GET.invest
Mobilising Renewable Energy Investments

Mozambique: Renewable Energy Independent Power Producer (IPP) Projects

Model Business Case: 20 MWp Solar Power Plant (With Battery Storage)

INTRODUCTION

In order to become less dependent on large hydropower projects, with support from its development partners, the government of Mozambique is seeking to attract private sector renewable energy developers to provide electricity to the national grid as independent power producers (IPPs). This Model Business Case (MBC) analyses the financial feasibility of a hypothetical 20 MWp solar PV independent power project fitted with a battery energy storage system (BESS) ("the Project"). A solar PV power project with battery storage can generate and store power, which allows the system to provide electricity during peak night-time hours when the sun is not shining and can also enhance grid stability.

TARGET AUDIENCE

The output of the power plant will be sold under a 25-year power purchase agreement (PPA) to the state-owned national power utility, Electricidade de Moçambique (EDM). The BESS enables a portion of the power generated during off-peak periods – i.e., when solar production is typically at its highest – to be stored for supplying power to critical loads when the utility grid is facing outages.

GET.invest Mozambique is financed by

Supported by

proMove ENERGIA
cooperação alemã DEUTSCHE ZUSAMMENARBEIT
Sweden Sverige
Ministry of Foreign Affairs of the Netherlands
Austrian Development Agency

A detailed financial analysis of the Project was conducted to determine its viability and its ability to adequately service debt while providing attractive returns to investors. The target audience of this MBC includes (but is not limited to):

- **Project developers** who may be interested in pursuing opportunities for solar PV IPP development in Mozambique;
- **Potential investors** who may be interested in financing solar PV IPPs in Mozambique;
- **EPC and O&M contractors** who may be interested in having shareholdings in solar PV IPPs in Mozambique;
- **Government officials** and **regulators** who may be interested in understanding solar PV IPPs for the purpose of issuing authorisations, concessions and other licences; and
- **Off-takers** who may be interested in becoming shareholders of a solar PV IPP.

KEY ASSUMPTIONS

This MBC is based on several assumptions which are described below. The assumptions presented in this analysis are mainly based on publicly available information gathered through desk research. A detailed feasibility study would be required to determine the actual applicable costs and parameters for specific projects.

Technical assumptions

Table 1 presents the assumptions related to the power generation capacity of the power plant.

TABLE 1. Technical assumptions

SOLAR PV SYSTEM TECHNICAL PARAMETERS	UNIT	VALUE
Base annual yield	kWh/kWp	1,654[1]
Solar PV system capacity	MWp	20[2]
Annual generation – Year 1	MWh	33,080[3]
Storage capacity	MW	2[4]
Storage capacity	MWh	5[5]
Inverter capacity	MW	16[6]
Project lifetime	Years	25[7]
Annual module degradation	%	0.5%[8]
Storage capacity degradation	%	1%[9]

1) Local stakeholder consultations; https://www.proparco.fr/en/actualites/president-republic-mozambique-officially-launches-construction-works-metoro-solar-power
2) Hall, M., "Financial close for Mozambique's first solar-plus-storage project," PV Magazine, (December 21, 2021): https://www.pv-magazine.com/2021/12/21/financial-close-for-mozambiques-first-solar-plus-storage-project/
3) Derived by multiplying the annual yield by the system capacity.
4) Hall, 2021.
5) Hall, 2021.
6) Ibid.
7) Africa Energy Portal: Mozambique starts construction on first solar energy storage IPP: https://africa-energy-portal.org/news/mozambique-starts-construction-first-solar-energy-storage-ipp
8) "Uganda: Captive Power – Model Business Case: Solar Photovoltaic (PV) for Commercial and Industrial Facilities," GET.invest Market Insights, (2020): https://www.get-invest.eu/wp-content/uploads/2020/11/GETinvest-Market-Insights_UGA_Captive_MBC-Facilities_2019.pdf
9) USAID/Power Africa Southern Africa Energy Program.

Macroeconomic assumptions

The Euro (EUR) to Mozambican metical (MZN) exchange rate is assumed to be 66.5.[10] Based on projections for Mozambique, annual inflation is assumed to be 6% over the life of the Project,[11] while the annual MZN to EUR depreciation is assumed to be 1.5%.[12]

Taxes

A corporate income tax rate of 32% was applied to the Project. A value added tax (VAT) rate of 16% is applicable to the equipment and services required for the Project in addition to an import duty of 7.5% on any imported equipment.[13] Two scenarios were considered for the analysis: **i)** a scenario with VAT and import duty exemptions in addition to corporate income tax reductions;[14] and **ii)** a scenario without incentives.

Capital costs

Table 2 presents the capital cost assumptions for the Project. Capital costs include the total cost of executing the engineering, procurement and construction (EPC) contract, development and non-financing costs, as well as financing costs.[15] It is assumed that the plant will be depreciated via straight line depreciation over its 25-year lifetime at a rate of 4% per year. For the scenario with incentives, it was assumed that the equipment eligible for VAT and import duty exemption constitute 50% of the Project capital cost.

TABLE 2. Capital cost assumptions[16]

CAPITAL COSTS	UNIT	WITH INCENTIVES	WITHOUT INCENTIVES
Installed cost per Watt	EUR/Wp	€1.57	€1.76
Total CAPEX	**EUR Million**	**€31.5**	**€35.1**

10) Currency conversion as of 3 December 2022.
11) Mozambique Inflation Rate: https://tradingeconomics.com/mozambique/inflation-cpi
12) Calculated based on MZN/EUR historical exchange rate data.;
13) https://taxsummaries.pwc.com/mozambique/corporate/taxes-on-corporate-income; https://taxsummaries.pwc.com/mozambique; and https://www.get-invest.eu/market-information/mozambique/
14) Based on information presented in the Developer Guide on the available fiscal incentives, the following corporate income tax rate reductions were applied: 80% in the first five tax years; 60% from the 6th to the 10th year; 25% from the 11th to the 15th year.
15) The EPC costs include the cost of equipment, cost of services from the EPC contractor, cost of freight, taxes (onshore and offshore), and applicable duties in addition to interconnection costs. The development and non-financing costs include the soft costs that are capitalised at financial close of the Project, including developer premium, project management/owner's engineer costs, pre-funded working capital requirements (start-up costs), land acquisition costs, cost of technical, legal, financial and tax advisory services (including any success fees due to the advisors), pre-commissioning O&M costs, construction insurance, lender's advisor costs, and other pre-construction costs (licences and permits, etc.). Financing costs constitute the debt commitment and lenders upfront fees, the upfront funding for the credit enhancement instruments (Political Risk Insurance, Letter of Credit) during the construction period, and the Interest During Construction (IDC).
16) Takouleou, J.M., "Mozambique: Globeleq closes financing for its Cuamba solar power plant (19 MWp)," Afrik21, (January 5, 2022): https://www.afrik21.africa/en/mozambique-globeleq-closes-financing-for-its-cuamba-solar-power-plant-19-mwp/

Operating costs

It is assumed that the annual Operations and Maintenance (O&M) costs are 1.5% of the total capital cost of the Project.[17] It is also assumed that the O&M costs escalate by 6% annually in line with inflation. **Table 3** presents the assumed costs of battery replacement in the 11th and 21st year, and inverter replacement in the 16th year of operation.[18] The replacement costs are based on an annual price reduction assumption of 3% compared to the initial investment.[19]

TABLE 3. Component replacement cost assumptions

COMPONENT	TOTAL COST WITH INCENTIVES (EUR MILLION)	TOTAL COST WITHOUT INCENTIVES (EUR MILLION)
Battery replacement cost (Year 11)[20]	€1.09	€1.36
Battery replacement cost (Year 21)[21]	€0.80	€1.00
Inverter replacement cost (Year 16)[22]	€1.10	€1.38

PPA tariff

The model assumes an indicative tariff of EUR 0.081/kWh based on the previous PPAs signed between EDM and IPPs.[23] It was also assumed that the PPA tariff is indexed to the EUR and escalates by 4.2% annually.[24] The actual tariff and applicable escalation mechanisms for the Project will be captured in a PPA to be executed between EDM and the Project Company.

17) Explanatory Memorandum for CERC Draft (Terms and Conditions for Tariff determination from Renewable Energy Sources) (Fifth amendment) Regulations, 2016: https://cercind.gov.in/2016/draft_reg/Exp16.pdf
18) Smith, K., et al., 2017. "Life Prediction Model for Grid- Connected Li-ion Battery Energy Storage System," National Renewable Energy Laboratory (NREL), (May 2017): https://www.nrel.gov/docs/fy17osti/67102.pdf; and
Sangwongwanich, A., et al., 2017. "Lifetime Evaluation of Grid-Connected PV Inverters Considering Panel Degradation Rates and Installation Sites," IEEE Transactions on Power Electronics, https://www.researchgate.net/publication/314121765_Lifetime_Evaluation_of_Grid-Connected_PV_Inverters_Considering_Panel_Degradation_Rates_and_Installation_Sites
19) "Zambia: Solar PV and Hydro Mini-Grids: Model Business Case: Solar PV Mini-Grid for Rural Electrification," GET.invest Market Insights, (2020): https://www.get-invest.eu/wp-content/uploads/2020/10/GETinvest-Market-Insights_ZMB_Mini-grid_-MBC-Solar_2019-1.pdf
20) Cole, W., Frazier, W., and Augustine, C., "Cost Projections for Utility-Scale Battery Storage: 2021 Update," National Renewable Energy Laboratory (NREL), (June 2021): https://www.nrel.gov/docs/fy21osti/79236.pdf
21) Ibid.
22) Based on an initial cost assumption of EUR140,000/MW (source: https://www.get-invest.eu/wp-content/uploads/2020/11/GETinvest-Market-Insights_UGA_Captive_MBC-Facilities_2019.pdf)
23) To date, the agreed tariffs on PPAs signed between IPPs and EDM range between 8.5 to 13 US cents/kWh (Source - EDM Strategy Report 2018-2028). It was assumed that the Project will obtain grant funding to compensate for the additional cost of the energy storage component rather than pricing it into the tariff.
24) Assumption based on EDM Integrated Master Plan (2018-2043). The escalation rates agreed on in the previous PPAs between IPPs and EDM are not publicly available.

Financing scenarios and debt assumptions

In line with the funding structure of the Cuamba Solar Power Plant, it was assumed that the Project will be financed with 25% equity, EUR7.6M grant funding with the balance of funds covered by debt (**Table 4**).[25]

Two debt financing scenarios were considered: i) EUR-denominated debt; and ii) MZN-denominated debt. The interest rate is assumed to be 7% for EUR-denominated[26] and 15% for MZN-denominated debt.[27] The debt tenor is assumed to be 18 years under both scenarios.[28]

TABLE 4. Capital structure

	WITH INCENTIVES		WITHOUT INCENTIVES	
CAPITAL TYPE	% OF CAPEX	TOTAL AMOUNT (EUR MILLION)	% OF CAPEX	TOTAL AMOUNT (EUR MILLION)
Debt	50.8%	€15.99	53.3%	€18.74
Equity	25.0%	€7.86	25.0%	€8.78
Grants	24.2%	€7.61	21.7%	€7.61
Total	**100%**	**€31.46**	**100%**	**€35.12**

25) Takouleou, 2022.
26) Stakeholder consultations, 2022.
27) Based on BCI green credit line interest rate.
28) Based on the debt terms for similar solar IPPs in Mozambique. No grace period is assumed in order to be conservative. It is also worth noting that for the MZN-denominated debt scenario, such long-term debt is currently not available from local banks in Mozambique, however, the assumption was made for illustration purposes.

RESULTS

There are different types of investors active in financing utility-scale solar power projects, with different objectives and varying return targets. Utility investors such as Engie, EDF or Enel, which have deep sources of low-cost capital might accept 7-8% equity IRR as they also earn revenues as EPC and O&M contractors and have long-term strategic objectives. Purely financial investors such as AIIM will likely require a minimum equity IRR of 15% to invest in a project in Mozambique. Hybrid developer/financial investors such as Serengeti Energy or Berkeley Energy might accept a minimum equity IRR of 12% as they also earn on the developer fee.[29]

Based on the assumptions described above, the financial analysis yielded the following conclusions:

- Under the scenario with incentives with EUR-denominated debt, the Project will be attractive to both financial and strategic investors with an after-tax equity IRR of 12.7% and payback period of 10 years.

- Under the scenario with incentives with MZN-denominated debt, the Project will only be attractive to strategic investors with an after-tax equity IRR of 8.3% and payback period of 15 years due to the high cost of local debt.

- Under the scenario without incentives with EUR-denominated debt, the Project will also only be attractive to strategic investors with an after-tax equity IRR of 8.8% and payback period of 15 years.

- Under the scenario without incentives with MZN-denominated debt, the Project is unattractive with an after-tax equity IRR of 5.2% and payback period of 19 years due to the high cost of local debt.

- The minimum Debt Service Coverage Ratio (DSCR) is 1.2 in all the scenarios due to the cost of battery replacement in Year 11, indicating the need for a debt service reserve account.

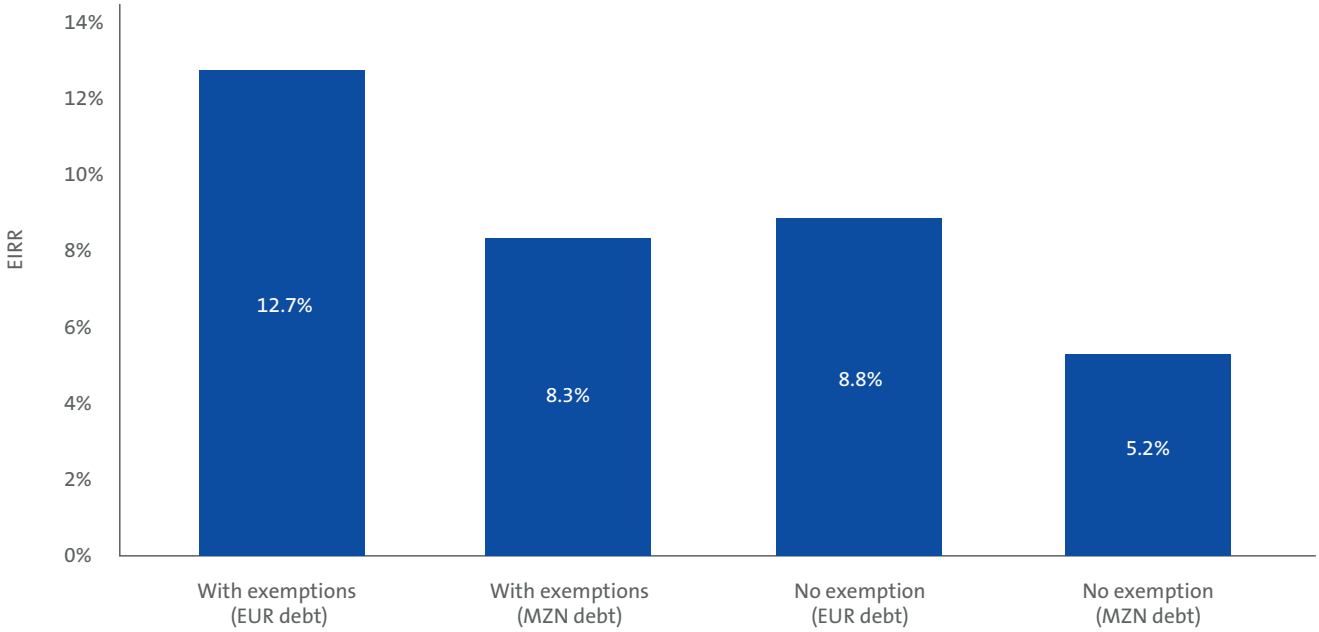
The results of the financial analysis are summarised in **Table 5** and **Figure 1**.

29) Stakeholder consultations, 2022.

TABLE 5. Financial analysis results

	WITH INCENTIVES		WITHOUT INCENTIVES	
INDICATOR	EUR-DENOMINATED DEBT	MZN-DENOMINATED DEBT	EUR-DENOMINATED DEBT	MZN-DENOMINATED DEBT
Avg. annual revenue	€4.2M		€4.2M	
Avg. annual expenses	€0.85M		€0.95M	
Avg. EBITDA	€3.4M		€3.3M	
Avg. net income	€1.2M	€0.8M	€0.9M	€0.5M
LCOE	€0.10	€0.11	€0.11	€0.12
Total CF to equity	€44.2M	€37.5M	€37.2M	€29.7M
Net CF to equity	€36.3M	€29.6M	€28.4M	€20.9M
After tax equity IRR	12.7%	8.3%	8.8%	5.2%
After tax project IRR	6.6%		4.7%	
Equity NPV	€0.6M	€–3.9M	€–3.0M	€–8.2M
Equity payback period (years)	10	15	15	19
Project payback period (years)	13	13	16	16
Avg. DSCR	1.92	1.76	1.56	1.45
Min. DSCR	1.17	0.75	0.84	0.62

FIGURE 1. Financial analysis results



SENSITIVITY ANALYSIS

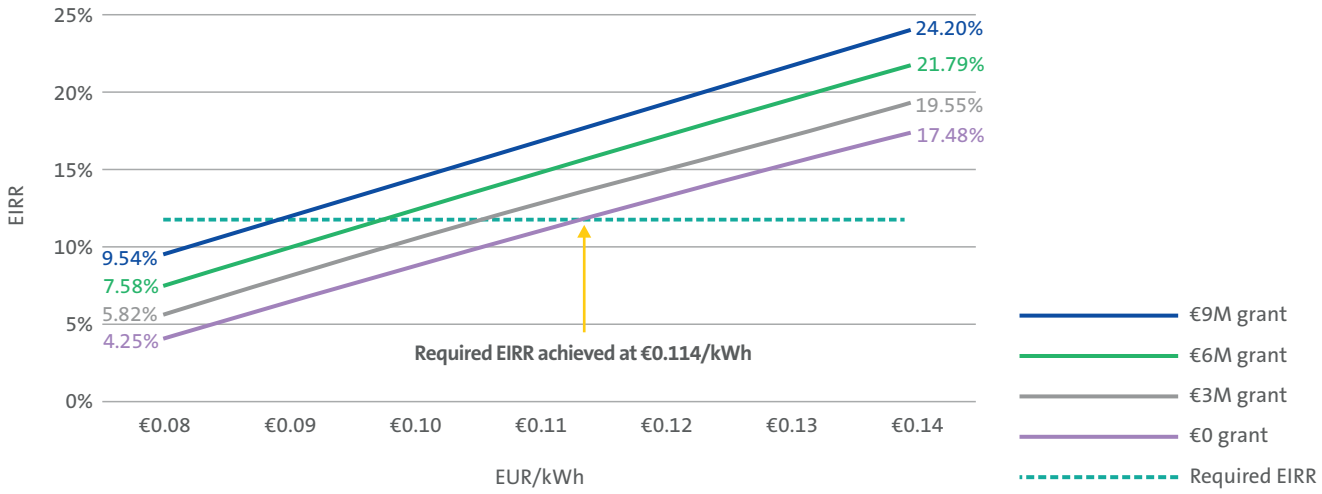
A sensitivity analysis was conducted to determine the impact of changes in key assumptions on the equity IRR (EIRR) and minimum DSCR as measures of the viability of the Project under the scenario without incentives. The figures below present the results under various scenarios assuming the Project is financed with EUR-denominated debt.[30] It is assumed that the required rate of return for financial investors to consider a project attractive is 12%.

30) The debt interest rate scenarios show sensitivity analysis results for both the EUR-denominated debt and MZN-denominated debt.

Tariff and grant scenarios

Figure 2 illustrates the impact of increases in the PPA tariff and grants on EIRR under the scenario without incentives. The results show that the required EIRR can only be achieved without grants if the tariff is at least EUR 0.114/kWh.

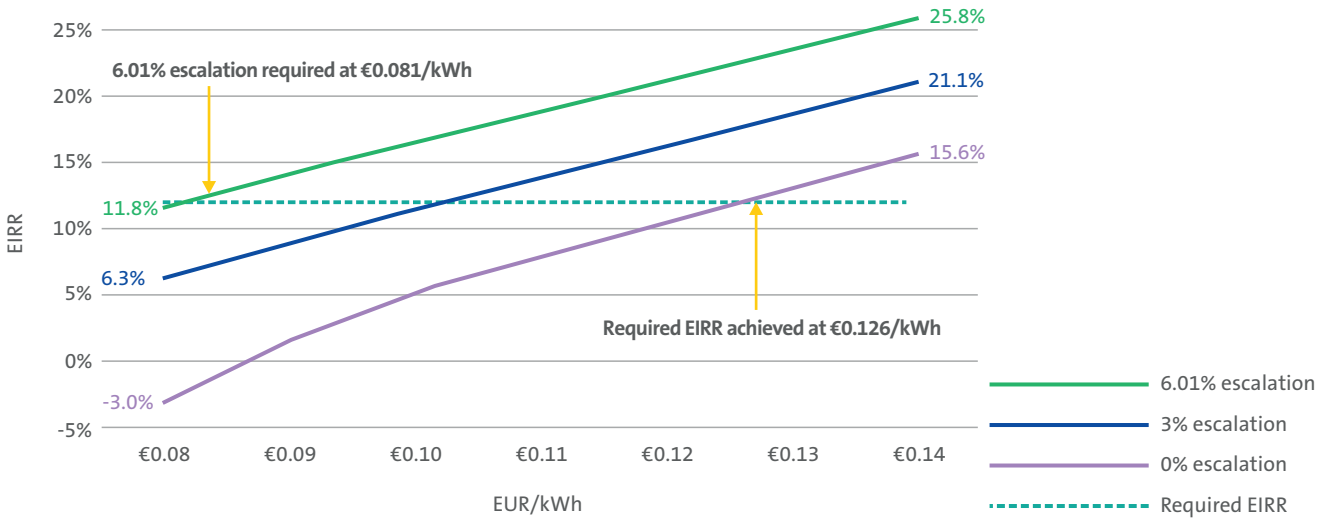
FIGURE 2. Equity IRR at various tariff and grant levels



Tariff and escalation scenarios

Figure 3 illustrates the impact of increases in the PPA tariff and the tariff annual escalation rate on EIRR under the scenario without incentives. The results show that the PPA tariff will need to be negotiated to accommodate annual escalation at PPA tariffs below EUR 0.126/kWh for the required EIRR to be achieved. In addition, the required EIRR will only be achieved if the PPA tariff escalates annually by at least 6.01% at the assumed tariff of EUR 0.081/kWh.

FIGURE 3. Equity IRR at various PPA tariff and escalation levels



Debt interest rate scenarios

Figure 4 and **Figure 5** illustrate the impact of increases in both the EUR-denominated and MZN-denominated debt interest rates on EIRR and minimum DSCR respectively under the scenario without incentives. The analysis shows that the required EIRR cannot be achieved at the debt interest rates considered, indicating that low debt pricing will not be enough to make the Project attractive to financial investors. It also reveals that the minimum DSCR will be below the required 1.2 threshold at the interest rates considered, meaning that the Project will require a DSRA.

FIGURE 4. Equity IRR at various debt interest rates

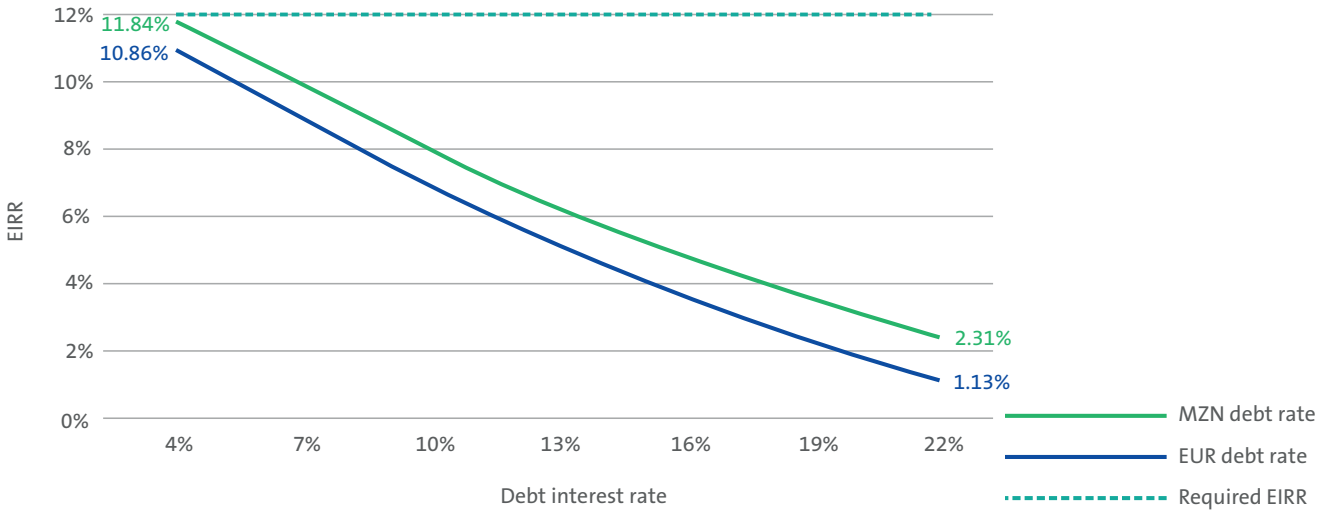
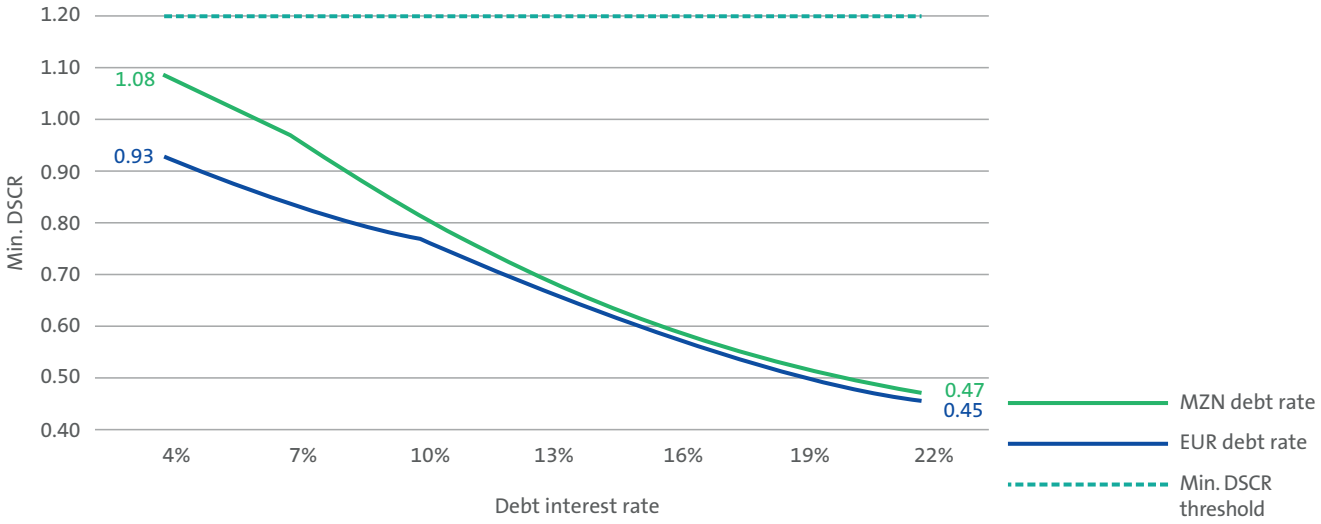


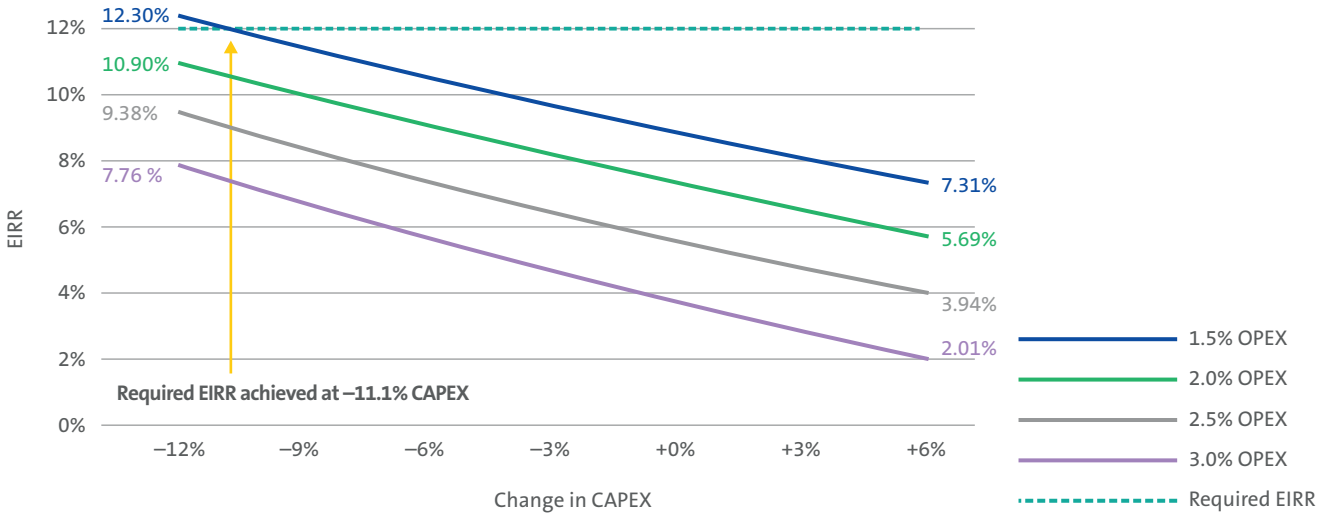
FIGURE 5. Minimum DSCR at various debt interest rates



CAPEX and OPEX scenarios

Figure 6 shows the impact of changes in CAPEX and OPEX on EIRR under the scenario without incentives. The analysis found that the required EIRR can be achieved with an 11.1% decrease in CAPEX, if OPEX remains unchanged. This indicates that the Project can become attractive to financial investors with a USD 3.9M reduction in capital costs.

FIGURE 6. Equity IRR at various CAPEX and OPEX levels



CONCLUSIONS AND KEY TAKEAWAYS

Based on the assumptions in this MBC, the Project is estimated to be attractive to both financial and strategic investors under the scenario with incentives, while it will only be attractive to strategic investors under the scenario without incentives.

- Under the scenario with incentives, the Project is estimated to be attractive to financial and strategic investors with an after-tax equity IRR of 12.7% and payback period of 10 years when financed with EUR-denominated debt. However, given the additional cost of the energy storage component, grant funding will be required for the Project to be attractive at the current PPA tariff levels. When financed with MZN-denominated debt, the Project will only be attractive to strategic investors with an after-tax equity IRR of 8.3% and payback period of 15 years due to the high cost of local debt.

- Under the scenario without incentives, the Project will only be attractive to strategic investors with an after-tax equity IRR of 8.8% and payback period of 15 years when financed with EUR-denominated debt. However, it is worth noting that without incentives, the Project can be made attractive to financial investors if the PPA tariff is at least EUR 0.114/kWh (without grant funding), or if the PPA tariff is negotiated to accommodate an annual escalation of at least 6.01% (at the assumed tariff and grant funding level), or if the capital costs reduce by 11.1% to EUR 1.56/Wp.

- Under the scenarios considered, the Project will require a debt service reserve account (DSRA) to adequately meet lenders' minimum DSCR requirements.

Battery storage is the most expensive component of a solar PV system; as a result, including batteries can dramatically affect the economics of a solar project. However, a solar IPP with storage is also more impactful, as it is capable of providing electricity during night-time peak hours and supporting grid stability. A regulator negotiating a PPA with such a project has to clearly understand these cost and benefit dynamics and weigh them in the tariff calculation.

KEY DEFINITIONS

Avg. annual revenue is the average annual revenue generated over the life of the Project.

Avg. annual expenses is the average annual operating expenses incurred over the life of the Project.

Avg. EBITDA is the average earnings before interest, taxes, depreciation, and amortisation over the life of the Project.

Avg. net income is the average net income generated over the life of the Project.

LCOE (levelised cost of energy) is the net present value of the total costs incurred by the Project over its lifetime divided by the net present value of the total power generated over its lifetime.

Total cashflow to equity refers to the total cash flow distributed to the equity investor over the life of the Project.

Net cashflow to equity irefers to the total cashflow to equity less the equity investment in the Project.

After tax equity IRR is the post-tax internal rate of return on the equity investment after taking account of debt service.

After tax project IRR is the post-tax internal rate of return on the Project. It is the discount rate at which the net present value (NPV) of the Project is equal to zero.

Equity NPV is the net present value of the free cash flows to the equity investor using the required equity rate of return as the discount rate.

Equity payback period (years) refers to the number of years it takes to recover the equity investment in the Project.

Project payback period (years) refers to the number of years it takes to recover the initial capital cost of the Project.

Avg. DSCR is the average debt service coverage ratio over the life of the Project.

Min. DSCR is the minimum debt service coverage ratio over the life of the Project.

ABOUT GET.INVEST MARKET INSIGHTS

The first series of GET.invest Market Insights was published in early 2019 covering four renewable energy market segments in three countries, namely: renewable energy applications in the agricultural value-chain (Senegal), captive power (behind the meter) generation (Uganda), mini-grids (Zambia) and stand-alone solar systems (Zambia).

A **Developer Guide** aims to inform project developers, private sector technology suppliers, innovators and entrepreneurs about renewable energy (RE) independent power producer (IPPs) opportunities in Mozambique. The Guide is organised into four main sections: **1)** introduction; **2)** description of the IPP market in sub-Saharan Africa, including an overview of the sector's development, enabling environment, financing mechanisms, key indicators for assessing IPP potential, and profiles of IPPs that are active in the region; **3)** examination of the market for RE IPPs in Mozambique, including a review of the country's RE potential and existing and planned IPP projects and programmes; and **4)** exploration of the "Route to Market" – i.e., how to leverage the market research presented in the Guide to set up an IPP project in Mozambique.

Accompanying the Guide are two corresponding **Model Business Cases**, which provide financial analyses for concrete business examples. The two Model Business Cases included in this package analyse: **1)** a 40 MWp solar IPP project without battery storage; and **2)** a 20 MWp solar IPP project with battery storage.

The GET.invest Market Insights summarise a considerable amount of data that may inform early market exploration and pre-feasibility studies. It is therefore recommended to cross-read this Developer Guide and the Model Business Cases for a comprehensive overview. The products are accessible at www.get-invest.eu.

ABOUT GET.INVEST MOZAMBIQUE

GET.invest is a European programme that mobilises investment in renewable energy, supported by the European Union, Germany, Sweden, the Netherlands and Austria.

Since 2019, to focus specifically on the Mozambican energy sector, the programme has been operating a country window in Mozambique funded by the European Union and Germany as part of PROMOVE ENERGIA – a comprehensive strategy between the EU and the Government of Mozambique to provide households and businesses in rural areas with access to sustainable and affordable energy. Find out more at www.get-invest.eu/get-invest-mozambique/.

GET IN TOUCH

We welcome your feedback on the Market Insights by sharing any questions or comments via email at info@get-invest.eu.

ACKNOWLEDGMENT

This document would not have been possible without the valuable inputs, comments and feedback provided by our collaboration partners and peer reviewers.

CONTACT

GET.invest
E info@get-invest.eu
I www.get-invest.eu

Place and date: Brussels, November 2023
Photo credits: © Globeleq & Source Energia