

Senegal's Gas-to-Power Ambitions: Securing Scale and Sustainability

PAPA DAOUDA DIENE, THOMAS SCURFIELD, AARON SAYNE AND JESSICA OBEID

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Key messages

- Senegal will benefit from generating electricity from some of its gas, but authorities should carefully consider the scale of the country's "gas-to-power" ambitions and how they relate to its renewable energy plans. This is a pivotal moment for achieving the government's energy and sustainable development objectives.
- Recent plans to develop over 3 gigawatts (GW) of gas-to-power capacity by 2050 may face obstacles. Senegal may not be able to extract enough gas to feed the power plants; it may also struggle to raise sufficient funds (at least USD 2.2 billion) to build the necessary infrastructure.
- A more balanced energy mix, with a stronger emphasis on renewables alongside gas, offers Senegal a more secure pathway, but necessitates a cohesive long-term strategy and international support.
- Senegal's participation in a Just Energy Transition Partnership (JETP) has led to increased medium-term renewable power generation goals—possibly to around 1 GW by 2030. To help the country reach them, Senegal's development partners must deliver the promised financial and technical support.
- But if Senegal realizes only those plans that are published, gas will comprise 75 percent of installed capacity in the long term. The absence of a long-term plan for renewables could lock the country into this large role for gas, inhibiting the intended catalytic effect of the JETP and preventing the government from fully leveraging the country's solar and wind potential.
- A more transparent and inclusive approach will help Senegal's government to refine and implement its energy plans, helping to manage public expectations, foster public trust and increase credibility with investors.

Summary

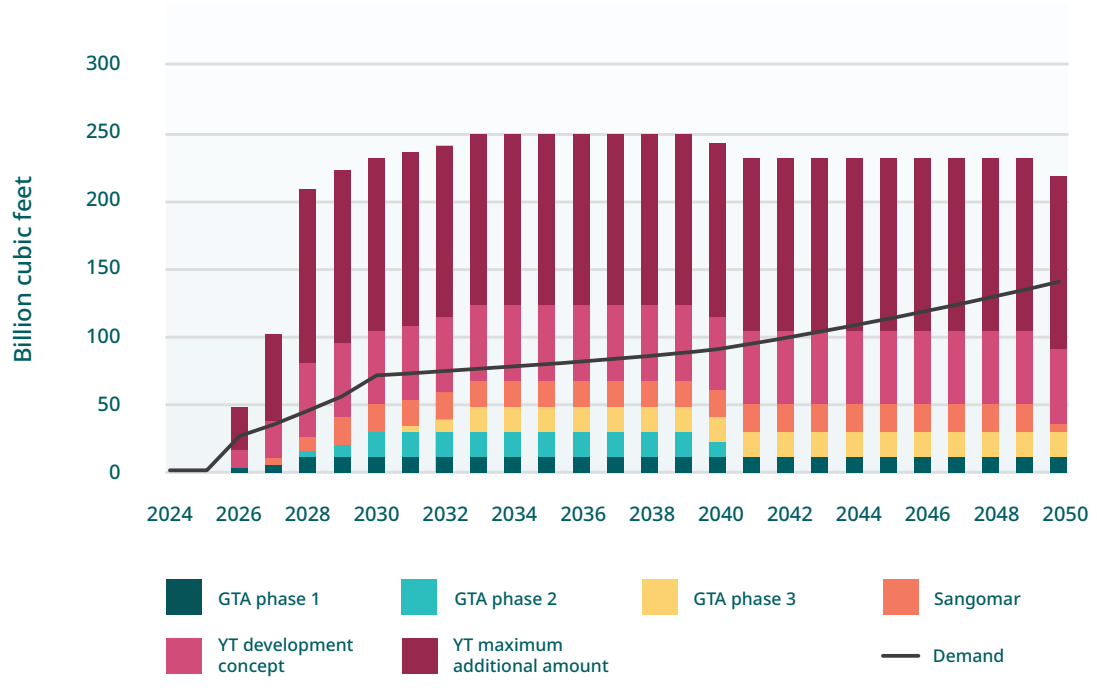
Senegal has undergone an important political evolution with the recent elections and peaceful transition of power. Yet certain priorities remain consistent for the Senegalese government and population, including increasing the supply and affordability of energy. Achieving this is essential to addressing lingering energy poverty in the country and driving further economic development.

Following significant gas discoveries, and with the ongoing development of several gas projects, many Senegalese expect that domestic use of gas will be the answer to Senegal's energy needs.

While gas will have an important role, including in directly increasing power generation, the size of gas-to-power plans and their interplay with renewables plans will be a critical determinant of whether the government achieves its energy and sustainable development goals.

The government risks falling short of its goals if it (a) pursues as large an expansion of gas-to-power capacity as envisaged in recent plans and (b) underestimates the role that renewables could play in the country's future energy mix.

Gas demand and domestic supply based on government expectations[1]



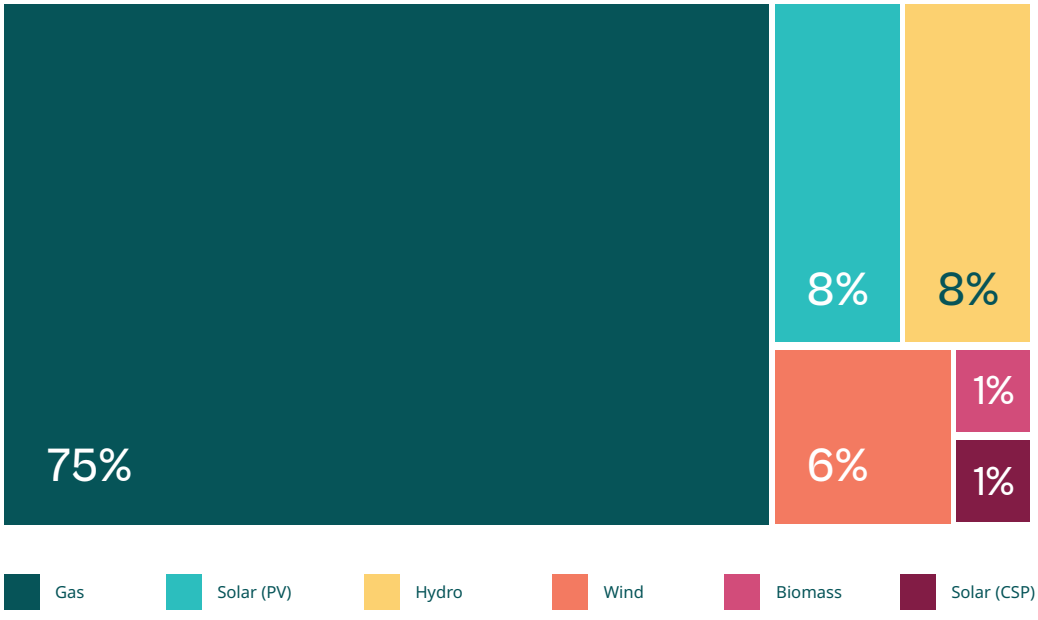
The most recent government plans, as set out in a policy review undertaken by the International Energy Agency (IEA) in collaboration with the Senegalese government, envision developing gas-to-power capacity of more than 3 gigawatts (GW) (through converting existing thermal plants and building new ones). However, the government may struggle to implement this plan. It faces risks of a gas shortage and a shortage of funding to build the necessary infrastructure.

Our modeling suggests that while the amount of domestic supply currently envisaged by the government is sufficient to meet expected demand, it may ultimately prove lower and slower to materialize than the government expects. The Yakaar-Teranga project is particularly critical for supply. Yet a range of factors increase the uncertainty around the project's development and design. These include BP's exit from the project, the impending audit of the petroleum sector promised by the new administration that may prompt contract renegotiations, and the global energy transition.

The government might also face a funding shortage. In addition to its plans to increase investment of public money in upstream projects such as Yakaar-Teranga, we estimate that it might need to find at least USD 2.2 billion to construct the planned pipelines and power plants. But the pool of financing available for gas-to-power infrastructure is shrinking given global climate concerns and associated pressure on financiers. The reduction in international public finance is a particularly significant challenge given its role in derisking projects for private capital.

In contrast to the government's plans for gas, plans for renewables are unclear. The aim of Senegal's recently announced Just Energy Transition Partnership (JETP) is to increase the share of renewables to 40 percent of installed capacity by 2030—possibly to around 1 GW. However, current plans do not indicate any additional renewables capacity in the longer term (beyond 2030) despite the catalytic impact that the JETP should have on this potential.

Senegal's power mix in 2050 if only plans in IEA policy review realized [2]



If that remains the case and the plans detailed in the IEA policy review are the only ones realized, even if Senegal does reach the JETP target of 40 percent renewables by 2030, gas will increasingly dominate the mix in the long term.

A larger role for renewables alongside gas could offer a less risky pathway to achieving Senegal's energy goals as well as other benefits, such as freeing up gas for non-power uses. The lack of detail on renewables plans may reflect the fact that the government is in the process of developing the JETP investment plan. Officials also might worry that the JETP financing will not materialize.

Nevertheless, as the government is making decisions on the gas sector now, a full accounting of the interplay between gas and renewables cannot wait. Otherwise the government risks locking Senegal into using large quantities of gas far into the future. Any delay will inhibit the catalytic impact of the JETP on longer-term renewables prospects and thereby prevent the country from benefiting as renewables become increasingly cheaper and more secure than gas.

This more balanced approach will still likely require a significant expansion of gas-to-power capacity from today's levels, and Senegal's international development partners should recognize this by providing necessary financial and technical support. However, the government should right-size this expansion. It should use gas as a complement to renewables by employing gas as a "peaker" as much as possible. To achieve this, the government must make careful choices about gas plant technology and carefully negotiate gas purchases and gas power plant contracts.

Pursuing a pathway with a larger role for renewables is not without its own challenges given their higher upfront costs and the need for grid investments to address intermittency. We estimate that the additional 346 MW renewables capacity required to reach 1 GW by 2030 could cost around $920 million (exclusive of any necessary grid upgrades, flexibility systems, and energy storage capacity).

Senegal's international development partners must deliver on their JETP promises in the near term, including by bringing down high financing costs and making riskier investments in hard-to-finance projects. They must also provide more money in the longer term. Rich countries must reverse their dismal records on meeting their climate finance commitments.

At the same time, Senegal's government must create a stronger enabling environment for both gas-to-power and renewables investments. It should produce a credible long-term strategy on power sector development that provides clarity to relevant stakeholders, including investors. It should also resolve the overlapping responsibilities between institutions and provide more clarity on the processes and procedures for making key regulatory decisions.

Building more public consensus and trust will support the credibility of this long-term planning and the stability of the regulatory framework. Given high public expectations of the transformative impact of gas-to-power, greater public awareness of the various opportunities, risks and trade-offs could change the narrative and allow for the new administration to adapt the energy strategy as appropriate. The new president's commitment to transparent governance bodes well in this regard,[3] paving the way for Senegal's new administration to refine and implement its energy plans with greater transparency and inclusivity than past administrations.

The above actions will give Senegal a better chance of achieving the energy future that the government's strategy is striving for.

Introduction

Despite Senegal's success in reducing energy poverty in recent years, the country still faces energy challenges. While Senegal's electrification rate of 75 percent is relatively high for Africa, large disparities exist between urban and rural areas, regions and income groups.[4] The country's reliance on heavy fuel oil imports for power generation results in some of the highest electricity costs in Africa, hindering development. These high costs prevail despite the government providing large subsidies, which constitute a substantial and volatile burden on the budget, and in turn prevent other priority expenditures.[5]

Government officials and many citizens hope that the country's imminent gas production will address these and other challenges. The Grand Tortue Ahmeyim (GTA) field, which Senegal shares with Mauritania, is expected to start production in 2024. This field, involving partners BP and Kosmos Energy, is estimated to contain up to 20 trillion cubic feet (tcf) of natural gas.

Another important project on the horizon is Yakaar-Teranga, which is fully situated in Senegalese waters and thought to contain around 25 tcf of gas in place.[6] Kosmos Energy has a 90 percent interest in this project following BP's withdrawal, though Senegal's national oil company, Petrosen, is planning to ultimately assume a substantial stake and a third partner is expected to join the joint venture.[7] The government is targeting a final investment decision (FID) for the first phase in 2024 and first gas in 2026.[8] A third project, Sangomar, which is operated by Woodside Energy, started production in June 2024. It mainly has oil reserves but a future phase may produce some gas.

With this gas potential, the Senegalese government has set out big ambitions in recent times, seeing it as a "game changer" for Senegal's development.[9] It hopes for significant revenues from LNG exports,[10] as well as the elimination of energy poverty and further economic development through domestic use. Using large amounts of gas to generate power ("gas-to-power") has been at the heart of these domestic use ambitions.

This report comes at a time when Senegal's newly elected government is determining how to pursue its stated goal of achieving universal access to electricity. The new administration's aspirations of high-quality, low-cost universal access are clear in the electoral program of Coalition Diomaye Président.[11] However, how it will pursue these ambitions and the extent of convergence or divergence with previous administrations remains unclear.

Senegal's recent ambitious gas-to-power plans coincide with a challenging global context for gas. The International Energy Agency (IEA) has said that the world must cut its gas consumption by 78 percent by 2050 to avoid the worst climate outcomes.[12] As a result, countries including the U.S. and several EU member states committed to end public funding for gas projects at the COP26 climate conference in 2021.[13]

Senegalese officials have rightly called out the hypocrisy of this stance.[14] Not only does the climate threat from gas come mainly from wealthy countries,[15] but only a few months after the declaration at COP26, some of the same countries started courting African producers, including Senegal, in an attempt to replace Russian gas supplies after Russia's 2022 invasion of Ukraine.[16]

Since then, some international players have changed their tone and made greater distinctions between gas for export versus gas for domestic use in developing countries. Both the World Bank and G7 have acknowledged the importance of gas for increasing energy access in developing countries under certain conditions.[17] However, whether this will result in an increase in funding for gas-to-power remains to be seen.

The divisiveness of this question was seen in the negotiation of a Just Energy Transition Partnership (JETP) between Senegal and the International Partners Group (IPG) of Canada, the European Union, France, Germany and the U.K. In June 2023 the partners announced the contours of a JETP worth EUR 2.5 billion, which foresees renewables reaching 40 percent of the power mix in terms of installed capacity by 2030,[18] up from 29 percent of installed capacity in 2022.[19] Gas is described as a "transitional energy" in this agreement, but, in contrast to initial Senegalese government expectations, gas-related projects seem unlikely to receive any funding through the JETP.[20]

Organizations including NRGI have argued that development partners should be open to supporting some domestic gas projects in developing countries where the use of gas is:

- Necessary to advance an urgent development goal, such as improving energy access;
- The only option for furthering the goal due to a lack of viable non-gas alternatives;
- A small part of energy sector plans and funding proposals; and
- Not obviously and grossly misaligned with Paris Agreement climate goals.[21]

At the same time, the JETP's promotion of the role of renewables is welcome. If it has the intended impact, it will not only result in an expansion of renewables in the near term but will also catalyze renewables expansion in the longer term. Senegal's renewables potential is significant, with large amounts of sunshine and strong winds, and the government should take full advantage.[22]

The size of gas-to-power plans and the interplay with renewables plans is critical for determining the likelihood of success in achieving overall energy and sustainable development goals.

As the new administration considers the next steps in pursuit of these goals, we urge it and other actors (including development partners) to consider six issues:

1. Sufficiency of domestic gas supply for a large gas-to-power plan
2. Source of financing for gas-to-power infrastructure
3. Role of renewables and their advantages and challenges
4. Features of gas-to-power contracts and infrastructure necessary for balanced power sector growth
5. Impact of the JETP on Senegal's future power mix
6. Public consensus and trust around Senegal's power plans

After presenting Senegal's power plans in more detail based on the most recent government information, we discuss each of these issues in turn.

Senegal's gas-to-power and renewables targets

Senegal has large gas-to-power ambitions and less clarity on long-term renewables plans

Senegal had a total generation capacity of 1,789 megawatts (MW) and produced 5,908 gigawatt hours (GWh) of electricity in 2022 (the most recent year for which data is publicly available).[23,24] Most of this power—around 71 percent of capacity and 79 percent of generation—came from thermal plants, many of which run on imported heavy fuel oil (HFO).

The remainder, equivalent to an installed capacity of 525 MW, comes from renewables, after Senegal invested heavily in new solar and wind production in the last few years. All the country's 245 MW of solar photovoltaic (PV) capacity has been added since 2016, while the Taiba Ndiaye 159 MW wind park was commissioned in 2020.

These additions mean that the government has already met its unconditional target of solar PV capacity of 235 MW and wind capacity of 150 MW by 2030 in the country's Nationally Determined Contribution (NDC) to address the climate crisis.[25] It is yet to meet the hydropower target of 314 MW. However, construction of the Sambangalou 128 MW hydro project started in 2023.[26] When completed, this project will bring the country closer to that target and the total installed renewable energy capacity target of 699 MW. Renewables capacity reached 29 percent of total installed capacity in 2022, and contributed 21 percent of total generation.[27]

Table 1. Senegal's power mix in 2022[28]

Generation type	Installed capacity		Power generated	
	MW	% of total	GWh	% of total
Thermal	1,264	70.7%	4,646	78.6%
Hydro[29]	121	6.8%	486	8.2%
Solar	245	13.7%	381	6.5%
Wind	159	8.9%	396	6.7%
Total	**1,789**	**100%**	**5,908**	**100%**

The government has planned to change this mix significantly in the coming years, pivoting to a large role for gas. In the 2018 gas-to-power strategy, gas is presented as critical for achieving the goal of universal access to electricity.[30] The hope is that by allowing a shift away from HFO, gas-to-power will also mean lower and more stable energy costs. In turn, lower costs should make it easier for the government to eliminate subsidies, which it had been targeting by the end of 2025.[31] Finally, in its NDC, Senegal has also identified replacing HFO with gas as a key driver in its efforts to lower emissions from its power sector.

Senegal's current gas-to-power plans are set out in the IEA energy policy review of Senegal, conducted in collaboration with the Senegalese government, which was published in January 2024.[32] These plans target around 3,067 MW of gas capacity by 2050, comprising 476 MW of converted HFO power plants and 2,591 MW of new plants. This addition of new plants has started with the construction of the 130MW Malicounda flexicycle plant and the 366MW Cap des Biches combined-cycle gas turbine (CCGT) plant, both of which will use HFO until gas supply becomes available.[33] Construction has also recently started on a 225 MW CCGT plant in Saint Louis (and a pipeline connecting the plant to the GTA project), which is expected to start operation around 2026.[34,35]

Plans for renewables are less clear, particularly for the long term. The power plans of the national electricity company, the Société nationale d'électricité du Sénégal (Senelec), as of November 2022 indicated no new solar, wind or hydro projects after 2025.[36] The JETP agreement means additional capacity is now anticipated, though the details are currently limited.

The IEA policy review only refers to the conditional targets in Senegal's NDC of 2020: additional solar PV of 100 MW, wind of 100 MW, biomass of 50 MW and concentrated solar power (CSP) of 50 MW, resulting in total renewables capacity of 999 MW, by 2030. It suggests that the government is planning to commission several renewables projects, but the only specific project it references is a plan to expand the Taiba Ndiaye wind park by 100 MW.

As Figure 1 shows, this 999 MW of capacity would be insufficient to reach the JETP target of 40 percent by 2030 (unless at least 360 MW of existing thermal capacity is retired within this period). Even if only the 591 MW of gas-to-power capacity currently under construction comes online by 2030—that is, no additional gas-to-power capacity comes online by then—renewables would represent only 35 percent of installed capacity in 2030. Additional renewables capacity prior to 2030 may therefore be needed to meet the JETP target.

The JETP should not only result in additional renewables capacity this decade but also improve the prospects for more renewables in the longer term. However, in contrast to the plans for a significant ramp up in gas-to-power in the long term, the IEA policy review does not indicate any government plans for additional renewables capacity from 2030. If that remains the case and the plans in the policy review are the only ones realized, even if Senegal does reach the JETP target of 40 percent renewables by 2030, the mix will look very different in the long term. Gas would increasingly dominate, and the role of renewables would shrink over time.

The lack of detail on renewables plans may reflect the fact that the government was focused more on building out gas capacity than renewables capacity prior to the JETP agreement, and since then has been in the process of developing the JETP investment plan with the renewables projects to be financed under the JETP needing to be agreed within the JETP framework. Officials also might worry that the JETP financing will not materialize. This is understandable, given rich countries' dismal records on meeting their climate and transition finance commitments including other announced JETPs.[37] Nevertheless, given that the government is making decisions on the gas sector now, rigorous consideration of the interplay between gas and renewables in the long term (beyond 2030) cannot wait.

Figure 1. Senegal's installed capacity in 2030 based on existing capacity, gas plants under construction and NDC's conditional renewables targets[38]

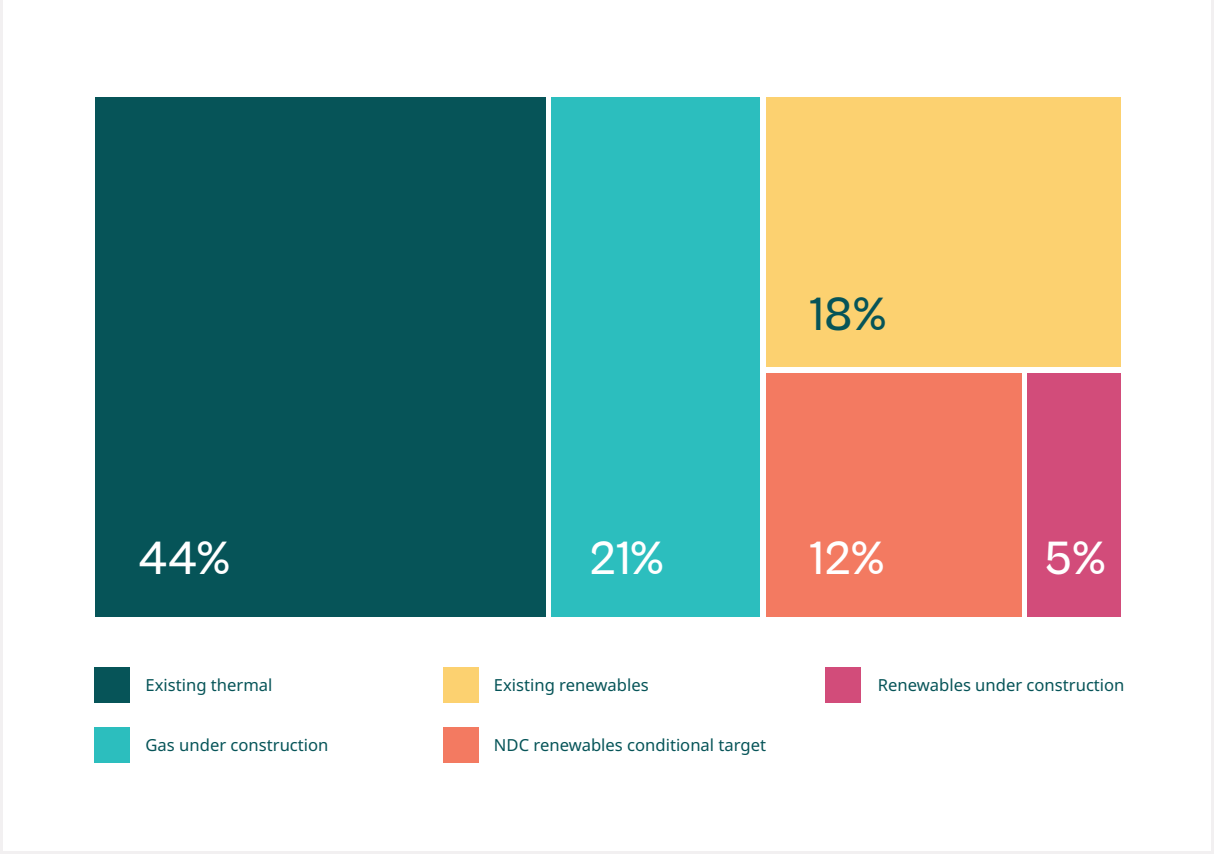
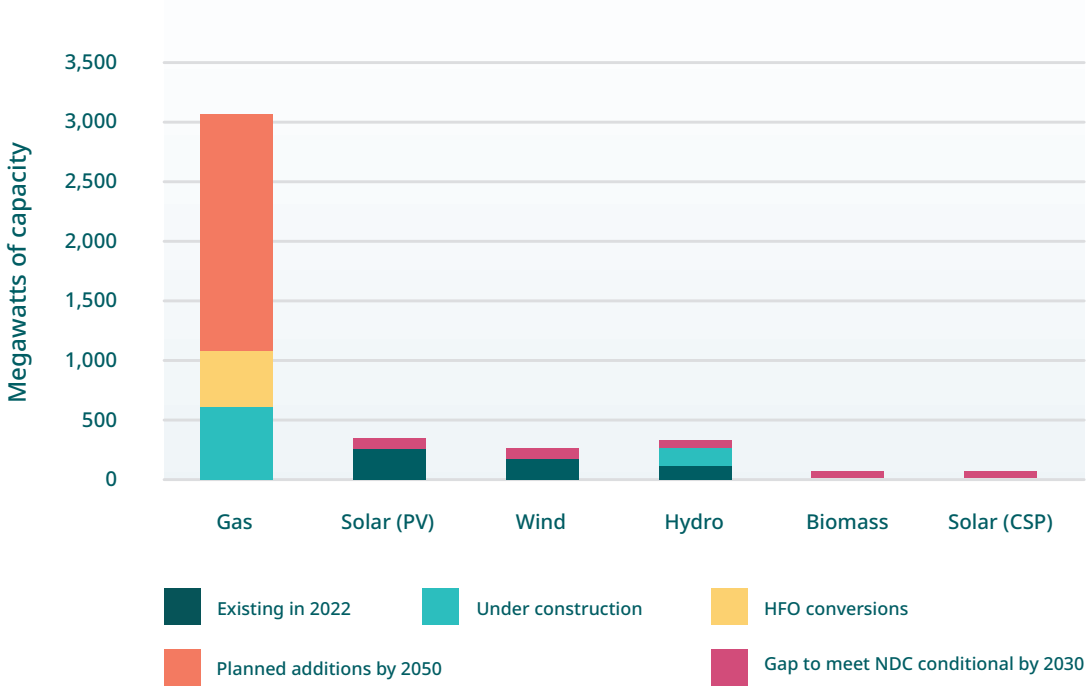


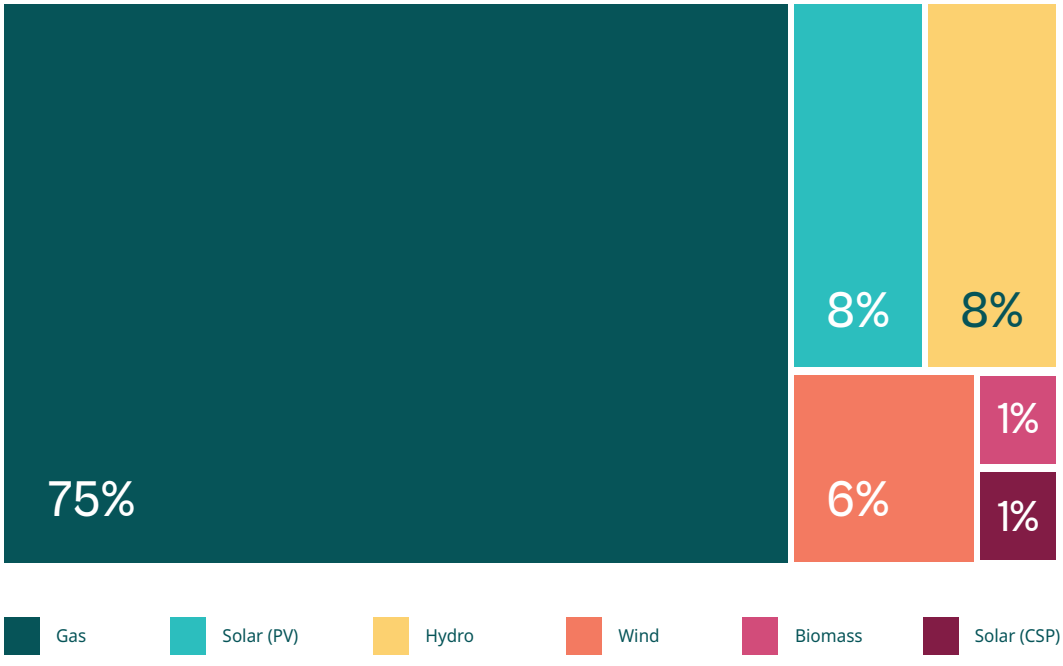


Photo by Sebastien Van-de-walle for Unsplash

Figure 2. Senegal's planned power generation capacity up to 2050 referenced in IEA energy policy review[39]



Senegal's power mix in 2050 if only plans in IEA policy review realized



Ongoing planning processes highlight Senegal's efforts to reshape its energy future

The ruling party, in its electoral program, implicitly recognized the interplay between Senegal's gas-to-power plans and renewables. It envisions a strengthened renewable sector, including increased hydro capacity, but also references investment in gas-to-power in the "short term" and nuclear in the "medium term."

The new administration can further refine its ambitions using several ongoing policy processes:

1. Update of the Gas-to-Power Strategy, led by the Ministry of Energy, Petroleum and Mines
2. Development of a Gas Master Plan, led by the Ministry of Energy, Petroleum and Mines
3. Development of a ten-year Integrated Low-Cost Generation Plan, led by the Ministry of Energy, Petroleum and Mines
4. Negotiation and implementation of an investment plan for the recently announced JETP, led by the Ministry of Energy, Petroleum and Mines
5. Development of the next Energy Sector Development Policy Letter (LPDSE) 2024-2028, the medium-term action plan for the energy sector, led by the Ministry of Energy, Petroleum and Mines
6. Development of a low-carbon and climate-resilient development strategy, led by Enda Energy (a Senegalese civil society organization) with oversight by the Ministry of Environment and the Ministry of Energy, Petroleum and Mines
7. Update of Senegal's Nationally Determined Contribution to meeting the Paris climate agreement, led by the Ministry of Environment

The new administration should consider the following six key issues as it weighs gas-to-power's future role and the interplay with renewables in the upcoming wave of planning and negotiations.



Photo by Raphael Pouget for Climate Visuals Countdown

Issue 1. Sufficiency of domestic gas supply for a large gas-to-power plan

- Domestic supply, particularly from Yakaar-Teranga, is beset with uncertainties related to company decision-making, potential contract renegotiations and the accelerating global energy transition.
- The amount of domestic supply currently envisaged by the government is sufficient to meet expected demand, but this supply may ultimately prove lower and slower to materialize than anticipated.
- To reduce the risk of a shortage, the government could attempt to increase domestic supply, fill any supply gap with LNG imports or divert supply from non-power uses, but all three options carry costs and risks that could jeopardize one or more of the government's energy goals.

Consideration of Senegal's gas-to-power plans requires determination, through detailed scenario modeling, of whether the country has sufficient exploitable reserves to adequately fuel its power plants. Further, the government should not commit to buying more gas than it needs, as doing so would have significant negative financial ramifications.

Domestic gas demand will increase considerably as the government ramps up gas-to-power

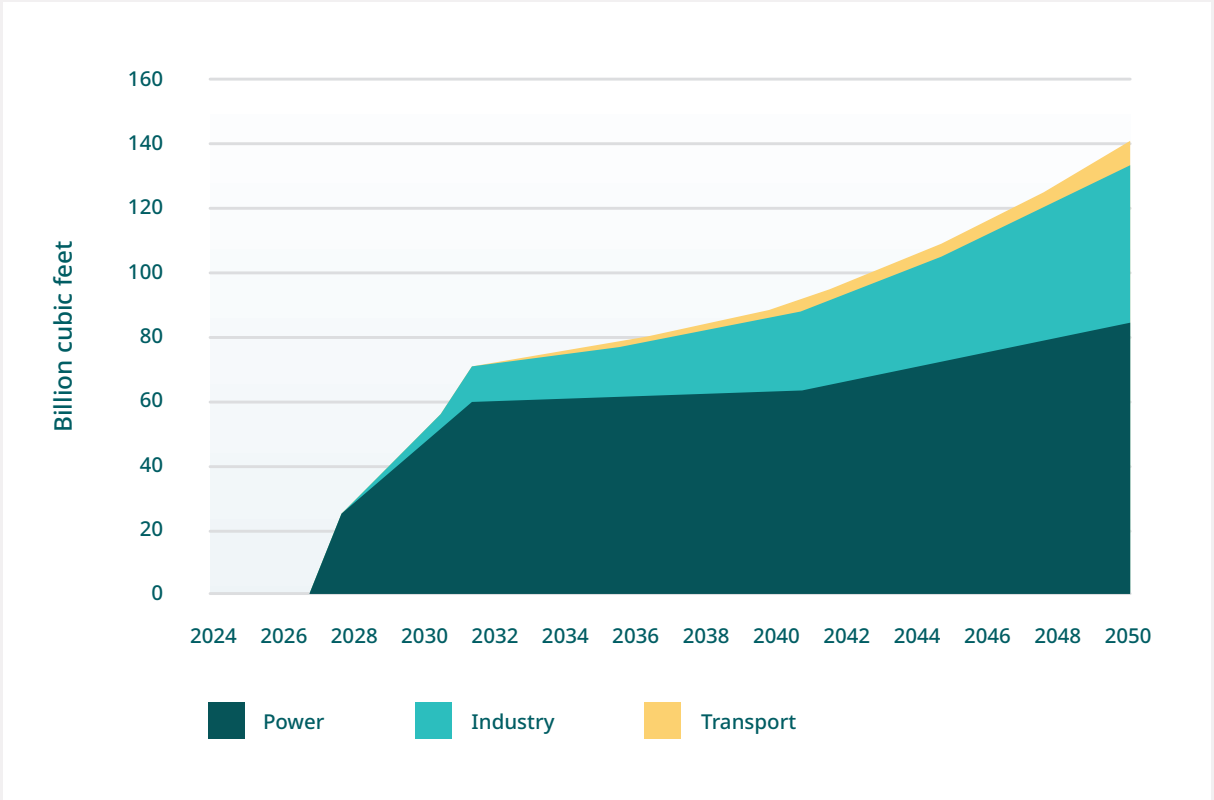
Senegal currently consumes a small amount of gas, around 0.6 billion cubic feet (bcf) in 2021, which is produced from the onshore Gadiaga field.[40] Most of this gas is used in cement production. Senegalese demand will increase considerably in the coming years.

The government's current gas demand projections are set out in the IEA energy policy review for 2030, 2040 and 2050.[41] It estimates that overall demand will be around 71 bcf in 2030 and 141 bcf in 2050. Most of this demand is from power generation needs. The government estimates power plants will need about 60 bcf in 2030 and 85 bcf in 2050. It expects non-power uses of gas to increase over time, from around 11 bcf in 2030 to 56 bcf in 2050.

The review contains minimal information about these non-power plans, but government presentations reference ambitions for a range of uses such as for heat by industries, as feedstock in new industries such as fertilizers, liquefied petroleum gas for cooking by households, and compressed natural gas for transport.[42]

Figure 3 shows these projections, extrapolated to show possible demand in all years between now and 2050. (See appendix for further explanation.) There are other ways that the power and non-power sectors could develop, and the government should consider a range of scenarios when estimating gas demand. However, we have not developed any other demand scenarios given the lack of planning documents in the public domain to inform them.

Figure 3. Government of Senegal's gas demand projections, extrapolated[43]



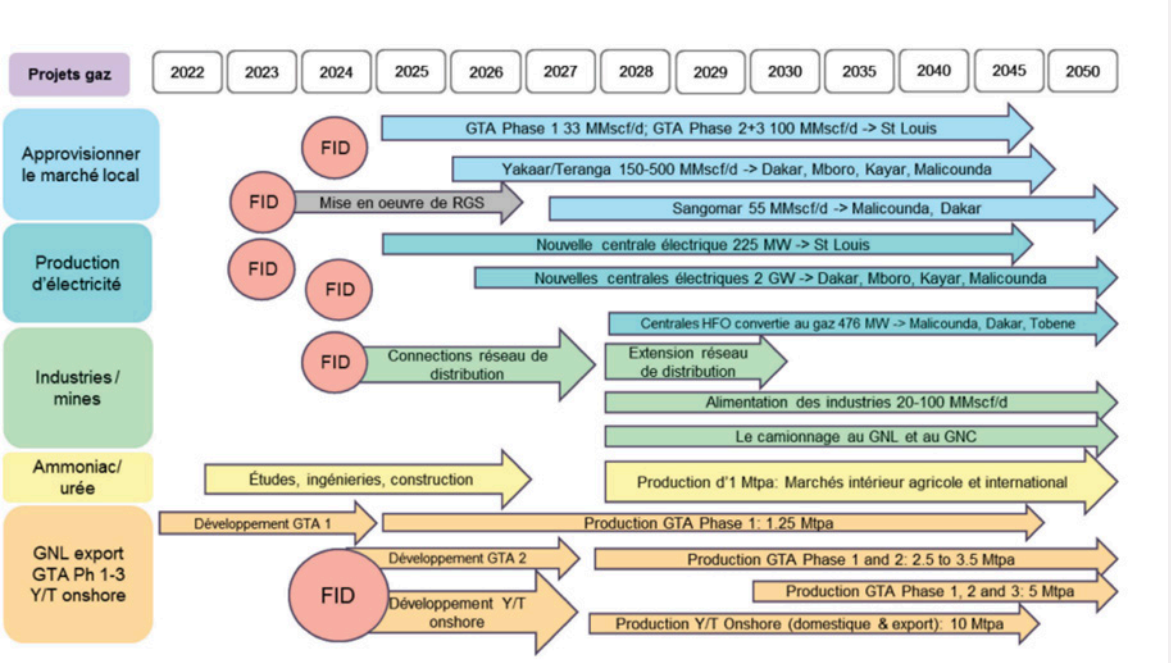
Company decision-making and the energy transition make domestic supply volumes uncertain

Most domestic supply depends on future investment decisions

As noted above, Senegal currently produces a small amount of gas from the onshore Gadiaga field, which is supplied to the domestic market. The country is about to produce much more from its offshore fields. The most recent government plans envision the offshore operations supplying large amounts to the domestic market, as set out in the IEA policy review and in Figure 4.[44] However, most of this domestic supply depends on investment decisions that companies have yet to make and is subject to negotiation between the government and companies. Both the amount of gas supply and its timing are therefore subject to varying degrees of uncertainty.

The first phase of GTA is the only development which includes domestic supply that has reached FID. Initially expected to start production in 2021, it is now due to start production in 2024. This phase will initially produce 2.5 million tonnes per annum (mmtpa) of LNG for export. As long as construction of the pipeline to Saint Louis goes as planned, it will also supply 33 million cubic feet (mmcf) per day or 12 bcf/year of gas to the domestic market (with another 33 mmcf/day potentially supplied to the Mauritanian market), from around 2026.[45]

Figure 4. Senegal's gas roadmap in IEA energy policy review



Notes : Y/T = Yagaar/Teranga ; FID = décision finale d'investissement ; MMscf/d = million de pieds cubes standard par jour ; CNG = gaz naturel comprimé ; mtpa = million de tonnes par an ; RGS = Réseau gazier sénégalais.
Source : MPE (2023), modifié par l'AIE.

BP intends to increase GTA's LNG exports from the initial 2.5 mmtpa to 5 mmtpa in phase two and to 10 mmtpa in phase three. The government expects these phases to also supply a total of around 100 mmcf/day or 37 bcf/year to the domestic market. FID for the second phase was initially expected in 2022. BP subsequently pushed back this timeline because of delays to the first phase, and then to redesign the project structure. The government now expects FID for phase two in 2025.[46] Even this may prove optimistic. Rystad Energy expects FID for phase two in 2026 and FID for phase three not before 2032.

The associated gas produced by Sangomar's first phase will be re-injected—at least initially.[47] Government discussions suggest officials will reassess supply options after two years of production. Woodside will also use the first phase to establish the feasibility of extracting the unassociated gas in future phases given the complexity of the reservoirs.[48] The volume of gas that Woodside can extract economically is therefore currently uncertain. Given Sangomar's smaller volumes of unassociated and associated gas, the government expects any future supply to go to the domestic market. It envisages domestic supply of around 55 mmcf/day or 20 bcf/year from 2027.

The government has particularly high expectations for Yakaar-Teranga. Based on statements by Kosmos, the current development concept for Yakaar-Teranga phase one envisages peak production of 550 mmcf/day or 201 bcf/year, with 3 mmtpa of LNG and around 150 mmcf/day or 55 bcf/year supplying the domestic market.[49] However, Kosmos has stated that this concept is "now being optimized to best meet the domestic and international requirements,"[50] and the government appears to be assessing whether to negotiate more domestic supply, possibly up to 500 mmcf/day or 183 bcf/year in total. Yakaar-Teranga production was initially expected to start in 2024.[51] The government is now targeting Yakaar-Teranga production in 2026, but Kosmos does not expect first gas until 2027 and Rystad not until 2028.[52]

The design of the first phase of Yakaar-Teranga will significantly influence the design of any subsequent phase, but the government appears to expect this to center around LNG production, with total LNG capacity across all phases of 10 mmtpa. Previously announced plans for a virtual pipeline suggest the government may be envisaging taking some of this LNG production for the domestic market.[53]

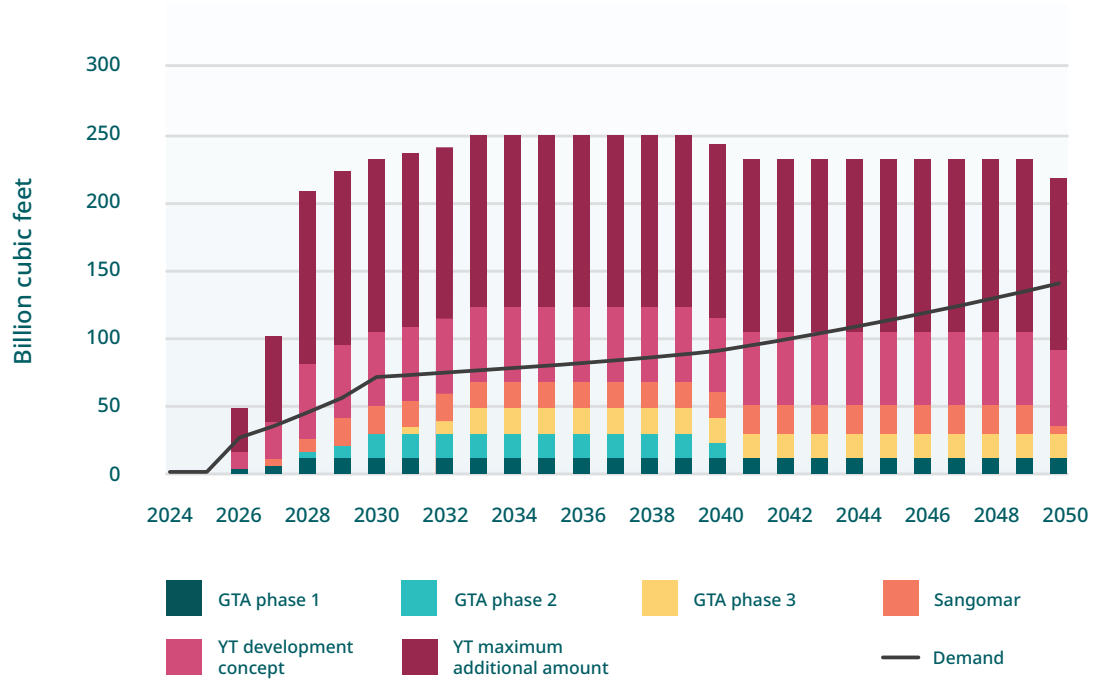
Figure 5 shows the domestic supply expected by the government based on information in the IEA policy review document. This document reports the year that the government expects domestic supply to start and the amount of gas it expects at peak production but provides limited information on the duration of this supply. We used Rystad reserves estimates and the LNG export plans set out in the IEA policy review to model the possible production profile and duration of domestic supply for each project and phase. (See appendix for further explanation.)

Yakaar-Teranga is the most important for gas-to-power ambitions but also the most uncertain

The government's emphasis on Yakaar-Teranga for domestic supply is understandable. As Figure 5 shows, even if future phases of GTA and Sangomar go ahead, meet the government's accelerated timelines and deliver the envisaged domestic supply, it would be insufficient to meet government ambitions. While these projects would be able to supply most expected demand in the 2030s, they would be able to supply less than half of expected demand in the 2040s. Only Yakaar-Teranga supply could fill this gap.

The prospects and design of Yakaar-Teranga are the most uncertain, however. BP's withdrawal from the project leaves a lack of clarity on the ownership structure and financing, which are intertwined with the ongoing negotiation of the design of the project, including how production will be allocated between the domestic and export markets.[54]

Figure 5. Gas demand and domestic supply based on Senegalese government expectations[55]



The government does not fully control the design of Yakaar-Teranga. Notwithstanding Petrosen's stated ambition to acquire the largest stake in Yakaar-Teranga, it will most likely rely on its joint venture partners contributing the majority of development costs and to operate the project. The identity and priorities of the third partner that is expected to join the joint venture will therefore also likely impact the design.

Part of the reason that BP withdrew from the project was disagreement with the government over the volume and sequencing of domestic supply and exports.[56] This tension may continue despite the project changing hands. To secure sufficient investment to extract the gas, the companies will need to provide certainty that they can sell enough gas, at a sufficiently high price, to pay back shareholders and creditors.

The domestic market is currently small, and its trajectory is uncertain. The government can reduce the offtake risk for investors by setting out a clear, credible plan on the financing, construction and operation of the necessary pipelines, power plants and other sources of demand. However, even then, investors will likely view the large, established overseas LNG markets as offering greater certainty. Such markets also tend to offer the potential for higher prices. While prices to the domestic market are constrained by the need to remain affordable to Senegalese consumers, LNG prices are more correlated with global supply and demand dynamics.

Contract renegotiations and global developments could impact domestic supply

The allocation of production between domestic supply and exports is just one potential source of tension between the government and companies, both for the Yakaar-Teranga project and future phases of GTA and Sangomar.

The government's plan to audit and potentially renegotiate oil and gas contracts could generate other tensions if not carefully managed. The government should establish clear objectives, set realistic timelines to avoid further project development delays, maintain transparent communication, and ensure that its approach is informed by thorough economic and market analysis.[57] Given the advanced status of the first phases of GTA and Sangomar, renegotiation may not significantly impact their production plans. However, it could affect pending investment decisions. Caution is particularly important given that these projects already face a challenging context.

While overseas markets provide more certainty than the domestic market for investors, the global energy transition means future export plans must also account for significant uncertainty. Europe's search for non-Russian gas imports has created inaccurate perceptions in many countries that the global energy transition toward cleaner energy sources is slowing—but it is actually accelerating.[58] Efforts to tackle the climate crisis are still insufficient, but economic and energy security considerations are providing the transition with significant momentum. Global capital expenditure on renewables projects is now greater than investment in new and existing oil and gas wells.[59] The IEA now predicts that based on countries' current policies (as set out in the IEA's Stated Policies Scenario, or STEPS) global gas demand will peak by the end of this decade and then gradually decline over the following two decades.[60]



Photo by Witthaya Prasongsin via Getty Images

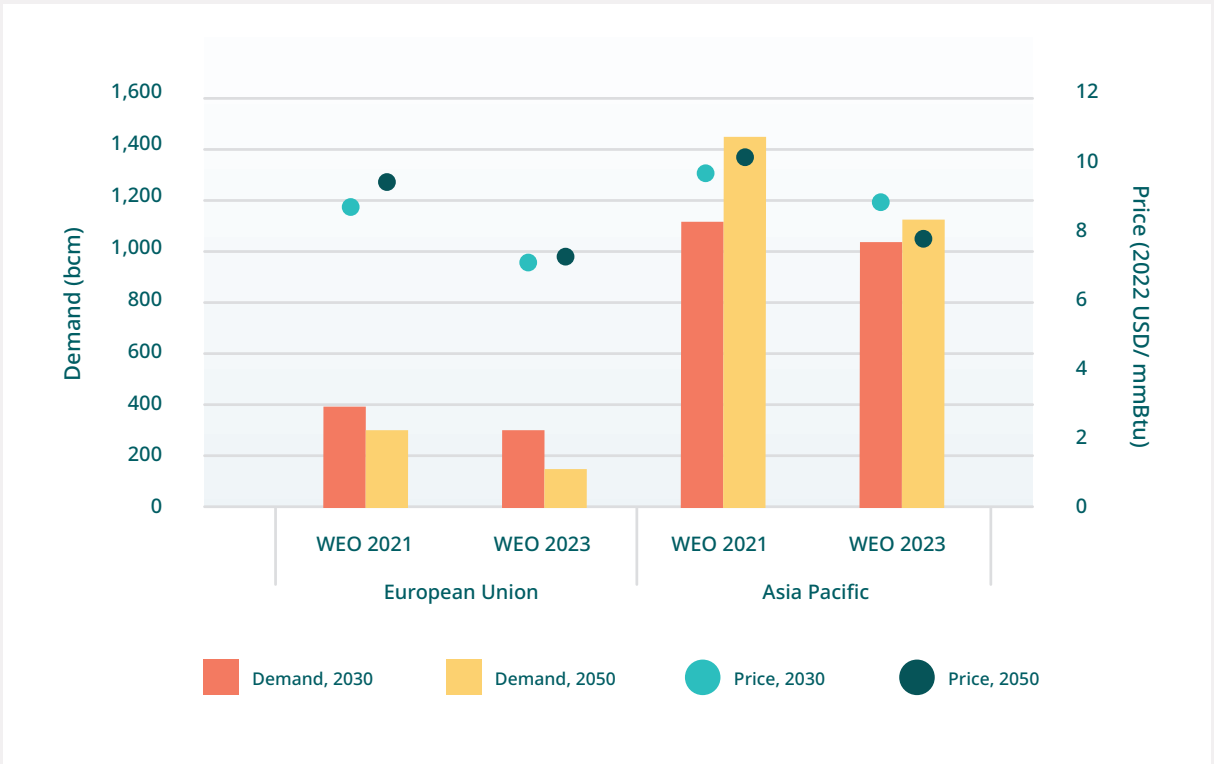
As Figure 6 shows, this accelerating transition is evident in the two key markets for Senegalese exports—Europe and Asia.[61] Within this context, GTA's future phases and Yakaar-Teranga still have export opportunities, but they are narrowing. Rystad estimates that, based on current development concepts, they will need a long-term LNG price at the point of delivery of around $6 per mmBtu (the "breakeven price").[63] This is slightly higher than the average breakeven price of all export projects yet to start production globally, but is below European and Asian prices up to 2050 in STEPS. However, the competition for investors and buyers will likely be fierce.

The viability of Senegal's future projects is more uncertain if the energy transition is faster than in STEPS.[64] This highlights a key dilemma for companies considering large, capital-intensive LNG projects: how to reconcile strong near-term demand growth with uncertain but possibly quickly declining longer-term demand.

Uncertainty on the viability of future export plans does not necessarily mean these projects will supply the domestic market instead if the export conditions are not right. If the companies are planning to primarily export (given the expected size and reliability of the respective markets), the government will need to demonstrate that the domestic market provides a sufficient alternative. Companies will likely decide not to proceed with future phases at all if they are uncertain of being able to sell a sufficient amount of gas to the domestic market. Such a scenario would therefore mean less rather than more domestic supply given these phases were to supply some gas to the domestic market if they had gone ahead.

GTA, Yakaar-Teranga and Sangomar may not be Senegal's only gas prospects. A 2020 licensing round did not result in any successful bids, but the government had been planning another licensing round.[65]

Figure 6. Change in gas demand and prices in IEA STEPs between 2021 and 2023[62]



However, even if the next licensing round is more successful, any supply from prospects not yet discovered is likely far off, and therefore at even greater risk from energy transition dynamics. It has historically taken sub-Saharan African countries around 15 years to move from gas discovery to production.[66]

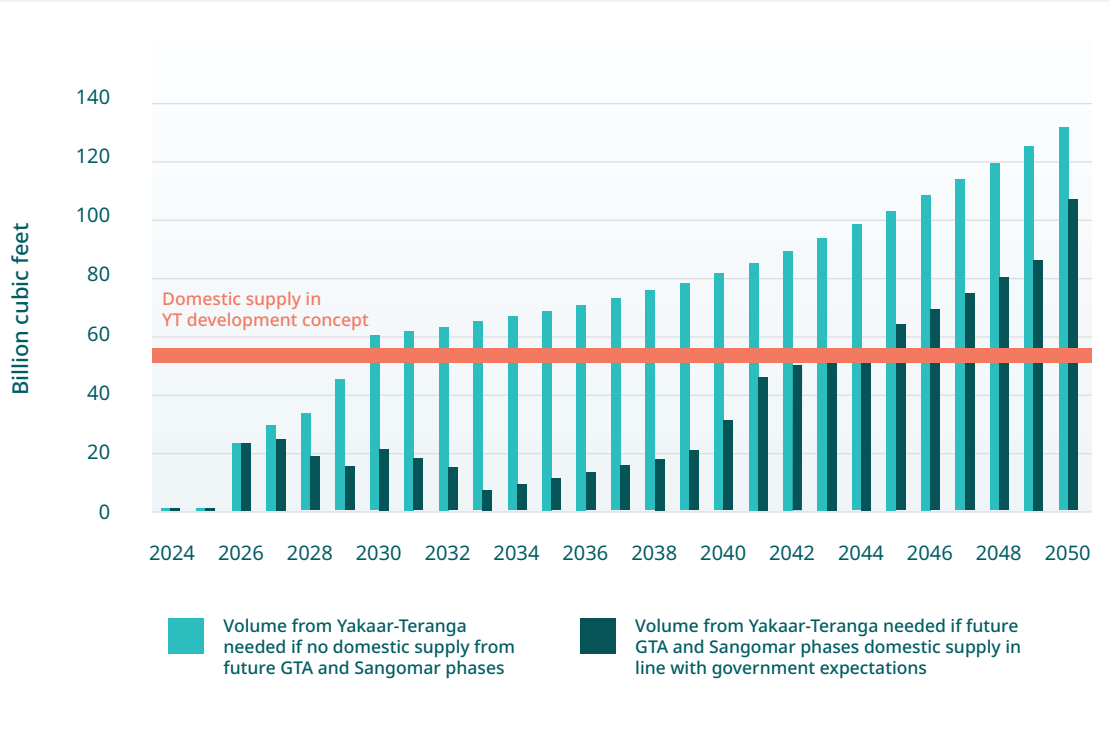
Supply uncertainties mean potential for both gas shortages and surpluses

Comparing expected gas demand and possible domestic supply in Figure 6 above paints a complex picture for the government to navigate. The most immediate and challenging dilemma that the government faces is how much domestic supply to try to negotiate from Yakaar-Teranga. For illustrative purposes, Figure 7 shows, based on our simplified production profiles, the volume that the government must secure from Yakaar-Teranga to meet expected demand in two scenarios: (i) if the only other domestic supply is from GTA phase 1 and (ii) if GTA and Sangomar supply the domestic market with all the gas that the government expects, including from future phases. If no future GTA and Sangomar phases proceed, from 2030, the government will likely need more domestic supply from Yakaar-Teranga than the amount in the current development concept. However, if all future phases proceed, it will need more than the amount in the current Yakaar-Teranga development concept only in the 2040s. Until then, it will need significantly less than the amount in the development concept.[67]

To reduce the risk of a shortage, the government should negotiate a volume from Yakaar-Teranga that is based on GTA's future phases not providing any domestic supply. If these phases do ultimately proceed, all resulting gas can be exported to generate additional government revenue and foreign exchange instead.

The government should make a different calculation for Sangomar's gas. Its smaller volumes mean exports are not likely to be feasible.

Figure 7. Yakaar-Teranga supply needed to meet expected domestic demand (bcf)[68]



It will therefore be stranded if it cannot be used domestically. This would not only represent a lost opportunity for Senegal, but it could also result in the associated gas being flared or vented with significant negative climate and environmental impacts for the population.[69]

This approach will also help ensure the government does not end up with more gas than it needs and large take-or-pay penalties. The government will likely have to sign take-or-pay contracts for most domestic supply to provide investors with confidence that the domestic market will be able to purchase the volume of gas needed to make the investment profitable.[70] These contracts mean that any miscalculation of supply needs will be costly.[71]

However, as we note above, the amount of domestic supply that the government can secure is not fully under its control. Domestic supply from any of these projects—but particularly Yakaar-Teranga—could be lower and slower to materialize than the government expects—or may not materialize at all. Senegal's gas plans have already been disrupted and no stakeholder should disregard the possibility of further such difficulties.

Any further delays will mean gas plants that have already been constructed will use HFO imports for longer than anticipated or require LNG imports. Until these supply challenges and uncertainties are resolved, additional gas-to-power capacity is likely to ramp up slower than the government is envisaging. It may never reach the intended scale if sufficient supply does not materialize.

The government has three options for reducing the risk of a shortage: attempt to increase domestic gas supply, develop plans to fill any gap with LNG imports, or divert gas from non-power uses. However, all three options have costs and risks that could jeopardize one or more of the government's goals of increasing energy access, reducing costs and increasing energy independence.

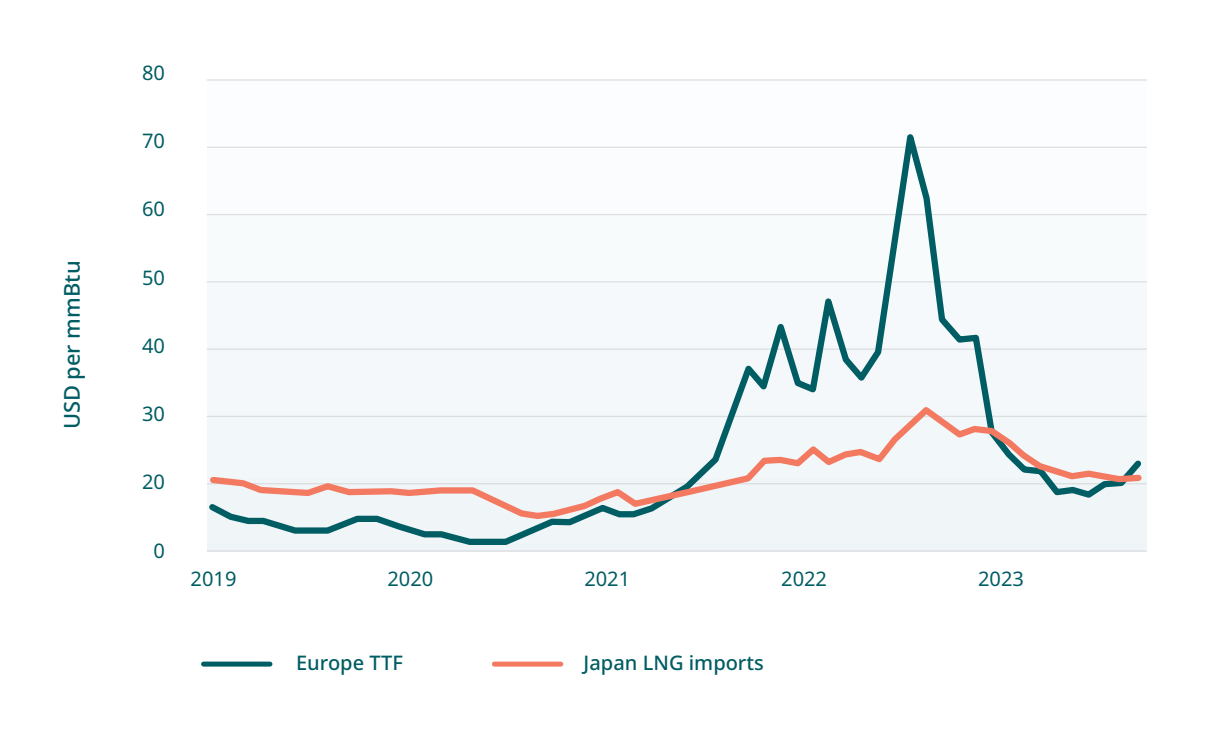
The government could attempt to ensure sufficient and timely supply from Senegal's projects by increasing their attractiveness to investors.

The government could offer tax concessions to companies, but this would run counter to its stated aim of renegotiating contracts to secure more revenue. If it did offer concessions, it must ensure that they do not result in a project generating insufficient benefits to compensate for the environmental and social harms that it causes. The government could also use public money (likely by incurring debt) to make a larger contribution to development costs. It appears to be considering this for Yakaar-Teranga. However, it must weigh whether investments with public money are an overly risky bet, using limited resources and incurring further debt for projects that ultimately may not generate sufficient benefits to warrant diverting money from other urgent development needs.[72]

Senegal could instead look to LNG imports to fill any supply gap. Yet LNG imports bring the same problems as Senegal is currently experiencing with HFO imports. Dependence on imported LNG sent shockwaves through several South Asian countries after Russia invaded Ukraine. Sudden LNG shortages and the record prices shown in Figure 8 led to closed power plants and factories, skyrocketing electricity prices, weaker local currencies, foreign exchange shortages, costly public debt, lost jobs, and a return to dirtier, dangerous fuel sources like coal and private generators.[73] Indeed, the Senegalese government has had to delay the switch from HFO to LNG imports for the Karpowership currently moored off the coast because of the Russian invasion of Ukraine.

While LNG prices may fall over the coming years, LNG imports will likely still be more expensive given liquefaction, regasification and shipping costs.[74] These higher costs would make the economics of new gas plants more challenging for investors. The government would need to agree to higher prices in the power purchase agreements (PPAs), and given this will mean higher risk of non-payment, provide guarantees. Doing so would limit the cost savings from shifting to gas-to-power for Senegalese households and businesses, or for the government if it decided to continue subsidizing prices as a result and put the risk onto the public budget.

Figure 8. Gas prices in Europe and Japan[75]



Finally, the government could increase the likelihood of power plants securing sufficient supply by reducing supply to non-power users, such as cement producers. However, unlike for power generation where renewables are an alternative, there are currently limited alternatives for most other gas uses. The government should therefore consider the opposite—prioritizing gas supply to non-power users over gas supply to power plants.

The government could plan a larger role for renewables to replace some of the envisaged gas-to-power instead. This would mean that Senegal's energy goals are not so heavily reliant on everything going to plan in the gas sector, which is beset by uncertainties. While Senegal would generally benefit from further diversification of energy sources, a larger role for renewables would be particularly beneficial in reducing the fuel supply risks that the country faces.

Achieving the share of renewables envisaged by the JETP agreement is crucial. However, the increase in share of renewables will need to continue after 2030 to significantly reduce the risks brought by gas shortage.

A larger role for renewables also provides an opportunity for a "win-win" outcome. Senegal's energy needs would still be met. But a larger portion of these needs being met by renewables would free up more gas for export, which would mean more government revenue and foreign exchange if those export projects were developed. Several key oil and gas producers, such as Saudi Arabia, are pursuing this strategy.[76] The reverse—using more gas domestically and exporting renewables output—is not true, at least for the time being. Power is expensive to export. Until exports of green hydrogen derivatives (such as ammonia) are proven to be technically and economically viable, power from hydro, wind and solar resources can therefore only be used in Senegal, or to a small extent, neighboring markets. Therefore, if more gas is used to meet Senegal's energy needs, renewable resources will likely go unexploited.

Issue 2. Source of financing for gas-to-power infrastructure

- The government may need financing of at least $2.2 billion to create the planned gas-to-power capacity.
- Funding for gas-to-power is shrinking, with reductions in international public finance earmarked for oil and gas, making it more difficult to attract private investment.
- The government could ultimately have to pay for much of the infrastructure itself. Such a large role for gas could therefore hinder rather than help its goal to lower energy costs.

Debates over how much gas Senegal should expect to produce and burn will become redundant if the country cannot find the capital to build the necessary infrastructure. Information on the potential infrastructure cost of implementing the planned amount of gas-to-power is limited, but estimates for the cost of certain components provide an indication. As set out in Table 2, financing of at least $2.2 billion could be needed. Our lower cost estimate for the additional new capacity of 2 GW envisaged by the government aligns with the average global cost of around $0.8 million per MW. Our higher cost estimate reflects the average cost that the government expects for new Senegalese plants in the medium term of around $1.6 million per MW.[77] It is not currently clear who will finance much of this infrastructure.

Table 2. Possible financing requirements for Senegal's gas-to-power plan

Infrastructure	Cost (USD millions)	Source
Conversion of existing HFO plants	60-100	Government estimate[78]
New gas-to-power capacity of around 2 GW	1,600 – 3,200	NRGI estimate
Planned 472km pipeline network	300	Government estimate[79]
Virtual pipeline network	250	Government estimate[80]
Total additional financing required	**2,210 – 3,850**	

The gap between ambitions and available capital for domestic gas projects in lower-income countries is widening

Governments in lower-income countries often struggled to raise amounts that they targeted for domestic gas pipelines and power plants even prior to the energy transition and growing climate concerns. The difficulties raising funds stem mainly from the fact that gas-to-power infrastructure projects can carry substantial economic and counterparty risk for investors. Domestic gas projects often fail to offer decent returns on investment, or turn a profit at all, because of dysfunction and financial problems elsewhere in the supply chain or economy. A range of problems can erode cash flows, including high infrastructure costs and grid losses, lower-than-expected demand, customer inability to pay, non-cost-reflective electricity tariffs and weakening local currency values. These risks translate into higher financing costs, further deterring investment.

Many of the deterrents to investment in gas power projects apply to other types of large-scale power projects, including renewables. But many investors and financial institutions are becoming more risk averse regarding gas-to-power projects as concerns grow about gas' climate impacts and its uncertain future.

Global investment in gas power generation has fallen substantially in the past decade.[81] Africa's share of this investment has always been quite small but is also falling, exacerbating the downward global trend in gas financing for African countries. Africa received 12 percent of global gas power generation investment in 2015 but only 5 percent in 2023, equivalent to a reduction in investment from $11 billion in 2015 to $5 billion in 2023.[82]

The impact of this shrinking pool of capital is starkly evident. Governments and companies currently have plans to build 53.7 GW of new gas-fired power in Africa at a cost of around $52 billion, but they are yet to find funding for most of it.[83] In contrast, while Africa's share of the growing pool of capital for renewables generation capacity is very small, at 3 percent, this share has remained relatively stable during the period. This translates to an almost doubling of investment from $11 billion in 2015 to $21 billion in 2023.[84] With the energy transition and climate concerns making investments in gas power infrastructure riskier in general, investors appear to be shying further away from countries perceived to already pose significant economic and counterparty risk.

Several factors could make Senegalese power plants appear less risky than other destinations in the region. These include:

- political stability embodied by the recent peaceful transition of power
- strong economic performance
- PPA terms that allow for full cost recoupment
- take-or-pay clauses in PPAs
- currency risks that are relatively small for West African oil and gas producers given the CFA is anchored to the euro and therefore relative stable
- if taken, the potential as a new producer for legal, institutional and governance frameworks that minimize methane emissions from the gas value chain from the start and thereby reduce climate-based resistance to gas-to-power investment.[85]

It will be important for Senegal to maintain these advantages, including as the new administration refines its agenda. However, these advantages may still not counteract the effects of the global outflow of capital from gas power projects on Senegal's ability to attract financing.

A key driver of these outflows is a reduction in international public finance. International public financing for domestic gas projects, from multilateral development banks (MDBs), state-owned or controlled development banks and finance corporations (referred to collectively as "development finance institutions" or DFIs) and export credit agencies (ECAs), is critical for reducing risks and therefore "crowding in" investment from the private sector. The large foreign companies that build gas-fired power plants in developing countries often look to ECAs or other public financiers for loans and guarantees in order to reduce the amount of their own capital at risk in a project. Likewise, private lenders—foreign and domestic—often shy away from developing country gas projects unless public lenders commit first and assume the biggest risks, whether through equity stakes, debt subordination or provision of guarantees and insurance.[86]

DFI and ECA finance has been important for Senegal's power sector. To date, every gas power plant that the country has built or is currently developing has received financing commitments from at least one DFI or ECA. Now, however, international public financial support for projects like those in Senegal has become a highly divisive issue. Since the declaration at COP26 by a group of jurisdictions including the U.S. and EU for an end to the international public funding for gas,[87] many large funders have strict criteria for supporting gas power plants.[88] It remains to be seen whether Europe's increased demand for African gas exports and a slight change in stance by some countries and institutions translates into greater financing of gas infrastructure for domestic use.[89]

We understand that in the JETP negotiations, as noted above, the government and IPG members diverged over whether some of the money should be used to finance gas infrastructure. Wealthy, high-emitting countries should be open to financing gas-to-power projects in lower-income countries subject to conditions.[90] However, until donors and lenders commit to providing this support, it would be risky for Senegal to rely on securing such financing.

At this point, a handful of smaller, mostly African DFIs and ECAs appear to be the least conflicted, more likely supporters of new gas projects in countries like Senegal. The financing of the Cap des Biches, Malicounda and Saint Louis plants reflect this new landscape. Financing for those projects comes primarily from African multilateral institutions such as the African Development Bank, Africa Finance Corporation and Afrexim Bank, as well as from African private-sector banks.

Financing gas projects with government money could strain Senegal's already stretched budget

While support from African institutions is extremely valuable, their smaller capitalization may restrict their ability to provide financing across Senegal's ambitious gas-to-power plan. Competition for funds will be fierce. Senegal may therefore have to find other ways to reduce risks for private investors through, for example, agreeing to high prices in the PPAs and providing government guarantees. If this government support was given to well-connected domestic investors without demonstrable due diligence, it could also raise corruption concerns, with implications not just for sector performance, but for Senegal's reputation as an investment destination.

In the end, Senegal may also need to directly use its own budget (including by borrowing) to implement some of its gas-to-power plans. In one model, Senelec could take a large equity position in new projects, though this would run counter to the current trend in the region of building out power supply through independent power producers while state-owned enterprises oversee transmission and distribution.

And if the new projects are not profitable, the government could be on the hook to provide regular cash injections from public funds or assume more debt.

Senegal's budget is already over-stretched, for such high investments. For example, the investment requirement of at least $2.2 billion is similar to the total direct taxes that the government collected in 2024 ($2.36 billion). The planned pipeline network, expected to cost around $550 million, is greater than the amount budgeted in 2024 for defense ($499 million), security and public order ($444 million) or health ($451 million).[91] The planned investments would not all happen in a single year, but they could still add considerably to the country's public debt and force the government to make hard trade-offs on funding other urgent priorities.

The government should take these financing challenges into account in its strategy for achieving its energy goals and explore whether such a large role for gas is necessary.



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Issue 3. Role of renewables and their advantages and challenges

- Senegal's government could increase its chances of meeting its energy goals if it takes advantage of the country's renewables potential to reduce the large role of gas.
- Increasing the role of renewables is not without challenges, but it appears feasible for the government to do so in both the near and longer term.
- Development partners must provide financial and technical support, including lowering the cost of capital. The JETP provides a valuable mechanism to facilitate and coordinate this support.
- The government can take several steps—on strategy, institutional framework, regulatory framework and investor outreach—to increase financing prospects.

Senegal's potential for renewable energy deployment is considerable

Renewables can play a larger role in both the near and longer terms than the government plans described in the IEA policy review. In addition to Senegal's large amounts of sunshine and strong winds, a range of other factors can support further growth. Investment conditions are relatively good for the country.

In addition to the factors supporting investments in gas listed above (e.g., relatively good cost recovery under PPAs and lower foreign exchange risk), incentives for investors and consumers, like value added tax exemptions of solar and wind components, are in place Foreign investor interest is high, and the country already has examples of operating bankable, utility-scale renewables projects.[92]

Recent analysis by the World Bank also suggests there is room for Senegal to grow its renewables capacity more than planned in the near term. Specifically, as Table 3 shows, the World Bank suggests around 216 MW of additional solar would be economically viable to develop by 2027, compared to the government's current plan, based on projected costs and integration needs.

It sees further non-hydro renewables capacity becoming economical towards the end of the decade. Similar to the electoral program of Coalition Diomaye Président, the World Bank also highlights valuable hydro potential within the region of which the government can take advantage (though climate change has reduced rainfall, which could limit hydro's role in the longer term).[93]

Table 3. World Bank projections of economically viable renewable generation capacity (MW)[94]

	2021	2022	2023	2024	2025	2026	2027
Hydro	75	121	121	305	305	436	436
Solar PV	226	251	451	551	551	551	551
Wind	159	159	159	159	159	159	159
Total renewables	**460**	**531**	**731**	**1015**	**1015**	**1146**	**1146**

Renewables present their own short-term challenges for Senegal, but development partners can help mitigate them

Solar and wind's variability necessitates significant grid investments, but a different role for gas will also help

There are of course real limits to the role that variable renewable energy sources such as solar and wind can play in meeting Senegal's power needs on their own. This is mainly because the electricity they produce is not dispatchable.

It cannot be generated and distributed on command when there is demand, flowing onto the grid only when the sun is shining, or the wind is blowing. Solar PV, for instance, can generate power in the country for only around 12 hours a day, and outputs go down during rainy season. Daily peak demand for power also occurs in the early evening when solar PV plants are not generating energy.

Solar and wind availability can also vary given the changeable nature of weather. This variability provides a challenge to grid operators, who must balance supply and demand not only across seasons and at different times of the day to ensure adequate electricity supply, but also second-by-second to ensure grid stability and prevent grid failures like brownouts and blackouts.[95]

These challenges have often been cited as reason to pause ramping up renewables further in Senegal—in particular, that adding more renewables now would destabilize the grid.[96] This conclusion has been at least partly supported by World Bank analysis and private studies.[97] At the same time, the size and nature of the challenge this could pose for Senegal, both now and in the future, is not clear from information in the public domain.[98]

How to model and respond to the challenges caused by adding renewables to the grid is a complex analytical question. The World Bank previously commissioned some integration studies, but these are not in the public domain. If the government is often relying on the bank-funded analysis, it should disclose the main findings and its own plans for integration. Or, if those studies require updating, this should be undertaken, and the results disclosed.

Senegal's grid will certainly need updates and extensions as the generation fleet grows, some of which will take considerable time and money to implement. Some of this is particular to renewables—for example, the establishment of a renewable grid integration center. However, much of the investment will be necessary whether Senegal invests in renewables or gas power since the grid has limited capacity to increase its load right now. This was evidenced by the grid disturbances resulting from the Sendou coal plant coming online in 2018, leading to the government delaying its operation to allow for grid improvements.[99]

Encouragingly, the government and development partners have already made improving transmission and distribution infrastructure a priority.

For example, Senelec has been working to extend and increase the reliability of the network at a cost of around $400 million, funded by the U.S. Millennium Challenge Corporation.[100] Further development of this infrastructure is set to take place under the new government as set out in the electoral program of Diomaye Président Coalition.[101] Recently completed interconnectors with Mali and the Gambia as part of the West African Power Pool, and the recently signed Energy Transport Services Contracts between the Gambia River Development Organization of Senegal, the Gambia, Guinea and Guinea-Bissau (OMVG), should also help.

The government and development partners have also been exploring battery storage solutions, for example at the Taiba n'Diaye wind farm.[102] This is encouraging given substantial storage will likely be needed to enable renewables to ramp up to a much higher level. However, some changes in the financing landscape probably will be needed before storage systems become a large-scale solution for Senegal. Unlike new solar arrays or wind farms, energy storage systems do not provide constant cash flow, which reduces investor interest.

For storage system projects to be bankable, storage operators need the option of "stacking" revenues by offering multiple grid services (e.g., frequency regulation or energy arbitrage). Some may also need to charge buyers capacity payments for storing electricity. To help the monetization of such services, DFIs should commit to concessionary project financing, including guarantees, for energy storage. Storage should also become a more standardized, expected part of tenders for new generation projects.

Adding gas-fired power to the grid could be another way to help to manage variability, and would be particularly valuable while large-scale storage solutions for Senegal are in a relatively nascent stage. Rather than being used instead of renewables, gas could complement them by acting as a "peaker" that provides power when renewables generation drops, or demand is high. Gas is well suited to this role given it can ramp up and down quickly and flexibly.

However, this role will require careful planning. As discussed in the next section, using gas in this way requires different technologies, regulatory frameworks and contractual arrangements to when gas is used for baseload generation. The government also must pay careful attention to the amount of gas power actually needed for stability. USAID's generation master plan suggests that the additional load of reserve power required for more renewables to connect to the grid without grid failure would not be large (though the government would likely need to revisit this question with fresh modeling given developments since the master plan was produced).[103]

Investing in grid upgrades, storage or new gas infrastructure are not the only ways to plan for and respond to power fluctuations. Other options can be as simple—and cost-effective—as using new software, such as IRENA's System Planning Test models, or training people to do their jobs differently.[104] Studies and articles have pointed to a range of options Senegal could explore to improve grid stability as renewables grow in the mix.[105] These include:

- identifying locations for renewable energy zones where both solar and wind can be developed given wind generation tends to peak in the evenings and could therefore be a good complement to solar
- adopting a more flexible power dispatch mechanism
- improving weather and demand forecasting
- developing a new synchronous power reserve strategy
- promoting smart meters and energy efficiency measures.

None of these steps will solve the problems of renewables variability alone. But the government should publicize which ones it has already tried and commit to studying the others that may hold promise.

Renewables are becoming cheaper, but development partners must help bring down the high cost of capital

Both globally and in West Africa, the cost of renewable generation capacity has fallen considerably and is expected to continue to decline. According to the IEA, the levelized cost of electricity (LCOE)[106] fell globally by about 90 percent for solar PV, 70 percent for onshore wind and 60 percent for offshore wind between 2010 and 2022.[107,108] Already in 2022, the global average LCOE for new utility-scale solar PV was 29 percent lower than the cheapest fossil fuel generation; new onshore wind generation was 52 percent lower.[109] The IEA has concluded that many African wind and solar projects are also already competitive compared to gas combined cycle gas turbines (CCGTs), which is the type of gas plant that Senegal appears to be planning to build.[110]

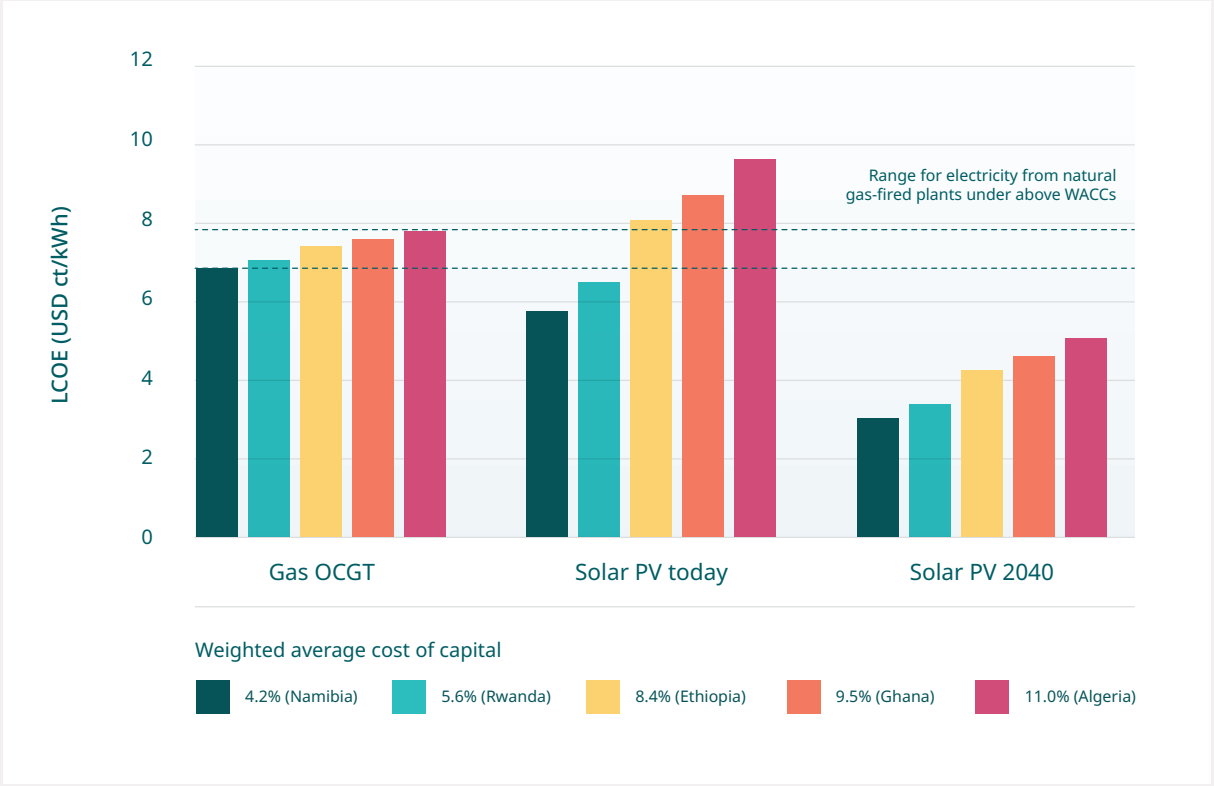
For many African countries, the economics of renewables are potentially more challenging than these estimates suggest, however. Despite LCOE being the most used and only widely available metric for comparing the costs of different technologies, it suffers from several weaknesses; one is that it does not account for the wider costs related to the functioning of the overall power system.[111]

The assumed capital cost of seven percent used by the IEA in the studies referenced above is also lower than the real costs for several African countries. While solar or wind projects can have lower operating costs, not least because fuel costs are zero, they still often have higher upfront capital costs than new gas power plants. For this reason, the cost of capital has a bigger impact on overall costs of renewables than for gas. This is particularly important in the African context. Actual and perceived risks of investing in many African countries mean capital costs for energy projects are up to three times higher in Africa than in Europe and North America on average, and higher for smaller-scale projects.[112,113]

This is despite African projects having lower overall default rates than the global average, in part because projects are so heavily vetted.[114] One study estimates that capital costs for renewables projects in some African countries may be as high as 18.5 percent.[115]

A World Resources Institute comparison of open-cycle gas turbines (OCGTs) and solar PV projects (Figure 9) showed that these capital costs would significantly change the competitiveness of renewables, at least until the cost of renewables falls further, as forecast.

Figure 9. Impact of capital costs on cost of gas and solar plants[116]



Public estimates of Senegal's cost of capital vary. While the International Renewable Energy Agency suggests utility-scale solar PV projects could have incurred capital costs of only 4.3 percent in 2021, the IEA suggests that they may have been around 9 percent in 2022.[117,118] Further analysis is required to establish the current cost of capital for Senegal and its implications for renewables' competitiveness, particularly against the background of higher capital costs globally. The government is also updating its least-cost generation planning for the power sector. Once finished, it should communicate the results, to show its own findings about which fuels will provide the cheapest power under different scenarios.

At the same time, the government and its development partners should work to reduce the cost of capital for Senegalese renewables projects to further increase their competitiveness. According to IEA discussions with investors, efforts should focus on reducing offtake risk—Senelec's payment record and accumulation of arrears has worsened over the past few years—and removing transmission bottlenecks.[119]

As with gas, international public financing for renewables projects is critical for derisking through concessional financing and guarantees. The difference is that there could be more money available for renewables.

Renewables have high upfront costs, but larger amounts of financing could be available via the JETP

While LCOE estimates suggest that at least some solar and wind projects in Senegal could be competitive against gas projects in terms of their overall cost even now, renewable projects often carry higher upfront capital costs than gas projects. The Senegalese government will therefore find it even more challenging to use its own public budget to finance a significant expansion of renewables capacity than for gas, even excluding the wider costs related to grid upgrades and storage. We estimate the additional 346 MW renewables capacity needed to meet the NDC conditional targets by 2030 could cost around $920 million based on current medium-term cost estimates and Senegal's past project costs.[120] This cost is exclusive of any necessary grid upgrades, flexibility systems and energy storage capacity. External financing will therefore be crucial.

The potential pool of funding for clean technologies that Senegal can access is growing, as demonstrated by the new African Development Bank and World Bank partnership to connect 300 million Africans to renewable power by 2030.[121] Total renewables finance for Africa has almost doubled since 2015.[122] Between 2016 and 2019, Senegal attracted nearly three-quarters of a billion dollars in funding for renewables.[123] Recent solar and wind projects in Senegal have attracted loans and guarantees from international public institutions that are stepping back from gas, including the European Development Bank, U.S. Development Finance Corporation, World Bank and various development finance institutions from Denmark, Finland, France, Germany and the Netherlands.[124] Many of these institutions and countries have not backed an African gas power plant in half a decade or longer.[125]

Figure 10. Investment in gas and renewables generation capacity in Africa, 2015-2023[126]



Senegal will need considerably more financing to significantly ramp up its renewables capacity, however. As African leaders made clear in the communique from the Africa Climate Summit in Nairobi in September 2023, and as argued by proponents of the Bridgetown Initiative among others, meeting these needs will require a shift in the approach of DFIs.[127,128]

The bulk of funds for clean energy are still going to wealthier countries.[129] The continent has the world's highest solar resource potential and over 600 million people without electricity access—but thus far is home to only 1 percent of all solar panels.[130,131] This is partly because rich countries have been failing to meet their climate finance commitments to developing countries. It is also because many DFIs have been reluctant to make high-risk, low-return investments.[132] Combined, these have had a knock-on effect on private capital, which the IEA believes will need to constitute 52 percent of financing for Africa to meet the continent's energy and climate goals by 2030.[133]

The JETP could facilitate this step change for Senegal's energy sector: providing coordinated financial and technical support that not only has direct benefits but should "crowd in" more capital, including from private investors.

Given that JETPs are relatively nascent and existing partnerships have been slow to advance, it is unclear how much additional financing the Senegal JETP could leverage.[134] Yet the World Bank has already approved $500 million of co-financing for South Africa to supplement that country's JETP's $8.5 billion package.[135] Other countries have also successfully used international public financing to leverage additional amounts. Morocco, for example, received $230 million from the Green Climate Fund, which mobilized an additional $757 million. A disbursement of $63 million from the Global Environment Facility mobilized co-financing around 13 times this initial amount.[136]

Despite its challenges, Senegal's JETP could therefore still have a considerable impact. To achieve that, it will need to:

- Derisk utility-scale generation capacity investments, including through enhancing the credit-worthiness of Senelec (by providing guarantees that cover payment delays) and innovative instruments that address other key challenges for private investors (such as the shortage of CFA-denominated debt finance with low interest rates and long maturities).
- Provide longer, more generous grants to projects like minigrids that still have uncertain economics.
- Complement existing funding for the grid extensions, upgrades and storage (discussed above) that private investors are unlikely to finance.

In doing so, the JETP would not only increase renewables capacity in the medium term, but should lay the foundations for an even greater expansion in the longer term. As noted above, this long term ramp up is important to ensure that the JETP's target of 40 percent renewables power generation capacity by 2030 is not undone post-2030 by a subsequent massive expansion of gas-to-power that is left unmatched on the renewable energy side.

The government can take several steps to unlock renewables financing, through and beyond the JETP

The IPG must come through with the financing it has committed through the JETP. However, the government should aim to increase the role of renewables even if the JETP were to fail, given the risks that a large gas-to-power expansion entail for Senegal's energy goals and the larger amount of funding likely available for renewables.

There are several ways that the Senegalese government can create a stronger enabling environment for renewables investment—on strategy, institutional framework, regulatory framework and investor outreach. Many of these would also increase the government's chances of attracting investment in gas-to-power. Each of these steps is multifaceted, and without further information not presently in the public domain, detailed guidance is difficult to provide. What follows are some broader principles for consideration by officials.

On strategy, the government must detail a clear, credible long-term pathway on power sector development, endorsed by all institutions, to provide clarity to investors. As noted above, different institutions are leading various policy processes. This presents an opportunity. However, the Ministry of Energy, Petroleum and Mines should coordinate these processes to ensure the same goals and clear investment plans for achieving them.

On the institutional framework, the government should resolve the overlaps and coordination challenges between government entities in general, and the overlaps relating to rural electrification in particular. Encouragingly, the new administration has set out this ambition in its electoral program.[137] The IEA recommends that the government combines the agencies responsible for energy management and renewables, and possibly the rural electrification agency, within a single body.[138]

On the regulatory framework, Senegal scores well overall on the African Development Bank's latest Electricity Regulatory Index, ranking third on the continent. However, it is ranked only 28th on the design of the regulatory framework. It scores particularly poorly on predictability, highlighting the need for the government to provide more clarity on the processes and procedures for making key regulatory decisions.[139]

The government should establish a one-stop shop for authorizations of power plants. It should clarify the applicability and simplify the processes for accessing the incentives it offers for renewables investment.[140] It could also consider reforms to the Electricity Code, adopted in 2021, in the medium term to address the lack of consideration for small-scale, decentralized power generation capacity and the lack of incentives for storage systems.[141]

On investor outreach, in addition to having a clear investment plan and effective institutional and regulatory frameworks, the Ministry of Energy, Petroleum and Mines in collaboration with the Ministry of Finance and Budget must engage with financial institutions and climate funds. The government could engage with the largest providers of international public finance in this area to identify potential projects, adequate financial instruments and necessary reforms. It has already begun engaging with the Green Climate Fund on a readiness program that helps Senegal build the necessary technical and institutional capacity to access its funds and secure co-financing.[142]

Issue 4. Features of gas-to-power contracts and infrastructure necessary for balanced power sector growth

- The government's approach to gas-to-power should allow for longer-term ramp up of renewables as they become increasingly cheaper and provide more energy security than gas.
- The amount of gas-to-power capacity built will largely determine the room that solar and wind have to grow. This highlights the risk of the government continuing with the planned amount of gas-to-power, even if it builds some additional renewables capacity in the near term.
- Careful choice of gas plant technology and contracts will help enable an optimal mix in the long term.

Because renewables' benefits will increase over time, gas-to-power plans should leave room for solar and wind to grow

In Senegal's future electricity mix, gas and renewable power can coexist. The government therefore need not make an either-or choice between the technologies. In some scenarios, building new gas capacity could help encourage the spread of solar and wind—for instance, if the new capacity helps balance the grid or attracts capital for investments that would also benefit renewables (e.g., funds for grid extension and upgrades). In other scenarios, more gas power could have little or no impact on the growth of renewables, especially if new gas plants serve different customer bases than solar or wind installations and do not undermine the power sector's economic or technical performance (e.g., open cycle gas turbines for peak loads).

However, the government must be clear about how it sees gas and renewables working together. The combination of plans for a large ramp up in gas-to-power and a current lack of plans for additional renewables capacity after 2030 risks gas "crowding out" renewables in the longer term. This is the case even if some additional renewables capacity is built using JETP financing in the near term and the JETP puts in place the enabling conditions for a longer-term ramp up. This would leave Senegal locked in to gas long after renewables would be cheaper, cleaner and more secure and therefore be more likely to meet the government's energy goals.[143]

A range of factors and dynamics can put a country on a path to long-term gas dependence, several of which are already evident in Senegal. First, as noted above, the government will likely have to sign take-or-pay contracts for most domestic supply. The government will likely have to sign contracts with similar clauses with gas power plant operators to facilitate their financing. Such contracts could result in the country using gas for decades and prioritizing gas in the power mix because not doing so would lead to costly penalties.

While lock-in through these contracts is impossible to avoid entirely—particularly in relation to gas purchases—the government could explore ways to design contracts that give gas power plants the flexibility to run at lower capacity as renewables grow. As a starting point, officials should conduct their own analyses of investors' actual needs for achieving acceptable rates of return. They should also try negotiating terms in the power purchase agreements for any new gas power plants that could reduce lock-in risk. These could include a flexible operating regime that allow plants to operate at lower capacity over time; affordable, dynamic capacity payments; less risky alternatives to take-or-pay penalties, such as "take-and-pay" or "take-and-cancel", or less risky ways of structuring their take-or-pay obligations;[144] and workable, enforceable provisions for renegotiation, refinancing, decommissioning and early retirement.[145]

Another large lock-in risk lies in the gas infrastructure that will be built to implement the gas-to-power strategy. Most gas infrastructure must run for two to three decades to be cost-effective. However, for power plants, the choice of technology has a considerable influence on the level of risk. Senegal appears to be planning to mainly build CCGT plants. To significantly ramp up baseload generation, this makes sense as CCGTs can generally do this at a lower cost per kWh than other technologies. However, OCGTs cost less to build. Therefore, they can more easily generate a profit while running mainly as a back-up to renewables—for instance, operating in peak or balancing/ancillary modes. Authorities may also be able to retire OCGT plants earlier, depending on the debts and contracts attached.

By contrast, CCGTs' design and high capital costs require them to run frequently and for a long time. CCGT plants are therefore less appropriate for back-up generation, in which capacity they would sit idle most of the time. This could make them more likely to compete with, rather than complement, solar and wind. USAID concluded that smaller reciprocating engine turbines would be the most effective technology for integrating renewables in the grid,[146] though they would be less effective for quickly expanding electricity access. Reciprocating engines that run on gas cost less to build than CCGTs or OCGTs and can ramp up more quickly, but they can cost more per MWh to run and maintain.

Other lock-in risks arise from the opportunity cost of the money, time and political capital spent on gas. For example, the substantial amount of public money that the government may need to finance its gas-to-power plans will mean less funds available to prepare the grid for a larger role for renewables. Key decision-makers will have their hands full trying to implement the former, reducing the amount of attention they can devote to the latter.

These risks highlight the long-term ramifications of decisions made today on the gas-to-power plan. Decision makers must therefore carefully weigh the consequences of an overly large role for gas.

Issue 5. Impact of the JETP on Senegal's future power mix

- The government should pursue expansion of renewables capacity even if the JETP fails. But the JETP is the best opportunity for Senegal to ramp up renewables in both the near and longer term.
- The IPG and the government must deliver expeditiously on the JETP. Failure to advance renewables through the JETP on an accelerated timeline, or uncertainty about the fate of the JETP, would likely result in the government reverting to alternative investments in gas-to-power, at which point Senegal would face an even greater risk of a gas and energy shortage.
- Failure by the IPG to deliver on its commitments will further undermine the credibility of rich countries and their commitment to a just transition.

The 2023 Senegal JETP political declaration was only a first step, paving the way for a series of complex negotiations.[147] If the South African, Indonesian and Vietnamese JETPs are any indication, many negotiations remain before the funds flow.[148] This applies not only to what the EUR 2.5 billion will fund, but also the composition of the funding (e.g., the proportion of grants and concessional loans, and their levels of concessionality), pace and how much additional financing the parties will seek from other sources.

The government is likely to stick to a large gas-to-power plan if it does not think the IPG will deliver

One of the challenges for the government in making decisions about its gas-to-power plan, including on the contracting of gas, is uncertainty about whether and when the JETP financing will materialize. If it plans on a smaller role, it will presumably export the gas it would previously have contracted for the domestic market and build out smaller-capacity domestic supply infrastructure, such as the pipeline network.

Therefore if the JETP financing does not ultimately materialize and the government decides to revert to its previous gas-to-power plan, it would face an even greater risk of a gas shortage. The country could end up with neither enough renewables nor enough gas.

This outcome would also embarrass the IPG members. It would result in more of Senegal's gas being exported, likely to some of the IPG countries, while the promise to ramp up renewables remained unfulfilled and less of Senegal's gas was available to generate power for Senegalese consumers. This situation would further undermine the credibility of climate finance commitments and further increase the understandable skepticism by people in Senegal and other low- and middle-income countries that rich countries genuinely care about a just transition.

However, the government deciding amid uncertainty around the JETP to instead still contract gas for the domestic market could lead to a domestic gas surplus if the JETP financing materializes and there is no need for more gas capacity. This could lead to costly take-or-pay penalties or encourage the government to offer expensive subsidies to stimulate greater demand.

Significantly delaying these contracting decisions until it is clearer whether the JETP financing will materialize is also risky: it could delay investment in upstream activities. Because the energy transition is accelerating, gas investment could become less likely, or may not materialize at all. This will also mean a greater risk of gas shortage if the government ends up relying on a larger role for gas domestically, as well as less export revenue.

The government could mitigate the impact of this uncertainty by still planning on a larger role for renewables both in the near and longer terms whether the JETP financing materializes. This would mean that it can make decisions now with clarity on its energy plan. However, given that the JETP is the best opportunity for Senegal to ramp up renewables, and the risks for all sides in uncertainty, delay or eventual failure of the JETP, the IPG and the government should deliver expeditiously on the JETP.

Issue 6. Public consensus and trust around Senegal's power plans

- Public consultation and publication of information on the government's long-term power plans has been limited, which hinders the building of public consensus and trust, and in turn reduces the credibility of these plans and the ability to attract investment.
- The Ministry of Energy, Petroleum and Mines should disclose signed contracts so that civil society and media can ensure deals are made in Senegal's long-term interest. Contract transparency will also increase public acceptance of deals, which will further boost investor confidence.
- Civil society's role is particularly important in shaping and implementing the JETP since the fulfilment of the JETP's promise hinges on its just execution.

Public consultation and publication of information on the government's long-term power plans has been limited

Key planning documents are not in the public domain. The gas-to-power strategy has evolved since 2018, but more recent versions are not yet publicly available. The government has also not published current versions of the Gas Masterplan, Power Generation Masterplan, Least-Cost Generation Plan and Distribution Masterplan.

The government has not actively consulted with stakeholders on these plans. None of the stakeholders we spoke to were aware of the government soliciting any inputs on the Gas Masterplan. The JETP was close to being signed without any consultation with parliamentarians, civil society actors, or others.[149]

Government plans will understandably evolve over time given geological and commercial uncertainty, which in turn impacts negotiations with companies on upstream projects, and changing funding opportunities, such as the JETP. However, greater transparency and consultation is essential. Without it, parliamentarians and civil society, among others, are unable to effectively participate in the decision-making process, hindering the building of public consensus and trust. Building more public consensus and trust will also support the credibility of long-term planning and therefore increase Senegal's ability to attract investment.

The various policy processes underway provide an opportunity for the new administration to take a different approach. Officials should change approach now, given high public expectations of the transformative impact of gas-to-power and the difficult decisions that the government will need to make to achieve its energy goals.

Contract transparency is urgently needed

The government must increase transparency not only around its long-term plans, but also around the contracts it has signed to implement these plans: from extracting the gas to selling, transporting and burning it. By disclosing these contracts, government officials and companies will be encouraged to strike deals that are in Senegal's long-term interest. With the right contextual information, contract disclosure will also make it more likely that the public accepts the deals that the government makes. In doing so, this will ensure a more stable regulatory environment and boost investor confidence.

The original production sharing agreement (PSA) signed with Petro-Tim Limited for the Cayar Offshore Profond area, which hosts the GTA and Yakaar-Teranga projects, is in the public domain.[150] However, because these projects are now separate operations operated by different entities, some of the original terms are likely to have been revised. While the Extractive Industries Transparency Initiative currently only requires the Ministry of Energy, Petroleum and Mines to disclose PSAs and amendments signed after 2021,[151] the government should also publish amendments (if any) signed before then.

As domestic supply plans are finalized, officials should also consider disclosing the gas sales agreements, including any take-or-pay arrangements, and the contracts that the government signs for the construction and operation of supply infrastructure. Public information on the operations of Réseau Gazier du Sénégal, the state entity responsible for establishing the pipeline network, is limited.

While the disclosure of upstream contracts such as PSAs is increasingly common across the world,[152] disclosure of power purchase agreements (PPAs) signed with power plant operators is lagging, despite the importance of PPA terms.[153] Senegal is scored as "partly transparent" by Energy for Growth Hub's PPAWatch. The government provides some information on its PPAs but does not disclose the PPAs themselves.[154] While parties to PPAs often cite concerns about commercial confidentiality as reasons for not disclosing them, countries including Brazil have published them.[155] The amount of information that does legitimately relate to commercial competitiveness is often minimal and can be redacted.[156]

A JETP that is just in practice requires active civil society involvement

The role of civil society is particularly important in shaping and implementing the JETP given the fulfilment of its promise hinges on its "just" execution. Energy projects, whether powered by fossil fuels or renewables, often entail adverse effects like population displacement and loss of livelihoods, as conflicts during the Taiba N'Diaye power plant construction demonstrated. At the same time, expectations are high that the JETP will help reduce the urban-rural divide in energy access, and foster local employment and business opportunities.

Civil society actors can play a crucial role in mobilizing and advocating for stakeholders in an inclusive consultation process, ensuring that decision makers adequately address communities' hopes and concerns. Civil society should create information exchange platforms, reach a consensus on just energy transition priorities, and ensure projects align with community needs.

However, ensuring that participants in consultations are accountable to wider civil society is crucial, as arbitrary selection of a few actors could compromise the legitimacy of the consultation process. The government and civil society itself share responsibility for ensuring genuine representation. Encouragingly a platform has already been established to facilitate the active participation of civil society in the implementation process of the JETP, and the government is engaging with it.[157]



Photo by JaviAcebal for iStock

Conclusion and recommendations

Senegal has made considerable progress in developing the power sector and expanding energy access in recent years. As the new administration seeks to provide more affordable, reliable energy to the country's households and businesses, one key decision concerns the type of generation capacity it uses.

There has been a lot of attention on the JETP agreement. However, the JETP agreement does not necessarily mean the government has right-sized its gas-to-power ambitions. These aspirations are as significant for whether the government succeeds or fails to meet its energy goals as the JETP agreement itself.

Gas will play an important role in achieving the government's energy goals. However, the government risks falling short of these goals if it pursues as large an expansion of gas-to-power capacity as it is apparently planning. It risks both a shortage of gas and a shortage of funding to build the necessary infrastructure.

If the government does successfully implement a large gas-to-power plan, the decisions it takes over the next few years could inhibit the catalytic impact of the JETP on renewables expansion in the long term. It could lock Senegal into using large quantities of gas far into the future when the alternatives would be unequivocally cheaper and more secure.

The Senegalese government could therefore consider:

1. **Devising a smaller role for gas-to-power that is supportive of a larger role for renewables.** A larger role for renewables would offer a less risky pathway to achieving Senegal's energy goals, and offer additional benefits. Renewables may offer a cheaper source of energy than gas even now, particularly if development partners help bring down the cost of capital. Greater use of renewables will also free up additional gas for non-power uses and export and thereby generate greater jobs and revenue for the country. Increasing renewables capacity will not eliminate the need for building some further gas capacity. However, the government should right-size this expansion and use gas to complement renewables as a "peaker" as much as possible. That requires clear planning on the interplay between gas and renewables in the long term, including careful choice of the gas plant technology and negotiation of gas purchase and gas power plant contracts.

2. **Improving the enabling environment for domestic energy investments.** The government can redouble its efforts to create a stronger enabling environment for both gas-to-power and renewables investments in several respects. The government must have a clear, credible long-term pathway on power sector development to provide clarity to investors. It should coordinate the ongoing policy processes led by different institutions to ensure aligned goals and consistent plans on how to achieve them. The government could also clarify the institutional framework, including resolving the overlaps between institutions, and provide more clarity on the processes and procedures for making key regulatory decisions. Finally, it could consider reforms to the Electricity Code 2021 and Senelec's business model in the medium term. These reforms should allow for greater use of small-scale, decentralized power generation and storage systems.

3. **Increasing transparency and stakeholder engagement.** The government being more transparent and consultative in its planning and decision-making would help it achieve these goals. Given high public expectations of the transformative impact of gas-to-power, greater public awareness of the various opportunities, risks and trade-offs will change the narrative and ease some of the pressure on the government to stick to the current strategy. As part of this, the government should publish not only planning documents but also relevant contracts such as PSA amendments and PPAs. Building more public consensus and trust will also support the credibility of long-term planning and stability of the regulatory framework, and therefore increase the ability of Senegal to attract investment.

Pursuing a pathway with a larger role for renewables is not without challenges. It will require significant support from development partners. However, the funding and technical assistance required will likely be easier to access given global economic and political dynamics.

Development partners should:

1. **Deliver JETP funding.** Senegal's government will have a better chance of meeting its energy goals with a larger role for renewable, regardless of whether the IPG delivers on its JETP commitments. But this does not reduce the importance of the IPG delivering. First, this financing is still the best opportunity for Senegal to expand renewables in both the near and longer terms. Second, if the government does reduce its gas-to-power plans because of the JETP, it is likely to revisit them if the JETP is not delivered, at which point the risks for Senegal will be even greater since more gas will have presumably been committed to export. In that case, the country will have neither enough renewables nor enough gas. Third, the IPG failing to deliver on its commitments will further undermine the credibility of rich countries and their commitment to a just transition. IPG members should act quickly to increase trust in the process.
2. **Focus on derisking and financially challenging projects.** To maximize both the direct benefits and the amount of private capital that is catalyzed by the JETP, the IPG should derisk utility-scale generation capacity investments. This derisking should include improving the credit-worthiness of Senelec by providing guarantees that cover payment delays, and providing innovative instruments that address other key investor concerns such as high local interest rates or the shortage of CFA-denominated debt finance for solar and wind projects. The IPG should also provide longer-term, more generous grants to projects like minigrids that still have particularly uncertain economics. Finally, it should fund the grid extensions, upgrades and storage that private investors are unlikely to finance.
3. **Consider some financing that supports some of the government gas-to-power plans.** Alongside the JETP, DFIs should consider financial and technical support to gas-to-power in Senegal. The ability of the country to meet its development goals, including eliminating energy poverty, largely depends on it. This support should be based on a clear, credible long-term government plan in which the role of gas is right-sized and supports rather than undermines growth of renewables.[158] If these criteria are met, such support should be feasible on the basis of DFIs' own more recently nuanced positions around gas-to-power financing.

Other stakeholders, such as civil society and the media, also have a critical role to play. They must encourage the government to increase transparency and consultation and utilize any increase in government openness to effectively engage with, and interrogate, the planning process. These stakeholders should also seek to hold the government and development partners accountable for delivering these plans.

If all stakeholders play their part, Senegal will have a better chance of achieving the energy future to which the new administration aspires.

Appendix. Methodology for gas demand and supply projections

Gas demand

The government's current gas demand projections for 2030, 2040 and 2050 are described in the IEA energy policy review and are shown in Table 4.[159] We extrapolated these projections to show possible demand, based on government expectations, in all years between now and 2050.

Table 4. The government's gas demand projections in IEA policy review (bcf)[160]

Sector	2030	2040	2050
Power	60.01	63.54	84.72
Industry	10.59	24.71	49.42
Transport	0.706	3.53	7.06
Total	**71.306**	**91.78**	**141.2**

Demand from power generation in the next few years is intertwined with the commencement of domestic supply of offshore gas. We assumed demand from power generation starts in 2026. With GTA phase 1 expected to start production in 2024, the St Louis power plant should be able to access its gas as soon as construction of the plant and accompanying pipeline are completed, which is currently expected in 2026. The Malicounda and Cap des Biches plants can switch from HFO to gas once Yakaar-Teranga starts production and the necessary processing and pipeline infrastructure is completed, which the government expects to also be in 2026. It is unlikely that any other gas-to-power plants will be constructed and ready to start operation in 2026.

We therefore based demand in 2026 on the capacity of these plants and an operational ramp-up period. We extrapolated assumed demand in 2026 to 2030, and then for the following two ten-year periods.

We assumed that a limited amount of industry demand will continue from now until the start of domestic supply from the offshore. We assumed demand in 2024 and 2025 aligns with production by the Gadiaga field, as modeled by Rystad. We assumed industry demand increases from 2026. We extrapolated it to 2030, and then for the following two ten-year periods. We assumed that the transport sector will start demanding gas in 2030. We extrapolated demand for the following two ten-year periods.

Gas supply

The government's current expectations of domestic supply from the GTA, Yakaar-Teranga and Sangomar projects are set out in the IEA policy review.[161] This document reports the year that the government expects domestic supply to start and the amount of gas it expects at peak production but provides limited information on the duration of this supply. We used Rystad recoverable reserves estimates and the LNG export plans set out in the IEA policy review to model the possible production profile and duration of domestic supply for each project and phase.[162] These assumptions are set out in Table 5.

We modeled two possible designs for the Yakaar-Teranga project, though the actual design may ultimately be different to both. For the "Yakaar-Teranga – development concept" design, we assumed domestic supply of 150 mmcf/day or 55 bcf/year and LNG exports of 3 mmtpa in phase 1, and an additional 7 mmtpa of LNG exports in phase 2. For the "Yakaar-Teranga – maximum additional amount" design, we assumed domestic supply of 500 mmcf/day or 183 bcf/year and no LNG exports in phase 1, and 10 mmtpa of LNG exports in phase 2. Given the significant amount of LNG capacity envisaged in phase 2 with either design, we assumed it is constructed incrementally (the construction profile does not affect our results). The allocation of reserves between phases 1 and 2 is unclear and therefore we combine them to create one production profile for each design.

The production profile of the three projects and their phases will depend on multiple factors including the physical features of the gas reservoirs and the well drilling schedule. For this analysis, we made a simplifying assumption of production for each use reaching its peak after two years (with the exception of LNG capacity in Yakaar-Teranga's phase 2 as noted above). We assumed production would remain at this level for as long as there are sufficient reserves.

Table 5. Assumptions for domestic supply profiles based on government expectations[163]

Project, phase	Recoverable reserves (bcf)	Production start	LNG volume (mmtpa)	LNG production start	Domestic supply volume (bcf/year)[164]	Domestic supply start
GTA, phase 1	4,986	2024	2.5	2024	12	2026
GTA, phase 2	1,784	2028	2.5	2028	18	2028
GTA, phase 3	6,533	2030	5	2030	18	2030
Yakaar-Teranga – development concept	14,129	2026	Phase 1: 3 mmtpa Phase 2: 7 mmtpa	Phase 1: 2026 Phase 2: 2028	55	2026
Yakaar-Teranga – max. additional amount	14,129	2026	Phase 1: 0 mmtpa Phase 2: 10 mmtpa	Phase 1: - Phase 2: 2028	183	2026
Sangomar, gas phase	443	2027	0	-	20	2027

Of course, government expectations could prove over-optimistic. One potential source of disappointment is timing, with domestic supply from these projects starting later than expected. Rystad's estimates of when these projects and phases will start are set out in Table 6.

Table 6. Rystad estimates of the first year of production[165]

Project, phase	Production start
GTA, phase 1	2024
GTA, phase 2	2030
GTA, phase 3	2036
Yakaar-Teranga, phase 1	2028
Yakaar-Teranga, phase 2	2033
Sangomar, gas phase	2036



Photo by Lamine Coulibaly for CIF Action

Endnotes

1. Government expectations are set out in International Energy Agency (IEA), *Senegal 2023 Energy Policy Review*, 2024, www.iea.org/reports/senegal-2023. We explain the adjustments we made in the appendix. The "maximum additional amount" of domestic supply from Yakaar-Teranga is the volume set out in the IEA policy review additional to that envisioned in the current development concept.
2. IEA, *Senegal Energy Policy Review*.
3. rfi, "Economic transparency now a requirement in Africa," 5 April 2024, www.rfi.fr/fr/podcasts/%C3%A9co-d-ici-%C3%A9co-d-ailleurs/20240405-la-transparence-%C3%A9conomique-d%C3%A9sormais-une-exigence-en-afrique.
4. The urban electrification rate reached 97 percent, while rural electrification lagged at 55 percent in 2022. IEA, *Senegal Energy Policy Review*.
5. International Monetary Fund, *Senegal: Selected Issues*, 2022, www.imf.org/en/Publications/CR/Issues/2022/01/14/Senegal-Selected-Issues-511935.
6. Kosmos Energy, "Kosmos Energy Increases Working Interest and Assumes Operatorship of Yakaar-Teranga," 11 June 2023, investors.kosmosenergy.com/news-releases/news-release-details/kosmos-energy-increases-working-interest-and-assumes.
7. Petrosen is planning to ultimately have the largest stake in the project, holding 34 percent of the shares, with Kosmos and a third partner each holding 33 percent. Petrosen Holding, "Communique De Presse – Réaménéagement de l'Association avec montée en participation de PETROSEN et un rôle d'opérateur de Kosmos," 7 November 2023, twitter.com/Groupe_PETROSEN/status/1721846905095803195.
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42. Thierno Seydou LY, "Investment opportunities in the Senegalese Oil and Gas sector," Ministry of Energy, Petroleum and Mines, 2022, ambassadesenegal.be/wp-content/uploads/2022/07/Presentation_to_Investors_Investment_Opportinuties_Oil_Gas_rf.pdf.
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48. Woodside Energy, "Sangomar," no date, www.woodside.com/what-we-do/growth-projects/sangomar.
49. Marc Howard, "Senegal: Kosmos takes Yakaar-Teranga operated stake, outlines LNG plan," African Energy, 7 November 2023, www.africa-energy.com/news-centre/article/senegal-kosmos-takes-yakaar-teranga-operated-stake-outlines-lng.
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56. Katarina Hoije, "BP Exits Gas Field in Senegal After Disagreement Over Exports."
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58. Sam Butler-Sloss and Kingsmill Bond, "The Energy Transition in 2022," RMI, 21 December 2022, rmi.org/energy-transition-in-2022.
59. IEA, *World Energy Investment 2024*, 2024, www.iea.org/reports/world-energy-investment-2024.
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61. The IEA expects demand to fall faster in Europe and to rise less in Asia than it had only two years ago, and therefore for European prices to be around $7 per mmBtu between 2030 and 2050 and Asian prices to fall from around $9 per mmBtu in 2030 to around $8 per mmBtu in 2050. The IEA only reports prices for China and Japan in Asia, so we take a straight average of the two. IEA, *World Energy Outlook 2021*, 2021, www.iea.org/reports/world-energy-outlook-2021; IEA, *World Energy Outlook 2023*.
62. Rystad assumes a hurdle rate in nominal terms of 10 percent and an inflation rate of 2.5 percent.
63. In the IEA Additional Pledges Scenario, European prices are a little over $6 per mmBtu in 2030 and a little over $5 in 2050, while Asian prices are around $8 per mmBtu in 2030 and $6 per mmBtu in 2050. Prices are even lower in the IEA Net Zero Scenario.
64. Ed Reed, "BP tipped to reach next Senegal FID this year," Energy Voice, 27 January 2023, www.energyvoice.com/oilandgas/africa/lng-africa/478810/senegal-bp-lng-fid.
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68. Demand includes expected demand from non-power uses.

69. Papa Daouda Diene, Thomas Scurfield and William Davis, *Why Senegal Should Minimize Petroleum Operations Emissions* (NRGI, 2023), resourcegovernance.org/publications/why-senegal-should-minimize-petroleum-operations-emissions.

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79. IEA, *Senegal Energy Policy Review*.

80. Seydou LY, "Investment opportunities in the Senegalese Oil and Gas sector."

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92. USAID, *2017-2035 Power Generation and Transmission Master Plan for Senegal*, 2017, pdf.usaid.gov/pdf_docs/PA00T14V.pdf; BloombergNEF analysis of Senegal renewables prospects (no longer online); IEA, *Africa Energy Outlook 2019: Senegal*, 2019, iea.blob.core.windows.net/assets/1d996108-18cc-41d7-9da3-55496cec6310/AEO2019_SENEGAL.pdf.

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96. Ndiate Cisse, *The second wave of Senegal's energy transition: From HFO to renewables to a hybrid gas-renewable system* (Energy for Growth Hub, 2021), www.energyforgrowth.org/wp-content/uploads/2021/07/The-Second-Wave-of-Senegals-Energy-Transition_vf.docx.pdf.

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107. IEA, *World Energy Outlook 2023*.

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110. IEA, *Africa Energy Outlook 2022*, 2022, www.iea.org/reports/africa-energy-outlook-2022.

111. Morgan Bazilian and Sakhi Shah, *LCOE and its Limitations* (Energy for Growth Hub, 2020), energyforgrowth.org/article/lcoe-and-its-limitations.

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About the authors

Papa Daouda Diene is an Africa senior economic analyst at the Natural Resource Governance Institute (NRGI) where he leads analytical work in Francophone Africa. Thomas Scurfield is an Africa senior economic analyst and Aaron Sayne is the domestic energy transition lead at NRGI. Jessica Obeid is the founding partner of New Energy Consult.

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