 Senegal's bilateral co-operation agreement with Switzerland under Article 6 of the Paris Agreement

Switzerland foresees using carbon credits from other countries to achieve its Nationally Determined Contribution. The governments of Switzerland and Senegal signed a bilateral co-operation agreement which will govern the use of internationally transferred mitigation outcomes under Article 6 of the Paris Agreement. The signing ceremony of the bilateral agreement between the Swiss Federal Office for the Environment and the Senegalese Ministry of the Environment and Sustainable Development was held in July 2021 in Dakar.

The KliK Foundation was mandated to implement the carbon credit scheme. Along with the negotiation of the bilateral agreement, the Foundation KliK initiated the process of identifying eligible projects and put in place the Climate Action Wheel to call for proposals. The KliK Foundation plans to procure around 20 million tonnes (Mt) of eligible emissions reductions in the form of internationally transferred mitigation outcomes generated by emissions reduction programmes until the end of 2030. Three key projects are currently in place:

- Battery Energy Storage and Renewable Energy Programme to stabilise Senegal's national grid and move away from fossil fuel-based power generation (750 000 t CO_2 between 2024 and 2030, Africa-REN; Lekela Power).
- Ecocar Solaire: Diesel-fuelled buses are converted into environmentally friendly, solar-powered "cars solaires" (300 000 t CO_2 between 2022 and 2030, myclimate).
- National Biogas Programme with the dissemination of domestic biogas digesters in Senegal's rural and peri-urban areas (500 000 t CO_2 between 2021 and 2030, Consortium of Climate Focus [lead], Carbon Limits & Afrique Énergie Environnement).

Source: Klik (2023), Foundation for Climate Protection and Carbon Offset.

Assessment

Senegal is strongly committed to Sustainable Development Goal 13 (climate action) and upgraded its climate ambitions in 2020 to account for the sustainable economic development of the country, in line with the energy sector policy and overall PSE strategy towards 2035.

Senegal's INDC was adopted by the Council of Ministers in 2015. In the context of the Paris Agreement, an NDC was updated in 2020 and adopted, with objectives broken down by sector. By 2030, the NDC aims to reduce energy-related emissions by 10%, compared with projections made in 2010, and even by 50% (NDC+) subject to international financing.

Senegal is heavily involved in the COP climate negotiations. The MEDDTE chairs the group of climate negotiators from least developed countries. Senegal has achieved a large

part of its objectives with regard to the NDC and the Sustainable Development Goals, but challenges remain with regard to clean energy and universal access to energy.

To achieve its NDC, the government drew up a roadmap, an investment plan and "climate" projects. The MEDDTE is responsible for interministerial co-ordination.

The energy sector is ahead with targets on the share of renewables (1 000 megawatts [MW] by 2030), domestic fuels, access to clean cooking, energy efficiency and the introduction of gas in electricity generation. Many of the energy sector actions will also improve climate resilience and adaptation.

The overall increase in GHG emissions (to 8.4 Mt CO_2-eq in 2020) in Senegal is due to higher emissions from electricity generation, mainly from HFO. As mentioned in the NDC, natural gas is essential for reducing the carbon intensity of electricity generation.

In 2020, Senegal accounted for 0.03% of global energy-related CO_2 emissions. Even with the development of natural resources, the impact on global emissions will be negligible. According to the IEA's Africa Energy Outlook 2022, more than 5 000 billion m^3 of natural gas resources have been discovered to date in Africa, but their development has not yet been approved. The cumulative CO_2 emissions linked to the use of these gas resources over the next 30 years would be around 10 gigatonnes. If the cumulative lifetime emissions from the combustion of this gas were added to Africa's current contribution, this would bring its share to around 3.5%.

With regard to energy efficiency, by 2030, the NDC forecast energy savings of 630 000 gigawatt hours [GWh] and a reduction in electricity demand of 800 MW, corresponding to a reduction of around 50% in peak demand expected in 2030.

Senegal is developing a long-term low-carbon development strategy, as set out in the Paris Agreement. The government is currently preparing scenarios with international and local partners. In view of the future contribution of the energy sector, the MPE could prepare an investment plan to specify how the energy transition can contribute to and accelerate carbon sobriety. The LPDSE for 2024-2028 is very important in this context. It could improve the visibility of the government's action and its ability to adopt a long-term, low-carbon objective.

The Intergovernmental Panel on Climate Change's report (2018) highlighted that the Western Sahel region will be subject to drier weather conditions with lower rainfall for the next fifty years. The consequences of climate change on Senegal are described in more detail in the country's NDC, including less rainfall, higher average temperatures, rising sea levels, disruption of arable soils and ecosystem vulnerability.

A National Adaptation Plan has been under development since 2020 with a long-term vision for all sectors (health, biodiversity). The NDC estimates that a USD 4.3 billion investment will be needed to ensure climate adaptation in Senegal, which is half the amount required for mitigation (USD 8 billion). This is estimated to be very low by IEA and international comparisons and should be re-evaluated.

Senegal's overarching five-year economic development action plan (2019-2023 Priority Action Plan) places a strong emphasis on climate adaptation, which is one of its key goals in line with the 2035 Plan for an Emerging Senegal, which guides Senegal's development agenda.

In 2021, Senegal's methane emissions, which represented 380 kt per year, mainly came from agricultural activities; only 3% came from the energy sector. Most energy-related methane emissions come from bioenergy, according to the IEAs Methane Tracker 2023. Methane emissions will increase with the start of gas production. Senegal signed the Global Methane Pledge in 2022, joining 130 governments that collectively aim to reduce methane emissions by at least 30% by 2030 across all sectors. The government is working on a National Methane Roadmap that will serve as input to its 2025 NDC update and contribute to achieving its commitment under the Global Methane Pledge.

The government has initiated a revision of the 2002 Environmental Code, which includes new measures, notably a ban on flaring. A climate has to introduce a carbon mechanism (market or tax). The NDC provides for significant offsets in the forestry sector. Senegal could also attract more carbon credits under Article 6 of the Paris Agreement, building on certification and first projects, such as its collaboration with Switzerland.

Recommendations

- Put in place a cross-cutting climate action plan to strengthen the implementation and annual monitoring of the Nationally Determined Contribution, communication and society's awareness of the challenge of sustainable development and environmental protection. Strengthen the greenhouse gas data collection, verification and reporting mechanism.
- Within the framework of the Paris Agreement, adopt a long-term strategy integrating mitigation and adaptation measures beyond 2030 in a context of economic growth.
- Implement the measures set out in the National Adaptation Plan and reassess the needs required for adaptation to climate change.
- Strengthen the Environmental Code and its application to include objectives for monitoring and controlling methane emissions and the environmental impact of the hydrocarbons and mining sectors.

3. Access to modern energy

Key data (2022)

Access rate to electricity: 75% (urban 97%, rural 55%); +34% since 2005, +18% since 2011

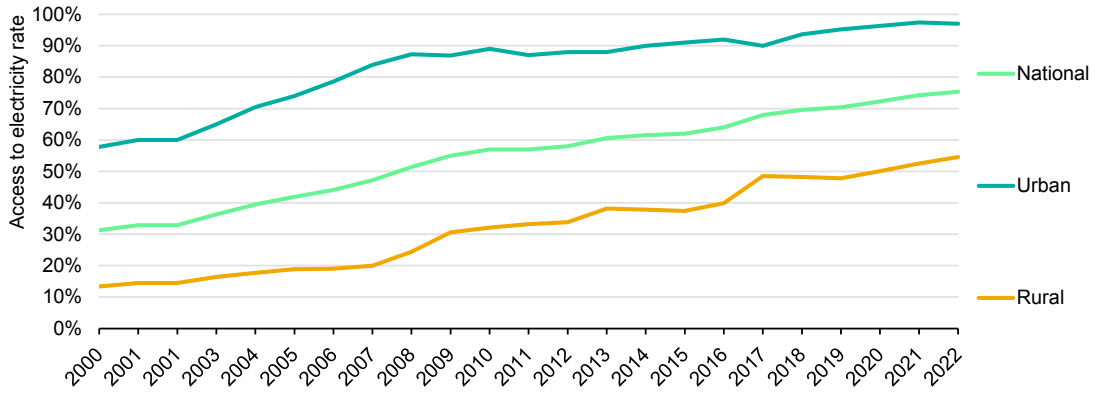
Access rate to clean cooking: 29% (urban: 52%, rural 6%); -9% since 2005, -3% since 2011

Sources: IEA (2023) SDG7 Database, IEA (2023) A Vision for Clean Cooking Access for All

Access to electricity

In 2022, Senegal achieved a 75% access to electricity rate (Figure 3.1)[1]. This is one of the highest rates in sub-Saharan Africa (excluding South Africa) and well above the average in sub-Saharan Africa (47% in 2022, excluding South Africa). Progress in access to electricity was very rapid in the first decade of the century, with an annual gain of 2 percentage points. Growth has slowed down since 2010. Contrary to several countries in the subregion, the rapid demographic growth does not outpace progress achieved in electrification, and the number of people without access decreased steadily in Senegal. In 2022, there were 4.3 million people without access, down from 6.7 million in 2000.

Figure 3.1 National, urban and rural access to electricity rates in Senegal, 2000-2022



Source: IEA (2023), SDG7 Database.

The relatively high national electricity access rate, compared to the average for sub-Saharan Africa (excluding South Africa), masks strong disparities among territories. As in other regions, access to electricity in urban areas is higher and has increased faster than the national average. While almost all Senegalese city dwellers have access to

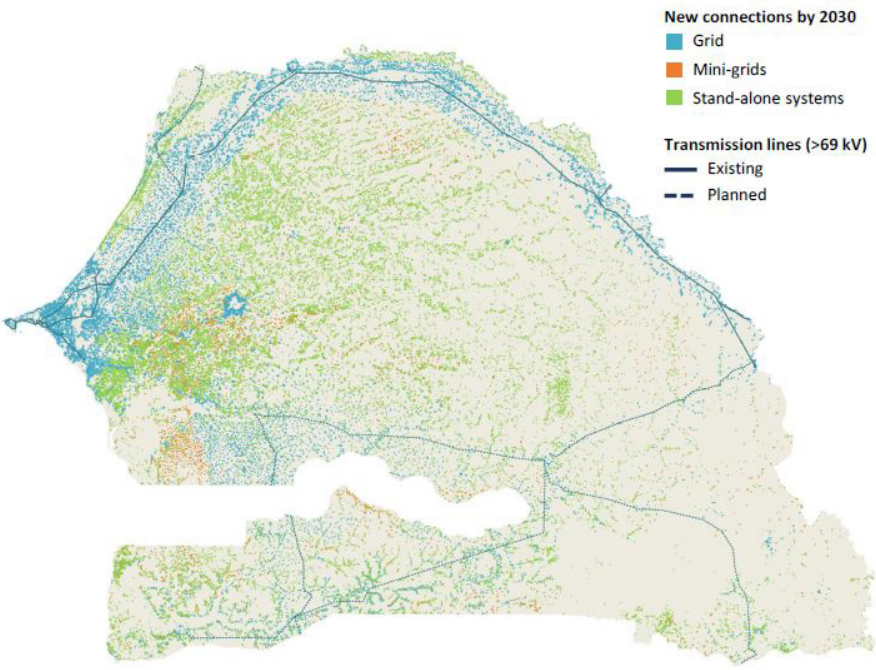
[1] The latest data shared by the MPE for access to electricity rates for 2021 slightly differ from IEA statistics due to methodological considerations: national: 85%, urban: 94% and rural: 58.2%.

electricity (8.5 million people), with a 97% urban access rate in 2022, in rural areas, only 55% of the population does. In 2022, around 4 million people living in rural areas still lacked access to electricity services.

The recent progress has been largely a function of the expansions of central power systems, although several initiatives have supported the deployment of mini-grids and solar home systems. With a relatively limited territory and most of the population concentrated around urban areas, the national grid has been the first option to connect to electricity most of those who have recently gained access, especially in urban areas, where the rate rose from 58% to 90% over the period 2000-14, to reach almost full access today. In rural areas, the access rate has increased by about 40 percentage points since 2000, reaching around 55% in 2022. Although progress trends in access have been hindered by the overlapping impacts of Covid-19 and the energy crisis, Senegal is set to achieve universal access just before 2030 in the IEA Stated Policies Scenario, which considers current and stated energy policies.

According to IEA geospatial analyses, grid expansion and densification are projected to remain the least-cost solution for three-quarters of Senegalese gaining access in future years. Mini-grids are the least-cost solution for around 15%, and solar home systems for the remaining most remote households.

Figure 3.2 Senegal's electricity access solutions by type, IEA Africa Case Scenario



Note: kV = kilovolt.

Source: IEA (2021), Clean Energy Transitions in the Sahel.

Electricity access targets and policy framework

Senegal has put electricity access at the core of its policy strategy. In 2014, the government adopted the Plan for an Emerging Senegal (PSE), with the aim of achieving structural transformation of the domestic economy and reaching middle-income status by 2035. The PSE sees energy as a vital sector for the country, with enshrined access to reliable and affordable energy one of its goals.

Within this framework, the government set the goal of achieving universal access to electricity by 2025. This objective is reflected in the LPSDE 2019-2023, which sets out as a guiding principle the need to "strengthen access for all to energy in sufficient quality and quantity at an affordable cost, which is sustainable and environmentally friendly".

To achieve its ambitions, the PSE is supported by the Priority Action Plan (PAP), which is split into two phases. PAP 1 (2014-2018) laid out the investment needs to meet the PSE's development objectives. PAP 2 (2019-2023) set out specific targets, including an intermediate objective of 85.9% of access to electricity by 2023. PAP 2 has further been adjusted following the Covid-19 crisis, becoming PAP 2A and revising some of the initial goals (e.g. from 85.9% electricity access target by 2023 to 85% in urban areas and from 81.6% access in rural areas to 79.1%). The revision of PAP 2 has mainly granted a greater role to the national private sector within the domestic energy system. Together with renewables and energy efficiency targets, the PAP entails improved access to electricity, strengthened access to quality energy services in rural and peri-urban areas (PAMACEL), and modernised and extended electricity transmission and distribution networks.

The PSE framework also included a strong focus on reducing inequalities between urban and rural areas, particularly with regard to electricity access. In 2015, the government adopted a National Rural Electrification Plan (*Plan National d'Electrification Rurale* – PNER) with the aim of accelerating rural electrification through the launch of an urgency programme between 2015 and 2017, the National Emergency Rural Electrification Programme (*Plan National d'Urgence d'Electrification* Rurale – PNUER), and a Complementary Plan for Universal Access by 2025.

These programmes followed the previously implemented Senegalese Action Plan for Rural Electrification (*Programme d'Action Sénégalais d'Électrification Rurale* – PASER), which included a 20-year plan spanning 2002-20. The key objective was to support rural electrification through the creation of ten rural electrification concession areas to be managed by the private sector. These rural electrification concessions were a hallmark of PASER but experienced difficulties and obstacles in their implementation despite six of the ten concessions being awarded. Such difficulties included the complexity of the tendering and administrative processes related to contract award, uncertainties linked to tax exemptions (which delayed their implementation), and the uneven level of services and prices between on-grid and off-grid services that resulted in the concessions facing resistance from the rural population due to higher prices and lower levels of services *vis-à-vis* on-grid services of Senelec.

In addition to these concessions, PASER also included locally led electrification initiatives for village and community-based projects in very remote and hard-to-reach areas under the national grid extension plans or rural concessions.

Legal framework

Among its policy orientations, the PSE also included the objective of restructuring the electricity sector and the public utility, Senelec. To achieve this, the government approved

a new Electricity Code in 2021 through Law No. 2021-31 of 9 July 2021 (and the related Law No. 2021-32 on the updated status of the Energy Sector Regulatory Commission), which replaced previous laws applicable to the electricity sector.

The Electricity Code regulates the power sector and integrates provisions related to rural electrification, IPPs, renewables and energy savings. Following the entry into force of the new law, a series of implementing decrees were prepared and approved by parliament. In February 2023, the Decree on Decentralised Rural Electrification was adopted with the objective of defining a new framework that aims to tackle several challenges faced in previous rural electrification schemes.

Key stakeholders

Electrification efforts through grid expansion have been the monopoly of the national public utility, Senelec, which also played the role of project manager for rural electrification. Nowadays Senelec manages and operates the electrified villages within its scope and develops *ad hoc* projects and programmes (e.g. a new programme supported by the French Development Agency, the European Investment Bank, KfW and GIZ for grid extension and mini-grids).

The Senegalese Rural Electrification Agency (*Agence Sénégalaise d'Électrification Rurale* – ASER), created in 1998, is a key public stakeholder operating within the rural electrification space. ASER is responsible for promoting rural electrification through a range of initiatives. It is currently the implementing arm of rural electrification policy and is tasked with the monitoring, control and evaluation of all projects and programmes related to rural electrification.

The Commission for the Regulation of the Energy Sector (*Commission de Régulation du Secteur de l'Énergie* – CRSE) was established by the parliament of Senegal as the regulatory commission for the energy sector. Initially established as the regulator for the electricity sector, it saw its mandate expand to the oil and gas downstream sector, and to the upstream and midstream gas sector in 2021. The CRSE has broad regulatory attributions, including with regards to tariff setting.

Off-grid access and affordability challenges

Like many countries in the region, Senegal has private sector companies operating in the off-grid space to support electrification efforts, particularly where the national grid is absent. Members of the Global Off-Grid Lighting Association (GOGLA), Senegal section, have reported to have distributed around 230 000 certified solar products between 2018 and 2022, but the real figure could be higher as its members represent only a share of the market. These solar products, however, include very small off-grid solar systems, which are not included in the IEA access accounting methodology and can represent up to 40% of the total sold systems. This retail activity has contributed to bringing access through solar home systems to remote areas, mostly through pay-as-you-go models (PayGO), whereby the customer pays an initial deposit followed by regular small instalments done by mobile money to overcome the upfront cost. However, for the poorest households, affording a solar off-grid system large enough to power basic services is still a concern, even on a PayGo contract, and a model that includes incentives (e.g. Energy-as-a-Service) needs to be implemented for targeted locations and households.

Even though this is typically a non-regulated retail activity, the government of Senegal has carried out efforts to map all off-grid private sector stakeholders, supported by development partners. Investments in this type of activity require some level of certainty with regard to grid expansion plans and off-grid electrification plans to ensure co-ordination among the different stakeholders and minimise the investment risk for retailers. To incentivise investment in access, in May 2020, the government approved a tax exemption applicable to a list of renewable energy materials, such as solar PV panels, wind blades and street lighting materials, which would not be charged the 18% value-added tax (VAT). In 2023, the Strategy and Regulation Directorate of MPE introduced updated rules that enlarge the list of materials to parts related to the value chain, such as container solutions for solar panel imports. This should accelerate the deployment of solar PV in Senegal.

One specific challenge the government faced when pursuing its electrification strategy through national grid expansion complemented by off-grid initiatives included dissatisfaction from populations gaining access through off-grid solutions such as solar home systems. On the one hand, populations gaining access through such solutions had more limited services than those connected to the national grid, notably less reliable services with more limited power. On the other hand, these limited services were often more expensive than the service provided by the national grid, which led the government to intervene and adopt measures to ensure affordability by harmonising electricity tariffs across the country ("*péréquation*") and a subsequent compensation mechanism to customers of off-grid supply.

According to IEA analysis, affordability challenges are among the main deterrents of electricity access projects, particularly due to the limited profitability of electrification projects in rural areas linked to low potential demand. The IEA estimates that in sub-Saharan Africa, due to affordability constraints, only around half of the new grid and off-grid electricity access connections providing the most basic energy services are likely to be commercially viable without incentives such as reduced connection charges, lower tariffs and subsidised electrical appliances.

In Senegal, thanks to social electricity tariffs and a relatively higher household income compared to other countries in the region, if provided with a grid connection, only around 8% of households would not be able to afford essential electricity services[2] without further incentives. However, climbing the energy ladder and consuming the electricity required for more extended energy services is not affordable for around half of Senegalese households.

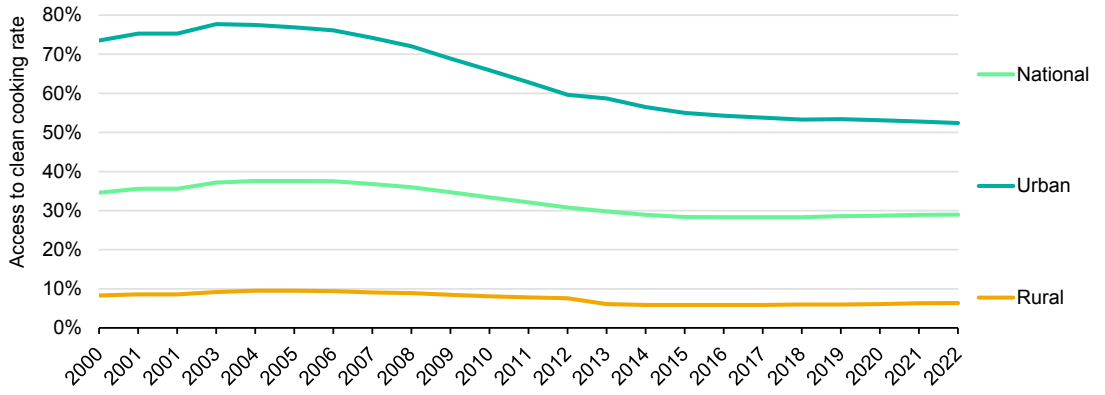
Utilities, mini-grid operators and other energy companies need to recover the cost of electricity to continue operating and expanding new connections. End-user risks are likely to be too high for private companies to pursue rural electrification without a combination of well-targeted government subsidies covering grid and off-grid solutions (e.g. cross-subsidisation), derisking mechanisms including grants, demand stimulation and reliance on productive uses as anchor loads.

[2] The essential electricity service or bundle includes: four lightbulbs for four hours per day, a fan for three hours per day and a television for two hours per day, which equates to roughly 500 kWh per household per year. This can be provided by a solar home system of 50 watt-peak and above or a small fossil generator. The extended electricity service or bundle includes: a refrigerator, four hours for lighting, four hours for TV and six hours for a fan, which equates to roughly 1 250 kWh per household per year, and can be supplied by a fossil generator or a large solar home system of more than 100 watt-peak.

Access to clean cooking

In 2022, almost 30% (5 million) of the Senegalese population had access to clean cooking fuels and equipment (Figure 3.3). This rate reached 50% in urban areas, where LPG is primarily used but remained below 7% in rural settlements. Considering the limited progress and the strong demographic growth, the number of people still relying on traditional biomass for cooking has increased faster than the total population, doubling from 6.5 million in 2000 to 12.5 million today. Two-thirds of the population without access live in rural areas (8.5 million).

Figure 3.3 National, urban and rural access to clean cooking rates in Senegal, 2000-2022

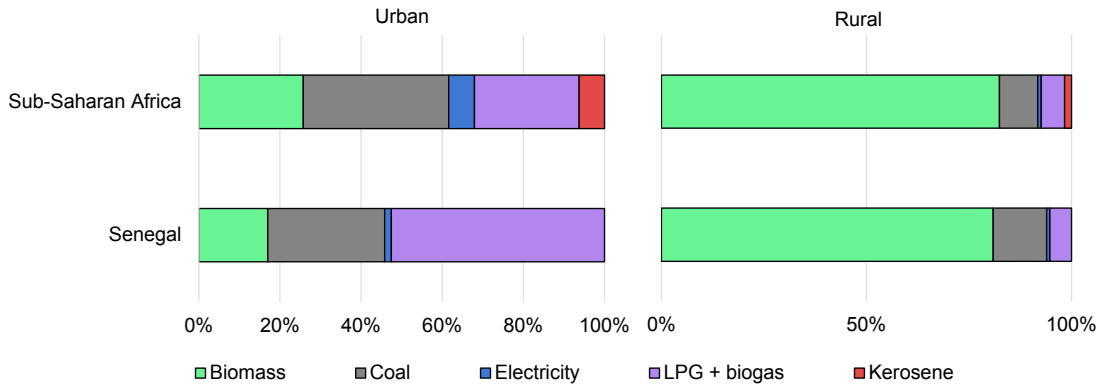


Source: IEA (2023), SDG7 Database.

Although accurate and recent data on energy demand and practices for cooking are uneven and scarce, it is clear that while rates of access in urban areas are higher thanks to the replacement of traditional biomass with LPG, the rural population continues to use traditional biomass (Figure 3.4). LPG and biogas are used for cooking by almost 30% of the total population in Senegal and by 53% of the urban population, which represents one of the highest shares in sub-Saharan Africa. Due to the high share of households with a grid connection, electric cooking presents a strong but yet untapped opportunity in Senegal, with only around 1% of the population cooking primarily with electricity, which is mostly due to the relatively high cost of electricity.

On the other hand, firewood, charcoal dung and other solid biofuels are still the primary cooking solution for around 70% of households in Senegal, especially in rural areas, where alternatives are less available and biomass can often be collected for free. As of 2021, more than 95% of the rural and just below half of the urban population still used solid biofuels as a primary source for cooking. In urban areas, charcoal is predominantly used among solid biofuels, while firewood and other primary solid biofuels are mostly used in rural areas.

Figure 3.4 Primary fuels used for cooking by households in Senegal and sub-Saharan Africa, 2021



Source: IEA analysis based on WHO (2023).

Traditional use of biomass causes people to breathe in harmful smoke, which contributes to premature deaths, with women and children the most at risk. Basic cooking also negatively impacts productivity due to the hours spent collecting firewood and other fuel sources, which in rural areas in Senegal carry huge economic costs. Furthermore, rudimentary cooking methods increase deforestation and GHG emissions, which, particularly in the norther regions, home to cattle headers and small subsistence farmers, represent a major threat. Introducing advanced policies is, therefore, of key importance from an economic, health and social perspective.

Policy framework

As part of the LPSDE 2019-2023, Senegal adopted a programme to promote and diversify domestic fuels with a view to "ensuring a sustainable supply of cooking energy for households while preserving forest resources". The programme included a focus on six areas of intervention: 1) strengthening the institutional framework; 2) implementing the national domestic fuel strategy and financing its action plan; 3) setting up a transport equalisation mechanism to harmonise butane gas prices; 4) finalising and implementing an integrated information system for the sustainable management of forest resources and domestic fuels; 5) strengthening the actions of domestic fuel development projects; and 6) consolidating sustainable supply and participatory forest management.

Liquefied petroleum gas

In a bid to preserve its forests, since 1974, Senegal has been pursuing a policy of "butanisation" to limit the use of biomass for cooking and deforestation by subsidising LPG cylinders (targeting the lowest income households likely to buy the small 2.7 kilogramme [kg] and 6 kg cylinders), fostering the creation of gas-refilling stations and financially supporting the costs of transporting the cylinders across the country. Domestic policies have supported the distribution and affordability of LPG with tax and duties exemptions for small 3 kg cylinders. LPG adoption has been successfully boosted, mainly in urban centres. However, due to the burden of this subsidy on public finances (estimated at FCFA 237 billion between 1987 and 2009), in 1998, the government started to progressively phase it down while taking measures to maintain affordability: VAT and import taxes were removed, while distributors' and wholesalers' margins and revenues were maintained.

The removal of the subsidy has translated into a significant change in the energy mix for cooking in households; the overall rate of use of butane has experienced a recession from 97.4 % to 85.2%, and coal and wood have increased from 77.8% to 90.2% and 12.8% to 16.8%, respectively. Despite the tax exemption granted to butane as an accompanying measure, the transition to this product has been interrupted, especially among the poor, which ultimately had negative effects on the forest cover. The effect at the level of small production companies and commercial services has been instead a reduction in the monthly consumption of butane gas.

Biomass

The Programme for the Sustainable and Participatory Management of Traditional and Substitute Energies (*Programme de Gestion Durable et Participative des Énergies Traditionnelles et de Substitution*, PROGEDE) supported sustainable wood fuels production in Senegal while promoting energy-saving tools and protecting forests. Financed by the World Bank, PROGEDE was developed in two phases: PROGEDE I started in 1998 and PROGEDE II ran from 2010 to 2015; it was the main programme for forest and biomass management, set by the Ministry of Environment and Sustainable Development.

PROGEDE's main goal was to increase the availability of diversified household fuels in a sustainable and gender-equitable way and to contribute to increasing the income of participating communities while preserving forest ecosystems. More specifically, PROGEDE II aimed to reform the charcoal value chain; develop a sustainable wood fuel supply; and promote diversified and modern household energy and institutional arrangements for project implementation. Charcoal value chains are generally informal and rely on highly inefficient processes for transforming firewood into charcoal. It is estimated that it generates more than FCFA 20 billion in turnover and is heavily dominated by forest managers; the local population only gets 6% of the sector revenues.

The government of Senegal aims to promote the use of efficient processes and kilns, including la Meule Casamance, that include a chimney and can offer efficiency rates of 25-30% compared to a baseline of 15%. A dedicated programme was created to convert several informal charcoal producers into a formal activity and support the acquisition of such kilns, with a licensing process, production quotas and taxes on charcoal production.

The FASEN project (*Foyers Améliorés Sénégal*) was created in 2005 under the Promotion of Rural Electrification and Domestic Fuel Supply programme and implemented by GIZ to facilitate the distribution of improved cookstoves in urban areas in Senegal. FASEN, one of the many projects participating in the Global Alliance for Clean Cookstoves, has supported the dissemination and local production of Jambaar ICS (i.e. a portable stove with a fired clay combustion centre enclosed by a metal casing, both for charcoal and firewood use). The programme also supported the setting up of quality standards with the support of the Standards Association of Senegal and the definition of refining test protocols with the Centre for Study and Research in Renewable Energy.

Other distribution programmes include the Safe Access to Fuel and Energy programme, implemented by the World Food Programme, which has successfully supported Senegal in producing and distributing 3 857 improved stoves. The programme focused on three activities: 1) providing institutional fuel-efficient stoves in schools; 2) training local artisans on the production of household and institutional fuel-efficient stoves; and 3) delivering

sustainability awareness-raising sessions to promote improved cookstoves. GIZ/EnDEV has implemented other initiatives with the Global Climate Fund.

Under a market-based approach, several companies have been selling cookstoves, including Baobab+ (a leading microfinance institution and distributor of solar products under PayGo schemes) and Burn Manufacturing, a leading producer and distributor of charcoal stoves in East Africa (manufactured in Kenya). No fiscal incentives have been introduced (full import duties and VAT are applied to these products), but these companies usually get voluntary carbon credits. Moreover, these stoves' level of efficiency helps customers save significantly on their spending for charcoal, offering a quick and high return on investment for the acquisition of the stove.

Box 3.1 Best practices for clean cooking

In Senegal, achieving universal access to clean cooking facilities by 2030 would necessitate an annual increase in access of approximately 7.5%. This projected required growth may, in fact, be lower, as parts of the population considered without access in rural areas due to statistical methodologies already have an improved cookstove. Improved cookstoves provide a first step to accelerating the gap in clean cooking access in rural areas. Biogas, ethanol and e-cooking will also play a role toward clean cooking access in Senegal, where the latter can be used as a primary cooking option or to simply reduce demand for other fuels.

Recent IEA analysis shows, that historically, some Asian countries, such as Indonesia (4%), India (3%) and the People's Republic of China (2%), have accomplished similar improvements over the past decade. Noteworthy success stories in Africa include Kenya, Nigeria, South Africa and Sudan, where new clean cooking strategies were implemented between 2015 and 2021. Since 2010, these countries have been able to extend clean cooking facilities to about 1% of their populations annually, with an acceleration to 1.5% since 2015.

The significant progress in providing clean cooking has largely been driven by the adoption of LPG. For instance, in India, the number of people primarily using LPG for cooking increased by almost 300 million from 2015 to 2022, thanks to impactful measures like the Pratyaksh Hanstantrit Labh, which has been subsidising LPG refills since 2015, and the Pradhan Mantri Ujjwala Yojana, which has provided over 80 million deposit-free LPG connections to women in impoverished households since 2016. Similarly, in Indonesia, the government's LPG subsidy programme contributed to a population-wide increase of 60 million people primarily using LPG for cooking during the same period, representing more than 20% of the population.

Source: IEA (2023), A Vision for Clean Cooking Access for All.

Biogas

The National Biogas Programme (NBP) was established in 2009 to support the development of modern energy services through the installation of biodigesters. The programme aims to promote the development of biogas and contribute to domestic socio-economic development, access to energy, and food security. The use of biodigesters by households consists of transforming organic waste into gas used for cooking and lighting but also obtaining fertiliser as a by-product sold for agricultural purposes.

The NBP pursues a set of specific objectives, namely the provision of a source of energy for cooking and lighting for rural households, the improvement of farming operations through organic fertilisers and the establishment of a mechanism to finance biodigesters backed by a guarantee fund for Energy, Agriculture and Sustainable Development. To achieve these goals, the programme has supported the training of technicians on building and maintaining biodigesters, raising awareness among users and setting up local producer groups for the sale of fertilisers.

During the NBP's pilot phase (2009-12), 579 biodigesters were installed. The 2020 VAT exemption measures, which cover equipment for biogas (biogas flow analysers, prefabricated biodigesters, biogas pumps, biogas stoves, desulphurisation units, water traps, biogas generators and substrate mixing units), have further accelerated the deployment of biogas. More than halfway through phase 2 (2020-2025), the programme is estimated to have already contributed to the installation of over 2 300 biodigesters, the production of close to 3 000 tonnes of fertilizers and the creation of over 12 300 jobs. According to the NBP, average income of households with a biodigester have gone from 31 604 FCFA/month (2014) to 92 952 FCFA /month (2020). As households in rural and peri-urban areas gain access to a clean alternative fuel replacing firewood for cooking, deforestation is expected to decrease, as well as GHG emissions. With over CFAF 90 billion invested by 2030, the programme aims to support the installation of almost 60 000 biodigesters.

Three key projects have the potential to further expand the impact of the NBP. The largest, supported by ID BIO.SA (Senegal) and EKOTRA (Côte d'Ivoire), has a budget of CFA 56 billion and is expected to enable the installation of 40 000 biodigesters, the construction of five enriched organic fertiliser production plants and the setup of a digital production monitoring and financial management platform. The OSSI YETO (Switzerland) project, with an estimated cost of CFA 25 billion, intends to deploy 7 500 biodigesters and acquire 35 sewer trucks. A third project aims to tap into Article 6 of the Paris Agreement and transfer to Switzerland's KLIK foundation 615 959 teq CO_2 of avoided emissions thanks to installed biodigesters and allocate 813 532 towards Senegal's NDC. The estimated investment amount for this project is CFA 10 billion.

Assessment

Access to electricity

Senegal has one of the highest rates of access to electricity in sub-Saharan Africa and has set the target of achieving universal access by 2025. Progress has mainly been achieved through the expansion of the national electricity grid, although off-grid initiatives have also

played a role. The access rate has progressed in cities but remains a challenge in rural areas, where 4 million people remain without access to electricity.

The government has been proactive, adopting a framework and strategy for rural electrification in the 2000s and launching initiatives such as the large-scale deployment of mini-grids and, more recently, a consultation mechanism to facilitate the activities of private distributors of solar home systems. Measures to ensure affordability also include the harmonisation of electricity tariffs across the country (*péréquation*) to align the prices paid by consumers connected to the national grid and those paid by consumers with an off-grid connection.

While progress in electrification efforts has mostly resulted from the national grid expansion, ASER and other entities have set up numerous programmes in rural areas to accelerate rural electrification. The multiplicity of actors and stakeholders involved in off-grid electrification efforts has sometimes created co-ordination difficulties and additional challenges in the past, despite the efforts the government has made in collaboration with donors.

To stimulate investment in off-grid solutions, the government approved a VAT exemption on solar PV and other renewable energy equipment. While this was a welcome development, some companies importing these products reported challenges in applying for the exemption, notably that the scope did not cover certain materials and did not extend to other levies, such as customs duties. Broader incentives, covering cables and other materials required for solar PV installations and potentially extending to additional levies, could encourage distributors to reduce the selling price to end customers and, therefore, reduce the central government support needed to enhance affordability. In 2023, the Strategy and Regulation Directorate of MPE introduced updated rules to expand the list of materials included in the exemption to cover a broader part of the solar PV value chain.

Despite these efforts, affordability remains a challenge, particularly for rural populations, with implications for both establishing the first connection to a source of electricity and for purchasing electrical appliances. Such challenges make rural electrification projects less profitable, have a negative impact on their financing, and considerably reduce the interest of private investors, especially of mini-grid and stand-alone systems players who are generally smaller.

In addition, some segments of the population have a negative perception of solar home systems, as these solutions are often considered to be inferior to grid access, which is still perceived as the most reliable and secure access to quality electricity services. The treatment of end-of-life equipment, particularly solar panels, was raised by several stakeholders as a point for attention with regard to their recycling or possible reuse.

Planning electrification by steps and developing campaigns to inform households of the benefits of being equipped with a stand-alone system while waiting for other solutions to become available in the area can be key. In addition, the adoption of Energy-as-a-Service models can be beneficial for the adoption, acceptance and more efficient use of these solutions. These are models where solar home systems or other off-grid solutions are deployed on a utility-like business model where the household pays for electricity but does not own a system and the energy provider is responsible for the system maintenance, replacement and end-of-life.

Access to clean cooking

Senegal has a good system for collecting energy data (SIE-Sénégal), bringing together both decision makers and the main data suppliers in a consultation framework. However, it should be emphasised that obtaining quality data on domestic energy and clean cooking, especially for tracking the traditional and non-commercial use of biomass, is largely dependent on conducting regular household surveys, which require adequate funding. International technical co-operation allows data to be collected on the projects it finances. However, this progress is insufficient to develop a detailed strategy for promoting clean cooking. Co-operation and pooling of resources between public institutions should be encouraged, along the lines of that between SIE-Sénégal and the National Agency for Statistics and Demography.

Although the issue of clean cooking is often raised in public energy policy documents, it must be acknowledged that there is no clear regulation in the domestic fuel sector. A multitude of public and private players (MPE, National Agency for Statistics and Demography, EnDev, the National Biogas Programme, non-governmental organisations, private operators) invest in the sector without any clearly established co-ordination. Regulations could help ensure that this issue is taken into account for urban construction and electric cooking in the future. Furthermore, the need for developing a national Clean Cooking Strategy and a dedicated working group comprising all international, public and private players becomes clear. Efforts have been made to control and certify clean cooking technologies, notably by the Centre for Study and Research in Renewable Energy. However, the government does not provide sufficient support for research and development. The lack of co-ordination among institutions, coupled with insufficient governmental control over the clean cooking technologies deployed, leads to a low rate of adoption.

Other factors contributing to low adoption rates include unawareness of the benefits of switching to clean cooking and affordability. The poorest households, especially those relying on collected biomass, do not see the benefits of starting to pay for something they can apparently get for free, as the potential value of the time saved by women is not factored in. However, these barriers could be removed or mitigated with more inclusive approaches, sensitisation campaigns and targeted incentives towards specific segments of the population. Moreover, carbon finance instruments, such as carbon credits, could provide valuable opportunities to finance clean cooking projects and lower the cost of clean cooking solutions, making it more affordable to families that are ravaged by affordability issues.

Recommendations

Access to electricity

- ☐ Continue efforts to achieve universal access by 2025 through indicative planning based on reliable and timely data, particularly geolocation data; ensure that all public and private players are involved in this exercise through a dedicated working group that meets regularly.

- Improve the regulatory and incentive framework to establish fair market conditions that encourage and secure private sector investment, particularly in off-grid areas, while also providing targeted support to the most vulnerable citizens.
- Strengthen co-operation between all public and private entities, including donors, involved in defining and implementing the electrification strategy and long-term integrated planning with a view to maximising synergies and efficiency gains, and ensure timely tracking, delivery through action plans and clear responsibilities.
- Consider regulating the treatment of end-of-life equipment, in particular through recycling or reconditioning.

Access to clean cooking

- Improve the quality of data on domestic electricity and clean cooking access by strengthening the human and material resources of the bodies responsible for collecting it.
- Step up information campaigns on alternative fuels (LPG, electricity, ethanol and biogas); encourage competition to ensure supply (storage, bottling, distribution) in rural areas to limit deforestation.
- Introduce incentives to make clean cookstoves and fuels more affordable, particularly in rural areas. Consider regulating and facilitating the use of carbon credits for clean cooking projects.
- Support research, training and marketing of alternative and inclusive technologies linked to forest preservation (e.g. optimised use of biomass) for the benefit of beneficiaries of improved stoves.

4. Energy efficiency

Key data (2021)

TFEC: 134 PJ; +20% since 2011

TFEC by source: oil 42%, bioenergy and waste 33%, electricity 14%, coal 11%

TFEC by sector: buildings 47%, transport 34%, industry 19%

TFEC per capita: 7.9 GJ/capita (IEA average: 106 GJ/capita); -9% since 2011

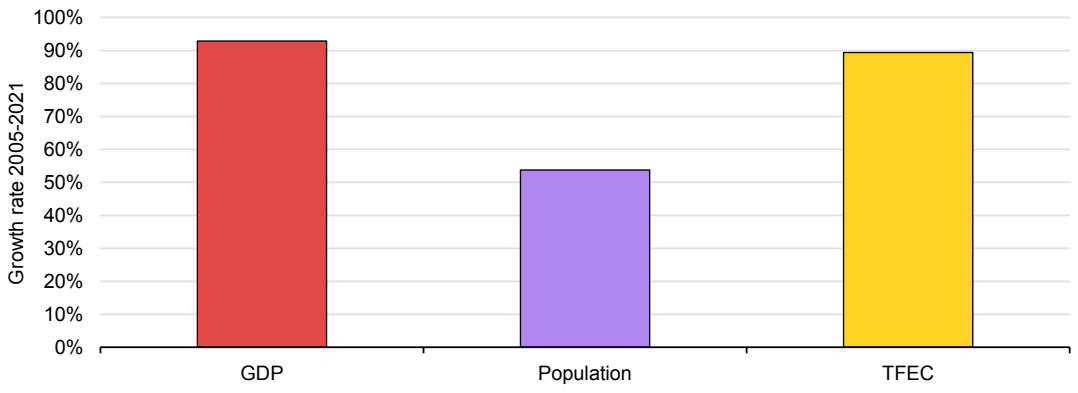
TFEC per GDP: 2.3 MJ/USD (IEA average 2.4 MJ/USD); -27% since 2011

Source: IEA (2023), World Energy Balances

Overview

Senegal's energy consumption has steadily increased, with an average population growth rate of 5% over the past decade. As the country is on track to achieve universal access to electricity and has a growing economy, Senegal's energy consumption is on a growth path: from 2005 to 2021, total final energy consumption increased by 89% (Figure 4.1). Over the same period, Senegal's GDP increased by 93% and its population by 54%.

Figure 4.1 Growth rate of GDP, population and TFEC in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

Together, the agriculture and fishing sectors account for the majority of the working population, even though these economic activities generate a lower value than others. In 2019, the sector with the largest share of employment was the services sector (48%), due

to growing urbanisation, followed by agriculture (34%) and industry (13%). The services sector accounts for 50% of GDP, followed by industry (24%); agriculture, forestry and fishing (15.3%); and manufacturing (15%).

Energy efficiency institutional framework

The MPE is responsible for the implementation of the energy strategy, including energy efficiency. The MEDDTE supports efforts to improve air quality, equipment control and environmental protection, as well as health and safety.

Senegal's energy efficiency agency, the AEME, is in charge of the design and implementation of energy efficiency policies, the administration of financial incentives, and support programmes. The government is keen to bolster the institutional governance of the AEME and the skills, competences and capabilities needed. The AEME has a wide range of tasks, including the evaluation of energy efficiency potentials by sector and activity and the adoption of sectoral strategies, action plans and programmes. It can propose energy management programmes and contribute to the development of the legislative and regulatory framework for energy efficiency in Senegal.

The government's policies often combine energy efficiency and renewable energy projects as well as energy access objectives. Many activities are split across a range of actors and institutions. Progress is driven by the funding and institutional capacity of the government and its agencies, notably the AEME and, to some extent, the National Agency for Renewable Energies.

At the regional level, ECOWAS has a Centre for Renewable Energy and Energy Efficiency, which was created in 2010 with the support of the ECOWAS Commission and the Austrian and Spanish governments, with technical assistance from the United Nations Industrial Development Organization.

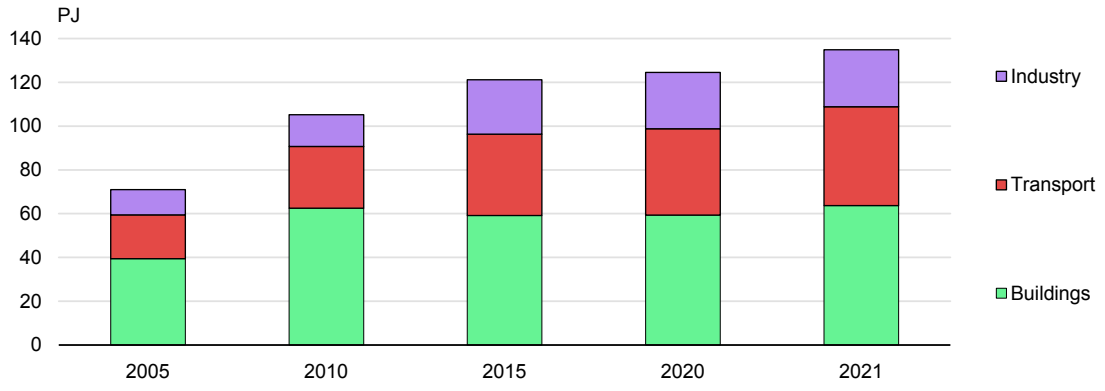
Tracking the progress of energy intensity improvements is not part of the government's policy to date, but the Office for Orientation and Tracking the PSE screens progress across a range of indicators.

Energy consumption and efficiency progress

From 2005 to 2021, Senegal's TFEC increased from 71 PJ to 135 PJ (Figure 4.2). Its TFEC grew steadily, even in 2020, despite the world's economic slowdown due to the Covid-19 pandemic.

The buildings sector was the largest energy-consuming sector in 2021, covering 47% of TFEC (45% residential and 2.6% services sector buildings), followed by transport (34%) and industry (19%). Electricity consumption has increased by 102% over the past decade, followed by coal (53%) and oil (43%). Consumption of bioenergy and waste sources has decreased by 17%.

Figure 4.2 Total final energy consumption by sector in Senegal, 2005-2021

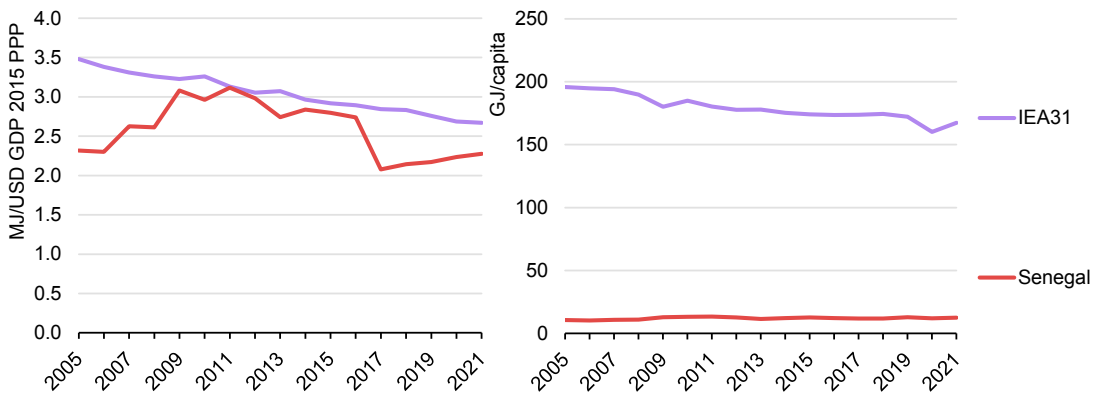


Source: IEA (2023), World Energy Balances.

Energy efficiency targets

Senegal's energy intensity rate decreased from 2.84 in 2014 to 2.14 in 2018 (Figure 4.3), but energy intensity improvements started to decline thereafter. Compared to the IEA members average, Senegal has a very low energy intensity per capita (12.6 GJ/capita versus 167.36 GJ/capita in 2021).

Figure 4.3 Energy intensity per unit of gross domestic product and per capita in Senegal and the IEA, 2005-2021



Note: MJ/USD GDP 2015 PPP = megajoules per United States dollar per unit of gross domestic product in 2015 purchasing power parities

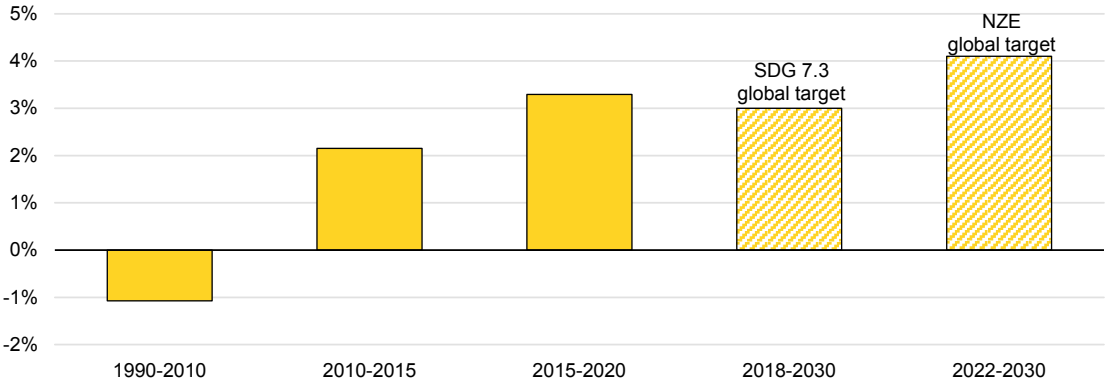
Source: IEA (2023), World Energy Balances.

SDG global target 7.3 calls for doubling the global rate of improvement in energy intensity (measured as TES/GDP) by 2030, which translates into energy intensity improvements at a 3% rate over the period 2018-2030 (Figure 4.4).

The IEA Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach shows that to meet its Net Zero by 2050 Scenario, the global annual rate of energy intensity improvements for the period 2022-2030 will have to increase to 4.1% from a baseline scenario of 2.2%. Senegal started realising energy intensity improvements in the period 2010-2015 (2.2% on average), up to 3.3% in the 2015-2020 period, in line with the SDG

target of 3% from 2018 to 2030. During the IEA's 8th Annual Global Conference on Energy Efficiency, Senegal, alongside 45 other governments, endorsed the goal of ramping up annual energy efficiency progress from 2.2% today to over 4% annually by 2030 in a move that would create jobs, expand energy access, reduce energy bills, decrease air pollution and diminish countries' reliance on fossil fuel imports, among other social and economic benefits.

Figure 4.4 Annual rate of energy intensity improvements in Senegal (1990-2020) and global targets until 2030



Note: Energy intensity improvements are measured as the ratio TES/GDP.

Sources: IEA analysis based on IEA (2023), World Energy Balances, Net Zero Roadmap (2023 update); SE for all.

Energy efficiency strategy

Senegal included energy efficiency objectives in its NDC, which are aligned with the PSE and the country's five-year Energy Sector Development Policy Letter.

Senegal's energy efficiency policy across sectors is framed, as a priority, within a rationale of reducing energy bills. The government promotes the adoption of modern appliances (lighting, labelling and technology deployment). It takes the lead to reap energy savings in the public sector by reducing electricity consumption thanks to more efficient energy performance of buildings, notably through efficient public lighting.

The government has the stated objective to develop an energy efficiency framework with adequate regulatory, quality control and financing rules.

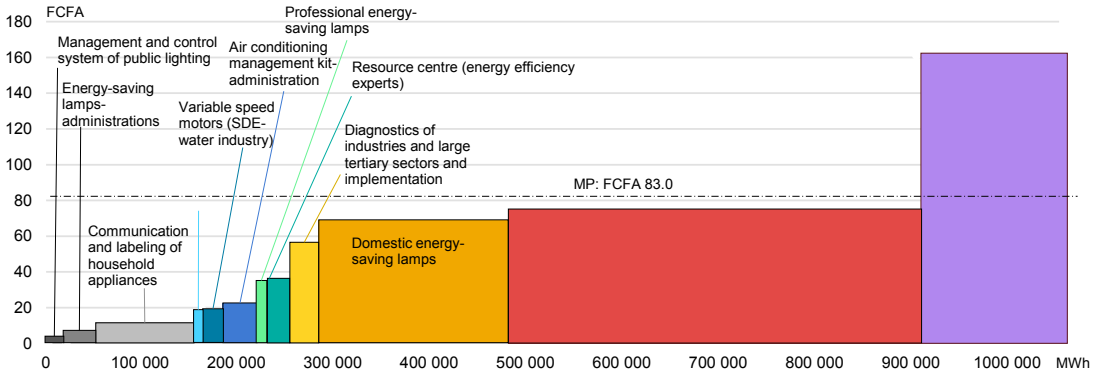
The AEME elaborated the Strategic Development Plan 2019-2023 and the 2030 Energy Management Strategy in accordance with the PSE and the orientations of the LPDSE.

The implementation of the actions contained in the 2030 Strategy is expected to deliver total accumulated energy savings of 25 887 GWh (1 725.8 GWh/year) and peak-shaving of 441 MW by 2030. The energy efficiency potential is expected to be the highest for cooking fuels (40%), followed by electricity (36%) and hydrocarbons (18%).

Over the five-year period of the Strategic Development Plan 2019-2023, Senegal targets 320 GWh of savings in final electricity consumption, or 9.6% from 2018 levels, alongside a reduction of 65.9 MW of peak-shaving capacity and an FCFA 9.8 billion (USD 66.6 million) reduction in final electricity bills corresponding to 224 575 t CO_2.

The AEME identified a list of cost-effective energy efficiency measures (Figure 4.5), ranging from energy-saving lighting systems, energy efficiency audits and energy labelling to more expensive measures, such as upgrades of domestic appliances and equipment.

Figure 4.5 Marginal costs of Senegal's energy-saving actions



Source: AEME (2023), as modified by the IEA.

Regional energy efficiency framework

Senegal's energy efficiency policies are determined by the efficiency rules and regulations (e.g. minimum performance standards), which are set for the ECOWAS common market. ECOWAS includes the WAEMU, a customs and currency union of eight – mainly French-speaking – countries within ECOWAS, which includes Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Co-ordination of energy efficiency policy has been one of the key areas of regional collaboration among ECOWAS and WAEMU members.

In 2013, ECOWAS took action to adopt and implement a Regional Energy Efficiency Policy. The overall target of the policy was to double, by 2020, the annual improvement in energy efficiency. Each year, the amount of energy needed to produce a certain quantity of goods and services would decrease by about 4%.

The specific target of the regional policy is to implement efficiency measures that free-up 2 000 MW of power generation capacity by 2020 through the following concrete actions:

- lighting: phase out inefficient incandescent bulbs by 2020
- electricity distribution: reduce losses in electricity distribution from the current range of 15-40% to less than 10% by 2020
- cooking: achieve universal access to safe, clean, affordable, efficient and sustainable cooking for the entire population of ECOWAS by 2030
- standards and labels: establish an ECOWAS Technical Committee for Energy Efficiency Standards and Labelling and adopt initial region-wide standards and labels for major energy equipment by the end of 2014
- Building Code: develop and adopt region-wide efficiency standards for buildings (e.g. building codes)

- finance: create instruments for financing sustainable energy, including carbon finance, by the end of 2013, and in the longer term, establish a regional fund for the development and implementation of sustainable energy projects.

The ECOWAS energy efficiency action plan includes flagship initiatives, each of which includes policy, capacity building, awareness-raising and financing elements:

- Initiative on Efficient Lighting to phase out inefficient incandescent lamps and replace them with high-efficiency fluorescent or LED lamps.
- Achieving High Performance Distribution of Electricity by reducing commercial and technical losses.
- Safe, Sustainable and Affordable Cooking to ensure that the entire ECOWAS population has access to clean and efficient stoves, with an assured supply of adequate fuels.
- Standards and Labelling Initiative to create a regional harmonised system of energy standards and energy efficiency labels.
- Develop and adopt region-wide efficiency standards for buildings.
- Finance for sustainability will mobilise climate finance instruments for energy efficiency projects.

Energy efficiency financing

Senegal has good access to international financial support, including for funding targeted improvements in energy efficiency, renewable energy and energy access. Until now, energy efficiency programmes have been financed by international funds in close partnership with local authorities and banks.

In 2022, FONSIS and the AEME joined forces to create a Super Energy Services Company (Super ESCO), which was one of the key provisions of the implementation of the LPDSE and a strong driver for cross-sector progress in energy efficiency.

IEA analysis shows that Super ESCOs are useful to ensure the financial viability of energy efficiency projects. Super ESCOs can address many of the key barriers to implementing energy efficiency projects in the public sector: awareness, budgeting and contracting barriers.

Existing programmes designed to engage clients with ESCOs, such as energy audit programmes, rebates, direct install programmes, demand-side management bidding or standard offer approaches, rarely provide the full amount of funding required to cover implementation costs such as engineering, procurement and installation costs.

Box 4.1 ECOFRIDGES programme

A dedicated funding mechanism was launched in 2021 for Senegal to promote energy-efficient refrigerators and air conditioners based on a refundable green credit through prepaid electricity refills (Woyofal). The mechanism supports investment in energy-efficient and environmentally friendly cooling solutions and includes the recycling of old appliances.

For the purchase of a refrigerator or an air conditioner approved as "ECOFRIDGES Sénégal Equipment", Woyofal customers subscribing to Senelec will have access to a zero-interest rate consumer credit for at least 24 months. The refund will need to be deducted from their Woyofal reloads each month during the repayment period. La Banque Agricole offers these green loans to eligible households.

Under the United Nations Environment Programme's United for Efficiency, ECOFRIDGES Sénégal is run in partnership with the Agency for the Energy Savings and Management, the Directorate of the Environment and Classified Establishments, the Basel Agency for Sustainable Energy, Senelec and La Banque Agricole as a partner bank. Electronic Corp and Senfroid are the appliance service providers. The programme is financed by the K-CEP (Kigali Cooling Efficiency). By 2024, ECOFRIDGES Sénégal aims to unlock USD 5.6 billion in financing to support the purchase of more than 19 200 energy-efficient and environmentally friendly cooling units, saving approximately 14 000 MWh of electricity consumption for households.

Sources: IEA (2023), Financing Clean Energy in Africa: World Energy Outlook Special Report; UNEP (2021), U4E Ecofridges Senegal.

Energy prices and subsidies

In 2022, more than 4% of Senegal's annual GDP was spent on subsidies for electricity, oil products and butane gas. Senegal aims to reduce its share of spending on energy subsidies while diversifying its energy sources to meet growing demand and reduce costs.

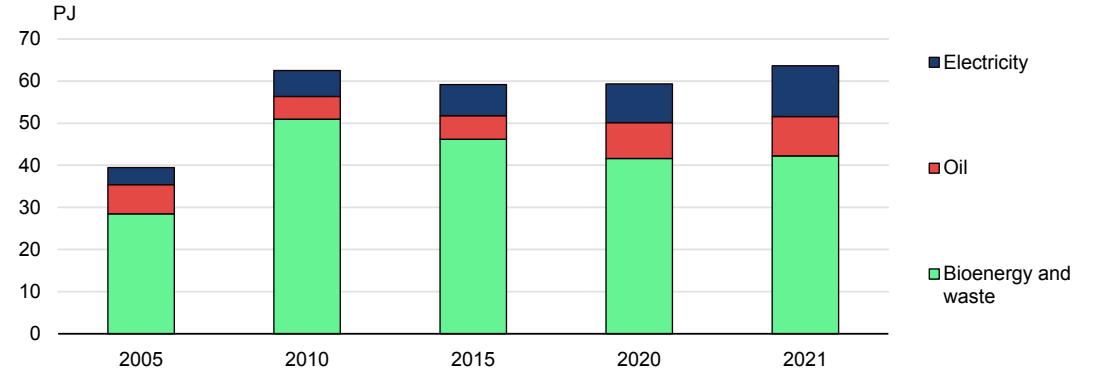
In early 2023, the government of Senegal decided to progressively remove subsidies in the energy sector (for electricity, oil products and butane gas) by 2025, according to the roadmap of the Ministry of Finance and Budget released in 2023. The progressive reform aims to reduce energy subsidies in the order of 1% of GDP by the end of 2024 before eliminating them entirely by 2025. In 2023, the government adjusted the increase in certain energy prices and mitigated the impact on vulnerable households. It also plans to review the formula for determining fuel prices and the structure of electricity tariffs and improve the cash transfer system by the end of 2023. This measure will lead to an increase in electricity prices of FCFA 18.97 per kilowatt hour (kWh) (USD 0.031/kWh) for low voltage, FCFA 22.79/kWh (USD 0.038/kWh) for medium voltage and FCFA 14.31/kWh (USD 0.023/kWh) for high voltage. For diesel and premium fuel, the increase will be of FCFA 100/L (USD 0.016/L).

Energy efficiency policy and measures by sector

Buildings

In 2021, the energy consumption of buildings made up 47% of TFEC, with residential buildings accounting for 95% and service sector buildings 5%. From 2010 to 2021, total energy consumption in buildings increased by 1.8%. The main source of energy consumption in 2021 was bioenergy and waste (66%), followed by electricity (19%) and oil (15%) (Figure 4.6). Renewable energy sources accounted for 66% of energy consumption in buildings.

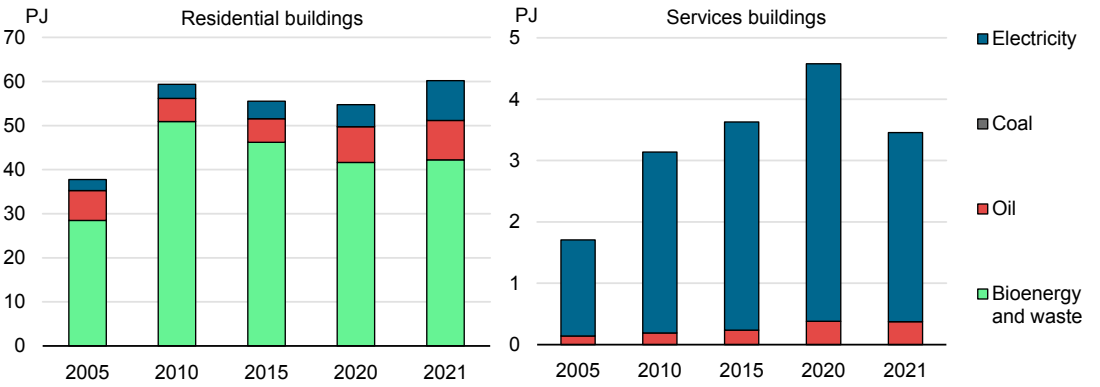
Figure 4.6 Buildings final energy consumption by fuel in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

In 2021, the largest share of energy consumption in residential buildings was from bioenergy and waste (70%), followed by oil (15%) and electricity (15%) (Figure 4.8). Conversely, for services sector buildings, electricity (89%) dominated energy consumption. Some oil (11%) is consumed in service sector buildings.

Figure 4.7 Residential and services buildings final energy consumption by fuel in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

Policies and measures in the buildings sector

The government of Senegal has focused on improving the energy performance of public buildings by providing technical assistance to government entities. The programme has targeted 66 administrative sites with efficiency gains of 31.01 GWh and savings of FCFA 3.3 billion.

Stringent construction codes are very important in a region where most of the buildings are recent or will be built in the coming decade.

Among the WAEMU countries, energy efficiency construction codes are set out in Directive 05/2020/CM/UEMOA for all new constructions and all existing buildings undergoing a major renovation (with a minimum floor area of 100 m² for residential and 500 m² for all other sectors). The Directive also requires a minimum of 10% of renewables in the buildings sector for the provision of hot water and electricity. Minimum efficiency

requirements have been adapted to climatic zones within WAEMU members, reflecting more arid or subtropical conditions. Senegal is divided into three climate zones: 0B arid subtropical climate, 1B arid climate Sahel-type climate and 2B semi-arid hot climate.

Appliances, equipment and lighting

Senegal has a refrigeration programme (FCFA 6.4 billion) targeting the replacement of 10% of the refrigerator fleet, or 21 655 refrigerators. Expected benefits are significant: 16 676 GWh of electricity consumption, emissions savings of 11 673 t CO_2 and financial savings of FCFA 1 817 billion per year.

One very successful programme is the General Efficient Lighting Programme, which led the roll-out of LED lamps from 2015 to 2018 with efficiency gains of 73 041 GWh and financial savings of FCFA 7 864 billion.

Decree 2017-1411 prohibits the import, production and commercialisation of incandescent light bulbs and favours LEDs.

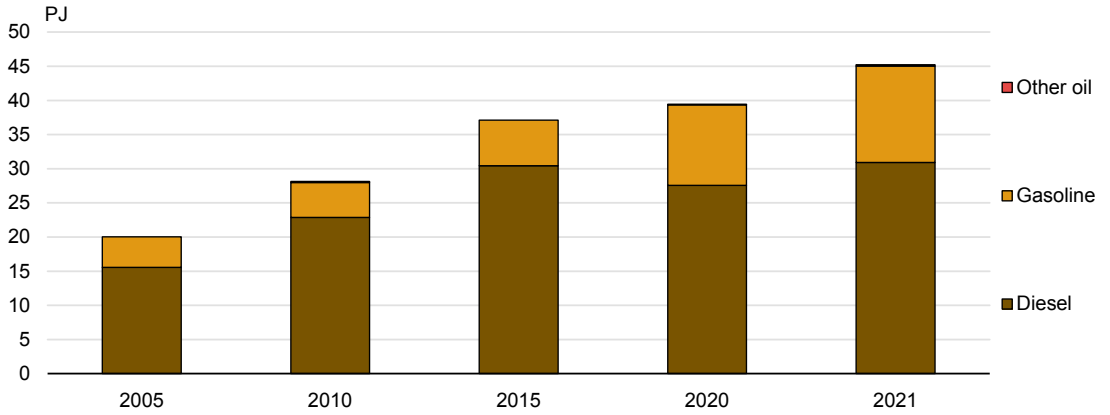
Common rules under Directive 04/2020/CM/UEMOA include energy efficiency obligations for light bulbs, air conditioners and refrigerators. WAEMU member states had to transpose the Directive into national law by the end of 2022. The Directive is expected to increase energy efficiency in the region by 30%. It requires testing and efficiency labelling of the appliances covered by suppliers and distributors. It also indicates that a national structure will be put in place to deliver the pre-authorisations for import and commercialisation, including the data collection and Minimum Energy Performance Standards labelling. The government created the National Lighting Lab, which is in charge of quality control and the certification and testing of LED lamps. The Directive obliges member states to adopt programmes for managing appliances that reach their end-of-life.

With rapid population growth, Senegal is expected to see increasing opportunities for households to use energy-efficient fans and air conditioning. Most emerging markets that have sizeable cooling loads have introduced Minimum Energy Performance Standards, with 85% of the air conditioners sold worldwide in 2016 covered by such performance standards. Lighting, appliances and equipment account for more than 50% of total global electricity demand, which is expected to more than double by 2050 in developing countries. Energy-efficient lighting, appliances and equipment save emissions and livelihoods.

Transport

In 2021, energy demand in the transport sector was 34% of TFEC, 5% lower than in 2010. From 2010 to 2021, energy consumption in the transport sector increased by 61% (Figure 4.8). Oil was the only source of fuel in Senegal's transport sector in 2021. The largest share of transport consumption was covered by diesel (68%), followed by gasoline (31%).

Figure 4.8 Transport final energy consumption by fuel in Senegal, 2005-2021



Note: "Other oil" is not visible at this scale and accounted for 0.18 PJ in 2021.

Source: IEA (2023), World Energy Balances.

Policies and measures in the transport sector

In 2020, the ECOWAS Council of Ministers adopted Directive C/Dir.2/09/20 on the harmonisation of vehicle exhaust gas and particle emissions limits in the ECOWAS region. The limits require at least the Euro IV emission standard for the WAEMU, notably for cars imported into the region. Until 2020, fuel quality specifications were EURO III, leading to imports of lower quality fuel and vehicles than in international markets.

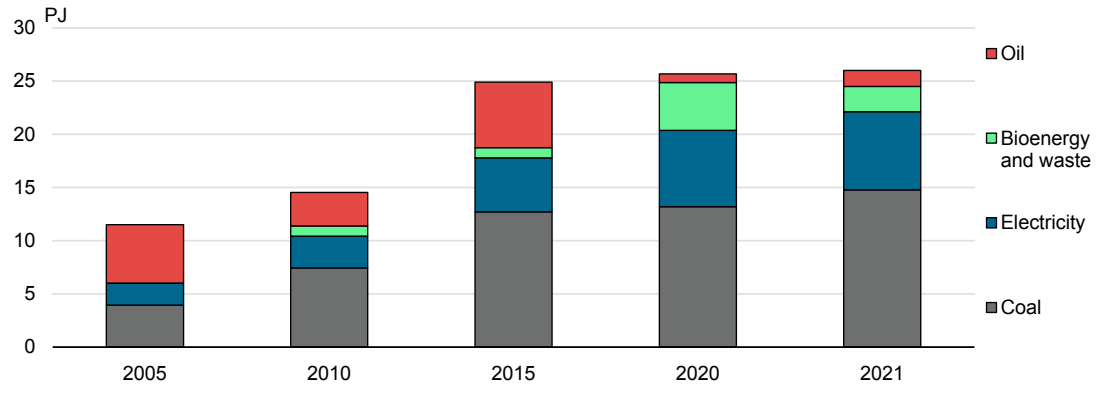
Senegal is promoting less polluting vehicles (LPG, compressed natural gas, electric vehicles, etc.). This option is reaffirmed in Law 25-20 on the orientation and organisation of road transport.

With regard to urban transport, the city of Dakar has opted for electric buses for rapid transit and compressed natural gas buses for the future restructured network, with a first phase planned for the period 2023-25 (14 lines and 400 buses). In the future, natural gas production in Senegal may also become relevant for use in public transport.

Industry

Industry was the sector with the lowest energy consumption, accounting for 20% of TFEC in 2021. Over the period between 2010 and 2021, energy consumption in the industry sector increased by 61% (Figure 4.9).

Figure 4.9 Industry final energy consumption by fuel in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

In 2021, the main energy source in the industry sector was coal (57%), followed by electricity (28%) and bioenergy and waste (9.1%). Oil represents a very small share (5.8%) of industry's energy consumption. From 2010 to 2021, coal consumption increased by 115% in the industry sector and electricity consumption almost by 1.5 times, reflecting the strong GDP growth. Bioenergy and waste consumption in industry increased by 366% from 2010 to 2020 but decreased again in 2021 and the role of oil has become marginal.

Policies and measures in the industry sector

Many industrial facilities have conducted energy efficiency audits (the African Refining Company, Senelec, Sedima, SIMPA, SCL, AVISEN, etc.), but their results and improvements are not communicated, and their implementation is not verified. There are no regional or national legal obligations in place with regard to industrial energy efficiency actions. The creation of Senegal's Super ESCO supports greater efficiency of public industrial companies, including the shift to greater digitalisation and smart metering.

Box 4.2 Best practices of industrial energy efficiency

The Moroccan industrial sector is very responsive to peak electricity tariffs. The preferential tariff for industries (known as "super-peak") invites companies to voluntarily shift their energy consumption away from peak periods so they can take advantage of a much lower tariff during the low-demand hours. Many energy-intensive companies, including in the steel industry, have joined this programme to reduce their energy bills. The pricing is part of the connection/supply agreement with Morocco's National Electricity and Drinking Water Board (ONEE), which requires energy-intensive industrial sites to disconnect from high-voltage networks during evening peak hours.

Source: IEA (2019), Energy Policies Beyond IEA Countries: Morocco 2019.

Assessment

Energy efficiency is a critical policy in a country where energy is short in supply and expensive, given the lack of universal access. Efficiency is also critical to saving GHG emissions, which is why the government of Senegal has included energy efficiency ambitions in its NDC of 2020.

The energy efficiency component of SDG 7.3 is a key priority of the LPDSE 2019-2023, which includes the following actions: promoting the use of efficient equipment and setting up the infrastructure for quality control of equipment to ensure compliance with standards; reducing the state's electricity bill as part of public expenditure management; implementing an awareness-raising and information programme on energy management and efficiency; supporting local authorities in improving energy performance and the management of public lighting; and improving the energy efficiency of buildings in new constructions and major renovations.

Progress has been good, according to the government's latest evaluation; in particular, the efficiency and financial gains from the public lighting programme have been impressive. The government is implementing measures to raise awareness and information, support citizens to purchase more efficient appliances and control minimum standards and quality.

The AEME, which was set up in 2011, acts as the "operational arm" for implementing Senegal's energy efficiency policy. For example, it has identified the potential for savings in the country's various sectors of activity, i.e. 18%, 36% and 40%, respectively, in the hydrocarbons, electricity and domestic fuels sub-sectors. It has also drawn up a highly diversified programme based around 6 strategic areas and 66 projects, which it is trying to implement on the basis of the rather modest funding it receives from the state or technical assistance, which limits the scope of its actions. The AEME has also made significant progress in the field of equipment standardisation and in setting up an equipment quality control laboratory. For example, Senegal has banned the import of incandescent lamps and is prioritising the use of LED lamps. The WAEMU has contributed to the introduction of energy efficiency standards for buildings and the labelling of electrical appliances in its eight member states, while ECOWAS, through the Centre for Renewable Energy and Energy Efficiency, is conducting a number of energy efficiency projects. These standards have not yet been transposed into legislation.

In addition to the AEME, a number of public and semi-public bodies are involved in energy efficiency, including the ANER, SENELEC and projects which are funded by technical assistance.

Public funding for the AEME's energy efficiency programme is inadequate. The AEME often relies on external funding and technical assistance from development partners. Another consequence of this lack of public funding is that it spends too much time seeking funding for its activities to the detriment of the necessary co-ordination of energy management and efficiency activities.

The establishment of a Super ESCO with FONSIS and the AEME, following a study financed by the World Bank on strategies for financing energy efficiency in the public sector (lighting, universities, hospitals), is a welcome development. With its economies of scale,

Senegal will be able to improve the efficiency of the residential and services sectors, which have seen a decline in energy intensity improvements in the past decade.

The question of data availability also arises despite the partnerships noted between the AEME, the National Agency for Statistics and Demography, and SIE-Sénégal. Surveys and energy audits are essential for establishing a sound energy efficiency policy. Senegal has the advantage of being a member of both ECOWAS and the WAEMU, two subregional institutions concerned with energy efficiency. A partnership with these institutions would help to improve data quality.

The Ecofridges programme is an important tool for the government to support upgrades in domestic appliances and equipment. However, a loan programme only offers support to households that can afford to do so. Most of the vulnerable population would benefit from a grant programme.

Recommendations

- Ensure sustainable funding for energy efficiency programmes and strengthen the Agency for the Energy Savings and Management's human and financial resources.
- Adopt a legislative and regulatory framework to encourage investment in energy efficiency. In this context, explore the adoption of a suite of energy efficiency policies following the policy package approach, which promotes policy design and implementation built on three essential elements: regulation, information and incentives.
- Strengthen partnerships with subregional organisations (WAEMU, the Centre for Renewable Energy and Energy Efficiency-ECOWAS).
- Ensure that WAEMU Directives are transposed into national legislation and that standards on the import and use of efficient equipment are applied. Develop and implement Minimum Energy Performance Standards for appliances that are aligned with major exporting countries, drawing on examples of standards and labelling programmes in Ghana and other countries in the region.
- Establish a voluntary network of key energy-intensive companies that can work together, supported by the government through guidance and advice, to improve their energy management and inspire others, using international experience and benchmarking of industry.

5. Renewable energy

Key data (2021)

Renewables in TFEC: 47 PJ, 35% of TFEC (bioenergy**:** 44 PJ, solar 1.5 PJ, wind 1.1 PJ)

Renewables in electricity generation (2022): 1.7 TWh, or 23% of electricity generation (solar 0.8 TWh, wind 0.7 TWh, solid biomass 0.1 TWh)

Renewables by sector: buildings 59%, industry 13%

Installed capacity (2022): 245 MW solar and 159 MW wind, 30% of installed electricity capacity[1]

Sources: IEA (2023), World Energy Balances; Senelec (2023), Annual Report 2022

Overview

Senegal's renewable energy capacity has been expanding, with soaring solar power (245 MW in 2022) and wind (159 MW). Senegal commissioned its first solar projects in 2017 and started to deploy wind power in 2019. In 2022, renewables represented 30% of the share of overall installed capacity in Senegal (hydro included). Wind and solar power have been growing since 2017 and reached a share of 23% in electricity generation in 2021 thanks to rising investment, notably from IPPs.

Renewables play an important role in Senegal's climate and sustainable development strategy. The government set out targets for renewables in the electricity mix as part of the PSE and installed capacity targets under the NDC. In terms of installed capacity, Senegal has already achieved its targets under the unconditional NDC.

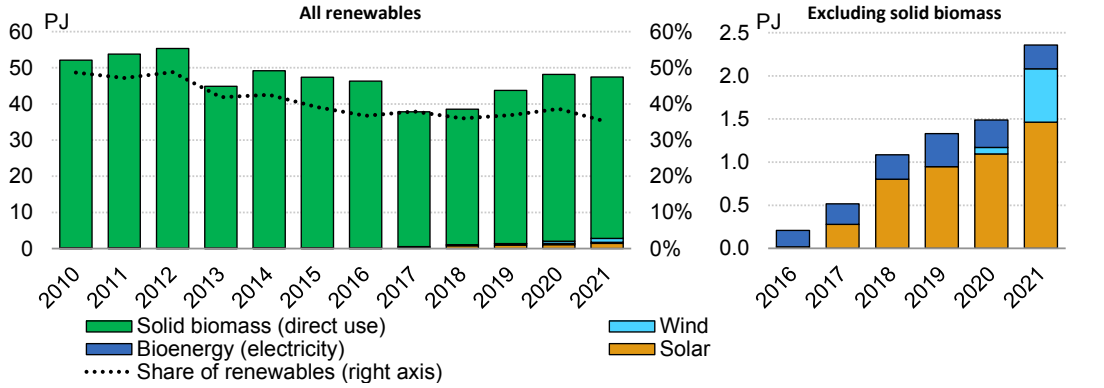
Senegal aims to accelerate renewable deployment in the coming years. In 2023, along with its partners from Canada, the European Union, France, Germany and the United Kingdom, Senegal signed an agreement to facilitate up to EUR 2.5 billion in financing under the Senegal Just Energy Transition Partnership. The JETP Senegal can help to increase the share of installed renewable energy capacity to 40% by 2030. This will require a power sector transition strategy for transitioning the electricity mix from highly polluting fuels to clean energies to reduce the sector's emissions.

To reach 40% target and to tap into its vast solar resource potential, Senegal needs to focus investment in expanding flexibility for system integration of wind and solar PV, notably through grid investment and balancing power, using the policy best practices and experience of other emerging and developing countries.

[1] Hydroelectricity, imported from Mali within the framework of the Senegal River Basin Development Authority, formally owned by Senegal, is included.

The share of renewable energy in TFC was 35% (47 PJ), dominated by solid biomass. Nevertheless, the share of renewable energy in TFC has been falling in recent years due to growing energy consumption(Figure 5.1).

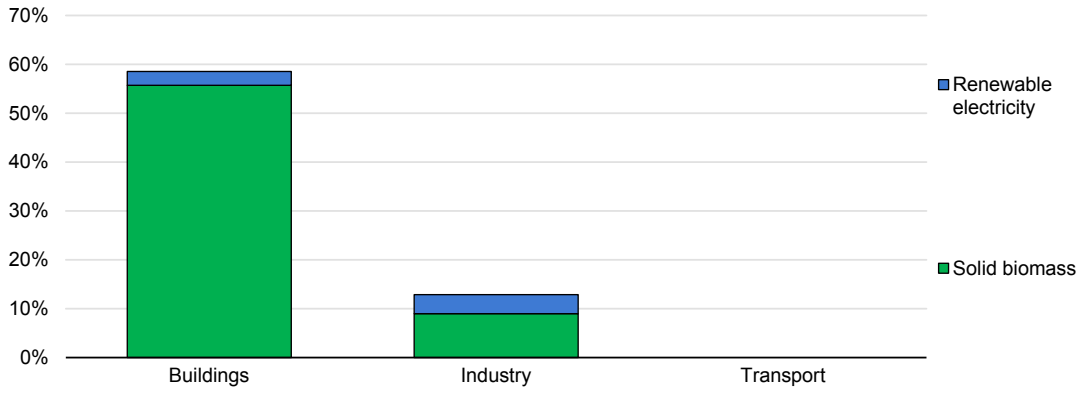
Figure 5.1 Renewable energy in total final consumption by source in Senegal, 2010-2021



Source: IEA (2023), World Energy Balances.

Today, renewable energy in Senegal is largely used by households in the form of solid biomass for cooking purposes, followed by the industrial sector (Figure 5.2). Renewable electricity is not present in industry. The use of liquid biofuels is not recorded to date.

Figure 5.2 Renewable energy by sector in Senegal, 2021



Source: IEA (2023), World Energy Balances.

Resource potential

Senegal has vast renewable resources and one of the highest irradiation potentials in the world, with an average daily theoretical solar PV irradiation potential of 5 798 kWh/m^2. In Senegal, the solar resource potential, measured as the annual PV output per unit of capacity (MWh/kWp/year), falls in the efficiency range of 1.6-1.8 for around 90% of its land area. For comparison, only 20% of the world's land falls in the same category, and only around 20% falls in classes with higher efficiency ranges, showing the strong potential of Senegal for this technology.

The cost for concentrating solar remains very high, and despite its contribution to system integration (with eight to nine hours of integrated storage capacity in some technologies), this technology is not yet deployed in Senegal.

As for wind power density (W/m^2) measured at a height of 100 m, Senegal's land area entirely falls in the lowest category (<260 W/m^2). Areas in the third class or above are considered to be a good wind resource. While onshore wind resources are not the first in class, Senegal has consistent wind resources along the coast, with wind speeds of 5.7-6.1 m/s observed on the northern coastlines between Saint-Louis and Dakar. An estimated offshore wind potential of 45 GW-13 GW of fixed wind power and 32 GW of floating wind power – has been evaluated (DTU et al., 2023).

Senegal also has good potential for biomass/waste-to-energy and biofuels, using its agricultural waste and agribusiness by-products, such as bagasse. The estimated potential for biomass generation is around 2 900 GWh.

To scale up the use of bioenergy, including energy from waste in the industrial sector, robust sustainability rules are needed. This will enable the country to tap into its renewable energy potential, help reduce the cost of electricity and subsidies, and lower the dependence on fossil fuel imports while providing for greater decentralised and economy-wide use of renewables for completing universal electricity access for all.

In industry, Senegal is piloting co-generation plants with biogas and waste-to-energy (see Chapter 8). In 2010, a Law on Biofuels was passed (Law No. 2010-22 of 22 June), creating the conditions for the development of biofuel production and use, mostly for domestic consumption. It will be timely to review the institutional, legal and regulatory conditions for utilising land for biofuels production.

Senegal has hydropower resources along The Gambia River and the Senegal River Basin, which are managed respectively by the Organisation for the Valorisation of the River Gambia (Organisation pour la Mise en Valeur du Fleuve Gambia, OMVG) and by the Organisation for the Valorisation of the River Senegal (Organisation pour la Mise en Valeur du fleuve Sénégal, OMVS).

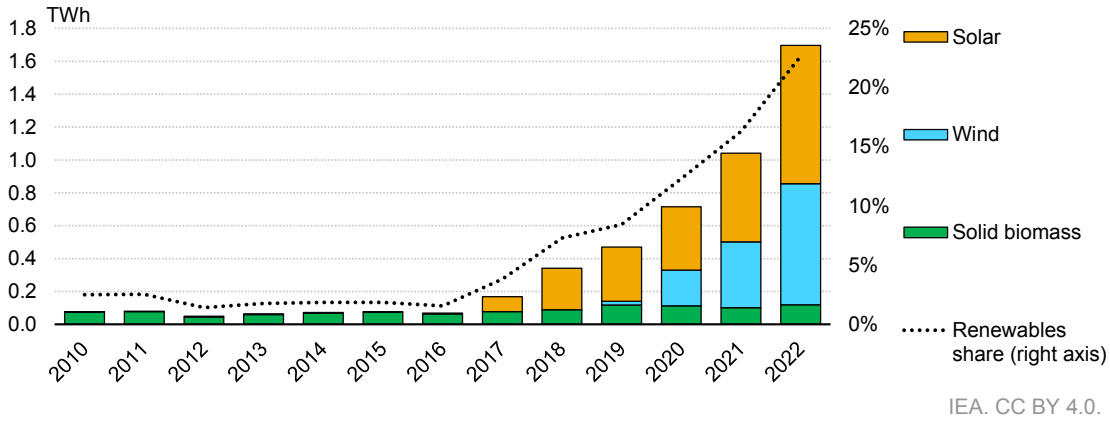
Renewable electricity

In 2022, renewables accounted for 23% of total electricity generation and for 30% of installed capacity. Taking into account hydropower imports, the share is above 30% in 2022.

Renewable energy development was led by the tenders developed under the World Bank's Scaling Solar, which targets 60 MW of solar capacity (World Bank, 2023) and resulted in some of the lowest electricity costs in the solar power plants in the regions of Kael (25 MW) and Kahone (35 MW). Senegal also hosts West Africa's largest wind farm (158 MW), Taiba N'Diaye.

Within the total of renewables used in electricity generation in 2022 (Figure 5.3), solar had the highest share (50%), followed by wind (43%) and solid biomass (7%). In 2020, for the first time, the share of modern renewables (wind and solar combined) in electricity generation increased to double digits, thanks to new solar and wind installations, growing from less than 1% before 2017 to 21% in 2022.

Figure 5.3 Renewable energy in electricity generation in Senegal, 2010-2022



Note: Data on hydroelectricity (imported from Mali within the framework of the Senegal River Basin Development Authority) are not included.

Source: IEA (2023), World Energy Balances.

Hydropower installed capacity serving Senegal equalled to 121 MW in 2022, coming from the three hydro power plants situated in Mali and managed under the framework of the OMVS: Manantali, Félou and Gouina. The latter started operation in 2022, adding 46 MW of hydro capacity to Senegal's electricity mix, increasing hydro capacity by 61% from 2021 to 2022. Hydropower imports contributed to around 9% in the power mix in 2022, according to the Senelec.

Renewable energy targets and progress

Senegal reached a share of 30% of renewable energy in installed capacity. Following the signature of a Just Energy Transition Partnership (JETP) with partners, the ambition has been raised to 40% renewable energy in total installed capacity by 2030. Thanks to commitments from international partners and multilateral development banks to mobilise EUR 2.5 billion, this will likely accelerate the deployment of renewable energy. Under the PSE, Senegal set out targets for the share of renewable energy in electricity generation and the total energy mix. Under the NDC 2020, Senegal had aimed for 40% by 2035 with specific targets for each renewable source in installed capacity (Table 5.1). By 2030, Senegal's NDC targeted developing 235 MW (unconditionally) of solar PV plus 100 MW under the condition it obtained additional finance (a total of 335 MW) and 150 MW of wind power plus 100 MW (for a total of 250 MW), 314 MW of hydropower (equally under the conditional and unconditional targets), 50 MW of biomass (conditional) and 50 MW of cost for concentrating solar (conditional).

Senegal had an installed capacity of 245 MW of solar PV and 159 MW of wind in 2022, thus meeting its unconditional targets almost a decade ahead of schedule (Figure 5.6).

Table 5.1 Senegal's renewable energy targets

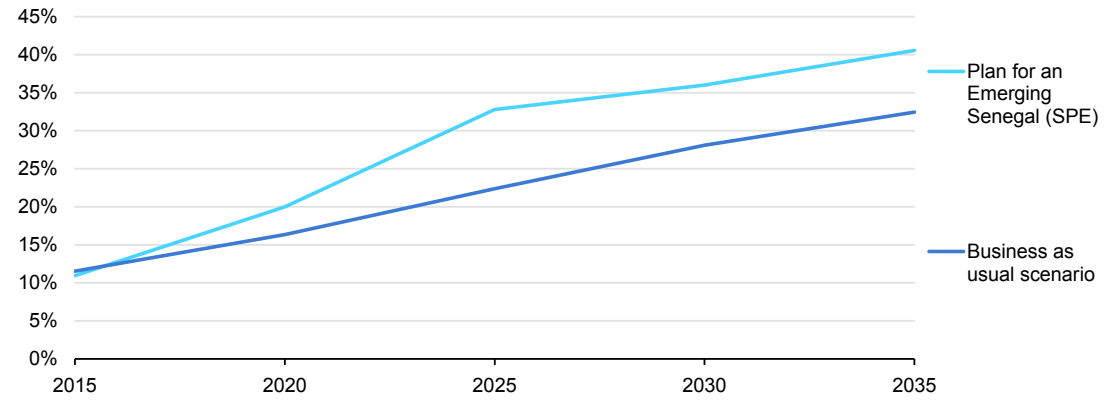
Energy sources	Unconditional (MW)	Conditional (MW)
Solar	**235**	**335**
Wind	**150**	**250**
Hydro	**314**	**314**

Energy sources	Unconditional (MW)	Conditional (MW)
Bioenergy		**50**
Cost for concentrating solar		**50**
Total		**999**

Source: IEA analysis based on UNFCCC (2020), Senegal's Nationally Determined Contribution.

Under the NDC, Senegal expects to overachieve its renewable energy targets, reaching 40% by 2035 in the electricity generation mix (Figures 5.4 and 5.5) with current policies.

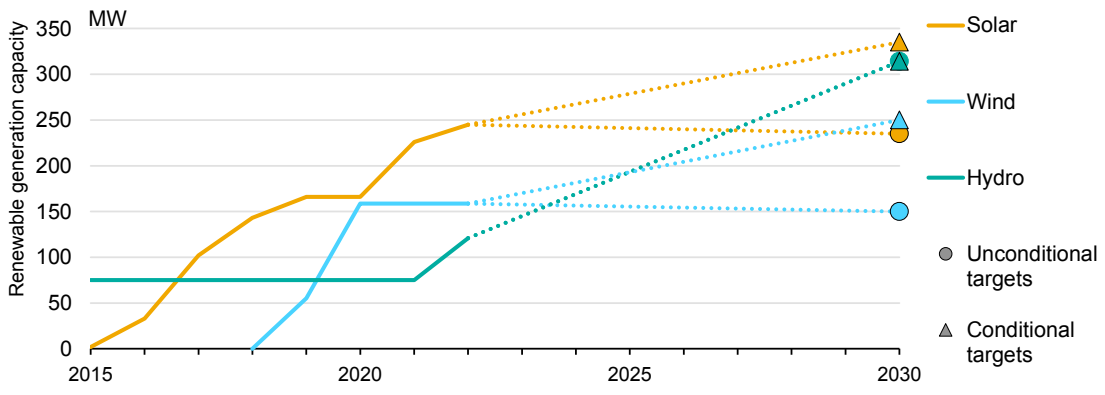
Figure 5.4 Share of renewable energies in electricity generation in Senegal (NDC), 2015-2035



Source: IEA analysis based on UNFCCC (2020), Senegal's Nationally Determined Contribution.

Senegal is set to commission several renewable energy projects. With regard to hydropower, the large Sambangalou hydropower dam is under construction on The Gambia River in south-eastern Senegal, which will add 128 MW of capacity. An expansion of the Taiba N'Diaye wind park (100 MW) is in the planning. No major wind energy investment has taken place in the past five years.

Figure 5.5 Senegal's progress towards 2030 renewable energy capacity targets, 2015-2022



Source: IEA analysis based on UNFCCC (2020), Senegal's Nationally Determined Contribution; Senelec (2023), Annual Report 2022.

Renewable policy framework

In 2010, Senegal enacted a Law on Renewable Energy, which was its founding policy document on the topic. According to this law, self-production of electricity from renewable sources is allowed, but a licence is necessary to sell surplus to the grid, as is a grid connection from Senelec. Utility-scale renewable energy projects require a tender overseen by the regulator (CRSE) and the signature of a power purchase agreement with Senelec. The law has been revoked by the Electricity Code of 2021, which encompasses renewable energy provisions.

Important decrees followed in 2011, which set out the terms for the purchase of electricity, remuneration of electricity generated from renewable energy sources and grid connection of these stations, including tariffs. Decree No. 2011-2014 notably limits the maximum installed capacity of self-production systems to 120% of peak capacity for a domestic producer and 110% of nominal capacity for industrial and professional producers. It *de facto* requires decentralised projects to install solar PV and battery storage to balance the system at the distribution low-voltage level.

With regards to the fact that self-production is allowed in the country, the regulator has issued a guiding document (Decision No. 2018-09) which sets out the conditions under which surplus can be sold to the grid and the applicable tariffs. The regulator has recently approved a regulation further clarifying the conditions for the declaration of self-producers, according to which self-producers under certain thresholds are subject to a licence application and the filing of a complete set of documents detailing the size, capacity, location, technology and obligations of the self-producer.

International experience suggests that electricity market liquidity can be increased by allowing self-consumers to sell surplus electricity to the grid. In Morocco, for instance, similar arrangements were made for surplus energy to be made available for the wholesale market to increase trading and liquidity.

The government is promoting private sector involvement and supporting renewable energy resource development, whose projects benefit from fiscal and tax incentives such as VAT exemption on solar panels and associated technologies since 2020. According to the Interministerial Decree No. 010158 of 28 May 2020, equipment intended for the production of renewable energies is exempt from VAT. The Support Fund for the Energy Sector and incentives through the “feed-in tariff” of surplus self-production of renewable energies (“green tariff”) support renewable energy projects.

Permitting remains an issue, with several local and government authorities in charge of approvals and land access, which slows down the process and applications. International experience in emerging and developing economies can provide useful lessons for Senegal. In India, the creation of solar (and wind) parks and the adoption of centralised permitting/licensing, covering also land access, is managed by one dedicated government authority.

Box 5.1 Case study: India's bioenergy policies and programmes

India has several programmes to make use of biogas and solar thermal applications. The National Biogas and Manure Management Programme included targets for the deployment of biogas plants. A programme to promote off-grid and decentralised concentrated solar thermal technologies supported community cooking, process heat, and space heating and cooling applications in industrial, institutional, and commercial establishments. Government of India also provides capital grants for solar thermal applications. The programme offers a subsidy for a variety of concentrated solar thermal applications, such as community cooking, solar process heat and solar cooling.

At the end of 2018, around 300 MW of energy from waste capacity had been installed, and the country's largest plant (24 MW) was commissioned in New Delhi in 2017. The government of India promotes the use of urban, industrial and agricultural waste and residues with a programme providing financial assistance in the form of a capital subsidy and grants. The Ministry of New and Renewable Energy has partnered with the United Nations Development Programme to promote clean energy use for small businesses and industries under the Access to Clean Energy for Rural Productive Uses programme. It aims to enhance the use of reliable and affordable renewable energy for rural productive uses, providing livelihoods in areas in the states of Assam, Madhya Pradesh and Odisha.

Source: IEA (2020), India 2020: Energy Policy Review.

Accelerating investment in renewable energy in Senegal

As Senegal is navigating the next phase of renewable energy deployment with deployment rates expected to reach up to 40% renewable energy in total installed electricity capacity by 2030, cost-effective grid integration, including investment in grids and storage and ensuring an enabling framework for renewable energy investment, are critical for making the most effective use of the available public and private financing.

Table 5.2 Risks and risk management for renewable investment in Senegal

Risk	Description	Potential managing mechanisms
Power purchase	Delays in the payment of power purchase.	Improving the financial viability of supply companies and expanding options for third-party off-takers; project structuring with financial guarantees.
Non-recovery of granted reductions in taxes and duties	Developers face uncertainty over the applicability of some tax incentives and procedures to benefit from them/be reimbursed.	Government clarity for project development supplemented by contracts with equipment suppliers. Streamline exemption application and recovery processes.

Risk	Description	Potential managing mechanisms
Contract renegotiation	With renewable energy prices well below the cost of heavy fuel oil, the need arises to renegotiate power purchase contracts to lower electricity prices and the provision of ancillary services (ramp-up/ramp-down).	Enforcement of sanctity of contracts by regulators.
Transmission investment	Insufficient capacity to connect large renewables capacity and exchange of electricity and lack of regulating power, which can hamper balancing.	Design a grid development plan in a transparent and regular manner; with an integrated system vision.
Land acquisition	Lack of clarity over land titles, with outdated records and fragmented landholdings; rights-of-way concerns.	Solar photovoltaic and wind parks.
Evacuation infrastructure	Availability of local grid connection and network is uncertain; no secondary market for connectivity rights.	Solar parks; timely planning for grid infrastructure; penalty mechanisms to protect generators in case of transmission non-availability.
Financing for small-scale projects	Lack of frameworks for evaluating the creditworthiness of small companies; limited capacity of local banks, which prefer bigger transactions.	Lines of credit from public financial institutions for on-lending; credit appraisal methods for small consumers and capacity building for local banks; state-supported aggregation mechanisms.
Transparency of asset-level risks	Lack of ongoing metrics for lenders to assess susceptibility of assets to become stressed.	Developing dynamic asset-level risk assessment for projects.

Senegal stands out in many ways, as it attracts substantial multilateral and bilateral financing (International Finance Corporation, United States International Development Finance Corporation, European Investment Bank, World Bank, often jointly), which have provided guarantees and risk management funding for major renewable energy projects. For instance, major solar installations have been commissioned in Senegal thanks to the World Bank Group International Finance Corporation's Scaling Solar Program. Such programmes have helped to set up solar projects with the lowest kWh prices in the subregion, notably the Kael (25 MW) and Kahone (35 MW) solar power plants, with tariffs of around 24 FCFA/kWh (USD 0.04).

Chapter 6 provides a detailed analysis of the necessary conditions for successful grid integration, including the expansion of supply and demand-side flexibility sources through regulating power, investment in transmission and distribution grids, interconnections, battery storage, and electricity pricing/subsidy reform.

Assessment

Senegal is a regional leader in the deployment of renewable energies in its energy mix and has strong renewables resources (notably solar PV), an excellent basis for significant development in the coming years. Already in 2021, Senegal had the largest installed renewable energy capacity in the subregion, which in 2021 accounted for 24% (excluding hydroelectricity) and 13.4% (solar 7.7% and wind 5.7%) of electricity generation. The objective of achieving an installed capacity of 40% by 2035 presents an integration challenge, given the growth in electricity demand, which is estimated at 6% per year.

Most of the solar PV and wind power plants installed in the country are operated by IPPs. Hydroelectricity generated by hydro power plants (located in Mali) as part of the OMVS complete the country's modern renewable energy mix.

Renewable energies were previously governed by Law No. 2010-21 of 22 June 2010, which laid the ground framework of policies that encouraged the development of solar and wind power projects. This law was recently repealed by the Electricity Code (Law No. 2021-31 of 9 July 2021), which now governs renewable energies.

As there is no longer a dedicated law for renewable energy (as the 2010 law is no longer in force), the government will need to adopt an investment framework (with incentives, trajectories for auctions, faster permitting and authorisations, and/or renewable energy zones) to ensure the acceleration of renewable energy deployment in Senegal.

A number of implementing decrees have been approved, notably on the self-generation regime, quality control standards for the equipment making up a solar PV system, and the decree setting the conditions for the purchase and remuneration of electricity produced from renewable energy sources and their connection to the grid. The code provides for the gradual phasing out of the single-buyer model.

Senegal does not have a policy framework in place for decentralised energy (such as small-scale wind and solar rooftop development for individual households or commercial installations). To open this market segment, feed-in tariffs will be needed, alongside incentives to purchase the battery installation. The government needs to strengthen grid integration at the level of the distribution grids. Decentralised renewable energy and renewable energy community frameworks could be used across Senegal, using experiences in Australia and the European Union.

Among the incentives for renewable energies is the exemption from VAT granted to a range of equipment needed to develop these projects, including PV panels and ancillary materials. Some developers are experiencing practical difficulties in recovering these amounts or note that these exemptions do not apply to all the equipment needed for installations, which may be taxed at a VAT rate of 15-30%. ANER and ANS are working to address quality concerns and work on testing of solar PV panels and the possible introduction of import quality norms. There also seems to be concerns regarding the customs duties applicable to this equipment, a particularly important issue for off-grid solutions. Other challenges identified by investors include access to land.

The opening up of the electricity market as a result of the 2021 Elecritity Code is widely seen as a very positive development, which will bring opportunities for the private sector in renewable energy. Some uncertainties remain to be clarified, particularly with regard to

the self-generation regime in the context of business-to-business relations and the relationship between players and Senelec.

Because of their low cost, renewable energies offer an attractive opportunity to reduce the cost of producing electricity in Senegal, as well as the sector's emissions, in tandem with the "gas-to-power" strategy (see Chapter 6). This compares to the cost of electricity of almost 0.16 USD/kWh for heavy fuel oil in 2023.

Implementing the gas-to-power strategy will mean continuing efforts to attract investment in renewable energies in Senegal to reach the target of 40% renewables in the electricity mix. In the same vein, the intensification of electricity exchanges at the regional level will offer opportunities for improved balancing and resource sharing and integrating a greater share of energy produced by variable sources.

Senegal has good potential to develop its bioenergy resources and can learn from India's bioenergy policies, notably for the use of bagasse in waste-to-energy plants, biogas programmes and biofuels refining activities of oil marketing companies. A policy strategy for the industry and transport sectors would provide an opportunity for the country to evaluate its policy options.

Recommendations

- Review the framework for tax incentives and the customs regime to make its application simpler, if not automatic, for all the equipment needed to produce renewable energy from solar and wind sources. Provide incentives for local manufacturing as part of the tax credits.
- Continue to attract significant levels of long-term investment in the renewable energy sector.
- Facilitate the investment framework for renewables with better regulations for access to land, a one-stop shop for authorisations, non-discriminatory access to the grid, and incentives and trajectories for deployment, through auctions or renewable energy zones.
- Strengthen co-ordination across the electricity sector in support of grid integration of higher shares of variable renewable energy, notably solar photovoltaics.
- Adopt a policy framework for decentralised energy and renewable energy communities and open the retail market, including through investment grants and subsidies.

6. Electricity

Key data

Electricity generation (2022): 7.5 TWh (oil 70.2%, solar 11.2%, wind 9.8%, coal 5.7%, bioenergy and waste 1.6%, heat 0.5%, natural gas 0.4%); +117% since 2012

Electricity consumption (2021): 7.3 TWh (residential buildings 47.3%, industry 36.5%, service sector buildings 16.2%); +152% since 2011

Installed capacity (2022):* 1.8 GW

*Senelec (2023)

Source: IEA (2023), World Energy Balances

Overview

Senegal has a small electricity system with a stringy power grid stretching along the northern and western parts of the country. Its electricity mix is dominated by HFO, which accounts for 70% of the total. Renewable energy has grown quickly in recent years to become the second pillar of electricity generation.

To meet rising demand, which had an average growth rate of 10% from 2005 to 2021, electricity generation increased as well, with an average annual growth rate of 7%. The highest growth rate occurred in 2019, with an annual increase of 19% from 2018 levels. Growth in electricity generation is necessary to satisfy Senegal's goal of providing electricity to all, in good quality and quantity, and at an affordable price, an objective that Senegal aims to accomplish by 2025. The electrification rate will have to grow from 76% in 2019 to 100% in 2025, mainly by providing electricity to rural areas.

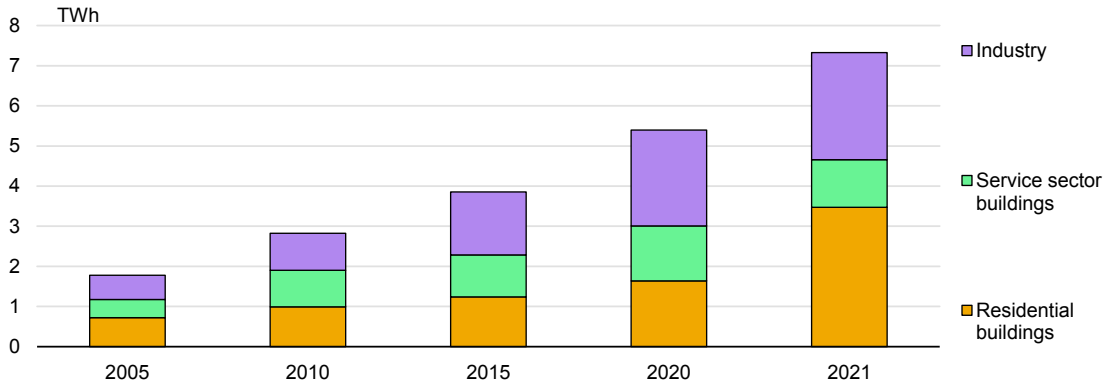
Supporting the switch from HFO to natural in power generation is the key priority of Senegal's electricity sector roadmap, the Integrated Low-Cost Plan (a direct result of the new Electricity Code) and the gas-to-power strategy. The retirement of old HFO plants could reduce the country's energy-related CO_2 emissions, pollutants and the cost of electricity, while also lowering the country's import dependence and import bill, as most of the HFO today is imported.

A comprehensive strategy is needed to synchronise the decommissioning of the oldest HFO plants and the construction of gas-fired power plants as peakers to support the power system's flexibility while adding renewable energy to the system to reach a share of 40% of renewables in installed power capacity. Depending on the capacity for the integration of higher shares of variable renewables into the system, this can also boost the share of renewables to 40% by 2030.

Demand

Electricity demand has been continuously growing in Senegal since 2005 (more than fourfold by 2021), with a 10% average growth rate. This was supported by industrial demand, which reached a share of 36% in 2021, even though the residential sector is the main driver (47% of the electricity demand in 2021) (Figure 6.1).

Figure 6.1 Electricity demand by sector in Senegal, 2005-2021



Source: IEA (2023), World Energy Balances.

Assessment framework

Based on the characteristics of the Senegalese power system and its institutional governance, including the level of interconnectivity, market design, system operation and the structure of the industry, this chapter examines challenges and opportunities for the power system transformation to foster environmental goals, economic efficiency of the power markets, and the security and reliability of the system. A good practice policy framework needs to satisfy at least three main objectives:

- align with environmental goals in support of the clean energy transition
- maximise the economic value of investments and consumer outcomes
- ensure power system security (adequacy/reliability, flexibility and resilience).

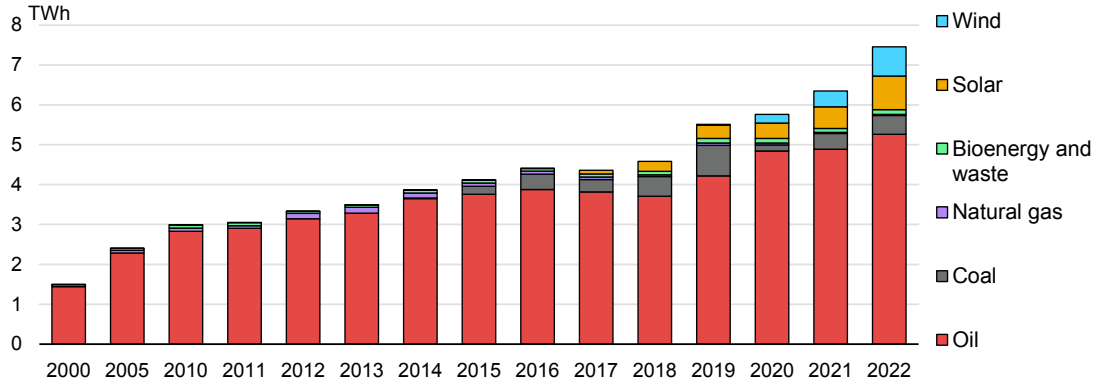
The following assessment is therefore divided into three parts (Sections A, B and C). Section A examines the latest trends in the transformation of the Senegalese electricity system, which has very high shares of renewable energy. Section B will look at how the regulatory framework is being revised to meet those new demands. Section C explores the electricity security impacts and the need for new ways of system operation and planning, including at a regional level within the West African Power Pool.

A. Decarbonising the power system

Electricity generation growth has been consistently positive during the past decades in Senegal, more than doubling from 2012 to 2022 (+117%) (Figure 6.2).

The most important source for electricity generation in Senegal remains HFO, which accounted for 70% of the total in 2022. Solar PV was the second source for electricity production, at 11% in 2022; followed by wind (9.8%), which almost doubled from 2021; and coal (6.3%). In 2022, the electricity mix also included shares of bioenergy and waste (1.6%) and natural gas (0.4%).

Figure 6.2 Electricity generation by source in Senegal, 2000-2022

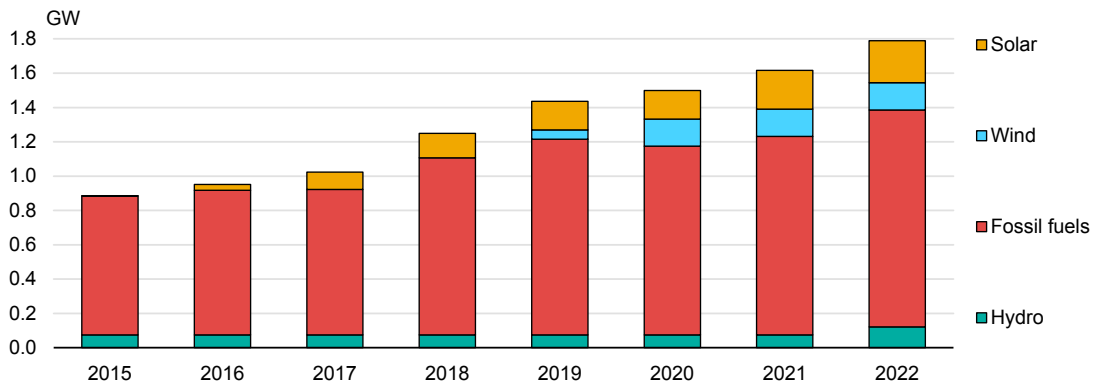


Note: Data on hydroelectricity (imported from Mali within the framework of the Senegal River Basin Development Authority) are not included.

Source: IEA (2023), World Energy Balances.

In 2022, total installed generation capacity in Senegal amounted to 1.79 GW; fossil fuels accounted for 70% (1.26 GW) of the total, mainly heavy fuel oil (Figure 6.3). However, the share of installed fossil fuel capacity has declined over time from a share of 91% in 2015.

Figure 6.3 Installed generation capacity by source in Senegal, 2015-2022



Note: The generation capacity includes hydro, physically produced in Mali but owned and used by Senegal within the framework of the Senegal River Basin Development Authority.

Sources: IEA analysis based on IEA (2023), World Energy Balances; Senelec (2023), Annual Report 2022, Senelec (2022), Annual Report 2021.

The diversification of Senegal's capacity mix started with the installation of solar power projects and wind power plants in 2016. Two twin solar power projects, Ten Merina and Senergy, with 30 MW, came online in 2018. In 2022, solar and wind accounted for 14% and 9% of the mix, respectively (0.25 GW for solar and 0.16 GW for wind).

Senegal is home to the largest wind farm in West Africa, the Taiba N'Diaye facility (158 MW), the first utility-scale wind project in Senegal, completed in 2019 under the PSE. The project was implemented in phases and started operations in 2020. Taiba N'Diaye followed the IPP model and is owned and operated by Lekela, a British renewable energy development firm with a 20-year power purchase agreement with Senelec, signed in 2013. Engineering, procurement and construction of the station was awarded to Vestas, a Danish wind turbine manufacturer, in 2018, along with a 20-year operations and maintenance contract. In December 2021, Lekela received funding from the United States' International Development Finance Corporation to carry out feasibility studies for an additional 100 MW of capacity and additional battery storage beyond the 175 MWh already installed.

Although it does not have hydropower facilities installed in the country, Senegal imports hydropower from three hydropower plants located in Mali: Manantali (providing 66 MW of the 200 MW of the plant's total capacity), Félou (15 MW of 60 MW) and Gouina (46 MW of 140 MW).

Policies for decarbonising Senegal's power system

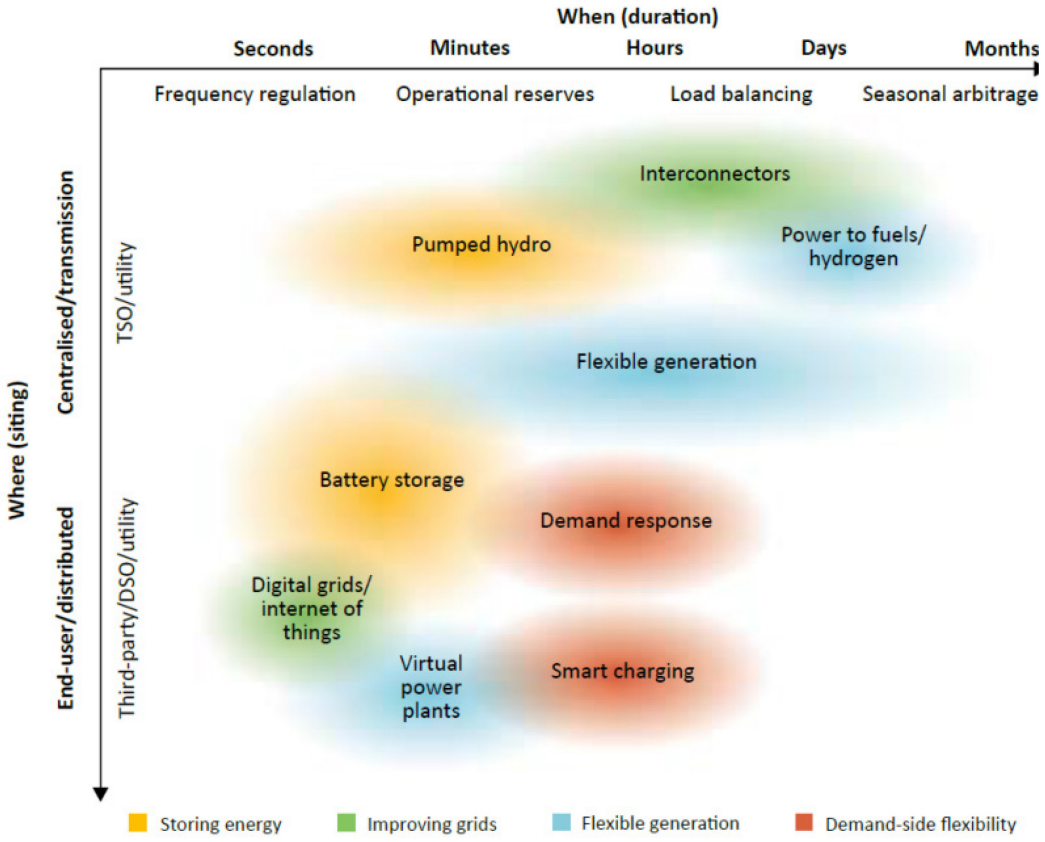
The government of Senegal is pursuing a strategy of achieving universal access by 2025 under the Plan for an Emerging Senegal and an electricity roadmap for 2035. The Integrated Low-Cost Plan focuses on reducing the high cost of electricity, which is set today at the level of the marginal fuel, HFO. The government adopted the gas-to-power strategy, which envisages replacing HFO with natural gas in the coming years.

Over the past decade, Senegal has been pursuing a strategy to increase the share of renewable energy, wind and solar power, based on the ambitions and targets set out under the Renewable Energy Action Plan and the NDC, as described in detail in Chapter 5. Senegal has already achieved its renewable energy capacity targets for solar and wind power as per the NDC and is now striving to reach a target of 40% by 2030, provided financing from the JETP is made available to support the investment needed in the country's energy sector.

Completing the electricity market design for higher shares of variable renewables and continuing its efforts to build a regional power market across the subregion (WAPP) will also help support the continuous decarbonisation and reliability of Senegal's power system, making efficient use of an abundant and diverse energy resource base in the region.

Since Senegal is on track to achieve universal electricity access by 2025 and if it meets its renewed ambition to achieve 40% of installed renewable installed capacity by 2030, it is likely that variable electricity generation also increases. Rising shares of variable sources, notably solar PV, which is already the second-largest source of electricity supply, are expected to put pressure on the distribution grids. The government must prioritise efforts to reinforce the reliability and system integration, which will require a wider portfolio of system flexibility needs from advanced technologies as it enters advanced stages of system integration. This means that a larger portfolio of flexibility services is needed at several moments in time and locations (Figure 6.4).

Figure 6.4 Flexibility needs across a larger portfolio of services and time frames in Senegal



Note: DSO = distribution system operator.

Sources: IEA (2020), Energy Policy Review of the European Union 2020.

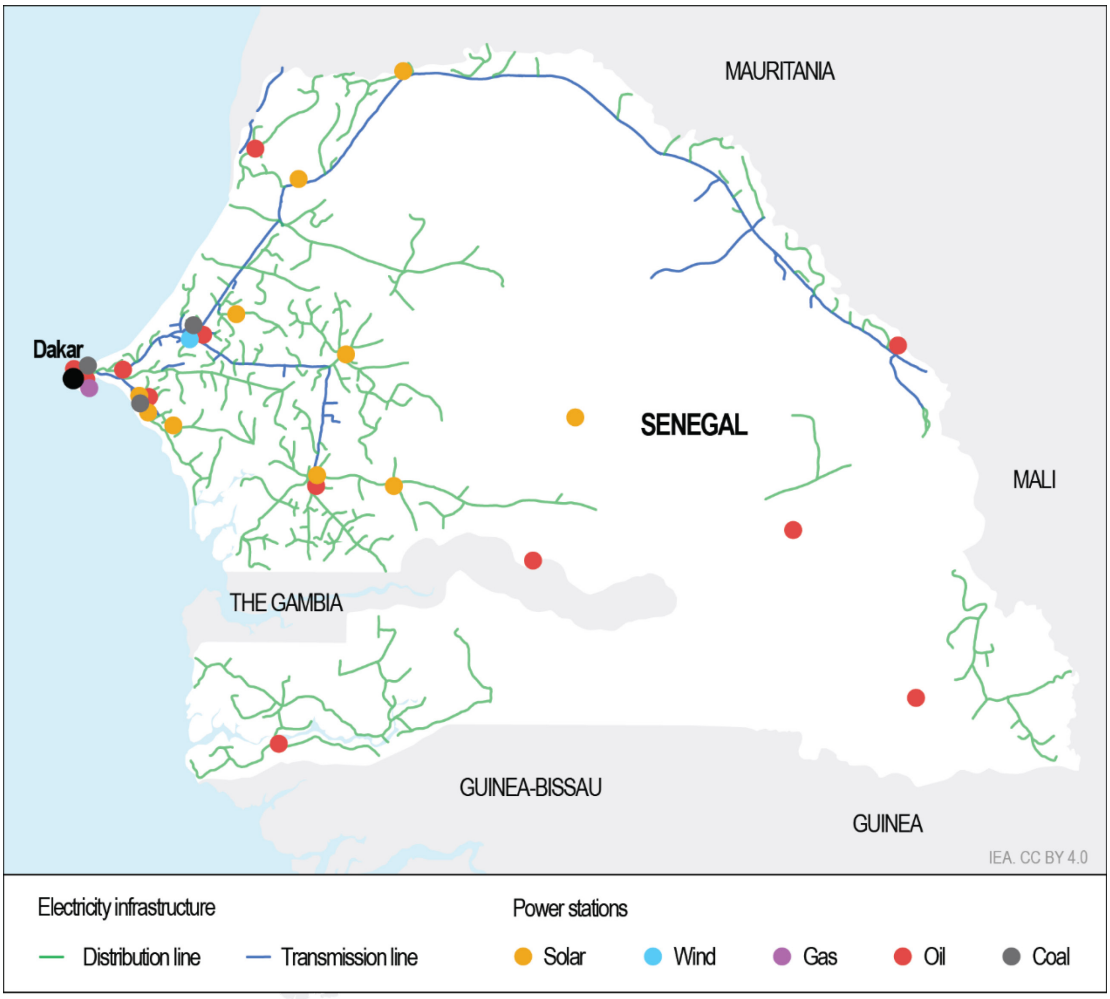
Electricity grids

The Senegalese transmission network is stringy and mainly developed along the northern and western parts of the country. It includes a national and a supranational network with connections to Mali (Figure 6.5). The national network, which extends over 972 kilometres (km), includes medium- and high-voltage lines (90 kilovolts [kV] and 225 kV, respectively). With the co-operation of Senelec, transmission lines were reinforced with 90/30 kV and 225/30 kV substations in Dakar.

The Senegalese distribution network includes 15 589 km of medium voltage, 16 875 km of low voltage and a total of 8 773 substations. A widespread distribution is crucial for granting access to end users farther away from urban areas, as envisaged by the LPDSE 2019-2023 and to comply with the 2025 universal access goal.

Senegal has a long and good track record in deploying mini-grids for rural electrification, with several models implemented and programmes conducted. As described in detail in Chapter 3, in recent years, off-grid solutions such as solar home systems and water irrigation pumps have been on the rise. In 2018, the MPE set up a consultation framework with private sector stakeholders of off-grid electrification.

Figure 6.5 Electricity infrastructure and power plants in Senegal



Box 6.1 Network planning for the energy transition

Senegal is preparing an Integrated Low-Cost Plan for its power sector. Experience from the Australian grid operator can provide insights for Senegal. The Australian grid operator developed an Integrated System Plan for its network planning, which prioritises the needed production and grid capacities. The Integrated System Plan is a roadmap for the National Electricity Market that optimises consumer benefits through a transition period. The Integrated System Plan supports Australia's energy transformation towards net zero emissions, enabling low-cost renewable energy and essential transmission to provide consumers with reliable, secure and affordable power. It serves the regulatory purpose of identifying actionable and future Integrated System Plan projects, as well as the broader purposes of informing market participants, investors, policy decision makers and consumers.

Source: AEMO (2022), 2022 Integrated System Plan (ISP)

B. Electricity markets to maximise investment and consumer outcomes

Senegal has undergone a number of transformations in terms of its electricity market design, moving from a fully integrated vertical public utility to a liberalised system, although full liberalisation has not yet moved from law to practice. Being one of the first countries in the region to open the electricity sector to private participation (of IPPs), Senegal has created a favourable environment for private sector participation and the necessary conditions for a competitive electricity market.

The electricity market is made up of independent upstream producers, a vertically integrated operator (Senelec), a transmission and distribution network, and captive end customers. In terms of governance, the government has introduced a performance contract with incentive indicators to monitor and improve the quality of the service Senelec provides. Senegal is a member of the international regional organisations for the development of The Gambia and Senegal Rivers (The Gambia River Basin Development Organization and OMVS, respectively).

Major electricity market reforms

The electricity sector has undergone significant transformations since the creation in 1983 of the then fully integrated national electricity utility, Senelec. At the time, as most utilities on the continent, Senelec had the monopoly over the production, transmission and distribution of electricity within the country.

In the early 1990s, following Chile's successful liberalisation model, development finance institutions such as the World Bank and the International Monetary Fund sought to drive similar reforms in other regions, including West Africa. In Senegal, those institutions provided conditional loans and grants, which were contingent on the country adopting laws and regulations to restructure the electricity sector. The stated pillars of the reform were privatising Senelec and sector unbundling, along with the creation of an independent regulation authority, opening up the sector to private investment and introducing competition in energy markets.

In 1998, Senegal adopted the first law on the electricity sector to establish an electricity market framework (Law No. 98-29) to end Senelec's monopoly and induce the liberalisation of the market. The CRSE was created, as well as the Agency for Rural Electrification.

The attempt to fully privatise Senelec was, however, short-lived. After that, it was awarded to a French-Canadian consortium composed of Hydro-Québec and Elyo France in March 1999, but the government of Senegal reverted the decision in September 2000 and renationalised the company.

In 2002, the Electricity Code of 1998 was slightly amended (Law No. 2002-01) to open the generation segment to private participation. Senelec was therefore enabled not only to keep developing its own production capacity but also to outsource it to independent production, with the tenders of IPPs managed by the CRSE.

In December 2010, the first Law on Renewable Energy was introduced (Law No. 2010-21). Additional implementation decrees were passed in 2011 to regulate the purchase conditions for renewable energies, as well as tariffs.

In 2021, Senegal's electricity market was reformed under the 2021 Electricity Code (Law No. 2021-31). The CRSE and the National Hydrocarbons Committee were merged to create the Energy Sector Regulatory Commission. The new code ends Senelec's monopoly on the purchase, distribution and wholesale of electricity, achieving the unbundling of its sectors. The implementation of the Electricity Code will be a major priority in the coming years. Importantly, the Electricity Code also integrates the Law on Renewable Energy, paving the way for the system integration of higher shares of variable renewables into the electricity market and grid. The new Electricity Code will guarantee non-discriminatory access to the grid for independent producers, open up the market for large consumers and create an independent regulator (the CRSE), in charge of approving the maximum authorised revenue and of approving electricity tariffs.

The law sets out ambitious timelines for Senelec to complete a full accounting separation of the different activities – generation, transmission, distribution and retail. Key questions the government and Senelec must address relate to the operationalisation of a fully liberalised sector as enacted by the 2021 Law, implications for the historic operator and plans to involve other entities in the electricity market, particularly in the transmission and distribution segments. There are concessions for rural electrification and solar home systems in the off-grid areas.

Figure 6.6 Institutional framework of the Senegalese electricity sector

<table>
<tr><th colspan="3">MPE</th></tr>
<tr><td colspan="3">The MPE prepares and implements the general policy in matters of production and distribution of energy, and promotion of renewable energies. The MPE sets the applicable standards for the electricity sector, grants licenses and concessions provided for by law and withdraws them, where applicable.</td></tr>
<tr><th colspan="2">CSRE</th><th>ASER</th></tr>
<tr><td colspan="2">It is responsible for regulating the activities of production, transport, distribution and sale of electrical energy and which, among other things, determines the tariff conditions applicable by operators in the sector</td><td>The mission of the ASER consists of promoting rural electrification and providing, to this end, the technical assistance and financial assistance required to support the electrification initiatives.</td></tr>
<tr><th>Senelec</th><th>AEME</th><th>ANER</th></tr>
<tr><td>Senelec is the historic operator of the sector, which holds the monopoly on energy transport in the territory, and currently has the status of sole buyer. As such, it has a monopoly on the purchase and wholesale sale of electrical energy.</td><td>The AEME is responsible for promoting the rational use of energy and the sustainable reduction of national energy consumption by establishing solid foundations with an integrated approach which takes into account the main forms of energy.</td><td>The ANER is responsible for the promotion of renewable energies, including bioenergy in all sectors.</td></tr>
<tr><th>Independent energy producer (IPP)</th><th>Rural electrification concessionaire (CER)</th><th>Local/ decentralised rural electrification projects</th></tr>
<tr><td>The IPP is any independent operator carrying out an electrical energy production activity who sells its production to Senelec or to any other buyer authorised by the legal and regulatory provisions in force</td><td>The CERs, recruited through the call for tender, have a concession for the distribution of electrical energy in rural areas, these concessions are the subject of a priority rural electrification program.</td><td>They are carried out and operated in rural localities not included in the priority programs or investment programs of the CERs by private companies or local authorities in partnership with a private.</td></tr>
<tr><th colspan="3">Autonomous solar system suppliers</th></tr>
<tr><td colspan="3">The sale for cash or installment of solar kits and other individual autonomous electrical systems is free to exercise throughout the entire extent of Senegal subject to the provisions in force.</td></tr>
</table>

<table>
<tr><th>Ministry of Finance and Budget (MFB)</th></tr>
<tr><td>The MFB ensures the mobilisation of domestic resources for the financing of projects approved in the budget.</td></tr>
<tr><th>Ministry of Economy, Planning and Cooperation (MECP)</th></tr>
<tr><td>The MEPC supports the mobilization of necessary financing for the sector by working on the development of the price sector, the establishment of PPPs and the strengthening of cooperation with PTFs.</td></tr>
<tr><th>Technical and financial partners (PTF)</th></tr>
<tr><td>The PTFs participate in the financing of investment projects in the sector, to respond to the growing demand for energy as well as the promotion of ENR.</td></tr>
</table>

Source: MPE (2020), Universal access to electricity in 2025, as modified by the IEA.

Retail market and prices

The CRSE is responsible for regulating electricity tariffs, including setting the tariffs for all segments of the electricity sector and establishing the modalities for reviewing those tariffs. Senelec charges its customers retail electricity tariffs, which the government currently subsidises. It nonetheless aims to phase out subsidies by 2025.

Tariff components vary depending on the voltage, with different consumption charge prices for low voltage (0.20 EUR/kWh), medium voltage (0.18 EUR/kWh) and high voltage (0.13 EUR/kWh). The low-voltage tariff includes fixed monthly charges for residential and commercial power and public lighting. The medium-voltage tariff has fixed charges based on the length of usage, ranging from short to general and long use. Tariffs for high voltage include fixed charges for general and emergency use. All three voltage levels have the same 18% VAT rate, included in consumption charges and fixed charges. Communal taxes vary depending on the region.

Retail tariffs in Senegal are among the highest in the region. In 2019, the average retail tariff for households, factoring in subsidies, was 110 FCFA/kWh (0.20 USD/kWh), double the regional average. The average for households in sub-Saharan Africa was 65 FCFA/kWh (0.11 USD/kWh). This is because electricity is principally provided by HFO generators.

Regional electricity trade

Senegal's electricity trade with its neighbouring countries is limited today, mostly because the regional power pool that will eventually connect the West African region (see next section) is still to become fully operational and interconnected.

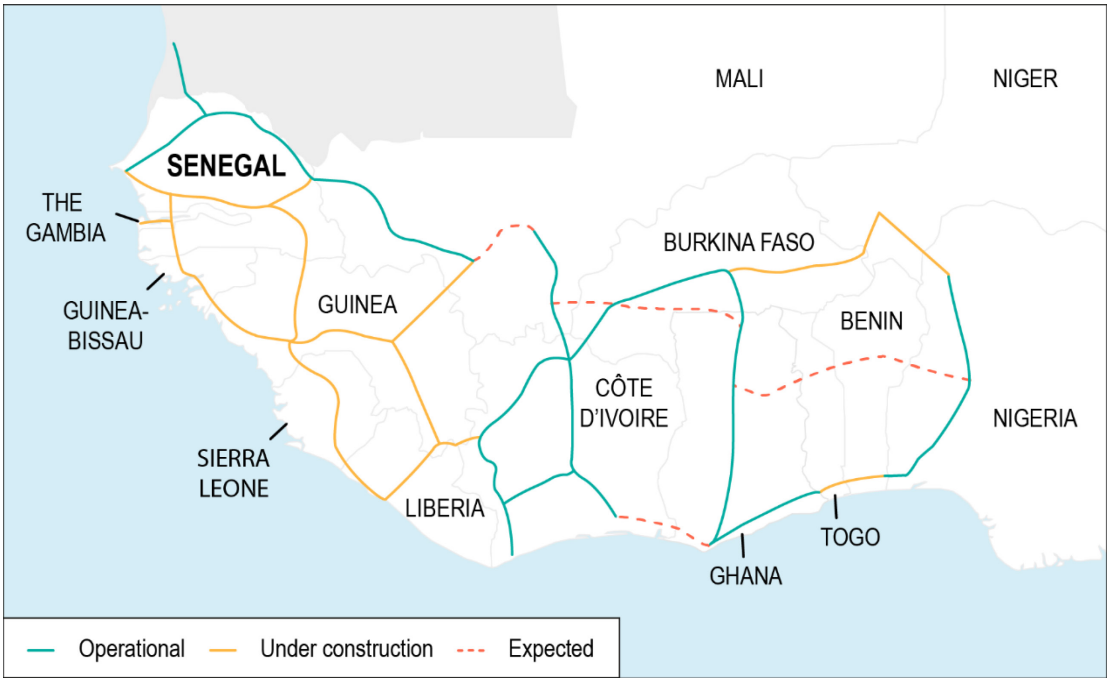
Trade is linked to the use of hydropower at the subregional level and with countries. The Manantali dam was built by the intergovernmental organisation, the OMVS, established by the Malian, Mauritanian and Senegalese governments to preserve the Senegal River, which crosses the three countries. The capacity Senegal can use is fixed at 121 MW; other portions go to Mali and Mauritania. Trade linked to the Manantali dam is supported by the 945 km long supranational network that connects the Manantali, Félou and Gouina plants in Mali to the substations of Matam, Dagana, Sakal and Tobène in Senegal (Senelec, n.d.). The connection to the transmission line of the OMVS is also relevant for Senegal and its neighbouring countries.

Wholesale market

Senegal is part of the WAPP, which aims to promote and develop power generation and transmission infrastructures and co-ordinate power exchange among ECOWAS member states.

The WAPP, which was created in 1999 by ECOWAS, counts strengthening interconnections among member countries among its top priorities so as to create a regional electricity market.

Figure 6.7 Operational and planned interconnections within West African Power Pool countries



Note: "Under construction" includes lines that are close to being made operational, under construction or for which funding is secured.
Source: World Bank (2021), World Bank Blogs, as modified by the IEA.

The WAPP aims to interconnect the 14 mainland ECOWAS countries by 2025 and put in place a competitive regional power market that delivers abundant affordable electricity to all. Current trade within the WAPP is mostly done on a bilateral basis between interconnected countries and a functioning wholesale market is still to become operational. During 2023, Senegal was interconnected to the electricity grid of the WAPP, which will be a turning point for future electricity exchanges. This also serves the needs of The Gambia, which is connected to Senegal.

The WAPP has many partners and international donors supporting the financing for the construction of transmission infrastructure to realise the vision of establishing a competitive regional market, including the transmission line linking Côte d'Ivoire, Guinea, Liberia and Sierra Leone. To attract finance more effectively, the four countries established a supranational company, the Transmission Company of Côte d'Ivoire, Liberia, Sierra Leone and Guinea (Transco CLSG). Transco CLSG was able to secure concessional loans from the World Bank, the European Investment Bank, KfW and the African Development Bank. In March 2022, it reported 96% completion of construction work on the line, with work remaining on some segments and associated infrastructure.

Box 6.2 International lessons for regional market integration

Senegal is part of the West African Power Pool (WAPP), which is based on the co-operation of the national electricity companies in Western Africa under the auspices of the Economic Community of West African States (ECOWAS). Created in 2010, the WAPP is now looking to create a reliable power grid for the region and a common market for electricity. Africa has a total of five regional power pools. In addition to the WAPP, these include the Southern African Power Pool (SAPP) with 12 member countries, the Eastern Africa Power Pool with 13 member countries, the North African Power Pool with five countries and the Central African Power Pool with ten countries.

On the continent, the SAPP and the WAPP are the most developed, and both include replicable elements that have helped attract investment. The SAPP, which connects Southern Africa Development Community countries, has had a functioning power market since 2001. The SAPP's member countries, represented by their respective utilities, participate in the power trading, which has allowed many countries in the region to rely on imports from neighbouring countries. In addition to utilities, the SAPP includes several private operators and an additional participant – Africa GreenCo – which acts as an intermediary aggregator between buyers and sellers. By purchasing power from renewable independent power producers and selling it to both utilities and private sector off-takers through the SAPP market, it effectively contributes to derisking those projects by addressing the offtake risk through the natural hedge of demand aggregation.

The synchronous grid of continental Europe, the largest of its kind globally, has promoted over time cross-border electricity exchanges, common rules for trading and interconnections.

Several areas are of interest for the WAPP as it develops its next level of interconnection and market expansion across the common market in West Africa. In Europe, the creation of common institutions for the common market with common rules helped the trade to expand quickly. The third energy package created the EU Agency for the Cooperation of Energy Regulators, a body that promotes the co-ordination of national regulatory authorities, and of the European Network of Transmission System Operators (ENTSO-E), which works to ensure the security and the reliability of the interconnected power systems.

The WAPP may also benefit from common grid codes. For instance, the EU electricity market integration is building upon a system of common network codes, as elaborated by ENTSO-E, reviewed by the Agency for the Cooperation of Energy Regulators and adopted in EU law. The Clean Energy Package (2019) introduced another paradigm shift for the common EU market, promoting stronger interconnectivity to support the system integration of variable renewables. At the common wholesale market level in Europe, Clean Energy Package rules are now adapted to the system with very high variable renewables. These rules aim to increase and optimise cross-border capacity through infrastructure development, balancing, intraday markets and greater cross-border capacity made available by transmission system operators. The Clean Energy Package also revised the EU electricity security of supply rules and introduced an EU-wide electricity emergency response mechanism.

Sources: IEA (2020), European Union Energy Policy Review, IEA (2014), Energy Policies of IEA Countries: The European Union 2014 Review.

C. Electricity reliability

Ensuring energy access and the reliability of electricity supply are the key pillars of Senegal's power market reforms.

Senegal suffered from frequent power shortages and related public unrest but has rapidly overcome the impacts. In the 2000s, Senelec had frequent supply issues caused by rising consumption and high fuel prices. Adequacy of electricity supply over growing demand remains a key concern for Senegal, and often, the price of imported HFO becomes the restrictive factor.

To cover the expected national peak demand in 2025 (1 350 MW), the government plans to almost double the installed capacity from today's 1.79 GW to 3.58 GW by 2030. More granular and detailed planning will be useful and is underway in the Integrated Low-Cost Plan.

SENELEC's service quality is assessed by analysing the nominal service interruptions and the associated energy not supplied (NFE). A significant improvement was seen in 2020 compared to 2019. Total NFE for 2020 is estimated at 12.27 GWh compared to 16.87 GWh in 2019.

The structure of energy not delivered due to service interruptions continued to be dominated by network incidents, which accounted for 65% of total NFE. Second, undelivered energy due to a lack of generation accounted for 2% of NFE, down 62% from 2019. Third, undelivered energy from planned works for the maintenance of installations or the connection of new installations accounted for 29% of NFE in 2020, 7% less than in 2019, according to Senelec.

Senelec's electricity grid will require important reinforcements to comply with N-1 contingency events. This will also be a prerequisite for greater regional interconnection of Senegal (to avoid power outages from spilling across the region).

Integrating electricity markets at the regional level, in turn, can boost electricity reliability, as it diversifies the generation mix and gives access to generating capacity in case of a shortage in any one country. The countries in the subregion will be going through a paradigm shift as market integration and higher electricity trade flows support the system integration of rising shares of variable renewable energy. Interconnectivity will also become a driver of system integration of variable renewables. International experience reflects that the electricity system operation is changing with higher needs for system management, peak ramp requirements and ancillary services.

Assessment

The Senegalese government has brought forward a series of major legislative reforms in the electricity sector, with an independent regulator and a new Electricity Code. Some implementing decrees have already been put into effect, while others will follow shortly. All these measures are aimed at reducing the price of electricity, which is among the highest in the subregion. These reforms are also important in the regional context. Senegal is a member of the WAPP and aims to trade electricity on a regional scale.

The incumbent operator, Senelec, is in the process of "unbundling" its operations, with the planned separation of generation, transmission and distribution activities, as well as end customers, into three separate companies grouped in a holding company. This should improve the governance of the electricity market and increase the level of competitiveness to reduce electricity prices while ensuring a quality supply.

In 2022, national electricity generation was dominated by heavy fuel oil, which provided 79% of the electricity produced, while renewable energies (hydro, solar and wind) accounted for just 21%. Installed capacity, equal to 1789 MW in 2022, was made up of 30% renewable energies. Peak consumption was around 950 MW. Domestic production covers the country's needs, but most fossil fuels have to be imported, making electricity expensive by regional standards. Current projections by Senelec/MPE predict a doubling of electricity consumption (around 10 TWh/year) and peak demand (2 057 MW) by 2030. As a result, Senelec has proposed a plan to increase production capacity based mainly on fossil fuels: diesel generators 310 MW, combined cycles 1 280 MW, hydro 340 MW (The Gambia River Basin Development Organization) and batteries 150 megawatt peak to cover the expected increase in electricity consumption.

The Senegalese government is in the process of setting up an Integrated Low-Cost Plan. The Plan is led by the MPE with technical support from Senelec. Its aim is to provide a basis for planning and prioritising investment in new generation and network capacity. This plan takes into account economic growth, demographic change, energy efficiency and energy transition and aims to ensure high-quality electricity at lower cost (SGD# 7). The first results are expected by the end of 2024.

The insufficiency of transmission grids is often the reason for delays in bringing generation projects online, which was the case for Senegal's wind farm. Senegal aims to connect all urban and rural areas and to improve interconnections with neighbouring countries.

Senegal's electricity network is interconnected to the north with Mauritania, to the west with Mali and Guinea (under construction), and to the south with The Gambia and Guinea-Bissau (under construction).

It is an integral part of the WAPP. Preliminary regional frequency control trials are underway, and Senegal has a modern network code. A common network code at the level of the WAPP would boost electricity trade and form the basis of greater reliability and interoperability, a pillar of market integration.

The actual frequency control does not allow integrating more renewable power, as the installed capacity is not flexible enough to integrate variable renewable power generation. Senelec is working to improve frequency control so that more renewable generation can be integrated. Despite these measures, the energy not served was 50 hours in 2021, among other things, because of a lack of "N-1" redundancy in the electricity network as well as planned and unplanned maintenance work. Senelec plans to invest around FCFA 660 billion to extend and improve the reliability of its transmission and distribution networks over the next few years.

Senegal is currently developing a "gas-to-power" strategy to use the production from the future Yakaar/Teranga domestic gas fields, as well as its share of the cross-border (Senegal-Mauritania) Greater Tortue Ahmeyim (GTA) gas field to supply its fossil-fired power stations with gaseous fuel in order to reduce its dependence on imports and cut CO_2 emissions. Senegal plans to invest heavily in a territorial gas network to supply

power stations and a future petrochemical industry, as well as in converting existing power stations to gas and in new electricity production units.

Senegal has successfully developed a first wave of wind and solar power plants, which have increased the share of renewable energy to 30% of installed capacity, including the first and largest wind power plant in West Africa (Taiba Ndiaye). Senegal has 30% of the capacity installed under the Manantali project (OMVS), as well as 340 MW (1 200 GWh) from The Gambia River Basin Development Organization network.

Investments are planned as part of the implementation of the priority “gas-to-power” strategy, as well as the extension of the transmission network (looping of the Senegalese high-voltage network) and distribution network (universal access to electricity by 2025). These investments are being made by Senelec and the Senegalese gas network operator, with the government intervening only on a subsidiary basis, providing a sovereign guarantee only where necessary.

The price of electricity is today subject to subsidies and has seen a major increase in tariffs (directly linked to the rise in the price of oil in 2022). To cushion this shock, a social tariff (for consumers <150 kWh/month) has been created, and to avoid disparities between towns and rural areas, the tariff is unified across the country. In addition, all tariffs are progressive to encourage consumers to save as much electricity as possible. Large consumers have a peak rate (7 pm-midnight). The Senegalese government has subsidised electricity for a long time. Commendably, the government adopted a roadmap to progressively reduce the subsidies by 2025.

Both international experience and system modelling suggest that increasing shares of variable renewables can be integrated in a secure manner through appropriate market reforms, amended system operation and planning, and targeted investments that unlock flexibility in the power system. The four main sources are dispatchable generation, transmission interconnection, demand response and storage. In addition, system-friendly renewable deployment, including the use of high load-factor wind turbines and smart inverters for solar, can reduce the need for additional flexibility sources. In the context of the JETP Senegal, system integration should be prioritised. Senegal is already working on an integrated system plan for least-cost electricity.

As detailed in Chapter 5, renewable energy needs to be developed in a synchronised manner, using all the renewable energy potential through renewable energy zones, taking into account experience from Australia, India, Mexico and Türkiye. Renewable energy zones will also support the scalability of renewable energy development. Using the full flexibility of the system also means investing in gas-fired power plants to support ramping capabilities and regulating power. Some of the older HFO plants will need to be tested for flexibility, while many will need to retire based on an economic and environmental assessment.

In transmission and distribution, another key question relates to the need to update the network code at the national and regional levels, which could regulate the use and operation of a transmission and distributed grid that no longer legally falls under the monopoly of the national utility, which notably included non-discriminative grid access (to avoid discrimination of renewable energy sources) and the potential expansion of the role of the regulator to include oversight of wheeling charges and the establishment of tariff-setting mechanisms for transmission services. This will avoid curtailments and commercial losses for investors. For now, provisions for access to the grid are included in the 2021

Electricity Code and tariff-setting is done through negotiation in accordance with principles set out by the regulator. Senegal has chosen to maintain the monopoly/concession for transmission with Senelec (but has not yet put in place the non-discriminatory third-party access regime to the transmission grid and connection charges).

Senegal is part of the WAPP, which has ambitious plans for regional integration and interconnection. Advancing regional integration will be effective in a step-by-step approach, as used in other regions in Africa, such as the SAPP. Many lessons can also be learnt from the EU electricity market integration, such as the creation of a network of all transmission system operators (ENTSO-E) and the adoption of EU-wide network codes.

Recommendations

- Complete the transmission network upgrades and aim for N-1 redundancy in the network meshing to minimise outages. Make full use of the Integrated Low-Cost Plan when planning the network investments, using international best practices.
- Improve network frequency control to increase the penetration of renewable energies.
- Accelerate the implementation of the “gas-to-power” strategy by ensuring that the timetables of the various players are aligned and by prioritising investments to maximise the production of electricity from domestic gas.
- Continue to open up the electricity market by gradually liberalising the supply of electricity to large consumers, encouraging all forms of self-consumption and introducing an obligation to buy back electricity produced by self-consumption.
- Intensify regional collaboration to make the West African Power Pool operational by implementing technical rules for network interoperability and market operation standards, building on the experience of the EU regional market integration.

7. Oil

Key data (2021)

Net imports of crude oil: 18 kb/d in 2021; +21% since 2011

Domestic crude oil production: no production as of 2023

Net imports of oil products: 41 kb/d in 2021; +52% since 2011

Share of oil: 70% of electricity generation (2022), 49% of total energy supply, 42% of total final consumption, 100% of transport, 15% of buildings, 6.0% of industry

Oil consumption by sector: 56.9 kb/d (domestic transport 39%, electricity generation 32%, international bunkers 12%, residential buildings 11%, industry 6%, services buildings 0.3%)

Source: IEA (2023), World Energy Balances

Overview

Oil is the most important energy source in Senegal. HFO is the main source of electricity generation, with ensuing economic and environmental costs.

Senegal is not an oil producer and depends entirely on imports to meet its demand for crude oil and oil products. Almost all its crude oil needs are imported from Nigeria and then refined in Senegal's only refinery, African Refining Company (SAR), supplemented by imports of oil products. Relying on oil product imports to cover 60% of the related demand, Senegal has been exposed to oil price hikes in recent years.

Senegal produces minor amounts of natural gas. It does not yet produce crude oil domestically but has made a significant discovery offshore – the Sangomar oil field. The Sangomar field is expected to start producing by the end of 2024, which prompted the SAR refinery to develop a road map on oil products supply chain (Figure 7.6) and to realise investments to upgrade and expand the SAR refinery.

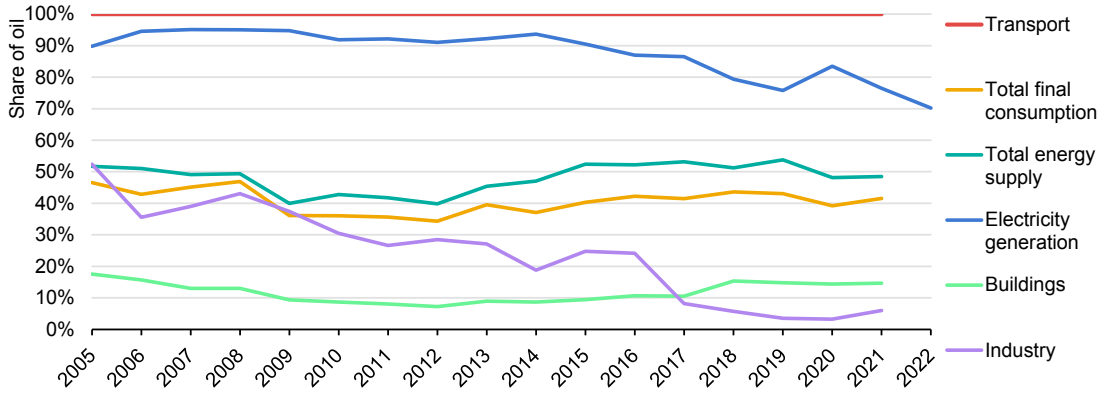
The discovery of hydrocarbon resources off the Senegalese coast is also reshaping the country's energy policy. The government reformed laws and policies to prepare for the status of energy exporter while aiming to avoid the potential future negative impacts, such as Dutch disease. Such policies are included in the PSE 2035, the LPDSE, and the Oil Code and the creation of new funds to manage the distribution of future revenues from oil/gas production.

The government targets full fuel switching from HFO to natural gas in power generation by 2030 as part of the gas-to-power strategy. The government set out plans in the LPDSE for the transition of the power sector away from old HFO plants by building new HFO plants, which are convertible to natural gas.

Oil supply and demand

The share of oil in TES was 49% in 2021 (Figure 7.1). Oil is the prime source of electricity generation, accounting for 70% of the total in 2022, the lowest share ever in Senegal, but still higher than the year before in absolute values (+8%). The share of oil in TFC was 42% in 2021, showing an increasing trend over the past decade (+5% since 2011). As for the end-use sectors, the share of oil in industry reached 6.0% in 2021. Demand for oil from buildings increased from 8.0% in 2011 to 15% in 2021. The transport sector exclusively relies on oil to serve a domestic fleet of 800 000 vehicles (51% diesel and 49% gasoline).

Figure 7.1 Share of oil by end-use sector in Senegal's energy demand, 2005-2022

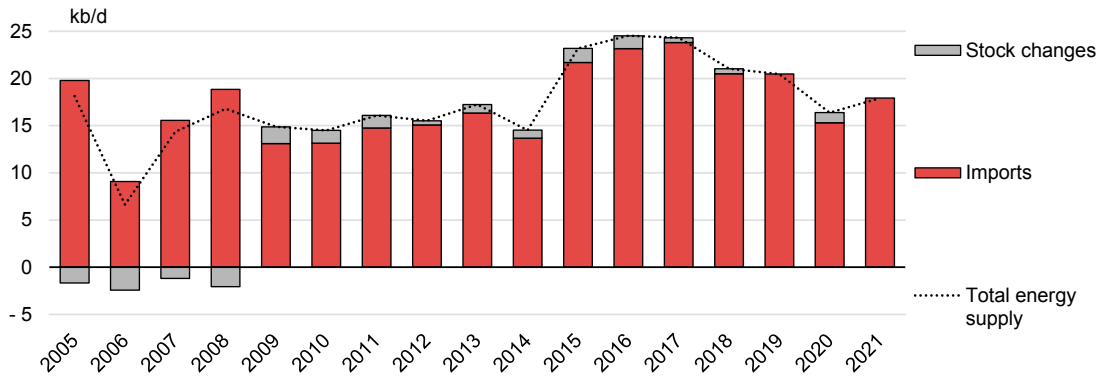


Note: Only the figure for electricity generation is available for 2022.
Source: IEA (2023), World Energy Balances.

Crude oil production and trade

As of 2023, Senegal is not (yet) a crude oil producer. All of the oil the country consumes is imported (Figure 7.2). In 2021, imports were 18 thousand barrels per day (kb/d), still lower than the pre-pandemic levels (20 kb/d in 2019), when imports peaked.

Figure 7.2 Imports and stock changes of crude oil in Senegal, 2005-2021



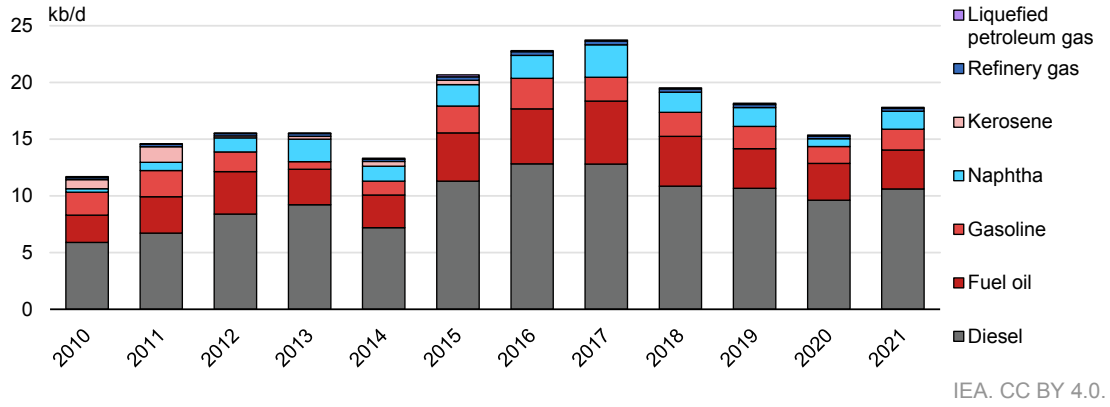
Note: Stock changes are statistical differences, not physical stocks.
Source: IEA (2023), World Energy Balances.

Oil products production, demand and trade

Senegal's only refinery, SAR, imports mainly light sweet crude oil coming from Nigeria (mainly Erha, 35°API and 0.2% sulphur based on *Kpler* trade data). The country also imports oil products, almost exclusively light products, to supplement local production. The SAR output peaked in 2017 at 24 kb/d and has decreased every year since, down by 15% from 2019 to 2020, but rebounding in 2021 to 18 kb/d (Figure 7.3) before falling again in 2022 around 17 kb/d (2022 based on latest *Kpler* trade data). Domestic oil products production satisfied around one-third of Senegal's demand.

In 2021, diesel accounted for 60% of total production (18 kb/d), followed by fuel oil (19%), gasoline (10%), naphtha (9.0%), with the residual volumes shared among refinery gas (1.3%) and LPG (0.6%).

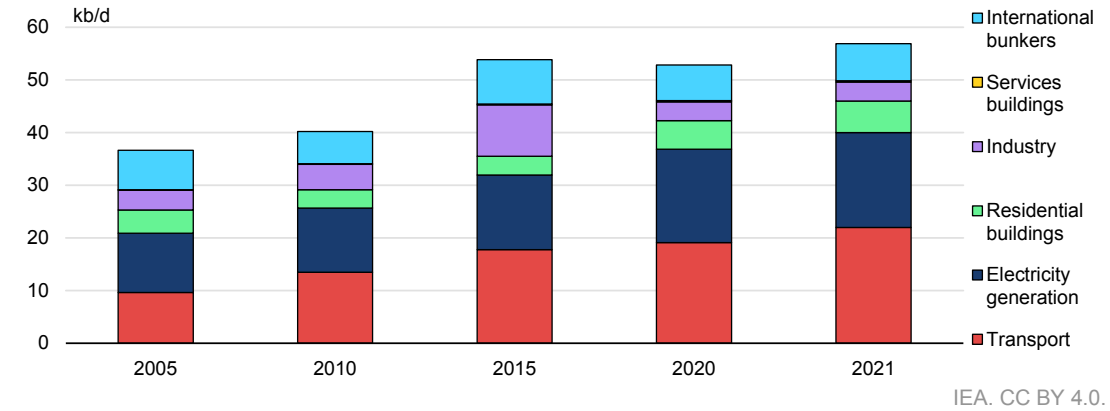
Figure 7.3 Oil products production by fuel in Senegal, 2010-2021



Notes: Liquefied petroleum gas is not visible at this scale.
Source: IEA (2023), World Energy Balances.

In 2021, Senegal's total demand for oil products was 57 kb/d (Figure 7.4). From 2011 to 2021, demand increased by 40%. In 2021, transport was the largest sector (22 kb/d or 39% of total demand). Demand for oil products is also strong in electricity generation (18 kb/d or 32%), international bunkers (7.0 kb/d or 12%) and residential buildings (6.0 kb/d or 11%), followed by industry (3.6 kb/d or 6%) and services buildings (0.3 kb/d).

Figure 7.4 Oil products demand by sector in Senegal, 2005-2021

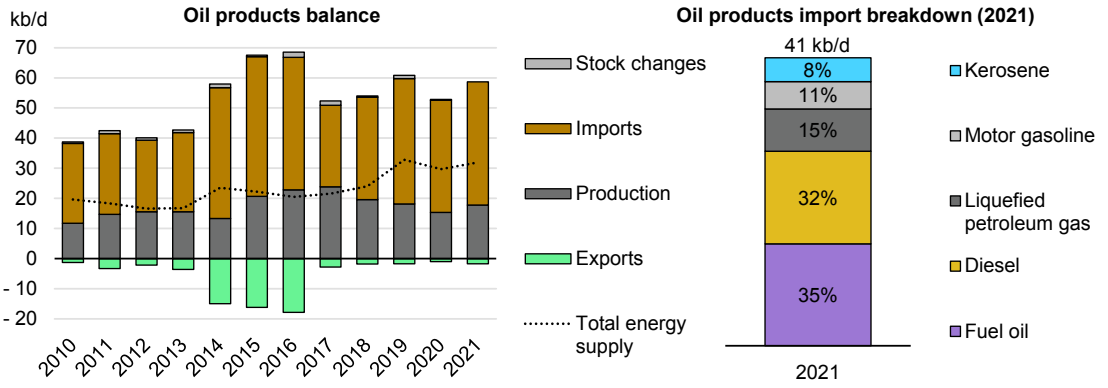


Source: IEA (2023), World Energy Balances.

In 2021, Senegal produced 18 kb/d of oil products, up 21% from 2011, and imported 41 kb/d to cover its oil product demand (Figure 7.5). A small amount was exported (2 kb/d), mainly jet and kerosene.

Imports have increased over the past decade (+52%) to reach 41 kb/d in 2021, which was mainly fuel oil (35%), followed by diesel (32%), LPG (15%), gasoline (11%) and kerosene (8%).

Figure 7.5 Oil products balance (2010-2021) and imports by product (2021)



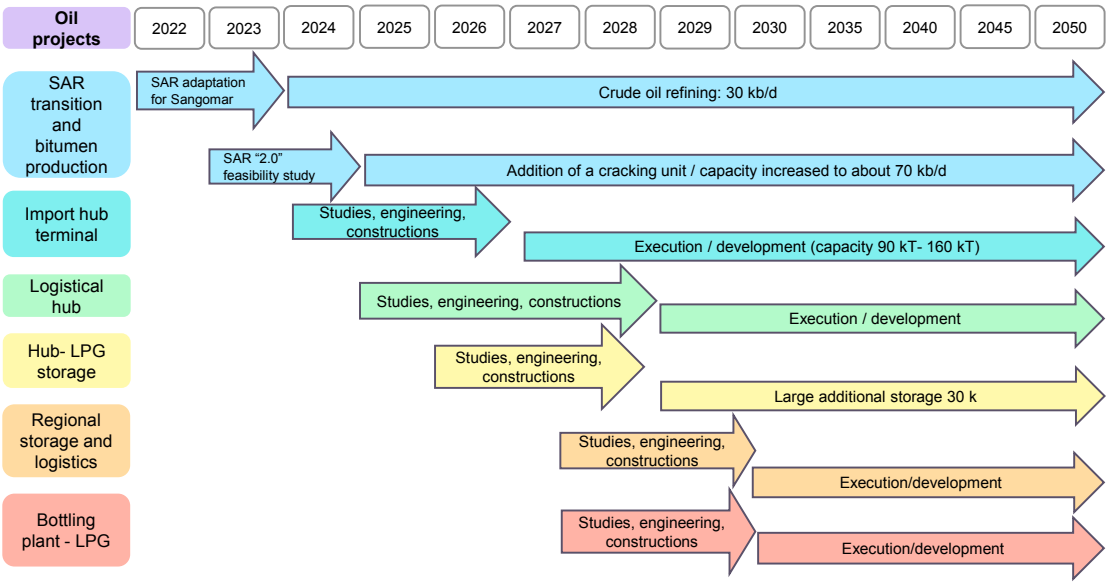
Source: IEA (2023) World Energy Balances.

As for trade partners, in 2020, Senegal mainly exported oil products to Mali (84%), Guinea-Bissau (2%) and Burkina Faso (2%), and imported from the Russian Federation (23%), the Netherlands (22%), Belgium (22%), Spain (10%) and others.

Oil products demand and production outlook

The government presented a roadmap for the country's oil products production development and refinery optimisation planning (Figure 7.6). In 2023, investments are being made in the SAR refinery upgrades to process the heavy Sangomar oil, notably sulphur scrubbers. In addition, the gas resources associated to Sangomar are planned to be used to increase LPG products production, which will enable Senegal to supply the local and potentially the regional market.

Figure 7.6 Roadmap for oil products in Senegal, 2022-2050

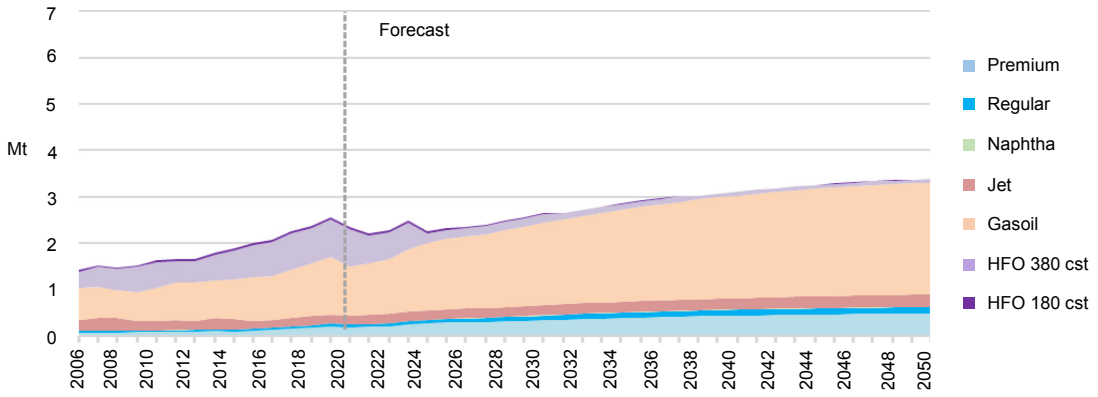


Note: SAR = African Refining Company.

Source: MPE 2023, as modified by the IEA.

The government expects oil products demand to increase in Senegal (Figure 7.7). To meet domestic demand and improve regional LPG storage, logistics and bottle manufacturing, the government adopted a roadmap which envisages the expansion of the SAR refinery that aims to adapt to Sangomar production, boost diesel output and eliminate HFO production (by converting the latter into bitumen).

Figure 7.7 Oil products demand (2006-2020) and forecast for 2050 in Senegal



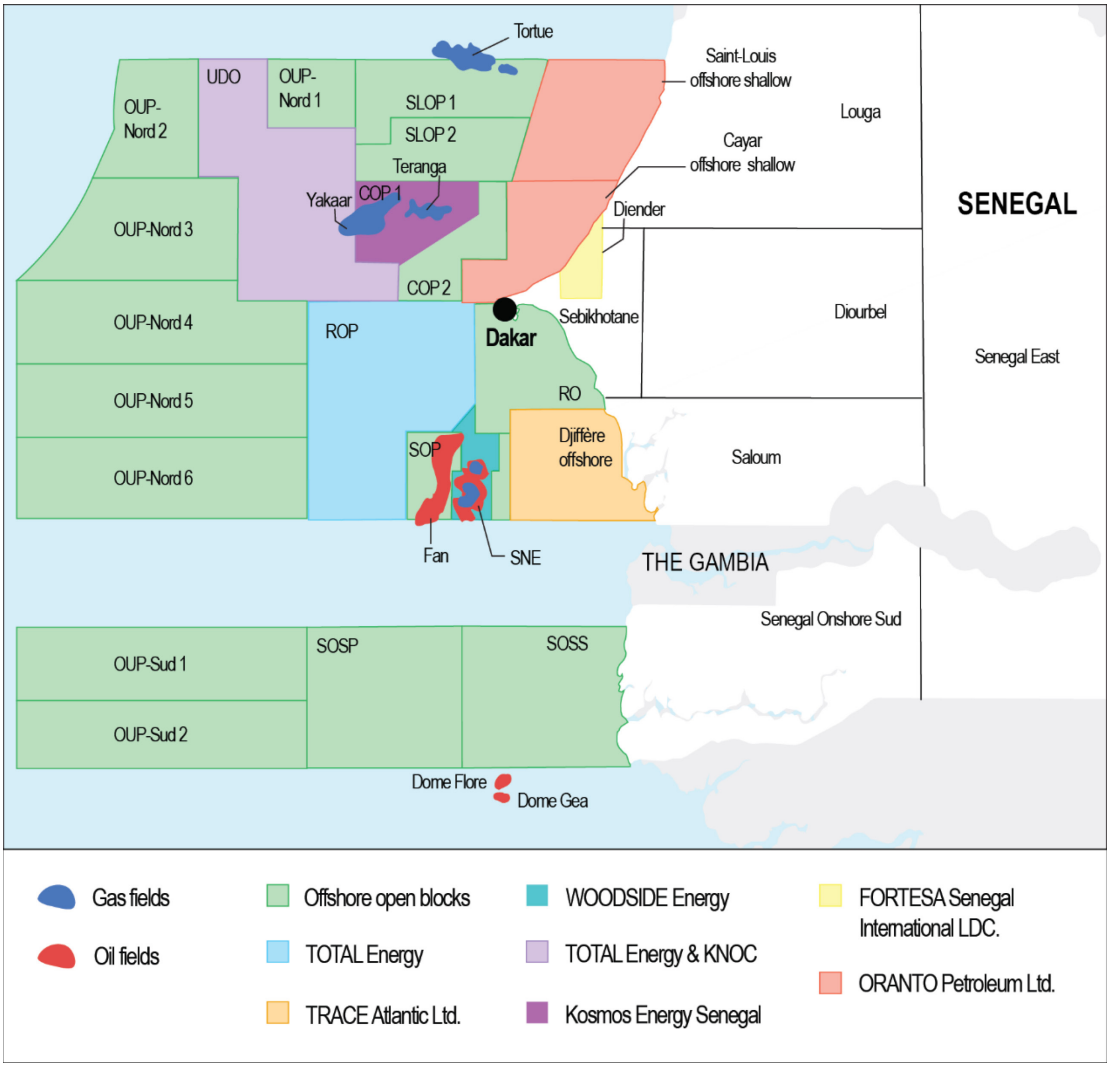
Source: MPE 2023, as modified by the IEA.

Oil upstream exploration and production

Oil exploration and production started in the 1950s with around 180 exploration fields drilled over the period 1950-2019. Estimated oil reserves (1P) amount to 56 million barrels (mb). However, there are substantial resources: the Sangomar field located offshore Dakar, holds an estimated 630 mb of resources. This does not include the SNE Nord with 100 mb of resources and the FAN field, discovered by Cairn Energy, which holds estimated resources of 300 mb, according to the MPE.

Woodside is the operator and is responsible for the development of the 100 kb/d Senegal floating production storage and offloading vessel that will produce from the Sangomar field. It holds 82% interest and Société des pétroles du Sénégal (PETROSEN) retains the remaining 18%. The commissioning of the field has been delayed due to the Covid-19 pandemic. It is now expected to come online in May 2024. The final investment decision was taken in 2020 by the consortium PETROSEN/Woodside after the large SNE and FAN discoveries in 2014.

Figure 7.8 Offshore oil and gas infrastructure in Senegal



Source: MPE (2023), as modified by the IEA.

Key institutions

Senegal's national oil company PETROSEN holds a 10% stake in all joint ventures set up to implement exploration and production sharing contracts relating to the country's oil fields. PETROSEN is supported by the other co-contractors during the exploration phase and therefore does not participate in the expenses of the joint venture during this period. In the event of the discovery of deposits, and once the final investment decision has been taken, PETROSEN has the option of increasing its share to 30%, of which 10% continues to be held during the development of the field. In the production phase, it ceases to be supported.

By participating in the joint ventures, PETROSEN is entitled to the same rights and obligations as the other contracting parties, in particular with regard to the production shares within the joint venture, which will be allocated in proportion to the shareholdings among members.

In 2020, Senegal reformed PETROSEN S.A. into three entities: PETROSEN Exploration & Production (which participates in joint ventures with a minority 10-20% shareholding); PETROSEN Trading & Services; and PETROSEN Holding S.A. The Holding controls 93.7% of the SAR refinery shares as well, alongside Sahara Group, ITOC, Locafrique and TotalEnergies Sénégal, and 51% of the shares of the company Réseau gazier du Sénégal, alongside Senelec and FONSIS.

The President created a dedicated Committee for the Strategic Co-ordination of the Hydrocarbons Sector (Comité d'Orientation Stratégique du Pétrole et du Gaz, COS-PETROGAZ). The GES-PETROGAZ was created at the MPE to manage the financial and administrative side of COS-PETROGAZ's activities.

The MPE guides the development of upstream production in Senegal and related contractual arrangements. It holds a cadastre of all upstream and downstream activities.

Oil products prices are regulated in Senegal with a view to ensuring stable prices at the pump. Under Law 2021-32, the CRSE, responsible for regulating the electricity sector as well as downstream oil and gas, sets prices on a monthly basis and submits them to the MPE for review and determination of the state's tariff policy.

Oil policy

Oil and gas discovered under the continental shelf off the coast of Senegal, belong to the country under international treaties, and more specifically to the Senegalese people, as established by the Constitution. However, for technical and financial reasons, exploration, development and production activities require the participation of international oil companies. In the event of a discovery and subsequent development, the selected companies logically claim a portion of the oil and gas production profits.

The Petroleum Codes of 1998 and 2019 lay the foundations for the repartition of the oil rent, the production sharing agreements and the payment of royalties to the state. The 1998 Code continues to apply to exploration and production sharing agreements signed before 2019, under the Stabilisation Clause. The new Code (from 2019), which is fully in force, governs all new contracts.

Under the Code's profit-sharing mechanism, PETROSEN holds a minimum interest of 10% during the exploration phase and up to 30% during the production phase.

The 2019 Code establishes the principle of national preference and refers to a specific law on local content. It stipulates that oil companies must use local labour and materials at equivalent quality and cost, and contribute to training funds for local workers. In line with this, the Senegalese Parliament approved Law 2019-04 of 1 February 2019 setting out the provisions on local content, followed by all the decrees ensuring its implementation from 2020.

A digital Oil Register was introduced in May 2021 to increase the transparency of oil and gas sector-related activities.

The development of Senegal's oil and gas resources is expected to have a huge impact on the economy. The hydrocarbons industry will generate royalties from production and export, tax revenues to the government, and related energy services in industry, employment and mobility. Such development is accompanied by several risks, generally associated with producer economies. When the economy depends on oil exports, it is subject to the global demand uncertainties and international prices. Another risk is related to price volatility, which may lead the country to develop pro-cyclical policies. Overdependence on hydrocarbon revenues also impacts other sectors, resulting in, among other things, the so-called ''Dutch disease''.

Senegal has already prepared anti-corruption and transparency laws and has invested in the development of the oil rent repartition to avoid the problems that high dependency on fossil fuel exports may bring.

Senegal adopted the legal framework (Law No. 2022-09 on 19 April 2022) for the distribution and management of revenues from the hydrocarbon production (the ''Orientation Law''). In 2023, following the national consultation on the management of revenues from oil and gas exploitation, Senegal adopted the budgetary planning under the Orientation Law on the use of oil and gas revenues for the coming years (which are expected to start flowing by the end of 2024). The budget plan has three objectives: to finance immediate development needs, but also to mitigate the impact of the price volatility on the State Budget and prepare for the post-oil era.

The Orientation Law establishes the principle of full budgeting of all revenues, for full traceability, before allocating a portion to the State Budget and to two separate funds created as follows: 1) the Stabilisation Fund to protect the budget and revenue-financed programmes against external shocks from international markets, 2) the Intergenerational Savings Fund. The amounts allocated to the State Budget are to be used exclusively to finance structural investment programmes to support the country's economic development (infrastructure, education, health, etc.).

Oil mid- and downstream infrastructure

Refineries

Built in 1963, Senegal's only refinery, SAR, underwent modernisation work that was completed in 2022 and had a total capacity of 30 kb/d (1.5 Mt/y) on the same year, to meet

the total demand for 57 kb/d (2.8 Mt/y)[1]. These adaptations are designed to enable SAR to process crude oil from Sangomar and are part of Senegal's roadmap for the oil products value chain (Figure 7.6).

The SAR is obliged to deliver HFO to cover the needs of Senegal's electricity production by Senelec, which is subject to subsidies from the Support Fund for the Energy Sector.

There is a plan to expand capacity to meet the growing domestic demand of 3.5 Mt by 2026 with a view to improve fuel quality and meet the entire national demand for oil products.

Transportation and storage

In 2023, total oil storage capacity amounts to 436 923 m^3 and 16 000 tonnes for butane. The lion's share (or 65% of the total capacity) is operated by SenStock S.A., which is owned by DIPROM (36.9%), TotalEnergies SENEGAL (28.7%), PUMA ENERGY (18%) and SAR (16,4%). Senegal has ten storage sites within the periphery of the capital Dakar.

Under the law, Senegal requires 35 days of commercial stocks, which is not always respected by the companies. There is a strong interest by the sector to invest in additional oil storage sites (seven projects are underway). The MPE is undertaking a study to analyse the adequacy of storage capacity and port infrastructure investment.

Table 7.1 Senegal's oil products storage sites and ownership

Storage site	Storage company
SENSTOCK S.A.	Diprom, TotalEnergies, Puma, African Refining Company
DOT	Vivo, OLA
ORYX SENEGAL	Oryx
JETEE NORD	Vivo
BAD	Vivo
SDE	TotalEnergies, Vivo
TOTAL GAZ	TotalEnergies, OLA
TOUBA OIL (LPG)	Diprom
PUMA	Puma
LOBBOU MAME DIARRA BOUSSO	Lobbou Mame Diarra Bousso

Source: MPE 2023.

Oil market structure

State-owned PETROSEN Trading & Services is active in the downstream sector and has recently also entered the LPG business. It holds 25% of butane import quotas and participates in supplying the country with petroleum products by importing oil products. International players in the oil downstream sector are OLA, Puma, TotalEnergies and Vivo.

[1] Based on data provided by the Comité National des Hydrocarbures for the year 2022.

The large national distributors are Elton, EDK, MKA, Star Oil and some smaller companies, including API, Omega, Maack, Touba Oil and PETRODIS. Senegal has 1 169 service stations.

Senegal has import quotas for LPG in place. The distribution of LPG to the rural population entails high costs and bottlenecks remain in the logistics to move products from Dakar to the isolated areas of the country.

Prices and taxation

End-user prices are regulated in Senegal. In November 2023, diesel was fixed at 755 FCFA/litre (1.26 USD/L) and premium unleaded gasoline at 990 FCFA/litre (1.66 USD/L[2]), according to the MPE. As a comparison, in the third quarter of 2023, the average price of diesel in IEA member countries was 1.72 USD/L and the average price of premium unleaded gasoline was 1.84 USD/L.

The regulated price is composed of a capped import margin, a distribution margin, a retail margin and taxes. Through a cost socialisation mechanism, the state is increasing its revenues during periods of low crude oil prices and is able to maintain fixed prices for consumers when international crude oil prices are high.

Retail prices often do not cover the cost and may create budgetary deficits for the operators, which are reimbursed by the state with delays. In 2022, the global energy crisis and resulting oil price hikes have left many companies with huge budget constraints, as they could not cover the rising fuel costs. It was the case in the electricity sector for HFO.

Oil subsidies

In 2022, Senegal spent more than 4% of its annual GDP on energy subsidies. In 2023, subsidies for the electricity sector cost Senegal FCFA 280 billion (USD 460 million), while subsidies for petroleum products cost FCFA 525 billion (USD 860 million). In all, these subsidies cost FCFA 800 billion (USD 1 300 million) in 2023, almost 7% higher than in 2022 (FCFA 750 billion [USD 1 200 million]), reaching around 5% of GDP. The magnitude of the subsidies diverts funding from social expenses such as healthcare and education.

The government decided to gradually remove the price subsidies of electricity and petroleum products (diesel, gasoline and premium fuel) by 2025.

A six-step roadmap was published in January 2023 to guide the major subsidy reform:

- Phase 1 (January 2023): upward adjustment of energy prices (to reduce subsidy cost to 2.7% of GDP), while supporting vulnerable households. As for electricity, customers consuming less than 150 kWh benefit from a social tariff. Diesel and unleaded petrol prices increased by FCFA 100 each, with no social tariff, as the lower income segment of the population is considered not to own a car. Public transport and taxis received targeted subsidies.
- Phase 2 (by the end of 2023): Revision of the fuel price formula to reflect international prices. As for electricity, the subsidy phase-out will require structural changes and the government ordered a financial audit of Senelec.

[2] Conversion at 610 FCFA/USD in November 2023.

- Phase 3 (by the end of 2023): Stronger community-based targeting by moving more consumers to cash transfers for vulnerable households and by digitalising payments. This will ensure more secure and rapid payments.
- Phase 4 (by the first semester of 2024): Launch of a communication campaign to inform of the advantages of the reform, its progressive nature and fiscal costs.
- Phase 5 (by the end of the fiscal year 2024): Reduction of the subsidy cost to 1% of GDP. A new electricity tariff structure and a new oil fuels price mechanism will be in place, complemented by cash transfer mechanisms.
- Phase 6 (by 2025): Full elimination of the energy subsidies through price adjustment mechanisms, in line with international markets. Targeted cash transfers to vulnerable households will protect them from the impact of price fluctuations.

Assessment

The Sangomar oil field (formerly the SNE field) has crude oil resources (known as Sangomar crude) estimated at 630 mb, with Woodside targeting 230 mb reserves in their first phase of development. State-owned PETROSEN, in partnership with Woodside, began developing the field in 2020, with the aim of bringing it on stream by the end of 2023. Unforeseen delays have pushed the project start-date back to the second half of 2024. Senegal is currently working with oil multinationals to carry out exploration and production operations. In the future, Senegal also intends to acquire this technical expertise through PETROSEN.

Senegal now has sufficient natural resources to ensure its energy independence beginning in 2024 and is gradually modernising its legislative arsenal and oil facilities to enable it to better control and optimise the use of its oil resources. This commitment has been formalised as the first major guideline in the 2019-2023 LPDSE. The National Assembly has already enacted the Law on the Distribution and Management of Revenues from the Exploitation of Hydrocarbons. This Law provides for the revenue to be divided between the State Budget, the Stabilisation Fund and the Intergenerational Fund. A future opportunity could be to dedicate part of the oil and gas revenues to financing the energy transition in order to secure part of its financing. As set out in the LPDSE 2019-2023, a master plan for oil and gas was realised as well.

The Senegalese government has set itself an objective to be transparent in the management of national oil resources. The modernisation of its legislative texts systematically takes into account this obligation. Senegal has been a member of the Extractive Industries Transparency Initiative since 2013. The Initiative awards an international label to assess the level of transparency in the management of revenues from the extraction of a country's mining, gas and oil resources. The latest Extractive Industries Transparency Initiative assessment of Senegal in 2021 placed the hydrocarbons sector in the highest performance bracket for revenue collection and management mechanisms. To be even more effective, Senegal could facilitate the sharing of information on oil and gas resources in conjunction with the new Law on the Distribution and Management of Revenues from the Exploitation of Hydrocarbons.

Senegal revised its Petroleum Code in 2019, repealing the old Petroleum Code of 1998. The revision was accompanied by the creation of the COS-PETROGAZ, the MPE and the Technical Committee. These various legal bodies, including the CRSE, as well as the

National Hydrocarbons Committee, are responsible for managing and regulating the oil business from a legislative, technical and economic perspective. The multiplication of these entities, especially when their fields of competence are close, requires very good co-ordination to be able to function in an optimal way. Two decrees implementing the Petroleum Code have been adopted: decree 2020-2062 setting out the terms and conditions for applying the Code and decree 2023-2084 on the standard model for hydrocarbon production sharing contracts and association agreements.

Senegal's energy sovereignty requires it to secure its oil supplies using its own resources. To meet domestic demand, estimated at 2.6 Mt of oil products a year, Senegal will soon complete the modernisation of its only refinery, the SAR. The modernisation of the refinery will increase the country's annual production of refined products from 1.5 Mt to 3.5 Mt. Excess production will be exported. The refinery's compulsory technical shutdowns will be easily offset by imports of products that have already been refined.

Hydrocarbons are still the most widely used source of energy in Senegal. As such, projects aimed at improving the management and saving of hydrocarbon resources deserve to be given the same priority as other renewable energy projects.

Improving energy efficiency in the hydrocarbon sector, in particular, by adopting more stringent standards for vehicles at the regional level and continuing efforts to electrify the transport sector, will limit polluting emissions and thus improve air quality.

The regulator's (CRSE) remit now includes regulating the downstream oil and gas sector, supervising tenders in the energy sector, monitoring the market by regulating prices, and ensuring third-party access to networks. The price regulation mechanism, which guarantees affordable tariffs for the population, has a significant impact for the State Budget. The IEA encourages the Senegalese government to pursue its policy of gradually abolishing subsidies for petroleum products while maintaining a financial support system for the most vulnerable sections of the population.

Recommendations

- Facilitate the smooth distribution and utilisation of LPG widely across the country to favour its use for clean cooking and reduce the use of wood and charcoal, thus supporting the future transitions to natural gas or electricity for cooking in homes.
- Facilitate the sharing of information on oil and gas resources in connection with the Law No. 2022-09 of 19 April 2022 on the distribution and management of revenues from hydrocarbon production.
- Improve energy efficiency in the hydrocarbons sector, in particular, by adopting more stringent vehicle standards at the regional level and continuing efforts to electrify the transport sector.
- Continue the policy of gradually eliminating subsidies for petroleum products while maintaining support for the most vulnerable populations.

8. Natural gas

Key data (2021)

Natural gas production: 7.1 mcm; -85% since 2011

Share of natural gas: production 0.3%, electricity generation 0.4%, TES 0.1%

Source: IEA (2023), World Energy Balances

Overview

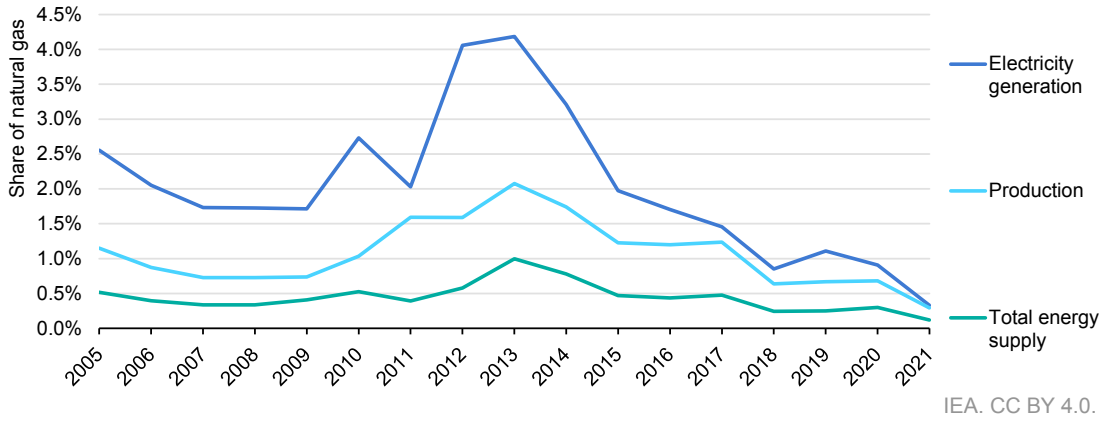
Today, natural gas plays a limited role in Senegal's energy system, but the country's discoveries since 2014 will allow it to considerably increase its gas production. Senegal plans to become a gas exporter by 2024 (the GTA LNG project encountered delays due to the Covid-19 pandemic), with the goal of serving the global market by shipping liquefied natural gas (LNG), as well as developing a strong internal market.

Natural gas production peaked in 2013 at 52 million cubic metres (mcm) per year (2.1% of total energy production) and started decreasing afterwards, reaching 0.3% in 2021 (Figure 8.1). The share of natural gas in Senegal's TES was 0.5% in 2005. It reached its peak at 1% in 2013, then decreased to 0.1% in 2021. In 2005, natural gas accounted for 2.5% of electricity generation in Senegal. The share peaked in 2013 at 4.2% and continuously dropped until 2021 (0.4%), except for a short increase in 2019 (1.0%).[1]

The government of Senegal has major plans to use natural gas to provide the country with domestic energy for power generation and industry, as well as to export LNG. Its gas-to-power strategy includes a 40% renewable target, but does not include a target for the share of gas, nor a plan to convert old oil-fired power stations to natural gas for the electricity sector.

[1] At a 75% load factor, a combined cycle gas turbine plant has an efficiency of 58%, and consumes 0.111 bcm of gas per year per 100 MW of capacity, according to international experience.

Figure 8.1 Shares of natural gas in Senegal's energy system, 2005-2021



Source: IEA (2023), World Energy Balances.

Gas supply, demand and trade

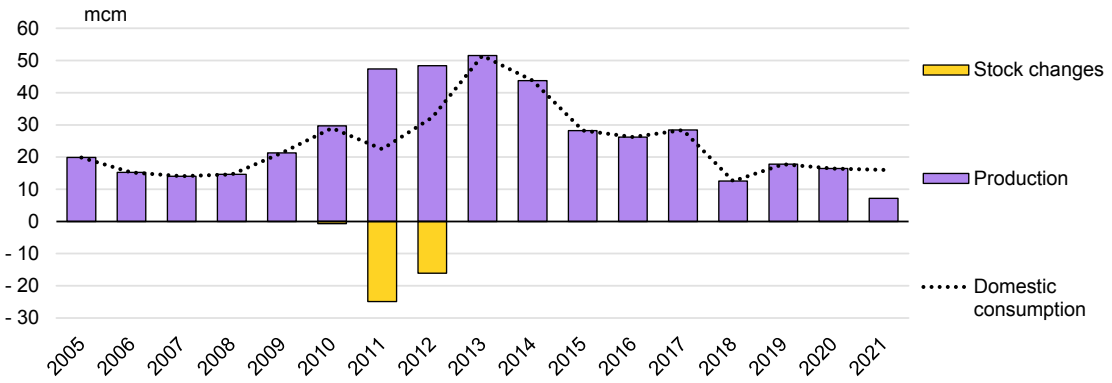
Gas reserves

The Greater Tortue Ahmeyim offshore project is expected to turn Senegal into an LNG exporter on a global gas scale. The gas fields were discovered in 2015 at a depth of 2 800 m below the surface of the ocean, on the maritime border between Senegal and Mauritania, so the project is shared between the two countries. In July 2021, the GTA project was granted the status of "national project of strategic importance" by the Presidents of Mauritania and Senegal. BP is leading the consortium, which includes the American oil company Kosmos Energy and Mauritanian (Société Mauritanienne des Hydrocarbures) and Senegalese (PETROSEN) companies. The gas reserves are estimated to range from 480 billion cubic metres (bcm) to 560 bcm. The consortium (PETROSEN, SMH, BP and Kosmos) took the final investment decision on Phase 1 of the project in December 2018 with a targeted production of 2.5 million tonnes per annum (mtpa) of LNG. The first phase of the GTA is expected to come on stream in 2024 and will export gas to a floating production, storage and offloading vessel approximately 40 km offshore, where the gas will be processed and liquids separated before exporting gas onward to floating LNG facilities 10 km offshore. Phase 1 is designed to operate for over 20 years, with the possibility of expansion. The project plans for a concept Phase 2 were announced in February 2023, with an agreement by the co-contractors to continue studies for a development based on a GBS (Gravity based structure) in concrete and a 2.5-3 mtpa additional production capacity. The final investment decision of Phase 2 is expected for 2025. Eventually, the field is expected to produce up to 10 mtpa.

Senegal's natural gas production fluctuated from 2005 to 2021. So far, the only gas-producing field is Gadiaga, operated by Africa Fortesa, despite consistently low production. The field is owned by PETROSEN (30%) and Africa Fortesa (70%). The gas is transported by pipeline to the main consumer (Sococim Industries, Senegal's largest cement producer). Production increased from 20 mcm in 2005 to peak at 52 mcm in 2013, and then decreased to the lowest point of 13 mcm in 2018 (Figure 8.2). In 2021, natural gas production was 16 mcm. Demand and supply for gas were not affected by the economic consequences of the Covid-19 pandemic in early 2020. Senegal does not import

natural gas, although an LNG import infrastructure, the FSRU KARMOL Powership Africa, has been in place since 2021 and is ready to be commissioned off the coast of Dakar

Figure 8.2 Natural gas supply by source in Senegal, 2005-2021

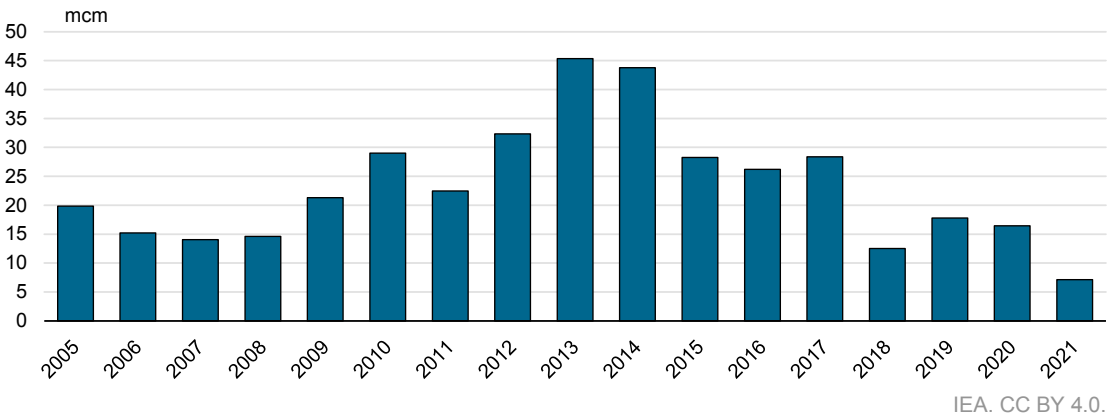


Source: IEA (2023), Natural Gas Information.

The domestic production of gas will come from the gas fields of GTA, Yakaar-Teranga and Sangomar. With the LNG production on GTA, the country is expected to be an exporter from 2024 onwards. Phase 1 of the development of the Sangomar project will target production of oil first and is scheduled to start mid-2024. The exploitation of natural gas from Sangomar is planned during the second phase of the project, for which the final investment decision has not yet been taken. The development of the national gas-to-domestic power Yakaar-Teranga project aims to supply the growing Senegalese market with domestic gas at a competitive cost, thereby guaranteeing the country's security of supply, and to generate revenue for the country through LNG exports. To date, no final investment decision has been taken. Following BP's announced withdrawal from the Yakaar-Teranga gas project in November 2023, Kosmos Energy now holds a 90% stake in the project, with PETROSEN holding the remaining 10%.

In 2021, Senegal's demand for natural gas came exclusively from electricity generation (Figure 8.3). Natural gas accounted for 0.4% of overall electricity generation in Senegal.

Figure 8.3 Natural gas demand in electricity generation in Senegal, 2005-2021



Source: IEA (2023), Natural Gas Information.

Natural gas consumption is so far inexistent in Senegal. With the upcoming production of the GTA and Yakaar-Teranga natural gas fields, gas is expected to be used for electricity production in the first stage and for public transport and industries in the short to medium term.

Table 8.1 shows the MPE's estimations for gas demand for power generation, industry/mining and transportation.

Table 8.1 Gas demand forecast for selected sectors in Senegal, 2030, 2040 and 2050

Horizon	2030	2040	2050
Gas-to-power – Base (bcm/year)	1.7	1.8	2.4
Industrial sector – Base (bcm/year)	0.3	0.7	1.4
Transportation – Base (bcm/year)	0.02	0.1	0.2
Total gas demand estimate (bcm/year)	**2.02**	**2.6**	**4**

Source: MPE (2023), Gas-to-Power Strategy.

The roll-out of natural gas to consumers is planned through the Senegalese gas network, which has yet to be developed. The natural gas sector should increase as a replacement to imported HFO, first in the gas-to-power, and then gas would become important under the gas-to-industry strategy. The variations in demand and seasonality expected for future natural gas uses will be similar to those observed today for HFO.

With the emergence of domestic oil and gas production, Senegal's energy supply and demand are evolving, with gas, as well as wind power and other renewable energy sources, playing an increasingly important role, as seen in the IEA's Senegal country-modelling in the 2022 Africa Energy Outlook.

Natural gas policy and regulation

The government of Senegal has major plans to develop natural gas to provide the country with domestic energy for power generation and industry, as well as to produce LNG in order to serve the global market.

In 2020, Senegal adopted a Gas Code (Law No. 2020-06) to keep attracting investments and ensure the development of a robust and efficient gas value chain. This Gas Code was created to provide a framework to regulate and oversee the midstream and downstream gas activities. The MPE is the authority responsible for implementing the policy defined by the Head of State (Article 4, Gas Code), including through the President's Strategic Orientation Committee for Oil and Gas (COS-PETROGAZ).

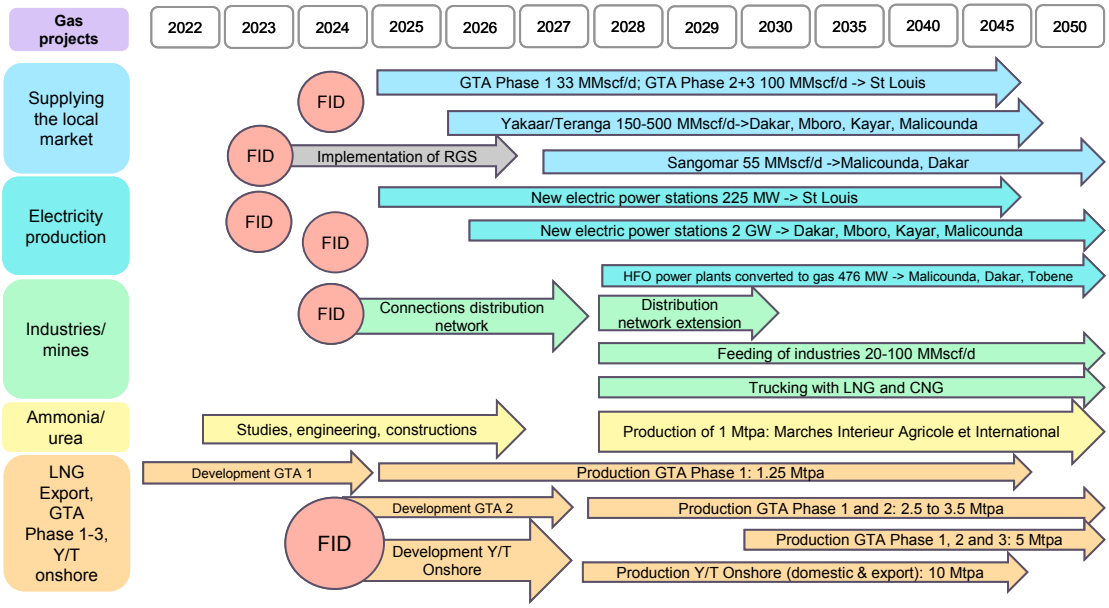
Key innovations introduced by the Code notably include third-party access to gas infrastructure; the establishment of a gas regulator to regulate and oversee the participation of the local and international private sector in gas operations; the protection of consumers' and operators' rights and interests; and the compliance with international quality norms in the areas of health, safety and environment.

Activities in the midstream and downstream segments of the oil and gas sector are subject to compliance with the rules set forth in the Law on Local Content in the Hydrocarbon Sector and its implementing decrees.

Senegal's gas network (*Réseau Gazier du Sénégal*) has been created as an empty shell and would be the transmission system operator in charge of developing, investing in and operating the gas transportation system.

The policy adopted by Senegal to produce electricity is as follows: all power plants must be dual fuel and have a back-up supplied with naphtha or HFO to ensure the operation of the power plants in case of an interruption of the gas supply. The foreseen route of the gas network passes through high demand areas (industries, power plants, cement factories, etc.), which makes the connection to the network easier.

Figure 8.4 Gas opportunities roadmap for Senegal, 2022-2050



Notes: Y/T = Yagaar/Teranga; FID = final investment decision; MMscf/d = million standard cubic feet per day; CNG = compressed natural gas; mtpa = million tonnes per year; RGS = Réseau Gazier Sénégalais.

Source: MPE 2023, as modified by the IEA.

Natural gas market structure

Natural gas infrastructure

To date, Senegal has an upstream natural gas pipeline network (54 km long in total length) which links the Gadiaga gas production site to the Cap des Biches area, via the SOCOCIM cement plant site, which is the principal consumer of the natural gas produced. This network is supported by the Kabor intermediate station, which has a natural gas buffer storage at SOCOCIM. This network is set to be developed as part of the Réseau Gazier du Sénégal (RGS) project, which aims to provide the country with modern gas transport and buffer storage infrastructure. Senegal's energy strategy is to divert the HFO-rich energy mix away from only fossil fuels and towards gas and renewables. Senegal has yet to develop its gas industry and related infrastructure.

Gas-to-power strategy and solutions

While awaiting the local gas production, the Government of Senegal had plans to import LNG as a bridging measure and convert all current heavy fuel plants to gas-to-power plants. Senegal's convertible production capacity is estimated at between 400 MW and 500 MW, which corresponds to the production capacity of one combined cycle gas turbine unit. The gas consumption of this power plant could be covered by 0.5-1.0 bcm per year, coming from either LNG or gas production from domestic fields.

For this purpose, in June 2021, the 125 470 m^3 floating storage and regasification unit KARMOL LNGT Powership Africa, owned by KARMOL, a joint venture between Karpowership and Mitsui OSK Lines, arrived at the port of Dakar. The vessel was supposed to be part of the country's first LNG-to-power project and to be connected through a natural gas pipeline to a 235 MW floating power plant, Karadeniz Powership Ayşegül Sultan, owned by Karpowership. The start of operations has been delayed due to the high spot LNG prices.

Gas pipelines development

With a total length of about 472 km, the cost of constructing the network is estimated at around USD 300 million and will be carried out in several successive phases. The United States Trade and Development Agency awarded a grant to Senegal's sovereign wealth fund, FONSIS, in September 2020 for a feasibility study for an onshore pipeline network to supply natural gas from Senegal's offshore gas fields to its power plants.

Gas infrastructure would be useful for the western part of Senegal, where most of the population lives.

Gas in industry

In addition, Senegal is interested in developing gas-based industries, such as urea, to increase productivity in the national agriculture sector.

Prices and taxation

Under the Gas Code adopted in 2020 (see above), the gas regulator is notably in charge of establishing pricing structures for gas, from its production until its distribution, based on a price ceiling principle. Ceiling prices for gas are set by order of the MPE in line with the state tariff rules to protect customers from price spikes on international gas markets and optimise the subsidies from the state.

Biogas

Sustainable feedstock in Africa is relatively important and would be sufficient to meet the needs of the 600 million people in sub-Saharan Africa who remain without access to electricity. There is also a considerable push to develop biogas for clean cooking to move away from the traditional use of biomass. The potential of biogas production in Senegal, is estimated at 400 000 biodigesters under the NDC. Production of biogas can reduce deforestation and indoor air pollution associated with fuelwood, as well as pollution of groundwater in rural areas of Senegal. To achieve this, Senegal has set up a National Biogas Programme (NBP) in 2009. The NBP has resulted in 2300 biodigesters being deployed by end of 2023. Three key projects are offering the scale-up the deployment in

the coming years under the collaboration with ID BIO.SA EKOTRA (Ivory Coast), Swiss partners KliK and OSSI YETO with a total investment envelope of CFA 91 billion (see also Chapter on Access to modern energy).

Some biogas projects have already started, such as the project launched in 2021 supported by the Swiss government to develop around 60 000 biodigesters in Senegal by 2030 The installations will be used to produce biogas from cattle dung and faecal sludge in rural areas.

In other African countries, such as Benin, Burkina Faso and Ethiopia, governments provide subsidies that can cover from half to all of the investment, while numerous projects promoted by non-governmental organisations provide practical know-how and subsidies to lower the net investment cost. In addition to these subsidies, credit facilities have made progress in a few countries, notably a recent lease-to-own arrangement in Kenya that financed almost half of the digester installations in 2018.

Assessment

Between 2014 and 2016, large quantities of offshore oil and gas were discovered in Senegal, attracting international oil companies. The country will become an oil and gas producer as soon as its resources begin to be exploited in 2024.

The GTA project is located on the boundary between Senegalese and Mauritanian waters, 125 km off the coast. The final investment decision for Phase 1 was taken in 2018. It will be operated by BP, which owns 56.29% of the project. The other shareholders are Kosmos Energy (26.71%), PETROSEN (10%) and the Mauritanian Société Mauritanienne des Hydrocarbures (7%).

GTA's natural gas resources are expected to be between 15 and 20 trillion cubic feet (TCF). The annual LNG production for Phase 1 is expected to produce 2.5 mtpA (or 3.4 bcm/year) over 20 years, i.e. around 50 Mt LNG over 20 years. The GTA project sta'eholders' objective is to achieve a total natural gas production for the domestic market of 10 mtpA (or 13.5 bcm/year) through additional phases 2 and 3. Operating revenues will be shared equally between Senegal and Mauritania. Natural gas production for the domestic market will be around 70 million standard cubic feet per day (to be shared equally between Senegal and Mauritania, i.e. 0.361 bcm/year each). Final investment decisions have not yet been taken for the subsequent phases.

The Yakaar-Teranga project aims to develop a conventional offshore natural gas field off the coast of Senegal. In November 2023, the consortium (BP, Kosmos Energy, PETROSEN) announced that BP would relinquish its rights and obligations in the licence, transferring its shares to Kosmos and PETROSEN. The new joint venture will be responsible for operations, particularly in terms of planning the development of the field in line with the natural gas-to-power strategy. The Yakaar-Teranga project aims to secure energy for Senegal with the development of the national gas-to-domestic power; it has not taken a final investment decision yet. In October 2023, BP pulled out of the project and is looking to divest its stake in the Yakaar-Teranga gas field offshore Senegal to Kosmos Energy, which would take a 90% stake.

The Sangomar oil field is 100% located in Senegalese waters. The Sangomar project, costing close to USD 5 billion, is 82% owned by the Australian group Woodside and 18%

by PETROSEN. The final investment decision for Phase 1 was taken in 2020. Phase 1 is scheduled to come on stream mid-2024 and will produce oil only, with all associated gas reinjected. Commercial exploitation of the natural gas will be examined in a dedicated project phase. In any case, gas reserves in this field are limited (2-5 TCF). Phase 2 is currently being discussed between Woodside, the Senegalese government and PETROSEN, with a view to supplying the domestic market and setting up an alternative infrastructure to transport the gas to the Senegalese coast.

The exploitation of oil and gas resources linked to the two GTA and Sangomar projects represents a source of revenue for the country, with tax revenues and royalties estimated at FCFA 20 000 billion (around USD 30 billion) over 30 years.

Natural gas production is primarily destined for international markets, but part of it will be shipped to Senegal for domestic use. Funding is being sought for the development of a gas transmission network under the responsibility of RGS (Réseau Gazier Sénégalais). This network will link the offshore gas production platforms to the mainland to supply Senegal with natural gas, mainly for power station projects and certain industrial projects. It will cover around 300 km, part of which will be offshore.

Senegal's electricity production is currently based mainly on the use of HFO. Senegal has major ambitions to use domestic gas resources to generate electricity through its "gas--to--power" strategy decided in 2018, which aims to reduce national energy dependence on oil and coal by incentivising investment in natural gas as a transitory fuel in the energy transition. Natural gas/LNG production projects will soon come on stream.

Senegal's natural gas resources make it possible to develop industrial projects (petrochemicals and fertilisers) under economically competitive conditions.

In terms of logistics, the lack of existing midstream transport infrastructure to allow domestic access to gas is an issue. The regulatory framework and feasibility and environmental studies are well advanced, but financing remains a stumbling block. Natural gas is also a good ally of renewable energies, particularly when it comes to managing intermittency.

In Europe, gas networks were initially built and financed under long-term contracts before the market was regulated and opened to competition. The situation in Senegal is different: the infrastructure has yet to be developed and financed. It is, therefore, important to continue to put in place an appropriate regulatory framework upstream. The aim is for regulation to be ready and operational when the gas infrastructure has been developed.

The Senegalese government should ensure that companies develop these upstream projects in compliance with international standards on methane emissions, which will be introduced in the new Environmental Code.

Recommendations

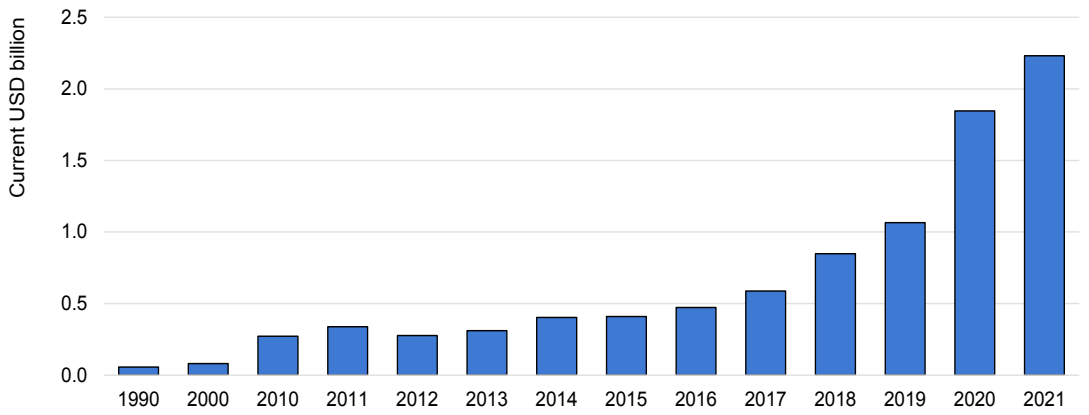
- Define a roadmap for the interaction between the Just Energy Transition Partnership's efforts to promote renewable energies and the development of Senegalese gas in terms of whether the gas will be used domestically or exported. This roadmap should include penetration targets for both renewables and natural gas in the energy mix at defined dates.
- Define an action plan to attract investment in the midstream with a view to linking upstream resources and power plants to ensure the success of the "gas-to-power" strategy, as well as certain potential industrial users (petrochemicals and fertilisers). Explore the feasibility of partnering with an existing midstreamer to ensure faster, more efficient transfer of knowledge and experience.
- Adopt standards for methane emissions following the commitments made at COP26.

9. Energy investment and financing

Overview of the investment climate

Senegal has undergone various reforms over recent years to attract foreign direct investments, encourage higher levels of private sector participation across the economy and increase investments diversification. Foreign direct investment net inflows to Senegal reached USD 2.2 billion in 2021, a 21% annual compounded increase from 2010 levels and almost 30 times higher than the value in 2000 (Figure 9.1). Foreign direct investment inflows started to accelerate considerably in the mid-2010s as a result of the PSE, the government's strategic roadmap developed in 2012 to put Senegal on track to become an emerging economy by 2035. The PSE is based on three axes: 1) accelerating and ensuring inclusive growth (doubling growth from around 3-4% in 2014 to 7-8% in 2023); 2) human development; and 3) good governance.

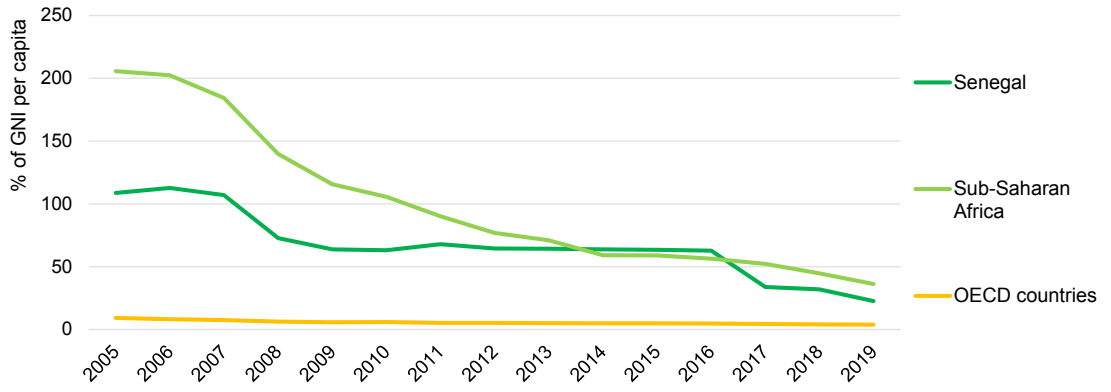
Figure 9.1 Net inflows of foreign direct investment in Senegal, 1990, 2000, 2010-2021



Source: IEA analysis based on World Bank (2021), Foreign direct investment, net inflows (BoP, current USD) – Senegal.

Various flagship projects have been built under the PSE, along with measures to improve the business environment and facilitate businesses, including much more digitalisation (e.g. introducing a one-stop shop or *guichet unique* to help investors). These reforms have translated into lower costs for starting a business, as well as faster ways of doing so. Tax procedures, like tax declarations, have also been simplified, making the investment ecosystem more attractive for both domestic and international investors.

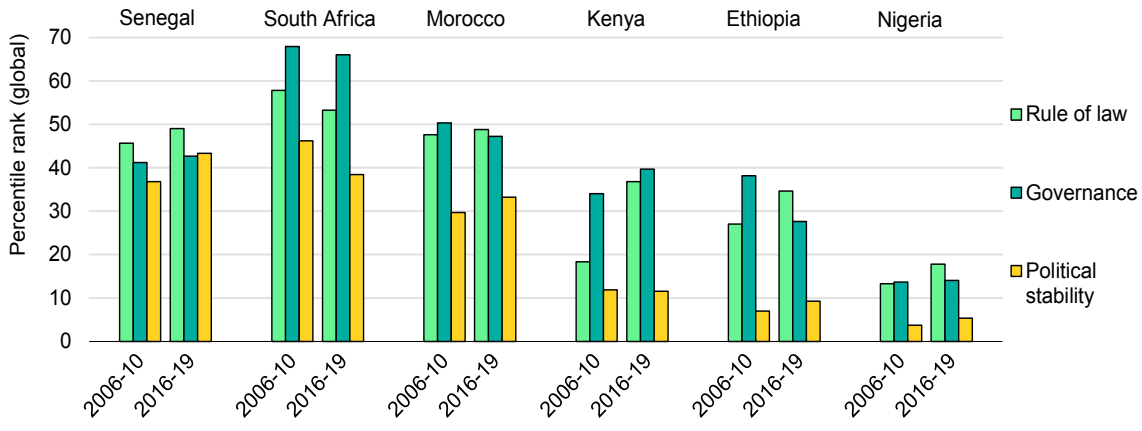
Figure 9.2 Cost of starting a business in Senegal, sub-Saharan Africa and OECD countries, 2005-2019



Note: OECD = Organisation for Economic Co-operation and Development, GNI = Gross national income.
Source: IEA analysis based on World Bank - Data Bank (2023), World Development Indicators 2023.

Senegal also performs better compared to other West African countries as well as sub-Saharan Africa in general, in both economic and development indicators. For example, Senegal's GDP per capita growth has consistently outperformed average per capita growth in sub-Saharan Africa, with a 4.3% average growth between 2015 and 2022 compared to 1.2% for the region. Senegal also scores relatively well in terms of governance factors – such as political stability, rule of law and government effectiveness – all of which have important implications for investors' and financiers' risk perceptions and, ultimately, investment (Figure 9.3). However, African countries, as well as most of the emerging and developing world, generally do not perform as well as advanced economies in these institutional matters.

Figure 9.3. Evolution of governance indicators for selected emerging market and developing economies, 2006-2010 and 2016-2019



Note: A higher percentile means the governance indicator is better ranked.
Source: IEA analysis based on World Bank (2021) and methodology by Kaufmann (2010).

Box 9.1 Key issues for financing clean energy in Africa

To secure financing for clean energy in Africa, the IEA estimates that over USD 200 billion is needed annually by 2030 under the Sustainable Africa Scenario, more than double the level of investment today. Clean energy will account for over two-thirds of energy investment across the region by 2030 and private investment for over half of all investment. The cost of capital in African countries is often more than two to three times higher than in North America or Europe. Under the Sustainable Africa Scenario, concessional funds to support private mobilisation will increase tenfold to USD 28 billion by 2030. This does not include concessional funds to support public sector financing or for the broader enabling environment. It is not just the amount of capital that increases under the Sustainable Africa Scenario, but also the role of that capital. The mobilisation of private capital becomes a key focus area for concessional funds. Concessional finance providers are able to draw on a range of evolving credit enhancements and derisking mechanisms, such as guarantees and insurance, risk sharing and pooling products, liquidity support, and currency hedging.

Source: IEA (2023), Financing Clean Energy in Africa: World Energy Outlook Special Report.

Energy investment and financing

Major energy investment in Senegal

In the power sector, Senegal has a vertically integrated state-owned utility (Senelec) with private sector participation in generation and a single-buyer model. Private participation is also allowed in distribution for electricity access purposes through concessions (as described in more detail in the access section).

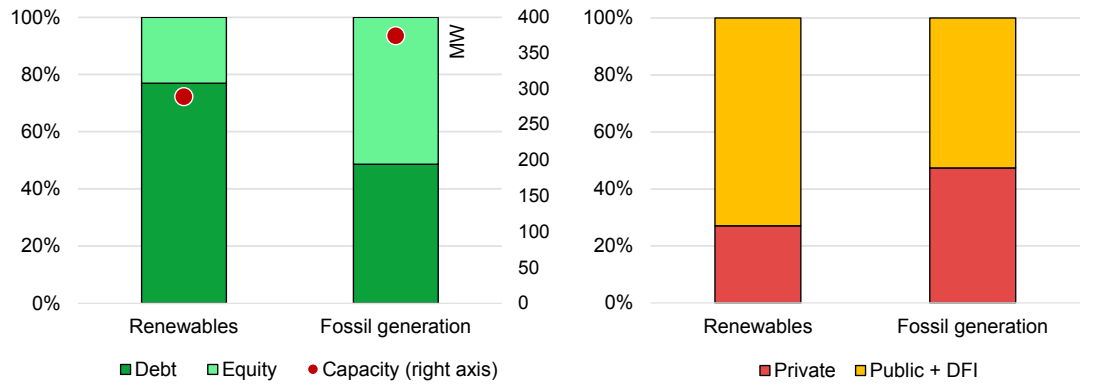
Senegal has mobilised over USD 1 billion to IPP projects over the last decade, to more than ten IPPs. Around 375 MW of fossil fuel-based IPPs reached financial close between 2014 and 2022 in Senegal, and around 310 MW of renewables (160 MW of wind and 150 MW of solar PV). The large majority of the capital provided for these projects came from international institutions and over 60% was from development finance institutions (DFIs) and in the form of debt.

Wind and solar PV projects required a higher degree of DFI support, compared to fossil fuel power IPPs given these were the first projects of the kind in Senegal and the sector was still under development. For instance, the first solar PV projects to reach financial close were the Bokhol (20 MW) and the Ten Merina (30 MW) solar PV plants, in 2016. The first wind project was the Taiba N'Diaye IPP, a 159 MW plant that reached financial close in 2018. Competitive tendering for solar PV plants started with the introduction of the Scaling Solar Programme, an initiative of the World Bank Group that aims to help governments procure and develop utility-scale solar IPPs. Scaling Solar provides a package of technical assistance, support with standardised power purchase agreements, pre-approved financing, and blended finance instruments like guarantees or insurance.

Two solar projects were awarded under Scaling Solar – Kahone Solaire (35 MW) and Kael Solaire (25 MW) – at a tariff below 0.04 EUR/kWh, one of the lowest levels achieved by a solar IPP in sub-Saharan Africa. The equity providers of these two 25-year contract agreements were the France-based investment fund Meridiam (40%), the French energy

company ENGIE (40%) and the Senegalese sovereign wealth fund FONSIS (20%). Scaling Solar provided land, helped with drafting the contract and permitting. The International Finance Corporation (the private arm of the World Bank Group), along with other DFIs, provided blended finance. The financing package included EUR 38 million low-cost debt in the domestic currency FCFA and a EUR 6.9 million 15-year guarantee for non-commercial risks.

Figure 9.4 Financing sources for independent power producers in Senegal by type and capacity, 2014-2022



Notes: DFI = development finance institution. Based on 12 public-private power projects that reached financial close in Senegal between 2014 and 2022.

Source: IEA analysis based on World Bank Group (2022), Private Participation in Infrastructure database.

Major developments have also taken place on the energy supply side, with important gas discoveries over the last years – along with the bordering Mauritania. Senegal was not a fossil fuel producer, "but the major gas discoveries are expected to change the picture and to lead to gas production of 9.5 bcm in 2040", according to the 2019 Africa Economic Outlook. The UK energy company BP (60%), together with Kosmos Energy (30%), and the national oil companies of Senegal and Mauritania – PETROSEN (5%) and Société Mauritanienne des Hydrocarbures (5%) – are currently finalising the first phase of the GTA field, a project valued at around USD 4.8 billion. The natural gas project will be used for domestic purposes as well as for exports. The final investment decision for Phase 1 was announced in December 2018. The gas, produced in deep waters, will be transported to an inshore terminal via a pipeline, which includes a USD 1.3 billion floating liquefied natural gas facility (also under construction). According to the President of Senegal, Phase 2 of GTA could require around USD 5 billion in investment.

A second natural gas project, Yakaar/Teranga, managed by Kosmos Energy (90%) and PETROSEN (10%) after the exit of BP, is currently under development and its final investment decision is expected by late 2023 and production by 2025-26.

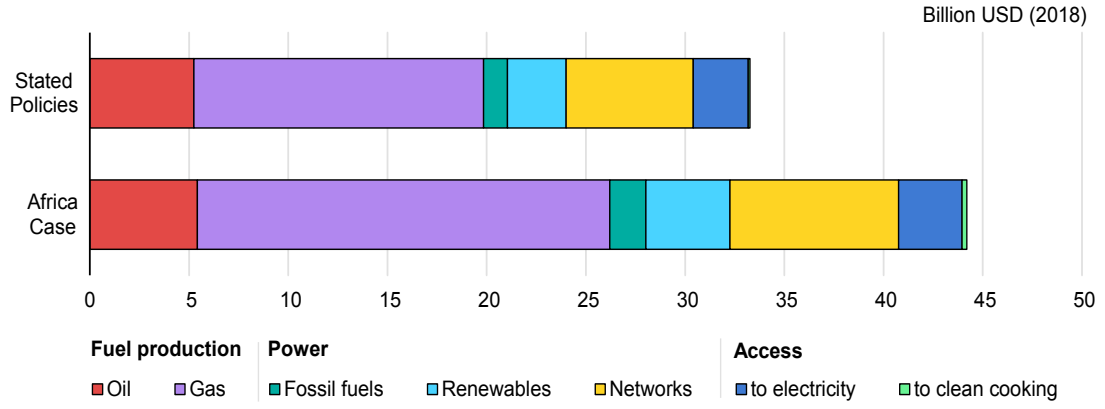
A third project, Sangomar, a field containing both oil and gas, is also set to start production in the second part of 2024. Sangomar is majority-owned by the Australian company Woodside (82%), partnering with PETROSEN. This project reached final investment decision in 2020 and is expected to cost around USD 4.5 billion and start producing in 2024.

Investment needs

Electricity demand is expected to grow in Senegal in the coming years as the country becomes wealthier and more households consume more electricity, car ownership increases, and commercial and industrial groups require more energy. As domestic oil and natural gas production emerges, Senegal's energy supply is also expected to shift, with gas playing an increasingly important role and investments in renewables bringing more diversification – as can be observed in the IEA's Senegal country-modelling in the 2019 *Africa Energy Outlook* (Figure 9.5).

This rump up of demand and domestic supply requires important investments. The 2019 *Africa Energy Outlook* estimated that cumulative energy investment needs would amount to USD 33 billion through to 2040 in the IEA's Stated Policies Scenario, with most of the investment required to unlock the potential for gas, expand electricity grids and improve electricity access. The Africa Case – a scenario developed for the 2019 *Africa Energy Outlook* that assumed high growth and high productivity in Africa – showed a level of cumulative investment to 2040 in Senegal around a third higher than that of the Stated Policies Scenario, with even more prominence of gas and renewables in power.

Figure 9.5 Cumulative investment needs scenarios in Senegal, 2019-2040



Source: IEA (2019), Senegal Energy Outlook, part of Africa Energy Outlook 2019.

Assessment

Reforms to attract private capital have produced tangible results in Senegal, such as reducing the cost of setting up a business and speeding up procedures. Tax procedures and declarations have also been simplified, making the general business environment more attractive to investors. Senegal is also among the best performers in terms of economic, development and governance indicators in the subregion of West Africa, all of which have important implications for risk assessment by investors and financiers. Senegal's respect for democratic institutions is also an example in the region, with numerous transfers of power between different parties and free elections.

This context, combined with an improved policy and regulatory framework, has enabled considerable investment in the energy sector. In the power sector, over USD 1 billion has been raised for more than ten IPP projects in the last decade. Major investment decisions

have also been taken in the upstream sector, including two projects for around USD 10 billion in total, and new projects are expected.

Despite the progress, though, investment needs remain high and much more capital is needed in the coming years to achieve Senegal's economic and climate ambitions. With the emergence of domestic gas production, Senegal's energy supply is set to evolve, with gas playing an increasingly important role in the electricity sector, helping to reduce generation costs while cutting emissions. On the power side, for example, the Senegalese government aims to replace oil with domestic gas while maintaining a level of around 30% of its installed capacity coming from renewables. Investment plans include projects to improve PETROSEN's refinancing capacity, building the gas pipeline to connect the domestic gas upstream with the gas-fired plants, as well as the next phases of gas projects (e.g. GTA 2). Electricity demand is also expected to grow as the country becomes wealthier and households and industries consume more power.

However, there are still various challenges to scaling up energy investment. The lack of a visible and comprehensive pipeline of energy projects could prevent Senegal from realising the required investment needs and the goal of reducing energy costs while abating emissions. For example, the midstream gas infrastructure is still under discussion, and it is unclear how much it will cost, who will finance it and when it will be ready. A least-cost power expansion plan is under development, an exercise that will be appreciated by investors and financiers, though it is yet to be published. The government of Senegal, together with international development partners, announced Senegal's JETP in June 2023, which aims to strengthen the deployment of renewables as part of this integrated electricity plan. One of the JETP's objectives is to increase the share of installed renewable power capacity to 40% by 2030. The partnership also includes the commitment by international institutions and DFIs to mobilise EUR 2.5 billion in new and additional funds starting in 2023 and following the next three to five years. A successful implementation of the JETP will be critical to provide a long-term policy signal to investors. The JETP also confirmed the importance of Senegal's gas production opportunities and the role of gas in Senegal's energy transition.

While public financing will continue to play an important role, closing the investment gap will require a much greater role for private financing. Efforts are needed to attract both equity and debt, as different energy projects require different capital structures, e.g. renewable projects are more capital-intensive and more reliant on debt, while upstream oil and gas projects are generally more equity-heavy. Attracting this wide pool of sources of finance will require different strategies and a comprehensive effort to reduce perceived risks.

Currently, though, the availability and cost of finance remain a major challenge. Access to finance is more available for renewable projects than for gas-related projects, though mostly from international banks or foreign financial institutions. The level of development of Senegal's domestic financing sector is still low and access to long-term finance for new greenfield projects is constrained (it is hard to get low-cost debt in the local market, especially loans with long maturities). Despite the country's success at attracting capital to renewable power IPPs, investors and financiers also worry about payment delays (which affect project cash flows negatively), a key impediment to reaching lower levels of cost of capital.

Senegal's sovereign risk is lower than that of other African countries, and especially in West Africa, with investors highlighting the country's economic and political stability as an asset. However, there are still risks to be managed on top of payment concerns, such as the risk of integrating renewable energies into the electricity grid, the land risk and changes in regulations.

On the contrary, finance for gas projects – whether in the power sector or midstream – is harder to obtain. DFIs are no longer supporting gas-related projects and commercial investors do not find the risk-adjusted returns of some of these investments attractive (e.g. regulated assets like pipeline gas). RGS, for example, is still looking for capital to finance the gas network.

Financing electricity access also presents unique challenges. Senegal has made impressive progress in extending the electricity network and has high ambitions in the short term, but associated risks remain high and private companies still struggle to make ends meet. Revenue uncertainty is still a major challenge for mini-grids companies, for example, as customers have low and unpredictable income and subsidies are uncertain. The lack of clarity about what happens when the grid arrives (i.e. how are mini-grids compensated) is another major challenge for off-grid systems operators.

Recommendations

- Intensify efforts to attract a diversified set of financial resources in a co-ordinated manner by developing a plan for long-term investments accompanied by a communication strategy.
- Continue to work with donors to increase the availability of concessional funds, reduce the cost of capital on energy transition projects and facilitate financing by local banks.
- Attract additional, lower cost financing for gas-to-power projects while prioritising investment in gas infrastructure.

ANNEX A: Review team and supporting stakeholders

Review team and preparation of the report

The review visit took place from 8 May to 15 May 2023 in Dakar. The review team met with government officials, energy suppliers, market participants, public and private sector interest groups, consumer associations, research institutions, and other organisations and stakeholders.

The report was drafted on the basis of the information obtained during these meetings, the team's preliminary assessment of Senegal's energy policy, the Senegalese government's response to the IEA energy policy questionnaire, and information on subsequent policy developments from the government and private sector sources. The members of the team were:

IEA member countries

Didier Houssin, former IEA Director for Sustainability, Technology and Outlooks (team leader)

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Ibrahima Dabo, Institut de la Francophonie

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The review team expresses its gratitude to the Ministry of Petroleum and Energies, in particular Fatou Thiam Sow, Director of planning, studies and energy information systems, and Papa Samba Ba, Director of Hydrocarbons, for their tireless efforts in co-ordinating the review visit, providing invaluable knowledge and insights, prompt responses to all of the team's requests, and patience throughout the weeks leading up to and during the review. The review team extends its warm thanks to the Ministry for the effective management and co-ordination of the review, notably the peer expert visit, the tireless efforts and professional support at all times, and prompt responses to the requests throughout the review process.

Sylvia Elisabeth Beyer and Rita Madeira managed the review and designed the report. Sylvia Elisabeth Beyer is the lead author of the report. Rita Madeira wrote chapter 3 with contributions from Gaia Guadagnini, Carole Etienne wrote chapter 8, Lucila Arboleya Sarazola wrote chapter 9 and Anders Caratozzolo contributed to chapter 7. Zakia Adam and Fabian Burkard from the Energy Data Centre led the energy data and statistics part of the review.

The following IEA staff provided insights and expert comments, chapter reviews and helpful updates: Gianluca Tonolo, Jacob Messing, Joel Couse, Arnaud Rouget, Nouhoun Diarra, Sanne Van der Mijl, Trevor Criswell, Rena Kuwahata, Conor Gask, Blandine Barreau and Tanguy de Bienassis.

Special thanks to the IEA Secretariat with regard to the data, publication and editing. Alessio Scanziani and Anders Caratozzolo designed and prepared the energy data sections of the report, dedicated analysis, figures and tables, supported by Ismail Aykin, Gaia Guadagnini, Han Young Chang, Eloi Borgne, Edoardo Campo Lobato and Stella Jun. Fabian Burkard, Zakia Adam, Gianluca Tonolo, Pouya Taghavi-Moharamli and Arnau Risquez-Martin provided support on statistics and data. Isabelle Nonain-Semelin managed the editing process and Astrid Dumond the production process. Clara Vallois managed the translation process. Jennifer Allain edited the report. Eléonore Carré prepared the maps. Daria Ostaptschuk and Nicolette Groot supported the organisation of the energy review team visit.

Organisations visited

Agency for the Energy Savings and Management (Agence pour les Économies d'Énergies et la Maîtrise de l'Énergie, AEME)

Commission for the Regulation of the Energy Sector (Commission de Régulation du Secteur de l'Énergie, CRSE)

COS-PETROGAZ

Ministry of Finance and Budget (Ministère des Finances et du Budget)

Priority Investment Guarantee Fund (Fonds de Garantie des Investissements Prioritaires, FONGIP)'Centre d'Études et de Recherches sur les Énergies Renouvelables (CERER)

ENDA Énergie

Natural Governance Resource Institute

Heinrich Böll Foundation

Action pour la Justice Environnementale (AJE)

Oxfam

Organisation pour la Mise en Valeur du Fleuve Gambie (OMVG)

Agence Sénégalaise pour la Promo'ion de l'Investissement (APIX)

Ministry of Petroleum and Energy (MPE)

Ministry of Environment, Sustainable Development and Ecological Transition (Ministère de l'Environnement, du Développement Durable et de la Transition Ecologique, MEDDTE)

Ministry of Urban Development and Buildings (Ministère de l'Urbanisme et du Logement)

Ministry of Transport (Ministère des Transports)

Ministry of Industry, Research and Development (Ministère de l'Industrie Recherche et développement)

National Electricity Company of Senegal (Société Nationale d'Électricité du Sénégal, Senelec)

National Agency for Renewable Energies (Agence Nationale des Énergies Renouvelables, ANER)

Senegalese Rural Electrification Agency (Agence Sénégalaise pour l'Électrification Rurale, ASER)

African Refining Company (SAR)

PETROSEN

Off grid Europe

BBOXX

Baobab+

BP

Kosmos Energy

Vivo Energy

Engie

Lekela

Wärtsilä

Innovent

Eurocham

Meridiam

International Finance Corporation (IFC)

World Bank (Banque Mondiale)

African Development Bank (AfDB)

Global Green Growth Institute (GGGI)

Agence Francaise du Development (AFD)

Kreditanstalt fuer Wiederaufbau (KfW)

GIZ

European Union Delegation to Senegal

JICA

USAID

ANNEX B: List of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

AC	Alternating current
CCS	carbon capture and storage
CCUS	carbon capture, utilisation and storage
COP	Conference of the Parties
DSO	distribution system operator
DFI	development finance institution
ESCO	energy service company
EPC	energy performance certificate
ETS	Emissions Trading System
EU	European Union
EUR	euro
EV	electric vehicle
ECOWAS	Economic Community of West Africa
FCFA	Franc Communauté Financière Africaine
GDP	gross domestic product
GHG	greenhouse gas
HFO	heavy fuel oil
IEA	International Energy Agency
IPP	independent power producer
LED	light-emitting diode
LPG	Liquefied petroleum gas
LULUCF	land-use, land use change and forestry
OECD	Organisation for Economic Co-operation and Development
PPA	power purchase agreement
PSO	public service obligation
PV	photovoltaics
R&D	research and development
RD&D	research, development and demonstration
RD&I	research, innovation and development
SME	small and medium-sized enterprise
SSA	Sub-Saharan Africa
TES	total energy supply

TFEC	total final energy consumption
TRL	technology readiness level
TSO	transmission system operator
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar
WAEMU	West African Economic and Monetary Union
WAPP	West African Power Pool

Units of measurement

bcm	billion cubic metres
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
g CO_2-eq	gramme of carbon dioxide equivalent
GJ	gigajoule
Gt CO_2	gigatonne of carbon dioxide
GW	gigawatt
kb/d	thousand barrels per day
kg CO_2-eq	kilogramme of carbon dioxide equivalent
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
L	litre
MJ	megajoule
Mt	million tonnes
Mt CO_2	million tonnes carbon dioxide
Mt CO_2-eq	million tonnes carbon dioxide equivalent
MW	megawatt
MWh	megawatt hour
PJ	petajoule
t CO_2	tonne of carbon dioxide
TWh	terawatt hour

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Government action plays a pivotal role in ensuring secure and sustainable energy transitions and combatting the climate crisis. Energy policy is critical not just for the energy sector but also for meeting environmental, economic and social goals. Governments need to respond to their country's specific needs, adapt to regional contexts and help address global challenges. In this context, the International Energy Agency (IEA) conducts Energy Policy Reviews to support governments in developing more impactful energy and climate policies.

This *Energy Policy Review* was prepared in partnership between the Government of Senegal and the IEA. It draws on the IEA's extensive knowledge and the inputs of expert peers from IEA member countries to assess Senegal's most pressing energy sector challenges and provide recommendations on how to address them, backed by international best practices. The report also highlights areas where Senegal's leadership can serve as an example in promoting secure clean energy transitions. It also promotes the exchange of best practices among countries to foster learning, build consensus and strengthen political will for a sustainable and affordable clean energy future.

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