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Mobilising Renewable Energy Investments

Nigeria: Powering Electric Mobility

Model Business Case: Mini Grid-Powered Rural E-Mobility Project

INTRODUCTION

This Model Business Case (MBC) analyses the financial feasibility of a hypothetical project deploying two-wheeled electric vehicles (EVs) for mobility in a rural community in Nigeria powered by a solar mini-grid ("the Project"). It is assumed that the project sponsor – a private EV operator – will finance, procure and maintain the EVs, and lease the EVs and additional batteries on a daily basis to certified local drivers. The EV operator is also assumed to purchase electricity from the solar mini-grid operator to power its charging station.

TARGET AUDIENCE

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):

- **EV operators** who may be interested in pursuing opportunities for the deployment of EVs in rural areas of Nigeria;
- **Potential investors** who may be interested in financing rural e-mobility projects in Nigeria; and
- **Government officials, development partners and financiers** who may be interested in understanding the quickly-emerging EV market in Nigeria to inform the development or improvement of supporting policies and programmes.

This MBC is accompanied by a Developer Guide, which aims to inform key stakeholders about opportunities in the e-mobility sector in Nigeria and a second MBC that analyses an urban-focused e-mobility company.

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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 and local stakeholder interviews. A detailed feasibility study would be required to determine the actual applicable costs and parameters for specific projects.

Technical assumptions

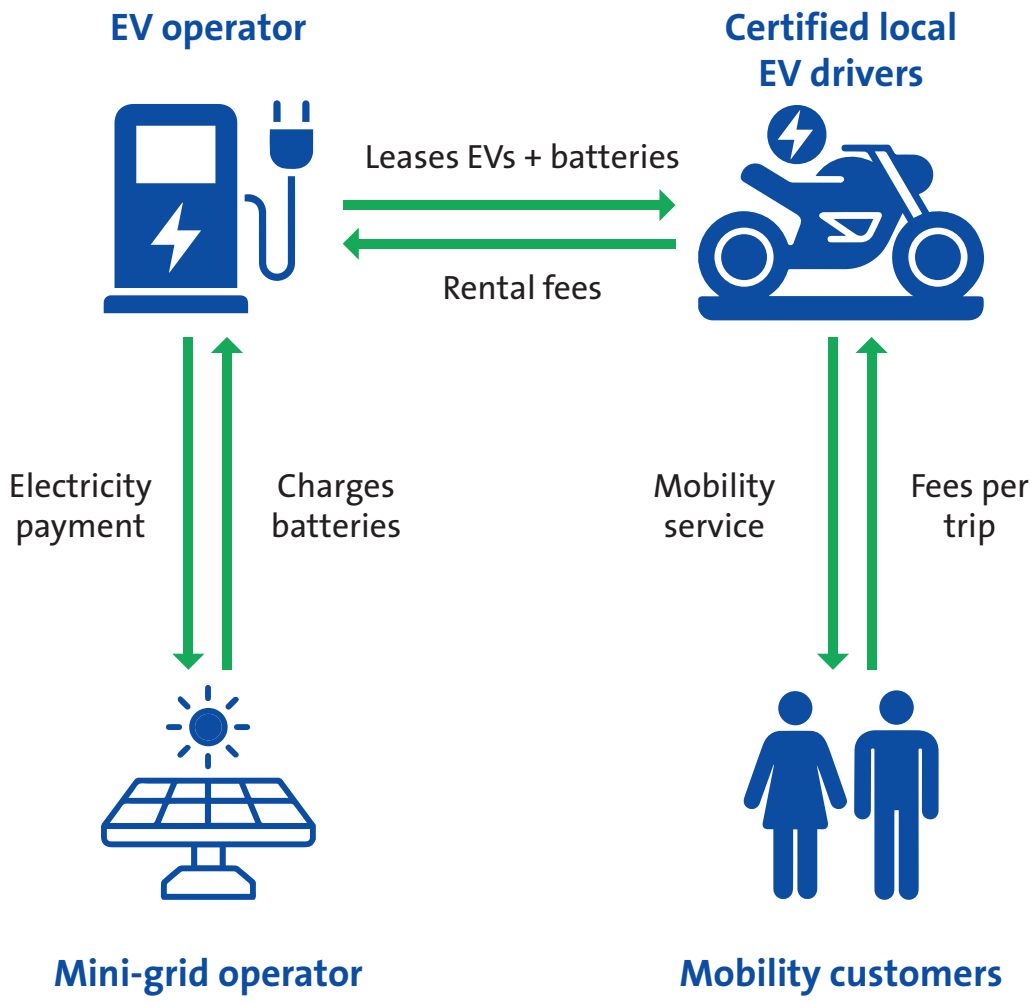
Table 1 presents the assumptions related to the EV fleet size, daily rentals, battery swaps and electricity consumption levels, based on data obtained from a pilot conducted between 2020 and 2021 by MAX, an e-mobility company, and Rubitec Solar, a green mini-grid operator, in Gbamu Gbamu, a rural community in southwest Nigeria.[1]

TABLE 1. Technical assumptions

CUSTOMER LOAD CHARACTERISTICS	UNIT	VALUE
Fleet size	#	10[2]
Daily vehicle utilisation rate	%	80%[3]
Number of EVs rented daily	#	8[4]
Average distance travelled per rental	km	100[5]
Daily electricity consumption per rental	kWh/day	5.3[6]
Total daily charging station load	kWh/day	42.4[7]
% of renters requiring battery swap	%	100%[8]
No. of battery swaps per day	#	8[9]
Battery size	kWh	3.6[10]
No. of batteries required per EV	#	2.2[11]
Total no. of batteries required	#	22[12]
% of batteries charged during daytime	%	80%[13]
% of batteries charged during night-time	%	20%[14]

1) The mini-grid operated by Rubitec in Gbamu Gbamu is powered by an 84 kWp solar array, a 310-kWh battery bank, and a 67 kVA backup diesel generator to serve over 550 small residential households and 150 larger customers and businesses.
2) Based on MAX-Rubitec pilot.
3) Stakeholder consultations, 2023.
4) Derived by multiplying the fleet size by the daily vehicle utilisation rate.
5) Allee, A., Sherwood, J., and Schroeder, J., "Powering Small-Format Electric Vehicles with Mini-grids: Assessing the Viability of Two- and Three-Wheeled EVs for Rural Mobility," Shell Foundation and Factor[e] Ventures, (April 2022): https://rmi.org/wp-content/uploads/dlm_uploads/2022/04/powering_small_format_electric_vehicles_with_minigrids.pdf.
6) Based on MAX-Rubitec pilot.
7) Derived by multiplying the number of EVs rented daily by the total daily charging station load.
8) Stakeholder consultations, 2023.
9) Derived by multiplying the number of EVs rented daily by the percentage of renters requiring battery swaps.
10) Based on MAX-Rubitec pilot.
11) Stakeholder consultations, 2023.
12) Derived by multiplying the number of batteries required per EV by the fleet size.
13) Stakeholder consultations, 2023.
14) Stakeholder consultations, 2023.

FIGURE 1. Business model illustration



Macroeconomic assumptions

For this analysis, the Nigerian naira (NGN) to EUR exchange rate is assumed to be 1356.75,[15] while the annual NGN to EUR depreciation is assumed to be 10%.[16] Annual inflation is assumed to be 20% over the life of the Project, based on projections for the country.[17]

15) Based on April 7, 2024 exchange rate.
16) Nigeria Exchange Rate Management: https://www.bodeagusto.com/post/nigeria-ex-change-rate-management
17) Nigeria Inflation Rate, Trading Economics: https://tradingeconomics.com/nigeria/inflation-cpi

Capital cost assumptions

The EVs are assumed to cost EUR 1,200 (USD 1,300) each,[18] while the batteries are assumed to cost EUR 152.3 per kWh.[19] These estimates are inclusive of procurement costs, shipping costs, import duties and value-added tax (VAT). It is assumed that the EVs will be depreciated via straight line depreciation over a 4-year lifespan at a rate of 25% per year while the batteries will be depreciated over 5 years at a rate of 20% per year.

Operating cost assumptions

Table 2 presents the operating cost assumptions for the Project. It is assumed that the operating costs will escalate by 20% annually in line with inflation. It is assumed that the costs of EV and battery replacements are based on an annual price reduction of 3% compared to the initial investment.[20]

TABLE 2. Operating cost assumptions

COST DESCRIPTION	UNIT	COST
EV mini-grid daytime electricity tariff	EUR/kWh	€0.18[21]
EV mini-grid night-time electricity tariff	EUR/kWh	€0.22[22]
Charging depot building/infrastructure rental fee	EUR/month	€36.90[23]
EV O&M cost	EUR/km	€0.0032[24]
Insurance premium	% of EV CAPEX	3%[25]
Staffing costs and operational overhead	EUR/EV	150[26]

Taxes

A corporate income tax rate of 30% is applicable to the Project if its turnover is greater than NGN 100M (EUR 73,706); 20% if its turnover is between NGN 25M (EUR 18,426) and NGN 100M (EUR 73,706); and 0% if its turnover is less than NGN 25M (EUR 18,426). The Project is also subject to a tertiary education tax of 2.5% of its profit. In addition, a standard VAT rate of 7.5% was applied to the products and services used for the Project.[27]

Revenue

The model assumes a daily EV rental fee of NGN 2,800 (EUR 2.06) and an additional fee of NGN 1,400 (EUR 1.03) for a battery swap.[28] It is also assumed that the rental fees will escalate by 20% annually in line with inflation.

18) Stakeholder interviews, 2023.
19) Catsaros, O., "Lithium-Ion Battery Pack Prices Hit Record Low of $139/kWh," Bloomberg New Energy Finance, (November 26, 2023): https://about.bnef.com/blog/lithium-ion-battery-pack-prices-hit-record-low-of-139-kwh/#
20) "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
21) Stakeholder interviews, 2024.
22) Stakeholder interviews, 2024.
23) Based on MAX-Rubitec pilot.
24) Based on MAX-Rubitec pilot.
25) Based on MAX-Rubitec pilot.
26) Stakeholder interviews, 2023.
27) PwC: Nigeria: Corporate - Taxes on corporate income: https://taxsummaries.pwc.com/nigeria/corporate/taxes-on-corporate-income#:~:text=The%20CIT%20rate%20is%2030,in%20the%20year%20preceding%20assessment; and PwC: Nigeria: Corporate - Other taxes: https://taxsummaries.pwc.com/nigeria/corporate/other-taxes
28) Adjusting the cost comparison presented in the Developer Guide to account for the average prevailing petrol price of NGN 900 per litre in rural parts of Nigeria (https://dailytrust.com/petrol-sells-for-n1000-per-litre-in-ogun-border-communities/) translates to a daily ownership cost of over NGN 4,300 for petrol bikes. A driver renting an EV and additional battery at the assumed rental fee level will spend less than a petrol bike driver.

Financing structure and debt assumptions

It is assumed that the initial Project capital costs will be financed by the EV company with 20% equity, 20% debt and 60% grants.[29] Two debt financing scenarios were considered: **(i)** EUR-denominated debt; and **(ii)** NGN-denominated debt.

Table 3 presents the project debt assumptions for both scenarios. The debt tenor is assumed to be 4 years under both scenarios.[30] It is also assumed that the cost of equipment replacements will be covered by 30% grants and 70% equity. The required rate of return for equity investors to consider the Project attractive is assumed to be 15%.[31]

TABLE 3. Project debt assumptions

PROJECT DEBT	UNIT	EUR DEBT	NGN DEBT
Debt amount	EUR/NGN	€3,715	NGN 5.04M
Debt interest rate	%	9%[32]	25%[33]

RESULTS

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

- Under the EUR-denominated debt scenario, the Project is attractive, with an after-tax equity IRR (EIRR) of 16.6%, equity NPV of EUR 810 and a minimum debt service coverage ratio (DSCR) of 1.23, which is above the threshold of 1.2 typically required by lenders to finance a project.

- Under the NGN-denominated debt scenario, the Project is also attractive, but to a lesser extent, with an after-tax EIRR of 16.2%, equity NPV of EUR 608 due to the high cost of local debt. However, due to insufficient cashflows in the first year, the minimum DSCR is 0.95, which is below the threshold of 1.2 typically required by lenders. This indicates that a debt service reserve account (DSRA) or concessional terms will be required.

The results of the financial analysis are summarised in **Table 4**.

SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to determine the impact of changes in key assumptions on the EIRR and minimum DSCR as measures of the viability of the Project. The figures below present the results under various scenarios.

Rental fee and grant scenarios

Figure 2 shows the impact of increases in the daily rental fee and grants on the EIRR. The analysis found that the required EIRR can only be achieved with grants of at least 56.7% and 57.6% under the EUR debt and NGN debt scenarios, respectively, at the assumed acceptable daily rental fee level (NGN 2,800). Without grants, the Project will require a daily rental fee of NGN 3,852 and NGN 3,876 to achieve the required EIRR under the EUR debt and NGN debt scenarios, respectively. This will not be attractive to the drivers, as the total daily rental fees will exceed the cost of operating a petrol bike.

29) The productive use of energy (PUE) equipment component of the Nigeria Electrification Project (NEP) provides grants covering 30%-60% of equipment cost based on incentive factors including gender, scalability and poverty index.

30) Stakeholder interviews, 2023.

31) "CrossBoundary Energy fully exits first fund at 15% net internal rate of return (IRR), raises $40M to continue to scale financed solar for businesses in Africa," CNBC Africa, (17 November 2020): https://www.cnbcafrica.com/2020/crossboundary-energy-fully-exits-first-fund-at-15-net-internal-rate-of-return-irr-raises-40m-to-continue-to-scale-financed-solar-for-businesses-in-africa/

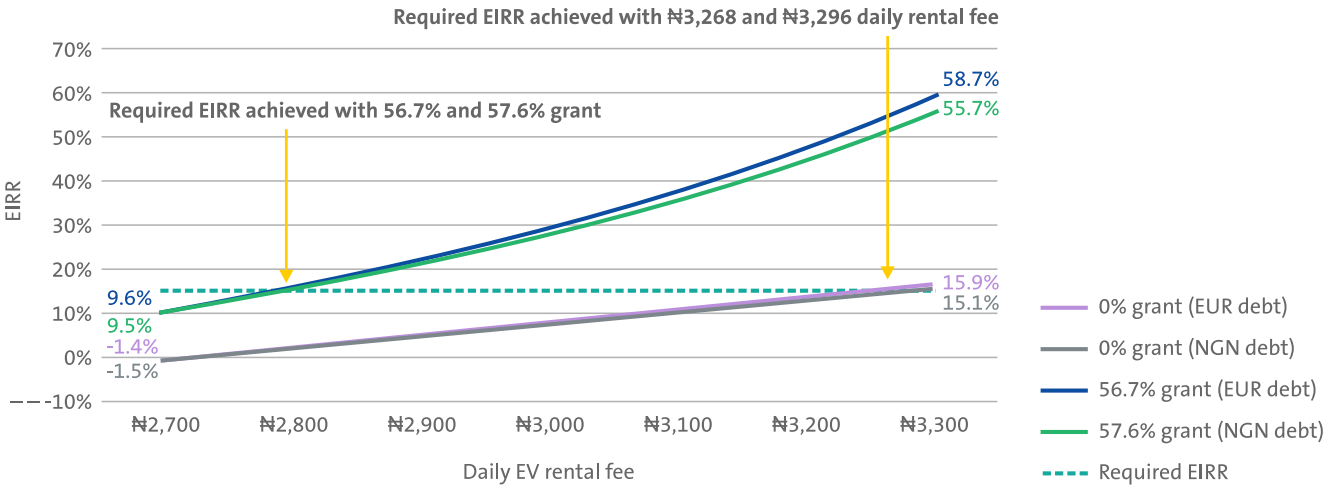
32) Stakeholder interviews, 2023.

33) Stakeholder interviews, 2023.

TABLE 4. Financial analysis results

INDICATOR	EUR-DENOMINATED DEBT	NGN-DENOMINATED DEBT
Avg. annual revenue	€21,236	
Avg. annual expenses	€16,827	
Avg. EBITDA	€4,409	
Avg. net income	€448	€403
Total cash flow to equity	€38,474	€38,354
Net cash flow to equity	€34,759	€34,639
Cash on Cash Return	9.36x	9.32x
After tax equity IRR	16.6%	16.2%
After tax project IRR	15.9%	
Equity NPV	€810	€608
Initial equity payback period (years)	12	12
Initial project payback period (years)	12	12
Avg. DSCR	1.69	1.83
Min. DSCR	1.23	0.95

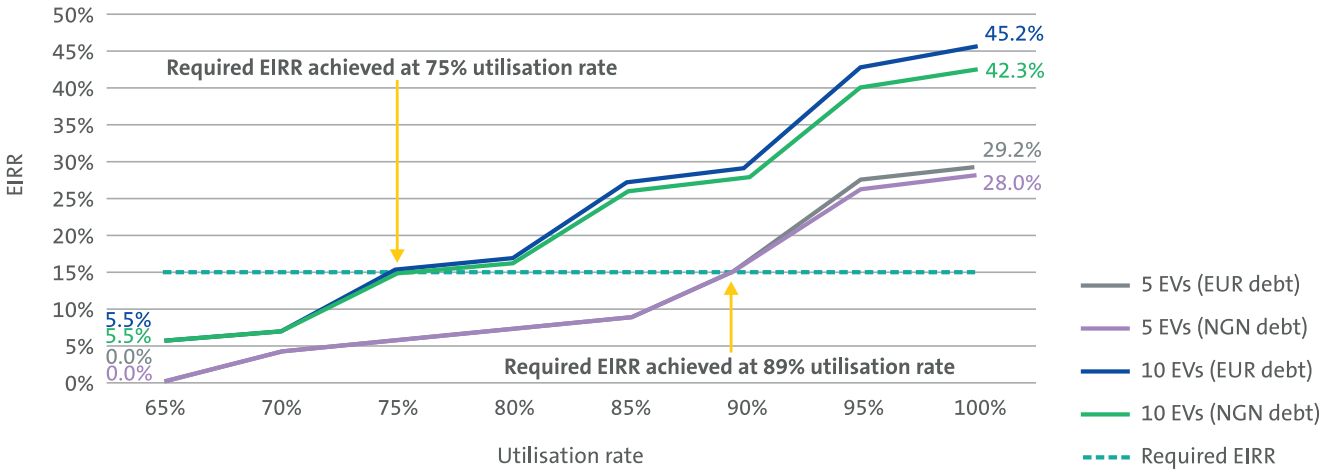
FIGURE 2. Equity IRR at various EV rental fee and grant levels



Fleet size and utilisation scenarios

Figure 3 illustrates the impact of increases in the daily vehicle utilisation rate and fleet size on the EIRR. The analysis found that the required EIRR can only be achieved if the daily utilisation rate is at least 75% (below the assumed utilisation rate of 80%). The results also show that the EIRR increases with fleet size as the utilisation rate increases, indicating that the viability of the Project depends on the ability of the EV operator to deploy as many EVs as possible and achieve/sustain high vehicle utilisation rates.

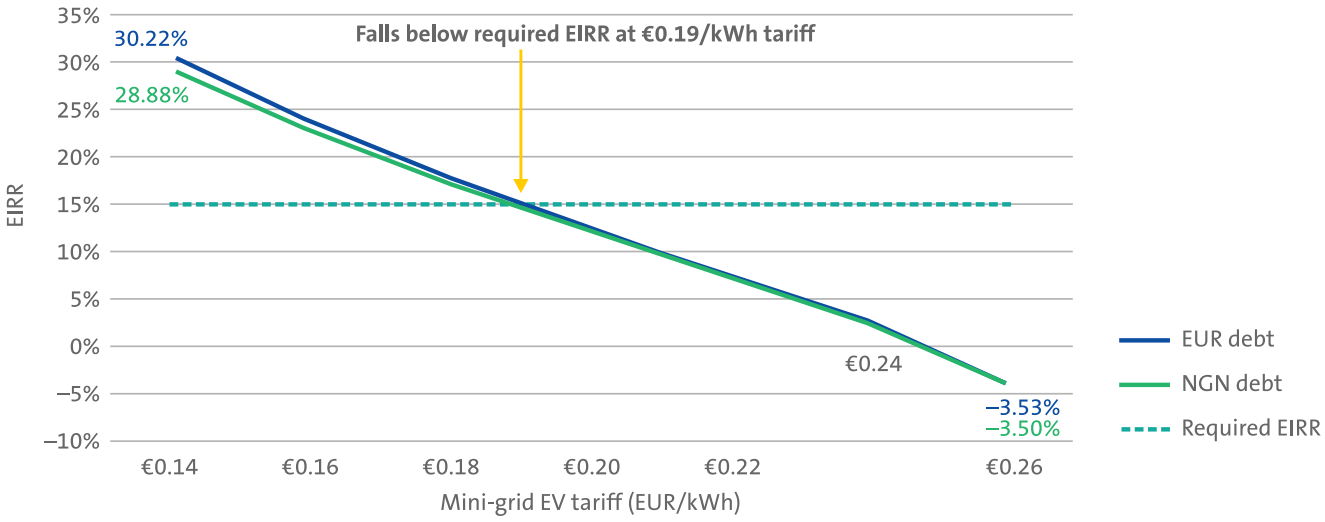
FIGURE 3. Equity IRR at various utilisation rate and fleet size levels



Mini-grid tariff scenarios

Figure 4 shows the impact of increases in the tariff charged by the mini-grid operator for EV charging on the EIRR. The analysis found that the required EIRR will only be achieved if the daytime mini-grid tariff does not exceed EUR 0.19/kWh (just above the assumed EUR 0.18/kWh level) under both scenarios. This shows that the Project will need to take advantage of a time-of-use discount on the tariff charged to regular mini-grid customers, which is currently about EUR 0.22/kWh and above, by charging most of the EV batteries during off-peak hours.

FIGURE 4. Equity IRR at various mini-grid EV charging tariff levels



Debt interest rate scenarios

Figure 5 and **Figure 6** show the impact of increases in both the EUR-denominated and NGN-denominated debt interest rates on EIRR and minimum DSCR, respectively. The analysis found that the required EIRR will only be achieved with EUR debt priced below 22% (well above the assumed rate of 9%) and NGN debt priced below 36.6% (well above the assumed rate of 25%). The analysis also found that the minimum DSCR threshold can only be achieved with EUR debt priced below 10% (above the assumed rate of 9%) and NGN debt priced below 13.8% (below the assumed 25% rate). This indicates that the Project will require concessional debt terms (e.g., grace period) and/or a DSRA if financed with NGN debt.

FIGURE 5. Equity IRR at various debt interest rates

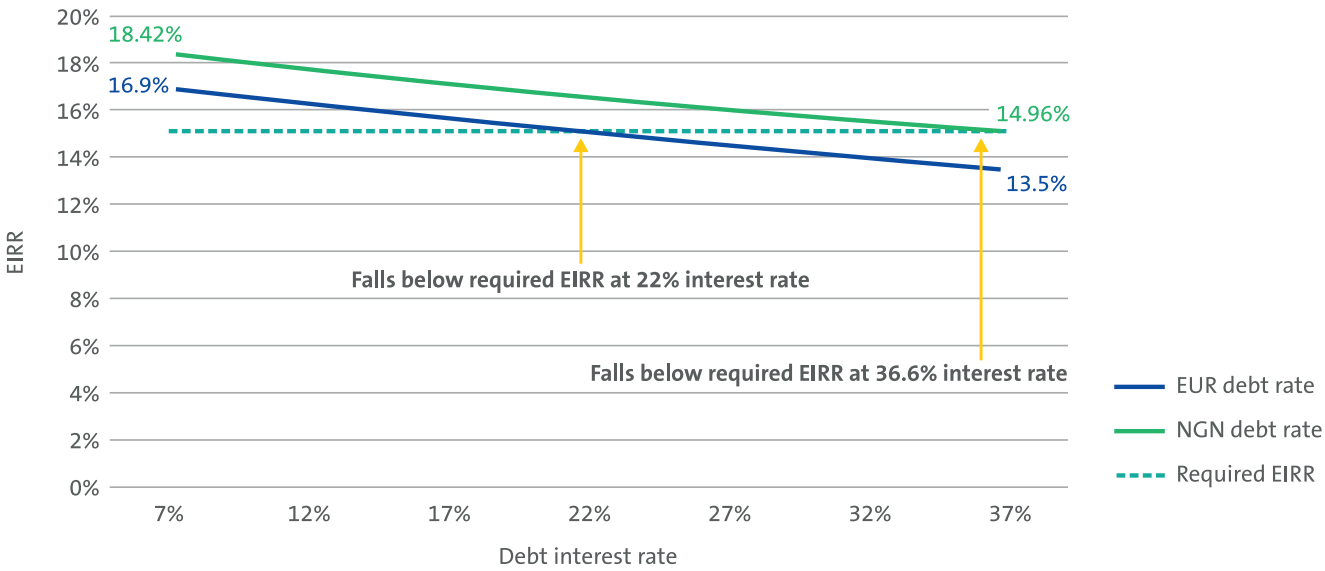
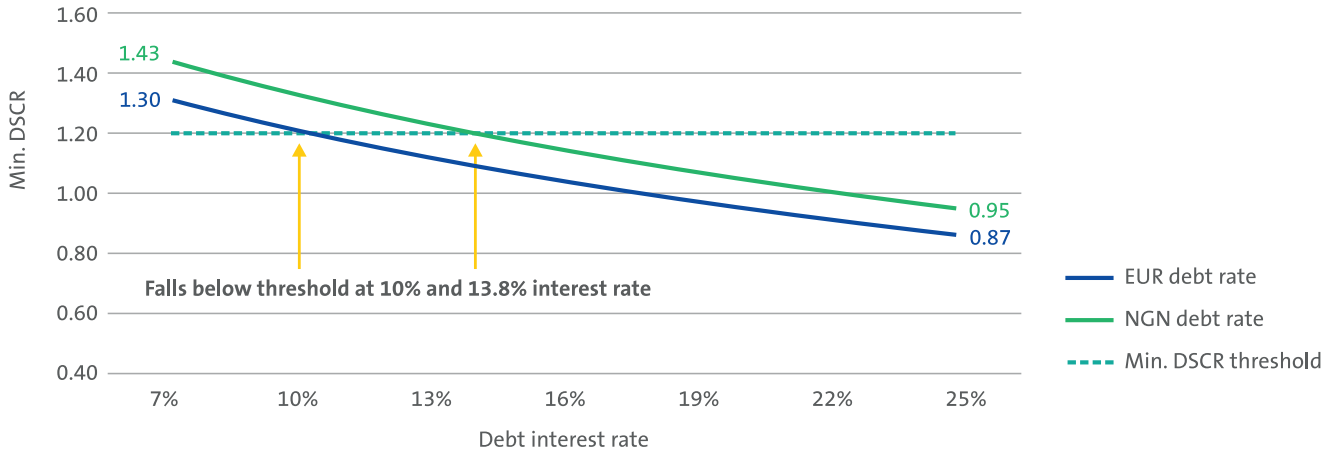


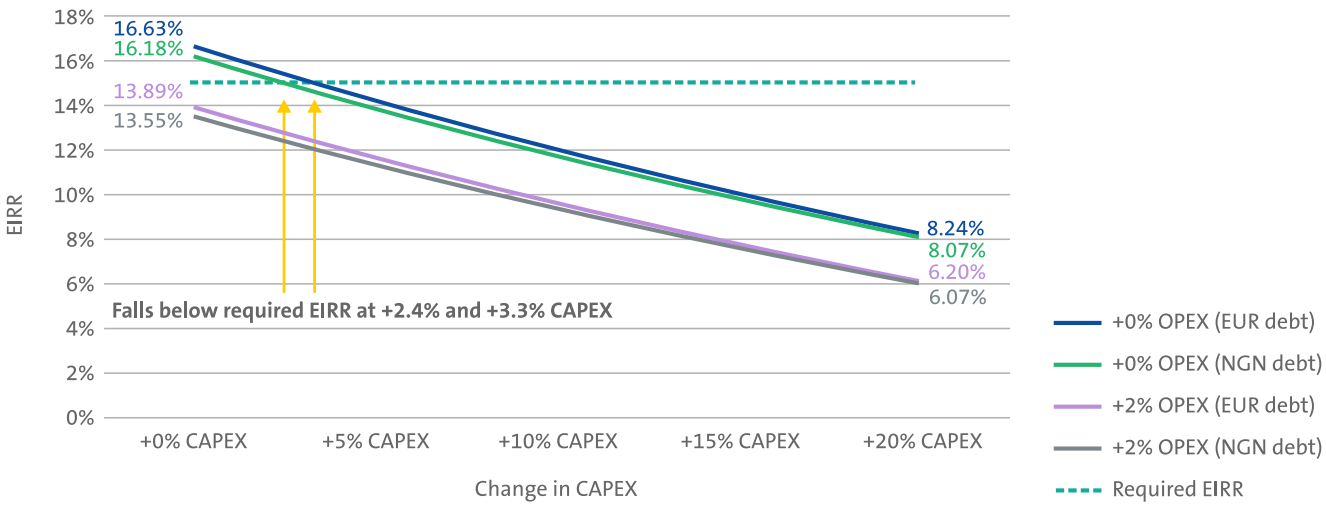
FIGURE 6. Minimum debt service coverage ratio at various debt interest rates



CAPEX and OPEX scenarios

Figure 7 illustrates the impact of changes in CAPEX and OPEX on EIRR. The analysis found that the required EIRR will not be achieved at the assumed OPEX level if CAPEX increases slightly by 3.3% under the EUR debt scenario and 2.4% under the NGN debt scenario. Also, the required EIRR will in both cases not be achieved if OPEX increases by a mere 2%, indicating that the Project is very sensitive to minor cost increases and is more sensitive to increases in OPEX than CAPEX.

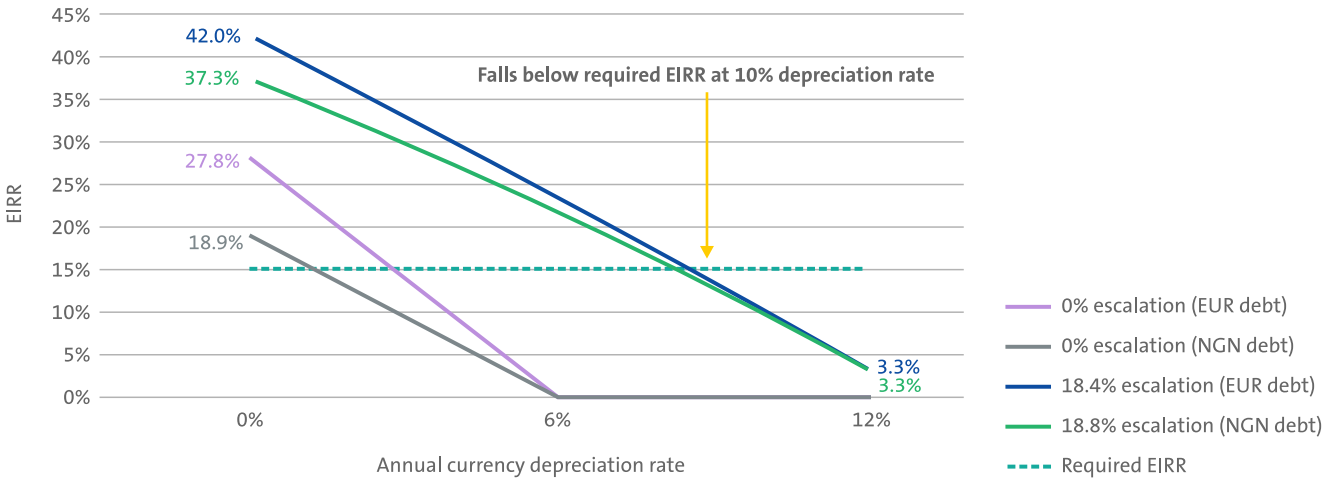
FIGURE 7. Equity IRR at various CAPEX and OPEX levels



Local currency depreciation and inflation scenarios

Figure 8 shows the impact of increases in the annual local currency depreciation rate and inflation rate on the EIRR. The analysis found that at the projected local currency annual depreciation rate of 10%, the required EIRR will only be achieved if the rental fees and costs escalate annually by at least 18.4% and 18.8% (below the assumed inflation rate of 20%) under the EUR debt and NGN debt scenarios, respectively. This indicates that the viability of the Project will depend on the stability of the NGN and the EV operator's ability to increase fees.

FIGURE 8. Equity IRR at various currency depreciation and inflation levels



CONCLUSIONS AND KEY TAKEAWAYS

Based on the assumptions in this Model Business Case, the Project is estimated to be attractive, with an after-tax EIRR of 16.6% and 16.2% when financed with EUR debt and NGN debt, respectively.

However, the viability of the Project will depend on the ability of the EV operator to (i) consistently achieve a high vehicle utilisation rate; and (ii) to increase rental fees. The analysis found that the required EIRR can only be achieved at a daily utilisation rate of at least 75% and an annual fee escalation rate of at least 18.4%. The Project will also require grant funding of at least 56.7% (at the assumed acceptable rental fee of NGN 2,800) and a discounted time-of-use tariff of a maximum of EUR 0.19/kWh from the mini-grid operator.

In addition, the Project will require concessional debt terms (e.g., grace period, low interest rate) and/or a debt service reserve account (DSRA) if financed with local currency debt. The viability of the Project is also sensitive to minor increases in both OPEX and CAPEX, so the EV operator will need to carefully manage costs.

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.

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 refers 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.

Initial equity payback period (years) refers to the number of years it takes to recover the equity investment in 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 opportunities in Nigeria's electric mobility sector. The Guide is organised into four main sections: **1)** introduction; **2)** context for e-mobility development in different countries across sub-Saharan Africa, including an overview of the sector's policies, regulations, financing mechanisms and business models; **3)** examination of the potential for e-mobility in Nigeria, specifically looking at its enabling environment, business models, financing mechanisms and opportunities for e-mobility to support rural economic development; and **4)** exploration of the "Route to Market" – i.e., how to leverage the market research presented in the Guide to contribute to e-mobility development in Nigeria.

The two **Model Business Cases** included in this package analyse: **1)** a mini-grid powered rural e-mobility project; and **2)** an urban e-mobility business.

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

GET.invest is a European programme that mobilises investment in renewable energy. The programme targets private sector companies, project developers and financiers to build sustainable energy markets in sub-Saharan Africa, the Caribbean and the Pacific.

Services include tailored access-to-finance advisory, a funding database, market information, and financial sector support to increase local currency financing.

The programme is supported by the European Union, Germany, Norway, the Netherlands, Sweden and Austria. Find out more at www.get-invest.eu.

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

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