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Assessing the Financial Viability of Utility-Scale Solar Power Investment in Zambia: Evidence from Copperbelt Energy Corporation

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Abstract

The purpose of this study was to examine the financial viability of Copperbelt Energy Corporation's (CEC's) solar investment in Zambia, considering the recently installed 34MW Riverside Solar Power Plant and ongoing construction of the 60MW Itimpi Phase 1 solar plant. The current paper fills a gap in the literature regarding the topic of renewable energy investments in terms of practical experience of firm-level renewable projects in sub-Saharan Africa, since most previous research in the area has focused on either macro-level policies, policies-related issues, or pre-construction feasibility studies of the potential renewable energy project. This research aimed to achieve several objectives to examine the return profile of CEC's solar investment, to estimate the solar generation capacity that CEC has built through its solar plants, and to analyse the payback and financial break-even aspects of the solar projects. The Resource Based View and Capital Budgeting Theory were employed as theoretical frameworks in order to consider solar energy investment in terms of the firm's ability building resource as well as long-term capital project that requires formal financial analysis. A mixed-methods approach to single case design was adopted for the research. According to the findings, the strategies resulted in significant expansion in the CEC's portfolio of renewable power generation capacity. Solar power installation reached 94 MW in 2024, while solar power generation increased to 153.8 GWh. Solar revenue improved from USD 2.54 million in 2023 to USD 8.66 million in 2024, and solar net profit from USD 0.22 million to USD 1.08 million during the same period. These figures suggest that the solar business unit became commercially viable by 2024 but did not recover its initial capital expenditure fully during the study period. Accordingly, a future-oriented financial projection for the project was conducted to determine its mid-term viability. The management case scenario yielded an estimated IRR of 12.0%, NPV of USD 16.60 million at a 10% discount rate, and an estimated payback period of 7.9 years starting from January 2024. The research finds that the decision by CEC to invest in solar energy is both operationally sound, strategically important, and commercially viable within the assumed conditions for the medium term. The paper claims that the current case is valuable to the body of knowledge because it proves that even when corporate solar initiatives in Zambia have a low accounting recovery at the beginning of the projects, they can still be viable throughout their life span.

1. Introduction

The provision of funds for the development of renewable energy systems has become a key focus of discussion in both corporate finance and the broader discourse of energy transition. In Zambia, the topic has particular relevance, since the country's electricity sector has traditionally been dominated by hydropower, thus making the national electricity grid and its major consumers vulnerable to climatic risks in terms of hydrology. Given these circumstances, Copperbelt Energy Corporation (CEC), which is one of the most prominent electricity firms in Zambia, has ventured into solar energy production at a utility level scale with the Riverside and Itimpi solar plants. These endeavors are not only strategically crucial due to the change in business model from electricity transmission and trade to renewable energy production but also financially vital as substantial investments require proof of their feasibility.

In essence, the key issue under discussion in this study is the confusion that arises due to the unclear nature of the economic feasibility of renewable energy projects at the corporate level. Huge capital investment, lengthy life cycles, and a long gestation period may make some projects economically unfeasible when evaluated from an accounting perspective in the early stages of implementation. In contrast, most renewable energy projects can still be economically feasible when evaluated using capital budgeting tools such as net present value, internal rate of return, and payback period. The current study, thus, aims to determine whether the solar projects undertaken by CEC are economically feasible.

1.2 Statement of the Problem

Although CEC has invested significant funds in solar energy production on a utility scale, a financial evaluation of such investments is complex. Historical performance data indicate robust gains in installed capacity, electricity generation, earnings, and net profit from solar energy after commissioning; however, the projects remained at an initial stage of recovery by the end of 2024. An investment decision thus emerges concerning how to determine if a project is financially sound either through early-year operations or based on a more extensive analysis of cash flows? There is no level-headed, empirical answer to the question within Zambia's context, creating both practical and academic voids. More information on the profitability and ability of large solar energy facilities to recover their investments within a feasible time frame and enhance business performance is needed.

1.3 Objectives

- To determine the financial return profile of CEC's solar power investment.
- To evaluate the solar generation capacity added by CEC's solar projects.
- To assess the project's payback profile and expected financial breakeven.

2 Literature Review

2.1 Theoretical Frameworks

This study is based on two theories, namely the Resource Based View and Capital Budgeting Theory. RBV describes how the use of solar resources can become strategic assets for building organizational capabilities and competitiveness when used within organizational processes in conjunction with complementary assets (Barney, 1991). On the other hand, Capital Budgeting Theory describes the use of financial evaluation methods like NPV, IRR and payback period to evaluate long-term projects instead of looking at their financial success only after the initial period (Justice and Pious, 2020).

2.2 Conceptual Framework

The logic underlying this article lies in the way in which CEC's investment in solar power impacts the financial viability of the project via three interlinked channels: through expanding its installed generation capacity, translating this installed capacity into productive output and hence, profits, and by producing the kind of mid-term cash flows necessary for calculating the net present value, internal rate of return, and payback period.

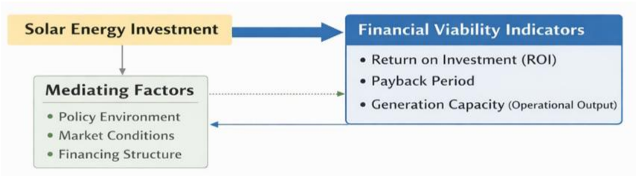

Figure 1: Conceptual framework diagram
Source: Author

2.3 Empirical Review

Renewable Energy Literature Now Includes That Solar Power Is Not Just An Environmental Solution But Is Also A Practical Source Of Power. Across the world, the declining cost of technology, reduced installation time and greater bankability are some reasons why utility-scale solar is becoming more appealing to both state and non-state investors (IRENA, 2023). However, for countries in Africa, the uptake rate of solar investments has always been slow because of issues such as lack of capital, inadequate infrastructure and poor regulations. More recent literature indicates that this trend has started changing in the right direction (Quaid, 2025).

In terms of firm performance, previous studies have shown that firms with renewable energy sources tend to perform better because they have lower operating costs and stable supply along with their capabilities. For example, Xie, Huo and Zou (2019) discovered that environmental innovation tends to contribute positively to the bottom line as long as innovation helps in improving productive efficiency and reducing cost. Similarly, Ghisetti and Rennings (2014) also claim that innovation will only add more value to firms as far as their financial performance is concerned if such innovations relate to resource productivity rather than just being regulatory.

Unfortunately, however, there is much that could be improved regarding the current state of affairs, since existing literature can be criticised in terms of several limitations. Firstly, numerous studies are based on forecasts of future performance, rather than actual results. Secondly, the majority are conducted at either a macroeconomic or an industry level, rather than a firm level. Finally, very little literature has ever tried to merge two different streams of thought in explaining renewable investment decisions.

3 Methodology

The research design employed for the study combines both qualitative and quantitative approaches in a single-case study method. The case study is concerned with the solar investment projects of CEC from 2019 until 2024, including the Riverside Solar Power Plant and the Itimpi Phase 1. The quantitative method entailed gathering financial and operations data related to the projects from documents provided by CEC. Data was then analyzed using methods such as descriptive financial analysis, ratio analysis, historical review of operations, forecasting cash flow model, and sensitivity analysis. For qualitative data, semi-structured interviews were conducted with four purposively selected personnel from CEC who had knowledge of the projects. Interviews were analyzed using thematic analysis.

In this study, there exists an important distinction between historical observation and forecast of the projects' viability. Financial data from before the end of 2024 were gathered for a historical assessment of what the projects had accomplished to date. Since the projects were still in their initial recovery period, a model for forecasting the NPV, IRR and payback period for a medium-term horizon was developed. Using forecasts as if they are observations could lead to improper interpretation of the data, since they represent projections rather than observed reality.

4 Data Presentation and Analysis

Results are organized based on the objectives of the study. The first set of findings pertains to return profile and viability, while the second set relates to additional generation capacity. The last one deals with payback and breakeven.

4.1 Historical operating performance and financial viability

From the historical data provided, it is clear that CEC's solar energy business unit was not economically significant until the completion of Riverside in 2023 and Itimpi Phase 1 in 2024. Throughout the pilot project phase between 2019 and 2022, the level of solar energy production was roughly 1.5 GWh per annum, and the economic impact of the business unit was negligible. However, following the completion of the projects, solar energy production grew to 46.6 GWh in 2023 and 153.8 GWh in 2024. Solar energy revenues increased from USD 2.54 million in 2023 to USD 8.66 million in 2024, whereas solar energy profits increased from USD 0.22 million to USD 1.08 million during the same period.

Table 1: Historical solar operating performance, 2023–2024.

Indicator	2023	2024	Change
Installed capacity (MW)	34	94	176.5%
Solar generation (GWh)	46.6	153.8	230.0%
Solar revenue (USD m)	2.54	8.66	240.9%
Solar net profit (USD m)	0.22	1.08	390.9%

While these are good results for operations, the historic data also indicate that capital recovery was not fully realized until the end of 2024. Given the cumulative profit from solar energy from the operating data, it can be said that the cumulative accounting rate of return was still small. Therefore, it should be noted that the project entered the period of earning money and not that of capital recovery.

4.2 Forecast project appraisal

The cash flow forecast used to gauge the viability of the project in the medium term was prepared using a project capex base for Riverside & Itimpi Phase 1 of USD 83.0 million. In the forecast, the two years (2023 and 2024) were considered ramp-up periods, while revenue, EBITDA, taxes, maintenance capex, and change in working capital was forecasted for 2025 through 2032. With management case assumptions, the forecast indicated that the project had an IRR of 12.0%, NPV of USD 16.60 million with a discount rate of 10% and NPV of USD 0.12 million with a discount rate of 12%.

Table 2: Forecast investment appraisal metrics.

Metric	Result	Interpretation
Initial project capex base	USD 83.0 million	Base used for forecast recovery model
Internal Rate of Return (IRR)	12.0%	Acceptable if required return is 10–12%
Net Present Value (NPV) @ 10%	USD 16.60 million	Clearly positive
Net Present Value (NPV) @ 12%	USD 0.12 million	Marginally positive
Payback period	7.9 years	Commercially reasonable for utility-scale solar

4.3 Added solar generation capacity

From the findings, it is evident that the second objective has been met quite satisfactorily. From an initial installed capacity of 1 MW in the pilot scheme, the installed capacity went up to 34 MW in 2023 and up to 94 MW in 2024. The implication is that, within the time frame of this analysis, the company added 93 MW of solar power generation capacity beyond the pilot level. In terms of capacity being turned into actual generation capability, in 2024 alone the annual production stood at 153.8 GWh.

4.4 Payback and Breakeven

Interpretation of the Payback Result
A careful interpretation of the payback result should be made at this point. The break-even was not yet achieved by the end of 2024, based on historical observation. As such, the payback time is considered a forecast evaluation result and not an historical observation. At 7.9 years, the payback period is commercially reasonable for a durable investment good and implies that the venture is likely to recover the cost of capital in good time before it can create further value thereafter.

4.5 Discussion of Findings

The results indicate that the CEC's solar venture should be regarded as a project that exhibits high levels of operational success, good initial business results, and a viable financial outlook. This perspective is more realistic than the alternative interpretations that view the project either as a highly successful business opportunity or an underperforming green project. The case corroborates previous research indicating that renewable energy investments enhance business performance when embedded within efficient and strategic frameworks rather than symbolic initiatives (Xie, Huo and Zou, 2019; Ghisetti and Rennings, 2014).

Furthermore, the analysis contributes to the existing literature in various aspects. First, it offers firm-level evidence from the case of Zambia, a country where empirical studies focusing on renewable energy investments by firms are not abundant in the literature. Second, the case demonstrates that there can be a considerable discrepancy between short-term accounting recoverability and medium-term viability. Third, the analysis underscores the significance of financing decisions. The positive NPV of the project at 10% and marginally positive NPV at 12% indicates that cost of capital is critical to the value created from renewable infrastructure projects. Therefore, the use of green bonds with relatively long maturities may have increased the likelihood of asset-liability valiabilty

These results can be explained by a joint theoretical approach as well. Capital budgeting theory can help explain the reasons for the need to use NPV, IRR, and payback to evaluate the viability of the project. The resource-based view of the company can explain the importance of solar resources from a strategic perspective even in the early stages of recovery.

5 Conclusions and Recommendations

5.1 Conclusions

This paper finds that CEC's solar energy venture represents operational success, strategic significance, and financial sustainability in the medium term on the above assumptions. The past performance figures indicate that the solar venture had become economically viable by 2024, recording considerable growth in capacity, power generation, income, and net profit. Nonetheless, total capital recovery had not been realized within the analyzed time frame, implying that purely accounting data cannot be used to determine the overall feasibility of the venture. Instead, the future cash flow model appears more relevant since it indicates an IRR of 12.0%, a positive NPV at 10% discounting rate, and payback period of 7.9 years. In essence, this suggests that corporate investment ventures involving solar energy in Zambia can indeed become profitable and strategic if well evaluated and implemented.

5.2 Implications for policy

Recommendations derived from the findings include that CEC should continue using capital budgeting methods for assessing future solar energy projects. In cases of projects having similar levels of risk, it is advisable to appraise investments based on a discount rate of between 10% and 12% in nominal US dollars with 10% as the base case. Future projects should have a base-case internal rate of return of more than 12%, positive net present value at 10% and a payback period of no more than 8 to 10 years. Post-investment analyses should be done after one year, two years and three years following completion of the projects, with formal management reviews initiated in the event of deviations from forecasts.

5.3 Recommendations for Future Research

It will be useful for future researchers to follow up on CEC's solar projects in the long run, thus assessing the life cycle returns that are achieved in addition to any degradation that may occur, as well as refinancing issues that might arise. A comparison between the CEC's project and those by other companies in Zambia and the surrounding regions will be important in understanding if the project represents a general case.

5.4 Limitations of the study

The limitations of the research include the use of case study approach, which limits the results of the experiment to analysis and not statistical inference. The qualitative component involved four selected subjects, which gave useful managerial insights and not full representation from the institutions. Furthermore, the values obtained for IRR, NPV, and payback period are model predictions and not actual data; hence, they are susceptible to the assumptions made such as discount rate, output performance, and income stability.

Declaration of Competing Interests

The author(s) declare that they have no competing or conflict of interest regarding the publication of this manuscript.

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Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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