CARBON FINANCING AND PROFITABILITY OF RENEWABLE ENERGY FIRMS REGISTERED UNDER THE ENERGY AND PETROLEUM REGULATORY AUTHORITY, KENYA

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ABSTRACT

Erratic profitability for renewable energy firms has pushed them to looking for additional sources of funding and carbon financing has emerged as a critical source which also contributes to achieving sustainable growth. By allowing businesses to generate revenue through the sale of carbon credits, carbon financing offers a powerful incentive for investing in cleaner technologies and processes. This financial mechanism not only supports companies in meeting regulatory climate commitments but also opens new revenue streams, increasing profitability and enhancing their financial resilience. Despite Kenya's rich potential, high capital costs, inconsistent regulations, limited financing, and operational inefficiencies hinder firms' financial sustainability. Additional issues like grid connectivity, market competition, and currency fluctuations further complicate their profitability. The study's principal aim was to establish a link between carbon financing and profitability of renewable firms registered under Kenya's Energy and Petroleum Regulatory Authority. More precisely, the study examined key carbon financing variables that include carbon credits, project initial cost, credit issuance and transactional costs, tax incentives and their effect on profitability. The study was based on and supported by the resource-based view theory, market-based theory and agency theory. The study employed a descriptive survey design and adopted a positivist research philosophy. The research design relied on primary data collected using a structured questionnaire that relates to carbon financing. The target population was fifty (50) renewable energy companies registered under Energy and Petroleum Regulatory Authority, and a population approach was used. Both descriptive and inferential statistics was used for data analysis with the help of Scientific Package Social Sciences (SPSS). Descriptive statistics including mean and standard deviation. A multiple regression model was performed to estimate the relationship between carbon financing and profitability. The results were presented on frequency tables, charts, and graphs. The results revealed that carbon credit, tax incentives, credit issuance and transactional costs and projects costs have significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority. Further, firm size does have a significant moderating effect on the relationship between carbon financing and profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority. Therefore, all the five hypotheses were not supported and the study concluded that carbon financing has significant effect on profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority and this effect is strengthened by firm size. The study recommended that management should consider diversifying the types of carbon credit projects in which the firm engages. Expanding into various carbon credit initiatives, such as forest preservation and renewable energy projects, can help mitigate risks associated with fluctuations in carbon credit prices and market demand. The government should continue to support the development and growth of carbon credit markets, both locally and

internationally. Policies should focus on creating a stable and transparent regulatory framework that encourages both local and foreign investments in carbon credit projects.

Keywords: Carbon Financing, Renewable Energy, Carbon Credits, Credit Issuance and Transactional cost, Initial Project Costs and Tax Incentives

INTRODUCTION

The adoption of the Sustainable Development Goals (SDGs) by the UN General Assembly in 2015 marked a significant step towards combating climate change and saving the planet for future generations (Schwerhoff and Sy, 2017). As Schwerhoff and Sy (2017) informed, increasing renewable energy (RE) production can contribute significantly to attaining many SDGs. Some of these SDS include improving health and education, protecting forests, combating climate change, and ending poverty. In essence, increased adoption of RE can play an integral role in solving some of the world's major challenges. However, financing is a major challenge hindering the adoption of RE. According to Taghizadeh-Hesary and Yoshino (2020), global investments in RE and energy-efficient projects reduced in 2017 and 2018 by 1% and 3%, respectively, and there is a risk that such reductions could be experienced in the future. Given the role RE and energy-efficient projects can play in attaining SGDs, it is imperative to overcome the challenge of financing. In Kenya, the Energy and Petroleum Regulatory Authority (EPRA) regulates the energy sector, including renewable energy. The country has made notable efforts to promote renewable energy to combat climate change and diversify energy sources. Several studies have explored the role of carbon financing. Gatimbu and Wabwire (2016) examined how environmental disclosure affects financial outcomes of firms listed on the Nairobi Securities Exchange, using leverage and ROE as measures. Their findings showed a positive link between disclosure and financial performance. Baimwera (2018) studied factors influencing carbon finance uptake in renewable energy projects. The study found that project size, level of carbon technology used, and market affiliation influenced financing inflows. Major constraints identified include inadequate capital and high transaction costs associated with carbon credits, limiting access to carbon financing for many projects.

Carbon Financing

Carbon financing offers key financial benefits to renewable energy (RE) firms in Kenya. One major benefit is the creation of an additional revenue stream through the sale of carbon credits generated from clean energy projects (Bridge et al., 2020). This income can boost financial performance and profitability. Additionally, carbon financing attracts investment from private equity firms, impact investors, and clean energy funds that prioritize environmental sustainability. It signals a firm’s commitment to climate action, making it more appealing to

investors. Participation in carbon financing also enhances reputation and market positioning. Being EPRA-registered and involved in carbon markets reflects regulatory compliance and sustainability focus, fostering customer trust, market access, and potential business growth—all of which contribute to improved profitability for RE firms.

The ultimate target of all organizations is to achieve profits. RE companies pursue profitable objectives when accessing carbon finance markets to lessen climate change consequences. Achieving the breakeven is crucial to securing the existence of RE companies as they gear toward future markets. The inability to attain profitability is another factor hindering RE projects from attracting investors, escalating to failures. Net Profit Margin (NPM) and Return on Investment (ROI) remain the most commonly used indicators to assess profitability for renewable energy enterprises, given their unique advantage of showing direct tangible results in terms of financial gains and cost inputs. Besides carbon financing, it is crucial to state that renewable energy firms' revenue generation and profitability act based on other determinants. They include market factors, government incentives, rivalry, productivity, and fund accessibility (Simon et al., 2012).

Profitability

Return on Investment is appropriate for evaluating firms' profitability in the RE industry regarding carbon financing since it can directly show investment efficiency. Kopecká (2018) defines ROI as helping to distinguish the efficiency of various investments using the rate of net income and investment costs. This makes it a suitable prospect for RE firms since it creates a convenient way of measuring any number of projects' fiscal profitability while not compromising capital investment and operational expenses. Other profitability measures include Return on Assets (ROA), Economic Value Added (EVA), and Return on Equity (ROE). Still, ROI is unique when assessing specific project-based investments typical in the renewable energy sub-industry (Kopecká, 2018). Another issue of concern regarding carbon financing projects within the Kenyan setting is cost recovery and profitability, which may, on some occasions, hinder the growth and sustainability of this sector. Another factor would be the volatility and substantial differences in carbon credit prices that prevail in the international market and affect profitability. For instance, the price of Certified Emission Reductions (CERs) of CDM was as high as €20 per ton in 2008 and as low as below €1 per ton in the current financial year of 2023 (State Department of Energy, 2023). This has led to such a variation in pricing in ROIs that, on average, carbon projects in Kenya have shown a return on investment ranging between 8% to +12 %, as indicated below (UNEP, 2024). It causes high price risk, which makes project developers unable to determine the possible revenues, mobilize long-term funds, or obtain stable returns on investment.

Further, the expenses of developmental, validation, and verification of projects are frequently inaccessible, thus placing most Kenyan enterprises, small and medium, in need of more capital. For carbon project development in Kenya, a UNEP study shows that costs range from US $ 50000 to US $ 250000 depending on the type and size of a project (UNEP, 2024). Such high initial costs combined with market risks have resulted in an average payback of 6–8 years, with little over 30% of the projects possibly guaranteed to be financially unprofitable for the first

decade of their operation (State Department of Energy, 2023). These relatively high initial costs associated with unpredictable revenues from market volatility are a hurdle and an embodiment of constant profitability challenges to many prospective project developers. Project development times for forestry projects range from 7 to 10 years, which is not good for profitability or for attracting investors in need of quick returns; few firms have enough working capital, and project cash flows are severely stretched (Leley et al., 2022).

Another factor that significantly impacts the ROI of carbon financing projects in Kenya is the inadequacy of local demand for carbon credits, forcing project developers to rely immensely on export markets. It exposes projects to other risks, including exchange rate volatilities and changes in climate policies in other countries, which pose extra risks to the revenue and profit of the project. A study into the financial ratios of carbon projects in Kenya for the last five fiscal years reflects the worst trend of ROI and only an average profit percentage of about 18% projected for 2023. Secondly, variability in the ROI is demonstrated by gross profit margin fluctuation in the years under analysis project by project, ranging from (-25%) to (+20%) (State Department of Energy, 2023). Moreover, the organization of the carbon markets and the abilities required to understand these markets include operational capability, which demands hiring international consultants and modifiers, thus cutting fabulous profit. The Kasigau Corridor REDD+ Project in Kenya was a real-life case to determine whether the project was in a position to sell carbon credits. However, these credits slot back approximately $30 million to global middlemen and consultants, thus depressing the project's ROI (Ndichu, 2016).

Statement of the Problem

Carbon financing projects in Kenya face significant challenges related to cost recovery and profitability. The international carbon market is highly unpredictable, with Certified Emission Reductions (CERs) prices dropping from over €20 per ton in 2008 to under €1 in recent years. This volatility has led to fluctuating returns on investment, ranging between -8% and 12% annually. High development costs—ranging from $50,000 to $250,000 combined with average payback periods of 6 to 8 years strain financial resources, especially for small and medium enterprises. About 30% of projects struggle to break even within the first decade. Long gestation periods, particularly in forestry projects, discourage investors seeking quicker returns. These issues hinder the sector’s sustainability, making carbon financing a risky and less attractive investment option in Kenya.

Low local demand for carbon credits in Kenya significantly affects the profitability of carbon financing projects, forcing developers to rely heavily on export markets. This reliance exposes projects to risks such as exchange rate fluctuations and foreign policy changes, which reduce revenue potential. Between 2019 and 2023, average profit margins dropped from 18% to 7%, with annual variations ranging from -25% to +20%. The lack of local expertise increases dependence on expensive international consultants, as seen in the Kasigau Corridor REDD+ Project, which returned $30 million to intermediaries. Forestry and land-use projects often take 4–6 years to generate their first carbon credits, leading to prolonged losses and a 35% failure rate within seven years. Most funding sources are short-term, yet carbon projects require long-term, patient capital. These factors—weak domestic markets, high intermediation costs, long

payback periods, and unstable global markets—collectively threaten the feasibility and sustainability of carbon financing in Kenya. While carbon financing schemes have gained traction globally, their impact on the profitability of RE firms registered under EPRA in Kenya is not well understood. Given the value of profitability on the sustainability of RE firms, it is important to examine how it is shaped by carbon financing variables. Therefore, the problem addressed in this inquiry was to explore the potential relationship between carbon financing and the profitability of these RE firms.

There are conceptual gaps in understanding the relationship between carbon finance constructs—such as carbon credits, issuance and transaction costs, initial project costs, and tax incentives—and return on investment (ROI). Few studies have linked these variables directly to the profitability of renewable energy (RE) firms, with most focusing on general performance metrics like ROA, ROS, and Tobin's q. Methodological gaps also exist, particularly the limited use of both primary and secondary data in analyzing carbon finance and profitability. Additionally, prior research has largely ignored firm size as a moderating variable. This study addressed these gaps by using structured questionnaires for primary data and EPRA records for secondary data. It also employed multiple regression analysis, diagnosing data for normality, collinearity, and autocorrelation to ensure statistical validity.
Contextually, while there are studies done on carbon financing in Kenya, there are none focused on how carbon financing shaped the profitability of RE firms in the country. Therefore, in the context of Kenya there exist a literature gap not only on the profitability of RE firms but also on how it is influenced by carbon financing. Overall, the study's objective was to fill the knowledge gap regarding the impact of carbon financing on the profitability of RE firms registered under EPRA in Kenya. The findings would enhance the understanding of the potential benefits and challenges associated with carbon financing, thereby yielding important insights for major stakeholders including policymakers, investors, and renewable energy companies.

Objectives of the Study

(i) To establish the effect of carbon credits on profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.
(ii) To determine the effect of credit issuance and transactional costs on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.
(iii) To establish the effect of projects costs on profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.
(iv) To determine the effect of tax incentives on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.

Research Hypotheses

The study was guided by the following null hypotheses:
H_{01}: Carbon credits have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.

H_{02}: Credit issuance and transactional costs have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.
H_{03}: Project costs have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.
H_{04}: Tax Incentives have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.

Significance of the Study

This research explored carbon financing and profitability of renewable energy firms registered under EPRA. Renewable energy has been instrumental in reducing carbon emissions and earning revenue for carbon project developers. Since the country is part of international ratification that advocates the carbon finance utilization as a mean of reducing carbon emissions, the research would be crucial to many stakeholders including the government, academic researchers, project developers, and climate change advocates. This research would inform the development of government policy tailored towards addressing climate change. The potential of Kenya in generating renewable energy is enormous. However, the adoption rate of carbon finance by RE developers relatively low given the projects that have been registered under CDM board. Despite the government of Kenya providing a conducive environment for participating in the voluntary market and the CDM, the framework of helping producers of renewable energy access carbon markets in the international arena has been missing (NEMA, 2016). By providing data about carbon financing and profitability of renewable energy firms registered under EPRA, the study would help government in formulation of policies and capitalizing carbon finance to enhance the development of RE in the country.

The researcher would also offer valuable findings for academic researchers. Academic literature on the role of carbon finance in enhancing investments in RE is hardly available in developing countries. Despite having a handful studies of carbon finance in Kenya, majority of them is in form of policy papers, which cannot be viewed as having authentic conclusions and findings. The research of carbon finance is scarce in the country of study, Kenya, and the better part of the African continent, which casts doubt on the severity of African scholars and researchers on the aspect of carbon finance. Majority of the previous research is affiliated to the European Union, likely due to the organization's emissions trading system, which has been quite successful. This paper would supplement knowledge of carbon finance in Kenya. Again, it would be a foundation of the country's academic literature the use and access of carbon finance, from where future researchers can infer and grow their knowledge in this subject. Energy project developers would also find the results of this study useful. Majority of developers in the RE sector do not comprehend the nature of carbon finance. The role played by projects of renewable energy cannot be downplayed. In developing countries like Kenya, financing projects to completion remain difficult. This study presents information regarding the prerequisites that RE developers need to address to achieve and sustain carbon finance. Through this study, climate change advocates would find a research basis for policy advocacy. There are significant social and economic challenges that the contemporary world is facing today. Informing people on the importance of addressing climate change is not only environmentally healthy but also developmental. This paper is therefore substantial in

informing the public on the importance and impact of carbon finance in achieving green energy to curb climate change.

LITERATURE REVIEW

Theoretical Literature Review

The following theories served as the foundation for the current research's scientific review : Agency theory, Market-Based theory, and Resource-Based View (RBV) theory

Agency Theory

The agency theory was officially put forth in 1976 by Michael Jensen and William Meckling. The theory analyzed how the separation of ownership and control creates agency costs, which are costs arising from monitoring, bonding, and residual losses due to misalignment of goals between owners and managers. The agency theory considers a firm as an agreement among individuals with self-interests. According to Panda and Leepsa (2017), Adam Smith, who is recognized as the father of modern economics, was the first to recognize the presence of the agency problem in 1776 through his book, The Wealth of Nations. The economist predicted that if a firm is operated by people other than its real owners, chances are they may not work for the owner's good (Panda & Leepsa, 2017). The agency theory was also later shaped in the 1970s by Stephen Ross and Barry Mitnick. While Ross considered the agency problem an issue of incentives, Mitnick attributed the problem to institution structure (Panda & Leepsa, 2017). Nonetheless, the idea behind both perspectives is similar. Agency theory is centred on the interaction between shareholders (principals) and managers (agents) [Panda & Leepsa, 2017]. According to Panda and Leepsa (2017), investors anticipate managers to maximise shareholder value in order to operate in their best interests. The aims of managers may, however, be different from those of the shareholders, such as job security, personal wealth creation, or following personal aspirations. The possibility of conflicts of interest between principals and agents is acknowledged by agency theory (Abbas et al., 2023). When making choices about the distribution of resources, including carbon financing, managers may be inclined to put their own interests ahead of those of shareholders. Managers might, for instance, allocate carbon finance funds to initiatives that boost their own reputations or benefit them personally rather than those that increase shareholder value.

Agency theory, while valuable for understanding principal-agent dynamics, has been criticized for its narrow focus on self-interest and financial incentives, often overlooking factors like trust, loyalty, and organizational culture. Its reliance on rational choice assumptions oversimplifies human behavior, ignoring cognitive biases and irrationalities. The theory's emphasis on formal monitoring can create inefficiencies and reduce agents' intrinsic motivation. Additionally, its limited capacity to address collective goals and adapt to dynamic, multi-stakeholder environments weakens its relevance in complex settings. Alternative theories like stewardship and stakeholder models may offer broader insights. In carbon financing, agency theory highlights the risk of moral hazard, where managers might misuse or misallocate resources, potentially leading to financial losses or reduced profitability for the firm. Agency theory highlights the significance of overseeing and putting in place suitable governance

systems in order to address agency issues (Panda & Leepsa, 2017). Monitoring tools including performance reviews, financial reporting, and audits can support the alignment of managers' and shareholders' interests. Managers can be held responsible for their decisions and actions by having clear performance measures and targets connected to the efficient use of carbon finance (Panda & Leepsa, 2017). In order to reduce agency issues, agency theory emphasizes the significance of contracts between principals and agents. Contracts can outline each party's obligations, rights, and performance standards, as well as the proper application of carbon finance resources. A framework for coordinating the interests of managers and shareholders as well as preventing potential agency conflicts can be found in well-designed contracts. Agency costs, which are associated with solving agency issues, are acknowledged by agency theory (Panda & Leepsa, 2017). These charges include monitoring costs, creating suitable contracts, and possible losses brought on by poor managerial choices. The potential benefits of aligning managerial behaviour with shareholder interests and enhancing financial performance should be balanced against the expenses involved in minimising agency concerns (Panda & Leepsa, 2017). The principal-agent problem exists in carbon financing of RE energy projects. The investors in RE projects require returns not only in the form of the production of environmentally friendly energy but also financial returns. It is for this reason that RE projects seeking financing from the carbon markets must undergo a thorough and costly verification process. This added to the costs of projects, which consequently affects profitability.

Market-Based Theory

Developed in the 1930s and 1950s by Mason and Bain, the theory focused on the external environment's impact on the operations of an organisation. The market-based theory emphasises strongly on how enterprises adapt to the demands and preferences of customers. Strong demand for renewable energy presents businesses with an opportunity to benefit from carbon financing incentives. As more consumers look for green energy options, businesses can increase their customer base, bring in more money, and enhance their profitability (McGee, 2015). In Kenya, the level of demand for renewable energy is a significant determinant of how businesses finance their carbon emissions. Market-based theory emphasizes the role of competition in shaping corporate behavior and performance. In the renewable energy (RE) sector, firms may seek competitive advantage through alternative funding sources like carbon financing. By engaging in carbon offset projects and demonstrating a commitment to reducing emissions, companies can attract environmentally conscious customers and improve profitability (Ji et al., 2023). According to the theory, market operations are largely influenced by regulation and incentives. Government policies—such as subsidies, tax incentives, and RE targets—significantly affect how RE firms operate. Favorable regulatory frameworks and market incentives may encourage firms to pursue carbon financing. These policies create an enabling environment by offering financial support and incentives, allowing businesses to leverage carbon finance to enhance profitability and gain a competitive edge.

Market-based theory emphasizes the importance of market entry and expansion strategies for firm performance. In the renewable energy (RE) sector, companies can incorporate carbon financing into these strategies to access additional financial resources. Carbon finance supports the development of new projects, infrastructure expansion, and entry into new market

segments, thereby enhancing growth and profitability. Market-based theory also stresses the role of innovation in responding to market pressures and evolving consumer preferences. In this context, RE firms are encouraged to develop innovative products, services, and business models. In carbon markets, the value of carbon credits depends on the extent of emission reductions achieved. Therefore, RE firms are driven to invest in technologies and practices that minimize emissions, aligning with both profitability goals and market demands for sustainability.

Resource-Based View (RBV) Theory

Resource-based View (RBV) theory was put forth in 1959 by Edith Penrose, who provided valuable information about the acquisition, use, and expansion of resources to help organisations attain competitive advantage (Burvill et al., 2018). According to the theory, not all resources are created equal. Physical, financial, human, and organisational capital are all distinct resources that any firm has access to. A renewable energy company's resources might include access to renewable energy sources, technological know-how, human capital, financial resources, connections to stakeholders, and market knowledge (Weiglet & Shittu, 2016) According to RBV, businesses should seek and develop resources that are valuable, hard to duplicate, and unusual since they can give them a sustained competitive edge (Burvill et al., 2018).

The link between corporate resources and financial success is highlighted by RBV. Renewable energy companies can bolster their financial performance by using and exploiting their resources more effectively. For instance, companies may be able to modernise infrastructure, increase market reach, and engage in RE projects with the help of carbon financing resources. The RBV theory places a strong emphasis on creating and constructing capabilities around valuable resources (Weiglet & Shittu, 2016). Businesses that use renewable energy can improve their financial performance by consistently making investments in the expansion of their resources and skills. For instance, funding R&D can result in technical developments, increased energy efficiency, and creative solutions. In addition to improving the firm's competencies and resource base, developing excellent relationships with stakeholders like suppliers, consumers, and governmental organisations can also help the company perform financially. Resources deemed to be valuable, rare, unique, and non-substitutable (VRIN) offer continuous competitive advantage (Nason and Wiklund, 2018). The capacity to obtain and efficiently use carbon money as a resource can give renewable energy companies a competitive edge.

Businesses may be able to acquire more capital, reduce financial risks, and carry out ecologically friendly projects thanks to the availability of carbon financing option. Businesses can attain differentiation in the market, draw in clients, and outperform rivals by leveraging carbon financing resources effectively, which boosts financial performance. As per Lubis (2022), resource integration and complementarity inside a corporation are significant in firm performance. By integrating and coordinating their resources and capabilities, renewable energy companies can create synergies and improve their financial performance. For instance, combining carbon financing with currently available renewable energy assets and capabilities

can result in cost savings, higher operational effectiveness, and better financial results. Enhancing financial performance can be achieved by ensuring that resources for carbon finance are allocated and coordinated effectively. RBV theory acknowledges that long-term competitive advantage depends on the sustainability of resources. Businesses that produce renewable energy should concentrate on creating resources that are robust and challenging to duplicate or replace (Bridge et al., 2020). When it comes to carbon finance, businesses may improve profitability by actively managing their carbon assets, funding carbon-reduction initiatives, and exhibiting a dedication to sustainability over the long term (Jeong & Kim, 2019). Businesses are able to maintain their competitive advantage and financial performance over time by regularly refilling and renewing their resources (Jeong & Kim, 2019).

Empirical Literature Review

Prokopenko et al. (2023) explored the effects of long-term investments and R&D expenses in RE technologies on the economic outcomes of ten major firms in the sector. It is important to recognize that investment and R&D costs are key project costs that can impact the profitability of a firm. The study's results show that R&D spending and long-term investments positively impact the indicators of profitability an organisation such as net income, ROI, earnings before interest and tax, and earnings before interest, taxes, depreciation, and amortization. In essence, if companies invest in RE technologies including their R&D, there is potential for positive financial performance.

Steffen (2020) investigated the cost of capital for different RE technologies and how it differs across different countries. The study assessed the cost of capital for RE technologies in 46 countries from 2009 to 2017. The findings indicate that the cost of capital increased from solar to onshore wind with offshore wind power bearing the highest cost. Furthermore, the study's findings show that developing countries have a higher cost of capital compared to industrialized countries. In essence, the high cost of capital in developing countries can increase project costs.

Jung et al. (2018) investigated whether investors take into account an organisation's exposure to carbon risk when making lending decisions. Specifically, the authors sought to find out if lenders increased the cost of financing if a company is exposed to high carbon risk. With 255 firms in its sample, the study explored the historical carbon emissions of the companies and measured the willingness of the firms to undertake the Carbon Disclosure Survey (CDS) [Jung et al., 2018]. The results of the inquiry depicted a positive link between cost of financing and carbon risk. This means that companies having high carbon risks face a greater cost of debt. While the study fails to link the high cost of debt to profitability, it is instrumental in documenting that a firm's carbon risk can elevate its debt cost.

Kangas (2016) sought to examine the profitability factors through examining carbon pricing mechanism and carbon risks. The author utilized sensitivity analysis to assess carbon price increases and their influence on profitability of 328 European firms. According to findings of the study, an increase in carbon pricing was associated with reduced profitability of companies not engaging in clean energy. In the long term, Kangas (2016) shows that companies investing in cleaner technology are profitable. The study used sales as a measure of sustainability, which limited compared to ROI that this study used.

Conte and Kotchen (2010) examined the factors shaping the inconsistency in voluntary carbon offset prices. The study analysed data from providers in North America, Australasia, and Europe. The authors observe that voluntary market prices can be determined by whether the project is established, that is whether it is in a developing or developed country. Projects in developing nations like Kenya attract steeper prices. While the study does not focus on profitability, it explores the price of carbon credits, which influences profitability. The current study sought to find how carbon credit price changes influences the profitability of RE firms.

Conceptual Framework

The conceptual framework of a research entails fundamental variables, concepts and factors that can be explored and their inter-relationships. It presents a visual illustration of how the variables of the research are connected to one another. The conceptual framework of this research was generated from the relationship between carbon financing and the financial performances of renewable energy firms. The dependent variable in this case is the financial performance while the independent variable includes carbon credits, credit issuance and transactional costs, initial project costs and tax incentives.

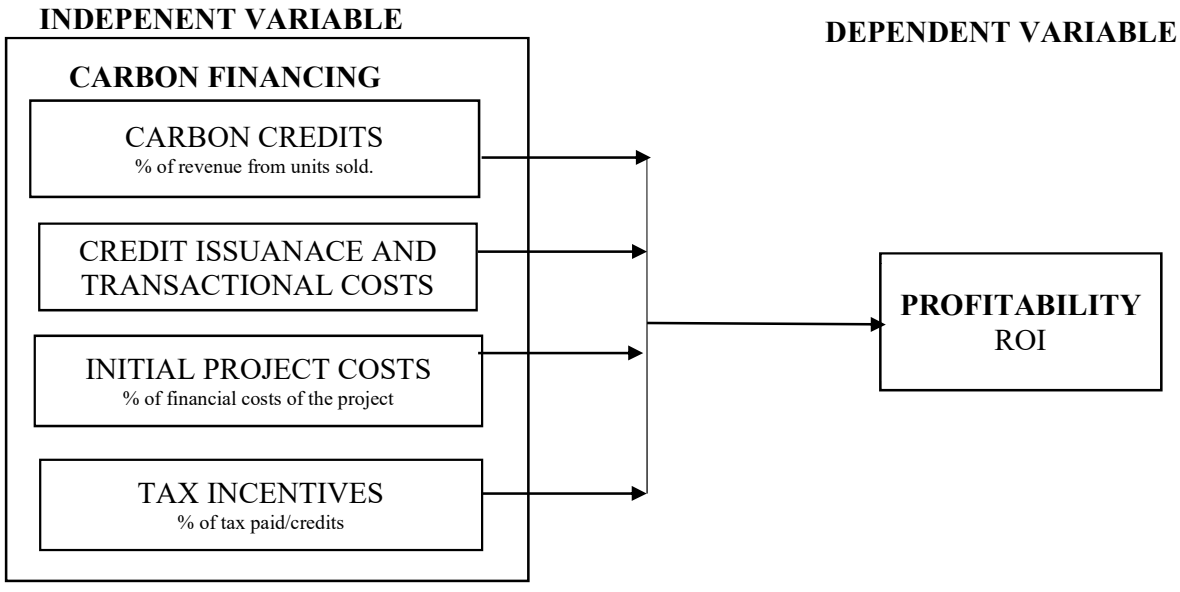

Figure 2.1: Conceptual Framework
Source: Researcher (2025)

RESEARCH METHODOLOGY

Research Philosophy

The philosophy applied in this study explained how knowledge can be developed so as to attain a wider and broader view of the research objectives. To launch a proficient probe and attain a good comprehension of carbon financing in the context of Kenya, this research adopted the post-positivism philosophy (Nickerson, 2022). Under this philosophy, different methods were adopted for analysis and data collection, which could attain goals and vast findings on how RE in Kenya has been impacted by carbon finance.

Research Design

The research made use of a causal research design to explore the link between carbon financing variables (carbon credits, carbon issuance and transactional costs, project initial costs, and tax incentives) and profitability. Firm size was the moderator variable, which shapes the relationship between the independent variables and the independent variable. Krauss (2005) point out a causal study helps the researcher in modelling and developing the causal influence of one variable on another. Therefore, this study's research strategy was valuable.

Empirical Model

In this study a multiple regression analysis of the data collected from 2018 to 2023 was performed using the SPSS software. The researcher made use of the multiple linear regression model below.

$ROI = \beta_0 + \beta_1 CC + \beta_2 C + \beta_3 IPC + \beta_4 TI + \varepsilon$

Where: ROI: Return on Investment; CC: Carbon Credits, C: Issuance& Transactional costs , IPC: Initial Project Costs , TI: Tax Incentives , $\beta 0$= constant; $\beta 1$= coefficient of Carbon Credits ; $\beta 2$= coefficient of Emission reduction ; $\beta 3$= coefficient of Project Costs; $\beta 4$= coefficient of Policy Impacts and ε = stochastic error term

Target Population

The population that was targeted in this research was fifty (50) RE firms registered under Kenya's EPRA. The generation of renewable energy has been monumental in the reduction of carbon emissions. The option of picking Kenya was purposed to ascertain data homogeneity and that it is a third world country, and thus desirable to host CDM projects. The population for the current investigation was obtained from the register of RE firms registered under EPRA among other relevant sources. To ascertain consistency of reactions and attain objectives set for the research, projects of renewable energy for the incorporation in the study was included. The included projects were those established between 2018 and 2023. The reason for this preference was that Kenya signed to the Kyoto Protocol in 2005 and the emissions of carbon prior to that time is termed as non-additional (Clifton, 2022).

RESULTS AND DISCUSSIONS H01:

Hypothesis Testing

A combination of the Beta coefficient, t-statistics, and P values were used to formulate the null hypotheses. If the B coefficient is not equal to zero (B≠0), t is greater than 1.96, and P is less than 0.05, then the hypothesis is rejected, as demonstrated in the following illustration (Kareithi, Aluoch, & Kimutai 2024).

Table 4.1: Hypothesis Testing

Hypothesis	B≠0	t>1.96	P<0.05	Verdict
H_{01}: Carbon credits have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.	0.257	3.645	0.001	Rejected
H_{02}: Credit issuance and transactional costs have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.	0.179	2.274	0.028	Rejected
H_{03}: Project costs have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority	0.215	2.594	0.13	Rejected
H_{04}: Tax Incentives have no significant effect on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority.	0.284	4.193	0.000	Rejected

Source: Researcher (2025)

This study sought to examine the influence of various factors specifically carbon credits, credit issuance and transactional costs, project costs, and tax incentives on the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority in Kenya. This was achieved through hypothesis testing using regression analysis. By incorporating each of these constructs into the regression model, the study assessed the strength and direction of their effect on profitability. The analysis focused on the beta coefficients, t-values, and p-values to determine the statistical significance of each factor. The results revealed that all the variables had a positive and significant impact on profitability, as indicated by statistically significant beta coefficients (B), t-values greater than 1.96, and p-values below 0.05. This enabled the study to reject all the null hypotheses and confirm the relevance of these factors in enhancing the financial performance of the firms.

Table 4.1 presents the results of hypothesis testing for four factors affecting the profitability of renewable energy firms registered under the Energy and Petroleum Regulatory Authority. Each hypothesis tested whether a specific factor had no significant effect on profitability. The results show that all four null hypotheses (H01 to H04) were rejected, as each factor had a regression

coefficient (B) significantly different from zero ($B \neq 0$), t-values greater than 1.96, and p-values below the 0.05 significance threshold. This indicates that carbon credits (B=0.257, p=0.001), credit issuance and transactional costs (B=0.179, p=0.028), project costs (B=0.215, p=0.013), and tax incentives (B=0.284, p=0.000) all have statistically significant positive effects on the profitability of these firms.

Table 4.2: Model Summary of Multiple Linear Regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.770[a]	.593	.557	.50396

a. Predictors: (Constant), Projects costs, Tax incentives, carbon credits and credit issuance and transactional costs

b. Dependent Variable: Profitability

Source: Researcher (2025)

The multiple linear regression analysis presented in Table 4.2 evaluates the relationship between profitability, the dependent variable, and the predictors, which include project costs, tax incentives, carbon credits, and credit issuance and transactional costs. The results reveal a strong positive correlation between the predictors and profitability, as indicated by the multiple correlation coefficient (R = 0.770). This suggests that the combined effect of these variables is significantly linked with the profitability of RE firms. The coefficient of determination (R Square = 0.593) shows that approximately 59.3% of the profitability variability is explained by the predictors encompassed in the model. This demonstrates that the independent variables are collectively indispensable in determining profitability. Nonetheless, the remaining 40.7% of the variability may be attributed to other factors left out in the analysis. The adjusted R Square value of 0.557 further refines this measure by accounting for the number of predictors present in the model. This denotes that 55.7% of the profitability variance is explained by the predictors when adjusted for potential overfitting, suggesting that the model is both reliable and generalizable to other datasets. The findings also exhibited a small difference between the R square and the adjusted R square, which demonstrates how the model fits the data appropriately when it comes to forecasting the association between carbon financing and profitability (Dhakal, 2019). In spite of this, the remaining 40.8% of fluctuations in the profitability were as a result of other factors that were excluded in the scope of the research.

Table 4.3: ANOVA Results for Multiple Linear Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.664	4	4.166	16.403	.000[b]
	Residual	11.429	45	.254		
	Total	28.093	49			

a. Dependent Variable: Profitability

b. Predictors: (Constant), Projects costs, Carbon credits, Tax Incentives, Credit issuance and transactional costs

Source: Researcher (2025)

The results of the ANOVA for the multiple linear regression model, as presented in Table 4.3 provide an overview of the model's overall significance in explaining the variability in profitability. According to Sawyer (2017), analysis of variance is used in research to delineate the relevance of the study outcomes and to offer insight into the amount of variability present in the regression model. In addition to this, it gives the researcher the ability to choose a model

that offers relevant insights based on replies that have significant outcomes. A significant F-statistic denotes statistical significance of the regression model, meaning that the model is able to explain a significant proportion of the dependent variable's variance, beyond what would be expected by chance. The p-value associated with the F-statistic is 0.000, a value well below the threshold of 0.05. This denotes that the regression model is statistically significant, denoting how predictors collectively have a notable impact on profitability. The regression sum of squares being relatively high compared to the residual sum of squares further underscores the importance of these variables in influencing profitability. The ANOVA results confirm that the multiple linear regression model befits the data. The predictors—project costs, carbon credits, tax incentives, and credit issuance and transactional costs—significantly explain the profitability variation, as evidenced by the strong F-statistic and highly significant p-value.

Table 4.4: Regression Coefficients Results for Multiple Linear Regression

	Unstandardized Coefficients		**Standardized Coefficients**			**95.0% Confidence Interval for B**	
Model	**B**	**Std. Error**	**Beta**	**T**	**Sig.**	**Lower Bound**	**Upper Bound**
(Constant)	.460	.455		1.010	.318	-.457	1.377
Carbon Credit	.257	.070	.372	3.645	.001	.115	.399
Credit Issuance and Transactional Costs	.179	.079	.231	2.274	.028	.020	.337
Projects Costs	.215	.083	.276	2.594	.013	.048	.382
Tax Incentives	.284	.068	.449	4.193	.000	.147	.420

a. Dependent Variable: Profitability

Source: Researcher (2025)

The study outcomes in Table 4.4 denoted that holding all carbon financing under the study constant, profitability would be 0.460. However, an introduction of carbon credits would increase profitability by (β=0.257, p-value=0.001) and credit issuance and transactional costs would enhance profitability by (β=0.179, p-value=0.028). Similarly, projects costs would increase profitability by (β=0.215, p-value=0.013) while tax incentives would increase profitability by (β=0.284, p-value=0.000). Hence, the multiple regression model transforms to: $Y = 0.460+0.247CC+0.179CITC+0.215PC+0.284TI$

CONCLUSIONS AND RECOMMENDATIONS

Conclusion of the Study

The findings demonstrated that carbon credits play a substantial role in shaping profitability. The study revealed a direct relationship between carbon credits and profitability, suggesting that rising carbon credits corresponds to a rise in profitability for renewable energy firms. Therefore, the null hypothesis (H01) is dismissed, as carbon credits have a significant effect on profitability. The findings suggest that increased income from carbon credits positively influences financial performance, which underscores the value of integrating carbon credit strategies into financial planning to boost profitability. The analysis shows that credit issuance and transactional costs significantly impacted profitability. The inquiry was able to document a direct relationship between these costs and profitability, which signifies that an increase in credit issuance and transactional costs results in a significant increase in profitability. Consequently, the null hypothesis (H02) is rejected, as these costs have a significant effect on

profitability. Operational efficiencies in handling these costs can lead to improved net profits. Additionally, government subsidies are recognized as beneficial in enhancing profitability, stressing the need for companies to optimize cost management and leverage available support mechanisms.

The results demonstrate that project costs significantly influence profitability. The research was able to identify a direct significant relationship between project costs and profitability, suggesting that a rise in project costs results to a significant increase in profitability. Therefore, the null hypothesis (H03) is dismissed, as project costs have a significant effect on profitability. Effective management of project costs is identified as a key factor influencing profitability. Controlling financing costs, preventing cost overruns, and ensuring efficient cost management are essential for maintaining financial viability. The research underscores the value of careful cost management practices for financial success in carbon finance projects. The findings indicated that tax incentives significantly affect profitability. The research demonstrated a direct significant relationship between tax incentives and profitability, which denotes that increasing tax incentives would translate to a significant increase in profitability. Thus, the null hypothesis (H04) is rejected, as tax incentives show a significant effect on profitability. The inquiry has shown that tax incentives significantly influence the profitability of renewable energy firms. Government-provided tax incentives enhance profitability, and compliance audits are crucial for qualifying for these benefits. The study suggests that better awareness and enforcement of tax incentive policies are needed to fully realize their potential benefits.

Recommendations for Practice

Management should consider diversifying the categories of carbon credit projects in which the firm engages. Expanding into various carbon credit initiatives, such as forest preservation and renewable energy projects, can help mitigate risks associated with fluctuations in carbon credit prices and market demand. Additionally, focusing on high-quality carbon credit projects that adhere to internationally recognized standards will ensure the firm receives premium pricing, boosting revenue potential. To improve profitability, management should streamline processes related to credit issuance and transaction management. By implementing more efficient operational practices, such as automated tracking and reporting systems, the firm can significantly reduce costs associated with these activities.

Given the significant impact of project costs on profitability, management must focus on implementing effective cost management strategies. This includes closely monitoring both capital and operational expenditures to ensure that projects remain within budget while maintaining high standards of quality and efficiency. It is crucial for management to continuously assess the cost structures across projects and identify opportunities for cost reduction without compromising the quality of outcomes. Tax incentives are a pivotal in reducing the financial burden faced by RE firms. To take full advantage of these incentives, management should ensure the company complies with all relevant tax regulations and undergoes regular compliance audits. By doing so, the firm will qualify for available tax benefits, directly enhancing profitability.

Recommendations for Policy

The government should continue to support the development and growth of carbon credit markets, both locally and internationally. Policies should focus on creating a stable and transparent regulatory framework that encourages both local and foreign investments in carbon credit projects. Policies should be put in place that encourage renewable energy firms to optimize the management of credit issuance and transactional costs. One way to do this is through the provision of technical assistance or financial support for firms seeking to implement more efficient operational practices. The government could also explore the potential of partnering with financial institutions to facilitate the provision of low-interest loans or subsidies for renewable energy firms looking to upgrade their systems or invest in more cost-effective technologies for managing these costs.

Given the significant impact of project costs on profitability, the government should develop policies that help reduce the financial burden on renewable energy firms. One such policy could be the introduction of concessional financing options for renewable energy projects, especially for SMEs. These financing options could include long-term, low-interest loans or grants for capital expenditure (CAPEX) and operational expenditures (OPEX) related to renewable energy projects. The government should focus on enhancing existing tax incentives and creating new ones that are specifically targeted at renewable energy firms. This could include extending the duration and scope of tax credits for renewable energy investments, providing tax exemptions for carbon credit sales, or reducing VAT on renewable energy technologies.

Suggestion for Further Research

While this study has made noteworthy contributions to the understanding of carbon financing and its relation the profitability of RE firms, there are a few areas for future researchers to consider. Firstly, the study's propositions stress the importance of establishing efficient and effective carbon financing among RE firms registered under EPRA. The four independent variables of carbon financing explained up to 59.3% while inclusion of firm size moved it to 80.4% implying there are other factors that may have effect profitability of despite carbon financing which further studies should consider. Methodologically, the research focused on renewable energy firms registered under Kenya's EPRA. This restricts the generalizability and applicability of the recommendations in the study to the other firms in Kenya. Therefore, further study should focus on renewable energy firms not registered under the regulatory body. Relatedly under methodology, the study used quantitative data, further studies should consider using a mixed methodology for the purpose of triangulation.

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