

---

# EPRA International Journal of **Socio-Economic and Environmental Outlook**

---

SJIF Impact Factor(2019): 6.124

Volume: 6 August - July 2019-2020

---

## **A DESCRIPTIVE STUDY ON CARBON FINANCING MODELS FOR CLIMATIC CHANGE MITIGATING PROJECTS**

**Arigela SrinivasaRao**

*Assistant Professor, Department of Commerce and Management Studies, Adikavi Nannaya University,  
Rajamahendravaram, Andhra Pradesh, India*

**Prof. S.Teki**

*Registrar, Adikavi Nannaya University, Rajamahendravaram, Andhra Pradesh, India*

---

### **ABSTRACT**

---

*Environmental Accountability of corporations has been identified by many statues around the globe. Awareness on global warming caused by increased emersions of CO<sub>2</sub> requiring the entities to invest in projects that reduce the emersion of Green House Gasses (GHG). Available literature on capital budgeting is reviewed with special emphasis on environmental issues. The aim of this research insight into identifies the major issues and challenges faced by management in application of carbon financing models. Defining benchmarks in terms of risk and return in environmental context needs critical perspective as well as systemic approach in application of techniques of capital budgeting. In Indian context, changes in fiscal policy of the Central Government have an impact on annual cash flows that make the capital budgeting decisions highly volatile. This research focuses on capital budgeting practices for environment accounting aspect especially on existing literature. This research paper prime face believes that every activity including the cleaning of pollution should ensure value addition. Hence industries involved in reduction of CO<sub>2</sub> and other GHG emissions shall have a positive NPV which create wealth to stake holders.*

**KEY WORDS:** *Capital Budgeting, Environmental Accountability, Carbondioxide (CO<sub>2</sub>), GHG, Fiscal Policy, India.*

---

### **1. INTRODUCTION**

Capital Budgeting is the process of evaluating financial feasibility of an investment proposal. According to Frank.J.Fabozzi, every capital budgeting process is guided by entity's corporate strategy. Capital budgeting process that does not support wealth maximization criteria which cannot be accepted. But currently management is facing a different situations advocated in general capital budgeting models. This is basically due to transformation from financial feasibility to ecological sustainability. Financial managers, energy or environmental managers around the globe are now looking at projects for cutting energy costs and reducing carbon emissions. These projects have not been seen as essential to the survival of the business, nor they usually mandatory from a legal or regulatory perspective. Hence historically these

projects were in a discretionary category. But when corporation's understands the fragility of our environment and the importance of its protection these projects shall not be considered as "discretionary".

The first attempt was made by Kite.D (1995) in the research article "Capital Budgeting: Integrating environmental impact." that made a path breaking impact on identification of environmental costs to be included in decision making process. All activities that are intended to create a product or provide a service seldom escape from a negative effect on the environment. These negative effects are in general in the form of air, water and soil pollutions.

Verbeeten (2006) examined the impact of uncertainty on the sophistication of capital budgeting practices. Results indicated that organizations tends to use multiple and sophisticated tools of capital budgeting in dealing with

uncertainty. Methods such as Monte Carlo simulations, certainty equivalents, Game Theory decision rules are Real option Reasoning were used by select industries of the study.

Lingesiya Kengatharan (2016) identified the need for extensive studies to robust knowledge of capital budgeting theory and practice in the chaotic environment. Bereft of behavioural finance and event study methodological approach were highlighted. This observation is significant in light of the need for identification of revised benchmarks for carbon financing models.

S.Teki (2019) in his study on Eco-friendly practices of industries in East Godavari River Estuarine Ecosystem (EGREE) identified that the need for application of cost – benefit analysis as a simple but purposive technique to select the best of the alternative practices that contribute more than the cost involvement. Cost-Benefits Analysis (CBA) is the process of using theory, data, and models to examine products, tradeoffs, and activities for assessing relevant objectives and alternative solutions (Womer, Bougnol, Dula, & Retzlaff-Roberts,(2006) in order to assist decision-makers in choosing the most appropriate alternative.

**2. NEED FOR STUDY**

Climatic Change (CC) had become a focus in the 21<sup>st</sup> century. Academicians, policy makers and all environmental activists are very keen on the need for redefining the organizational responsibility towards achieving the environmental sustainability. As such current study points out the recent developments in capital budgeting process and literature backup that help to diversify and redefine goals, objectives and principles of capital budgeting in light of environmental accountability.

**3. HYPOTHESIS**

H<sub>0</sub>: The basic methods of capital budgeting remains same for all projects. Review of existing research had enough evidence on application of these basic methods to evaluate the financial feasibility of projects mitigating CC.

H<sub>1</sub>: Literature review on capital budgeting practices may indicate variations in existing methodologies. Thus results of researcher’s recommends modification/ replacement of capital budgeting procedures for appraisal of CC mitigating projects.

**4. OBJECTIVES OF STUDY**

The current study was carried out mainly to identify the difference in application of methods of capital budgeting between selection of projects with and without environmental concern. In other words, literature on capital budgeting is reviewed to identify the change in versions as identified by earlier researchers and to offer construct acceptance, modifications and rejections on selected articles and text books on Financial management, Carbon financing and environmental accounting.

- (a) To study the opinions of various researchers on capital budgeting in general and Carbon financing in particular.
- (b) To critically and systematically examine the evaluation of sophisticated methods of capital budgeting with emphasis on Carbon financing.
- (c) To know various techniques implemented on capital budgeting by industries as identified by earlier researchers and offer constructive suggestions on their applicability in Indian context.
- (d) To explain the need for understanding the additional uncertainty involved in dealing with projects that depends on energy conservation and GHG reductions.

**5. METHODOLOGY OF STUDY**

The study has been collected from secondary sources. Totally 126 resources were reviewed for this presentation. Resource files are downloaded using the search facilities offered by Social Science Research Network (SSRN), Education Resources Information Center (ERIC), Directory of Open Access Journals (DOAJ), CIA World Fact book and Bielefeld Academic Search Engine ( BASE ).

**A Detailed Account of These Resources is as under**

Sources	Number of Papers	General Capital budgeting	Specific to CC mitigating Projects
Articles	81	52	29
Text books	9	5	4
UNFCCC publications	18	0	18
Others	18	6	12
Total	126	63	63

A total of 126 papers published in reputed Journals with international prominence were reviewed as a part of the review of literature concerning the research on “Carbon financing models to mitigate Climate change – A study with reference to select industries of Andhra Pradesh State”. However current presentation includes discussion on selected 21 literature only.

**RESULTS AND DISCUSSIONS**

Basson (2007), suggested the use of Monte Carlo Simulation (MCS) model for dealing with uncertainty situations. Traditional methods of capital budgeting that includes, Payback Period (PBP) method and Return on Assets (ROA) method are not suitable for optimized decision making. This is due to the simplicity adapted for convenience of calculation that cannot handle the complexity in estimating cash flows and opportunity cost of capital invested in CC

mitigating projects. Even the modern methods like, Net Present Value (NPV) approach and Internal Rate of Return (IRR) methods need to be tested for sensitivity involved in cash flows. Hence the observations of Basson on MCS model is a better criteria for taking capital budgeting decisions should be considered by production managers in acquiring the frontline equipment and their replacement.

Similar observations were also made by Tom Emile Kuppenset all (2018). They conclude that Net Present Value of an investment with high innovative technology is risky due to technical and economic uncertainties. Therefore, decision makers want to dispose of information about the probability of a positive NPV, the largest possible loss, and the crucial economic and technical parameters influencing the NPV. The application of MCS model indicated 87% chances for positive NPV with an expected value of 3 million euro (MEUR). Thus the reason for rejection of NPV method is

uncertainty involved due to use of innovative technologies. All carbon financing projects aims at reduction of energy usage to reduce the CO<sub>2</sub> emissions. Hence a straight forward application of NPV in appraisal of carbon financing projects is not recommended in light of above observations.

Irhan Febijanto (2013) identified that IRR can be found to be increasingly used for appraisal of CDM projects. In his study on mini Hydro power plant in Indonesia resulted in an increase of IRR from 10.28% to 13.52%. This significant contribution was mainly due to additional cash flows generated by sale of carbon credits. It may be noted that increase in IRR would indicate increase in NPV also.

Teresa Rojas, Holm Tiessen et al. (2004) had applied Cost-Benefit-Analysis (CBA), NPV, and IRR techniques for economic evaluation of Timber and Non-Timber Forest products in the southern Mexico. All methods gave consistent results in identification of economic feasibility. This is mainly due to high NPV with low capital inventiveness of selected project. Thus projects which are less sensitive to variations in discounted cash flows (DCF) can be handled with general techniques of capital budgeting.

Laurel J. Fish, et al. (2017) explains the application of MCS model for dealing with uncertainty and claims that many business professionals are not immersed in the realm of mathematics hence avoid MCS application for better decision making. According to them traditional business statistics focus on “asymptotic distribution analysis”, using tests based on the normal probability distribution and other large-sample based tests. These methods require large sample sizes to meet basic assumptions underlying the statistical procedures. In real life business situations, there might not be large populations or large samples available for analysis. MCS methods for using modern computers and can handle even a small sample of data to develop a model to predict the meaningful probabilities rather than searching for large sample data.

Roopali Batra et al. (2017) reviewed a sample of 77 Indian companies listed on Bombay Stock Exchange (BSE). Results of the study concluded that Indian companies prefer to direct application of capital budgeting methods. Majority of the companies were found to be applying Discounted Cash Flow techniques like NPV and IRR. Risk adjusted sensitivity analysis is also a popular method applied in Indian context. They identified a gap in application of specialized techniques of real options, Modified Internal Rate of Return (MIRR) and simulation.

United Nations Framework Convention on Climate Change (UNFCCC) uses normal capital budgeting practices for computing the discounted cash flows and applies NPV as the criteria for approving CDM status to projects. For the purpose of determining the “additionality” UNFCCC uses IRR method. A project becomes eligible for CDM approval only when its IRR ( without CDM revenue) is less than IRR hurdle rate but project IRR ( with CDM revenue ) is more than IRR hurdle rate

Luis M. Abadie (2009) demonstrated superiority of Real options valuation approach over NPV and IRR methods of capital budgeting. In his article, a faulty assessment of uncertainty can lead to wrong investment decisions. That means use of higher risk premiums or lower risk premiums lead to wrong cost of capital, which will make the project sensitive. McDonal (1998) explained the impact of rules of thumb approach such as payback and hurdle rates in

determining true value of an investment for which alternative options are available in uncertainty. Graham and Harvey (2001) indicated that for small and medium sized projects with lower life span payback and hurdle rate approaches can provide true results. Their work indicated NPV and IRR are used very frequently by organization lower levels of uncertainty in projected cash flows. Out of 392 responded chief financial officers (CFO), 74.9% were using NPV and IRR methods. This report also shows that a large number of firms use company-wide discount rates to evaluate projects rather than project-specific discount rates. Even without any embedded options (which are addressed by RO analysis), the valuation of long term investments depends on market prices. Thus, as a first step we need a stochastic cash flows valuation model that is consistent with the markets. Then it will be possible to value options by applying this valuation model to the process that governs commodity prices in the risk-neutral world. This can be accomplished by means of the numerical methods that are usual in the RO approach. Among them we have binomial lattices, Monte Carlo simulation, and finite difference methods.

Some previous research studies elucidate the emergence of relatively new techniques of real options (Busby, Pitts, 1997, Luehrman, 1998, McDonald, 2000, Walters, Giles, 2000). Real options are inherently present in any investment project where management has the flexibility to alter its course, i.e. expansion, contraction, delay, or abandonment (Bodie, Merton, 2000, Brealey et al, 2001). A noteworthy finding of the recent research studies is the gradual progression of real options, though the usage is still not extensive in India observed a relatively greater acceptance of this technique.

Review of literature reveals a continuous progress by the global business as well as the Indian corporate sector in the area of capital budgeting. However, for a long time, theory has emphasized financial issues in investment project evaluation, not taking into account other aspects. Some previous studies have also focused on the importance of non-financial factors in investment decision making. Studies by Fremgen, 1973, Porwal, 1976, Petty et al, 1975, Bansal, 1985 and Skitmore, Stradling, and Tuohy (1989) reported safety, social concern for employees and community, necessity of maintaining existing programmes, environmental responsibility (such as pollution control), competitive position, corporate image, and legal requirements as important qualitative considerations in evaluating investment proposals. Skitmore et al. (1989) presented a list of 44 non-financial relevant factors that influence the success of building projects. Many researchers have asserted that non-financial criteria play a role as important as sophisticated financial evaluation criteria and are expected to be able to recognise competitive advantages in a project that financial techniques fail to capture (Chen, 1995, Proctor, Canada, 1992). Chen (1995) identifies the following non-financial aspects in the evaluation of projects: strategy, quality, flexibility, potential future growth, market tendency, ethical and social considerations, prestige, and legal issues. Jiang, Klein, and Balloun (1996) also presented 13 financial and non-financial success factors of a project. Later studies have also emphasized that the investment analysis and decision-making process must cover a wide range of aspects, financial and non-financial, including strategic, technical, political, social, environmental, organizational, and legal aspects

## CONCLUSIONS

When dealing with CC mitigating projects, official organization is UNFCCC. As seen from the above results and discussion, NPV and IRR methods are used by UNFCCC for approving the CDM status to CC mitigating projects. However, it is not necessary for the entities to use the same methods for evaluating financial feasibility. Based on level of uncertainty involved in the project, management can apply more sophisticated methods that include MCS models and RO analysis to get more clarity financial feasibility.

A careful review of existing literature on capital budgeting does not indicate a large deviation from methods to be applied for CC mitigating projects. Thus we see that our null hypothesis is accepted to conclude that basic method of capital budgeting continues to be applied even to CC mitigating projects. Authors and researchers deviated from basic methods only with reference to the nature and size of the project and levels of uncertainty involved in cash flow projects. The extended methods of MCS help in estimating the probabilities for expected value of cash flows even with a small sample size. RO analysis extends the NPV criteria by including other available options in valuation.

In Indian context, NPV and IRR are widely applied techniques of investment analysis. Even in the event of existence of risk and uncertainty, Indian firms are found to be applying Risk Adjusted Discount Rate (RADR) in computing the NPV. Sensitivity analysis is applied by Indian industries to assess the risk levels of a long term projects.

Last but not the least, there is a need for invention of new methods of capital budgeting that can give due importance for non-quantitative issues ( i.e qualitative issues) in measurement of feasibility of any project. Measurement of success in terms of money in every walk of life can never guarantee sustainability of business entities that operate in vulnerable ecology.

## REFERENCES

1. Axel Pierru, and Denis Babusiaux. "Capital Budgeting and Cost of Capital: A Unique Formulation of the Main Investment Decision Methods". <[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=233120](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=233120)>
2. Basson L, Petrie J.G, (2007), *An integrated approach for the consideration of uncertainty in decision making supported by Life Cycle Assessment, Environmental Modelling & Software, Vol 22 pp 167- 176.*
3. Bansal, S. C. (1985). "Post completion audit of capital expenditure". *Chartered Secretary, March*, 151-155.
4. Chen, S. (1995). *An empirical examination of capital budgeting techniques: Impact of investment types and firm characteristics. The Engineering Economist, 40(2), 145-170.*
5. Denis Babusiaux, and Axel Pierru, *Investment Project Valuation: a New Equity Perspective Engineering Economist, volume 54, issue 2, p. 101 - 108. Posted: 2009.*
6. Frank H.M. Verbeeten. (2006) "Do organizations adopt sophisticated capital budgeting practices to deal with uncertainty in the investment decision?- A research note", *ELSEVIER, Management Accounting Research Journal 17 (2006) 106-120.*
7. Fremgen, J. M. (1973). "Capital budgeting practices: A survey. *Management Accounting, 54(11), 19-25.*
8. IrhanFebijanto (2013) "Economic analysis of cikaso mini hydro power plant as a CDM Project for increasing IRR" *Mechatronics, Electrical Power, and Vehicular Journal. 04 (2013) 89-98.*
9. John R.Graham and Campbell R. Harvey (2001). "The theory and practice of corporate finance: evidence from the field". *Journal of Financial Economics 60 (2001) 187-243.*
10. Kite, D. 1995. *Capital budgeting: Integrating environmental impact. Journal of Cost Management (Summer): 11-14.*
11. Laurel J. Fish, Dennis Halcoussis, and G. Michael Phillips.(2017) "Statistical Analysis of A Class: Monte Carlo And Multiple Imputation Spreadsheet Methods For Estimation And Extrapolation. *American Journal of Business Education - Second Quarter 2017 Volume 10, Number 2.*
12. LingesiyaKengatharan (2016). "Capital Budgeting Theory and Practice: A Review and Agenda for Future Research". [www.researchgate.net/publication/293026616](http://www.researchgate.net/publication/293026616).
13. Luis M. Abadie (2009). "Valuation of Long-Term Investments in Energy Assets under Uncertainty" *Energies 2009, 2, 738-768.*
14. McDonald, R.L.(1998). "Real options and rules of thumb in capital budgeting" <<https://pdfs.semanticscholar.org/77d0/2904af9f3d7a73b7007100336cbe74fa14a7.pdf>>
15. Petry, G. H. (1975). *Effective use of capital budgeting tools. Business Horizons, 18(5), 57-65.*
16. Porwal, L. S. (1976). *Capital budgeting in India. New Delhi: Sultan Chand & Sons.*
17. Proctor, M. D., & Canada, J. R. (1992). *Past and present methods of manufacturing investment evaluation: A review of the empirical and theoretical literature. The Engineering Economist, 38(1), 45-58.*
18. RoopaliBatra and SatishVerma (2017). "Capital budgeting practices in Indian companies" *IIMB Management Review (2017) 29, 29-44.*
19. Skitmore, R. M., Stradling, S. G., & Tuohy, A. P. (1989). *Project management under uncertainty. Construction Management and Economics, 7(2), 103-113.*
20. Teresa Rojas, Manfred Zeller, and Holm Tiessen(2004). "Economic Evaluation of Commercial Value of Timber and Non-timber Forest Products of Cordiadodecandra in Southern Mexico". <<http://www.tropentag.de/2004/proceedings/node397.html>>
21. Tom Emile Kuppens1, ParisaRafiaani, and Kenny Vanreppelen (2018) "Combining Monte Carlo simulations and experimental design for incorporating risk and uncertainty in investment decisions for cleantech: a fast pyrolysis case study". <https://www.researchgate.net/publication/325376314>
22. Womer, N. N., Bougnol, M. L., Dula, J. J., and Retzlaff-Roberts, D. D. (2006). "Benefit-cost analysis using data envelopment analysis." *Annals of Operations Research, 145(1), 229-250.*