ENERGY
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Country Guide: Mozambique

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The Republic of Mozambique stretches along the south-eastern coast of Africa and has a 2,470 km coastline on the Indian Ocean. Its terrain ranges from coastal lowlands in the east to a high plateau in the north-west and mountainous regions along the western flanks of the country. Climatically, Mozambique is characterised by sub-tropical conditions in the south-east and tropical conditions towards the north. The country borders South Africa and Swaziland to the south, Tanzania and Malawi to the north, and Zambia and Zimbabwe to the west.

Figure 1. Map of Mozambique. Source: d-maps

The country has a growing population, with a growth rate of 2.8% in 2021, bringing the total population to almost 33 million people in 2022. That said, the large size of the country means that the population density is less than 30 people/km^2.

Mozambique has an interesting and tragic history. A distinct Swahili culture has developed in northern Mozambique, with the development of Swahili ports between the 7th and 11th centuries frequented by traders from all over the Indian Ocean, Somalia, Ethiopia, Egypt, Arabia, Persia, and India. The voyage of Vasco de Gama in 1498 marked the arrival of Portuguese in the country, where they remained for over four centuries. The Portuguese colonisers enjoyed great economic success, due to the richness of Mozambican resources and strategic location. However, Mozambicans themselves did not benefit from this: the infrastructure and central services that were developed, such as healthcare and education, were not made available to non-Portuguese Mozambicans. Although Mozambique was a Portuguese colony for more than 450 years, just over 50% of the population speaks the country's official language, Portuguese, which is a low figure compared to former Anglophone and Francophone colonies. Those who speak Portuguese are mainly located in urban areas.

The War of Independence lasted for more than 10 years, between 1964 and 1975. The war was mainly a guerilla war, led by the communist and anti-colonial organization Front for the Liberation of Mozambique (FRELIMO). During the conflict, the Portuguese regular army maintained control over urban centres while the guerilla forces

sought support in rural and tribal areas. Eventually, the FRELIMO took control of the territory and Mozambique gained independence from Portugal in 1975. However, the country soon embarked upon another long-lasting civil war whose legacy is still strongly felt to this day. The Mozambican Civil War, fought between the incumbent Marxist FRELIMO and the communist insurgent forces of the Mozambican National Resistance (RENAMO), erupted in 1977. It only ended in 1992 with the end of the Cold War, when Soviet and South African (and US) support of rival factions ended. This war took a massive toll on the population. Over one million Mozambicans were killed in the fighting or starved due to interrupted food supplies. An additional five million were displaced across the region. The war also significantly impacted the development trajectory of Mozambique, with destruction of major infrastructure including roads, rail lines, hospitals, and schools. Following the collapse of USSR and anti-communist South African support to RENAMO, a peace agreement was signed in 1992, establishing a multi-party democracy.

The country's first democratic elections were held in 1994 and were won by the FRELIMO party, which remains in power today, having most recently won the 2019 general election. The period between 1994 and 2013 was largely politically stable; however, hostilities were reignited when the opposition party, RENAMO, claimed that the 2013 general elections were rigged and unconstitutional. This led to several armed confrontations between RENAMO supporters and the Mozambique national army, resulting in renewed social and economic disruption. In 2016, however, a truce was agreed between FRELIMO and RENAMO which sought to decentralise power and pave the way for private sector-driven economic recovery.

Table 1. Mozambique at a glance[1]

Capital	Maputo
Total area	786,400 km²
Population	33 million (2022)
Population growth	2.7% (2022)
Official languages	Portuguese
Rural population	62% (2022) *64% (2018)*
GDP	US$ 17,850 M (2022)
GDP per capita	US$ 541 (2022)
Currency	Mozambican Metical (MZN)
Exchange rate 01/03/2022 01/03/2020 01/03/2018	 1 GBP = 76.83 MZN 1 GBP = 83.18 MZN 1 GBP = 85.00 MZN
Access to electricity **Urban electricity access** **Rural electricity access**	31.5% (2021) *29% (2020)* 77.3% (2021) 3.8% (2021)

Since 2017, Mozambique has struggled with extremist insurgency in the northern parts of the country, primarily around Cabo Delgado province. The area is considered a fertile ground for radicalisation, particularly for youth, due to the high unemployment and low literacy rates. Members of the Al-Shabaab movement in Tanzania crossed the border to radicalise young people who are then embroiled in insurgent attacks. Between 2017 and January 2019, 150 people were killed and 500 houses destroyed in these attacks. In March 2021, Islamist rebels seized the city of Palma, causing the murder of dozens of civilians and the displacement of 35,000 people. The city was recaptured by the military forces of Mozambique two weeks later, backed by a South African private military organisation.

Economy

Mozambique is characterized as a low-income East African economy with significant inequalities: 64% of the population is living on less than 1.90 USD/day, while 46% of income is held by the top 10%[2]. While the country is rich in natural resources, 74% of the workforce are in rural jobs marked by low productivity. The economy is chiefly geared around fishing and agriculture, with growing industries in food and beverages, chemical, aluminium and oil. The ties with South Africa are pivotal to the country's development, the relatively wealthy southern neighbour that remains Mozambique's main trading partner. Maputo still preserves a close relationship with Portugal which provides an entry point to European markets. In the 2010s, important offshore natural gas reserves were discovered, with the potential to significantly increase Mozambique's development

[1] World Bank data 2022
[2] *Africa Energy Outlook* (IEA, 2022)

potential. The Islamist terrorism in the north however endanger these newly discovered natural gas reserves to exploitation. The country is facing a high public debt which amounted to 86.2% of GDP in 2021.

Mozambique is listed as a low-income country with a GDP per capita of US $541 and is ranked 47th out of 54 African countries in terms of GDP. Since the establishment of democracy in 1994, the country's economic structure has not changed significantly, with some deindustrialisation being seen in a few sectors, barring the extractive industries. In 2021, the agriculture and fishing sector still accounted for more than a quarter of the GDP (27.5%), on the rise compared to 2015 (22.9%) due to deindustrialization, while employing almost three-quarters of the workforce. Despite this and the country's favourable climate, the country is a net importer of food, especially from neighbouring countries such as South Africa.

As a share of GDP, manufacturing has remained under 10% since 2011 and currently stands at 8%, declining from 13% in 2000. Industry, however, has seen notable growth since the early 2000s, accounting for 22% of GDP in 2021. Extractive industry is dominated by coal for export, though increasing focus is being directed at the country's oil and gas sector. Tourism is also an important economic sector in the country, expecting to continue growing in importance.

Like many emerging economies, the Mozambican economy has been quite volatile, driven by external commodities pricing. Economic growth in 2015 was an impressive 6.7%, buoyed by coal, coke, natural gas and aluminium exports, however this slowed to an average of 3.7% in the years to 2018 then fell to 1.9% in 2019, mainly due to the damages inflicted by cyclones Idai and Kenneth. Mozambique was again hit by the Eloise and Gombe cyclones in 2021, followed by destructive floodings. 2020 saw a contraction of 1.2% due to the pandemic, followed by a recovery at 2.3% in 2021 and growth of 4.1% in 2022. Reaching a high of 19.4% in 2018, interest rates have since been reduced by the Bank of Mozambique to 13.4% in 2021. Between 2018 and 2021, inflation dropped to below 4%, but then rose steeply to 10.3% in 2022.

In 2016, following the peace agreement between the political factions, it emerged that the government had previously taken on debt without disclosing it publicly (and hence not following legal protocols). It emerged that Mozambique's debt was understated by around US $1.4 billion. This increase pushed the government debt-GDP ratio to just under 100%. As a result, 'debt dynamics', a measure of the sustainability of public finances, is one of the major issues that need to be addressed according to the Global Competitiveness Report, with Mozambique being rated as 140th out of 141 countries. The country is working to reduce its debt-GDP ratio through improved tax collection and debt restructuring agreements with international lenders.

The Mozambican economy is operating under a socialist regime, which has been in place since the 1975 independence from the capitalist Portuguese regime. During the Independence War, FRELIMO gained influence and control over the rural population by accusing the Portuguese forces of suppressing the poor and vulnerable through abusive labour, and depriving people of access to basic services such as education, electricity, and clean water. The subsequent socialist reform was therefore an integral component to the country's independence and sought to create an inclusive and equal economy that benefitted all members of society instead of a wealthy elite. The socialist regime has seen Mozambique nationalising many industries and has a general aversion to the private sector due to its history of exploitative practices in the country. This is especially apparent in sectors providing public services such as the energy sector, where the government assumes a controlling role and has been reluctant to cede control to the private sector.

As a result of the socialist regime, the government plays a central role in planning and there is a highly bureaucratic structure to the economy. When combined with cumbersome labour regulations and the corruption which has vastly weakened the economy over the last decade, this bureaucracy has stifled growth in many industries, frustrating private sector actors. There is a large informal sector in Mozambique which opts to not formalise their enterprises because of the bureaucracy and complexity inherent in dealing with government agencies.

In terms of the ease of doing business in 2020, as measured by the World Bank in their now-discontinued annual survey of business regulation in 190 economies, Mozambique ranked 138th globally. Figure 2 illustrates Mozambique's performance on a host of metrics, showing the need to improve the procedures for starting a business, getting finance and credit, and strengthen the legal system to enforce legal contracts. That said, Mozambique is performing well on matters pertaining to construction permits and licensing.

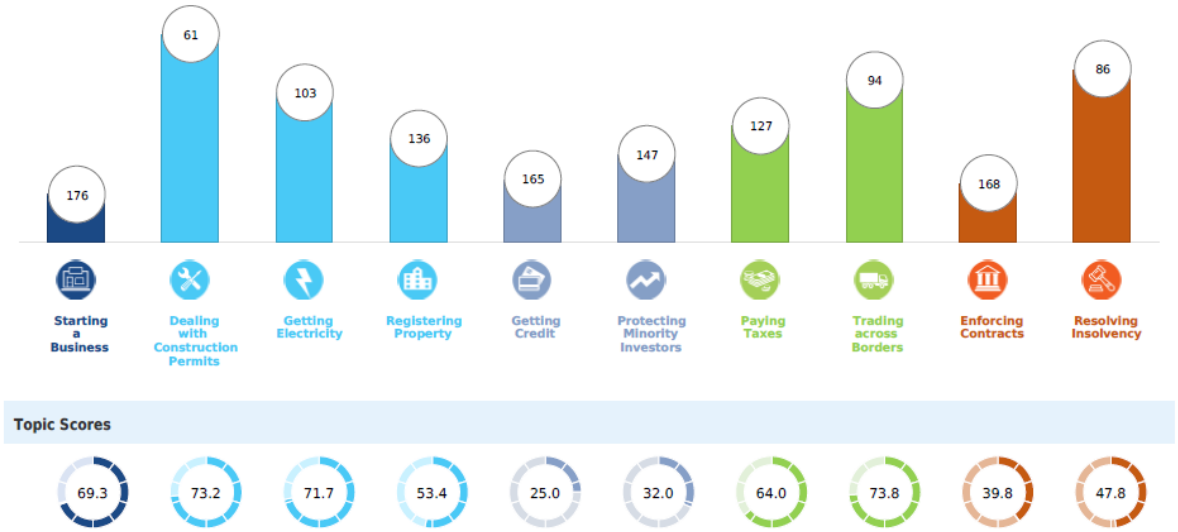

Figure 2. World Bank doing business 2020 global rankings and scores. Source: World Bank Group, 2020

The energy sector in Mozambique[3]

Looking at the energy sector through a primary supply lens, biomass, primarily in the form of forest resources, provides the vast majority (69% in 2022, amounting to 322,986TJ) of the total primary energy supply. Biomass is almost exclusively used for cooking and heating in rural areas where electrification rates are low. It must be noted that while this can be considered a renewable energy source, current forest resources in Mozambique are not being sustainably managed, leading to a current loss of 265kHa of forests annually. Crude oil is ranked second (12.3%) in terms of primary energy supply in Mozambique. It is mainly used for transportation (74%) and to a lesser degree within industry (12%). Hydro-energy, as a major electricity generating source (83%), is ranked third (12.1%) for primary energy supply. Natural gas (6.5%) completes the energy supply of Mozambique as coal and other renewable such as solar and wind are negligible (0.3% combined).

Mozambique has made considerable progress in terms of increasing electricity access: in 2001 just 5% of the population could access electricity, while this figure is 31.5% as of 2023. However, much work still must be done to ensure that those in rural areas have access to modern energy services and, to that end, a number of donor-funded electrification programmes are in progress.

At 187 GW[4] (excluding the theoretical solar potential), predominantly from gas and coal power, Mozambique has the largest electricity power generation potential in Southern Africa. Thus, theoretically, their security of supply should not be an issue. However, installed capacity sits at only 2,700MW, of which hydropower with Cahora Bassa plant accounts for 79%, and gas 16%[5]. Despite this low installed capacity, a considerable amount of the electricity generated in Mozambique is exported. Indeed, total electricity supply from Mozambican power plants in 2015 was 19,913GWh, 85% of which came from hydropower, versus a domestic peak demand recorded

[3] Main source of data: IEA country data Mozambique
[4] USAID - Power Africa data
[5] Development Bank of Southern Africa (DBSA) - Country priority plan Mozambique (2021)

at only 655MW and 3,908GWh, according to the Integrated Electricity Master Plan[6]. In 2020, according to the International Energy Agency, 18,957GWh was produced in Mozambique (83% of which by hydro), while the final electricity consumption amounted to 12,200 GWh.

Household and commercial use in Mozambique only consumes 10% of the electricity from the Cahora Bassa Dam (HCB), while a further 30% is exported to South Africa, and the remainder is fed into the Mozal smelter (60%). The Mozal smelter is an aluminium refinery owned by BHP Billiton that produces 540,000 tonnes of raw aluminium per year and is currently undergoing expansion upgrades to boost production to 740,000 tonnes per annum.

Electricity demand is expected to grow substantially in Mozambique in the coming decades. By 2043, consumption is expected to be ten times greater than current levels, with an annual growth rate of 8.5%. The growth in electricity demand is expected to arise from increasing economic growth and increasing electricity access.

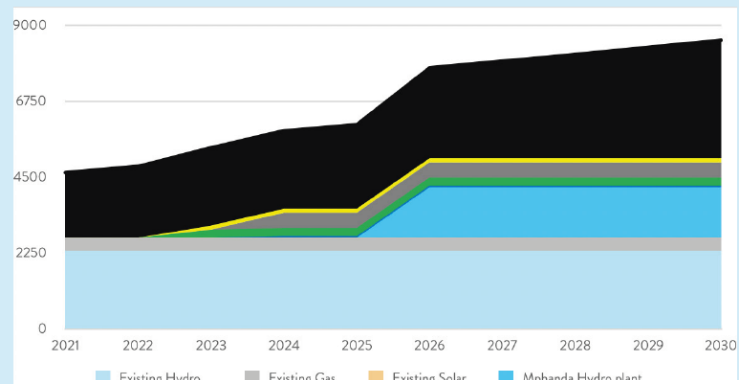

Figure 3. Expected evolution of the installed capacity

Source: DBSA: Country priority plan Mozambique (2021)

The Mozambique government has plans to expand the country's generation capacity from the current 2,700MW to roughly 5,000MW by 2030 as shown in Figure 3. To achieve this, the government has identified 4 priority interventions:

- *Mphanda Nkuwa Dam*: the most important investment as the hydropower plant will add 1,500MW of capacity to the grid. The project also includes the construction of a 1,300km high-voltage line between the project site in Tete province and Maputo. Due to the lack of infrastructure in Mozambique, a significant part of the electricity generated is planned to be sold to South Africa.
- *Tsate hydropower plant*: 50MW hydro power project located on Revue basin in the Manica region, which aims at strengthening the energy supply in the Beira corridor. The project is a run-for-river project, consisting of three turbines. The construction is expected to start in 2023 and the project to be commissionned in 2025.
- *The renewable energy auctions program (PROLER)*: The PROLER programme will support the Mozambican government in their bid for tenders for renewable energy generation projects (solar and wind). The objective stands at four renewable energy projects, three solar and one wind, with a unit capacity of 30MW to 50MW connected to the grid. The programme is expected to provide a cumulative capacity of 130MW at an estimated cost of about €200 million. Most of the funding will come from private investors, while the European Union will contribute roughly 20% of the funding. The first two projects selected under PROLER programme are the power plant in Mocuba, with an installed capacity of 40MW, and the 41MW Metero solar facility in the Cabo Delago province[7]. As of 2022, two more solar PV plants located in Lichinga (50MW) and Manje (40MW) are at their announced stage and the construction is expected to begin in 2023/24. In 2023 a windfarm of 50MW will also be auctioned through the programme[8].
- *The Temane combined cycle gas project*: a 450MW combined cycle gas-fired thermal plant located in Temane in Inhambane Province. The new facility with the capacity to meet the electricity demand of up to 1.5 million households is expected to start generating power in 2024, and will be operated under a public private partnership (PPP) between the public operator Electricidade de Moçambique (EDM) and the UK-based developer and operator Globeleq as the lead developer. The power plant will receive

[6] https://openjicareport.jica.go.jp/pdf/12318606.pdf
[7] https://solarquarter.com/2022/06/06/edm-to-invest-40-million-in-solar-and-wind-power-under-proler-initiative/
[8] Development Bank of Southern Africa (DBSA) - Country priority plan Mozambique (2021)

gas supply from the Pande-Temane gas fields, and the electricity generated will be transmitted into the grid through a 25km-long, 400kV single-circuit power transmission line connecting the Vilanculos substation. The project reached financial close in early 2022 for a total cost of $2 billion.

Oil and gas

Mozambique has major natural gas reserves from when significant gas discoveries were made around 2010. The total recoverable gas resources amount to 148 trillion cubic feet (Tcf), discovered in the Rovuma and Mozambique basins (respectively 138Tcf and 10Tcf), ultimately making up 14% of total recoverable gas discovered on the continent, ranking Mozambique third in Africa in terms of reserves, behind Nigeria and Algeria[9]. Despite Mozambique's vast offshore gas reserves, production has been slow to materialize, and Mozambique's developing Liquefied Natural Gas (LNG) sector is already being reshaped as domestic above-ground risks and global gas markets evolve. The natural gas reserves discovered in Mozambique could provide much needed economic and social prosperity, if these resources are managed and exploited in a way that is beneficial to all stakeholders.

The giant reserves of Rovuma basin hold three major LNG projects: the Mozambique LNG project, the Rovuma LNG project and the Coral South FLNG project split into two areas, Area-1 and Area-4, as seen in Figure 4 below. The exploitation of the Rovuma basin reserves has been slowed down by the instability of the Northern's Mozambique region due to the ongoing Islamist insurgency in Cabo Dalgo province, epitomized by the djihadist raid on 75,000 inhabitants Palma city in March 2021, mainly affecting the onshore operations.

First, the Mozambique LNG project comprises the Golfinho-Atum gas field development in the offshore Area-1 block, and the construction of a 12.9 million tonnes per annum (Mtpa) onshore LNG facility on the Cabo Delgado coast, with the ability to be expanded up to 43Mtpa[10]. The gas fields are located 1,600m deep, 40km off the coast. The Offshore Area-1 is estimated to contain 75Tcf of recoverable natural gas resources. The French oil major Total Energies holds a majority stake (26.5% acquired for $3.9 billion in september 2019) in the Rovuma Basin Area-1 development consoritum, and is the operator of the project. The $20 billion final investment decision was taken in June 2019, immediately followed by the start of construction works in August 2019. The project was frozen in 2021 due to security issues since the Palma raid, at the doorstep of the project for many gas workers, but the project is slated to restart in 2023.

[9] https://www.spglobal.com/commodityinsights/en/ci/research-analysis/is-floating-lng-the-key-to-unlocking-the-rovuma-basin-potential.html
[10] https://www.nsenergybusiness.com/projects/area-1-mozambique-lng-project/

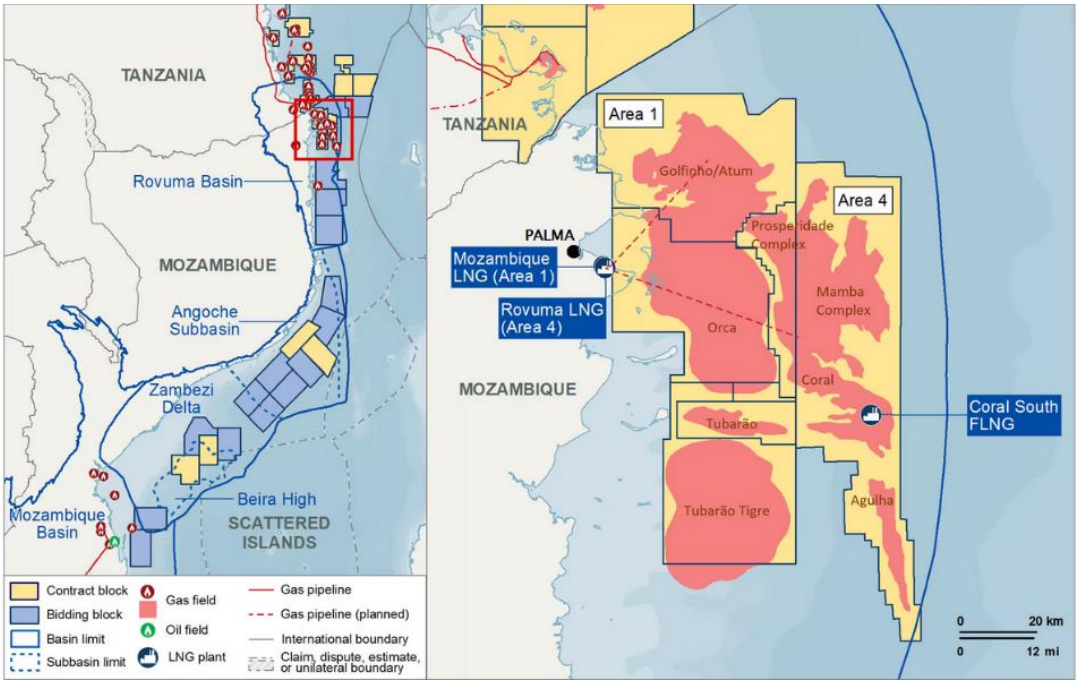

Figure 4. Mozambique's Rovuma Basin gas fields and LNG project locations

Source: S&P Global Commodity Insights [11]

The second area of Rovuma Basin, Area-4, hosts two LNG projects: Coral South Floating Liquified Natural Gas (FLNG) and Rovuma LNG. 70% of the permits are held by Mozambique Rovuma Venture, a joint venture between ENI, ExxonMobil and CPNC, holding 35.7%, 35.7% and 28.6% respectively. The remaining 30% are equally shared by a Mozambican (ENH), a Portuguese (Galp) and a South Korean (Kogas) company. Holding 25% overall ownership interests each, ENI and ExxonMobil will lead the development and operations of Area-4 projects. ENI will be responsible for the construction and operation of all upstream facilities, including the South Coral FLNG, while ExxonMobil will lead the construction and operation of the Rovuma LNG project and associated onshore facilities for the Area-4.

- The Coral South field is operational since late 2022 and should be transformational for country's economy. Exports from the Coral South field are expected to be 3.4Mtpa[12], which will be purchased by BP under a 20-year contract. It is the world's first ultra-deepwater FLNG to operate within 2,000m-deep waters. The FLNG facility of Coral South has taken eight years to reach first production since the final exploration well was drilled in 2014, but it remains well ahead of the onshore plants, which face ongoing delays mainly due to security concerns. The project reached financial close of $4.67 billion in 2017 and construction started in 2018[13].
- The Rovuma project is a 15.2Mtpa LNG export facility expected to be brought on stream in 2025 and to pave the way for the country to become one of the leading LNG exporters in Africa[14]. The project targets the development and commercialization of 21.7Tcf of high-quality gas resources. The plant will receive up to six billion cubic feet (bcf) of natural gas a day through a new 45km subsea pipeline corridor. As for the Mozambique LNG projects, both of them are intricately linked due to the geographic situation, Rovuma LNG project has experienced operational delays, first due to the pandemic and the sudden drop in oil prices, then from the security situation in Northern Mozambique. The Rovuma project has not yet reached financial close, and two major banks - BNP Paribas and Unicredit - have refused to

[11] https://www.spglobal.com/commodityinsights/en/ci/research-analysis/is-floating-lng-the-key-to-unlocking-the-rovuma-basin-potential.html
[12] https://www.offshore-technology.com/projects/coral-south-flng-project-rovuma-basin/
[13] https://www.nsenergybusiness.com/projects/coral-south-flng-project-mozambique/
[14] https://www.nsenergybusiness.com/projects/rovuma-lng-project-mozambique/

participate in the project due to pressure from social and environmental NGOs[15]. The completion of the Mozambique LNG project should, however, accelerate access to financing for the ENI-led project.

The Temane and Pande gas fields lie in the Mozambique Basin located in the central part of the country and straddling the coastline (both onshore and offshore) with a proven reserve of 3.5Tcf. In 2000, Sasol in partnership with the National Oil Company (ENH) entered into a 25-year agreement to produce 120PJ of natural gas that would be used domestically in Mozambique and exported to South Africa. The result of this partnership was the establishment of the Pande and Temane gas fields and the construction of an 865 km pipeline between the Temane gas field and to the Sasol plant in Secunda in South Africa. Gas production in this field began in 2009. By the end of 2019, about 1.1Tcf of gas and 1.8 million barrels of condensate were produced from these fields. The estimate for remaining recoverable reserves for this field is about 1.3Tcf gas, according to Sasol estimates. By end of July 2023, the Pande-Temane Complex conventional gas field recovered 74% of its total recoverable reserves, with peak production in 2017. The field currently accounts for approximately 68% of the country's daily output. Based on economic assumptions, production is expected to be tapering off from 2023 and will continue until the field reaches its economic limit in 2032. This will leave South Africa with a 98 million GJ gas shortfall. However, a joint development agreement between Total and the Southern African gas infrastructure developer was signed in 2019 for the establishment of a LNG terminal in Matola in Maputo's suburbs which would secure supply through the currently existing gas network. A proposed 2,000MW power plant will be operated by Matola & Co., a subsidiary of Gigajoules, which currently controls a 100km pipeline network around Maputo. As the gas is coming from Pemba and Temane gas fields in decline, Total has shown interest in supporting gas imports, firstly from international LNG markets, until liquefaction facilities in northern Mozambique start producing. Total is expected to provide up to 500,000 tonnes per year of LNG to the project.

The Mozambican constitution states that natural resources in the soil and subsoil belong to the state, so the government formulated a regulatory framework that would allow concessions of up to 30 years to allow these gas discoveries to be pursued. In 2014, Mozambique published its Natural Gas Master Plan, which is an instrument to promote intersectoral coordination on natural gas project design and implementation and plays an integral part in the strategy for natural gas exploitation. As such, according to the new Petroleum Law (2014), 25% of all the gas produced in Mozambique would need to be consumed locally. This was envisaged to spur on the development of major anchor projects in the oil and gas sector, including gas to liquids plants (50,000 barrels/day), methanol production, fertiliser production (500,000 tonnes per year) and electricity generation capacity (300MW in South Africa and 600-800MW in Mozambique).

There are two major IPPs in Mozambique utilising natural gas: the 120MW Gigawatt Project and the 175MW Central Termoeletrica de Ressano Garcia (CTRG) power plant (175MW), the latter of which is jointly owned by Sasol and Electricidade de Moçambique (EDM). There is also 65MW of peak capacity available from two gas-fuelled and one diesel-fuelled Aggreko power plants.

Hydropower

As of 2019, Mozambique was the 7th largest producer of hydroelectricity in Africa with 2,191MW of installed hydropower. The vast majority (2,075MW) of this supply comes from the Cohora Bassa Hydropower plant, operated by Hidrolectricita de Cahora Bassa (HCB). The HCB project is augmented by the Mavuzi (54MW), the Chicamba (43 MW), Massingir (40MW) and the Corumana (16MW) hydropower plants. Those last four are owned by national utility EDM. The government of Mozambique also owns 82% of HCB, but only 500MW is supplied to EDM, the rest of the production being exported to South Africa.

However, there is still a considerable untapped hydroelectric resource in Mozambique. Mozambique has close to 18GW of hydropower potential[16], mainly concentrated in the central and northern regions of the country, through the Zambezi and Rovuma Rivers.

[15] https://www.banktrack.org/blog/who_dares_to_finance_eni_and_exxon_s_dangerous_rovuma_gas_plans_in_mozambique
[16] https://www.mdpi.com/2076-3417/10/14/4842

The structural 1,500MW Mphanda Nkuwa hydropower project has been proposed as a run-of-river facility on the Zambezi River in Tete province. This project is expected to cost $2.4 billion and is being developed by EDM, HCB and a strategic partner that has yet to be selected. On completion, this plant will produce 8,600GWh of electricity. It is considered by the government as a key priority for the electrification of the country. In May 2023, the Mozambican authorities have chosen a consortium led by French companies EDF and Total as preferred bidders for the engineering and EPC. The project is highly contested because of its ecological and social impact on local populations. The most direct consequence will be the ruining of irrigation systems and aquaculture downstream, because of the rapid and severe fluctuations in river flow caused by the intermittent opening of turbine gates. The project is also expected to displace 1,400 families and affect the livelihoods of 200,000. Regardless of the controversial aspect of this project, the International Finance Corporation (IFC), subsidiary of the World Bank group, announced in October 2022 its participation in the project and the willingness of the government to implement it as a PPP. As of June 2023, the European Union and the European Investment Bank have also announced their contribution to the tune of €500 million. In total, the project will require an investment of $4.5 billion.

Another project is the 50MW Tsate hydro power plant, planned for construction on the Revue River in Manica. The project should be developed in a single phase with the construction likely to start in 2023 to enter into commercial operations in 2025 and expecting to generate 375GWh of electricity.

In the 2018 Integrated Master Plan, two other projects were described as in the feasibility study phase: Lupata hydro power plant (650MW) and Boroma hydro power plant (210MW). As of 2023, no other information on progress on these projects is available. In addition to these large-scale projects, there are eight mini-hydro projects that have been identified for development. Three of the projects, the Mavonde (450KW), Berua (1.9 MW) and Luaíce (479KW), have completed feasibility studies and are ready for construction.

Solar energy

Compared to all other forms of renewable energy, the Mozambican solar potential is the greatest. The western and northern parts of the country have excellent solar resources and on average the country receives between 1,700 and 2,200kWh/m^2 per annum, and the solar potential is estimated at 23TW. Figure 5 depicts the areas with the highest solar radiation and shows the high potential for solar energy in Mozambique.

According to the Mozambique Renewable Energy Atlas, there is 2.7GW of solar potential that could be easily developed for use as on-grid and off-grid electrification. 189 projects providing a combined 599MW of electricity capacity have been identified as priority projects to provide grid-connected power without the need for significant transmission network expansion.

Currently, there is an estimated 42.2MW of solar PV capacity installed in Mozambique, 40MW of which is from the Mocuba solar plant which was commissioned in August 2019 under the PROLER programme. The Mocuba solar plant was developed by Scatec Solar and funded by multiple development finance institutions, while the equity of the project is held by EDM (25%), KLP Norfund Investments (22.5%), and Scatec Solar (52.5%).

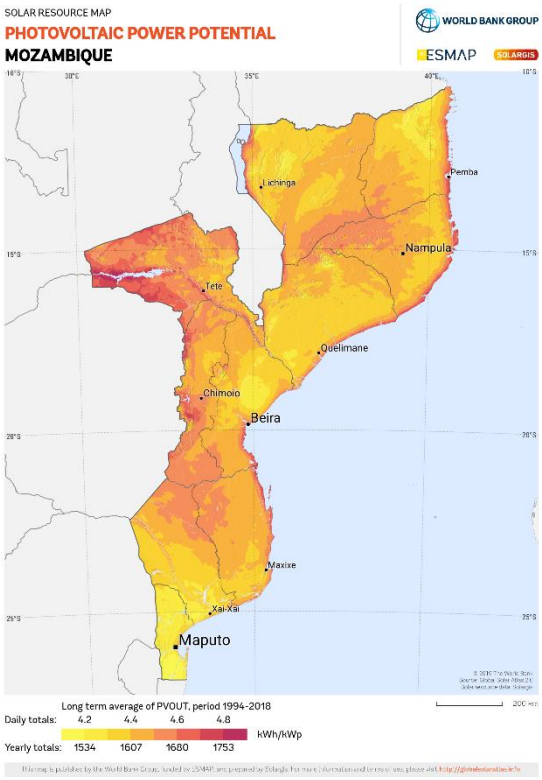

Figure 5 : Solar ressource Mozambique.

Source: Global Solar Atlas 2.0

The remainder are solar PV mini-grids, funded by the government of South Korea and the Portuguese Carbon Fund, and off-grid projects on a very small scale. Solar PV mini-grids represent the majority (1.5MW) of the installed off-grid solar PV capacity in Mozambique. The largest is the 1.3 MW solar PV mini-grid in Niassa.

In addition to the Mocuba plant, the Metoro solar project is another large-scale solar PV project that has begun construction as of January 2020. The Metoro plant is being constructed by Efacec and is developed by French developer Neoen, with a capacity of 41MW, making it the largest solar PV project in the country, completed in 2022. A third solar PV plant will be tendered in 2023 under the PROLER programme.

Biomass energy

As a tropical and sub-tropical country with ample sunshine and precipitation, Mozambique has considerable bioenergy potential. It is estimated that the country has 2GW of biomass potential, with 128MW of this identified as viable and of priority in the short-term (five years). More than half of the country's biomass potential (1,286MW) lies in forest resources as residues from logging, black liquor from the pulp industry, and dedicated energy plantations. This is followed by the bagasse resource potential of sugar mills (831MW) which could be used for cogeneration. Though difficult to measure, the industrial, municipal, and agricultural waste streams in Mozambique also offer notable biomass potential while also combating the deleterious environmental impacts of this waste's diversion to landfills.

Bioenergy is used widely in Mozambique for cooking and heating, and is the country's major source of energy. Indigenous forests and woodlands are the major source of this biomass, though the harvesting of these resources is unregulated and is not managed sustainably, which could lead to deforestation if left unchecked. Outside of these traditional bioenergy uses, there are no biopower plants or biofuels production facilities in the country.

Efforts from government and international funders are being directed at deploying clean cooking stoves in the country to improve the efficiency and reduce the amount of biomass required by households for cooking (80% of the Mozambican households still rely on biomass and wood). According to World Bank estimations from 2020, there is a $10m financial window to subsidise purchases of clean cooking solutions in eligible households in Mozambique. Additionally, bioenergy for electricity and biofuels has been noted as having high potential for job creation.

Wind energy

As of 2023, the only known wind generating facility in the country was a 300kW turbine installed in the Inhambane province. There is, however, 4.5GW of wind energy potential in the country, and 1.1GW of this currently has potential for grid-connection. The Mozambique Renewable Energy Atlas considers only 230MW of wind energy as high potential, with most of the country's wind resource located in the south (Maputo and Gaza) and in the west (Tete) provinces.

The biggest wind project in Mozambique is the Namaacha wind project with an installed capacity of 120MW. Located in the Maputo province and adjacent to the Eswatini border, the project is under construction, led by the American independent developer EleQtra for a total estimated cost of $280m. The first 60MW phase of the project is expected to be commissioned in 2023. As the first grid-connected project of the country, the electricity generated will be sold to EDM and fed to the grid under a power purchase agreement (PPA). A second 30MW wind farm is also expected to be commissioned in 2023. Located in the Inhambane province, the cost of the project is estimated at $45 million.

Table 1. Overview of the main stakeholders in the energy sector in Mozambique	
Institution	**Role**
Ministry of Mineral Resources and Energy (MIREME)	Responsible for national energy planning and policy promulgation. There are three divisions within the MIREME, the power sector, renewables, and liquid fuels, and these oversee the operations and developments within their respective spheres. The National Directorate for Electrical Energy (DNEE) is a technical body within the MIREME that is tasked with the preparation, analysis, and implementation of energy policies in the power sector.
Ministry for the Coordination of Environmental Affairs (MICOA)	The department has centralised power over all environmental legislation and policy making and is involved with many other ministries to coordinate on environmental issues. MICOA must give approval for environmental impact assessments and for ensuring compliance with international environmental protocols such as the Kyoto Protocol and Clean Development Mechanism CDM applications.
Ministry of Agriculture and Rural Development (MINAG)	MINAG manages and regulates traditional fuels, predominantly forest resources, and works closely with MICOA and MIREME for biomass energy developments.
The Energy Fund (FUNAE)	Funding and implementing energy projects specifically aimed at increasing energy access in rural areas and poor urban areas. FUNAE seeks to consolidate leadership in the dissemination of renewable energies and contribute to meaningful social and economic development.
Energy Regulatory Authority (ARENE)	Superseding the Conselho Nacional de Electricidade (CNELEC) in 2017, ARENE has decision-making, asset and budget autonomy but is supervised by the MIREME. ARENE, in turn, supervises, regulates, and represents electricity generation, transmission and distribution and effectively controls the electricity market (as well as regulating the liquid fuels and natural gas sector).
Electricidade de Moçambique (EDM)	The state-owned, vertically integrated electric utility in Mozambique tasked with electricity generation, transmission, and distribution. The majority of the power supplied via EDM is sourced from Hidroeléctrica de Cahora Bassa, which is 82% owned by the Mozambican government.
Mozambique Transmission Company (MOTRACO)	Owned by EDM, Eskom and the Eswatini Electricity Company (EEC), MOTRACO supplies the MOZAL aluminium smelter with electricity and provides electricity wheeling services to EDM and EEC.
Centro de Promoção de Investimentos (Investment Promotion Centre, CPI)	This institution assists domestic and international investors in identifying and accessing government incentives when establishing their ventures. The mandate is to boost investment in the country to generate economic growth and create wealth.
Empresa Nacional de Hidrocarbonetos de Mocambique (ENH)	ENH is a parastatal oil and gas company in Mozambique which has exclusive rights to explore and develop oil resources in the country. To date, ENH has exercised these rights in partnership with international oil and gas firms such as Enron, Sasol, BP, and local firms.

Energy policy

The National Energy Strategy 2014-2023 outlines the vision for Mozambique's electricity sector to overcome existing challenges and capture the opportunities to harness the country's energy resources in an inclusive, sustainable manner. The key challenges to overcome in the power sector are providing reliable and efficient electricity supply, increasing generation and expanding transmission capacity to meet current and future demands, and increasing electricity access, which is low compared to its peers. The overarching goal is to solidify Mozambique's position as a key regional energy producer and exporter, consequently alleviating poverty and generating economic prosperity through the development of the energy sector. The National Energy Strategy has five key focus areas with a strategy for each:

- **Regulation**: An energy regulator shall be established to regulate the entire sector, including electricity, liquid fuels, and natural gas. This was completed with the establishment of the Energy Regulatory Authority (ARENE) in 2017.
- **Energy Efficiency**: A legal framework that will govern energy efficiency, from energy supply to energy consumption, shall be created to promote the sustainable and responsible use of energy.
- **Feed-in Tariffs**: A programme to procure energy shall be approved and aimed at renewable energy technologies, which will provide electricity at costs in line with natural gas power with an environmental tax applied. In 2014, feed-in tariff (FiT) regulations were approved for solar, biomass, wind and small hydro technologies; however, connection of these potential projects to the grid still requires further regulation and as of 2017 the FiT programme was under revision.
- **Electrification**: Grid access needs to be extended and the quality of energy improved.
- **Tariff Calculation Methodology**: With private sector investment in the industry, there is a need to settle the tariff methodologies that are used to calculate the electricity price from these new projects. The strategy seeks to determine tariffs that are cost-reflective.

The Mozambican electrification plan, as laid out in the Integrated Electricity Master Plan, will utilise a combination of on-grid electrification and off-grid electrification. The on-grid electrification will prioritise connecting customers on a lowest-cost basis initially, by extending the infrastructure in grid-connected villages to those in the village without connections. The government recognises that extending the national grid to isolated communities will be costlier than those located close to the existing grid infrastructure, which is where off-grid electrification, utilising funding from the Energy Fund (FUNAE), will be used alongside private finance.

The on-grid electrification will expand the current grid to all 128 district headquarters. Electrification of these headquarters was completed in 2015. Although on-grid electrification has improved considerably from under 5% in 2002 to nearly 30% as of 2020, electrification in the north and central regions is low. Mozambique is lagging significantly behind the target of universal electricity access by 2030.

Off-grid electrification has been spearheaded by FUNAE under guidance from the Ministry of Mineral Resources and Energy (MIREME). FUNAE was initially tasked with providing funding for off-grid electrification projects but has since seen its mandate shift to responsibility for implementing off-grid electrification projects. As of 2017, FUNAE has electrified 180 villages, 790 schools and 690 clinics in Mozambique, providing modern energy to approximately 3.7 million people. This has been enabled through international donor support.

Up until 2009, off-grid electrification was primarily powered using diesel generation. However, this has since been halted as the electricity supplied from diesel generators is costly and access to diesel limited the electricity supply. FUNAE has since adopted off-grid electrification through three methods: micro-grids, mini-grids and stand-alone systems. Micro-grids are 5kW solar PV systems that supply 25 households with basic electricity at a fixed monthly tariff. Mini-grids have larger capacity (500kW) and are powered by solar PV or small hydro systems whereby electricity is billed according to customer usage. Stand-alone systems are solar home systems that are attached to individual households with a fixed monthly electricity tariff. As of 2019, FUNAE identified 111 mini-grid or micro-grid villages, and 81 stand-alone villages to be electrified via the off-grid plan. Additionally, 968 primary schools and 280 clinics have been earmarked for off-grid electrification across multiple provinces. To date though, there is no large-scale solar home system and pico-solar programme in the country and the few mini grids that have been installed have been fuelled by diesel generators and have suffered from operational and maintenance issues.

Private sector participation in the off-grid electricity sector has been limited to date, partly due to the country's unfamiliarity with opening up to the private sector. Although the government states that the private sector is to play a key role in the country's electrification, there are multiple barriers to private sector participation, namely restrictive regulations (including fossil fuel subsidies and high VAT and import duties on solar components), financing and human capacity.

In addition to the National Energy Strategy, the New and Renewable Energy Development Strategy 2011-2025 laid out renewable energy targets for Mozambique. For wind energy, the strategy seeks to install 10,000 turbines for off-grid electrification and install 100MW for on-grid generation. For solar PV, the country aims to develop PV production lines to supply the components that will be used in the mini-grid and off-grid generation projects. Small hydro would see 125MW of capacity being developed for both on-grid and off-grid electrification according to this strategy.

Lastly, in 2009, Mozambique approved a Biofuels Policy and Strategy to promote the uptake and usage of biofuels. It was envisaged that stimulating biofuels demand would increase the use of agricultural and industrial biomass wastes, simultaneously reducing greenhouse gas emissions from these waste streams, increasing revenue generation, and providing further energy security through reduced reliance on imported liquid fuels. Following this, in 2011 the MIREME imposed blending ratios and standards for biofuels which requires bioethanol to be blended into petroleum at a ratio of 15% from 2016-2020, and 20% from 2021. Additionally, biodiesel is to be blended at 7.5% from 2016-2020, and 10% from 2021.

Table 2. Active support programmes in Mozambique

Programme	Main activities
Supporting the Policy Environment for Economic Development (SPEED+)	A USAID programme launched in 2016 working with private, public, and civil society stakeholders to strengthen the operating environment for businesses to attract investment and expand the Mozambican energy market. SPEED+ has provided on-grid and off-grid legal, regulatory, and capacity building support to IPPs and ARENE.

Table 2. Active support programmes in Mozambique	
Power Africa: Southern Africa Energy Programme	The SAEP, financed by Power Africa, is supporting EDM to develop 560 km of high-voltage transmission lines between Temane and Maputo and ultimately to South Africa. This is known as the Temane Transmission Project (TTP).
Electricity for All National Programme	This programme was launched by the Mozambican government to achieve universal electricity access by 2030. The national utility, EDM, will lead the development of grid-connected electricity access, while FUNAE will focus on the implementation of off-grid solutions to achieve energy access in the more isolated areas. The MIREME decides the priority areas based on the cost of electrification and technical constraints and will fund this programme through government budget allocations, electricity export revenues (taxes), concessional funding and an electrification levy on grid electricity sales.
Energizing Development (EnDev)	A $4.5 million programme coordinated by German GIZ and the Netherlands Enterprise Agency (RVO) to bolster solar and improved cookstove distribution in Mozambique. The focus of this programme is on both supply (through solar home systems, mini-grids, and clean cookstoves) and demand (through credit support and finance models). The first phase of the programme ended in 2019 but the second, scale-up phase is under negotiation to expand the reach of these energy services. This programme has been funded using results-based financing (RBF).
Enabel (RERD Phase 2)	Support from Belgium to the tune of $13.7 million between 2018 and 2022 to support FUNAE on their mandate to supply reliable and adequate energy services. This programme will provide this support through technical and capacity building support and to fund the construction of the hydropower mini grids.
DfID Energy Africa (BRILHO)	Part of the 'Energy Africa' programme, it seeks to improve access to energy for rural households and businesses through private sector innovation, improved cookstove technology and the deployment of mini/micro grids. The budget allocated to Mozambique is $30 million and commenced in 2019 for a period of five years. DfID has been providing support through market development, research, technical assistance, and regulatory and capacity building support.

Table 2. Active support programmes in Mozambique	
Sweden and African Enterprise Challenge Fund (AECF) AECF initiatives	The Swedish Embassy through AECF has committed $6.5 million to Mozambique private sector companies to access capital and technical assistance with the aim of accelerating access to low cost, affordable, high-quality products and services by rural poor households and communities. This funding will be dispersed as matching grant funding to technology providers and developers operating in the mini-grid, solar home system and clean cooking space.
Sustainable Economic Development Project (KfW)	The Mozambican Commercial and Investments Bank (BCI) has been supported by KfW through the Sustainable Development project to create renewable energy and energy efficiency credit lines to provide enterprises with a subsidised interest rate (15%) for renewable energy technology and energy efficiency solutions.
Beyond the Grid Fund for Africa (BGFA)	Building on from the success of the programme in Zambia, the Swedish International Development Agency (SIDA) requested the Nordic Environment Finance Corporation (NEFCO) to establish and expand the programme to Burkina Faso, Liberia, and Mozambique. This expanded programme is the BGFA. Sweden has contributed 46 million Euros to the BGFA programme, which will be used to elicit proposals from off-grid energy companies to compete for this funding opportunity. The aim is to stimulate new sustainable business models which incentivise and accelerate the private sector to offer affordable and clean off-grid energy access at scale.
Promoçao de Leilões de Energias Renovaveis (PROLER)	The PROLER program assists Mozambique's national electricity company (EDM) in setting up calls for tenders. These calls for tenders enable renewable energy power generation projects to be launched with a total installed capacity of around 120 MW.

Industry associations

Mozambique Association of Renewable Energies (AMER) coordinates the representation and defence of its members. It serves as an essential instrument for the participation and awareness of the potential of natural renewable energy resources for the sustainable development of Mozambique.

Confederation of Business Associations (CTA) of Mozambique builds the capacity of the private sector to become an effective player in policy decision making and improves coordination between policy makers and the private sector to meet the needs of the private sector and represent their interests.

Lusophone Renewable Energy Association (ALER) is a Non-Governmental Development Organisation established to promote renewable energies in Portuguese-speaking countries such as Mozambique. The association facilitates business opportunities by supporting the private sector and attracting financing and investment, by liaising with national and international authorities to create a conducive regulatory framework, and by coordinating all stakeholders, acting as a cooperation platform and the common voice of renewable energies in Portuguese-speaking countries.

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Useful contacts

British High Commission
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