Barriers to and Determinants of Funding Sustainable Development Projects in Developing Countries: A Case Study of the EThekwini Municipality

By

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ABSTRACT

The purpose of this study was to evaluate the barriers to and the determinants of funding sustainable development through the implementation of the Clean Development Mechanism at the Bisasar Road and Mariannhill landfill sites.

The Clean Development Mechanism is an economic construct, arising out of the Kyoto Protocol (UNFCCC 2004:10), and formulated to promote social and economic welfare by transferring technology in such a manner, that it promotes sustainable development and ecological renewal. The stated goal of CDM (UNFCCC: 10) is to reduce harmful emissions and thereafter, to produce sustainable development and ecological renewal.

This research utilised the case study methodology as advocated by Eisenhardt (1989:538). The study employed multiple data collection methodologies which included face-face interviews, within case analysis, triangulation, field notes and photographs. An important component of the data collection methodology was to access financial records of revenue flows for the CDM implementation process from January 2009 to December 2015.

The research found that there is no conclusive evidence to suggest that the Clean Development Mechanism, as implemented at Bisasar Road and Mariannhill, reduced carbon emissions. Further, the study found that the production of clean energy produced financial losses rather than revenues for funding sustainable development.

The relevance and value of this research lies in the presentation and formatting of the *Systematic Sequential Analysis Model*. The purpose of the *Systematic Sequential Analysis Mode*l is to introduce a series of financial, macro-economic, micro-economic, and technical sustainability filters for the implementation of the Clean Development Mechanism in developing countries.

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CHAPTER ONE: INTRODUCTION

1.0 Introduction

The first chapter of this study systematically exposes the contextual framework of the phenomena of interest. The Clean Development Mechanism (CDM) is examined within the context of the implementation of CDM at the Bisasar Road and Mariannhill landfill sites. The chapter describes purpose of this research. This chapter also defines and describes the research problem and the research objectives arising thereof. Chapter one details the research process in addition to describing the research design. The rationale for this study is also provided. The final paragraphs of chapter one detail the organization of this thesis, describing the contents of each chapter. The purpose of this study is to evaluate the determinants of and barriers to funding sustainable development within developing countries with specific focus on the Clean Development Mechanism (CDM) at Bisasar Road and Mariannhill.

Clean Development Mechanism can best be described as a series of guiding economic constructs formulated towards structured economic activity for the prime purpose of driving-down carbon emissions in order to achieve an eco-friendly environment conducive to sustainable development on a global scale. CDM facilitates the transfer of skills from Annex 1 countries to developing countries under strict economic, accounting and pro-active management principles. The short-term goal of CDM is to drive down global, toxic, carbon-emissions to such an extent, that local ecological systems have an enhanced capacity for natural and cyclical renewal. The Clean Development Mechanism is therefore an economic tool designed to promote social welfare on a global scale by transferring technology in a manner that promotes sustainable development and ecological renewal.

Pigou (1920), the neo-classical, welfare economist, recognized the existence of externalities as an element outside of the mainframe economic activity which impact the system by transferring either unsolicited benefit or harm from economic activity (Steiger 1996:31). Pigouvian thinking is therefore the epistemological stance that is utilized by this study to interrogate the implementation of CDM at Bisasar Road and Mariannhill. This study particularly focuses on the funding and implementation of Clean Development Mechanism (CDM) projects from a Pigouvian theoretical perspective. The envisaged outcome of the study is a framework that with a set of indicators to monitor the implementation of a CDM project in a developmental state context.

For the purpose of establishing internal validity, this case study critically examines the protocol for implementing a Clean Development Mechanism as stipulated by the articles of the Kyoto Protocol (UNFCCC 2004:10). This case study sets out to establish what criteria are deemed essential for the implementation of CDM at Bisasar Road and Mariannhill based on the premise that in order to identify barriers and enablers to funding sustainable development, the functional integrity of implementing a Clean Development Mechanism has to be established beyond doubt. Without establishing the functional integrity of the process of implementing CDM, the possibility of determining barriers and enablers to funding sustainable development has little or no validity. The Kyoto Protocol (UNFCCC 2004:10) broadly defines a Clean Development Mechanism as a "project with a component that induces the reduction or sequestration of greenhouse gases". The CDM is the only mechanism (UNCCC 2004:10) that invites non-Annex 1 countries to implement emission reductions in their respective countries.

One of the primary objects of CDM is to promote sustainable development through a partnership between the host country and the project developer. The very basis for the implementation of CDM is the premise that Certified Emission Returns (CERs) have the capacity to produce additional project revenues to fund sustainable development. Sustainable development is broadly described in the Brundtland Report (1987) as development which meets the needs of the present generation without compromising the capacity of future generations to meet their developmental needs.

It is the contention of this study that Environmental Economics is encapsulated within neo-classical welfare economic theory and more specifically, within the theory of externalities. Therefore, the philosophical and theoretical directive of this study is informed by the philosophy and theoretical foundation of Arthur Cecil Pigou. Steiger (1996:31), states that Arthur Cecil Pigou identified the modern concept of economic externalities, which is described as "unintended side-effects' of an environmental nature that are not effectively captured into the economic equation of supply and demand. The Clean Development Mechanism is primarily based on the treatment of emissions, which are, in fact, externalities. The aspect of incorporating, quantifying and subsequently trading Certified Emission Returns constitutes the recognition of emissions as economic externalities. Therefore, this study grounds its philosophical validity on the theory and philosophy of Arthur Cecil Pigou.

While this study employs the fundamental directive of Eisenhardt (1989:536) for case study analysis, it also utilizes “Integrative Thinking” (Martin 2007) to critically asses the success and failure of CDM as a developmental tool. Based on Roger Martin’s (2007:25) integrative thinking and causal modelling, this case study sets out to design a new and innovative Sequential Analysis Framework for the implementation of sustainable development in developing economies.

1.1 Background to the Research Problem

The fundamental problem confronting this research is identifying and articulating barriers and enablers to funding sustainable development by evaluating the implementation of Clean Development at Bisasar Road and Mariannhill through the theoretical lens of Arthur Cecil Pigou. The motivation behind understanding the CDM implementation process is to establish weaknesses and strengths in the implementation process, thereby, constructing a framework that contains a set of indicators to monitor the implementation of CDM projects from a developmental state perspective.

CDM is the basic underlying point of reference for this case study. It is the mechanism defined by the Kyoto Protocol for the prime purpose of reducing or sequestrating greenhouse gas emissions (UNFCCC 2004:11). This is the only mechanism that involves the southern countries, allowing them to participate in emission reduction. Southern countries are referred to as non-Annex 1 countries. One of the crucial issues for the implementation of CDM is the aspect of *additionality.* Additionality dictates that any CDM project must show a reduction of emission that would not have occurred in the absence of CDM (UNFCC 2004:11).

Clean Development may be applied to the energy sector, waste management, the industrial sector, housing, transport, agriculture and forestry (UNFCCC 2004:12). This case study is a critical examination of the process of implementing Clean Development Mechanism (CDM) at Bisasar Road and Mariannhill for the specific purpose of identifying the barriers to and determinants of funding sustainable development within the context of developing countries. Both the Bisasar Road and Mariannhill CDM projects fall within the jurisdiction and management framework of the EThekwini Municipality. While Bisasar Road has seven electricity generators, Mariannhill has only one generator.

The two projects utilize the technology of converting landfill gas to electricity through the process of methane flaring. These two projects provide a platform for the conversion of harmful emissions

of methane and carbon from their respective landfills to produce clean energy and to trade Certified Emission Returns with Annex 1 countries, as prescribed by the Kyoto Protocol. The Mariannhill project was commissioned in 2006 and the Bisasar Road project was commissioned in 2008. The Bisasar Road Landfill had the capacity to handle 3500 tons of waste per day and stopped receiving waste at the end of 2015. Mariannhill handles 500 tons of waste per day and will stop receiving waste in 2022. Interviews with the senior engineer at Durban Solid Waste has established that the Bisasar Road Landfill will continue to produce gas till 2030, while Mariannhill will produce gas up to 2037. During the course of the interviews with personnel at Durban Solid Waste, it has been claimed that the two projects have reduced greenhouse gases by 1.8 million tons since inception some nine years ago. The senior engineer states that both Bisasar Road and Mariannhill fall under one project and jointly produce 45 thousand megawatts of electricity per annum.

During the World Summit on Sustainable Development in Johannesburg in 2002, the World Bank approached South Africa with the prospect of funding Clean Development Projects via the mechanism of trading carbon credits. The prospect of funding sustainable development through the sale of carbon credits promised attractive streams of revenues. However, after the 2008 crash of financial markets, Durban Solid Waste has never really succeeded in recovering from the loss of promised revenues from the sale of carbon credits. Durban Solid Waste has had to resort to selling electricity to Eskom at a huge loss in order to compensate for recurring losses due to the collapse of the global carbon trading market. This case study is a critical examination of the process of implementing a Clean Development Mechanism (CDM) at Bisasar Road and Mariannhill for the specific purpose of identifying the barriers to and determinants of funding sustainable development within the context of developing countries. CDM, established under the auspices of the Kyoto Protocol (Gillenwater & Seres 2011:1), is the foremost global offset program in existence today and it has been solely responsible for establishing a global market for trading greenhouse gas (GHG) emissions.

Within the context of cap-and-trade, according to Gillenwater and Seres (2011:5), “a GHG represents a reduction, avoidance, destruction or sequestration of GHG emissions that is from a source NOT covered by an emission cap or another emission reduction requirement “. When offsets meet the stipulated reduction criteria, institutions or countries are permitted to meet their compliance to emission reduction as though they had “purchased an emission reduction or made the reduction itself” (Gillenwater and Seres 2011:5). When developed countries have an emission

reduction target within the context of CDM, they are referred to as Annex 1 countries, according to the Kyoto Protocol (Gillenwater and Seres 2011:5). Countries are allowed to implement GHG reduction or extraction projects in developing countries for the specific purpose of generating Certified Emission Reductions (CERs) or carbon credits. Parties participating in joint CDM projects with Annex 1 countries are referred to as non-Annex 1 countries.

The primary aim of CDM is to stabilize the concentration of greenhouse gases on the planet by assisting highly industrialized countries to meet their emission targets (Gillenwater and Seres 2011:5). CDM provides a facility for the private sector to channel funds towards developing countries so that developing countries assist in the process of GHG reductions. CDM provides a means towards facilitating and funding sustainable development in developing countries.

Historically, most of the demand for Certified Emission Returns has come from the European Union. However, the fracturing of the European community through the emergence of popularism, has substantially weakened demand. The demand for the purchase of CERs has been diminishing since 2008 and it continues to diminish. There is a consistent and underlying argument, especially from the developing nations, that CDM is an excuse to allow Annex 1 countries to continue to pollute with GHG emissions by signing up to purchase Emission Reduction Certificates from developing economies.

Important questions have arisen as to whether CDM does in fact support sustainable development in developing economies or whether CDM is a pretext to allow Annex 1 countries free reign to pollute the global atmosphere unabated. The scope of this study is limited to the outcomes of the implementation of CDM but it may be necessary, at some stage, for another study to explore the motives and role of the World Bank in promoting CDM as a tool for the support and facilitation of sustainable development (specifically through the mechanism of CDM).

The broader implications of the outcomes of this study may point towards a scenario indicating that CDM does not, in fact, support sustainable development. Furthermore, it is highly likely that the search for barriers and enablers to funding sustainable development may uncover the reality that, far from funding sustainable development, CDM contributes towards eroding the gains of sustainable development. There may be a very valid argument that the motives of the World Bank are purely profit oriented when it comes to supporting the implementation of CDM. The implication then is that the World Bank is compliant in supporting the growth of developed economies by

condoning unhindered emissions and is using CDM as a screen to mask the real motives of the developed nations. By implication then, if this proves to be valid, then CDM works against sustainable development and contrary to its stated claims and objectives.

1.2 The Research Problem

The United Nations Framework Convention on Climate Change (2004:13) makes the claim that the prime objective of CDM is to contribute to the sustainable development goals of Non-Annex 1 countries by supporting local environmental projects; by contributing to the local economy; by making a direct foreign investment; and by lowering the costs of the project. The UNFCCC (2004:13) also claims that a CDM project has the potential to produce revenues of up to 15% of project investment costs. CDM generates offsets by investing in "GHG reductions, avoidance and sequestration projects in developing countries" (Gillenwater and Seres 2011:1). Up to 2011, the global carbon offset market was valued at around $2.5 billion (Gillenwater and Seres 2011:1). The value, credibility and functional integrity of the carbon offset market was greatly compromised by the outcomes of the 2008 financial market crash. The capacity to provide reliable revenue streams to developing economies was greatly compromised by the crash of 2008. The CDM plants at Bisasar Road and Mariannhill have been hard hit by the loss of revenues from the collapse of the GHG market.

While accounting systems and the correct project implementation protocol assure both host and Annex 1 countries of uncontested gains from the implementation of Clean Development Mechanism, Jyoti P. Painuly (2001:147-169), analyses the benefits in terms of how the Kyoto Protocol, and specifically the implementation of CDM, benefit developing countries in particular. Painuly (2001:147) discovered that gains to Non-Annex 1 countries (developing countries) from participation in Greenhouse gas emissions reductions (via CDM) might vary from six billion dollars ($6billion) to twenty-nine billion dollars ($29 billion) which amounts to approximately seven percent (7%) and twenty percent (20%) respectively of the global gains in the emission trading system. Painuly (2001:147) advises, however, that in order for developing countries to maximize gains from CDM, certain design and implementation aspects of CDM need to be resolved. These issues can only be resolved by allowing non-Annex 1 countries full participation in the design and implementation of CDM. In her concluding remarks, Painuly (2001:165) states that literature on the Kyoto Protocols impacts on developed countries indicates that global, as well individual country costs, in meeting the Kyoto targets (via CDM) are very high if countries with targets

(Annex 1 countries) have to act individually. Consequently, that there must be global participation in the decision-making process (including non-Annex 1 countries as well).

Kallbekken and Westkog (2005:57) conclude that “CDM is assumed to have high transaction costs, while developing countries are assumed to have low-cost abatement projects to offer” and suggest that developing countries could obtain significant welfare improvements by making a transition from CDM trading to pure emission trading (outside of CDM structures). This option would also benefit developed economies by providing a less expensive, negotiable trading mechanism. If emission capping would turn out to be more stringent and more expensive in the future, it would be better for developing countries to concentrate on better welfare gains by not committing to binding abatement arrangements coming out of the Kyoto Protocol (Kallbekken & Westkog 2005:57).

Rai (2009:70-75), in the *Harvard International Review*, states that experiences with CDM has been favorable at times and unfavorable at most times. Rai (2009:70), makes the startling statement that, overall, CDM has led to significant overpayment by developed countries to developing countries for projects with dubious emission reductions. Rai (2009:75) declares that the efforts to reduce greenhouse gases through CDM have not been serious and that to date, the emission reductions have been limited. Varun Rai (2009:75) describes *additionality* and the process of accurately calculating *additionality* as the basis of the problem. Therefore, investors make the incorrect investment decisions by not understanding the process of correctly assessing and evaluating the concept of *additionality*. Furthermore, Rai (2009:75) reports that evidence suggests that perverse incentives have been widely used to gain investments from developed countries for projects with questionable environmental integrity (in developing countries).

Edwin and Nusser’s (2011:302) analysis of large CDM dams in Himachal Pradesh has revealed that the promotion of hydro-power through the carbon abating scheme is highly dubious. Their evidence suggests that local regulations fail to ensure that CDM dams help in climate change mitigation. Nor do these dams contribute towards sustainable development. Edwin and Nusser (2011:302) posit that there is strong evidence to suggest that CDM dams in Himachal Pradesh produce outcomes that are in direct conflict with the aims of mitigating climate change and promoting sustainable development. These outcomes undermine the aims of CDM with respect to society and also with respect to mitigating climate change.

While the United Nations advocates that Clean Development Mechanisms promote and fund sustainable development, many authoritative scholars (as described above), have indicated that there is no significant proof that implementation facilitates the funding of sustainable development. After the financial crisis of 2008, the carbon credit market has virtually collapsed.

Therefore, this study confronts with the following problem:
Does the implementation of a Clean Development Mechanism at Bisasar Road and Mariannhill contribute to funding sustainable development while at the same time, facilitating the abatement of harmful emissions?

The research problem is encased and contextualized within the implemented functional integrity of the CDM protocol. The questions seek answers on whether the successful implementation of CDM funds sustainable development. These are interwoven and integrated within the barriers and enablers to funding sustainable development. Barriers and enablers are the direct outcomes of the capacity of the process of CDM to endorse the existence of externalities both in the Annex 1 and non-Annex 1 countries. The very presence of emissions in both participating parties gives credibility to the assertion that the emissions represent externalities. Externalities need to be factored into the economic equation of both Annex 1 and non-Annex 1 countries. An appropriate accounting system needs to monitor and quantify externalities to calculate the net surplus or net loss of revenues in the process of implementing CDM. Externalities, by their very nature, produce boons to some parties and harm or injury to other parties (Steiger 1996:3). The very existence of externalities produces an imbalance in the economic structures of CDM. For *Pareto Optimo* to be restored, taxes need to be levied on those benefiting from the presence of externalities or the outcomes arising out of externalities. *Pareto Optimo* refers to an economic anomaly whereby the process of relocating of resources benefits some individuals while causing detrimental effects on other individuals (Steiger 1996:3). Those producing beneficial externalities need to be compensated or subsidized. The *Pareto Optimo* also dictates that when an institution produces harmful externalities which impact society, that institution should be fined or taxed with appropriate fiscal measures. In a situation of perfect balance, ambient welfare standards ought to be restored to an acceptable level of compliance. There is an unstated assumption that by imposing taxes and subsidies, emission levels are controlled and restored to acceptable levels of conformity. When emission levels conform to accepted norms and standards, the process of ecological renewal is also restored to acceptable norms. This scenario represents the broad

framework within which the problem is encased. However, problem is by no means linear but rather, broadly interconnected within the context of CDM.

The problem arising out of identifying barriers and enablers to funding sustainable development, through the implementation of Clean Development Mechanism, is characterized by Snower (1976:2) as having certain distinct complexities, namely:

- The first complexity is to make certain that the process of implementing CDM follows the prescribed protocol as stated by the Kyoto Protocol;
- The second complexity seeks to determine whether the correct implementation of CDM contributes to the successful funding of Sustainable Development;
- The third complexity aims to clearly identify and articulate the barriers and enablers to funding sustainable development from a CDM implementation perspective;
- The fourth complexity seeks to encase the understanding of CDM from the perspective of Pigouvian thinking and by doing so, to determine how the production of positive and negative externalities impacts sustainable development from a welfare economics perspective;
- The fifth complexity is economic and seeks to find out whether there are suitable mechanisms in place to accurately quantify the impact of externalities on the economic system;
- The sixth complexity revolves around achieving *Pareto Optimo* or an economic balance by the imposition of taxes, subsidies and the sale of carbon credits;
- The seventh complexity centres on maintaining and restoring *Ambient Welfare Standards* during and after the implementation of CDM. (ambient welfare standards refers to the resulting effects of externalities upon the well-being of any given community);
- The eighth complexity is concerned with understanding whether the implementation of CDM and the sale of carbon credits thereof does, in fact, reduce greenhouse gas emissions;
- The ninth complexity focuses on how the implementation of CDM affects ecological renewal;
- The tenth complexity examines the role of effective supervision by the CDM executive Board, The Designated National authority and local management towards the effective implementation of CDM; and

- The eleventh complexity involves the determination of whether the revenue-generating capacity of the CDM projects contributes to its very own sustainability from a profit or loss perspective

It is apparent that the problem of determining what the barriers and enablers to funding sustainable development are, embraces multifaceted complexities. This study sets out to systematically evaluate each complexity through a series of theoretical and analytical constructs so that it becomes possible to formulate a framework that contains a set of indicators to monitor the implementation of CDM projects from a developmental state perspective.

Highlighting the core problem and then articulating each complexity strengthens the aspect of internal validity and reliability. The process of stating the problem and all the associated complexities facilitates the capacity of the research process to clearly define the purpose of the study.

1.3 The Purpose of the Research

Having detailed what CDM as a mechanism is capable of delivering towards funding sustainable development, the purpose of this research is to evaluate what CDM as it has been implemented at Bisasar Road and Mariannhill, can deliver in terms of what the Kyoto Protocol claims the projects are capable of delivering.

The primary purpose of this research is to establish whether the two plants successfully contribute towards funding sustainable development. This study also seeks to establish what aspects of the implementation outcomes constitute barriers and what aspects of the implementation outcomes constitute enablers to the process of funding sustainable development. The purpose is also to establish whether the sale of carbon credits constitutes a feasible mechanism for revenue generation. The study also aims to monitor the capacity of CDM to restore ambient welfare standards and to activate ecological renewal. After evaluating the funding capacity of the two projects from the perspective of the Clean Development Mechanism, the purpose of this study is to constitute a framework with a set of indicators to monitor the implementation of Clean Development Mechanism projects from a developmental state perspective.

1.4 The Research Questions and the Research Objectives

1.4.1 The Research Question

How does the successful implementation of a Clean Development Mechanism at Bisasar Road and Mariannhill Landfill sites contribute to funding sustainable development, while at the same time, sequestrating harmful emissions?

- What are the barriers and determinants of funding sustainable development projects?
- Could the CDM *"restore pareto optimo"*?
- How could the CDM restore ecological renewal?
- Could the CDM restore ambient welfare standards?

1.4.2 The Research Objectives

The primary objective of this research is to establish whether the implementation of the Clean Development Mechanism at Bisasar Road and Mariannhill contributes to funding sustainable development, while at the same time abating harmful emissions. From a Pigouvian theoretical perspective, the objectives are to determine whether the implementation of the Clean Development Mechanism restores the *Pareto Optimo*; restores ecological renewal; and restores *ambient welfare standards*.

- To discover the barriers and determinants of funding sustainable development projects
- To determine if CDM *"restores pareto optimo"*
- To determine if CDM restores ecological renewal, and
- To determine if CDM restores ambient welfare standards

Stating the research question and the objectives of this research motivate for the choice of an appropriate methodology for the implementation of the research. While the format of this study utilizes the methodology of quantitative analysis, this study is not measuring relationships between significant variables. This research is based on "Case Study" research design which contains elements of quantitative and qualitative analyses.

1.5 The Research Process

Lokke and Sorensen (2014:66) citing Eisenhardt (1989), Van Maanen (1979), Stake (2006) and Flyvbjerg (2004:428) state that research based on a case study design "focuses on a single

setting or unit that is spatially and temporarily bounded." The authors comment that it is often difficult to describe the boundaries in terms of the conceptual and contextual contents emanating from a case study. However, they state that the overall and distinct advantage of the case study design is that it allows for a snapshot or series of snap shots of real-life situations. These so-called snapshots of reality allow for real-life testing of the phenomena of interest.

The Clean Development Mechanism is a fairly new mechanism and although its functionality is marginally technical, most of the directives are based on economics, with a distinct slant towards current environmental issues. Although this study explicitly interrogates CDM from the theoretical perspective of Arthur Cecil Pigou, the research process involves a brief process of eliminating the theories of Robert Malthus, Stewart Mill and the Austrian Neo Classical theorists. These theorists are mentioned only, to lend validity to the choice of the Pigouvian thinking as the most relevant interpretive theoretical framework.

In searching for a philosophical and theoretical basis, this study explores the theory of Thomas Robert Malthus (1798) on the impact of population growth on the environment. The study proceeds to examine the theoretical and philosophical basis of John Stewart Mill's (1848) theory on population growth and the so-called steady state or state of equilibrium in the dynamics of population growth.

Furthermore, this study evaluates the impact of neo-classical theorists in terms of how neo-classical thinking rooted itself in an efficient market system of supply and consumer demand and consumption. The neo-classical thinkers initiated a value system that integrated social welfare into the process market-based economics. The Austrian neo-classical thinkers identified environmental degradation as one of the outcomes of economic activity. They considered that the outcome of environmental degradation resulting from economic activity posed a situation of apparent conflict between industrialists and consumers at large. The Austrian neo-classical thinkers resolved to seek and apply legal precedents to resolve the so-called conflicts between industry and the impact of industrial activity on the environment. Austrian neo-classical thinkers fell short of quantifying the impact that emissions had on the environment, but their philosophical analysis produced a niche for other philosophers to find a means to quantify the outcomes of industrial activity on the environment.

One such philosopher was Arthur Cecil Pigou (1877-1959). Pigou (1920) declared that market interactions produced beneficial and detrimental effects. Pigou referred to these as “unintended side-effects”. It was Steiger (1996:31) who declared that Pigou identified the modern notion of economic externalities, which are mostly of an environmental nature and not captured in market transactions. Externalities provide a viable and highly useful mechanism to quantify environmental variables, facilitating their inclusion into the accounting system for economic assessments. The identification of externalities paves the way for the inclusion of taxes, subsidies and discounting for environmental credits. Pigou provides the perfect fit for the philosophical and theoretical basis for this study. The entire methodology of the Clean Development Mechanism and the quantification of Certified Emission Returns fits the theoretical basis of Pigouvian thinking. This study embraces the philosophical and theoretical directives of Pigou as the theoretical basis for this research process.

Defining the contributions of allied fields of Environmental Economics, a green economy, Ecological Economics and Sustainable Economics are included in the research process to incorporate a better grounding to the theoretical framework of this study. The theoretical framework surveys the contribution of many academics on the identification, impacts and description of the emergence, utility and dissolution of externalities from the perspective of social and economic benefit and harm.

This study also evaluates various media reports on the issue of funding sustainable development. The debate on whether funding should be private or public exposes the trends and the current realities for the mechanisms of funding sustainable development.

Although interviews at the sites interrogate the process of implementation of CDM, the real consolidation and appraisal of the implementation process is informed by an evaluation of the theoretical basis for the Clean Development Mechanism. The fundamental motivation behind CDM was formatted by the United Nations Framework Convention on Climate Change under the auspices of the Kyoto Protocol in 1997. Since Funding is almost exclusively dependent on the functional integrity of the implementation process, this enquiry embarks upon a critical evaluation of the said process.

Chapter Three describes the case study methodology of Eisenhardt (1989:532). Eisenhardt’s research design and methodology proposes a step-by-step approach for the abstraction of theory

for the purpose of innovating new theoretical components. The questions embrace the Pigouvian ideology and from this perspective, the questions seek responses that establish the functional integrity of Clean Development. The Pigouvian theoretical approach seeks to evaluate the impact of externalities within the context of CDM.

Abductive logic, referred to as *integrative thinking* by Martin (2007:145), best describes the ontological positioning of this study. *Integrative Thinking* informs the ontological posture by asking questions relating to what is relevant; how can one interpret the object reality of CDM; what operations need to be implemented and in what sequence, reassembling and reformatting structural components to forge new models. Pigouvian social and welfare economic theory, encapsulated by integrative thinking, best describes the epistemological positioning. The core problem embraces Pigouvian thinking in order to determine how the successful implementation of CDM supports and funds sustainable development. In evaluating the ontological position, the epistemological perspective and the question of funding sustainable development, the foremost objective is to define a set of indicators that informs a framework which may be used to monitor the implementation of CDM from a developmental state perspective.

1.5.1 The Research Design and Methodology

In keeping with Eisenhardt's (1989:538) reference to multiple data collection methodologies, this study utilizes triangulation as well as within-case data analysis and field notes describing enfolding events and literature. The purpose is to reach a definitive closure.

The Sampling design advocated by Eisenhardt (1989:537) states that case study research relies on "theoretical sampling' whereby cases are chosen for theoretical reasons rather than statistical requirements. Lokke (2014:71) states that "generalization in theory-testing case studies is closely related to the issue of sampling". Therefore, the range of characteristics derived from the sample enhances the capacity for generalizability and validity according to Lokke (2014:71). Yin (2009:2) states that in case studies the sheer abundance of phenomena and the range of real life context requires the researcher to cope with a distinctive and unique situation. Yin (2009:7) also posits that case studies display exploratory, as well as descriptive, functions.

According to Yin (2009:18), the case study enquiry has to encounter many more variables of interest than "data points" alone. Case Studies source evidence from multiple sources and often, collected data has to be ordered and triangulated with other relevant information. In case studies,

the data is often collected from the framework of specific theories. Case study research includes single and multiple case studies (Yin R. K. 2009:19). This case study refers to the Clean Development Mechanism project at Bisasar Road as well as the Clean Development Mechanism project at Mariannhill. Data collection is conducted in a structured manner and each visit to the site is motivated by a specific theme.

Eisenhardt falls short of describing an appropriate methodology for data analysis. Therefore, data analysis is based on Integrative thinking, inductive logic, abductive logic and generative reasoning (Martin 2007:146). The purpose, according to Martin (2007:54), is to seek salience; search for causality; format new architecture; and innovate new models.

Category “A” questions seek to consolidate the structural integrity of CDM. Category “B” questions are designed to interrogate CDM from the perspective of Pigouvian “welfare-economics” theory. Category “C” questions are designed to extract information concerning the funding capacity of CDM for (funding) sustainable development. For the purpose of validity and reliability, questions were also posed to an Independent Authority and expert on the Clean Development Mechanism outside of Durban Solid Waste.

The data collection process is duly supported by a “Letter of Information” from Durban University of Technology; a “Letter of Consent” from EThekwini Municipality; and an appropriate “Letter of Introduction”.

Data collected from site visits and interviews is presented in Chapter Four of this dissertation, in the form of descriptive writings, pictures, tables, graphs and the actual responses from respondents. The collected data is systematically analyzed in seeking salience, causality, architecture and resolution according to the dictates of Martin (2007: 144), for the implementation of integrative analysis. Integrative analysis uses the tools of deductive logic, inductive logic and abductive logic. Integrative analysis and the three stated logics facilitate the formatting of the Sequential *Analysis Model* for the purpose of informing a framework for monitoring the implementation of Clean Development Mechanism from a developmental state perspective.

1.6 Rationale for the Research

This research conducts an extensive theoretical and literature survey to consolidate the functional integrity of a Clean Development Mechanism from the perspective of Arthur Cecil Pigou, a

nineteenth century social welfare economist who first recognized the impact of externalities and their influence on the social welfare and economic well-being of communities. The Pigouvian approach adds a theoretical framework to examine the impact of externalities on the economy, ecology, sustainable development and examines the mechanism of CDM from the context of how CDM monetizes externalities by adding monetary value to the outcome of emissions. The process of formalizing Certified Emission Returns quantifies the externalities that are the outcome from the implementation of the Clean Development Mechanism. This study questions the claim that CDM is a recognizable instrument for funding sustainable development. A systematic and critical assessment is conducted on the implementation of CDM at Bisasar Road and Mariannhill to ascertain whether the implementation does, in fact, fund and promote sustainable development. Clean Development Mechanism is supported and promoted by the World Bank. In analyzing the motives of the World Bank this study assesses and critically interrogates the motives of the World Bank when it claims that the trading of Certified Emission Returns promotes and funds sustainable Development in the Southern countries while facilitating the overall reduction of global carbon emissions (UNFCC 2004 :13). In assessing the validity of funding outcomes from the sale of Certified Emission Returns, this study conducts a critical analysis of profit and loss outcomes from accrued revenue streams (from the sale of CERs and from the sale of clean energy to Eskom). In determining what the barriers and enablers to sustainable development are, this study collates data to make an accurate assessment as to whether CDM does or does not support and fund sustainable development. A formal deficiency report indicates what the net effect of barriers and enablers is and from this deficiency report a new set of indicators are structured in such a manner so as to provide an effective model for the successful implementation of CDM from a developmental state perspective. A critical assessment of CDM is relevant to the aspirations of Southern Africa for clean energy, carbon reduction and affordable funding for sustainable development.

1.7 Definition of Terms

The following terms are repeatedly referred to throughout this dissertation and are therefore defined in terms of the contextual relevance to this study:

"The **Clean Development Mechanism (CDM)** is a mechanism defined by the Kyoto Protocol, whereby projects with a component that induces the reduction or sequestration of greenhouse gas (GHG) emissions are implemented. The CDM is the only mechanism in the Kyoto Protocol that involves non-Annex 1 countries, by enabling them to host emission reduction projects in their

territory. One of the objectives of the CDM is to foster sustainable development in these countries, as part of a partnership between the host country and the project developer" (UNFCCC 2004:10).

The term **"*additionality"*** refers to the criteria that "emission reductions of the project must be in addition to those that would have occurred had the project not been implemented" (UNFCC 2004:10).

Certified Emission Returns (CERs) refers to the sale of "carbon credits" and represents an additional source of project income (UNFCCC 2004: 10).

Steiger (1996:31) states that Pigou identified the modern notion of **"economic externalities** which he described as "unintended side-effects", mostly of an environmental nature "that are not captured in the market transaction itself".

Annex 1 countries are countries (developed Countries) with an emission reduction target allowed to implement greenhouse gas reduction or removal projects in Developing countries, also known as **non-Annex 1 countries** (UNFCCC 2004 :11).

1.8 Structure of the Thesis

This thesis is comprised of six chapters:

- The first chapter is a concise summary and introduction to the contents of the thesis. Chapter One provides an overall view of the interconnectivity of the entire thesis.

- Chapter Two details the process of theory building by introducing the context of the Theoretical framework. This chapter examines and evaluates the contribution of various authors and their views on economics; externalities and how externalities impact the environment; and what impact these have on social welfare. Chapter Two examines the Pigouvian theory of externalities and then examines and compares the contribution of Environmental Economics, Ecological Economics and Sustainable Economics. The seven essential components of a green economy are articulated and described. The significance of the Pigouvian contribution is reiterated to affirm that Pigou's identification of externalities constitutes the basic, fundamental philosophical foundation for this study. Some exposure is given to authoritative media reports to align theory to current thinking on the successful means to funding sustainable development. As funding sustainable

development depends to a large extent on the proper implementation of CDM, this study critically evaluates the theory and requirements for the implementation of CDM. The views, of various authoritative writers and scholars, on CDM, are critiqued.

- Chapter Three outlines the research design, defining the research questions, the research objectives and the research instruments. The ontological and epistemological positions are also stated and defined. This chapter describes the various approaches to the process of collecting data and also details appropriate methodologies for the systematic analysis of collected data. Mention is made of the unique process of deciding on what constitutes an appropriate sampling design. A schedule for site visits is sketched and special themes are allocated for each site visit for the purpose of soliciting focused interviews. The interviews span a period of ten days. Substantive detail is allocated to the process of combining Eisenhardt's methodology with that of Roger Martin for the purpose of data analysis. Chapter Three describes generative reasoning, deductive logic, inductive logic and abductive logic to seek out salience, causality and architecture for a new innovative model.

- Chapter Four presents the results and outcomes of the various site visits and interviews. This presentation takes the form of interview outcomes, quantitative data, qualitative views as well as illustrations, graphs, tables and pictures of the two sites and the extraction and flaring processes. Information in chapter four also includes revenue flows and costs associated with CDM. The second part of Chapter Four is entirely dedicated to systematically analyzing the collected data to ascertain and identify barriers and enablers to funding sustainable development. The broader implications of the analysis are concerned with understanding whether CDM, as a mechanism, is successful in generating sufficient revenues to fund sustainable development, and at the same time to lend value to the environment, social welfare and ecological renewable. Analysis looks critically at the feasibility of CDM and its capacity to fund sustainable development.

- Chapter Five outlines the Systematic Sequential Analysis model which introduces a framework that includes a set of indicators to monitor the implementation of CDM projects from a developmental state perspective. The Systematic Sequential Analysis provides a step by step decision-making protocol for the implementation of CDM.

- Chapter Six evaluates what the study set out to achieve and concludes by clearly outlining the findings. The limitations of this study are detailed in Chapter Six while avenues for further research are also described.

CHAPTER TWO: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.0 Introduction

The purpose of this literature review is to contextualize the Clean Development Mechanism within an appropriate theoretical framework which clearly exemplifies the complexities of funding sustainable development. While the literature review firmly establishes the philosophical directives of Cecil Thomas Pigou (1877-1959) as the only viable theoretical framework for the analysis and interpretation of CDM, this research also briefly outlines the historical connectivity and development of Pigouvian thinking from the writings of Thomas Robert Malthus (1798) and John Stewart Mills (1848). The brief expose on Thomas Robert Malthus and John Stewart Mills serves only to add theoretical validity to the selection of Pigouvian thinking as the most appropriate theoretical framework for the purpose of interrogating CDM.

CDM, as a mechanism, was mainly formulated by the United Nations Framework Convention on Climate Change (2004:13) and therefore, much of the descriptive literature on the Clean Development Mechanism was sourced from the archives of the United Nations. The various journal articles which challenge and alternatively support the theory of Pigou were sourced from the academic search engine, JSTOR. Some of the literature was sourced from the Durban University of Technology library and oftentimes, the librarians assisted in directing the search for key issues relating to this theoretical framework. Many of the articles on funding sustainable development were taken from newspaper clippings and articles. Google Scholar and Google searches provided updated information on current issues relating to funding sustainable development.

This search was guided by the terminologies arising from CDM; from the Pigouvian Theory of Externalities; Pigouvian Taxes and Levies; the Pareto Optimo and the ecological outcomes described by Pigou. These key words served as facilitators throughout the process of the theoretical survey.
Concepts arising from this literature search provide important guidelines for the method and direction of data collection.

The next paragraph introduces the broad context of the theoretical framework.

2.1 Context of the Theoretical Framework

The Brundtland Report (1987) defines sustainable development as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs.” The Daily News (Cairo, 22 November 2010 issue), made an interesting observation from the 2009 Addis Ababa summit on climate-change that funding is unquestionably a key ingredient in addressing climate change. Furthermore, the newspaper observed that funding sustainable development placed considerable pressure on public sector resources and that the only way to mitigate the risk of shortfalls in funding was to look at alternate sources of funding like private sector resources, to supplement existing flows. This is further highlighted by Helle, Steve, Helmuth and Smith (2010:1), who state that “financing is often the stumbling block of good public policy” when it comes to financing sustainable development and, in difficult economic times, projects may sit on shelves due to fiscal constraints. Helle *et al* (2010:3) suggest that funding should be secured by structuring bond insurance from private sector resources. Sheehan and Patrick (2010:2) conclude that banks are not quite interested in financing green projects and that “being green” is no guarantee of funding and could in fact be a hindrance. Banks look for credit-worthiness from a profitability perspective. This literature survey explores the Clean Development Mechanism as a viable alternate to funding sustainable development.

CDM, as a conceptual framework, is relatively new to South Africa and it has only been implemented in waste-to-energy projects located in the EThekwini and Ekurhuleni municipalities. (EThekwini Municipality 2012:1). Clean Development Mechanisms are based on the principle that human interactions with the external environment can have unsolicited outcomes that affect other humans and future generations as well. The Clean Development Mechanism attempts to alleviate the negative effects on people and environment. Clean Development Mechanisms arise out of an awareness of Environmental Economics and the theory of externalities, focusing attention on how environmental pollution impacts the attraction of optimal investment in terms of capital and the discounting of environmental credits (Perman and Stern 2000:1). Roy Cordato (2005:2) states that Environmental Economics is located within the context of standard neo-classical theories of efficiency and Pigouvian (welfare) economics.

The theory of Environmental Economics was developed in three distinct phases. Classical economists outlined how economic scarcity would arise from “the fact that society would have to sacrifice increasingly more to obtain less on the margin” (Steiger 1996:30) due to natural calamities, war and disease. In 1975, the socialist philosopher John Stewart Mill introduced the

idea that the natural beauty of the environment would be impaired through the impact of global population growth (Steiger 1996:30). The theory of Economic Externalities was developed by Pigou (1932) who provided the intellectual platform that gave credibility to the fact that externalities provided a significant mechanism of incorporating environmental damage into economic assessments which provided access to taxes to reduce environmental damage.
Hence Environmental Economics is encapsulated within neo-classical welfare theory and the theory of externalities (Steiger 1996: 29).

This constitutes the context of the research in relation to the theoretical framework.

2.2 Constructing the Theoretical Framework

2.2.1 The Contribution of Thomas Robert Malthus

The classical economists emerged during the period of the Industrial Revolution in the 1800s. Their philosophical enquiry was mainly concerned about how natural laws would impact the quality of lives of humanity and how these natural laws would impact the survival of humanity. The most prominent classical philosopher and economist was Thomas Robert Malthus who in 1798, made this fundamental statement:

"I said that population, when unchecked, increased in a geometrical ratio and subsistence for man in an arithmetical ratio" (Malthus 1798:6).

The implication of this statement is that agricultural production increases at an arithmetic rate while the demand for food, from an exploding population, increases at a geometrical rate, introducing the concept of shortage of supply and economic scarcity. Malthus (1798) predicted that the ever-diminishing capacity of the land to meet the demands from the increasing population would reduce revenue flows and marginal returns for the farmer. Furthermore, society would have to employ more hands to supply a growing population from a limited land capacity and this would lead to ever-increasing costs in terms of cost of food and also the cost of labor. The end result would be a greatly compromised standard of living for society.

Although Malthus was concerned primarily with the impact of population growth on scarce agricultural resources, by implication environmental degradation would have a similar devastating effect on natural, sustainable resources. Thus, the philosophical basis of Malthusian thought forms the intellectual platform for modern day neo-Malthusian thinking on increasing resource

scarcity from environmental degradation. The perverse impact of an increasing population would not only impact the availability of food supply, but would result in environmental degradation as well. Current Neo-Malthusian concerns are perhaps best illustrated by Paul Ehrlich. He explores the possibility of food shortages and the resulting deaths from nutrition-related issues and details how population growth would also cause devastation to the environment as forests are cleared, use of fertilizers increased and pesticides accelerate the greenhouse effect. Ehrlich goes to the extreme scenario of the possibility of nuclear war over food scarcity, and the possible impact on the environment. The Malthusian hypothesis regarding the variable of scarcity is still the basis of scientific enquiry into the aspect of economic supply and demand. In addition, the Malthusian hypothesis paints a scenario of devastation and deprivation in the event of mankind's future neglect of the environment.

Malthusian thinking fosters an awareness and points mankind to make the transition to a sustainable economy which shows respect for the biophysical limits of the global ecosystem. Failure to make this transition may result in ecological catastrophe and compromised living standards for mankind. Malthus envisaged population growth to be insidious, with devastating effects on labor costs, food and food production. This eighteenth century philosopher and economist did not foresee any regulatory mechanism nor any catalysts that would impose any mandatory balance; nor steady state between population growth and its devastating effects on food production and the environment (by implication). This fissure in the philosophical outlook of Malthus presented a window of opportunity for John Stewart Mill, the Utopian socialist philosopher of the early nineteenth century.

2.2.2 The Contribution of John Stewart Mill: The Utopian Socialist

Mill (1848:188) wrote at great length that the uncontrolled aggregation and amassing of wealth and unchecked population growth would have very serious repercussions for the quality of lives of humanity in general. Mill advocated a stabilization of population growth, less consumption and an equitable redistribution of wealth. The process of stabilizing the population, disciplining consumption and redistributing wealth was referred to as a "stationary" state. For Mill (1848), the prime purpose of achieving a 'stationary' state was to prevent the degradation of the human condition and importantly, to also prevent the degradation of the environment.

In defence of his argument against the greed of excessive production, Mill (1848:189) refers to the "trampling, elbowing and treading on each other's heels" for the sake of industrial progress.

With reference to protecting the environment, Mill (1848:191) states that "nor is there much satisfaction in contemplating the world with nothing left to the spontaneous activity of nature; with every measure of area of land brought into cultivation …in the name of improved agriculture".

The 'stationary' state hints at the aspect of sustainable development when Mill (1848:189) states that:

"But the best state for human nature is that in which, while no one is poor, no one desires to be richer, nor has any reason to fear being thrust back by the efforts of others to push themselves forward."

In essence, Mill contributed towards the theory of a "steady" state within the context of economics but, more importantly, Mill stated that this so called 'stationary' state would also have a regulating effect on the degradation of nature, human psyche and arable land. The 'stationary' state, however, gave no hint on how damage to human well-being and environmental damage could be quantified into usable variables for economic assessment. Early economists articulated and described the influence and impact of environmental variables but fell short of quantifying the price, in economic terms, of the degradation costs. They were primarily concerned about social welfare.

2.2.3 The Neo-Classical Economists

Towards the latter period of the nineteenth century, the neo-classical economists emerged at Cambridge University and instead of utilizing natural laws to interpret the outcomes of economic activities, began to use the mathematical models of engineers and scientists and came up with an entire series of graphs from calculus and analytical geometry to interpret economic data.

Steiger (1996:31) declared that neo-classical theory was rooted in an efficient market system within which producers and consumers maximized satisfaction between supply, demand and consumption. The unique relationship that developed between producer and consumer began to foster a value system that was conducive to social welfare but, in terms of Sustainable Economics, this neo-classical economic system still lacked a means to account for pollution and elements of environmental degradation. The Austrian neo-classical microeconomic theory interpreted economics from the perspective of marginality (Endres 1997:30) and defined economics as a science of choice "to distribute given scarce resources among given competing ends". Again, the

Austrian neo-classical economists did not formulate a mechanism to account for pollution and environmental degradation. Pollution and environmental degradation would, hypothetically, have to be resolved from the perspective of conflict of interest between two or more parties. The Austrian neo-classical economists perceived economics as the process of “needs satisfaction”, consumption and production (Endres 1997:33). Therefore, pollution could cause interpersonal conflict relative to the means of production and arising as a need satisfaction to one, but having the negative impact of pollution on another. This conflicted with the primary aims of the welfare economics of the neo-classical period.

2.2.4 Arthur Cecil Pigou and the Concept of Externalities

The need for an accounting system to quantify the effects of pollution and environmental degradation was resolved by Pigou (1877-1959), a British neo-classical economist. Pigou (1920) asserted that market interactions yielded beneficial and detrimental effects. Pigou (1920) describes the harmful impact of chimney smoke on community welfare, on the growth of crops, on laundry, on limiting sunlight. Steiger (1996:31) posited that Pigou identified the modern notion of “economic externalities”, which he described as “unintended side-effects”, as mostly of an environmental nature, “that are not captured in the market transaction itself “. Externalities provide a viable and highly useful mechanism to quantify environmental variables into the accounting system for economic assessment. Externalities pave the way for taxes, subsidies and discounting for environmental credits. Snower (1976:2), in exploring the theoretical context of Pigouvian economics, stated that “whenever the production activity of one firm affects a real economic variable involved in the activity of another firm or consumer and whenever the activity of one consumer affects a real economic variable of another consumer or firm, an *external* economic effect is present.” An externality is present, therefore, when one economic entity impacts the welfare gains of another economic entity or community without taking the latter’s welfare gains or losses into account. Snower (1976:3) states that externalities arise when one economic entity does not have to pay for harm it incurs or, alternatively, the economic entity is not compensated for the benefit it produces for another economic entity or community. Within the context of Environmental Economics, for example, when one economic entity’s pollution, emission or waste does not take into account the health hazards it imposes on other entities or communities, then an externality becomes apparent.

The entire methodology and execution of the Clean Development Mechanism (CDM) funding is based on the identification and establishment of externalities as defined by Pigou. The Pigouvian

approach to the economic significance of externalities is to quantify externalities by imposing taxes or subsidies within the context of social welfare concerns. In supporting this Pigouvian proposition, Frank Knight (1924:582), argued that economic entities may be obliged to consider the sum total of their welfare impacts through the re-assessment of property rights. The Pigouvian economic directive advocates a re-alignment of taxes and subsidies in such a manner that socially beneficial production, consumption and distribution of goods and resources are achieved. Therefore, within the context of Environmental Economics, the Pigouvian approach provides an economically viable solution to the losses experienced by the emergence of unsolicited externalities. Taxes and subsidies, arising out of the Pigouvian approach, depend to a large extent, on the nature and policy profiles of economic entities and more importantly, on the social-welfare impact of their actions (Snower 1976:6).

Policy issues are difficult to quantify and may differ from business to business. However, Baumol and Oates (1971: 42) based their analysis on the social welfare component rather than on an analysis of individual policy issues of economic entities. They formulated the following theorem:

"*For any given set of outputs produced by the firms in an economy and for the satisfaction of a given environmental standard, the use of unit waste taxes and subsidies permits the production of the above outputs at a minimum cost to society."*

Therefore, from the above theorem, it is safe to conclude that the Pigouvian approach to externalities, in the economic make-up of specific interactive components, prescribes socially acceptable fiscal measures in terms of disadvantageous outputs (like pollution) or, alternatively, when economic interactions produce a boon to another entity, entities or society at large.

The Department of Economics, Maryland University (1976:72) stated that the Pigouvian approach is not concerned exclusively with the identification of externalities but, rather, with the treatment that their adverse effects cause to society at large. The Pigouvian approach is concerned with identifying and isolating those specific goods and resources that may give rise to externalities (Maryland University 1976:72). Furthermore, the Pigouvian approach isolates the distortions caused by externalities and corrects these distortions by imposing taxes and levies. This process obviously involves the isolating of goods and resources that produce externalities and issuing appropriate measures to neutralize their effects within the context of maintaining a dynamic and productive economic environment. The Pigouvian approach places much emphasis on identifying

the goods and resources that give rise to externalities and then offers appropriate fiscal remedies to deal with such goods and resources. Baumol and Oates (1975:17) confirm that within the Pigouvian context, externalities are confined to the utilities and outcomes of the production facilities.

Baumol and Oates (1975:19-24) also state that Pigouvian fiscal prescriptions depend on the aspect of depletability and externalities are said to be depletable when their intake by one economic entity reduces their availability to others. Therefore, by implication, externalities are undepletable when they are absorbed or consumed by one entity without reducing their availability to other entities. In the cases of pollution and environmental degradation, the polluting agent, or alternatively, the outcome of degradation by one economic entity would impair usage by other entities or communities. Baumol and Oates (1975:27) have declared that in addition to depletable and undepletable externalities, depletability may also be identified according to pre-determined thresholds. In addition, one economic entity may produce both depletable and undepletable externalities and these are referred to as “mixed externalities”. Baumol and Oates (1975:21) state that undepletable and mixed externalities constitute the focus of attention when it comes to constituting public policy. Depletable externalities by their very nature dissipate or, alternatively, their dissipation is halted temporarily, by the imposition of pricing as for a scarce commodity.

Pigou (1920:194) describes the impact of smoke emission by factories on nearby businesses and private homes. From an economic and social welfare perspective, Pigou advocated the imposition of taxes on firms generating pollutants into the atmosphere. The tax per unit should be equal to the difference between the social marginal costs and the private marginal costs corresponding to the social output. Therefore, the output satisfying this condition and price equals the social marginal cost. The imposition of tax would have certain ramifications. The output costs would rise; demand would be reduced; and producers and consumers of negative externalities would share costs for mutual benefit. When prolific social interactions between producers and consumers become far too complicated, Pigou recognizes the possibility that there may have to be state intervention for the purpose of applying appropriate sanctions and obligations to conflicting parties. It is interesting to note that the social welfare scientist, Coase (1960) argues against state intervention in the form of taxes and levies to counter the outcome of externalities, but suggests that the state has a role to play in defining and enforcing property rights for environmental assets and also for the purpose of reducing costs.

Baumol and Oates (1975) highlight the aspects of marginal damage, marginal social-welfare costs, social outputs and the contextual uniqueness of each situation for the purpose of imposing taxes. Pigou describes the unique social ambience and social preferences representing norms of specific social groupings and these play an important role in benchmarking what is normal and what affects this normalcy because compensation or taxes need to be imposed. Therefore, it is a prerequisite in Pigouvian economic analysis to determine, scientifically what constitutes social ambience in the first place. Social ambience in effect represents a standard of measurement. Baumol and Oates (1975) identify two Pigouvian courses of action: measure the ambience and impose charges or measure and determine what permits may be granted. Having established the ambient standards of measurement, charges could be based on the costs of marginal adjustments of an establishment norm of ambience.

Alternatively, and more importantly, taking the Clean Development Mechanism into consideration, Baumol and Oates (1975:97) articulating the Pigouvian tax system, describe baseline levels of pollution norms and any variance from these norms would introduce a permit or quota trade-off mechanism and costed within the ambit of current market directives. The United Nations Conference on Environment and Development (UNCED 1992 : 85) held at Rio de Janerio in 1992 specifies the objectives of the environmental policy as follows:

(These policy objectives have a direct bearing on this study and are quoted as a global benchmark for the inclusion of environmental costs and social costs into economic activities.)

- *To incorporate environmental costs into the decisions of producers and consumers; to reverse the tendency to treat the environment as a "free good"; and to pass these costs on to other parts of society, other countries or to future generations;*
- *To move more fully towards the integration of social and environmental costs into economic activities so that prices will appropriately reflect the relative scarcity and total value of resources and contribute towards the prevention of environmental degradation; and*
- *To include, wherever appropriate, the use of market principles in the framing of economic instruments and policies to pursue sustainable development.*

(UNCED 1992 : 85)

The adoption of Agenda 21 represents a global accord and commitment to social development and environmental co-operation, inter-generational equity and the principle that the polluter pays.

Agenda 21 further calls for a precautionary approach in formulating environmental policies. The process of aligning Pigouvian economics and externalities with the UNCED environmental policy contextualizes Pigouvian economics within the ambit of current environmental directives and ventures forth certain significant and conclusive approaches to the treatment of externalities. This Pigouvian approach is best communicated by Snower (1976:28) as follows:

Snower states that depletable externalities, like all other private goods, have value relative to the marginal social welfare benefit they impart. An arbitrary zero value for a depletable, 'good' externality would ideally invite tax from the recipient and the imposition of a subsidy for the supplier. Snower (1975: 28) probably did not fully recognize the implications of pollution in 1975 but the principles of compensation, tax and subsidy are absolutely relevant in terms of validating the Pigouvian directive towards integrating fiscal costs into economic activity for undepletable externalities. Snower posits that for undepletable externalities, suppliers should be compensated in proportion to the social benefit imparted and receivers should not be taxed nor compensated. He does not, however, examine the effect of possible pollution and environmental damage and the taxes, subsidies and compensation thereof. However, Snower (1975:70) does refer to "waste" as a direct outcome of production and describes waste as an undepletable good:

"We define "waste" here as any produced good which incurs potential harm to at least one individual."

Snower quotes the example of Sulphur dioxide and nuclear refuse as being waste. The directives of Agenda 21 would apply in its totality to "waste" as an externality of economic activity.

Coase (1960:28), describing the Pigouvian view of social and private products, states that "when person A, in the course of performing some service for which payment is made, for a second person B, he incidentally also renders services or disservices to other persons (not producers of like services) of such a sort that payment cannot be exacted from the benefitted parties or compensation enforced on behalf of the injured parties". Pigou is very clear on this position but does not make any substantive recommendations nor remedies, either fiscal or legal, on how third parties, either benefit or were injured, in the economic relationship of production and supply between two or more other parties. The Pigouvian economic principles identify the emergence of externalities from relationships of production and supply. Pigou also identifies the good or injury that may result from producing goods for supply and he hints at compensation for the aggrieved

parties and subsidies for the producers of beneficial outcomes, from a social welfare perspective. Pigou also hints at possible legal recourse for the aggrieved parties and some legal ownership for parties producing some negative or positive social outcomes. However, Pigou's statements offer no substantive legal recourse. Pigou vaguely suggests that it is up to the state to position structures in place to amicably resolve the issue of externalities in terms of compensation and subsidies. (Coase 1960).

Sankar (2002:8), Madras School of Economics, distinguishes three different types of global environmental externalities. One is trade related, the second relates to pollution and the third relates to externalities arising from biodiversity. Within the perspective of broad categories, Ozone depletion, greenhouse gas emissions and biodiversity represent public bads and require international consensus on further global proliferation outside accepted frameworks and norms. This would also apply to the movement of hazardous chemicals, trade in endangered species and the export of items causing environmental degradation and harm.

The Austrian Theory of Environmental Economics is based on methodological individualism and originated in the late nineteenth/early twentieth century and is categorically opposed to Pigouvian welfare economics based on the identification of externalities. Cordato (2004:1) states that the Austrian School of Environmental Economics rejects Pigouvian welfare economics on the basis that it does not yield analysis that is conceptually valid. The Austrian school argues that the outputs from pollution generating production must be reflected as an add-on price in the prices of products so that the pollution producing product becomes economically relevant and economically valid as a substantive component in the overall economics of any country and by implication, in the global context as well. The inclusion of the pollution component in the price of the product would encourage the exclusion of the pollution producing component because it would impact on cost and negate demand for the product. The penalty for pollution is encoded in the cost of the product and not imposed as a tax or transferred tax. While Pigouvian economics is concerned with social welfare and how pollution and consequential environmental degradation impacts social welfare, the Austrian school is concerned about the marginal economic cost of pollution and environmental degradation (Cordato 2004).

Cordato (2004:3) indicates that the Austrian approach is grounded on the principle that human efficiency is based on praxeological, purposeful behavior and not on the pursuance of subjective, irrational values of wellbeing. Consequently, the basis of Austrian Environmental Economics

rests on the hypothesis that when the marginal private benefit of an activity exceeds the marginal social cost or benefit, then environmental costs are incurred as additive components, above the normal cost of a product. According to the principles tabled by the Austrian School of Environmental Economics, pollution is not measured as an externality harming the environment, but projected as the basis of human conflict revolving around the utility of scarce physical resources. Interestingly, Pigouvian economics is more concerned with resource allocation for social welfare, while the Austrian school highlights the cost of environmental irregularities and their impact on property rights of individuals. Rhetorically, should science promote social welfare or competitive conflict over environmental resources? These questions guide the evolution of the principles of an emerging "green economy" based on the principles of sustainable development. Both sustainable development and structures of a "greener economy" are based on the principle of "public goods".

Samuelson (1954:387) quotes the classic economic definition of a public or social good as one "in which all enjoy in common in the sense that each individual's consumption of such good leads to no subtraction from any other individual's consumption of that good".

Right up to the early 1990s, the fundamentals of Environmental Economics were based on renewable and non-renewable energy resources; theories of potential markets; Pigouvian taxation; and property rights, as well as public goods and welfare economics. However, Environmental Economics has evolved to include human development patterns associated with aspects like global pollution, climate change and ozone depletion.

2.2.5 Environmental, Ecological and Sustainable Economics

Environmental economists are confronted with variables of environmental change which impact present generations and have the potential to impact and affect future generations as well. Scientists have a deep understanding that externalities, besides having substantive local impacts, influence economies right across planet earth and have a global footprint. Environmental Economics measures limitations on economic capacity; determines penalties for pollution; and in many instances, structures mechanisms to measure trade and commerce right across global economic zones. Environmental Economics is not only limited to analysis based on the impact of carbon footprints, global warming, ozone depletion or deforestation alone! Economists are critically aware of how all the variables of Environmental Economics impacts human development as well.

This critical awareness arising out of Environmental Economics has highlighted uncertainty about the availability of global resources for future generations; uncertainty regarding the depletion of the ozone layer, of water and energy resources; as well as the dangerous effects of carbon emissions. Global awareness of the drastic effects of climate change and the depletion of sustainable resources has led to the emergence of sustainable development as a global phenomenon. Sustainable development is closely associated with the movement towards a greener economy and the associated preventative measures for further environmental degradation. The discipline of Environmental Economics has given rise to the emergence of "Ecological Economics" as a complementary discipline, structured to understand aspects of ecological change relative to environmental science.

Van Den Berg (2000:15) outlines the differences between Environmental Economics and Ecological Economics. *Environmental Economics* is concerned with the cost and impact of externalities, with specific reference to environmental degradation and the utility of unpriced natural resources outside the domain of market dynamics, provoked by one economic entity on another, without any substantive form of compensation. The underlying basis of Environmental Economics is the aspect of social welfare and the people affected thereof. The conclusion that people and the consequential social welfare have a precedence over the environment typifies the discipline of Environmental Economics. Pareto efficiency, or social welfare efficiency, is achieved by seeking the most optimal level of an externality. *Ecological Economics*, on the other hand, is more concerned with the relationship between the economy and ecology by understanding the causal interconnectivity between people and the environment. Therefore, Ecological Economics may be compared to resource economics (Van Den Berg: 2000) because the discipline is primarily concerned with the depletion and preservation of natural resources like fish, forests and water rather than the economics of what specific impact pollution has on social welfare and the compensation and subsidies thereof.

Van Den Berg (2000:15) categorically states that both Environmental Economics and Ecological Economics regard sustainable growth as their core theme but that Ecological Economics is more concerned with sustainable development on a global, planetary scale while Environmental Economics is not concerned with the global economies of scale, placing more emphasis on the outcome of compensation and social welfare on a micro or limited geographical scale. While Environmental Economics is concerned more with cause and effect in the interaction between society and the environment, Ecological Economics is more inclined towards considering

systems, markets and human interaction with the environment as evolutionary. Environmental Economics, in the basic analysis, is analytical and quantitative in its approach. Ecological Economics, on the other hand, is broadly qualitative and evolutionary in its assessments. Since it is apparent that both Environmental Economics and Ecological Economics have sustainable growth and sustainable development as their primary objectives, the next level of analysis must seek to relate the idea of a green economy with sustainable development from both an environmental and ecological perspective.

The dynamics of Environmental Economics, Ecological Economics and the very essence of sustainable growth and sustainable development point humanity in the direction of sustaining the global economy within the delicate confines of the finite biosphere. Daly (2005:100), cautions that GDP growth alone is not an indicator of economic progress because the real economy does not function in the emptiness of a void. Daly (2005:100) points out that the economy is a subsystem of the biosphere that supports it and when the economy expands too rapidly and encroaches upon the ecosystem that surrounds it, the process of depleting the natural capital begins. It is this natural capital in the form of forests, fish, fuel and water that adds real value to the economy. Without these natural resources, the real economy has no functional basis. Mercantile capital has no real value if it does not reflect its own inherent value within the context of the biosphere within which it operates. When an economy overheats and the dynamic balance between supply and demand is warped, the excessive imposition of demand on the assets of the biosphere ventures forth a preponderance of economic “bads” rather than “goods”. Uneconomic growth depletes the environment of essential renewable and non-renewable assets. The depletion of crucial, renewable and non-renewable environmental assets, due to an overheating economy, has the net result of obliterating the functional basis of the real economy. In addition, excessive, unbalanced demand on environmental assets produces pollution, degradation and ecological disaster.

Daly (2005:101) posits that humanity must, of necessity, make the transition to a sustainable economy. Such an economy must operate within the constraints, boundaries and limitations of the global ecosystem. The primary motivation behind making such a transition is to respect the biophysical limits of the global ecosystem. Failure to make this qualitative leap would certainly result in environmental degradation, disaster, economic impoverishment and an ecological catastrophe of unprecedented dimensions. When any activity expands to such an extent that it displaces other relevant, systemic economic entities, then that displacement is measured as a

marginal cost. Economic activity must, of necessity, cease when the marginal benefit equals the marginal cost. By implication, this statement defines the parameters of sustainable development. When economic activity costs more than it benefits, then economic activity is indeed not sustainable (Daly 2005:100). Natural capital is deemed to be the limiting factor in the process of economic activity. Considering that man-made capital and natural capital are inherently complementary, it becomes mandatory to place sustainable limits upon the utilization of natural capital. In economic terms, this process is referred to as 'capping'. The cap-and–trade initiative functions on recognizing that natural resources are not free goods but rather scarce, tradeable assets. The Clean Development Mechanism, for example, utilizes the mechanism of capping emissions in one global locality and then imposing a cost on marginal excesses which are tradeable in any other global locality, as if it is currency.

Fullerton and Stavins (1998:433) posit that:

> *"Environmental Economists are interested in pollution and other externalities, where some consequences of producing or consuming a good or service are external to the market. With a negative externality such as environmental pollution, the total social cost of production may exceed the value to consumers. If the market is left to itself, too many pollution-generating products are made."*

In the domain of environmental and Ecological Economics, the concept of a perfectly functioning capitalist market is inherently unsustainable because, by its very nature, an unchecked free market system is free to produce as many negative externalities as it deems feasible, as long as market needs of supply and demand are met. Therefore, the cap and trade mechanism is an evolutionary mechanism that allows any company with high abatement costs to buy permits from another company that has low costs in order to reduce the cost of abating pollution. Within the context of Environmental Economics, free market economies need sustainable stopping mechanisms so that market economies do not burn gaping environmental holes into the sustainable fabric of the global economy. If free market economies are allowed free reign, then environmental degradation, social inequity and poverty make the very idea of sustainability unsustainable! Fullerton and Stavins (1998: 433). This aspect of free market economics poses the imposing question of what measures need to be taken and implemented to foster a 'green economy'.

Elberts (2011:4), writing for the Organization for Economic Co-operation and Development (OECD), states that for the implementation of a green economy, considerable attention needs to be given to the creation of green jobs. Green jobs become a pressing priority because of concerns that the impact of climate change on growth rates will lead to further economic slowdown and environmental degradation. According to the OECD (2011:4), many countries are committed to fostering the development of a green economy that is clean, energy-efficient and implicitly sustainable. Furthermore, the path to economic recovery is seen by many states as being grounded in a 'green economy'. A green economy is generally perceived to be one that places particular emphasis on conserving energy and, conserving natural resources while at the same time reducing pollution. Elberts (2011:5), details some of the criteria that production and service outlets need to abide by within the framework of a green economy. Production and services operate strictly within the parameters of being environmentally friendly, subscribing and implementing activity conducive to renewable energy and thereby producing products and services that conform to the norm of utilizing renewable energy sources, as well as utilizing clean transport within green buildings and green work environments. These 'green production activities' adhere to energy efficient manufacturing processes, distribution and assemblages, whilst reducing the consumption of sustainable energy, materials and water resources. The process typifies the switch from carbon producing to non-carbon producing manufacturing processes (Elberts 2011: 5).

In 2011, the United Nations Environment Programme (UNEP) defined a Green Economy as:

"*One that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological sacrifices."*

The primary motivation, according to UNEP, for the movement away from the brown economy is its heavy dependence on fossil fuel. To make the transition to a green economy, clearly defined enabling conditions need to be adhered to, including enabling regulations, policies, incentives, trade protocols and the necessary legal infrastructures (UNEP: 2011). The movement towards a green economy also needs education to overcome the myth that sustainability hinders and reduces economic progress. A green economy is not a luxury that only wealthy countries can afford. Greening up the global economy does not mean more development for developed economies and less development for developing economies. UNEP (2011) indicates that the green economy initiative demonstrates a new economic engine rather than an add-on to the old

process of economic activities. This is achieved by motivating for the movement of both public and private funds to transform the brown economy to a green economy. The UNEP (2011) report demonstrates how the green economy can reduce poverty in important sectors like agriculture, fisheries, forestry and energy by introducing aspects of sustainability over depletion. It also provides directives to change policies to eliminate environmentally harmful or perverse subsidies; to reverse market failures resulting from externalities by providing market-related incentives from appropriate regulatory frameworks; and the procurement practices that encourage clean investment.

The key findings of the UNEP report (2011:5) clearly define the seven essential components of a Green Economy, namely:

- *A green economy recognizes the value of and invests in Natural Capital;*
- *A green economy is central to poverty alleviation;*
- *A green economy creates jobs and enhances social equity;*
- *A green economy substitutes renewable energy and low–carbon technologies for fossil fuels;*
- *A green economy promotes enhanced resource and energy efficiency;*
- *A green economy delivers more sustainable urban living and low carbon mobility; and*
- *A green economy grows faster than a brown economy over time, while maintaining and restoring natural capital.*

The UNEP report (2011:27) also describes certain core enabling criteria for implementing green economic activity as follows:

- *Establishing a sound regulatory framework;*
- *Prioritizing government investment and spending in areas that stimulate the greening of economic sectors;*
- *Limiting spending in areas that deplete natural capital;*
- *Employing taxes and market-based instruments to shift consumer preference and promote green investment and innovation;*
- *Investing in capacity building and training; and*
- *Strengthening international governance.*

In its final concluding remarks, the UNEP report (2011:37) claims that essential funding for green transformation will come from the private sector and that policy initiatives will overcome irregularities introduced by perverse subsidies and the cost of externalities. However, public sector funds will be required to initiate the process of transition from a brown to a green economy. The report claims that a green economy supports economic growth. A green economy has the capacity to generate as much growth as a brown economy and in the short to medium term has the capacity to promote even more employment than a brown economy. The UNEP (2011) definition of a Green Economy embraces the aspects of human well-being and social equity within an environment of reduced environmental risks and reduced ecological scarcities. The green economy, by definition, is resource efficient, socially inclusive and low on carbon emissions. Growth in income and employment is funded by private and public sectors. The necessary outcomes are a reduction in carbon emissions, reduction in pollution and the prevention of loss of bio-diversity and the ecosystem.

The United Nations Conference on Trade and Development (UNCTAD: 2011), cited by UNDENSA (2012:63), defines a green economy as one that results in improved human well-being and reduced inequalities, while not exposing future generations to significant environmental risks and ecological scarcities. In this definition, a green economy seeks to bring long-term societal benefits to short-term economic activities by mitigating environmental risks. The most significant inclusion by the UNCTAD is the declaration that:

"*A green economy is an enabling component of the overarching goal of sustainable development."*

Another definition states that a green economy is a resilient economy that provides an improved quality of life for all, within the ecological limits of the planet (The Green Economy Coalition: 2011 cited by UNDENSA 2012:63). The International Chamber of Commerce (2011), cited by UNDENSA (2012:63), describes a green economy as an economy in which economic growth and environmental responsibility work together in a mutually reinforcing fashion while supporting progress on social development. The United Nations Conference on Sustainable Development Rio+20 (2011), cited by UNDENSA (2012:63), states that a green economy can be seen as a lens for focusing on and seizing opportunities to advance economic and environmental goals simultaneously. The South African Government (2011), cited by UNDENSA (2011:63), states that the green economy involves largely new economic activity and must provide an important entry

point for broad-based black economic empowerment, addressing the needs of women and youth entrepreneurs and offering opportunities for enterprises in the social economy. The Danish 92 Group (2012), cited by UNDENSA (2012:63), states that the green economy is not a state but a process of transformation and constant dynamic progress. The green economy cannot be green without being equitable, providing human well-being and, equal access to opportunity, while protecting environmental and economic integrity.

The fundamental rationale in exposing different definitions of a green economy is to filter out the essential components of what constitutes a green economy and, in turn, to relate these to the concept of sustainable development. The point of reference is the definition by the United Nations Conference on Trade and Development that a green economy is an enabling component of the overarching goal of sustainable development.

The Green Growth Knowledge Platform (2013:3), citing Samans (2013), states that 'green growth' seeks to combine sustainable development's economic and environmental structures into a single intellectual and policy planning process, to reconstitute the core facilities of the development model in order to facilitate the production of strong and sustainable growth. Furthermore, the concept of a green economy is grounded on the economy, the environment and the social structures of sustainable development (Green Growth Knowledge Platform 2013:3). The concepts of inclusive green growth and sustainable development fully embrace the social-upliftment aspects of sustainability and the alleviation of poverty. Growing a green economy involves pricing externalities and imposing a cost value on natural assets. It also involves active and dynamic acts of innovative activity to counter unsustainable growth. Moving towards a greener economy requires implicit social participation from community to national levels (Green Growth Knowledge Platform 2013: 3). The Green Growth Knowledge Platform (2013) declares that a green economy has been proposed as a means for "catalyzing renewed national policy development and international co-operation and support for sustainable development."

The Green Economy is an energy efficient process of transformation that recognizes the value of natural capital; strives to alleviate poverty; brokers activities to promote employment and social mobility in a manner that protects the environment and ecological system for present and future generations by facilitating the substitution of renewable energy and low carbon technologies for fossil fuels; and in so doing, the green economy promotes human wellbeing and sustainable living.

These activities of a green economy, taken together, from a global, holistic perspective, are essential enabling components grouped together to achieve the aims and goals of sustainable development. A green economy serves as a critical platform to promote and fulfil the strategic aims and goals of sustainable development. The alignment of a green economy with sustainable development seeks to answer the question of how sustainable development projects are being funded from an historic perspective: What funding structures are used to fund sustainable development? What are the determinants to funding sustainable development? What are the barriers to funding sustainable development? What structures are conducive to formatting a workable framework? In order to answer these questions, this study briefly surveys relevant sources of literature spanning the period 1998 to 2015.

2.2.6 Pigou's Identification of Externalities

After due consideration of the Malthusian hypothesis of economic scarcity; Stewart Mill's steady state; the contributions of the British and Austrian Neo-classical schools of thought; Environmental Economics; Ecological Economics; and the contributions of green and sustainable economic thinking, a common thread emerges that unifies all these schools of thought. That common thread is the thread of "externalities" as identified by Pigou.

The aspect of a geometrical expansion of population growth was the externality that motivated Malthus and Stewart Mill. Pollution, in all its manifestations, is the "externality" that unifies Environmental Economics, Ecological Economics, green economic thinking and the multifarious aspects of Sustainable Economics.

The rational choice, therefore, is to ground this theoretical framework on the works of Arthur Cecil Pigou and to utilize the concept of economic externalities to interrogate the outcomes of Clean Development Mechanism… (Since the very nature of CDM is based on the identification of economic externalities).

This choice will be defended by exploring authoritative papers from 1971 to 2015.

In 1971, Meyer (1971:736) indicated that a brand-new inefficiency may result in a perfectly competitive economic environment when externalities are introduced. He suggests that the only way to handle these externalities is to introduce taxes or subsidies. This was further affirmed by Baumal and Oates (1971:42), who write that in the Pigouvian tradition, economists have

frequently proposed the adaptation of unit taxes or subsidies to control externalities in situations where the tax is equivalent to the marginal social damage. However, Baumol and Oates (1971:49) emphasize that advocacy of environmental pricing for externalities must have a clear understanding of the social welfare curve.

Gould (1973:53), quoting Professor Meade, distinguishes between the 'unpaid factor' and the 'atmosphere' types of the economy where the Pareto optimal is interrupted and where some gain and others lose because of the negative outcomes arising from the 'unpaid factors' of economic activity. Gauld (1973:53) refers to these unpaid factors as economic externalities which invite taxes and subsidies. Sorrentino and Whinston (1975:131) posit that the Pigouvian approach may be described as an equilibrium apparatus where profit-maximizing behavior is considered to be an acceptable norm in the economic function and is therefore clearly defined.

Profitability is factored into pricing structures by the incorporation of taxes or subsidies. Page and Ferejohn (1974:454), enquire into the possibility of acquiring Pareto Optimal and the acquisition of compensation for pollution sufferers. They conclude that the presence of an externality affects Pareto Optimal. Therefore, by implication, remedies have to be instituted to overcome the Pareto Optimal imbalance (in the form of taxes and subsidies). In examining property rights and externalities, Ali Ayub (1977:197), indicates that the "Marshal-Pigou" prescription for bridging the gap between private and social welfare was to impose taxation on industries which generate external economies and to subsidize those which have to tolerate the negative outcomes of externalities. These arguments consistently acknowledge the concern that externalities have a distinct impact on the economic process and as such, there has to be process of introducing costs and subsidies to incorporate the effect of externalities upon the mainstream economic directive. Aranson, Ferrar and Sassone (1978:5), caution that Pigouvian taxes are not designed to only reduce pollution to acceptable levels, but are specifically designed to maximize joint production value. They also caution that the Pigouvian tax or levies could hinder mutual construction clauses and interfere with ethical issues, which are essential for the due process of production.

Roumasset (1979:640), extends the examination of externalities to sharecropping, production and the theory of contracts. According to Roumasset (1979:646), under zero transaction costs and where the externality of production is geared by pre-contract competition, the contracting solution is identical to the market solution where a market externality exists. Also, the contracting solution is identical to the market solution and all are equivalent to the Pigouvian solution. Therefore, one

solution is not better than the other, indicating that market and commercial contract solutions could be just as equivalent as a Pigouvian solution.

Barnett (1980:1037) asserts that when externalities are of a public nature, there are policies in place to determine the correct rate of levying taxes and levies. The process of imposing taxes, however, becomes more difficult when dealing with an environment of unfair competition and monopolistic advantage imposed by certain private companies. Companies having the monopoly tend to determine what taxes ought to be imposed and this could lead to issues of compromised welfare compensation in certain cases. Barnett (1980:1040) concludes that where polluters are imperfectly competitive, second best optimal tax rates may be less than marginal effluent harm. Consequently, the compensation to those harmed by effluent could diminish with the polluting company experiencing less demand for their market-related product or products.

Carlton and Laury (1980:559), assert that the fundamental problem with including the influence of externalities into the economic equation is to assure efficiency in the competitive process. Carlton and Laury (1980:559) point out that imposing Pigouvian taxes on externality producing activity tends to skew the outcome of costs relative to production and this leads to an uneven allocation of costs and welfare benefits, while at the same time producing uncompetitive economic output due to changing variances in production costs. According to Carlton and Laury (1980), the remedy for this non-competitive allocation of Pigouvian taxes is to supplement the Pigouvian tax with a lump sum subsidy scheme for participating firms. The lump sum payment effectively negates the influence of economic variances which may accrue over time.

Robert Cotter (1982:1), highlights the contribution of Coase by introducing the system of correcting externalities through the imposition of liability law. The imposition of liability law would also introduce the aspect of bargaining for mutual benefit for the polluter and the victim of pollution, for example. Cotter (1982:2) effectively quotes the example of railroad sparks and crop damage and the liability, Pigouvian tax and the possibility of a negotiated response through bargaining at a court of law. The effect of accepting liability and the introduction of bargaining for compensation complements a competitive market economy but may actively produce outcomes which may disadvantage victims of externalities. The important message that Cotter (1982) introduces is the component of liability and the aspect of bargaining in a court of law for compensation and level of liability. This typifies the contribution of Coase, who proposed that there ought to be a legal and property-related component to liability and compensation. The

outcome, as argued by Cotter (1982:15) indicates that the introduction of bargaining for compensation and property rights would have the same outcome as if imposing Pigouvian taxes, albeit with the safety valve of the law protecting liability associated with property rights.

Murthy and Nayak (1982:1) most aptly describe the primary feature of the Pigouvian system of allocating taxes or subsidies. They state that the Pigouvian prescription deals with the problem of externalities by taxing or subsidizing the generator of externalities while at the same time leaving the victim alone. This process of taxing or imposing subsidies protects the essential core of the economy while ignoring compensation or relief to the victims. Therefore, the essential directive of Pigouvian tax or subsidies assures the progressive, dynamic directive of the economy. It may be argued that the Coase Theorem, which introduces legal obligation and bargaining thereof, may be perceived as being counter-productive to the main thrust of economic activity. However, the ethos and culture of compensation in a green economy in the twenty first century would certainly give precedence to compensation for the victims of externalities. Thus, the debate hangs over economic impetus or legal, bargained compensation for the victims of externalities. Yet no directive can ignore the relevance of the Pigouvian system of taxes and subsidies. The aspect of negotiated compensation in a court of law for the victims of externalities poses a window of opportunity for theory contribution and theory building for green economies and sustainable development.

It is rather interesting and relevant that environmental regulation in the United States reduced the number of establishments per industry but raised the average plant size, according to Kohen (1988:53). This indicates that there are fewer polluters but the economies of scale of externality-producing industries have become more expansive, producing externalities from a vastly broader economic base. Therefore, the relevance of the Pigouvian system of taxes and subsidies becomes more relevant now than in the last decade. In 1991, Kohn (1991:337) favored the introduction of an international overseeing authority to implement the Pigouvian system of taxing the polluting country for the benefit of society as a whole. Kohn (1991:337) cautions that the staging of an international authority may favor developed economies while imposing additional costs on developing economies in an unfair manner of allocating of taxes or subsidies.

Medema (1994:107) debates the issue of externality resolution and concludes that although the resolution of externalities results in parties who gain and parties who lose. Medema (1994:110) calls for an in-depth examination of each situation, examining legal rights and offering fair and

just compensation to victims but at the same time protecting the interests of all conflicting parties affected by the identification of externalities. Again, the aspect of fair and appropriate relief and compensation for parties affected by externalities offers a space of opportunity to build theoretical bridges to offer just and lasting solutions. Maskin (1994:333) endorses the typical response to lack of optimality caused by the intrusion of externalities, which is for the government to step in and introduce corrective policy and introduce Pigouvian taxes and subsidies. Maskin (1994:333) balances his endorsement by stating that consideration of the Coase Theorem mitigates unfairness by allowing bargaining and legal, contractually-based remedies.

Dickie and Trandwel (1996:388) state that when the production or use of a good produces an external cost, then an unregulated market produces an economically inefficient quantity of output. The authors state that one remedy for this inefficiency is to impose a Pigouvian tax equal to the marginal external damage associated with the production of that good. Dickie and Trandwel (1996:388) reiterate that those facing the imposition of a Pigouvian tax make decisions that are conducive to maximizing social welfare.

Portney (2000:199) worked on predicting future environmental problems and policy outcomes and forecast that the greatest interest to economists would arise from incentive-based approaches to environmental protection. Portney (2000:200) unreservedly stipulates that the increased utilization of Pigouvian taxes on externalities would carve out a niche in resolving future environmental problems associated with externalities.

It is noteworthy that many economists have attempted to modify or add components to the Pigouvian methodology of imposing taxes but, inevitably, the Pigouvian way serves as a benchmark for other methodologies. Coase recommends that the subsidy and tax ought to be negotiated or bargained upon from a framework of contractual legality. Gremer, Gahvari and Ladoux (year: 258) refer to a first best taxation equal to the marginal social damage caused by externalities and refer to second best taxation arising from other not so clearly defined mediators. Renaming externalities does not change the nature of externalities. So, it appears that some academics rename what is inherently Pigouvian methodology in the very first instance.

Owen (2004:127) argues that internalizing the cost of externalities would hasten the introduction of other sources of energy, like solar or Hydro power. This indicates that business, in general, would prefer to incorporate the cost of externalities into a cost to the end consumer in order to

maintain margins and profitability. Owen (2004:148) maintains that the process of internalizing the costs of externalities would give rise to consumers preferring cleaner, less expensive sources of energy.

Sandholm (2002:885) referring to the abatement of externalities considers the Game Theory to incentivize polluters with rewards for effective abatement. The Game Theory would apply in conditions of negative externality proliferation but would fall flat in the instance of positive externalities. In other words, the idea of utilizing the Game Theory is only half as effective as the Pigouvian model, which provides for subsidies as well as taxes. Simply arguing for theoretical implementation of the Game Theory without effective outcomes is a meaningless academic exercise and has to be avoided.

Jeane and Korinek (2010:403) express support for the Pigouvian system of taxation and subsidy. They advocate restricted capital inflows during economic upswings in order to curb unsustainable outflows during economic downturns. This prudence would facilitate the consistency of welfare benefits during boom and bust periods. This is yet another acknowledgement of the Pigouvian methodology (with an innovative suggestion of restricted capital outflows) to maintain consistent social welfare benefits.

Rezai, Foley and Taylor (2012:329) suggest that carbon emissions need vigorous financial interventions to bring emission levels back to pre-industrial levels. The authors do not refer to any Pigouvian solutions but suggest that industry has invested far too much in facilitating profitability rather than investing in mechanisms that promote the mitigation of carbon emissions. This is a rather empty argument because the very purpose of business is to promote profitability. To ask institutions to redirect profit towards mitigating carbon emissions has minimal chances of success. Successful mitigation would surely depend upon structured incentives like CDM.

Weisbach (2012:453) questions whether the precautionary component in taxation ought to be used to implement the Pigouvian methodology of implementation. He answers that the Pigouvian methodology is inherently precautionary but that further precautionary measures are required when harm from pollution or emissions or externalities may surpass normal acceptable norms. Emissions and pollution from nuclear or toxic waste would invite a greater degree of the precautionary component, for example.

The above discussion on grounding this study on Pigouvian thinking provides an intellectual basis and a solid theoretical framework to interrogate the Clean Development Mechanism from the perspective of identifying pollution, carbon emissions and toxic affluent as components that constitute externalities. After exploring various authoritative media reports on mechanisms to fund sustainable development, this study undertook an in-depth analysis of the integrated components of the Clean Development Mechanism as a viable funding mechanism. The outcomes of assessing the implementation of the Clean Development at the EThekwini Municipality was grounded on the theoretical framework of Pigouvian thinking. The assessment did not only utilize the principles of Pigouvian taxes and subsidies for externalities, but also utilized key Pigouvian directives to construct new theoretical possibilities associated with the implementation of the Clean Development Mechanism. It is relevant and indeed appropriate, to assert that this entire assessment of the Clean Development Mechanism is theoretically informed by Pigouvian thinking.

2.3 Authoritative Media Reports on the Issue of Funding Sustainable Development

As early as 1998, Panayatoe (1998:1) of the Harvard Institute for International Development declared that sustainable development was “grossly underfunded” and that vast sums of public sector funding went to waste, rather than funding sustainable projects. The significance of this statement is the affirmation that proper funding is the basis for sustainable development.

Montes (1998:2) explores the prospect of sourcing funding from alternate ‘green banks’ for sustainable development in Mexico “outside the sphere of the traditional financial system” (1998:1), implying that the fixed costs of sustainable development were far too high to obtain financing from traditional sources. Montes based her argument on the “socially responsible” green banks in Europe at that time, which specialized in “financing environmentally profitable projects” (1998:1). Therefore, the unwritten motivation for funding sustainability was profitability, both for the funding institution and for the funded project.

The Daily News, Cairo (22 November 2010 issue) made an interesting observation from the 2009 Addis Ababa summit on climate change that funding is unquestionably a key ingredient in addressing climate change. Furthermore, the newspaper observed that funding sustainable development placed considerable pressure on public sector resources and that the only way to mitigate the risk of shortfalls in funding was to look at alternate sources of funding, like private sector resources to supplement existing flows.

This is further highlighted by Helle, Steve, Helmuth and Smith (2010:1) who state that “Financing is often the stumbling block of good public policy” when it comes to financing sustainable development and in difficult economic times, projects may sit on shelves due to fiscal constraints. Helle *et al* (2010:3) suggest that funding should be secured by structuring bond insurance from private sector resources. Sheehan and Patrick (2010:2) conclude that banks are not quite interested in financing green projects and that “being green” is no guarantee of funding and could in fact, be a hindrance. Banks look for credit-worthiness from a profitability perspective.

After the implosion of the global financial system in 2008, funding sustainable projects became even more difficult. O’Connell (2011:2), referring to funding for renewable energy, postulates that government in the United Kingdom was prepared to pay for a twenty-five-year lease to source alternate energy based on solar energy. The aspect of guaranteed sunshine and guaranteed revenues for twenty-five years motivated for the formation of a venture capital association from pension funds to fund the alternate energy source. In this instance, funding was based on limited risk, sustainable revenue, profitability and return on investment. Additionally, there was a synergy between public sector support and sustainable development funding from the private sector. Benka (2011: 2) argued for funding for a small community theatre project and gained support from supporters who endorsed that the funding of the theatre project would produce employment but, more appropriately, would attract economic activity around that specific geographic locality, endorsing the mandate that funding depended on how it produced economic, social and developmental improvement, even on a micro-economic level.

There is an unwavering acceptance that sustainable development and greening up the economy are an absolute necessity for the welfare of humanity, social upliftment and economic sustainability. However, since the Brundtland Report in 1987, no substantive progress has been made in giving sustainable development the proverbial green light in terms of its unhindered propagation. This progress has been hindered by the lack of directive from global financial institutions. Governments and the developed economies have set aside a percentage of their gross national product for sustainability projects. However, public sector funds are clearly not sufficient to fund the enormous demands for sustainable development. Mathews (2012:3) unequivocally calls for financing from global bond markets which he contends are the true engines of capitalism, declaring that the value of global debt securities were in excess of one hundred trillion dollars in 2011. Mathews (2012:2) also argues that private sector resources are cautious to invest in carbon producing investments, due to carbon taxes, yet private sector resources are

not sufficiently invested in sustainable development. Despite the global call for sustainable, carbon-free investments, the World Bank issued a press release on 11 May 2012 that it would invest $8billion in Afghanistan's oil, gas and mining industries (US Fed News Service 2012:1), irrespective of the calls for sustainability and lowering carbon emissions. The investment was made purely for profitability, disregarding the calls for greening up the infrastructure of Afghanistan. Even the International Monetary Fund appears driven by profits, while sustainable development is a distant secondary priority outside of profitability. Although international capital would readily invest in highly profitable projects in the remotest, most hostile environments like Afghanistan, experts discussing financing sustainable development in Africa (June, 2012) declared that finance for sustainable projects was difficult to source, mainly because conditions in many parts of Africa constrained the effective implementation of sustainable development. Alternatively, those seeking funding in Africa were denied access to relevant institutions. However, there was an overwhelming call for innovative sourcing of funds from the private sector (AllAfrica.com 2012:1). In the Mena Report of December 4th (2012:1-3), Dr. Seetharam from the Doha bank group reiterated the need for private sector funders to fund in order to mitigate the effects of climate change on a risk and reward basis, utilizing innovative leverage mechanisms for investors willing to invest in projects that effectively reduce greenhouse gases.

The Organization for Economic Co-operation and Development (OECD), at its workshop on Financing Green Urban Infrastructure (OECD 2012:1) elaborated on various mechanisms and challenges in financing green sustainable cities. The report acknowledges that revenues from taxes, transport fees and municipal levies provided opportunities for funding green cities, but also pointed to limitations and public constraints for funding. Therefore, the report calls for effective partnerships between public sector resources and private sector resources, citing the use of loans, bonds and carbon financing to attract private funding for greening-up future cities.

The United Nations Task Team was set up in 2012 to find the most appropriate possibilities to raise private sector funding for sustainable development. The team described idiosyncratic risk as the primary challenge, followed by governance and regulatory issues; settlement and operational risks; as well as market risks.

Despite the apparent difficulty in sourcing funding for sustainable development in many parts of the world, the need for sustainable development in Hong Kong with its limited space and high population density prompted the government of Hong Kong to structure a sustainable

development fund in November 2013 as an absolute necessity to protect its limited insular resources and to promote a critical awareness of waste reduction and to build a sustainable community (Hong Kong Government News 2013 :1). In October 2013, the Xinhua News agency (Xinhua News Agency 2013:1) quoted the Secretary General of the United Nations, Ban Ki-moon as saying that: “international public finance will not be sufficient to build a more sustainable and prosperous world. Financing and investment from the private sector will play an increasingly vital role.”

The prime purpose of seeking appropriate funding for sustainable development arises from the United Nations Millennium Goals which expire in 2015. The Millennium Goals will be renewed in Addis Ababa in July, 2015 and the chairperson of the United Nations Sustainable Development Finance Committee (Targeted News Service 2013:1), categorically declared that financing sustainable projects in line with the Millennium Goals had to seek funding from sources outside the traditional public sector, with specific reference to seeking funding from trade and international investment with emphasis on climate change. The chairperson also alluded to funding under proper accounting principles and management systems, within clearly defined policy principles.

The Targeted News Service (24 June 2013), in describing the criteria for allocating $4.5million state funding for Native American Tribal Governments, stipulated that funding was granted on the basis that it enhanced opportunities for sustainable development; opened up facilities for skill development; encouraged small business development and entrepreneurship; generated revenues for sustained growth; improved access to employment; and improved the long-term health of tribal members. This suggests that funding authorities mitigate risk when funding by clearly stipulating and defining the specific, desired outcomes for sustainability and the effective, productive utility of funding and funding mechanisms. Public funding has many constraints and often these constraints in public policy or budgetary restraints prevent the effective implementation of sustainable projects. Hence, funding requires innovative solutions.

One such innovative solution, as quoted by Anonymous (National Journal 2013:1), describes the Chicago Infrastructure Trust Fund as becoming the first city in the United States to take the initiative and source funds by leveraging private capital, rather than queueing for public sector funding for infrastructure funding. Private investors had invested more than two hundred and twenty-five million dollars for energy-efficient upgrades to one hundred municipal buildings on the contractual understanding that investors would be paid over a period of fifteen years as a

consequence of accrued savings in energy bills. This is a great example of funding based on mutual benefit with funding and saving for the municipal authorities and, from these savings, the generation of revenues for fifteen years for the investors. The importance of sourcing alternate private sector funding has become a resounding theme in almost every United Nations meeting on sustainable development.

The Asia News Monitor, Bangkok (2013) describes Ban Ki-moon's call for a "coherent financing strategy" (2013:1) to sustain global growth. The article refers to The Monterrey Consensus (Mexico, 2002) and the Doha Declaration (2008) which emphasize the need for developed member states of the United Nations to conform to the stipulated contribution of 0.7% of Gross national income or the Official Development Assistance (ODI) of .31% of national income to meet the stipulated development goals of the United Nations. This article quotes Ban Ki-moon: "International public finance will not be sufficient to build a more sustainable and prosperous world, financing and investment from the private sector will play an increasingly vital role."

John Ash, the president of the General Assembly is quoted as saying that "Financing for development is the elixir the lifeblood, if you like..." (2013:2). It is interesting to note, however, that US $11million was allocated to Colombia in 2013 via the World Bank, primarily to support the development and implementation of policy reforms relating to sustainable development after devastating floods (MENA Report 2013:1). Therefore, one may conclude that funding granted by the World Bank is done so on the premise of viable, tenable, policy initiatives.

In March 2013 (MENA Report 2013:1) The European Commission launched a green paper on the long-term financing for the European economy and one crucial issue was raised:
"We need to identify what barriers exist to long-term financing and what more can be done to overcome them."

The Green Paper clearly articulates the historical dependence on the banking sector to finance long-term development projects and proves the assertion that dependence on the banking sector was not feasible and therefore, funding needed to be sourced from capital markets, specifically the bond market, as well as from institutional investors like pension funds and insurances. The paper directs attention to the needs of small and medium enterprises and their capacity and ease to source funding from banks and other private sector resources. Hashmi (2013:1), writing for the Pakistani Observer (1 January 2013), describes a series of inputs that are crucial for the

implementation and success of sustainable development. These include: appropriate funding; human resources; technology and infrastructure. Sustainable development is a societal directive, as well as an economic one (Hashmi 2013:2). Hashmi is essentially quoting some of the requirements that necessitated the achievement of the millennium development goals established at the 2000 summit of the United Nations. The 2000 summit which established the requirements for the attainment of the Millennium Goals did not foresee global conflict as an essential variable that would affect the achievement of these goals.

Bruck, Tilman, Milante and Gary (2014: 4), reporting on financing peace and security for sustainable development at the Stockholm International Peace Research Institute (SIPRI), made proposals that peace and security have to be an essential requirement to implement new goals after the 2015 summit in Addis Ababa. The writers suggest that collective mechanisms have to be installed to implement measures to quantify and measure peace and security as the underlying factor in the implementation of the new goals up to 2030. Therefore, any funding would be subjected to conformity to the principle of peace and security as a primary prerogative, suggesting that lack of security and peace posed a risk to funding. Bruck *et al* (2014:1) tabled the motion that global tax and peace bonds would be feasible sanctions to implement peace and security. There is an unwritten mandate that peace and security depend to a large extent on the principle of equitable distribution of profits and assets to those that have vested interests in the means of accumulating profit and wealth.

Soelman, Sujiharto, Lestari and Setyani Dwi (2014:1-11) explore the possibility of financing from the perspective of “Sukuk” or Islamic finance in Indonesia, where an equitable, pre-arranged profit from sustainable development is distributed to the investors and those involved in receiving funds for agricultural projects in a proportionally equitable manner. Islamic funding for agricultural projects in Indonesia are based on the principle of a balance between planet, people and profit. The principle of equitable distribution of profits from sustainable projects is an important variable or determinant in the basket of options for assessing the granting of funding, especially in light of the implementation of new Millennium Goals.

The importance of achieving these future goals was discussed in Addis Ababa on April 16, 2014 by The United Nations Economic and Social Council’s Economic Commission for Africa where priority issues were discussed regarding financing regional infrastructure and industrial development, climate change and the mobilization of resources for sustainable development (US

Fed News Service, Washington, 17 April 2014). The need to involve all relevant players in the process of sustainable development provoked gender activists in South Africa to make requests that funding climate change needed to include all players in any community from the perspective of gender equality (AllAfrica.com 2014:2). Equitable development involving all stakeholders represents an important component for sustainable development.

In the developing economy of Bangladesh where small and medium enterprises represent a very important means to job creation and to adding revenues to a buoyant economy, the key stakeholders seeking finance are small and medium businesses owned by males and females alike. These represent the landscape for funding in light of the diminishing capacity of the public sector for funding (The New Nation 2014:2). Sustainable SME development in Bangladesh is almost entirely dependent on the banking sector for funding. This works for Bangladesh because banks recognize that SMEs are the primary drivers of the economy. The synergy between SMEs and banks represents a principle which may be shared with more developed economies and possibly shared with the new Millennium Goals to 2030 at the United Nations. A major concern in densely populated countries like Bangladesh is the pollution outcome of sustainable development.

The United Nations Environment Programme (UNEP) (2014: 2) stated that the liability created in terms of air pollution, water pollution and land degradation resulting from sustainable development was not taken into consideration in 2000. UNEP therefore suggested that sustainable development should be financed in such a manner that recipients were incentivized in terms of positive cash flows if they set-up mechanisms to prevent pollution towards guaranteeing a greener environment. The impact of additional factors like pollution and land degradation were overlooked in 2000 when the United Nations set the Millennium Goals and the repercussions of this oversight prompted an Asia-Pacific meeting on sustainable development financing (Asia Monitor 2014 :1). This meeting brought together leaders from the private sector, public sector and civil society to innovate a creative strategy on how to source finance for development which would utilize the funding for development but at the same time incentivize against pollution and environmental degradation. The call for innovative financing has come from across the world.

In October 2014, in Geneva, leading members of the global finance and investment community gathered to implement new strategies for funding sustainable development. The president of Switzerland suggested that barriers ought to be brought down between public sector and private sector funding. He referred to “breaking down the silos” (The Sunday Observer 2014:2). The

Secretary- General of the United Nations conference on Trade and Development declared that "The core purpose of this year's World Investment Forum is to bring together public and corporate leaders to amplify the discussion about private sector involvement in sustainable development goals" (The Sunday Observer 2014:1).This global call for the mobilization of effective channels of funding for sustainable masks a fundamental reality that since the declaration of the Millennium Goals in 2000, very few countries have been able to meet the requirements of these goals. Setting up new goals for the next fifteen years up to 2030 has the dark cloud of non-achievement for the previous fifteen years. The very basis for the non-achievement is the lack of proper streams of funding.

Holmes, the former Commissioner General of Burundi's revenue authority, declared that "there is little chance of sustainable development without effective domestic revenue mobilization" (AllAfrica.com 2014:1), referring to the effective collection of taxes and state revenues with the broader implications for Africa and developing economies. Holmes' argument was that funding in the form of aid represented a dependency and therefore veered off the path of sustainability. Dependency undermines sovereignty and key developmental and financial decisions are placed outside the ambit of the state concerned. This represents a sensitive barrier to funding for grossly under-developed states.

Making way for the third international conference on financing for development beyond the 2015 development agenda, the intergovernmental committee of experts on sustainable development, meeting at the United Nations (US Fed News Service 2014:1), voiced support for coherent policy towards investment flows for environmental projects and for funding to come from individual national resources. The committee strengthened its call for proper debt management, fiscal transparency and budgetary constraints towards proper, sustainable development.

The call for local financing has seen the emergence of more venture capital in many countries and in March 2015, a group of companies, in Botswana set up "Dreamers and Angels" venture capital with the specific aim to make available angel capital to entrepreneurs in exchange for vested equity in new projects (AllAfrica.com 2015:1).

The literature review has highlighted the reality that public sector funds lack the reliability and consistency to fund sustainable development. This is attributed to macro-economic issues, budgetary constraints and also global policy initiatives. The literature review further affirms that

most sustainable projects are successfully financed by a combination of funding instruments including venture capital, private equity, bank loans, grants and mezzanine finance. How these funding instruments are deployed for funding CDM projects has not been adequately documented in literature.

2.4 Summary of Key Issues on Funding from the Literature Review

a) Motivation for funding:

The unwritten motivation for funding sustainability is profitability, both for the funding institution and for the funded project. The motivation for funding often depends on limited risk, sustainable revenue generation, profitability and return on investment. Funding is usually granted when it enhances opportunities for sustainable development; opens up facilities for skills development; encourages small business development and entrepreneurship, generates revenues for sustainable growth; and improves access to employment and social upliftment. The recurrent motivation for funding is mutual benefit for the funder and funded. Funding works successfully when funded projects are incentivized to conform to the norms and values of sustainable development. These incentives, for example, may take the form of financial benefits accruing from carbon credits.

b) The role of traditional financial institutions in funding sustainable development projects:

The funding of sustainable development remains outside the scope of banks and traditional lending institutions. Banks are not attracted to financing green projects. “Being green” is no guarantee of funding from banks and in fact, could be a hindrance. Banks are simply not interested, nor geared-up to fund sustainable development in Africa and throughout the world.

c) The imposition of Carbon taxes tends to have a negative impact on the possibility of getting funding for “green projects”:

The administrators of private sector resources are cautious to invest in carbon producing projects.

d) Finance for sustainable development is difficult to source in many regions of Africa:

Social, political and economic conditions in many parts of Africa tend to constrain the effective implementation of sustainable development and therefore, funders are reluctant to invest.

e) Public sector funds are clearly not sufficient to fund the enormous demands for sustainable development:

Financing sustainable projects in line with the Millennium Goals has to seek funding from sources outside the traditional public sector. Public funding has many constraints and these constraints in public policy or budgetary restraints prevent the effective implementation of sustainable projects.

f) Funding for sustainable development requires innovative solutions

g) There is a call from key opinion leaders throughout the world for the private sector to participate in funding sustainable development:

Sustainable project managers have been requested to take the initiative to source funds from the private sector instead of queueing for public sector funding. The importance of sourcing alternate private sector funding has become a resounding theme in almost every United Nations meeting on sustainable development. The President of Switzerland has called for the dropping of barriers between public sector and private sector funding.

h) Challenges to funding sustainable development:

Idiosyncratic risk is described as the greatest challenge; followed by poor governance and regulatory issues; settlement and operational risks; as well as market risks.

i) Some inputs that are crucial for the implementation of sustainable development:

Appropriate funding; human resources; technology and infrastructure; peace and stability.

j) Alternate sources of funding for Sustainable Development:

Venture Capital, crowd funding, Sukuk or Islamic funding.

Since this case study specifically seeks to examine the barriers and enablers to funding two Clean Development Mechanism projects in the EThekwini Municipality, attention is given below to a focus on the theoretical motivation behind the concept of the Clean Development Mechanism (CDM).

2.5 The Theoretical Basis for the Clean Development Mechanism (CDM)

The grave consequences of the effects of global warming on the environment was the primary underlying motivation to constitute The United Nations Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol was adopted at the third conference in Kyoto, Japan on December 11, 1997. While the broad policies of the convention are primarily concerned with the

stabilization of greenhouse gases (GHG), the Kyoto Protocol emphasizes and commits to implementing the stabilization of GHG, the principles of which were adopted at the Marrakesh Accord at the Conference of Parties 7 (COP 7) in 2001. The Kyoto Protocol was enforced on 16 February 2005 and 192 countries have ratified the treaty, placing a heavier burden on developed countries in terms of the shared responsibilities towards reducing greenhouse gases. The Protocol commits thirty-seven highly industrialized countries to reducing their emissions by an average of five percent against the 1990 levels over the five-year period 2008 to 2012. The Kyoto Protocol distinguishes two types of countries, namely:

- **Annex 1 countries:** Eastern and Western Europe, Canada, Japan, New Zealand, Australia, Russia and Ukraine. These countries are committed to binding emission targets. Also, these countries have assumed so called Quantified Limitation and Reduction Obligations (QELROs) and may supplement their local, domestic actions by utilizing the flexible mechanisms of the Kyoto Protocol, which include the Clean Development Mechanism, emissions trading and joint implementation (JI).
- **Non-Annex 1 countries:** China, India, South Africa, Uruguay, Brazil. These countries are committed to voluntary participation with the allowance of Clean Development Mechanism projects. With specific reference to South Africa, CDM is the only flexible mechanism permitted at this stage (UNFCCC 2011:1).

CDM is regulated by the CDM executive board. This board comprises ten members who are elected by the parties to the Kyoto Protocol. The ten members are committed to the decisions taken by the parties to the Protocol and their responsibilities include overseeing and supervising the entire CDM process from initiation to implementation. These responsibilities include assessing, approving and registering all CDM projects on a global scale. The board issues CDM credits to duly registered projects and advises, assesses and approves new project protocols for implementation. The board encourages flexibility and the implementation of new rules as an ongoing process of improvement. Additionally, the board approves and accredits independent audit firms to assure compliance and good governance. New projects are presented to the board by developers from various participating countries and the board has a set of protocols from within which projects are presented and reviewed at least two times before any substantive decision on approval is taken. Compliance issues may dictate approval, rejection or further assessment. The secretariat of the United Nations Framework Convention on Climate Change, in consultation with independent auditors and technical experts supports the capacity of the board to evaluate and approve CDM projects (UNFCCC 2011:1).

The United Nations Industrial Development Organization, Vienna (2003), declared that South Africa has signed the United Nations Framework Convention on Climate Change. South Africa has also signed the Kyoto Protocol. According to the United Nations Industrial Development Organization (2003), South Africa is fully aware of the many technical and political issues that surround CDM formulation and implementation and the country presents a high potential for the implementation of CDM projects in various sectors of the economy.

The Kyoto Protocol (UNFCCC 2011:1), defines the Clean Development Mechanism as a mechanism whereby projects incorporating a component that facilitates the reduction or "sequestration" of Green House Gas (GHG) emissions are successfully implemented. The Clean Development Mechanism, according to the Kyoto Protocol, is the only mechanism that is allowed for non-Annex 1 countries, allowing these countries the opportunity to host and facilitate emission reduction projects on their territory. The most important objective of CDM is to promote and encourage sustainable development in the host country. The host country embarks upon a partnership with the project developer and the eligibility of this partnership depends to a large extent on both parties complying with the domestic policies and strategies of the host country towards sustainable development. The Kyoto Protocol (UNFCCC 2011:1), stipulates that the emission reductions of the project must be *additional* to those that would have happened had the project not been implemented in the first instance.

The motivation behind the successful implementation of CDM projects dictates that there is, in the first instance, compliance with the broader goals of the member states of the United Nations towards climate change. Secondly, successful implementation depends on compliance and adaptation of the development goals and strategies of the host country. The primary benefit from the successful implementation of the CDM project for the project developer is the financial incentive from the sale of carbon credits which are referred to as Certified Emission Reductions (CERs). CERs produce additional project revenues, and in essence these revenues reduce idiosyncratic risk. Secondly, CDM projects are beneficial to the broader goals and objectives towards greenhouse gas reductions in the host country, allowing for successful local buy-ins.

One of the barriers to the successful implementation of CDM projects is the set-up costs confronting the project developer. The Kyoto Protocol (UNFCCC 2011:1), refers to these costs as "transaction costs". Transaction costs relate to the costs of formalization and validation. Additionally, costs are incurred within the allocated mandate of monitoring and verifying emissions

reductions. In keeping with the goals of sustainable development, projects that promise substantive greenhouse gas reductions tend to gather more favor from investing companies but incur the costs of training staff and personal.

In line with the criteria for the successful implementation of winning projects, Clean Development Mechanism projects are no different and demand proper pre-assessment and screening for eligibility and project success. In terms of preliminary screening, the Kyoto Protocol stipulates certain substantive eligibility protocols which will be discussed after an in-depth discussion on the crucial elements that define the concept of the Clean Development Mechanism.

CDM is seen by many countries in the South as a facilitator to source finance for greenhouse gas reduction projects. The preliminary requisite for CDM implementation is that CDM projects may only be implemented in countries not included in the Annex 1 list. The critical issue is that Non-Annex 1 countries are not bound to emission reduction obligations under the Kyoto Protocol but may act as host countries to facilitate carbon credits for Annex 1 countries and these carbon credits are monetized to have economic value to the host country. The underlying evaluation, in terms of Environmental Economics is that the atmosphere is one coherent, global entity, implying that reduction of greenhouse gases in any singular position on the planet has a global impact and a consequential benefit for the entire planet. This advances the possibility for carbon credits to be tradeable as marketable economic entities and these are converted to revenue generating mechanisms for the host countries.

CDM has been engineered to facilitate efforts against the adverse effects of climate change by implementing activities and technologies that act synergistically to reduce greenhouse gas emissions. The Kyoto Protocol (UNFCCC 2011:1), allows the host country to stipulate the directive and policy outcomes for sustainable development in terms of relevance to local demands and conditions. CDM projects can, in certain unique circumstances, generate emission reduction credits in favor of Annex 1 countries. These credits may be allocated to Annex 1 countries as partial or full credits. It is important to note that although CDM is intended for public sector and private sector participation, there is an inclination to favor the private sector in the hands of private sector project managers. CDM projects are no different to other projects and as such, are governed by the same legal, market and commercial regulatory constraints.

Gillenwater and Seres (2011:15-19) posit that the criterion of *additionality* is of primary importance for any CDM project to be approved. CDM defines *additionality* as a multi-step process that determines whether Greenhouse gas emissions are below those that would occur in the absence of the certified project activity. This process, according to the Kyoto Protocol, requires the additional process of establishing an accurate, verifiable baseline. The baseline defines what the Greenhouse gas emissions would have been prior to the implementation of the CDM project. To quantify the net emission would satisfy the following formula:

Baseline Emission minus project emission = actual emission or additional emission

BE–PE=CER (Baseline Emission minus Project emission equal Certified Emission Reduction)

This would represent the Certified Emission Reduction (CER) *additional* to the baseline norm. The offset figure from the established baseline is used to determine the value of the accrued credit. It becomes obvious that if the value of the difference between baseline project emissions is negative, then the project has exceeded the baseline emission and is not eligible for any credit. On the other hand, if the value is positive, this represents a positive offset which invites compensation in terms of its positive *additionality.* Gillenwater and Seres (2011:16) postulate that the process to establish a baseline emission value for the purpose of determining *additionality* involves four distinct steps.

The *first step* is to identify other sustainable alternatives to the proposed project. An alternative solution could be chosen on the basis that resultant end-points produce better, environmentally friendly emissions. Other economically or technologically feasible solutions that produce better end-points to the proposed project must be considered towards establishing *additionality*. The process of establishing a baseline emission level may also be influenced by local regulations.

The *second* step involves a search for possible barriers. Barriers could embrace investment barriers, technological barriers or other country-specific barriers.

If the *barriers* produce one feasible scenario, then that particular scenario is chosen as a baseline by a process of elimination. If barriers fail to produce suitable *additionality,* the project may be discarded completely.

The *final step* towards determining additionality is to conduct a common practice analysis whereby the previous steps are validated by comparing to similar projects in close proximity to establish the level of success of such non-CDM projects. If the proposed project conforms to the principles of common practice, then reasons must be tabled to establish what aspects make the proposed project unique, compared to others.

The project will be deemed to be *additional* if it conforms to all the requirements of the previous four steps. The four steps provide the basis for a feasibility report. The completed feasibility report has to be submitted to an accredited, independent auditor appointed by the board. The auditor checks and validates the feasibility report and then submits to the board for further assessment and approval or disapproval. After further appraisal and consideration, the board will make preparations for the registration of the project. Demonstrating *additionality* is the preliminary step in the development of the CDM project (Gillenwater & Seres 2011:16).

The Kyoto Protocol does not specifically stipulate which categories are eligible for CDM, but the Marrakesh Agreement singularly rules out eligibility of CDM for land use change and forestry (other than re-forestation and afforestation). Project categories that are suited for CDM are the energy sector, waste management sector, industrial sector housing sector and transport. This study is particularly interested in the description of CDM for the energy, waste management and industrial sectors. After assessing and describing the theoretical framework of CDM, this study will describe an actual, successful implementation of the CDM process.

The energy sector stipulated by CDM includes substitution of high carbon content fuels with lower content carbon fuels, with specific restrictions on the use of nuclear energy. Fuel switching may also include the replacement of energy-producing equipment. Fuel switching may include the improvement of existing technology or implementation of new technologies. CDM may also be applied to the process of co-generation of electricity, heat to produce high energy yields and the capture of methane gas from transport or flaring. In the waste management sector, CDM may be implemented for the process whereby bio-gas is captured from landfill sites. Methane is extracted and then combusted for energy capture and energy generation. Bio-gas may also be captured from sewage treatment sites. CDM may be applicable in the industrial sector whenever greenhouse gases are reduced or when methane is captured and reused for energy production and carbon reduction. CDM may also be utilized in the industrial sector whenever improved energy efficiency is actively implemented for industrial projects.

The primary objective of CDM is to achieve emission reductions in developing countries while allowing developed countries some leeway to meet their targets. The other objective is to promote sustainable development and to transfer technologies from developed to developing countries. Importantly, CDM plays a significant role in the process of capacity-building in terms of transferring technology and experience in the field of carbon mitigation. Capacity-building may facilitate the bargaining capacity for the sale of full CERs to first world countries and this in turn may facilitate long-term commitments to reduce harmful emissions in host countries. The implementation of CDM has played a leading role in international climate negotiations and will continue to do so in the future. Therefore, it is appropriate to describe how CDM benefits the host country on the one hand and the investor on the other.

Agence Francaise de Development (2004:13) describes these *benefits for the host country* as well as for the investor:

- The primary goal of CDM is to assist non-Annex 1 countries to fulfill their sustainable development goals. CDM is considered to be a viable source of funding for sustainable development projects.
- Implementation and funding of CDM projects places considerable importance on the capacity of the funded project to contribute positively to the local environment.
- Additionally, the CDM project must contribute to the coffers of the local economy to produce revenues and growth.
- The process of implementing CDM projects in host countries invites foreign direct investment, innovative technology and appropriate technology transfers.
- The major advantage of implementing CDM is the outcome of having funding available to enhance the viability of the project by lowering the cost of setting up and by reducing the operating costs.
- The success of the project functions on the symbiotic relationship between the project ownership and the funder. From a business perspective, the investor has the opportunity to extend the influence of the funding business to the host country. This may entail an entirely new and innovative way of doing business and setting up structures in the host country, which will facilitate the flow of revenues in both directions.

Agence Francaise de Development (2004: 13) details the *benefits to the project developer*. There are two distinct benefits, namely:

- The project developer gains revenues from the generation and sale of Certified Emission Reductions (CERs). These are referred to as carbon credits. These revenues, depending on the carbon dioxide price, can range from representing five to fifteen percent of the project investment costs (Afdd 2004: 13).
- Furthermore, CDM allows investing companies with emission volume restrictions to purchase additional CERs to meet the compliance requirements of the investing country. Additional CERs may be purchased directly from the invested project or alternatively, CERs may be purchased from another CDM project source in any other non-Annex 1 country that complies with the mandate of the Kyoto Protocol.

The possibility of purchasing carbon credit certificates from host countries is especially attractive to Annex 1 private sector buyers from highly developed nations that produce emissions outside the permitted barriers. The World Bank, under the auspices of the Prototype Carbon Fund, provides a facility to firms that wish to purchase carbon credits to offset their stipulated targets. Governments from Annex 1 countries, and especially from the European Union countries also purchase carbon credits from a highly-structured marketplace. In 2008, the penalty for exceeding the ceiling for emissions was 100 Euro per metric ton over. These penalties serve as a motivator for compliance against default and further penalties. The penalties provide the marketplace with adequate flows of revenue which facilitate the process towards sustainable development (Afdd 2004: 14).

The broader motivation for CDM is to encourage industry to buy into the process of environmental responsibility. Responsibility fosters an image of social and environmental responsibility for the funding and the funded institutions. This is important for firms to buy-in and conform to the process of clean development mechanisms. Payment compliance for CERs acknowledges the presence of emissions as externalities with a substantive value association to the local economy and also to the dynamics of broader market economics. This very acknowledgement and recognition sets the stage for improved environmental technologies and the consequential reduction in the prices of goods and services. A reduction in the prices of goods and services enhances the competitiveness of the project in the marketplace. The resulting market dynamics encourages innovation, social involvement, employment and enhanced effectiveness in the process of achieving sustainable development goals.

In determining what barriers and determinants impact on the process of funding sustainable development in host countries and more specifically at the EThekwini Municipality, it is crucial to have a thorough understanding of the Clean Development Mechanism; Certified Emission Reduction credits; the concept of *additionality*; and the process of eliciting payments for accrued credits from accredited CDM projects. It is also appropriate to understand how these structures contribute to the reduction of greenhouse gases and enhance the process of meeting sustainable development goals. The next theoretical perspective must determine what elements produce acceptance and eligibility for any proposed CDM project.

The CDM guidebook (2002:5) indicates that the primary concern towards eligibility entails the aspect of a prospective projects' emission reductions. Emission reductions must primarily be *additional* to the reductions that would have been achieved had the project not been implemented in the first place. *Additionality* is therefore the prerequisite for successful implementation. Baselines are calculations of what future emissions would be without the intervention of the CDM project. The Kyoto Protocol describes six greenhouse gases that may describe emissions for CDM purposes. These include: carbon dioxide CO2; Methane CH4; Nitrous Oxide N2O; Hydrofluoric-carbon HC; Perfluorocarbon OFC; and Sulphur hexafluoride SF6. Out of necessity for the principles of Sustainable Development, the project should not produce pollution or emissions that would harm the environment in any way.

A Guide to the Kyoto Protocol Project Mechanisms (2002:15) stipulates that approval by the host country is mandatory for any CDM project to be implemented. The protocol, by the government of the host country, involves the provision of a detailed motivation and description of reasons why the CDM project would contribute towards achieving the goals of sustainable development. Furthermore, the government of the host country must indicate acceptance of the potential CDM project. The CDM guidebook (2002:5) stipulates that the prerequisite for qualification as a CDM project involves developing the project within the policy framework and objectives of the host country. The implication is that any CDM project must conform to the principles of sustainable development and additionally, must facilitate the transfer of technologies to the host country.

A Guide to the Kyoto Protocol Project Mechanisms (2002: 16) advocates that in order for a CDM project to be approved and registered, the host country must structure an "institutional framework" embracing the following key components: Ratification of the Kyoto Protocol; Ratification of the UNFCCC; choosing a correspondent to facilitate negotiations on behalf of the host country

regarding the implementation of the UNFCCC and Kyoto Protocol as well as appointing a Designated National Authority (DNA) for the CDM. The DNA is required to manage and supervise the entire approval procedure. This DNA is also responsible for the final approval or rejection of the CDM project after thorough testing of the entire eligibility protocol. The DNA makes sure that the proposed CDM project conforms to the sustainable development goals of the host country.

One of the motivating factors behind the systematic analysis of the conceptual, structural basis of the Clean Development Mechanism is to identify key variables for usage in the measuring instrument for this case study. At this stage of the theoretical framework, certain key variables affecting CDM eligibility have been identified. These are:

- Ratification of the Kyoto Protocol;
- Designating and appointing a National Authority for UNFCCC;
- Principled support for the elements of the Clean Development Mechanism;
- Verifiable support for greenhouse gas reduction;
- Projects should embrace the utilization of sustainable energy, waste, transport, agriculture, afforestation and re-forestations;
- Usage and acceptance of transferable eco-friendly technology; and
- Clear demonstration of baseline requirements and the element of *additionality.*

Additionality for the purposes of CDM screening represents two distinct types of *additionality.* The first one represents environmental *additionality*, while the other (equally important) represents financial *additionality.* Financial *additionality* means that project funding has to be additional to CDM allocated funding (The CDM Guidebook 2002:5).

By implication, the identification of determinants of the implementation of CDM exposes possible barriers as well. These barriers represent technical barriers when technology is not suitable, available or represents risk in implementation; organizational and legal barriers to direct investment arising from legal and policy hurdles; financial barriers due to the exorbitant costs of funding; exchange rates; and procurement barriers to raw material (The CDM Guidebook 2002:7).

The above variables represent the initial screening requirements for possible CDM development and implementation. These steps facilitate the process of systematically eliminating technologies that fall outside the Clean Development Mechanism. The next step from this initial assessment and appraisal is to calculate and quantify the potential emission reduction for the purpose of

carbon income. The reduction from baseline will represent a level of revenue streams from the proposed project. When the projected revenue flows are extrapolated, and projected for quantifiable and sustainable periods of time, these revenue flow are then compared to the transactional costs to ascertain the level of commercial feasibility. Initial feasibility must be formalized before project implementation is documented for acceptance.

The CDM Guidebook (2002:2) explains that the rationale for carbon trading is based on the understanding that greenhouse gases interact and mix uniformly throughout the global atmosphere. Therefore, carbon dioxide, unlike Sulphur dioxide, has an equal impact on the atmosphere throughout the world and it does not matter where greenhouse gases are reduced. The net result is the same because the global atmosphere is one coherent entity. A reduction in Africa or in Europe or America has exactly the same effect on reducing global carbon emissions. The global uniformity of the impact of carbon on the atmosphere offers a common medium to trade carbon credits. The Guide to the Kyoto Protocol Project Mechanisms (2002:19) stipulates that a CDM project has the opportunity to secure carbon income by securing an “Emission Purchase Agreement”. The agreement quantifies the number of CERs produced in one financial year; the agreed price of each CER; and for what period of time the CERs will be generated. Currently in 2015, the price of CER is approximately $7 per ton. These pries will be further adjusted in December 2015. The terms of the Marrakesh Accord provide the project developer with the opportunity of choosing flexible contractual periods. The project developer may choose a non-renewable contract for ten years or, alternatively, choose to contract for a period of seven years and then renew for two further periods of seven years up to twenty-one years in total. Contractual periods vary from project to project, depending on life cycles of demand, supply and production, relative to the tradeable carbon credit.

The basis of choosing the contractual period and negotiating the price of the CERs stems from feasibility studies to determine the viability of any particular project. At this preliminary stage it is crucial to determine cash flows and accruable revenues in order to calculate the profitability of any project. An agreement that does not consider the market and economic context of the contract and accepting a marginally lower CER price structure may result in revenue shortages over the contractual period, resulting in project failure. The choice of the appropriate price and contractual period may guarantee project success.

Any proposed project will incur additional costs and these will have to be factored into the calculation of the feasibility of the project. These additional costs are referred to as transactional costs and may include documentation and validation costs, monitoring and verification of emission costs. These costs are relative to economic circumstances and project types. Crucial to the process of costing is the capacity to allocate correct value to CER (Carbon Emissions Reduction). Gilder and Henk (2011:4), in their presentation for Eco Metrix, South Africa, state that a CER is a commodity "that represents the absence of one ton of carbon dioxide equivalent that would, in the absence of the CDM project, have been emitted to the atmosphere". CER is described as a saleable commodity generated by a CDM market; trades across both "compliance and voluntary" markets; and has a "variable commercial value represented in an electronic data base in Bonn, Germany".

Carbon credits have a monetary value. The CDM Guidebook (2002:33) provides a formula for the calculation of carbon revenue from a CDM project for a period of one year:

Carbon revenue $/year = carbon credits (tons/year) x carbon price ($/ton)
Annual credits are calculated by:
Carbon credits = baseline emissions – actual emissions
{Formula quoted from The CDM Guidebook 2002:33}

Preliminary screening in terms of the capacity of any proposed project will facilitate the financial and economic feasibility of the proposed project. Feasibility, most importantly, depends on an accurate calculation of the future development costs of the project. Development costs are calculated by comparing the potential costs to potential income to determine whether costs fall within the ambit of a reasonable or budgeted level of profitability over the contractual period. Economic feasibility is the ultimate feature that determines whether a project merits further development or whether the project has to be scrapped. The success of the project depends to a large extent on the level of emission reduction because a greater reduction in emission translates into a far greater potential to generate CERs and therefore project revenues.

Based on the feasibility methodology quoted in A Guide to the Kyoto Protocol Project Mechanisms (2002: 21) on an approximate E3 (three Euros) per metric ton of reduction, for example:

- If a proposed project has the realistic potential to reduce emissions by more than 50000 metric tons of carbon dioxide, then the project is "of interest" in terms of feasibility.

- If a proposed project has the realistic potential to reduce emissions by between 30000 to 50000 metric tons of carbon dioxide, then the project may be “of interest” but would require a more indepth assessment for further consideration.
- If the project has the realistic potential to reduce emissions by less than 30000 metric tons of carbon dioxide, then it is very likely that the preparation costs of the proposed CDM project will be far too high relative to the potential carbon-income generating capacity. On the basis of this comparison, the project may be shelved or relegated to the status of small project.

In line with relating the theoretical and conceptual analysis to identifying variables for the measuring instrument of this case study, more substantive variables have emerged. The variables of interest in terms of project feasibility are:

- *Costs* of feasibility study relative to documentation, baseline, monitoring and information research.
- *Preparation Costs* relative to project design documents.
- *Project Approval Costs* in terms of assessing validity.
- *Cost of negotiating a purchase agreement.*
- *Registration costs* relative to registration by the CDM board.
- *Operational costs* relative to operations, management and maintenance, CER costs.
- *Net income from the sale of generation of CERs.*

The above variables of interest serve as important criteria for the initial assessment towards the probable feasibility of any proposed project. This case study will utilize these variables, amongst others, to determine whether the success or failure of the CDM projects in the EThekwini Municipality have any bearing on whether a successful feasibility study was carried out in the first place.

Once the initial feasibility has been executed, the process of formalizing the CDM project begins. The process of formalizing the project has to be registered by the Executive Board as a CDM project and certified to generate certified emission reduction. According to the Guide to the Kyoto Protocol (2002: 26), “all potential CDM projects must meet the same criteria and follow the same process, regardless of their size.” The local authorities of the host country and an independent third party accredited by the United Nations Framework Convention on Climate Change and referred to as the Designated Operational Authority, must assure that the project satisfies the

prescribed eligibility conditions. The Kyoto Protocol requires that the Project Design Document (PDD) has to be utilized as the only official guideline and document for project development. The compilation of the PDD has to follow a specified protocol as prescribed by the Kyoto Protocol.

After successfully assessing the proposed CDM project for eligibility, the project officer begins to prepare the documentation for registration by the CDM executive board. Thereafter, the project developer endorses and signs the emissions reduction purchase agreement for ongoing generation of CERs by the project. After carefully identifying the nature of the business, the aspect of sharing credits are decided upon, in terms of which parties are involved in the sharing of credits. In addition to specifying emission monitoring protocols, the baseline is established and confirmed after a formal request for approval of the host country. The next step involves the formal preparation of the PDD, the Project Design Document. The CDM involves an agreement between the following participants: The host country, The Operational entity, The Project Developer, The CDM executive board, and the Carbon credits investor.

The Kyoto Protocol Project Mechanism (2002:27) describes the host country as being the most important partner in the CDM agreement between the participating parties. The host country must have the capacity to perform and honor all the validation protocols. These include producing a letter approving the conditions of the project and a clear indication that as a host country, it meets all stipulated sustainable development objectives.

The Project Developer has responsibility over the operations within the project. The Designated Operational Entities (DOEs), appointed and approved by the CDM executive board, are responsible for the validation of the project; ensuring good governance and allowing access to the public to view design and development documents; encouraging and provoking public participation and feedback; validating, verifying and quantifying emission reductions and their certification.

The CDM executive board is responsible for the approval and implementation of new methodologies; appointing and suspending participants; maintenance and development of the CDM registry; verifying and validating reports and recording CERs in the CDM registry (AKPPM 2002:29).

The carbon credits investor or investors are entities that purchase some or all of the CERs produced by the project (AKPPM 2002: 29). Investors may originate from different localities from Annex 1 countries.

The Project Design Document is an essential technical document that comprehensively details the nature of the project. The document demonstrates the series of steps required to calculate baseline emission levels and from there, to accurately describe *additionality.* Furthermore, the PDD structures a monitoring mechanism; establishes an accounting period; and stipulates and quantifies actual greenhouse gas emissions and the consequential impact on society and environment. The PDD also includes comments and suggestions from stakeholders on the methodologies and design features of the project.

The study has already defined and explained the process of calculating the value of additionality relative to baseline emissions*. Defining* the accounting period for the project design document is a necessary feature to indicate the total volume of emission reduction that may be generated by the CDM for the purpose of calculating the certified emission reduction and therefore the value of the CDM project itself. The baseline emission value will remain the same throughout the stipulated accounting period. The PDD also describes in detail how emissions will be monitored and collected for submission to the relevant operational entity for verification throughout the accounting period. A report detailing the environmental impact of the project is mandatory and this report contains an environmental impact analysis, which is in line with the requirements of the local authority and also in line with the aims and objectives for sustainable development of the host country. The level of stakeholder feedback contributes towards the transparency of the project within the framework of the aims and objectives of sustainable development (AKPPM 2002:30).

Once the PDD documentation process has been completed, it has to be presented to the executive board for approval and ratification. The process of approval and ratification allows for the commencement to generate CERs.

The first step in the approval process requires approval by the host country in terms of complying with the rules and regulations of the host country, as well as conforming to the achievement of the goals of sustainable development. Host country approval is a prerequisite before presentation for approval to the CDM Executive Board. The host country, in return, must have ratified the Kyoto

Protocol. The Designated National Authority is responsible for approving the project on behalf of the host country. Therefore, it is the duty of the project development official to make contact and communicate with the Designated National Authority as an ongoing process. The Designated Operational Entity, an independent third party, is nominated to assess the appropriateness of the project and thereafter endorses the operational validity of the proposed project. The Marrakesh accord stipulates that the process of validation must seek international endorsement jointly brokered by DNA and the DOE. After validation, the project becomes open to the public and is registered with the Executive Board. Sometimes, an additional review may be requested before final registration.

The basis of generating revenues from a CDM project evolves almost exclusively from the generation of certified emission reductions. The Guide to the Kyoto Protocol Project Mechanisms (2002: 40) describes the process by which CERs are verified; who is responsible for verification; the documents required; the periodic intervals for verification; and how the emission reduction certificates are obtained. Varication of Certified emission reduction requires independent verification and the Designated Operational Entity (DOE) is the body that is responsible for the process of verification. “Verification is in fact a periodic and *a posteriori* review of emission reductions effectively measured, resulting in possible CERs” (AKPPM 2002:40). The DOE is responsible for verification of data collected under specific, pre-established monitoring rules. An important specification is that verification and validation cannot be conducted by the same Independent Authority. There is no specific pre-determined stipulation regarding the periodic interval for verification. Rather, circumstances may determine the process of verification. Typically, verification is conducted just prior to signing a purchase agreement for certified emission reduction.

Credits for certified emission reductions are only paid for after verification has been done. Therefore, the process of verification is of crucial importance for the generation of revenues from a CDM project. Certification for emission reductions are written assurances which stipulate that during a specific, pre-determined period of time, a Clean Development Mechanism project did, in fact, achieve validated and verifiable greenhouse gas reductions. The responsibility for the issue of certification for emission reduction is vested almost exclusively in the operational entity concerned. The certification report, compiled by the designated operational entity, is forwarded to the executive board for the purpose of soliciting certified emission reduction credits for specific, certified emission reductions. When the designated operational entity certifies a specific quota of

greenhouse gas reductions, corresponding certified emission reduction certificates are issued. CERs are approved by the Executive board and credited to the account of the corresponding project design document, on condition that the entire process of requisition, validation and verification conform to regulatory obligations and rules.

The CDM project has a very clearly designated and designed methodology. Establishing the sequence of this methodology advances a set of variables that may be utilized in eliciting responses for this case study. The methodology comprises two distinct processes. The **first** process involves establishing baseline and *additionality.* Baseline represents the scenario where anthropogenic greenhouse emissions represent the position in the absence of the project. Therefore, demonstrating *additionality* represents demonstrating, with verification, that the CDM project in question is not included in the baseline. This is the first and most important component of the CDM methodology. The **second** component of the methodology represents a clearly articulated series of well-defined steps that set out to monitor and ensure that all the greenhouse emissions associated with the CDM project are verified and quantified. The emission reduction must be continuously assessed over the period of the project so that data is constantly collected and quantified, then forwarded to the Designated Operational Authority for verification. The process then translates into establishing a credible and acceptable methodology; applying the methodology to establish baseline; calculating baseline emissions; and structuring a credible monitoring plan. It is crucial that the baseline is established with specific reference to conform to established national or sectoral norms. Mechanisms must be set up to maintain stringent transparency. If there is uncertainty in establishing a baseline then values are taken to represent the least favorable baseline situation, from the perspective of scientific conservativism. It is favorable to establish a recognizable methodology after due consultation with the executive board. In determining greenhouse emissions, the project developer has to establish clearly defined boundaries from within which to determine emissions. Any emission arising from the project itself, and which are deemed to be significant by established norms, have to be included in the emissions for the purpose of certifying and verifying emissions reduction. The process requires that emissions are quantified from within specifically demarcated boundaries. The project developer needs to establish what is under the project control, what is deemed to be significant in terms of emissions and what may be reasonably attributed to the project itself. Pre-determined boundaries ought to establish, without doubt, what are direct on-site emissions; direct off-site emissions; indirect on-site emissions; and indirect off-site emissions. In this instance, leakages outside the established boundaries have to be quantified and taken into consideration at the time

of verification. The next step is to formalize a series of steps to establish a methodology to assess project *additionality.*

In 2004, the Executive board put forward a series of steps to facilitate the process of determining *additionality.* The purpose of these proposed steps is to add validity to the process of determining *additionality* by exploring and eliminating any other beneficial technologies outside CDM.

- The first step is to explore, identify and assess alternative techniques. The purpose is to explore other technologies that produce equivalent emission reductions and to measure and assess the benefits against Clean Development Mechanisms. Besides scientifically quantifying the outcomes from alternate technologies, the project developer must indicate that maintaining the existing status quo, in terms of reducing emissions, is less effective than implementing the Clean Development Mechanism.
- Having systematically explored all the alternatives to CDM, the second step involves a step by step financial cost analysis indicating that the chosen option (from step 1) is the most cost effective and is therefore in line with the principles of sustainability.
- The third step involves an analysis of obstacles that interfere with the implementation of CDM. Obstacles may be represented by the unavailability or difficulty in sourcing development capital. Obstacles may also be represented by the difficulty in assessing technology and the efficient transfer of technology because of developmental incompatibility in the host country. Obstacles may also be quantified in terms of a lack of experience and benchmarking within the geographical context of the host country.
- The fourth step involves a process of comparing and bench marking the proposed CDM project against another, similar and successfully implemented CDM project. The prime motivation for this fourth step is to further refine the validity of *additionality* for the proposed project.
- In the fifth and final step, the project developer has to prove that the registration of the proposed CDM project would produce overwhelming benefits in terms of overcoming the stated obstacles; improving the outcomes for sustainable development; improving the environment for investment; and producing benefits that outweigh any other alternate technology, especially within the context of producing the best possible outcome for *additionality.* The lifeblood of any CDM project is its capacity to attract appropriate investments from potential investors and to produce beneficial revenue flows, while at the same time advancing effective emission reductions. The successful registration of the CDM project must therefore facilitate the attraction of additional finance, improve the local

economy and enhance the prospect of successfully generating revenues from the sale of CERs.

Although the rationale of this analysis seems to explore the impact of reasonable obstacles on the implementation of the proposed CDM project, this is merely a suggestion. The ultimate purpose of any such analysis must always help to expose the most advantageous and cost effective option within a set of constantly changing circumstances.

It is becoming apparent from the conceptual and theoretical analysis that although the sale of CERs may produce effective revenue flows and therefore finance the said sustainable development project (in the form of a CDM project), more finance is required to kick-start the project. This additional capital may take the form of start-up capital. A CDM project, once registered, is only the beginning of the process of generating revenues. Any CDM project must always look to obtain startup capital at first. The analysis thus far also exposes the aspect of idiosyncratic risk and failure. Based on the analysis, the study facilitates the understanding that registration of a CDM is only the beginning of a process of revenue generation and a means to an end. The time lapse will always produce risk and failures. The study suggests that in addition to assessing the broader barriers and opportunities to CDM implementation, a parallel assessment has to be made of idiosyncratic risk.

At this stage of the analysis, broader variables have emerged and these variables are essential for incorporation into the final measuring instrument. The identification and articulation of the essential, additional variables also served as a summary of the theoretical analysis thus far.
The additional variables that have emerged from the theoretical analysis represent:

- Project eligibility;
- Facilitating effective agreements between participating parties;
- Acquiring and sharing carbon credits;
- Validation and verification protocols;
- Establishing baseline and *additionality;*
- Conforming to effective documentation protocols as stipulated by the Kyoto Protocol;
- Cost analysis;
- Establishing recognizable boundaries; and
- Implementing effective methodologies.

Before establishing and structuring any acceptable monitoring plan, the project developer has to clearly formulate a process to determine the net emission reduction and to carry forward this process across the stipulated period of the CDM project to maintain validity, relevance and substantive verification of all data. The generally accepted guideline to determine the net emission reduction is to subtract the total project emissions from the baseline emissions and the recording of this data must take into consideration any possible leakages, incorporating these leakages into the net emission reduction. For obvious reasons, circumstances may differ from project to project, depending on the contextual environment. The guideline is broadly applicable.

The monitoring plan is closely dependent on the calculation of the baseline emission levels as well as the resultant net emissions calculation. Approval of the CDM project includes the joint approval of baseline emissions, as well as the monitoring plan thereof. The monitoring plan is an essential component of the Project Design Document (PDD). The Kyoto Protocol (AKPPM 2002: 55) suggests that the monitoring plan should be able to account for the gathering of data over the entire accreditation period in order to facilitate the process of estimating and measuring of project-specific emissions within clearly defined boundaries, as presented and validated by the Executive Board of the CDM project. The monitoring plan also takes into consideration emissions outside of these stipulated project boundaries.

The Kyoto Protocol (AKPPM 2002: 55) states that the monitoring plan describes a series of monitoring activities which ensure that all project greenhouse gas emissions are quantified, recorded and monitored on an ongoing basis. The prime purpose for an effective monitoring plan is to guide the project developer in conforming to the emission requirements of the Kyoto Protocol to ensure sustainable long-term emission reductions. An effective monitoring plan details the actual monitoring process, incorporating elements of consistency and reliability. The purpose of the monitoring plan is to identify the source of all greenhouse gas emissions relative to the CDM project and thereafter, to clearly define the methodology for monitoring emissions. The monitoring plan also stipulates the methodology for the collection of data on an ongoing basis. Data has to be securely stored over the entire period of the CDM project. Storage implies easy accessibility to historic and current data. The monitoring plan also details protocols that guarantee accountability and verification. The monitoring plan resorts to verifiable calculation techniques with respect to the accurate calculation of emission reductions resulting from the implementation of the CDM project.

Further to the implementation of the monitoring plan and once the project and the Project Design Document have been verified by CDM Executive Board, the project developer has to decide how CERs will be shared between himself and other partners. It is incumbent upon the project development officer to negotiate and broker proper contractual relationships with partners in order to ensure the accrual of revenue benefits for the host country and also to ensure that the sale of Certified Emission Credits has proper legal and contractual obligations for both parties. CERs may be sold to more than one party and all of these have to conform to legal, ethical and contractual obligations. The project development officer has to decide on the most effective sharing of the CERs. The sale of CERs must produce financial, economic, social and development gains. The project development officer has to establish and define, in the first instance, ownership of the CERs.

The Kyoto Protocol (AKPPM 2002: 58) stipulates that CERs may be transferred from the Executive Board to a third-party Annex 1 country under certain strict conditions, which the project development officer has to be familiar with.

Firstly, CERs may only be transferred to Annex 1 countries that have ratified the Kyoto Protocol. These countries have to clearly calculate and indicate the assigned amount that may be transferred as a credit. It is also incumbent upon the receiving country to set up a national register and establish a mechanism to estimate the level of greenhouse gas emissions and from these, to set up a register to record an annual national inventory. As carbon credits are shared and traded across the world, the Kyoto Protocol refrains from defining specific parameters for credit ownership and transfers from CDM projects. However, there is a contractual obligation between the seller and the buyer as the Kyoto Protocol makes provision for contractual agreements between different individuals and different countries. CDM project developers have to conform to the specific rules and regulations of the host country.

The capacity to trade carbon credits has specific relevance to this study because the opportunity to trade carbon credits amounts to having the capacity to enhance cashflows. The increased liquidity translates into having usable capacity to fund the sustainability of the CDM project. The opportunity to generate revenues from the CDM project itself is particularly attractive when considered against the difficulty in attracting funding from the private and public sector. In essence, effective implementation of CDM in the host country means that the CDM project is self-funding, which is determined by the manner in which carbon credits are utilized. A project

developer may decide to accumulate the credits and register these carbon credits in a special registry account. This serves two purposes. Firstly, the developer may 'bank' these as if consolidating revenues on behalf of the project and secondly, the developer may use the register of accumulated carbon credits to conform to the principles stipulated by emission regulations.

When the developer requires funds, they may decide to sell the credits and convert to revenues. This is dependent on the contractual agreement the project developer has with a particular purchaser or more than one purchasers. The sale of carbon credits has the potential to generate sufficient revenues and these revenues serve as the perfect cost-effective and sustainable mechanism of self-funding for the CDM project. This is the aspect that makes the Clean Development Mechanism such an attractive funding option for sustainable development. Since the sale of carbon credits defines a credible, sustainable vehicle for funding the CDM project, the project developer has to pay close attention to drawing up contractually relevant purchase and sale agreements with interested parties. Effectively, any such purchase and sale agreement would define the terms and conditions for credit delivery and payment thereof between the project developer and the buyer.

The purchase and sale agreement would factor-in issues relating to the legal ownership and transfer of ownership of carbon credits. The purchase and sale agreement must set up conditions for the effective currency exchange with respect to the risks associated with currency fluctuations, inflation and other relevant economic risk indicators. The agreement must define default and compensations for default. The purchase and sale agreement must comply with all national and international regulations and within this context, must define the specific nature of the contractual agreement. It may be required to define ownership of credits, stakeholder interests and obligations within the components of the project design document. The purchase and sale agreement must define the commitment of the parties; indemnity; termination of contract; confidentiality; dispute resolution; local tax obligations; purchase conditions; and the allocation and sharing of idiosyncratic risk.

In the absence of a clearly defined document from the Kyoto Protocol regarding legal ownership of carbon credits; transfer of ownership of carbon credits; risks associated with ownership; terms of revenue generation form carbon credits; and the capacity for carbon credits to generate revenues for CDM projects, the purchase and sale agreement between parties serves as a valuable document for consolidating a CDM project and must of necessity be included in the

project design document. Payments for carbon credits may take different forms depending on risk, productivity of the project, consensus between stakeholders and the level of development of the project. The project developer is assumed to be the owner of emission credits. The project developer has the task of funding the project and will therefore seek to maximize the revenue flows to fund the project. The best form of payment for emission credits are advanced payments to the project developer. An advance payment represents a loan with respect to a credit emission that has not yet been delivered. Although this represents a major boost for the revenues of the project, it represents a risk to the purchaser who accepts a greater level of risk and the possibility of default. The project developer and the purchaser have to reach a level of consensus to guarantee delivery of goods or compensation in the event of unforeseen default. The primary advantage of an advanced payment is that payment is guaranteed. An advanced payment represents a risk to the purchaser in the event of default on delivery.

If and when advance payments do not work, the buyer and seller may agree for payments to be made on delivery of goods (emission credits). Emission credits may be sold directly by the host country or via the Executive Board, depending on the purchase and sale agreement between the buyer and seller. Payment upon delivery commands a higher price than an advanced payment, thereby enhancing revenues and improving cash flows. Generally, the price is guaranteed and not subject to market risks. Payment is fixed. The consequence of payment on delivery is that pricing of emission credits may be fixed relative to delivery dates, currency fluctuations and the stipulated number of credits over a specified time. Another consequence of payment on delivery is variable pricing. Prices may be linked to market dynamics and varying levels of demand and supply. The buyer and seller may decide to agree on varying prices within a workable range and within specified parameters but neither party has any control over market pressures on pricing. The purchaser may request to exercise a call option with specific pricing relative to the call option. Default on the delivery option may result in higher pricing after default. The call option imposes a sense of urgency on the options of delivery and places pricing penalties for defaulting on prior arrangements.

The seller and owner of the emission credits may decide not to contract with any purchaser or groups of purchasers but rather to employ the services of an international broker to take advantage of open market competition and thereby acquire the best possible pricing options. This option obviously depends on market and economic indicators. The seller, in this instance assumes the risk, but for the option of better prices and therefore better revenue flows for the

project. The payment options discussed in the preceding chapters represent a broad methodology for payments between project developers and purchasers. Depending on market fluctuations and global economic conditions, parties may use different buying and selling options. The Kyoto Protocol has taken a cautious stand on clearly defining ownership of emission credits. Since emission credits represent a form of carbon emission currency, ownership is subject to constant change. The contractual basis of a purchase and sale agreement has to be confined to specific time periods and thereafter subject to renewal and amendments.

In summary, purchasing contracts for emission reductions may be separated into two broad categories. In the first option, purchasers pay in advance for CERs which in effect do not exist yet. In the second option, payment is made on delivery of goods. The purchase and sale options explored in the preceding chapters represent the emergence of more variables that may be utilized in the measuring instrument for this case study. The variable of ownership and transfer of ownership from the project developer to a purchaser of CERs constitutes a valuable transactional variable in the search for an effective mechanism for the funding of sustainable development between host countries and institutions in Annex 1 countries. The Clean Development Mechanism represents a co-operation between Annex 1 countries and host countries for the prime purpose of internalizing the aspect of reducing the global carbon footprint. The payment options arising from the CDM have cascaded into various creative, scientific, social, financial and economic solutions towards solving the challenge of carbon reduction and the consequential impact of global warming.

This theoretical analysis concedes that the financial calculations for emission reductions are not completely finalized yet, and that the process of Clean Development Funding is itself in a process of development. This study is open to the emergence of more unexplored variables that may contribute towards the refinement of the Clean Development Mechanism.

2.6 Summary of Key Issues Relating to the Clean Development Mechanism (CDM)

The United Nations set up the United Nations Framework Convention on Climate Change at the Rio Earth summit in June 1992 to address the concerns relating to global warming arising from anthropogenic climate change. Although large countries like the United States and Russia, which produce huge carbon footprints are in principle opposed to the systematic reduction of carbon emissions, the Kyoto Protocol was ratified in 1997.

The Kyoto Protocol was due to expire in 2012 but at the Doha Accord in 2012, the Kyoto Protocol was extended to 2020. The Kyoto Protocol drew up a list of countries into two broad categories. Annex 1 countries comprise Eastern and Western Europe, Canada, Japan, New Zealand, Australia, Russia and Ukraine. The Kyoto Protocol imposed binding emission targets on Annex 1 countries. These countries have adopted emission limitations by concerted domestic action and by subscribing to the directives of the Kyoto Protocol. These directives include the Clean Development Mechanism, emissions trading with Non-Annex countries.

Non-Annex countries comprise China, India, South Africa, Uruguay, Brazil and other smaller countries. The Kyoto Protocol did not impose binding emission targets on these countries but requested and succeeded in getting a commitment from these countries for voluntary participation in the process of emission reduction. The Kyoto Protocol encourages Non-Annex countries to participate in CDM projects and to trade emission reductions with Annex 1 countries on the understanding that reductions in emissions have a global effect, no matter where in the world the emission reduction is achieved. The achievement of emission reduction by a Non-Annex country can be sold to Annex 1 countries from CDM projects so that Annex 1 countries, being huge emitters of greenhouse gases, can succeed in meeting their emission targets.

The Clean Development Mechanism brokered by the Kyoto Protocol is a mechanism structured on market principles geared primarily towards creating an awareness amongst Annex 1 and Non-Annex countries of the serious social, economic and humanitarian crisis that greenhouse gas emissions may have for future generations. The prime motivation of the Clean Development Mechanism is to broker change in the attitudes towards global warming arising out of unchecked carbon emissions and to encourage developing countries to adopt and implement CDM for sustainable development and greenhouse gas reduction. The process involves the sharing of technology and the generation of tradeable CERs.

A CER represents the absence of one metric ton of carbon dioxide that would have been emitted into the atmosphere had a CDM project not been implemented. A CER is a marketable commodity and may be traded between countries at market-related values within the constraints of supply and demand. The sale of CERs represents a currency-like entity which may be banked, sold, traded and used to finance sustainable development in developing economies. The purchase of CERs by Annex 1 countries facilitates their efforts to achieve emissions targets and also to contribute to the global reduction of greenhouse gases.

In terms of compliance, the CDM project is similar to all other projects and is subject to the same regulatory, legal, technical and financial requirements. Carbon emission reductions and CERs are also subjected to technical, regulatory and legal requirements. The theoretical and conceptual analysis of CDM indicates that CDM projects will substantially increase revenue flows into the host country. CERs are traded in US dollars, British Pound, Euros and Japanese Yen which provide enhanced revenue flows from exchange rates. An approved CDM project enhances the status of the host country in terms of efforts towards greenhouse gas reductions and climate change. Approval, in essence, is vested in the United Nations Framework Convention on Climate Change.

The CDM Guidebook (2002:2) states that the Kyoto Protocol describes two project-based mechanisms for emissions reduction. The CDM project comprises an agreement between an industrial and developing country. The Joint Implementation projects are similar projects between two developed industrial countries. The motivation behind CDM is sustainable development and the exchange of technology for the purpose of reducing greenhouse gases. The South African Government ratified the UNFCCC in August 1997 and subsequently ratified the principles of the Kyoto Protocol in March 2002. South Africa's emissions are comparatively high at 0.8 kg carbon dioxide per dollar of GDP, compared to the Non-OECD average of .66 kg of carbon dioxide in 2008 (OECD 2011:4).

The Ad Hoc working group of The United Nations Framework Convention on Climate change (2015:3) tabled the following articles on December 5, 2015 (amongst others) to the twenty-first session of the Conference of Parties (COP 21) held in Paris. In the preamble to articles referring specifically to funding sustainable development, Article 2 of the agreement describes the purpose of the agreement as strengthening the global response to the threat of climate change, whereby parties agree to take urgent action and co-operate with each other to:

(a) Maintain the increase in the global average temperature to below 1.5 degrees centigrade or well below 2 degrees centigrade;
(b) Increase the capacity of member states to adapt to the adverse impact of climate change; and
(c) pursue a transformation towards sustainable development that fosters climate resilient and low greenhouse gas emission societies and communities, and that does not threaten food production and distribution.

The forwarded articles do not alter the principles of the Kyoto Protocol but attempt to strengthen the campaign towards mitigating climate change and maintaining sustainable development. Article 6 (2015:11) refers specifically to financing aspects of sustainable development.

This theoretical framework will specifically detail the options of article 6, which strengthen the argument towards financing sustainable development from the perspective of defending and consolidating the original mandate of the Kyoto Protocol and to bring out any amendments that differ from the original mandate. It is apparent that the tabled articles aim to consolidate and strengthen the motivation towards enhanced funding for sustainable development. Article 6 advocates that finance flows should be consistent with low emission and climate resilient sustainable development that promote the eradication of poverty. Climate finance should continue to cascade from developed countries, including Annex 1 countries, to developing countries for the attainment of sustainable development goals, food security and to eradicate poverty. Developed countries and Annex 1 countries in a position to help should provide assistance to developing nations to facilitate mitigation and adaptation to climate change. Furthermore, developed country parties and other developed parties, included in Annex 1 to the convention, shall provide new and scaled up financial resources to developing countries to enable actions towards mitigation and adaptation to climate change. More specifically, parties in a position to help and support should provide help and support to developing countries towards their efforts of both mitigation and adaptation. The articles tabled at the twenty first session of the Conference of Parties (COP 21) advocates that developed countries and countries included in Annex 1 groupings shall mobilize financial resources beyond their previous efforts to support country-driven strategies, while taking into consideration and supporting the efforts of developing countries. The parties should strive to source funding from a wide variety of sources including private, public, bilateral, multilateral, domestic and international resources (UNFCCC 2015 :12). Option 10 of Article 6 of the suggested policy directive requests that the mobilization of climate finance should be scaled up to $100 billion US from 2020 (UNFCC 2015:12).

The articles presented above do not, in any way, interfere with the principles of the Clean Development Mechanism but in fact, further promote the principles of the CDM in the process of uniting the efforts of developed and developing economies in funding sustainable development for the purpose of achieving sustainable development goals and mitigating climate change resulting from carbon emissions.

2.7 Literature Review

This section of the theoretical framework examines the views of theorists, writers and academics on the essential theoretical framework described thus far. The critical analysis will systematically explore different views on the various key components of the theoretical framework.

Based on the argument that the Clean Development Mechanism arises out of an awareness of Environmental Economics and the theory of externalities, as well as how pollution in its broadest context impacts the phenomenon of environmental economics, this critique systematically explores the views of prominent writers and academics on various components of the theoretical framework from the aspects and views of classical economists, environmental economists, theories of externalities and the implications of cost and tax. After a critical assessment of the context of this research, focus will be moved to an exploration of the views of prominent writers on aspects of the CDM, its capacity to facilitate greenhouse gas reductions and also its capacity to broker sustainable development from the perspective of providing revenue flows for regional economic development.

Since the theoretical framework is composed of many different interacting variables, it is difficult to impose a general dateline on the broad theoretical framework in its totality. Instead, each element of the framework is assessed separately and each component will therefore have its own dateline. A summary of the essential components of the critique will describe a broad contextual dateline on the theoretical framework.

Swaney (1987:1772) writing on the aspect of evolutionary economics from a neo-classical, theoretical perspective, outlines some specific policy directives for economists. Swaney (1987) suggests that resources that threaten environmental degradation and lead to serious waste problems should be taxed and prohibited. He emphasizes that any activity that interferes with natural goods production and threatens the life support system should be discouraged. Swaney (1987) advocates the imposition of a co-evolutionary tax on fossil fuel usage as one form of deterrent. The aspect of activities that interfere with environmental life support systems demands the imposition of a new accounting mechanism which would hold perpetrators accountable. Swaney (1987) describes polluters as having an ill-begotten entitlement and these entitlement structures have to be dismantled to give way to a safe, sustainable environment through the sanction and imposition of taxes and levies.

Kneese (1988: 281), describes the economy as a “dissipative” structure, depending on a continuous flow of energy and material flows from the environment and then back to the environment. The dynamics of the flow from the environment and then back to the environment are governed by the neo-classical aspect of general equilibrium models. The energy and material inputs to the economy have shifted over the past two centuries from mainly renewable resources to nonrenewable resources (Kneese 1988). Dynamic economic growth is characterized by technological and policy dynamics and policy directives are in turn driven by government policy. These impact the global economy in such a manner that continuous, dynamic structural change characterizes the global economic system. Kneese (1988: 305) therefore advocates that a long-term “survival plan” has to be structured and implemented as soon as possible in order to reverse the historical movement away from renewable resources. Kneese (1988) moves away from the simple dynamic of measuring the impact of population growth on the natural resources and embarks on the widely embracing phenomena of renewable and nonrenewable resources. He examines how these have had an historical impact on the structures of the modern global economy. There is a strong suggestion that for the purposes of global economic and environmental heath, the movement away from the exploitation of nonrenewable resources must commence with a sense of urgency. Global economic and environmental health point to the direction of sustainable development.

Redclift (1991:36) refers to sustainable economic development as a process of maximizing the net benefits of economic development with the concurrent capacity to preserve the services and quality of natural resources over time. He argues that in order to achieve greater levels of sustainable economic development, economists have to implement the usage of environmental accounting systems to allocate a numeric value to environmental losses and costs. In assessing the relationship between the environment and economics, Steiger (1995:552) traces the history of three of the most influential economic theories contained in current day environmental literature. The first is the Malthusian doctrine of population growth and resource scarcity; the second refers to Stuart Mill’s theory of steady state economy; and the third refers to the neo-classical economic theory which links efficient markets as solutions to environmental and resource problems.

Steiger (1995:553) states that Malthus predicted diminishing marginal returns for farmers who were faced with the aspect of providing food for an ever-increasing population, implying that society would have to sacrifice more to obtain a lower margin. This defined the Malthusian

scarcity. Steiger (1995) refers to Mills “stationary” state where population growth and consumption arising thereof would reach a steady or “stationary” state. The end of the nineteenth century saw the emergence of the neo-classical school of economics which utilized analytical mathematical formulae, as opposed to natural laws, to emphasize the value of an efficient market in producing sustainable environmental solutions.

Shrader-Frenchette (1996:55) argues that neither the neo-classical economists nor individualism or holism will provide environmental sustainability. She states that there is no invisible hand, either in economics nor ecology, and that the best path to attain a sustainable future is through the middle path which she refers to as “hierarchical holism”. Hierarchical holism is based on metaphysical holism rather than any scientific theory. It relies on ethics and it includes some “second-order” ethical principles conducive to intervening in conflicts between human interests and environmental degradation.

However, Gowdy (2004: 239) states that in spite of rigorous attempts to build a positive, value-free science, neo-classical welfare economics remains an ethical and ideological system despite the “restrictive” assumptions of welfare economics. Despite all the scientific rigor of neo-classical welfare economics, it is impossible to ignore the directives and impact on Environmental Economics. Gowdy and Salman (2008: 337) articulate two major problems that dominate economic and social policy during the twenty first century. These are global climate change and the ever-increasing gap between the rich and poor.

In referring to Environmental Economics, Ciriacy-Wantrup (1971:36) states that environmental policy cannot be separated from policies relating to housing, working conditions family and racial relations, amongst others. In fact, the basis of environmental policy rests on the implementation of a proper analytical system and this analytical system is none other than the unity of economics. Ciriacy-Wantrup (1971:37) declares that it is an economic axiom that the marginal utility of individual income decreases with increasing income. The foundational basis of Environmental Economics rests on the Pareto criterion, which states that any change that makes at least one individual better and leaves no individual worse off, represents an increase in welfare.

In keeping with the principles of welfare economics, Spengler (1971:1) highlights the impact of population on economic wellbeing by comparing the works of Godwin and Malthus. Malthus placed less importance on the augmentability of food supply but believed that unchecked

population growth has a significant impact on economic wellbeing and especially food supply. Horner (1997:595) commenting on the writings of Henry George on the works of Malthus, declares that the Malthus population theory served as a means of social control by supporting the aspirations of land lords at the expense of progressive public policy. Horner (1997) in contrasting the policies of Henry George and Malthus, describes Malthus as reactionary and states that the contrast between Malthusian and Georgist policies highlights the difference between the economics of scarcity and the economics of abundance. Malthusian policy, according to Horner (1997), denies the possibility of equality because of nature's scarcity, and therefore analyzes how to limit "the number of people coming to the dinner party". Georgist policy, according to Horner (1997), demands a condition of equality and thus decides "on an ethical division of an ample amount of bread for guests" coming to the dinner table.

Brandler (2007: 1), exploring the debate on sustainability and whether the world will over- tax the natural environment, suggests that continued demographic transition to lower fertility is the primary requirement for achieving sustainable development. Brandler (2007) therefore supports the Malthusian principle that an increasing population will radically affect human progression and the quality of life by compromising the availability of essential food supply and other key components of social welfare. Brandler (2007: 35) emphasizes that the essential core of the sustainability debate is the same as the Malthusian debate of the 18th century and advocates a demographic transition to zero or very slow population growth for sustainable development to take root. The debate around the impact of population on scarce resources motivates authors to question how the irregularity of an increasing population would affect the so called 'Pareto efficiency state in economics. The searching question is how can the variable of population or indeed, any other variable including pollution and carbon emissions, impact economic dynamics without affecting the dynamics of the "Pareto efficiency", a state where one party's situation cannot be improved without making another party's situation worse. In explaining the "Pareto" state of equivalence, authors question how emissions arise out of economic benefit for the drivers of industry, while harming the environment and therefore the welfare of human existence in all its manifestations.

Dolbear (1967:90), while writing on the theory of maximum externality, refers to the state of "Pareto equivalence" and enquires about how the presence of an externality may be altered to produce a Pareto optimum. Dolbear (1967: 102) concludes that some of the standard tax proposals will not generate the results that always satisfy the requirements of Pareto optimality.

It is not always possible, according to Dolbear (1967:102), to impose a par unit tax which will compensate for any irregular externality (like emissions or pollution) and thereby achieve Pareto optimum.

Meyer (1971:736) points out that Pigou demonstrates the new irregularity in the form of externalities, which may emerge from a perfectly competitive market environment of supply and demand. Meyer (1971:736) argues that the presence of externalities, arising from environmental problems is provoking a new economic thinking in terms of seeking solutions for the intrusion of externalities into the dynamics of economic activity. Externalities, by their very nature, arise out of economic benefit for some while provoking harm or damage to others. The great economic debate centers on how to compensate for the ongoing damage or harm. Meyer (1971) suggests that the likely solution will take the form of subsidies and taxes but also suggests a re-examination of the status of any externality. Rather than literally looking to an externality as an element outside the inherent dynamics of regular economics, one should now afford any externality the status of a regular economic variable, and in so doing, convert the variable to one that will provoke value rather than disvalue.

Johnson (1973:35) posits that many of the "current social issues such as environmental control and poverty–and indeed most issues of topical interest-are practical manifestations of the pervasive existence of externalities". Johnson (1973:36) argues that externalities are not exclusively the outcome of market activities affecting marginal costs and benefits but also embrace an inherent legal element. The legal element arises from the argument that externalities may provoke real property damage to society, and from this perspective, externalities require a legal solution rather than an economic, compensatory one, taking the form of taxes and subsidies.

Dahlman (1979:141) asserts that classical externalities as conceptualized by Pigou are present where there is a divergence between private and social cost. The implication, according to Dahlman (1979), when all voluntary contractual arrangements have been formalized by market facilitators and participants, is that there still remain some interactions that "ought to be internalized" (Dahlman 1979: 141) which market dynamics, left to their own resources, cannot cope with nor resolve. Dahlman (1979:141) makes two valid conclusions:

- Firstly, since market forces do not have the capacity nor the mechanisms to eliminate these inefficiencies (or externalities), some government intervention is necessary.

- Secondly, any alternative to government intervention must arise from a conceptually feasible solution by accredited economic agents to remedy this market generated side-effect (or externality).

Greenwood and McFee (1991:103) state that the classical description of externalities pays attention to the quantity of commodity produced and not upon who produces the externality. In this situation, pollution for example, may be regulated by the imposition of *per unit* effluent taxes. Greenwood and McFee (1991), however, contend that some externalities do not embrace the irrelevance of the identity of the producer of the externality. The authors suggest that quantity limits should be imposed on an economic activity in the instance where individuals or firms who most desire to engage in it and cause the most social dissonance. This, for the sake of argument, could refer to the individuals or firms that are more conducive to producing emissions which are not acceptable to the norms of society, and therefore, must, as a consequence, be subjected to limitation on emissions rather than being taxed and allowed to produce as much pollution as possible.

Medema (1994:107) elaborating on the issue of resolving externalities, states that the issue of resolution is complex and encompasses diverse individuals and groupings of individuals with divergent goals for themselves and for society at large. The resolution of externalities inevitably results in a situation where some win and some lose, implying that some have more rights than others in the consequence of the resolution of externalities.

Referring to the ongoing debate over the economic relevance of externalities, Klink (1994:386) compares the essential difference between Pigou and Coase in their approaches to the handling and resolution of externalities, with specific reference to Environmental Economics. Klink (1994:386) indicates that the ideas of Pigou and Coase are crucial in the understanding of environmental economics, even though both Pigou and Coase were not directly interested in environmental economics. Many writers describe Pigou as a stubborn advocate of state intervention via taxation for the resolution of externalities. In the same instance, these very writers describe Coase as a stubborn advocate of free negotiations between parties affected by the presence of environmental externalities. Coase, according to Klink (1994:386), is opposed to state intervention in the resolution of externalities. In comparing the works of Pigou and Coase, Klink (1994:386) advises that economists and academics should not “pigeon hole” the contributions of

the two theoreticians. Rather, one ought to take a reflective stance when applying the theoretical inputs of Pigou and Coase.

In his assessment of the impact of externalities, Killinger (1996:332) states that international environmental externalities are gaining particular attention because of their unsanctioned irreversibility. The main characteristic of externalities, for example acid rain, is that the negative impact on the environment is not only limited to the host country but extends to impact the environment in neighboring countries as well. Killinger (1996:332) states that the absence of a supra-national authority to deal with effects of environmental externalities encourages produces and governments to continue to produce externalities in efforts to satisfy consumer demands, without considering the negative impacts on those very consumers and others in neighboring countries as well. Killinger (1996) states that consequently, environmental externalities are generated at a level too high to be accepted for global efficiency. Killinger (1996:332) also elaborates on the failure of the European Union to impose a common tax on its member states for relief from the effects of environmental externalities. The absence of a Pigouvian tax, according to Killinger (1996), imposes a situation of unsanctioned imprisonment by environmental externalities. In his concluding remarks, Killinger (1996:355) alludes to the imposition of capital tax and pollution tax to offer remedies to internalize externalities.

Simpson (1996:53) in comparing the Coase theorem to Pigouvian theory for the satisfactory resolution of environmental externalities, favors the applicability of Pigouvian state intervention rather than seeking a market, legal resolution based on the violation of property rights. Simpson (1996:53) argues that the Coase theorem has many limitations in providing wide ranging relief for the impacts of environmental externalities. He suggests that “The Pigouvian analysis shows us that it is much closer to conceive of better worlds than the one in which we live. But the problem is to devise practical arrangements which correct defects in one part of the system *without causing more serious harm in other parts.”* Collard (1996: 585) states that Pigou took the view that future generations should be treated equally with the present generation. Pigou referred to the transfer of knowledge and accumulated human capital in the form of skills and know-how, but also paid attention to the conservation of natural resources for future generations.

However, Collard (1996:585) points out that conservationist’s distrust neo-classical economists because they do not trust the aspect of discounting and its apparent neglect of the benefit of future generations. Collard (1996) defends his stand by expressing the view that even orthodox

economists have come to accept that economics is unable to deal with environmental issues of conservation, depletion and sustainability in an effective manner. The process of discounting and cost analysis for environmental externalities does not simply mean that this process will assure the transfer of environmental benefits to future generations. Collard (1996) argues that, over and above the process of analysis and discounting, there must be an expressed willingness to transfer benefits to future generation in a meaningful and obligatory manner. The decisions about the distribution of assets across generations, according to Collard (1996:586) ought to be the central theme in economics, even though economists were engrossed in the day to day issues of mundane calculations of costs and benefits. In his concluding remarks, Collard (1996:596) states that Pigou took the view that future generation should have equal consideration when compared to the present generations, especially with regard to the conservation of the environment. He also outlines the overarching view of Pigou that present actions could, in fact, impact the utilities of future generations.

In keeping with Pigou's view of externalities, Owen (2004: 129) defines externalities as:

> *"Externalities are defined as benefits or costs generated as an unintended by-product of an economic activity that do not accrue to the parties involved in the activity and where no compensation takes place. Environmental externalities are benefits or costs that manifest themselves through changes in the physical-biological environment."*

Owen (2004:155) argues in favor of the Clean Development Mechanisms for the generation of energy and re-iterates that the principle of internalizing externalities of carbon dioxide emissions is of global validity. He argues that this can be achieved through the imposition of a universal carbon tax and emission charges or indirectly by complying with the Kyoto targets. Owen (2004:155) asserts that the removal of both direct and indirect subsidies to power generation technologies and their appropriate pricing of fossil (and nuclear) fuels, must reflect the environmental damage created by their combustion. These, Owen (2004) emphasizes, are essential strategies for stimulating renewable energy technologies.

Lai (2007:339) elucidates an alternate view of examining externalities. Rather than accepting the Pigouvian outlook of seeking relief for the impact of externalities from the imposition of relief from state intervention, Lai (2007:339) examines the Coase Theorem, whereby relief is considered by assessing the marginal costs involved by the impact of externalities. Lai (2007) quotes the view

expressed by Coase that that there is no necessity for state intervention in assessing the impact (and resulting marginal costs) associated with the intrusion of externalities into the dynamics of a market economy. The view expressed is that certain property rights are violated by externalities and as such, this violation constitutes a legal conflict between two parties. Participants in a liberal market economy need not resort to state intervention to resolve conflicts associated with economic activity. Therefore, Lai (2007) examines and describes the Coase Theorem which advocates a market related solution between two or more affected parties. Lai (2007:364) suggests that it is unwise to simply substitute Coase for Pigou in the search for a market-related solution. Rather than simply internalizing the effects of externalities, Lai suggests an objective utilization of the Coase Theorem or, if applicable, the utilization of the Pigouvian suggestion of state intervention for remedies and relief for affected parties (where applicable).

Mankiw (2009:14) invited economists to join the Pigou Club by writing that emitting carbon into the atmosphere, constitutes a negative externality. He states that in the absence of any policy, people will emit too much. Mankiw (2009:16) posits that the Pigouvian policy response is to impose a tax on carbon emission. The imposition of carbon taxes will force households and firms to internalize the carbon externality when deciding how much to drive; what kind of car to buy; how much electricity to use; and what kind of electrical power plant to build. Dealing with the aspect of extended liability, Tirole (2010: 697) describes the requirement that the polluter pay the damage inflicted upon the pollute and raises the concern that the polluter may avoid legal liability by pleading bankruptcy or abandoning any operations that cause pollution. Tirole (2010:697) claims that proponents of the Pigouvian principle of taxation for emissions advocate that polluters must be forced to contract with third party participants who would guarantee and assure that in the event of the polluter reneging on its obligation to meet pollution taxes, the obligation would fall on the third-party participant who would fulfil such obligations under the appropriate laws of any specific country. The polluter would pay a fee to a financial institution or insurance company to avoid evasion of taxes for pollution. Tirole (2010: 728) also advocates that the government delegate monitoring of pollution to the third-party entity for full accountability.

Malte, Faber and Winkler (2006:803) explore the influence of the Austrian School of economics on ecological-economic analysis. The Austrian school of economics deviates from the Pigouvian point of view of identifying externalities; assessing the impact on the environment and society; and then securing state intervention in the form of taxes and subsidies. The Austrian school of economics places great emphasis on the aspect of heterogeneity and time in dealing with

ecological-economic analysis. According to Faber and Winkler (2006:803) this type of analysis is becoming increasingly relevant due to the increasing environmental and resource problems faced by humanity. Heterogeneity, referring to the multifaceted variables that are involved in the dynamics of economic interactions, places limitations on formal Ecological Economics. Therefore, Faber and Winkler (2006) argue that political philosophy is needed as an additional instrument to lend validity to the process of economic analysis (with specific reference to Ecological Economics). Utilizing the tools of The Austrian School, Faber and Winkler (2006:818) state that there exists an asymmetry between natural resources and environmental pollution because a market for scarce natural pollution degradation does not exist. The reference to the implementation of political philosophy provokes the idea that real political action is not simply limited to command and control but may internalize the harmful effect into the market system. The outcome of internalizing the harmful effect into the market system provokes the implementation of levies and taxes. Alternatively, the process of incorporating the harmful effect into the market system could possibly provoke the introduction of licenses.

As a point of interest, the so called “harmful effect” as described by Faber and Winkler (2006:818) is in reality another description of an externality. The point of deviation between the Pigouvian approach and the Austrian school of economics is on gathering support from political sources to internalize externalities into the mainframe market system and, from there, to impose market-related charges, levies and possibly taxes. Martin (2009:517) states that Austrian economics preaches “methodological individualism, marginalism and rational choice, while embracing emergence, open processes and error”. The process of economic analysis as prescribed by the Austrian school is informed within the context of social ontology and marginality. The identification of marginality within the context of a social ontology provokes the imposition of remedies in the form of taxes, levies and surcharges.

The Clean Development Mechanisms, however, arise out of a critical awareness of Environmental Economics and the theory of externalities. While Pigou identified the impact of externalities on the fundamental process of economic activity, he did not clearly extend the importance of externalities to the broader framework of economics. Neither did he relate the importance of ecological parameters to the relevance of economic activity. Any analysis of the CDM has to contextualize it within the framework of Ecological Economics. The theories associated with externalities are inherently grounded in Ecological Economics.

Costanza and Wainger (1991:45) proclaim that the “economic system is a subsystem of a larger ecological life-supporting system”. Furthermore, Costanza and Wainger (1991:46) state that sustainability may be described as the “amount of consumption that can be sustained indefinitely without degrading capital stocks-including ‘natural capital’ stocks”. These authors suggest that in order to attain sustainability, people must incorporate ecosystem goods and services into the mainframe economics system by quantifying the values of the said goods and services relative to the economy. The authors postulate that natural ecosystems of the world perform certain recycling functions essential to the sustainability of the natural ecology. Natural ecosystems perform the essential recycling functions for free. However, for the sake of quantifying the essential value of ecosystems in the event of replacement, these ecosystems must have an equal and quantifiable monetary value. Costanza and Wainger (1991) also caution that values ought to be determined after considering how much of the ecological system man is prepared to lose.

Viederman (1993:23) posits that the new economics must be Ecological Economics based on the conceptual understanding that the economic system is an “open subsystem of a closed and finite ecosystem”. The new economics, according to Viederman (1993:23), must incorporate the core values of human life and culture and accept the concomitant, essential value of natural capital. Viederman (1993:23) also asserts that the new economy must accept an obligation to future generations just as much as it assists present generations to meet their current needs. In his concluding remarks, Viederman (1993:23) requests that the new economic order “honor equity, the ecosystem and a humane economy”.

Harris (1995:18) contends that the theoretical gulf between economists and environmental analysts had resulted in conflict on issues of policy outcomes. He states that studies by economists tend to minimize the impact of environmental issues and often oppose proactive response; arguing that environmental costs impact economic growth or alternatively, impose high economic costs. Harris (1995:19) suggests that the idea that theories of economic activity need to be modified in response to global environmental crises has made little impact on mainstream economic thinking. The author also explains that many economists argue that global warming does not, in fact, pose any substantial threat to alter the dynamics of economic thinking. Harris (1995:20) concludes that from the ongoing debate by ecologists and economists, it has become apparent that it is no longer justifiable to analyze environmental issues and derive policy recommendations exclusively based on a neo-classical model.

Searching for linkages between ecological, social and economic dimensions of environmental issues, Booth (1995:445) suggests that when it comes to the economics of environmental ecology, the fundamental problems result from cost externalization. Cost externalization directs the costs to society rather than internalizing these costs. Booth (1995:445) details the process of voluntary negotiations to internalize environmental costs but suggests that transactional costs may be restrictive and concedes that the best possible solution would come from government intervention. However, Booth (1995:446) also elaborates that the ecological system, through a process of cyclic regeneration, adds incremental value to the economy of the world at no cost. The costs of replacing damaged ecological systems hint at the unwritten commercial value of ecological systems. Therefore, Booth (1995:446) suggests that cost internalization is an essential component that bridges the gap between social and environmental elements of the economy. The author also advises that cost internalization would succeed within the parameters of disciplined consumption of economic goods from the perspective of limiting population growth. The end-point of cost internalization is that it imposes restrictions upon the unsolicited damage to the environment by economic agents of production and consumption (Booth 1995).

The essential problem for theoreticians, economists and academics is to determine what constitutes the relationship between ecology and economics. Perrings (1995:60) states that the set of problems that have stimulated the Ecological Economics approach are linked to two common perceptions. The first perception is that the dynamics of the economic systems are not independent of the ecological systems of planet earth. Both the economic system and ecological system interact and impact each other in a dynamic, continuous and non-linear fashion. The dynamics of these interactions represent the interdependence of the ecology on economics and, alternatively, the interdependence of the economy on the ecological system within which their function. The second perception is that economies owe the dynamics of growth to the environment within which it functions. The unconditional implication of this interdependence is that economic growth cannot succeed when the environment is destroyed and the ecological dynamics does not support economic growth (Perrings 1995).

If economics is related to the environment, then the inherent dynamic of the functions of the environment must have quantifiable commercial value. The consolidation of this theoretical reality grounds the principle of the Clean Development Mechanisms, which reduce emissions into the environment by eco-friendly, clean mechanisms to produce substantive reductions which are tradeable as environmental commodities. The exposure of the relationship amongst ecological

systems, the environment and the economy facilitates the process of consolidating the theoretical framework of The Clean Development Mechanisms. The core essential motivation behind The Clean Development Mechanism technology is to protect the environment and its ecology from further degradation.

Power's (1996:976) critique elaborates on the overall hypothesis that environmental disruption seriously threatens human well-being, as well as human survival, because of the ongoing loss of biodiversity. Power (1996:977) explains that ecologists and environmentalists understand and appreciate the gravity of the consequences of environmental disruption but economists tend to distance themselves from the consequences of environmental decay. If the theoretical framework points to an interdependence between the economy and the environment, then this very interdependence impacts the outcome of sustainable development. Power's (1996) work emphasizes the point that humanity is prepared to make sacrifices for the protection of the environment and it is this human sentiment that is the precursor to all aspects of sustainable development and environmental protection.

In the search for defining Ecological Economics, Costanza (1996:978) reports that Ecological Economics represents a trans-disciplinary effort to link the natural and social sciences broadly, especially ecology and economics. The purpose of Ecological Economics is to develop a deeper understanding of the interconnectivity between ecological and economic systems and to utilize this knowledge and understanding to direct and formulate polices that promote an ecologically sustainable global environment. Costanza (1996:978) interprets the concept of an ecologically sustainable environment as one that promotes a fair distribution of resources amongst current generations and future generations in such a manner that scarce resources are allocated in an equitable and just manner by always taking the ecology and environment into consideration. This will entail new, integrated approaches that are "comprehensive, adaptive, integrative, multi-scale and pluralistic in such a manner that acknowledges the many uncertainties" along the path towards ecological sustainability. Costanza (1996:986) recommends that the new integrated approach may be implemented by structuring and adapting new integrated modeling techniques. The CDM, although not specifically described by Costanza, may represent such a new innovative model.

Ecological Economics, deduced from the above analysis, incorporates the relevant facilities of ecology and economics and lends credibility to the aims and aspirations of sustainable

development by co-ordinating the dynamics of society, environment and economics for the sole purpose of protecting and securing the ecology and environment for current and future generations.

Norton and Toman (1997:553) searching for a reconciliation between economic and ecological models as they impact sustainability across multiple generations, postulate that the chasms between the two disciplines remain distant and separated in at least two areas of interest. The first is represented by the concept of reversibility and substitutability. The second is represented by the concept of adequate accounting systems. Norton and Toman (1997:565) assert that the inherent theoretical differences provoke difficulties in conceiving a workable definition of Ecological Economics because of the dichotomous, conceptual divergence of ecology and economics. These two authors suggest that a two-tier approach be applied to narrow the chasms between the two disciplines to foster increased understanding and cross-appropriation for the purpose of broadening the understanding of human interaction with the environment.

In relating the conceptual overlap between sustainability, ecology and economics, Gowdy (2000:26) states that the meaning of sustainability has provoked lively debate by economists. While the neo-classical economists equate human welfare with the consumption of market-related goods and services, they perceive the natural world merely as an input into the economic process. Gowdy (2000:26) states that to neo-classical economists, sustainability means sustaining economic output. Ecological economists, however, express a much broader view of sustainability. They conceive sustainability as a process of recognizing the life-supporting systems of planet earth and this recognition also highlights the need for sustainability to be extended the ecosystems of the planet. Gowdy (2000) refers to the neo-classical outlook as weak sustainability, while referring to the ecological economist's views of sustainability as strong sustainability. Weak sustainability is conducive to preserving an economy's capital stock for the purpose of enhancing economic output. Capital stock comprises manufactured stock, human capital and natural capital and these are deemed to be interchangeable, in terms of value within the dynamics of the economic system. According to Gowdy (2000:26), Strong Sustainability does not recognize that manufactured stock, human capital and natural capital have the commonality and basis to be substituted for each other in terms of monetary and financial value. Gowdy (2000:26) further asserts that strong sustainability provokes an understanding that the interchangeability of the different types of capital is difficult, if not impossible. The author argues that the field of Ecological

Economics came into existence in response to the failure of mainstream economics to bridge the gap between economics and natural science.

Rees (2002:15) states that modern industrial society has imbibed a dangerous cultural myth that global sustainability and poverty reduction have no place when it comes to economic expansion and free trade. Economic expansion has priority over sustainability and poverty reduction. Rees (2002:15) suggests an alternate theoretical framework that recognizes human enterprise and economic activity as falling within the ambit of the ecosphere whose growth is "constrained by biophysical limits". He recommends that humanity and society in general need to adapt to a new framework of thinking in the light of the emergent dangers arising from gross exploitation of the environment. Rees advocates that human security depends on equitable, sustainable development and not exclusively on growth alone. Sustainability and the concomitant aspect of social justice require an unprecedented level of international co-operation based on the aspects of "compassion for both other peoples and other species" (Rees 2002:15).

Rees (2002:35) exposes the myth that human enterprise can grow forever without considering the impacts on the environment. He states that from an economic perspective, the great abundance of goods in global markets creates the myth that technology has freed humanity from the biophysical constraints on growth. Rees (2002:35) posits that technology and liberal trade have had the adverse effect of accelerating the depletion of "nature's vast warehouse".

An analysis of the variables in the theoretical framework has guided this study to enquire into the theoretical grounding of The Clean Development Mechanisms. CDM protects the environment and the ecosystem by reducing the levels of carbon into the atmosphere. The fact that CDM provides a facility for monetization provides a platform for revenue generation that enhances the aspect of economic output. While protecting the environment from carbon pollution, CDM reduces the cost of generating electricity and provides a basis for sustaining the current generation while protecting the environment for future generations. CDM therefore embraces the broad principles of Ecological Economics, as well as sustainable development.

Gowdy and Erickson (2005:207) proclaim that a revolution in neo-classical welfare economics is currently taking place. The core principles of neo-classical economics are being replaced by consumer and institutional behavior. According to Gowdy and Erickson (2005:207) this new directive is largely ignored by policy directives in Environmental Economics. The authors state

that Ecological Economics is poised to play a key role in “recasting the scope and method of economic science” (Gowdy & Erickson 2005:207).

The authors state that the crucial question at this time is to create policies that preserve the life support system of the planet. Although Ecological Economics is struggling to formulate appropriate policy structures at this time, Gowdy and Erickson (2005:219) state that Ecological Economics is the only discipline poised to come up with the theoretical rigor required to formulate the kind of policies that would preserve the life support system of the planet. The rationale behind this thinking is that Ecological Economics is the only discipline that recognizes the interdependence between the economic, biophysical and social worlds and is poised to become a viable alternative to “neo-classical orthodoxy” (Gowdy & Erickson 2005:219).

Tschirhart (2009:381) emphatically states that economic activity is threatening biodiversity and this could seriously impact the effectiveness of global ecosystems. However, economists have done very little work to redress the loss of biodiversity. Some economists are calling for an integration of ecological and economic thinking to generate suitable models to reduce biodiversity loss. Tschirhart (2009:381) suggests that new integrated approaches are required that relook at ecosystem services, externalities and remodeling methodologies to address the issue of biodiversity loss.

Tschirhart (2009:385) cites Daly (1968) as indicating that ecologists abstract from human economy and study nature’s interdependence. At the same time, economists abstract from nature and study human interdependence. Daly (1968) calls for integrating the human economy into the larger economy of nature. Tschirhart (2009:385) affirms that for the past two decades researchers have stressed that economic and ecological sub-systems are jointly integrated because economic variables have a dependence on ecological variables and in turn, ecological variables have a dependence on economic variables. Therefore, this co-dependence of ecological and economic variables call for the formation of workable models to resolve issues affecting both disciplines.

2.8 A Critical Evaluation of Factors Associated with the Clean Development Mechanism (CDM)

Bollen, Gielen and Timmer (1999:177) state that the major difficulty with The Clean Development Mechanisms is the absence of national targets in countries that host CDM projects. The absence of national targets creates the possibility for host countries to unwittingly allow carbon leakages.

Bollen *et al* (1999:200) advise that CDM-related leakages may be prevented by focusing the CDM primarily on replacement investments and on sectors which are sheltered from international competition. This dilutes competition from host countries to compete directly in energy intensive products. However, Bollen *et al* (1999:200) also point to the impact that CDM may have on regional energy markets. If the Host country is sheltered from international trade because of transport costs and trade policies, then it will be difficult to reduce energy consumption and carbon production in the host country. The grave implication is that credits given to Non-Annex 1 regions because of CDM investments tend to increase global emissions because there is a failure to reduce energy consumption outside of the Annex 1 regions (Bollen *et al* 1999: 200). The authors quote the example of China, where the majority of CDM projects will take place and where, for example, the coal market is exposed to excessive usage of coal for development.

Regarding greenhouse gas abatement and the implementation of the Clean Development Mechanism, Parson and Fisher-Vanden (1999:207) concede that the willingness of major industrial nations to accept tough emission limits will depend partially on practical flexibility mechanisms that can relocate abatement effort finance between nations by mutual consent. CDMs, according to Parson and Fisher-Vanden (1999:220), make stringent targets more acceptable because they reduce both the cost of meeting a target and the risk of failing to meet it by allowing abatement abroad to substitute for abatement at home. However, negotiations will determine the extent to which abatement shifting is available as a viable alternative. Parson and Fisher-Vanden (1999:221) argue that skepticism and conflict over claimed project abatement and inflation-related accounting rules may have a direct impact on the acceptability and validity of abatement claims. Therefore, an uncontroversial accounting system will help facilitate negotiations over abatement and also help to facilitate the mitigation of any conflict or skepticism. Parson and Fisher-Vanden (1999:221) further argue that for biases to be superseded in connection with the implementation of the Clean Development Mechanism, proper project-centered accounting systems need to be jointly implemented with every CDM project.

While accounting systems and the correct project implementation protocol assure both host and Annex 1 countries of uncontested gains from the implementation of The Clean Development Mechanism, Jyoti P. Painuly (2001:147-169), analyses the benefits, in terms of how the Kyoto Protocol, and specifically the implementation of CDM, benefits developing countries in particular. Painuly (2001:147) discovered that gains to Non-Annex 1 countries (developing countries) from participation in Greenhouse gas emissions reductions via CDM might vary from six billion dollars

($6billion) to twenty-nine billion dollars ($29 billion), which amounts to approximately seven percent (7%) and twenty percent (20%) respectively of the global gains in the emission trading system. However, Painuly (2001:147) advises, that in order for developing countries to maximize gains from CDM, certain design and implementation aspects of CDM need to be resolved. These issues can only be resolved by allowing Non-Annex 1 countries full participation in the design and implementation of CDM. In her concluding remarks, Painuly (2001:165) states that literature on the Kyoto Protocols' impact on developed countries indicates that global as well individual country costs in meeting the Kyoto targets via CDM are very high if countries with targets (Annex 1 countries) have to act individually. Therefore, the implication is that there must be global participation in the decision-making process, including Non-Annex 1 countries as well.

In seeking to quantify the sustainability benefits of CDM, Rowlands (2011:795) proposes that for the 'supplemantarity' of CDM, there must be a system of capping the extent to which CDM can be used to allow Annex 1 countries to meet their greenhouse gas emissions; that CDM eligibility be restricted to specific projects only; and that "geographical quotas" be introduced to encourage CDM activity throughout the developing world. Rowlands (2001:795) suggests that further studies need to be undertaken on how to place beneficial restrictions on CDM project eligibility. The investigative work executed by Rowlands (2001:808) concludes that two policy-related observations can be offered. Firstly, the imposition of control measures on the unfettered implementation of CDM yielded better outcomes towards sustainability. Secondly, although there are costs to the economy both for Annex 1 and Non-Annex 1 countries in the process of implementation, there are real, corresponding benefits to the ecology and society by implementing CDM. Rowland's findings (2011:808) indicate that the imposition of stricter eligibility criteria for the implementation of CDM translates into more substantive ecological gains and therefore needs support.

The implementation of CDM requires participating countries to have ratified the Kyoto Protocol. The United States and Canada have not ratified the treaty, although it could be argued that together, the United States and Canada would rank amongst the greatest polluters on the planet in terms of carbon emissions. In 2000, Mexico, the southern neighbor of the United States, ratified the Kyoto Protocol, and thereby creating an opportunity for the implementation of CDM on behalf of the host countries, the United States and Canada. Thomas, Basurto and Taylor (2001:209) indicate that industry leaders in the United States are beginning to explore opportunities presented by the implementation of CDM as one of the strategies to adapt to climate change.

Although the United States has signed but not ratified the Kyoto Protocol, many private and public players have taken the initiative to lay the groundwork for policy makers to ratify the treaty to foster CDM relations with Mexico and other non-Annex 1 countries. However, the process could take several years. Repetto (2001:303) makes the point that CDM could be the key that unlocks barriers to ratification of the Kyoto Protocol by the United States, but cautions that CDM contains perverse compliance incentives in connection with credit definition, monitoring, enforcement, leakage problems and potentially high transaction costs.

Repetto (2001:319) proposes the following remedies for the successful implementation of CDM:

- The market model of the CDM should be applied only to countries (Non-Annex 1 countries) with a strong private enterprise component and effective governance;
- The executive body of the Conference of Parties should establish eligibility pre-conditions that Non-Annex 1 countries must meet before entering into any CDM arrangements;
- The onus to determine which sectors are eligible for participation in CDM must fall upon the offices of national governments of Non-Annex 1 countries; and
- It should be the duty of the Executive Body to make available to non-governmental bodies, through the Internet, all information regarding the project, baseline calculations, transactions and credit payments.

Repetto (2001:320) cautions that the political conditions for Ratification of the Kyoto Protocol are not firmly in place in the United States and the entire process could take a long time.

There is often the suggestion that the United States, producing at least 20% of global greenhouse gases (Gupta 2003:4293) refrains from ratifying the Kyoto Protocol because the United States accounts for almost 25% of the world's energy consumption. The scale of any possible CDM implementation would rapidly increase the marginal cost of energy consumption. However, Gupta (2003:4297) states that despite the uncertainty of the scale of the CDM market in India, it is very likely that India will be a major player in utilizing CDM for greenhouse gas abatement. Gupta (2003:4297) states that emission trading would represent an important component in the drive for the abatement of greenhouse gases. The aspect of technical refinement and monitoring the CDM process may pose initial hurdles, but implementation of CDM promised short-term and long-term gains for India with its massive drive for economic growth (Gupta 2003:4297). Gupta (2003) cautions that India ought to be prepared to face many problems in terms of monitoring and

enforcing CDM before adapting a market-based solution (CDM) for the abatement of greenhouse gases.

Gundimeda and Guo (2003:4331) proclaim that there are certain non-participant risks involved in the implementation of CDM, specifically to the risk involved in allowing mediation by governments. They argue that governments are not equipped to recognize crucial elements of risk associated with CDM. Risk could be broadly based but specific risks like default or project failure motivate for the appointment of an independent intermediary to facilitate, bargain and assess the possibility of risk at various stages of implementation (Gundimeda & Guo 2003:4336). The authors declare that by appointing proper intermediaries, government could be shown benefits of CDM from the perspective of an expert intermediary and this process could potentially facilitate government participation in projects to prevent default and failure. Therefore, the argument to appoint intermediaries like the World Bank, for example, would assure close identification of potential risks and thereby guarantee project success. Gundimeda and Guo (2003:2003) refer to the World Bank having launched a prototype carbon fund for the successful implementation of CDM. By implication, the World Bank would have a vested interest in the success of current and future CDM projects and would therefore provide the basis for a strong intermediary for risk mitigation, negotiations between host country, Non-Annex 1 countries and government departments in order to secure project success. Furthermore, the authors place significant importance on the process of effective contracting, monitoring and delegating to appropriate disciplines.

CDM implementation between developed economies and developing economies may have to overcome unique regional hurdles. For example, due to its rapid economic growth, China has had significant impact on the atmosphere in the country and neighboring countries as well. Hayami, Masao and Yoshioka (2003:213) describe how the massive consumption of coal in China has resulted in harmful air pollution and acid rain in neighboring countries, including Japan. The Geographical closeness of China and Japan provides the perfect conditions for the implementation of CDM because Japan is considered a developed economy, with emission targets, while China is considered to be a developing economy. Hayami *et al (*2003:213) point out that government policies on how to manage environmental protection differs considerably between China and Japan. While Japan is keen to curtail carbon emissions from China's coal burning, this does not appeal to China's demand for cheap energy from coal. These policy differences pose major hurdles between the host country, China, and the Annex 1 country, Japan. The suggestion articulated by Hayami *et al (*2003:214), that oil should be burned instead of coal

in order to facilitate the implementation of an abatement mechanism is rejected by China because state policy would rather use cheaper and abundantly available coal rather than oil. Although Japan shows a willingness to meet its Kyoto Protocol obligations via CDM, the Chinese State policy would rather utilize less expensive methods. Therefore, policy differences pose significant impediments towards the implementation of CDM between politically divergent countries.

Kallbekken and Westkog (2005:41) question the rationale of developing countries committing to binding emission reduction agreements through mechanisms like CDM. The authors explore whether efficiency gains obtained by developing countries could offset possible economic risks when the future of emission trading is uncertain. Kallbekken and Westkog (2005:57) conclude that "CDM is assumed to have high transaction costs, while developing countries are assumed to have low-cost abatement projects to offer" and suggest that developing countries could obtain significant welfare improvements by making a transition from CDM trading to pure emission trading (outside of CDM structures). This option would also benefit developed economies by providing a less expensive, negotiable trading mechanism. If emission capping would turn out to be more stringent and more expensive in the future, it would be better for developing countries to concentrate on better welfare gains by not committing to binding abatement arrangements coming out of the Kyoto Protocol (Kallbekken & Westkog 2005:57).

Nepal, the small mountain kingdom in the Himalayas, ratified the Kyoto Protocol in September 2005, opening up the door to foreign investment through CDM, in carbon reduction projects. Mainali (2005:468) posits that the most feasible CDM projects in Nepal are focused on bio-gas (for cooking) and micro-hydropower projects. According to Mainali (2005:468), the bio-gas sector shows the most promise for the implementation of CDM, although only ten per cent (10%) of the countries needs are met by these means. Mainali (2005) therefore concedes that at present, fossil fuels appear to be less expensive than renewable energy. For this reason, and for the smallness of economies of scale, CDM is not an economically feasible proposition for a small country like Nepal.

The prospect for feasibility becomes more promising for the implementation of CDM when considering the economies of scale of the two huge Asian economies of Japan and Philippines. Rosalina Palanca-Tan (2006:41) explores the reasons why there is a relatively low level of engagement between Japan and the Philippines towards the usage and implementation of CDM.

Palanca-Tan (2006: 73) makes the following suggestions for effective co-operation between Japan and the Philippines on the possible utilization of CDM projects:

- The Philippines needs to take drastic measures to foster political and economic stability to attract CDM investment from Japan. Furthermore, the Philippines needs to curb rampant red tape, poor infrastructure development and poor governance;
- The Philippines must prioritize afforestation and re-forestation projects, waste to energy projects and renewable energy sectors for the vast rural regions;
- The readiness for participation in CDM projects with Japan must be communicated with a sense of urgency for an appropriate response; and
- Effective collaboration and reinforcement from Japan is equally important especially when Japan has to play a leading role in facilitating the prospect of the Philippines achieving its sustainability goals in accordance with the principles of the Kyoto Protocol.

The Climate strategy of the European Union is more widely embracing and therefore, exposes many more variables that may contribute to a better understanding of the dynamics required to address emission trading. Klepper and Peterson (2006:1-26) state that The European Emissions Trading Scheme (ETS) for carbon di oxide, is one of the major components of the European climate strategy for achieving European Kyoto targets. The ETS was convened in 2005 and embraces facilities for electricity generation; the production of ferrous and non-ferrous metals; and the utilization of energy in the mineral and pulp industry, as well as the paper and board industries. Klepper and Peterson (2005:1) state that these industries account for about forty-five percent (45%) of European Union Carbon dioxide emissions. The ETS, as stated by Klepper and Peterson (2005:1), allows the European Union to trade emissions through two mechanisms: CDM and Joint Implementation (JI). These two mechanisms help to reduce the cost of meeting European Kyoto targets. In analyzing the effectiveness of Joint Implementation and CDM as tools for emission trading in the European Union, Klepper and Peterson (2005:21) conclude that there still remains a large difference between the allowance price in European Emission Trading of Euros 5.7 / ton of CO2 and the implicit tax necessary to achieve reductions in non-ETS zones of between 30 to 110 Euros per ton of CO2. The authors therefore argue that while the implementation and use of JI and CDM drives down the allowance price in European Emission Trading by one third and reduces margins between implicit taxes outside the European Emission Trading Scheme and the allowance price, the distortions cannot be eliminated altogether. As a concluding remark, Klepper and Peterson (2005:21) proclaim that the welfare costs of meeting the European Kyoto targets are much higher than under an emission tax imposed unilaterally by

each member state. It may therefore, be deduced from the ongoing discussion in this theoretical framework on the implementation of CDM that costs pose a reasonable deterrent towards the implementation of CDM and indeed, JI.

Hirsch (2007:623) offers an alternate suggestion. He highlights the issue of whether it is more feasible to remove greenhouse gases through carbon sinks than through technology-based mechanisms. Hirsch (2007:628) describes carbon sinks as a process whereby greenhouse gases are removed from the atmosphere and stored in forests and oceans. The negotiators to the Kyoto Protocol initially debated the possibility of using carbon sinks in association with CDM, but after much debate the use of carbon sinks was abandoned. Although carbon sinks reduce costs, Hirsch (2007:633) outlines the problem of leakage where a CDM project's protection of one forest increases the pressure to exploit another forest outside the project boundaries. This is one of the primary motivations for rejection of carbon sinks for the greenhouse reductions associated with CDM.

However, CDM is still considered to be an attractive option to the massive Chinese economy. In an interview with Philippe Delhaise (Director of Carbon Management Consulting) by Favreau and Huchet (2007:73) it was stated that China has abundant by-products from its massive industrial output that has the potential to produce carbon and pollute the atmosphere. China would therefore like to utilize the The Clean Development Mechanism to convert these by products into electricity producing energy outlets. The interviewers quote the example of residual from sugar cane that could be burned to diffuse the potential carbon emission while at the same time producing energy to produce electricity.

Favreau and Huchet (2007:74) report that in 2007, China had the potential to embark upon projects with enormous potential to reduce emissions by up to 80,000 tons per annum. The potential emission reduction, they reported, was closer to about one and a half million tons. This gives China the potential to have more than one third of CDM financial transfers to be made to China! This massive potential is untapped because the United Nations is not satisfied with the ill effects on the environment caused by the huge dams built in many parts of China. Therefore, any country wishing to participate in the CDM program, no matter what their potential is to reduce carbon emissions, must produce a clean sheet in terms of showing a willingness to contribute to effective sustainable development at all levels. According to Favreau and Huchet (2007:76), the Chinese do not favor the division by the Kyoto Protocol of Annex 1 and non-Annex 1 countries.

The interviewers report that China expresses the view that some countries that receive subsidies under CDM are merely exploiting the system. This negates the call for emission reduction when the motivation by some countries is focused only on the receipt of subsidies.

While many non-Annex countries are willing to participate in The Clean Development Mechanism programs, there are some Annex 1 countries that argue that Non-Annex countries are exploiting the system purely for the financial benefit of the subsidies rather than for the reduction of emissions. Bumpus and Liverman (2008:127) state that the CDM process has commodified emission control and furthermore, has introduced a market link into the North/South debate to reduce carbon emissions. The CDM process, according to Bumpus and Liverman (2008:147), has created new institutions and regulations to govern the production and exchange of emissions reductions. These structures, have opened up the doors to unfair claims and unfair payments and Bumpus and Liverman (2008) suggest that the political economy of off-setting has produced highly unequal geographies that link permits to pollute and regulations to obtain cheap compensation. The authors also declare that a more serious critique of offsets is the argument that paying someone else to reduce carbon is unethical and that offsets should come from global behavioral and technical changes (Bumpus & Liverman 2008).

In the earlier years of the Kyoto Protocol, the motivation was to engage as many countries as possible to participate in the global effort to reduce carbon emissions. Although many accepted the motives of the Kyoto Protocol to reduce carbon emissions, many ethical questions arose from the aspect of one country paying another to pollute in such a manner so as to assist the Annex 1 country to reach its emission targets. This aspect of the Kyoto Protocol invited many who questioned the very ethics of the Clean Development Mechanism. As the global dynamics of economic output is changing constantly, it is now emerging that China will become the greatest emitter of Carbon now and in the near future, closely followed by the United States and India.

Chen (2008:145) makes the startling claim that China is reaping billions of dollars through participating in the Clean Development Mechanism projects. Chen (2008:145) claims that the incentive generated by subsidies from CDM projects are actually encouraging China to continue to pollute and even to enlarge its carbon footprint to attract more subsidies from the utilization of more The Clean Development Mechanism projects. The deeper ethical question, according to Chen (2008:146) is that China is using its economic power as leverage to continue to pollute without heeding the calls of the Kyoto Protocol to reduce emissions. The ethics of carbon trading

has placed China in the forefront of a new component of ethical behavior. In the new ethical debate, Chen (2008:171) refers to China's economic might as "hard Power" and its negotiation skills as "soft power". He claims that China uses both hard power and soft power to refuse to comply with the call for a greater concerted effort to reduce emissions. Chen also refers to the apparent collusion between India and China to support each other in undermining the call by the United Nations to unconditionally reduce carbon emissions.

India ratified the Kyoto Protocol in 2002 and even though its economy is growing at an average of seven percent per annum and the corresponding emissions have also grown proportionally, Singh (2008:17) states that India does not have any clearly demarcated emission targets. Singh (2008:19) posits that India has the potential to attract CDM for many of its projects but is failing to do so because of lack of capacity to forge proper negotiating platforms between project co-ordinators and Annex 1 countries. The author indicates that India must actively identify opportunities presented by CDM; the associated legal and regulatory requirements; the human capital requirements; and prescribe to curb emissions while at the same time generating revenues from the successful implementation of CDM. Singh (2008:19) postulates that state apparatus and individual project intermediaries do not have the necessary skills nor the capacity to evaluate and pursue the abovementioned criteria for the implementation of CDM. The author therefore recommends that the state set up a "Carbon Finance Fund" that would allocate resources to proper channels to explore the potential from projects and critically analyze the projects from the perspective of their feasibility to attract funding for CDM. The "Carbon Finance Fund" would also facilitate bridging finance before and after the successful implementation of The Clean Development Mechanism projects. It is rather interesting that Singh (2008: 17) conceptualizes CDM more as an opportunity to generate revenues rather than a mechanism to offset and reduce global carbon emissions. This aspect presents one of the major weaknesses of CDM because it has become apparent from the literature that project co-ordinators and state officials tend to perceive CDM more as a revenue generating mechanism rather than one designed to reduce global emissions.

Together, India and China are the greatest producers of carbon dioxide emissions in the world. Kim and Jones (2008:9) indicate that in 2006, China's emissions were eight percent (8%) higher than the United States at 6.2 billion tons of carbon dioxide (CO2), as compared to 5.8 billion tons for the United States. This makes China the greatest producer of carbon dioxide in the world. Ideally, this should offer a great opportunity to implement CDM in China to offset the dangers of

pollution. Kim and Jones (2008:12) state that the greatest hindrance to the implementation of CDM in China is lack of governance, lack of legal capacity and also the lack of effective monitoring mechanisms. Laws have to be enforced through an independent judiciary outside the ambit of local government, which produces unnecessary delays. Furthermore, Kim and Jones (2008:13) point out that China has a reluctance to succumb to Western requests for emission control. China refers to these requests as “Climate Terrorism”, stating that the West had its time for unfettered development and that the imposition of emission controls places major economic barriers towards development in China. For this reason, China is very reluctant to accept international limits to its greenhouse emissions. China refuses the imposition of capping on its greenhouse gas emissions and to date, the United States has not ratified the Kyoto Protocol (Kim & Jones 2008:13). These two countries therefore pose the greatest barriers towards the implementation of CDM as a viable mechanism to reduce global gas emissions.

Johnson and Wittman (2008:10) state that although the United States did not ratify the Kyoto Protocol to date, they are, however, allowed to participate in the capping mechanisms and trade certified emission reductions (CERs) as represented by CDM. Johnson and Wittman (2008:10) also argue that carbon off-setting that reduces social equity ought to be avoided as much as carbon trading that affects the ecology of the environment has to be avoided, as well. The authors make special reference to rural populations in developing countries that depend to a large extent on the environment for their livelihood. The risk of adverse social and environmental outcomes from carbon off-setting and carbon trading must be avoided at all costs. The argument is therefore that any acceptance and implementation of mechanisms like the CDM must only be mandated when no risk is directed to social outcomes, as well as to the environmental ecology.

The risk of adverse social, environmental and economic outcomes must be outlined by an appropriate, independent screening body. Gehring and Plocher (2009:669) highlight the role of The Executive Board, an expert body that acts as a trustee agent of the member states. Their role mitigates social, environmental and economic adverse outcomes through objective decision-making. Gehring and Plocher (2009:669) advise that Trustee agents like The Executive Board, help overcome the credible commitment problems of their principles and promise reason-based decision-making. An outcome of this is that decision-making criteria provide a valid, external point of reference towards the implementation of CDM. The authors also explain that the triadic relationship between The Executive Board, the principal and the agent protects the autonomy of the trustees and allows for making them accountable for their decisions. “Accountability

mechanisms intend to ensure that a trustee's decisions are in line with established decision criteria" (Gehring & Plocher 2009:669). The authors conclude that the appointing of The Executive Board provides a model for non-partisan international regulation with respect to the formal implementation of CDM.

Dutt (2009:48) highlights the importance of continuity for CDM projects post 2012. He writes that the crediting period of CDM projects can span over a period of 21 years and longer. Dutt (2009:48) emphasis that there is no agreement to follow the first commitment period of the Kyoto Protocol which expires on December 2012. Therefore, there is uncertainty on the value of Certified Emissions Reductions beyond 2012 but Dutt (2009) reminds one that there is great likelihood that CER will be recognized well beyond 2012 as tradeable currency for the process of abatement of greenhouse gas emissions because of recognition by the European Union, the United States and other global powers.

For developing economies like India and China, the burning of coal presents itself as the greatest producer of carbon gases. There is an argument that the process of capping and trading (as in CDM), commodifies carbon emissions and this process of commodifying subjects the carbon trade to price fluctuations and massive price changes. The process of commodifying adds a marketing dimension to the economics of carbon trading. There is a growing concern amongst developing economies that the more developed economies have been burning coal for decades to fire their economies and did so without the burden of capping and trading. Most developing nations are reluctant to wholly support the elements of capping and trading because the process of commodifying tends to inflate the cost of carbon production. Therefore, development is held to ransom by the penalties imposed by developing nations who want to continue to pollute and at the same time impose costs on development in developing countries. The economies of scale are so massive in China and India that any marginal change in the pricing of carbon emissions has a ripple effect on the overall cost of production across all sectors of development. Developing nations, China and India in particular, are hesitant to join any international treaty on climate mitigation for the reasons mentioned above. Joshi and Patel (2009:71) contend that India should only join a climate mitigation treaty after 2020 to see if mechanism like CDM have any significant leverage on the aspect of mitigating carbon reductions across the globe. Joshi and Patel (2009:76) suggest that even if India does join an international mitigation treaty in 2012 it must do so on its own terms and not on the terms of the developed economies. The authors advise the

Indian government that India must negotiate an allocation formula for permits which would compensate India for it mitigation costs for several decades (Joshi & Patel 2009:76).

The positions of India and China place special reservation on the welfare costs of implementing CDM or any other emission trading mechanism. The so-called North / South divide adds another dimension to the perceived discriminatory pricing of tradeable carbon emissions. Not much is written on the aspect of carbon trading in Africa mainly because development and highly developed production methods are only recently becoming apparent in Africa. It is therefore highly likely that the call for affordable prices on carbon trading will become a universal call from the developing economies of Africa sooner rather than later. Any negotiated implementation of CDM in the developing economies must include the aspect of fair pricing and fair trading.

Hultman, Boyd, Roberts, Cole, Corbera, Ebeling, Brown and Liverman (2009: 120) question whether international climate policy instruments such as CDM should embrace wider sustainable development goals as well or whether they should be limited to market effective mechanisms like CDM? Hultman *et al* (2009:122) respond that the CDM mechanism is exclusively centered on the process of abating carbon emissions for an exchange of cost at market-related prices. There is no direct reference to sustainable development because any inclusion of a non-carbon component may have the effect of increasing costs of implementation. Hultman *et al* (2009:122) also indicate that the inclusion of any sustainable component into the CDM mechanism would make it unattractive to potential investors.

Hultman *et al* (2009:122) further indicate that successful international climate policy must include two policy directives, namely:

- Diverse countries will have common but differentiated responsibilities towards environmental protection and climate change; and
- Environmental goals must be pursued in partnership with economic growth.

The authors argue that disassociating sustainable development from CDM could remove incentives for broad-based participation. They also advocate for broad-based participation based on fairness, good governance and mutual benefit to all parties (Hultman *et al,* 2009:122).

Rai (2009:70-75) states that experience with CDM has been favorable at times and unfavorable at most times. Rai (2009:70) makes the startling statement that overall, CDM has led to significant

overpayment by developed countries to developing countries for projects with dubious emission reductions. Rai (2009:75) declares that the efforts to reduce greenhouse gases through CDM have not been serious and that the emission reductions have been limited to date. Rai (2009:75) describes *additionality* and the process of accurately calculating *additionality* as the basis of the problem. Therefore, investors make the incorrect investment decisions by not understanding the process of correctly assessing and evaluating the concept of *additionality*. Furthermore, Rai (2009:75) reports that evidence suggests that perverse incentives have been widely used to gain investments from developed countries for projects with questionable environmental integrity (in developing countries). The author suggests that a critical assessment of *additionality* is required before investment takes place and future investment beyond 2012 should focus on projects that are interconnected with national aims towards the abatement of carbon emissions. These projects must be sanctioned by the national authority and fall within the domain of national policy directives towards development and emissions reduction.

Rai (2009) has highlighted some serious alleged flaws in the assessment of *additionality* and has questioned the effectiveness of CDM as a process in abating emissions, transferring of technology and in achieving the overall goals of environmental protection. These alleged weaknesses inherent in the implementation of CDM are not backed by substantive field data and therefore lack validity but point the researcher to incorporate mechanisms into the survey instrument to accurately assess the variable of *additionality.*

However, Erlewin and Nusser, (2011:293) reporting on the effectiveness of CDM in the mountain region of Himachal Pradesh, India, question the effectiveness of CDM hydropower projects in reducing carbon emissions. The authors argue that there is no abatement of greenhouse gases with respect to CDM hydropower projects because these projects have always been built in similar fashion and will continue to be built in similar manner in future, without CDM support. The very nature of the terrain in the Himalaya Mountains are conducive to hydropower rather than burning coal to produce energy for electricity generation. There is therefore the argument as to what benchmark one would use to determine baseline emissions for CDM.

Edwin and Nusser (2011:302) conclude that their analysis of large CDM dams in Himachal Pradesh has revealed that the promotion of hydropower through the carbon abating scheme is highly dubious. Their evidence suggests that local regulations fail to ensure that CDM dams help in climate change mitigation. Nor do these dams contribute towards sustainable development.

Edwin and Nusser (2011:302) report that there is strong evidence to suggest that CDM dams in Himachal Pradesh produce outcomes that are in direct conflict with the aims of mitigating climate change and promoting sustainable development. These outcomes undermine the aims of CDM with respect to society and also with respect to mitigating climate change. The authors claim, in fact, that hydropower plants in the mountainous regions produce clean power and do not impose dangerous emissions on the environment. Hydropower plants using natural environment and natural hydropower generation from fast flowing water generally produce outcomes that nourish the local environment and the process of damming water, produces more water for irrigation and more water for sustainable living (Edwin & Nusser 2011). Funding mountain hydropower electricity generation through CDM has negligible or zero effect in abating the production of greenhouse gasses because hydropower generation is inherently clean. It is wasteful to fund Mountain hydropower with CDM.

Hwang and Kim (2011:85-130) assessing the investment status and investment criteria involved in CDM and declare that the most direct criteria for attracting CDM investment is the volume of carbon emissions, with the proviso that the host country must provide appropriate infrastructural, political and policy support for the implementation of CDM. Hwang and Kim (2011:124) compare carbon emissions for developing economies. In 2007, they chose China, India, Korea, Iran, Mexico, Indonesia and Brazil as the most prolific produces of carbon emissions (by volume) of all developing economies. The carbon emissions of these nations rose dramatically from 2009 and in 2010, the Asia-Pacific region produced more than 80% of the emissions counted for CDM projects. Hwang and Kim (2011:124) also conclude that China and India have the most impressive capacity to attract CDM projects and state that in 2012, China and India accounted for 88 % of carbon reduction by volume, through the implementation of CDM. The authors point to the rapidly growing CDM investments in Korea and other Southeast nations like Indonesia, Malaysia, Vietnam and Thailand. Hwang and Kim (2011:126) further iterate that in 2011, thirty-five percent (35 %) of all registered CDM projects (287 out of a total of 826) and thirty-four percent (34%) of all CERs issued were issued to India. However, China is expected to lead India by virtue of projected volume of registered projects (Post 2012).

Statistics reveal that the rate of implementation of CDM projects seems to be directly proportional to the capacity for economic growth. With the Chinese and Indian economies growing at an average of seven percent (7%) per annum from a massive economic base, it becomes apparent

that most CDM projects are successfully implemented in China and India. The growing economies of South East Asia continue to attract CDM projects.

2.9 A Summary of Findings from the Critical Review of the Key Components of the Theoretical Framework

- The review of the theoretical framework suggests that resources that threaten the environment and lead to serious waste problems should be taxed and prohibited by the imposition of new accounting systems.
- A long-term survival plan has to be implemented on a global scale to reverse the historical movement away from renewable resources.
- Sustainable development requires the implementation of an environmental accounting system to allocate numeric value to environmental losses and costs.
- Environmental Economics seems to place its origins in the Malthusian Theory of Scarcity and Steiger's Theory of Steady State and then evolved into utilizing the neo-classical theoretical framework to implement mathematical and market tools in producing sustainable solutions for environmental problems.
- Neo-classical Welfare Economics will continue to provide an ethical, ideological and value-free platform for the interpretation of Environmental Economics.
- The fundamental basis of Environmental Economics rests on the Pareto criteria, which states that any change that makes at least one individual better and no individual worse off, represents an increase in welfare.
- The very basis of Environmental Economics and sustainable development revolves around the issue of how to alter the presence of an *externality* to achieve Pareto equivalence.
- It is not simple and easy to impose a par unit tax to compensate for any irregular *externality* (like pollution or carbon emission) and thereby achieve Pareto optimum.
- The presence of externalities arising from environmental problem, is provoking new economic thinking. In terms of Environmental Economics, Ecological Economics and the economics of sustainable development; *externalities* have become regular economic variables.
- *Externalities* may provoke real property damage to society and from this perspective, require a legal solution rather than an economic one, taking the form of taxes and subsidies.

- *Externalities* tend to manifest where there is a divergence between private and social cost.
- There is valid argument that market forces alone may not have the capacity nor authority to resolve the presence of *externalities* in the economic equation. Some state intervention may be necessary.
- The classical description of *externalities* pays attention to the quantity of the commodity produced and not upon who produces the *externality*. In the instance of pollution as an *externality*, pollution may be regulated by the imposition of *per unit* effluent taxes.
- The resolution of *externalities* inevitably results in a situation where some win and some lose, implying that some have more rights than others in the consequence of the resolution of *externalities*.
- Pigou advises state intervention towards the resolution of *externalities,* while Coase is opposed to state intervention. State intervention suggests the imposition of taxes and subsidies.
- Owen (2004:129), consolidating Pigou's view of externalities, defines externalities as: *"Externalities are defined as benefits or costs generated as an unintended by-product of an economic activity that does not accrue to the parties in the activity and where no compensation takes place. Environmental externalities are benefits or costs that manifest themselves through changes in the physical-biological environment"*
- There is growing consensus that the imposition of a universal carbon tax and emission charges will effectively internalize externalities, as proposed by the Kyoto Protocol.
- Assessing the marginal costs associated with the impact of externalities is an alternate to the principle of imposition of taxes.
- Pollution taxes must be monitored by independent third parties to assure conformity, compliance and fairness.
- The Austrian school recognizes that there is an asymmetry between natural resources and environmental pollution because a market for scarce natural pollution degradation does not exist. The Austrian school advocates the inclusion of marketing solutions with state intervention in levying taxes, levies and surcharges for pollution.
- The process of economic analysis, as prescribed by the Austrian school, is informed within the context of social ontology and marginality.
- The theories of externalities introduced by Pigou are inherently grounded in Ecological Economics.

- Ecological economists conceptualize the economic system as a subsystem to a larger ecological life-supporting system.
- When it comes to the economics of Environmental Economics the fundamental problems arise from cost externalization. Cost externalization directs the cost to society.
- Cost internalization is an essential component that bridges the gap between social and environmental elements of the economy. The end-point of internalization is that the process imposes restrictions upon the unsolicited damage to the environment caused by economic agents of production and consumption.
- The theoretical framework points to an interdependence between the economy and the environment and this interdependence impacts the outcome of sustainable development.
- Ecological Economics promotes an interconnectivity between ecology and economics and is responsible for the formulation of policy outcomes that promote sustainable development as a viable end-point.
- Broadly speaking, sustainability is perceived as a process of recognizing the life-supporting systems of planet earth and this recognition also recognizes the need for sustainability to be extended to the ecosystem of the planet for the benefit of current and future generations.

2.10 A Summary of the Findings of the Critical Evaluation of the Factors Associated with CDM

- The absence of national targets for emissions allows for host countries to unwittingly allow CDM carbon leakages.
- An uncontroversial accounting system will help facilitate negotiations over abatement and skepticism over the implementation of CDM
- The cost to comply with the requirements of the Kyoto Protocol with regards to CDM are high for Annex 1 countries and host countries alike. Therefore, there must be global consensus in the decision-making process.
- The imposition of control measures on the unfettered implementation of CDM yield better outcomes towards sustainability.
- Stricter eligibility criteria for the implementation of CDM translates into more substantive ecological gains.

- Governments are not equipped to recognize the crucial elements of risk associated with CDM and therefore an independent intermediary must be appointed to facilitate, bargain and assess the possibility of risk at the various stages of CDM projects.
- Government policy differences pose significant impediments towards the implementation of CDM between politically divergent countries.
- Transaction costs for CDM projects are extremely high and may drive non-Annex countries to abandon CDM projects for inter-country co-operation to trade carbon emissions.
- CDM tends to perform best in host countries with large economies of scale.
- CDM succeeds in an environment of political and economic stability.
- Regional price distortions may increase costs to host countries, as well as to Annex 1 countries.
- CDM structures have opened up doors to unfair claims and unfair payments and have in some instances increased pollution, even though funding was offered for greenhouse gas reductions.
- The commodification of CDM has resulted in unfair payments and unfair claims.
- The issue of getting one country to offset the emissions of another has provoked an ongoing debate on the ethics of CDM.
- CDM succeeds in countries with a proper legal and regulatory environment.
- The lack of governance, legal capacity and effective monitoring mechanisms have led to the failure of some CDM projects.
- The risk of adverse social and environmental outcomes from carbon off-setting and carbon trading must be avoided at all costs.
- The risk of adverse social, environmental and economic outcomes must be outlined by an appropriate, independent screening body.
- Developed countries should not impose terms on developing countries with respect to CDM projects.
- Fair pricing and fair trading are an absolute requirement for the implementation of CDM.
- With reference to CDM project implementation, environmental goals must be pursued with economic growth.
- Flaws in the calculation of baseline and additionality have led to the overpayment to developing countries.
- CDM investment must be based on the proper evaluation of conditions of feasibility.

The purpose of the theoretical framework is to search for relevant and appropriate theories and theoretical mechanisms to ground the basis of the Clean Development Mechanism. Theory suggests that CDM is invariably related to Environmental Economics, Ecological Economics and to the overarching principles of sustainable development. The presence of externalities arising from environmental problems is provoking a new economic thinking. In terms of Environmental Economics, Ecological Economics and the economics of sustainable development, externalities have become regular economic variables. Externalities tend to manifest where there is a divergence between private and social cost. Externalities may provoke real damage to property and society and from this perspective, require legal, economic or market-related solutions. Sometimes, it may require state intervention or intervention by the United Nations to enforce compensation for victims of externalities. The Clean Development Mechanism is a mechanism whereby Annex 1 countries may reach out to developing Non-Annex 1 countries and compensate the developing countries with funding to facilitate the process of meeting emissions targets. The funding mechanism associated with CDM pays for the reduction of harmful global emissions and this funding also provides a basis for funding sustainable development. Although CDM funds emission reduction, it also facilitates the transfer of technology from the developed world to the developing economies. The transfer of funding and technology provides a structural basis for sustainable development in both Annex 1 and Non-Annex 1 countries. The very basis of CDM revolves around the principle of externalities and how to compensate for the social and economic damage caused by the presence of externalities. From a funding perspective, CDM provides regular revenue flows to the host country for its contribution to meeting global emission targets. With specific reference to the EThekwini Municipality, this research sets out to measure the determinants of and the barriers to sustainable development, with specific reference to CDM as a funding mechanism.

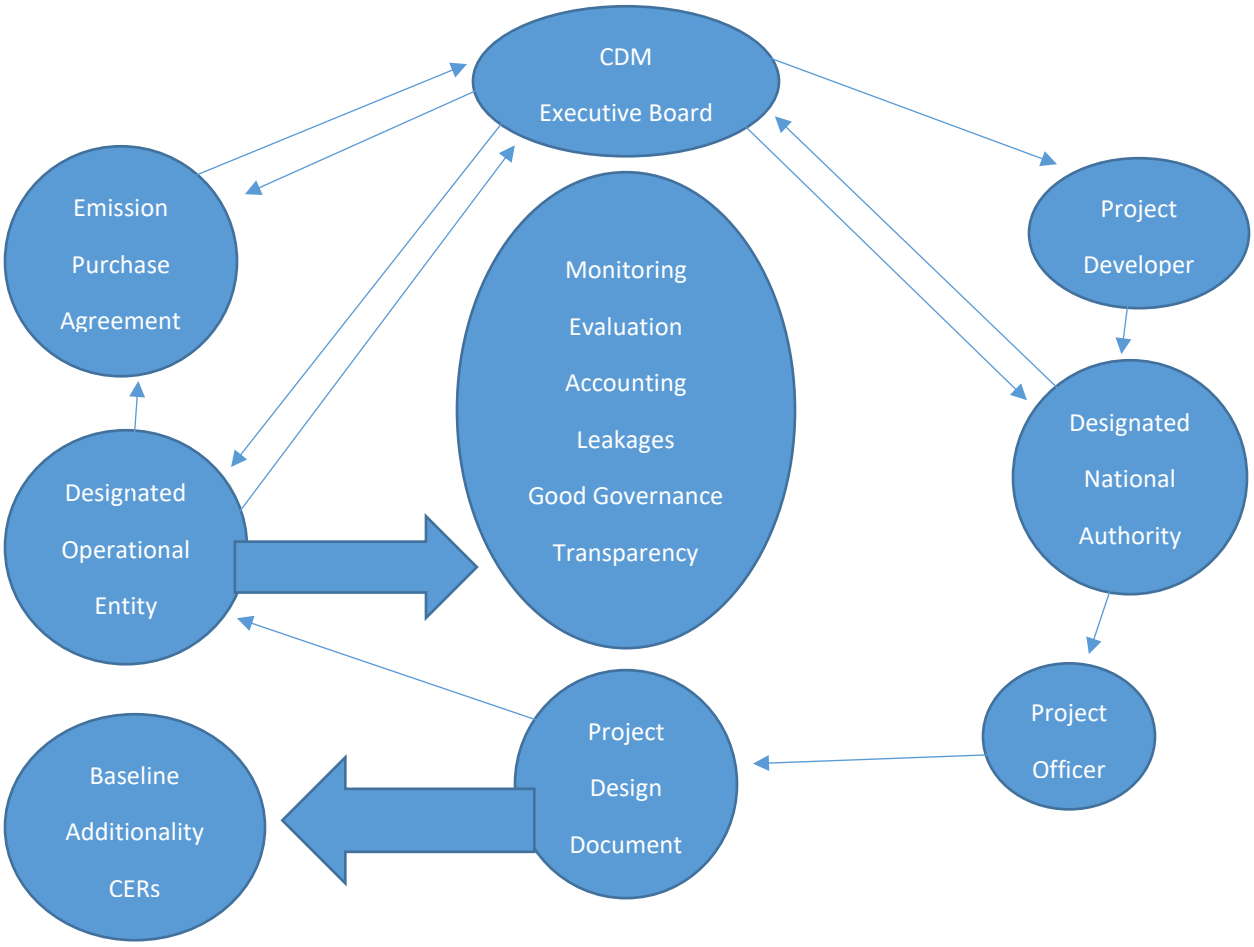
Further to the exploration of appropriate theoretical frameworks for The Clean Development Mechanisms, this theoretical framework has also systematically enumerated many variables that are associated with the implementation of CDM. The analysis and articulation of appropriate variables guides this study towards the construction of a befitting measuring instrument, with regards to how CDM is being implemented at the EThekwini Municipality.

The purpose of constructing a broad-based measuring instrument was to utilize the emergent variables from the theoretical framework in a useful and scientific manner to measure the various parameters of the Clean Development Mechanism as it is being implemented at two of the CDM

sites at the EThekwini Municipality. The measuring instrument served as a guide for the proposed interviews of important personnel involved in the implementation of CDM at Marianhill and Bisasar Road landfills. The purpose of the measuring instrument was to measure the effectiveness of the implementation process according to the criteria stipulated by the Kyoto Protocol. Secondly, the measuring instrument explored the dynamics of the relationships between South Africa as the host country and Annex 1 countries. Thirdly, the measuring instrument sought to measure and project the flow of revenues from CDM for both Bisasar Road and Marianhill against set-up costs and generally incurred expenses. Finally, the measuring instrument sought to enquire into the effectiveness of CDM as an instrument for funding sustainable development.

2.11 Critical Issues Relating to the Formatting of Questions for the Measuring Instrument

Figure 1: An Illustration and Guideline to the Cascade of Events and the Relevant Authoritative Mediators for the Implementation of CDM



The above illustration communicates the series of events that are necessary for the implementation of the Clean Development Mechanism. Although CDM is a funding mechanism designed to curb harmful emissions, there is a series of steps that are essential before the implementation of CDM.

The illustration places the CDM executive board in the prime decision-making slot. The CDM executive board is responsible for assessing, approving and registering all CDM projects. The board, consisting of ten members, issues CDM credits to duly registered projects and advises, assesses and approves new project protocols. The board approves and accredits independent audit firms to assure compliance and good governance.
The project developer makes sure that the CDM develops within the policy framework and objectives of the host country. The Designated National Authority supervises and manages the entire project-approval protocol. The projects officer is responsible for compiling the Project Design Document and calculating baseline emissions, additionality and manages the compilation and claims for Certified Emission Returns (CERs).

The Designated Operational Entity is responsible for monitoring; evaluation; implementing proper accounting protocols; the supervision and prevention of leakages; good governance and overall transparency. The Designated Operational Entity, in consultation with the CDM executive board, negotiates and commits to an Emission Purchase Agreement. The agreement quantifies the number of CERs produced in one financial year; the agreed price per CER; and for what period of time the CERs will be generated.

The measuring instrument incorporated a series of questions based on the cascade of events illustrated in the diagram above, for the purpose of facilitating responses that exposed the protocols that were utilized to get approval for the Bisasar Road and Marianhill landfill sites for CDM. The process of eliciting information from the respondents took the format of an interview.

Although this study set out to measure the revenue flows from the implementation of a Clean Development Mechanism, the interview process selectively ascertained what mechanisms were utilized to conform to the principles of the Kyoto Protocol for the awarding of CDM. The questions assessed conformity and difficulties that were confronted and overcome to gain approval. The funnel method was utilized in the interview process and the interview protocol focused closely on

the exact revenue flows from CDM, the costs involved and the net contribution to welfare benefits and sustainable development.

The first set of questions explored the effectiveness of the implementation process and the level of compliance with the requirements of the Kyoto Protocol.

The underlying purpose of this study is to evaluate the barriers and determinants to funding sustainable development within developing countries, with specific focus on The Clean Development Mechanism (CDM) at Bisasar Road and Mariannhill. The cascade of events articulated in the above illustration represents the start-up barriers to the successful implementation of CDM. Overcoming these start-up barriers represents the primary and essential structural integrity of any possible developmental framework. The process of overcoming these initial or start-up barriers has already successfully taken place at Bisasar Road and Mariannhill, as formatted in the above illustration.

The enquiry therefore consolidates the integrity of the Clean Development Mechanism at Bisasar Road and Mariannhill, with the specific aim of assessing the funding capacity of both the projects. This study clearly elicits and details whatever revenues are realized in both the projects. Revenues represent the basis of funding sustainable development. The initial, inductive enquiry is informed from the perspective of ratification of the Kyoto Protocol, through the lens of Pigouvian thinking.

The measuring instruments described in the next chapter (Chapter Three) selectively address each relevant theme from the theoretical framework with specific focus on the iterative themes of Pigou. The questions in the next chapter are therefore aligned to inform sustainable development funding and the implementation of CDM from a developmental state perspective.

2.12 Concluding Remarks Arising from the Theoretical Framework

The Theoretical Framework will form the basis for the process of grounding the findings of the field work associated with the Clean Development Mechanism, based on the principles of Pigouvian thinking and the methodologies for handling externalities. Furthermore, this study will critically assess the outcomes of the field study and thereafter consolidate theory and practice to format new directives for the implementation of Clean Development, based on Pigouvian thinking.

Chapter Three: Research Design and Methodology

3.0 Introduction

As mentioned in chapter one and as further reiterated in chapter two, this study seeks to examine the barriers and enablers to funding and implementing sustainable development projects. This study particularly focuses on the funding and implementation of The Clean Development Mechanism (CDM) projects from a Pigouvian theoretical perspective. The envisaged outcome of the study is a framework that contains a set of indicators to monitor the implementation of a CDM project in a developmental state context. This study gathers rich information from two specific CDM sites. One site is situated at Bisasar Road in Durban and the other site is situated in Marianhill, Durban. The process of gathering information by analyzing and examining human actions, words and records encapsulates this study within the paradigm of qualitative research. More specifically, this study utilizes the case study methodology as articulated by Eisenhardt (1989:532) which clearly defines a step by step protocol for abstracting theory, asking appropriate questions and conclusively reaching new and innovative theoretical directives to arrive at a definitive closure. The methodology prescribed by Eisenhardt (1989:532) entails eight distinct steps, namely:

i. Defining the research questions and priori constructs;
ii. Specifying theoretical sampling (not random) and defining the entities from which the research sample is drawn;
iii. Defining multiple collection methods;
iv. Including flexible and opportunistic data collection methods like field notes and photographs;
v. Eisenhardt (1989:533) refers to the next step as “within case analysis” and cross case appropriation;
vi. Iterative replication across cases and searching for evidence;
vii. Comparison with conflicting and similar literature; and
viii. Achieving a state of theoretical saturation when marginal improvement becomes negligible.

The questions are designed and formatted into two distinct groups: Category A questions and Category B questions

The first set of questions (Category A) are designed to abstract and consolidate relevant statistical and situational information for the two CDM plants from the date of inception to the current date. These questions are designed to confirm and consolidate the functional integrity of the CDM protocol to further address the Pigouvian assumptions and to define the research objectives. This information from Category A questions unlocks the sequential flow of questions for Category B questions. The second set of questions (Category B) seek to interrogate the process of CDM from the perspective of a Pigouvian "welfare-economics" theoretical framework.

The comprehensive theoretical framework identifies the following themes associated with Pigouvian thinking:

- Pigou identified *externalities* as benefits or costs produced as an unintended outcome of economic activity and which do not accrue to the parties involved in the said economic activity, but which may impact third parties without any compensation or cost.
- Pigou advocated the establishment of *accounting systems* to quantify externalities into mainstream marketing and economic protocols.
- Pigou advocated the restoration of *Pareto Optimal* by the imposition of taxes and subsidies to counter and engage externalities.
- Pigou advocated the establishment of *ambient welfare standards* to bridge the gap between social and private welfare in the face of impact from unsolicited externalities.
- Pigou put forward the theory that *taxes and subsidies or liability costs* for externalities reduced pollution/ emissions to restore production to normalcy.
- Pigou hinted that the implementation of all of the above would facilitate the *restoration of the ecological systems.* Pigouvian thinking facilitates and promotes the hypothesis that the cyclic renewal of ecological systems must have quantifiable cost equivalents.
- Pigou insisted that some *independent overseeing authority*, like the state apparatus, had to intervene to implement the management of variables associated with the impact of externalities on social, economic and political welfare-boons or losses.

3.1 Defining the Broad Research Question

This study seeks to examine and evaluate the outcomes of implementing the Clean Development Mechanism at Bisasar Road and Mariannhill from a Pigouvian theoretical perspective, with the specific aim of determining how the correct implementation CDM contributes to fund sustainable development in its broadest context, with the specific focus of identifying determinants and barriers to funding sustainable development.

3.2 Defining the Objectives of the Study

The primary objective of this research is to establish whether the implementation of the Clean Development Mechanism at Bisasar Road and Mariannhill contributes to funding sustainable development, while at the same time abating harmful emissions. From a Pigouvian theoretical perspective, the objectives are to determine whether the implementation of the Clean Development Mechanism restores the *Pareto Optimo*, restores ecological renewal and restores *ambient welfare standards*. This study also seeks to enquire whether The CDM Executive Board and The Designated National Authority continue to oversee and monitor the continuing implementation of CDM. The above questions and the objectives arising thereof will serve to structure a framework for the effective implementation of CDM in other Southern African and African countries.

3.3 The Ontological Perspective of this Research

Crotty (1998:10) describes Ontology as the study of "being". More appropriately, ontology is concerned with "what is ", with the nature of what reality is. While the epistemology informs the theoretical perspective, the ontological perspective provides the appropriate lens to interpret reality from a given perspective.

The ontological perspective of this study is based on Case study research. Stenhuis and de Bruijn (2006:2) state that "rational research conforms to the traditional deductive approach whereas existential research conforms to an inductive approach". Stenhuis and de Bruijn (2006:2) further elaborate that case study research is more existentially oriented "because it includes the context of the phenomena as part of the object of the study". Therefore, the case study research methodology derives explanation from concrete, objective data, "whereas artificial research is subjectivism" or deriving explanation from interpretation and artificial reconstruction of reality. As a contrast, survey research relies on perceptions and is designed to develop or test theory. Case study research is used to examine and investigate phenomena from an in-depth and limited-scope study (Stenhuis & de Bruin 2006:3).

Stenhuis and Bruijn (2006:4) also reflect on Yin's approach to Case study research and state that Yin follows the positivist and post-positivist approach which is significantly deductive in its ontology. The two authors also state that the Grounded Theory approach by Glaser and Straus (2006:5) is typical of generating theory by the methodology of comparative analysis, continuously cycling between data collection and data analysis. The ontology is therefore both deductive and

inductive (assuming that patterns become predictably repetitive). Most importantly, the authors refer to Eisenhardt's approach as somewhere between Yin's and the Grounded Theory approach (2006:7), therefore incorporating a deductive and inductive ontology.

This study utilizes "*integrative thinking"* as the most appropriate ontological framework to build and establish new theories from case study methodology (with specific reference to the methodology advocated by Eisenhardt). Martin (2007:144) describes the process of generative reasoning and *integrative thinking* as an ontological approach towards model and theory building. Martin (2007: 144) details the logic behind *integrative thinking* by describing and comparing the ontology of deductive and inductive reasoning. Martin (2007:144) describes deductive logic as the logic of what should be. It entails the process of establishing a framework and then applying the framework to a problem. Inductive logic, on the other hand, is the logic of what is operative "which infers general rules from empirical observation and draws conclusions about what is and isn't true". This process is referred to as *"induction or inductive logic"*. Martin (2007: 145) states that deductive and inductive reasoning facilitates the rationale for one to declare what is true or false. Martin (2007) however introduces a third form of reasoning which he refers to as "modal reasoning". Modal reasoning makes use of deductive and inductive logic, but utilizes a third form of reasoning called *abductive reasoning*.

Abductive logic seeks the best explanation and "attempts to create the best model or new theory that does not fit an extant model; "[i]t employs abductive logic to leap beyond the available data to generate a new model" (Martin 2007:146). This process of *abductive logic* is referred to as *integrative thinking*, and it is *integrative thinking* that best describes the ontological positioning of this study. This ontological stance is most conducive to building new theories and new models from the outcome of deductive and inductive ontological predispositions.

Integrative thinking and abductive logic have four essential constructs, namely:

- Salience - What features are important?
- Causality - How does one make sense of what one sees?
- Architecture- What tasks will be undertaken and in what order?
- Resolution- compiling or adding new models or new knowledge and theory.

This research attempts to arrive at new knowledge, new models and additional theoretical directives utilizing the constructs suggested by Martin (2007). The effective utilization of these

suggested constructs have been effectively implemented in design science to broker new models from new theoretical directives.

In terms of an ontological outlook, this study abstracts knowledge by deduction, induction and also by the novel process of abduction and abductive logic. Ontology and the ontological outlook gains significant functionality when placed and featured alongside the epistemological outlook. While ontology is the study and understanding of *being* from a philosophical perspective, epistemology refers to *how* we conceptualize what we know, and also *how* we understand the nature of what we know.

3.4 The Epistemological Positioning of this Study

Crotty (1998:8), citing Maynard, states that epistemology is concerned with providing a philosophical grounding for determining what kind of knowledge is admissible in the research process and how it is possible to ensure that whatever kind of knowledge becomes admissible has substantive capacity to be verifiable. Crotty (1998:8) describes three kinds of epistemologies:

- *Objectivism* recognizes that meaningful reality is positioned outside of human consciousness;
- *Constructionism* dictates that reality can only be verified and becomes verifiable when there is human engagement with the phenomenal world; and
- *Subjectivism*: In subjectivism, substantive meaning does not arise randomly between the subject and the objective phenomenal world. Meaningful reality arises only when the subject consciously imposes an interactive impact on the object (the objective phenomenal reality).

The three kinds of epistemological constructs propose a definitive guideline for the research process. CDM, however, is a highly interactive and iterative process and at different stages of implementation, all three epistemologies are identified.

The CDM can best be described as a series of guiding economic constructs formulated towards structured economic activity for the prime purpose of driving-down carbon emissions in order to achieve an eco-friendly environment conducive to sustainable development on a global scale. The Clean Development Mechanism facilitates the transfer of skills from Annex 1 countries to developing countries under strict economic, accounting and pro-active management principles. The short-term goal of CDM is to drive down global toxic carbon-emissions to such an extent that

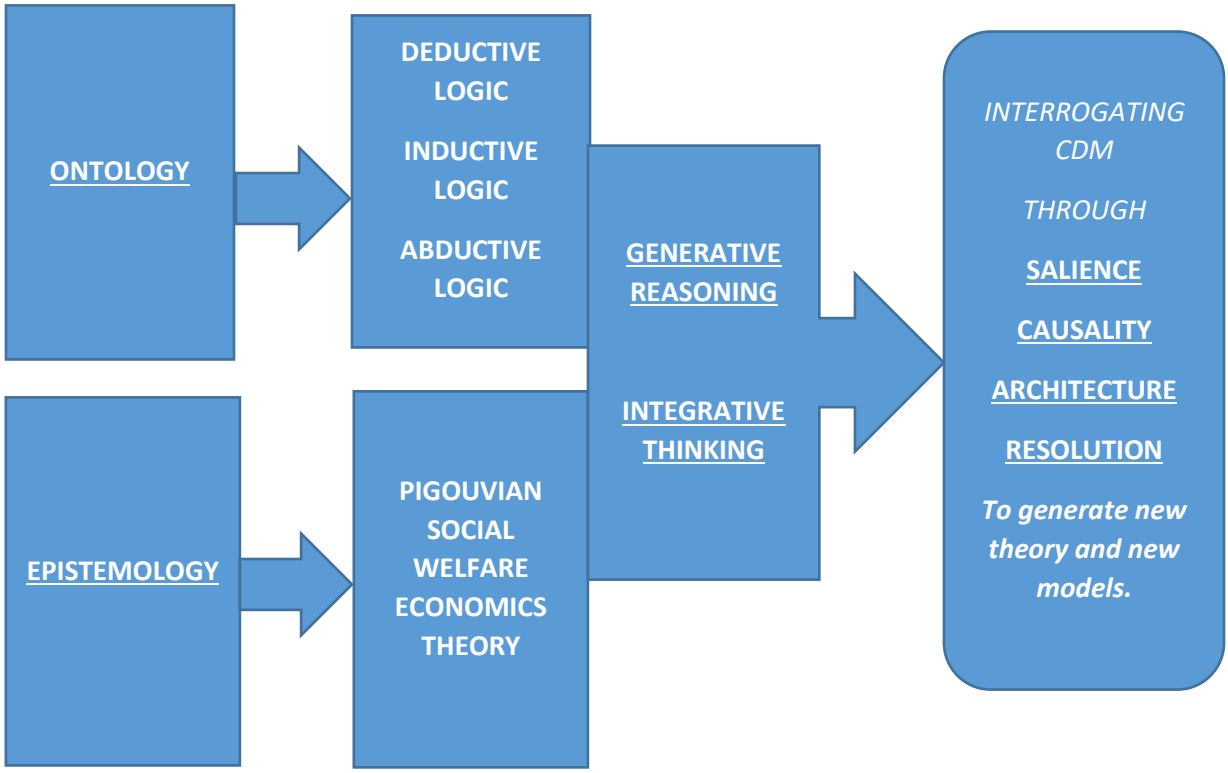
local ecological systems have an enhanced capacity for natural and cyclic renewal. The Clean Development Mechanism is therefore an economic tool designed to promote social welfare on a global scale by transferring technology in such a manner that it promotes sustainable development and ecological renewal.

Pigou, the neo-classical welfare economist recognized the existence of externalities as an element outside of the mainframe economic activity, but which impact the system by transferring either unsolicited benefit or harm from economic activity. Pigou recognized that externalities needed some mechanism to quantify the net impact on the economic system. Pigou also recognized that industrial smoke transferred harm to recipients in such a manner that little or no compensation was allocated from the then economic system. Similarly, Pigou also recognized that certain economic activities have the inherent capacity to transfer boons or benefits to unsuspecting recipients and therefore argued that economic activity causing harm should be taxed and economic activity that transferred a benefit or boon ought to incorporate a mechanism that would pay some definitive subsidy to the economic agent that inadvertently transferred the said economic benefit. Although Pigou did not openly and actively advocate for measures to enhance ecological renewal, the very recognition of the harmful effects of smoke emissions implies that measures ought to be positioned for the correction of or compensation for the harmful effects of smoke emissions. The very fact that Pigou recognized the existence of a state of economic imbalance promoted the motivation for the maintenance of *Pareto Optimal* from economic activity.

Pigouvian thinking is therefore the epistemological stance that is utilized by this study to interrogate the implementation of CDM at Bisasar Road and Mariannhill. To reiterate, CDM is interrogated from the perspective of recognizing the existence of externalities; recognizing the utilization of taxes and subsidies to counter the effect of externalities; recognizing the imposition of strict accounting measures in the process of calculating the net economic and environmental impact of externalities; recognizing the maintenance of Pareto Optimal as a guiding mechanism to foster economic balance; recognizing the necessity for implementing CDM under the auspices of a recognized overseeing authority; and searching for measures that arise out of CDM and facilitate for the natural renewal of existing ecological systems. Pigouvian theory and the consequential stance of Pigouvian thinking provides the philosophical grounding to determine what is admissible in the research process in terms of verifiable information leading to substantive scientific validity. Pigouvian thinking informs the theoretical framework of this research and

therefore communicates the epistemological stance. Having defined the ontological and epistemological positioning, the methodology proceeds to articulate the research design advocated by Eisenhardt.

Figure 2: Conceptualizing the Influence of Ontology and Epistemology on Case Study Research



The flow of Figure 2 is explained below:

The ontology is deductive when the theoretical framework of Pigou is applied to the process of interrogating CDM.

The ontology is inductive when general rules are inferred from empirical observation in the process of interrogating CDM.

Abductive logic seeks the best explanation and endeavors to structure the best model or new theory that does not fit any existing extant model.

New Theory is formatted by examining salience, causality, architecture and successful resolution.

The ontology and epistemology are prescribed within the context of Kathleen Eisenhardt's methodology of building theories from case study research. In this particular instance theory is grounded on Pigouvian ideology and thinking. Eisenhardt (1989:536) advocates that the primary step in commencing case study research is to clearly define the research problem. In this specific case study, the research problem may be defined as follows:

"Does the implementation of the Clean Development Mechanism at Bisasar Road and Mariannhill contribute to funding sustainable development, while, at the same time facilitating the abatement of harmful emissions?"

This case study interrogates the Clean Development Mechanism from the perspective of compliance with the prescribed CDM protocol. In addition, the study examines the enablers and barriers to funding sustainable development by identifying existential externalities, the Pareto Optimal; and mechanisms that promote restoration of the ecology and ambient welfare standards.

The process of generative reasoning enquires into the causal dialectics of the extant model and employs suitable measures to innovate new theory and new workable models.

This case study interrogates the research problem from the perspective of Pigouvian thinking.

3.5 Crafting Instruments and Protocols

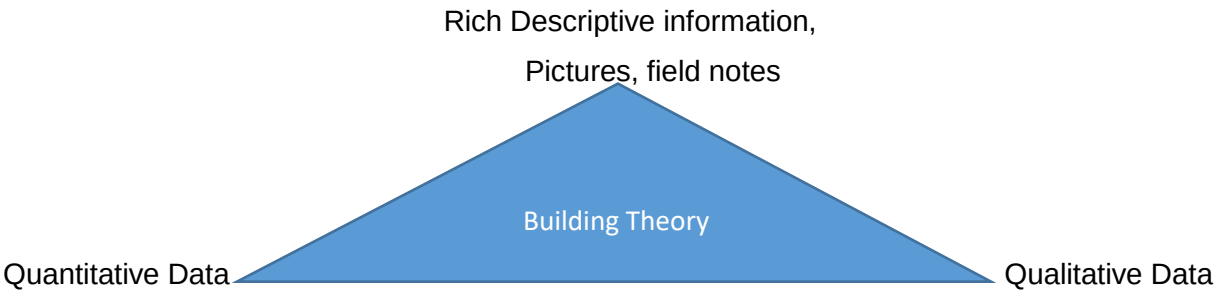
Eisenhardt (1989:537) concurs that the process of theory-building from case studies, requires a multi-faceted approach: The two CDM projects present a mine-field of information. There are rich graphic images of the process at work; there is an abundance of hard, quantitative data; and there is an abundance of soft, qualitative data.

At the very outset, this study seeks to consolidate the functional integrity of the CDM process by collecting hard, quantitative data, with specific reference to CDM implementation. This information is collected by utilizing a specially designed instrument for gathering as much hard data as possible. The first set of questions (Category A) are designed to abstract and consolidate relevant statistical and situational information for the two CDM plants from the date of inception to the current date so that a clear developmental pattern is established. The correct CDM protocol

establishes a revenue stream and revenue streams, from a project assessment perspective are the clearest indicators for any sustainable developmental pattern.

This measuring instrument is attached as Annexure 1. This particular measuring instrument is essentially a guideline and benchmark. The research process is open to adding more questions when the necessity arises in the field. Once the functional integrity of the process of implementing CDM had been established, the second set of questions (Category B questions) are consolidated and presented to gather rich qualitative data. This information, from Category A questions, unlocks the sequential flow of questions for Category B questions. The measuring instrument for Category B questions is attached as Annexure Two. The measuring instrument for Category B questions seeks to elicit broader, qualitative issues surrounding the implementation of CDM at the two sites in Durban. This study also gathers rich information in the form of field notes, photographs and related interviews. For the sake of validity, the Category B questions were presented, for responses, to another independent agent specifically involved in implementing CDM in another locality in Southern Africa. The two responses are collated and compared. Eisenhardt (1989:538) refers to this multiple-data collection methodology as “triangulation”.
A graphical representation of the Triangulation of relevant data follows:

Figure 3: Graphical Representation of the Triangulation of Relevant Data



Triangulation refers to a process of pooling Quantitative data, Qualitative data and rich descriptive information, pictures and field notes to build coherent theory.

It is noteworthy that Eisenhardt (1989:538) highlights the typical feature of case study data analysis whereby there is an overwhelming overlap and interconnectedness of collected data. Eisenhardt (1989) therefore encourages that the researcher actively engages in a process of keeping field notes to bridge the gaps between quantitative and qualitative information. The action

of actively engaging in keeping field notes facilitates the process of bridging gaps in knowledge acquisition and case study analysis.

Collecting data from multiple sources often highlights gaps in knowledge acquisition and the advantage in engaging in multiple data sourcing directs the researcher to facilitate additional adjustments to the data collection methods and protocols. These allow the researcher to further probe emergent themes and opportunities (Eisenhardt 1989:539). Whereas quantitative analysis seeks to analyze the relationships between engaging variables, case study analysis has the added advantage of utilizing multiple data capturing tools to expose and explore emergent themes and relations which may add value to the process of analysis and knowledge acquisition. The resultant indicators of emergent themes and relationships provides the researcher with a multifaceted, non-linear perspective. These tools facilitate the directive of the overall ontology of this study to utilize the lens of induction, deduction and then to seek abductive models outside of extant themes and relationships. The resultant knowledge outcome is therefore widely generalizable and wholly interconnected within the themes of scientific validity.

3.6 Within-Case Data Analysis

Eisenhardt (1989:539-540) posits that the essential feature of case study research is the effort directed towards embarking upon comprehensive data analysis and refers to a process of “within-case analysis” (1989:540) which refers to a detailed write-up for each case study site. These write-ups are purely descriptive in nature but Eisenhardt (1989) emphasizes that this process of description facilitates the identification of unique, emergent patterns. Emergent Patterns direct the researcher to search for “cross-case” patterns. These patterns may represent within group similarities or inter-group differences. Eisenhardt (1989:540) suggests some tactics for analysis, namely:

- Select categories or dimensions and look for similarities or differences;
- Select pairs of cases and then list similarities and differences; and
- Divide data by data source (example: observational data, field notes, interviews, questionnaire feedback).

The motivation behind cross-case searching, according to Eisenhardt (1989:541) is to encourage the researcher to go beyond initial impressions and to examine the emergent data and impressions from diverse perspectives so that the enfolding theoretical outcome is valid and

appropriate to the case study in question. Theory and data are constantly compared so that the collected evidence towards theory-building closely fits into the structures formatted by the data.

There is a consistent drive to match theory to data so that the emerging theory is coherently inter-related to the data from the perspective of validity and appropriateness. The process of constantly matching theoretical constructs to data also facilitates the process of identifying relationships between theoretical constructs as well as relationships between variables. The outcome of constantly searching for theory and theoretical relationships between constructs and variables sets the platform to declare emergent hypotheses. It must be stated that the hypotheses are judgmental rather than statistical. Hypotheses for case studies are declared from evidence and argumentative reasoning, rather than from statistical testing.

3.7 Enfolding Literature

Eisenhardt (1989:544) states that the fundamental feature of theory building is constant comparison of emergent concepts, theory or hypotheses with extant literature, looking for similarities, differences and conflicting findings. Conflicting findings point the researcher to further enquiry and adds substantive, reliable validity to the emerging concepts, theory or hypotheses.

3.8 Reaching Closure

Eisenhardt (1989:545) points to the significance of the nodal point of closure when theoretical saturation is reached in the instance of iterating between theory and data. The researcher needs to be critically aware of the nodal point of departure when the process of iterating between theory and data adds no new insights to the research process.

3.9 Sampling Design

Eisenhardt (1989:536) states that the selection of cases is of crucial importance when research is conducted to abstract theory from a case study. Population defines the set of entities from which the research sample is drawn (Eisenhardt 1989:537). An appropriate population sample defines the boundaries for generalizing the findings. Eisenhardt, however, qualifies her definition of sampling by stating that case study research relies on “theoretical sampling” (1989:537). Cases are therefore chosen for theoretical reasons and not for statistical reasons. Cases are chosen to replicate or elaborate on extant theory and to foster new models and new theory from extant models. The samples are not selected randomly but reflect specific choices intended to examine extant theory and to enhance the generalizability of emergent theory.

Therefore, this study has deliberately chosen to sample Bisasar Road and Mariannhill as the two cases which represent the actual implementation of the Clean Development Mechanism. The choice represents theoretical sampling because both the localities represent the active implementation of CDM as an extant model. The Bisasar Road CDM plant and the Mariannhill CDM plant are both situated at different locations in Durban. The Bisasar Road CDM plant was established in 2003, commissioned in 2008 and registered in 2009. The Mariannhill CDM plant was commissioned in November 2006 and registered in December 2006. Bisasar Road handles 3500 metric tons of waste per day and Mariannhill handles 500 metric tons of waste per day. Bisasar Road generates 6.5 megawatts of electricity per day, while Mariannhill generates 1 megawatt of electricity per day. For economic, budgetary and accounting purposes, the EThekwini Municipality conceives both Bisasar Road and Mariannhill as one CDM unit, although individual statistics will be made available for research purposes. This study gathers rich information from two specific CDM sites. One site is situated at Bisasar Road in Durban and the other site is situated in Mariannhill, Durban. These two sites, conjointly, define the unit of analysis. Although the two plants run in two different localities in the city of Durban, the plants are managed by one integral team headed by the chief engineer who also actively oversees and manages the plant. Free access was allowed to the researcher and any staff member may be interviewed during the course of any site visit. However, it is always the chief engineer who provides technical, accounting and sustainability responses and answers. For this reason, the researcher anticipates that validity may be compromised in the event of not getting verification from an independent outside authoritative source. Consequently, in addition to gaining technical, sustainability and accounting responses from the chief engineer, the researcher will validate the information by asking exactly the same questions to the General Manager of Ener-G Systems, a company familiar with Bisasar Road and Mariannhill, but very specialized in actively and independently implementing CDM in other localities in South Africa.

3.10 Data Collection

3.10.1 Ethical Issues Relating to the Data Collection

The letter of Information from the Ethics Committee of the Durban University of Technology is attached as Annexure 4 (Please Note: A full ethical declaration is included at the end of this Chapter).

Permission for all interviews and site visits to EThekwini Municipality have to be sought from the Deputy Head: Plant and Engineering, Cleansing and Solid Waste. Interviews have to be

conducted in a manner that does not disrupt the activities of staff. Therefore, permission has to be sought for each site visit and for any interviews thereof.

The Deputy Head is solely responsible for answering questions of a technical, administrative, accounting and managerial nature.

Research observations and findings are confidential within the parameters of what is allowed to the general public. Research findings and information with respect to the two sites may be published with the permission of the Deputy Head: Plant and Engineering, Cleansing and Solid Waste.

The Municipality has granted permission for the findings of this research to be made public and to be made available to public libraries.

The researcher has been given written approval to conduct this study at the two CDM plants. (Please refer to Annexure 5).

A letter of introduction, from the researcher will be given to each participant, detailing the purpose and nature of the research (the letter of introduction is attached as Annexure 6).

The interview protocol for the collection of data follows on the next page:

3.10.2 Table 1: Interview Protocol for Data Collection

Interview Protocol	Interview Theme	Scheduled Interview Date	Data Source	Questions	Additional information
1	Fundamental CDM integrity	First week July 2016	Management Site visit	Annexure 1 Observation	Field notes Photographs
2	Pigouvian Welfare Economics	Second Week July 2016	Management	Annexure 2	Field notes
3	Funding Sustainable Development	Second week July 2016	Management	Annexure 2 Annexure 3	Field notes
4	Integrity of Accounting system	Second week July 2016	Management	Annexure 2 Annexure 3	Field notes
5	Pareto Optimal	Second Week July 2016	Management	Annexure 2	Field notes
6	Ambient Welfare standards	Second Week July 2016	Management and Site Visit	Annexure 2 Observation	Field notes Photographs Pictures
7	Emission levels	Third Week July 2016	Management and site Visit	Annexure 2 Observation	Field Notes Photographs
8	Ecological Impact	Third Week July 2016	Tour around Adjacent Area	observation	Filed Notes Photographs
9	CDM Executive Board	Fourth Week July 2016	Management	Annexure 3	Field Notes
10	Designated National Authority	Fourth Week July 2016	Management	Annexure 3	Field Notes

The interview protocol was divided into 10 sessions to be conducted over a period of 10 days during July 2016. Most of the interviews were conducted at Durban Solid Waste offices adjacent to the Bisasar Road plant. This protocol served as a guideline to collect information on the different themes of interest. The ten themes ranged from establishing the Fundamental CDM implementation integrity to Discussing Pigouvian economics; aspects concerned with funding sustainable development; the integrity of the accounting system; Pareto Optimo; Ambient welfare standards; emission levels; the ecological impact of CDM; The CDM management process; and the role of the designated National authority.

The chief engineer was often kind enough to respond to questions relating to more than one theme at a time. For the purpose of accuracy, the engineer provided written responses to questions posed. Rough field notes were taken initially, but these were time consuming and interfered with the flow of responses. Field notes were replaced with an electronic voice recorder and eventually the chief engineer agreed to physically write out responses after each interview to prevent wastage of time. The responses from the engineer are documented in the next chapter and each response is reported verbatim.

For the purpose of validity, the broad questions on the CDM protocol and also the influence of Pigouvian externalities on the CDM were discussed with and tabled to an Independent Authority on CDM. These responses are reported verbatim in the next chapter. On request, the researcher was provided with excellent site photographs. There are aerial photographs of both sites, as well as photographs of the technical extraction and clean energy generating sites. The site engineer provided pictures of vertical and horizontal insertions into the landfill sites. There are also sketches of the entire process of extraction, conversion and flaring. These are also detailed in the next chapter.

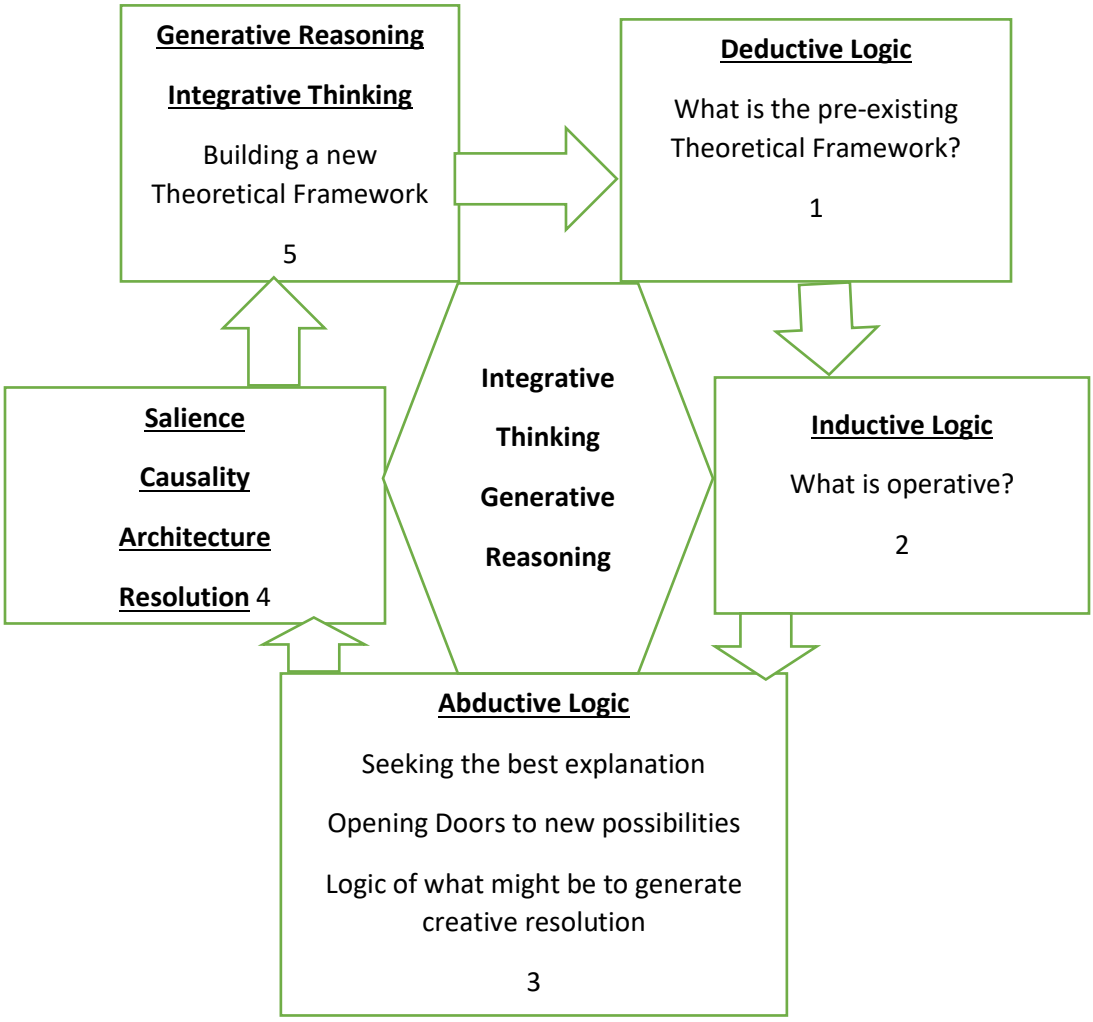
The site engineer took the researcher on conducted visit to the Bisasar Road plant. The Mariannhill plant is very small in scale and has only one furnace and operates with minimum staff. Bisasar Road has seven furnaces. The actual sites are laid out in small areas (as indicated in the pictures in the next chapter) and require very few staff to run the operation. All captured information is presented in Chapter Four.

3.11 Data Analysis

There are many suggestions as to what constitutes the best methodology for data analysis. Case studies represent a unique approach to delving into the process of research, collecting data and then analyzing data to arrive at new knowledge. Pare (2001:19) states that case studies produce large amounts of data that are not readily amenable to “mechanical manipulation, analysis and data reduction”. Pare (2001) asserts that the basic goal of qualitative analysis is an understanding which implies coherence and order, citing Kaplan and Maxwell (1994) and Miles and Huberman (1994) who propose a series of methods concerned with searching for existing data and generating strategies for collecting new data. Pare (2001:19) cites Miles and Huberman and indicates that data collection is divided into three categories, namely early stage analysis; “Within-Case Analysis”; and “Cross-case Analysis”. The author describes reflective analysis, coding protocols, within-case analysis and the search for cross-case patterns. In keeping with the ontological and epistemological directive of the study, “Within-Case” analysis and “Cross-Case” analysis are conducted within the ambit of integrative thinking and generative reasoning.

Generative reasoning, according to Martin (2007:111) is unique as an analytical tool because this form of reasoning advocates that whatever model exists now does not represent reality as it ought to be. The current model simply represents the most perfect fit for a particular time-span only. Generative reasoning embraces and leverages conflicting theories, approaches and styles to solve problem and innovate solutions towards new models. Generative reasoning advocates that better models exist that are not yet seen. It also holds that new and better models exist and can be brought out from abstract hypothesis to concrete reality. Generative thinkers are comfortable with a process of comprehensive analysis to “ferret” out new and innovative models. They seek innovative disruption of the status quo to foster new and better models. The most salient feature of generative reasoning is the capacity to look at the bigger picture, spending time analyzing and formatting new models and new theory. The motivation behind utilizing integrative thinking and generative reasoning as an analytical tool is the directive it gives towards assessing “what-is” from a current theoretical framework, to ask what ought to be and to seek out and implement better models from disruptive innovation. This process involves deductive reasoning, inductive reasoning and abductive reasoning represented graphically below:

Figure 4: Illustrating Data and Content Analysis using an Integrative-Thinking and Generative Reasoning Model



Integrative thinking and analysis based on the tools provided by Integrative analysis, work on the principle that deductive logic needs a pre-existing theory or model on which to base its reasoning (Martin 2007:146). Inductive logic seeks to draw inferences from repeated experiences or observations (Martin 2007:146). Abductive logic seeks the best explanation and attempts to create the best model that does not fit the extant model (Martin 2007:146). The use of abductive logic is what Martin (2007: 146) refers to as the utilization of generative reasoning, a process which offers the best explanation and attempts to create the best model.

Therefore, analysis will typically adopt the following format (Martin 2007:54):

- Seeking ***Salience*** based on existing frameworks
- Searching for ***Causality*** based on what is apparent

- Formatting novel ***Architecture*** from Abductive logic.
- ***Resolution*** (by creating new models or theories) based on generative reasoning.

3.12 Validity and Reliability

3.12.1 Validity

Msweli (2015:14) defines Internal Validity as the "extent to which research design and the data it yields allows the researcher to draw accurate conclusions". Msweli (2015:14) states that internal validity is based on the overall research approach, the research questions, the research objectives and the research propositions. Msweli (2015:14) reiterates that validity comprises Construct Validity, Predicative Validity and Content Validity. *Construct Validity* refers to the structures of the research design as described in this chapter. *Predicative Validity* embraces the aspects of theory, data collection and evaluation of results to define the possible outcomes and trends. Predicative is based on quantitative data or qualitative concepts, theories and observations. *Content Validity* examines the authenticity of data, information, observations and interview outcomes.

The approach to collecting data, information, pictures and collating observations were based strictly on what was relevant to the implementation of a Clean Development Mechanism at Bisasar Road and Mariannhill. Therefore, this study is particularly strong on the aspect of internal validity because case study research allows the researcher to clearly define the parameters and boundaries of the study and thereafter to delve into every aspect of relevant information specific to the domain of CDM (as implemented at Bisasar Road and Mariannhill).

It must be stated that the quantitative data collected from Durban Solid Waste strengthens the validity of the outcomes of implementing The Clean Development Mechanism. Quantitative information is so accurate and detailed over an expanse of nine years and this literally compounds the aspect of internal validity. It is the unwavering strength of the internal validity that allows for arguments to critically question the developmental and funding capacity of CDM.

Pigouvian ideology facilitates the process of ordering and consolidating the collected data and information into one coherent philosophical framework. Therefore, the researcher argues that the broad Pigouvian theoretical framework also facilitates and strengthens the outcomes of internal validity. The marginal outcomes of revenue flows produce such accurate data that internal validity is indeed unquestionable. The graphs, charts and trends thereof validate this claim. The aspect

of validity is closely aligned to reliability. Research outcomes with strong validity and internal validity outcomes need to have reliability as well. It is the reliability of research outcomes that facilitate the process of application to other similar situations.

3.12.2 Reliability

Msweli (2015:14) demonstrates that reliability is an outcome of conclusions arising from proper data collection and relevant conclusions thereof. Reliability is closely related to the aspect of ***generalizability.*** According to Msweli (2015:15), generalizability is the "extent to which conclusions drawn from research finding can be generalized to different situations".

This study draws on the reliability of conclusions drawn from the findings at Bisasar Road and Mariannhill to structure a set of indicators to facilitate the implementation of CDM in other localities from a developmental state perspective. The findings and detailed analysis of this case study take on the format of a detailed report. This study is conducted in accordance with the ethical requirements of the Durban University of Technology.

3.13 Ethical Declaration

This declaration is formatted in accordance with the Ethical requirements of the Durban University of Technology.

3.13.1 Deception

The researcher hereby declares that no form of deception or any deceptive questions have been used in this study. The researcher also declares that it was not necessary to impose any kind of placebo effect to elicit responses to any questions.

3.13.2 Confidentiality

Information elicited from the interviews and site visits are freely available to the public for inspection. The chief engineer at Durban Solid Waste has agreed to allow this study to be published with the proviso that a copy of this study be made available to the offices of Durban Solid Waste. The data collected is specific to this study only and does not include any personal and private information on any of the respondents at the two sites. The data will be made available to the Durban University of Technology and to the office of Durban Solid Waste. Permission has been granted for the findings to be published in academic journals.

The researcher hereby declares that none of the data and/or information will be sold for commercial gain nor published in any other forum without the express permission of Durban Solid Waste. No specific confidentiality is required for this dissertation to be stored at libraries or at any other academic institutions. None of the data was sourced from data banks regulated by private legislation.

3.13.3 Recruitment

The senior engineer at Durban Solid Waste had to be consulted for any information relating to the two CDM plants. The Senior Engineer shares no business, professional nor family relationship with the researcher. The recruitment protocol involved providing a Letter of Information from the Ethics Committee of the Durban University of Technology (this letter is attached as Annexure 4). The Researcher has been given a written letter of Approval from the senior engineer to conduct interviews and to conduct site visits under his supervision (the Letter of Approval is attached as Annexure 5). A formal Letter of Introduction was given to each respondent for the purpose of introducing myself and secondly, to explain the purpose and motivation behind the interview (this letter of Introduction is attached as Annexure 6). The respondents did not obtain any financial reward nor any other direct compensation for participating in the interview. This research did not target any specific ethnic or racial group. Nor did this study exclude input from any individual or group working at the offices of Durban Solid Waste and at the two CDM sites.

3.13.4 Informed Consent

As indicated in section 3.5.3, this research fully complied with the criteria for informed consent.
A letter of information was provided to each respondent and the respondents were required to sign a letter of consent. The letter of Consent is attached as Annexure 7.

3.13.5 Risks to Participants

Respondents were not subjected to any pressure, duress or discomfort. This study did not expose the respondents to any civil nor criminal liability. The respondents were interviewed with specific questions relating to the Clean Development Mechanism as implemented at Bisasar Road and Mariannhill. No aspect of this study placed any respondent in any compromising situation in terms of compromising their financial standing, social standing or their capacity for employability. The interview protocol took the format of one on one interview only.

3.13.6 Generic Considerations

The interview protocol was purely one-on-one interviews for the purpose of eliciting information and data relating to the CDM projects at Bisasar Road and Mariannhill.

3.13.7 Benefits

This research does not provide any direct advantage to the participants. The Researcher will not make any direct or indirect financial gain from this research.

3.13.8 Sponsors: Interests and Indemnity

This research was not undertaken on behalf of any commercial entity. The researcher has no affiliation nor financial involvement with any organization that has direct or indirect interest in CDM as a funding tool for sustainable development.

3.14 Concluding Remarks on the Research Design

The design of this research details and articulates a well-defined protocol for the collection, analysis and presentation of research outcomes. The direct responses from the questions are described in detail in the next chapter.

Chapter Four: Data Collection and Analysis

4.0 Introduction

As iterated in previous chapters, the purpose of this study is to identify and articulate the barriers and enablers to funding and implementing sustainable development. This study specifically focuses on the implementation of the Clean Development Mechanism from a Pigouvian theoretical perspective. The proposed outcome of this study is to format a set of indicators to monitor the implementation of CDM from a developmental state perspective.

This chapter sets out to clearly describe the outcome of observations and interviews relating to the two CDM sites at Bisasar Road and Mariannhill. Therefore, this chapter is purely descriptive and the data that is presented in this chapter is presented in the format of illustrations, pictures, graphs and responses to specific questions. Although the data is presented in an unbiased and value-free format as it appears, the description is guided and informed within the perspective of the stated ontological and epistemological perspective of this study, as articulated in the previous chapter.

Eisenhardt (1989:540) refers to a process of “within-case analysis”, which refers to a detailed write-up for each case study site. Although the write-up in this chapter is purely descriptive, the process of elaborate description facilitates the identification of unique emergent patterns. The emergent patterns direct to cross-case similarities between Bisasar Road and Mariannhill.

The process of description is also informed within the parameters of integrative thinking, thus seeking to identify deductive reasoning, inductive inferences from repetitive observations and the identification of extant models. The identification of any extant model or models prepares the study for the application of abductive reasoning in the next chapter on analysis in order to re-format the best model which is new and outside the fit of any extant model. This is the basis of innovation from integrative thinking. Therefore, the stated objective of this chapter is to format the description in a manner that facilitates the best and optimum explanation. Such explanation and description opens the doors to new possibilities and creative solutions.

The motivation is thus to foster an unbiased description as a precursor to a framework which will embrace a set of indicators to monitor and guide any future implementation of the Clean Development Mechanism from a developmental state perspective. The descriptive stance of this

chapter aligns with identifying salience, seeking appropriate causality and fostering salient architectural features for an effective resolution and analysis in Chapter Five. This introduces the purely descriptive aspect of the study. The series of interviews conducted at the office of the eThekwini Durban Solid Waste have yielded valuable information and data. Encased in this information and data are pointers to enablers and barriers to funding sustainable development from the perspective of CDM at eThekwini Municipality, with specific reference to Mariannhill and Bisasar Road.

The Durban Solid Waste Department of the eThekwini Municipality initiated the possibility of electricity generation and flaring of gases as early as 1994. The series of internal meetings yielded positive results in 2001 when Durban Solid Waste and Management at eThekwini Municipality made the first contact with representatives of Prototype Carbon Fund of the World Bank. In 2002, the the Clean Development Mechanism Executive Board communicated the Conditional approval for the two CDM projects with a reciprocal approval by the Designated National Authority. A Memorandum of Understanding was formatted between eThekwini and The Prototype Carbon Fund of the World Bank as early as 2003. The Memorandum of Understanding fostered Council approval for funding from the Municipality. The Role of Environmental Impact Assessment is one of the prime enablers of the project feasibility. The outcomes of the Environmental Impact Assessment paved the way for the signing of the Emissions Reduction Purchase agreement with the World Bank in 2004.

The table below outlines the series of events, in chronological order, of protocols that have enabled the successful implementation of CDM at Mariannhill and Bisasar Road.

4.1 CDM Events in Chronological Order

Table 2: The Series of Events, in Chronological Order, of Protocols that have Enabled the Successful Implementation of CDM at Mariannhill and Bisasar Road

Date	Mariannhill	Bisasar Road
2004	Environmental Approval	Environmental Approval
2006	Commissioning CDM registration Construction Begins	Revision of Environmental Approval
2007	CDM verification Delivery of First CERs	Construction Begins
2008	CDM Year One Verification	Commissioning of Flares and Engines
2009	Second Year CDM Verification	CDM Registration First CDM verification Commissioning 6.5 MW Installation of engines Installation of wells
2011	Third CDM verification	First Carbon issuance 65711 tons of Carbon Dioxide
2012		Gas Chiller commissioned
2013	Issuance of 16764 tons CO2 Issuance of a Further 39472 tons of CO2 Issuance of 59260 tons of CO2 Issuance of 33431 tons of CO2	Second CDM verification
2014	Fifth Verification Fifth Issuance of 33937 tons of CO2 Sixth verification	Second Issuance of 749 633 tons of CO2

(The above information was sourced from eThekwini Municipality from the GIZ-SALGA Municipal Renewable Energy Case Study Series)

Interviews with Durban Solid Waste have revealed that Mariannhill and Bisasar Road follow seven-year Clean Development Management cycles and these are renewable twice. Bisasar Road landfill site has the capacity of handling 3500 tons of waste per day, while Mariannhill has the capacity to handle 500 tons per day. Bisasar Road landfill has stopped receiving waste from 2015 but its capacity to produce gas will continue to about 2030. Marianhill will stop receiving waste in 2022, but will have the potential to produce methane gas for flaring for at least another twelve to fifteen years.

The initial motivation behind the projects was their potential capacity for the generation of income from carbon off-setting and, in addition, the generation of electricity from burning off methane gas. The initial approval by the Designated National Authority was motivated by the potential of receiving revenues from the sale of carbon credits. Although this motivation was indeed one of the primary motivators behind the two projects, there is a great deal of uncertainty regarding the flow of revenues from the sale of carbon credits. The international pricing of carbon is unpredictable and the potential for revenue generation from the sale of Certified Emissions Reductions (CERs) has collapsed because of the unreliable global market. It is therefore arguable that although the sale of CERs was the prime enabler for the implementation of CDM, it has proved to be the most unreliable. The interviews at Durban Solid Waste expose a situation of failure to secure reliable revenues from the sale of carbon credits. The projects at Bisasar Road and Mariannhill would have been failures if both did not have the capacities to generate electricity for the municipal grid.

The capacity for carbon destruction is enormous for the two plants. Up to December 2012, Durban Solid Waste has officially destroyed 11,121,092 tons of Carbon Dioxide (CO2). These are issued and verifiable. Durban Solid Waste has also destroyed the equivalent tonnage from January 2013 to date and the same equivalent of carbon dioxide has been destroyed by the process of flaring which, it must be stated, is not recognized and therefore not accepted. This poses another unforeseen barrier to the implementation of CDM. This is a significant barrier. The Unofficial and non-verifiable estimate for the tonnage of carbon destroyed since the inception of the project in 2006 is equivalent to 2.5 million tons of CO2. The potential for revenue generation and therefore the potential for funding sustainable development has been halved due to non-recognition by the World Bank and also the CDM executive board. Typically, emissions are composed of 53 % methane; 37% – 38% carbon dioxide; and about 9 % other impurities. It would be accurate to state that, since inception, the two projects have reduced greenhouse gases by 1.8 million tons.

Bisasar Road has the capacity to generate 6.5 megawatts of electricity, while Mariannhill has the capacity to generate 1 megawatt. The two projects are jointly producing 45000 megawatts per annum. The cost to generate electricity is 83 cents per kilowatt hour. Eskom pays 61 cents per kilowatt hour. There is therefore an ongoing discrepancy of 22 cents and this is an additive cost which, translates into an expense and ongoing barrier. The operational costs for all eight engines (7 at Bisasar and 1 at Mariannhill) range between R7 million to R8 million per annum. The total costs to date for both Mariannhill and Bisasar combined amounts to R135 million. The variable cost of carbon credits are approximately 46 Euro Cents. If CERs were freely tradeable, this would have bridged the gap of the 22 cents discrepancy between the cost of production and what Eskom pays.

The two projects have created employment for 11 permanent staff, 9 technicians, 2 unskilled positions and more than 250 temporary employment positions. It is arguable that with the current levels of unemployment in Durban, the aspect of providing sustainable employment is debatable.

From a cost perspective, it is not possible to employ more people. This, again, presents a barrier to sustainable development. The cost of Installation of Landfill Gas extraction wells for Mariannhill amounted to R17 million and was paid out to Envirotech solutions. Fountain Civil Engineers were paid R28 million for work done at Bisasar Road. In addition, Enviro Fill (PTY) Ltd was paid out R66 million for construction and engineering at Bisasar Road. Responses from the senior engineering official from Durban Solid Waste was often elaborated upon by Management at Ener-G systems for the purpose of lending research validity to responses.

Management at Ener-G have indicated that:

- *100,000 tons of domestic waste in a landfill per annum is equivalent to 1MW of power;*
- *600m3/hour of gas has the potential to release 1MW of electricity; and*
- *One metric Ton of organic waste has the potential to produce at least six cubic meters of inflammable gas.*

The sites at Bisasar Road and Mariannhill have provided electricity for the equivalent of at least 7500 homes, with a capacity of providing about 500 kWh of power per home.

The projects were initially financed by the World Bank and, loans to eThekwini Municipality from the French Development Agency. The status of the repayments is confidential. Graphs of

revenue streams and power production will be illustrated in the pages to come. The next few pages will display photographs of the Landfill sites and power generating plants at Bisasar Road and Mariannhill. All photographs have been supplied by Durban Solid Waste.

4.2 Bisasar Road Landfill Site: 29.8137° S, 30.9809° E

The Bisasar Road Landfill site was opened in 1990 and used to process 3000 to 5000 tons of waste per day. Set in Clare Estate, Durban, this is Africa's largest Landfill. The The Clean Development Mechanism project at Bisasar Road was funded by the World Bank and the French Development Agency. This landfill is an active polluter of carbon and methane. In addition, the Landfill contributes to the loss of biodiversity; landscape and aesthetic loss. The Landfill contributes to seepage of toxic substances which pollutes ground water. (Information sourced during site interview).

Figure 6: Bisasar Road Landfill Site

4.3 Bisasar Road Generator and Flare Compound

The generation compound at Bisasar Road has seven generators and a single flare. This facility has the capacity to generate 6.5 megawatts of electricity. The flaring mechanism burns-off toxic methane and carbon. The burning of methane also facilitates the reduction of carbon emissions. (Information sourced during interview and site visit)

Figure 7: Bisasar Road Generators and Flare

4.4 Mariannhill Landfill Site: 29.50707° S, 30.50180° E

The Mariannhill landfill was opened in 1997 on an eco-friendly site conducive to protecting biodiversity. This site was registered as a the Clean Development Mechanism project in 2006. The project is partly funded by the eThekwini Municipality, the Department of Trade and Industry, the South African Department of Minerals and Energy and the French Development Bank. The CDM project is instrumental in the production of clean energy from gas. (Information sourced during interview).

Figure 8: Marianhill Landfill Site

4.5 Mariannhill Generator and Flare Compound

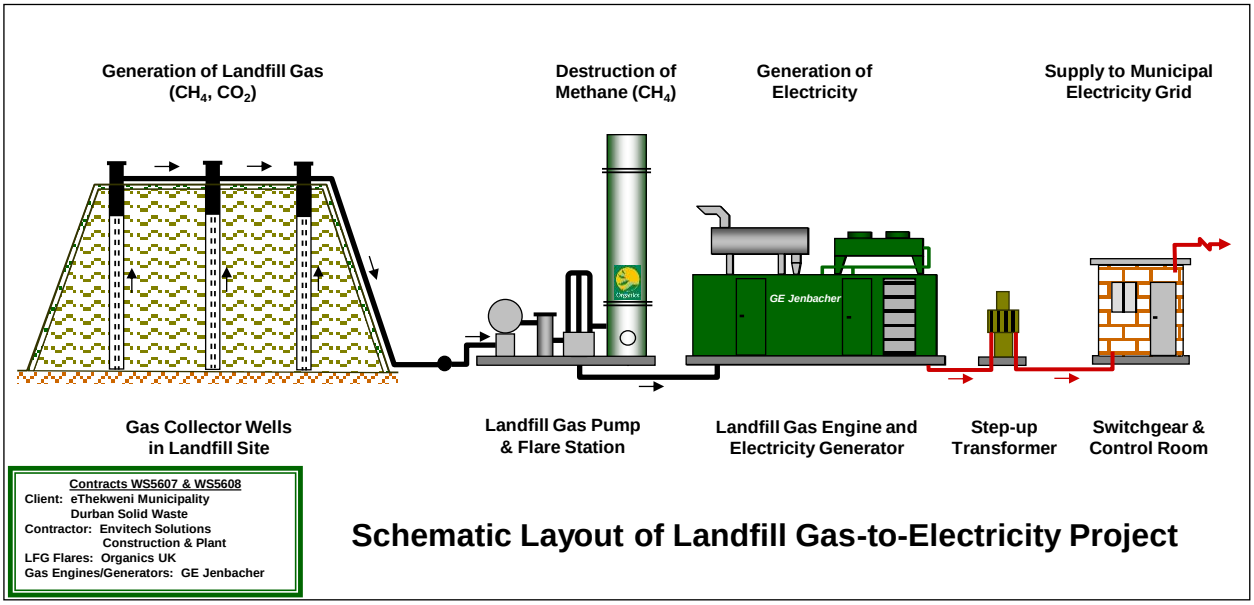
The Mariannhill compound is small and has a single generator and a single flare. The generator has the capacity to produce only 1 megawatt of clean electricity by burning and flaring harmful methane gas. Carbon emissions are also reduced during the process of burning methane.

Figure 9: Marianhill Generator and Flare

4.6 Schematic of Landfill Gas-to-Electricity

Landfill gas is captured vertically or horizontally as illustrated below. The gas is piped-into the Flare station. The process of flaring destroys methane gas and reduces carbon emissions. Gases from the landfill are burned to produce clean energy in the form of electricity, which is directed to the municipal grid. Both Bisasar Road and Mariannhill utilize this mechanism of burning, flaring and electricity generation.

Figure 10: Schematic of Landfill Gas-to-Energy



4.7 Sectional Pipes

Figure 11: Sectional Incisions on Pipes Inserted Vertically or Horizontally into Landfills to Extract Bio-Gas

4.8 Vertical Extraction

Figure 12: The Process of Insertion of Vertical Extraction Pipes

Figure 13: Horizontal Constructed Feed Pipes with Taps for Feeding Bio-Gas into Flares and then Bio-Gas Electricity Generators - Common to Bisasar Road and Mariannhill

Figure 14: Typical Soil Dug-Out at Landfill Site for Horizontal Pipe Insertion

4.9 Multiple Horizontal Insertion Pipes at Bisasar Road and Mariannhill

Below is an illustration of multiple pipes inserted horizontally into a section of the landfill for the extraction of Bio-gas. The pipes are covered with natural top soil for the purpose of the continuation of the greening effect and for the protection of the environment and biodiversity. Horizontal insertions are utilized both at Bisasar Road and Mariannhill.

Figure 15: Multiple Horizontal Pipe Insertions

4.10 Revenue Generation and Energy Production at Bisasar Road and Marianhill

The two most important criteria in the consideration of enablers to funding sustainable development in developing countries is the aspect of the capacity of any given project to generate revenues and sustainable outcomes, not only to support its own inherent project sustainability but to broaden the scope of sustainability to the aspect of revenue generation within the scope of

protecting the environment, reducing emissions, protecting biodiversity and promoting a *modus-operandi* which enhances the protection of valuable resources for future generations as well.

With specific reference to Bisasar Road, the implementation of a Clean Development Mechanism since March 2008 has produced a total of 297 892 966.4 Kilo Watt hours of electricity (peak, standard, off-peak) up to January 2016. For this same period, the CDM project generated revenues to the total value of R132 142 116.15.

With reference to the Mariannhill project, the implementation of a Clean Development Mechanism since July 2008 has produced a total of 32 621 529 kilo Watt hours of electricity up to January 2016. For this same period, the CDM project at Mariannhill produced revenues to the value of R15 221 125.16.

Combining the outputs of both the CDM projects, a total of 230 514 195 Kilo Watt hour of electricity was produced up to January 2016. For this same period, both projects have produced revenues to the value of R147 363 241.31.

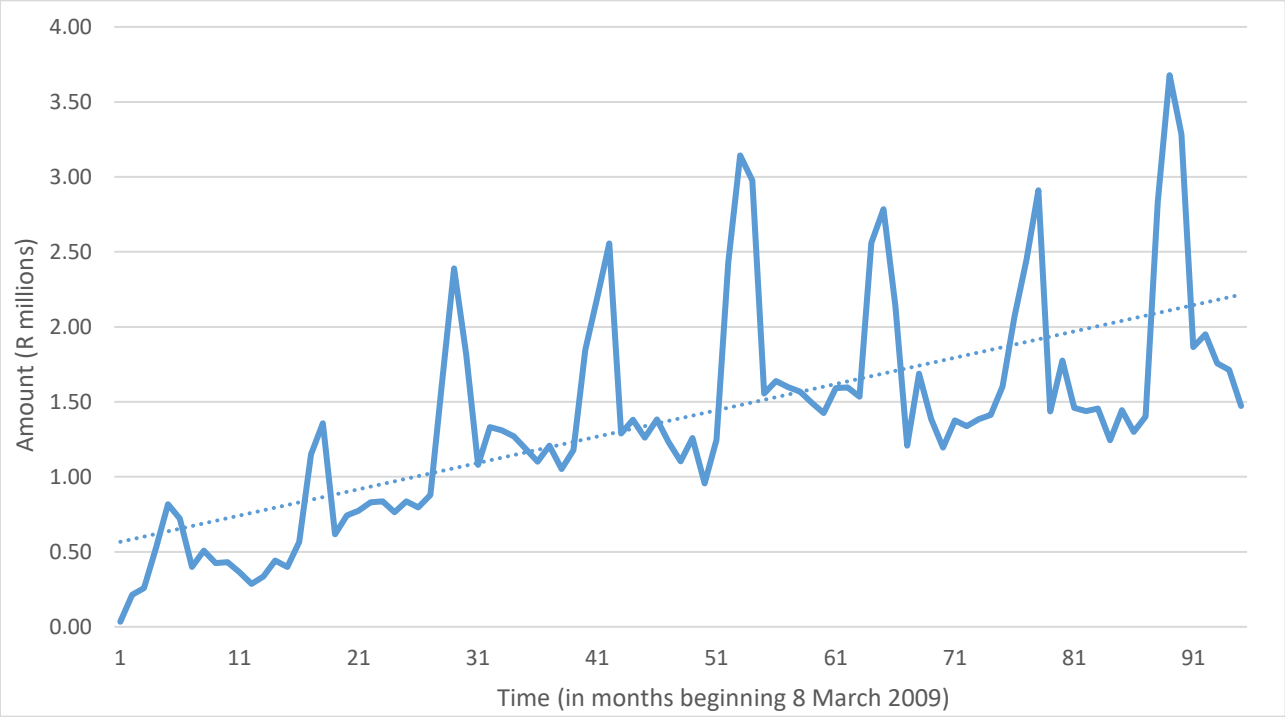
Because of the unreliability and inconsistency of the Carbon Credit market, revenues from Carbon credits are indeed marginal and insignificant when taken in the light of the motivation behind the Clean Development Mechanism. The outcome from the one-on-one interview with Durban Solid Waste indicates that the total revenue from carbon credits for both projects from the time of inception to January 2016 was only R13.84 million from the sale of 1.1 certified emission returns (CERs). This brings the total revenue for both projects to R161 203 241.31.

The historical costs / expense to run both the projects has been approximately R135 million.
The gross margin is therefore R26 203 241.31 for the entire period up to January 2016. The public is not privy to any detailed expense account, so this revenue of approximately R15.5 million is an indicator of the health of the project.

The total net revenue generating capacity for any CDM project must surely be the most recognizable enabler because the very concept of sustainable development depends on the capacity of any project to generate sustainable revenues. The question of sustainability may be explained by careful inspection of the graphic representation of revenue flows and power generation over the project's life span to date, as represented in graphs below.

Figure 16: Bisasar Road - Revenue Generation against Time

Bisasar Road



Model

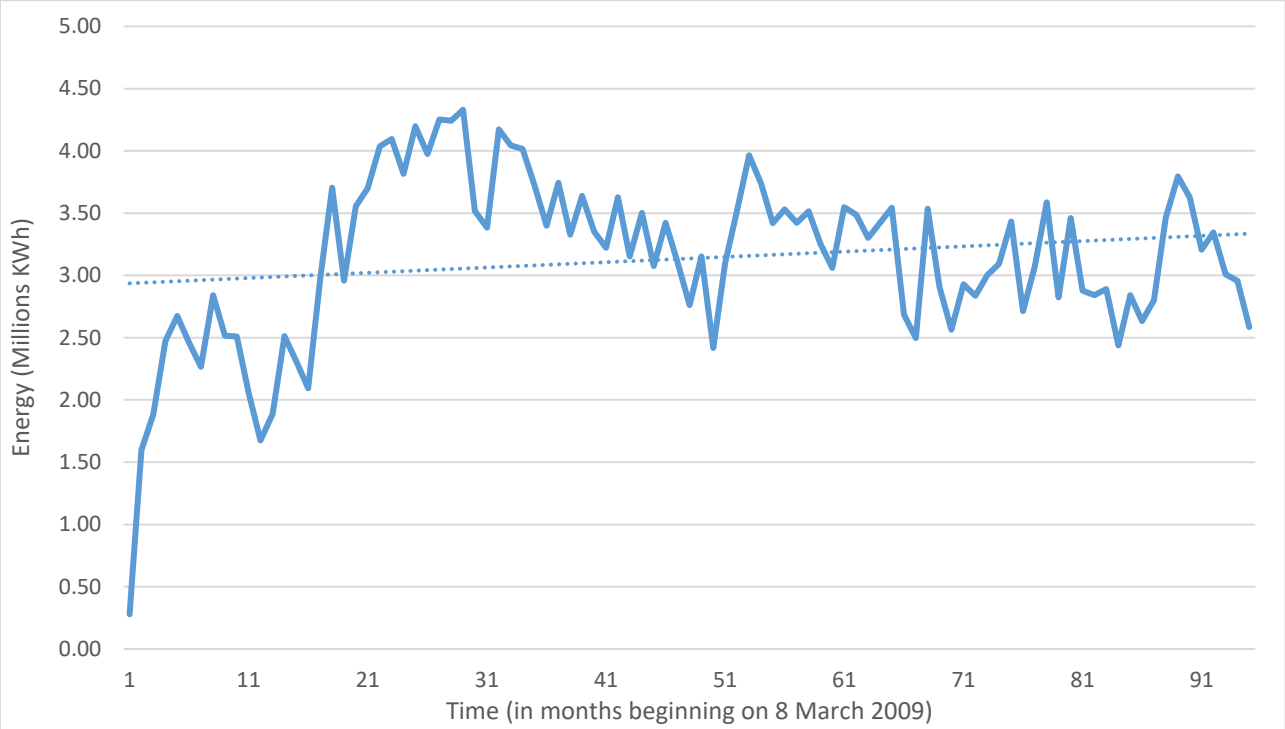
y = 17538x + 549124

$R^2 = 0.4392$

The R^2 value indicates that 44% of the variation in Amount can be explained by the changes in time.

(This is a good percentage)

Figure 17: Bisasar Road - Energy Production against Time



Model

$y = 4241.9x + (3 \times 10^6)$

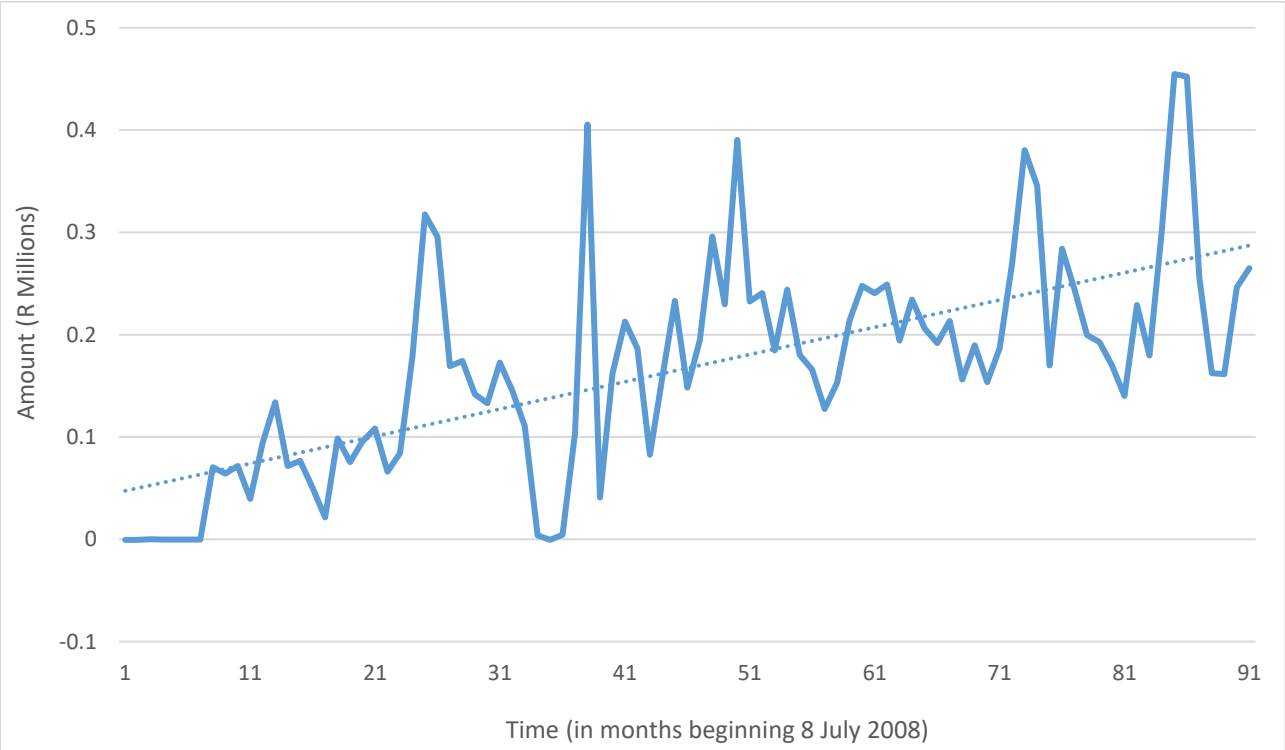
$R^2 = 0.0304$

This R^2 value indicates that only 3% of the variation in Energy can be explained by change in time.

It is noticed that after about month 30, the average becomes constant (that is, the slope becomes horizontal).

Figure 18: Marianhill - Revenue Generation against Time

Marian Hill

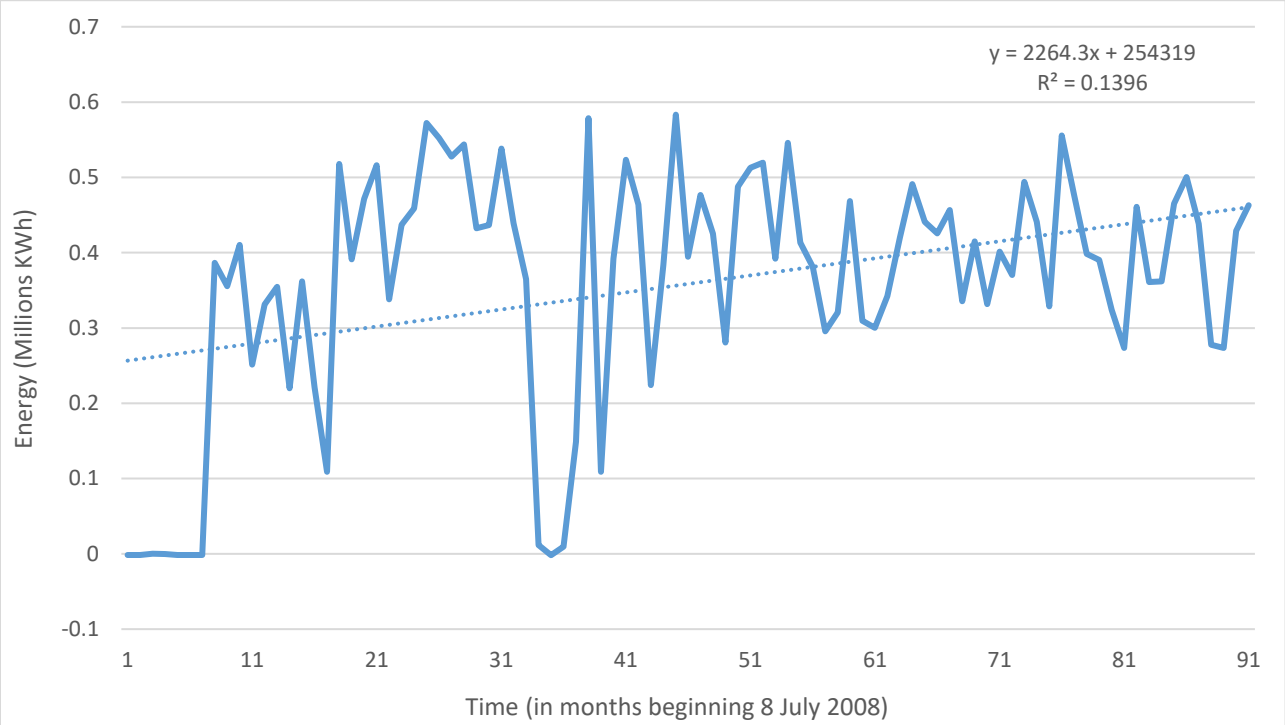


Model

$y = 2664.8x + 44684$

$R^2 = 0.4473$

Figure 19: Marianhill - Energy Production against Time



Model

y = 2264.3x + 254319

$R^2 = 0.1396$

14% of the variation is explained here. Still not a good value.

Note:

The **kilowatt hour** (symbol **kWh**) is a derived unit of energy equal to 3.6 megajoules. If the energy is being transmitted or used at a constant rate (power) over a period of time, the total energy in **kilowatt-hours** is the power in kilowatts multiplied by the time in hours.

The graphs above represent the movement of two essential enablers towards sustainable development and the propagation of the Clean Development Mechanism. For both Bisasar Road and Mariannhill, the graphs represent the production of energy in Kilowatt Hours against time, as well as the production of revenues in Rand over the same period of time. There is a symbiotic

relationship between energy production, time and the production of revenue. The revenues are produced from the sale of energy. For both Bisasar Road and Mariannhill, one notices that the production of energy from the plants stabilize and even plateau after thirty months. The stable production and the phenomena of representing the plateau effect on the graphic representation quantifies the aspect of sustainability in terms of energy production. This represents an important enabler in terms of consistent, sustainable and reliable production of energy. The graphic representation of the propagation of energy production also represents the success of both the plants in terms of clean energy production.

There is an underlying contention in every conversation with respondents that the basis of sustainable development is economics, albeit at a micro level at Bisasar Road and Mariannhill. The aspect of demand and supply manifests in the sustainable production of energy which, in turn, manifests in the production of sustainable revenues. The graphic representation of revenue growth over the 91 month period represents the basis of sustainability and sustainable development. Without revenue streams there can be no sustainable development! The very basis of sustainability is revenue generation. The capacity for any project to generate sustainable income represents the economic basis of development because any form of sustainable development needs the successful generation of sustainable revenues. Without doubt, the successful generation and sustaining of revenue generation over the period of a project represents the most significant enabler. The graphs for both Bisasar Road and Mariannhill indicate that revenue streams show a significant growth over the period of 91 months. The graphs show sustainable flows in revenue growth and even as at January 2016, the actual movement of revenue indicates an upward movement. In the model, “R” squared for both Bisasar Road and Mariannhill is around 44 % and this means that 44% of changes in revenue can be explained by the variable of time. Forty-four percent represents a sustainable percentage for revenue growth. The revenue growth for both Bisasar Road and Mariannhill represent strong enablers towards funding sustainable development.

For both projects, energy production is the basis of revenue generation and the symbiotic relationship between revenue generation and energy production jointly represent significant enablers to funding sustainable development. At Bisasar Road, only 3% of the variation of energy production can be explained by changes in time. For Mariannhill, the variation is 14%. Technically, both 3% and 14% do not represent favorable percentages for the explanation of changes in energy production over time. In terms of sustainable development, however, the percentages are

compromised because of the plateauing effect of energy production. This is understandable because the mechanical capacity for the production of energy does not change. After about 30 months, one notices the plateauing phenomena on the graphs. This represents a level of reliability in terms of sustainable predictability of the production of energy. The argument that funding sustainable development depends on the sustainable production of energy is a valid argument when considering that the synergy between the two variables together represents the most significant enabler to funding sustainable development. The phenomena of the plateauing on the graphs for the sustainable production of clean energy in fact represents a reliability for energy production and therefore, the basis of reliable and sustainable revenue generation.

For the two projects under consideration for this case study, it must be stated that the two most significant enablers of funding sustainable development is the constant and reliable synergy between energy production and revenue generation. This synergistic relationship between energy production and revenue generation would have been even better if there was a constant and reliable sale of Certified Emissions Returns over the period of 91 months, which represents the snapshot of this case study. The significance of the relationship between energy production and revenue generation would have been more significant if the two projects successfully gained revenues from the sale of carbon credits. The very basis of clean development is the sale of carbon credits to Annexure 1 countries to offset carbon emissions in the industrial nations of the North. Ostensibly, the potential capacity for the sale of carbon credits represents a very significant enabler to funding sustainable development. With specific reference to these two projects, the joint accrued revenue from the sale of carbon credits, according to the respondents at Durban Solid Waste, is only R13.84 million. The potential for the sale of carbon credits is indeed an enabler to funding sustainable development and realistically, the potential for a baseline reduction of carbon emissions is significant for both the plants. Jointly, the two projects have destroyed over 2.5 million tons of carbon emissions. This is significant and indeed a significant enabler to funding sustainable development. However, this potential has not been realized because revenues of only R13.84 million have only been realized from the sale of 1.1 million Certified Emission Returns. Therefore, it is argued that the dynamics of the World Bank are not conducive to the successful conversion of carbon credits to sustainable revenues for Non-Annexure 1 countries. This case study does not make any verifiable claims against the World Bank but the poor handling of the sale of carbon credits actually represents a barrier to sustainable development funding because Non-Annexure 1 countries, mainly in the South, cannot rely on the policy pronouncements of the World Bank regarding the potential of The Clean Development Mechanism projects to generate

sustainable revenues from the sale of carbon credits. The motivation of the Word Bank, it seems, is profit generation for itself rather than for making revenues available for sustainable development to Non-Annexure 1 countries of the South. There is an underlying hypothesis, which needs further intensive investigation, that the banking industry has no real interest in aspects of sustainable development but place more emphasis on their own profitability rather than on sustainable development and carbon reduction. In fact, it appears that Banks and the World Bank in particular, look at carbon credits as variables which have the potential for revenue generation from the void. This serves as the perfect model for profitability. The World Bank pays lip service to sustainable development and its policy towards the trading of carbon credits to date is rather myopic and irrelevant relative to the reduction of carbon emissions.

The two plants jointly capture 3900 cubic meters of gas per hour from their respective landfill sites. Mariannhill alone captures 470 cubic meters per hour. Captured gas comprises 53% methane, 40% carbon and 7% other impurities. When the gases are combusted, the harmful methane is reduced to zero. Most of the impurities are also destroyed. Therefore, 3900 x 0.53 (2067) cubic meters of methane is destroyed in the combustion process.

In addition, 1.4% of impurities are destroyed (0.014 x 3900) which amounts to another 55 cubic meters. The system destroys 2120 cubic meters of gas and 1780 passes through.

Methane is 25 times more harmful than carbon. Therefore, the capacity for the two plants to destroy harmful emissions is significant. The capacity to destroy harmful emissions reduces baseline emissions and this is important criteria to attract international project funding. In addition, the capacity to negate harmful emissions contributes to the capacity of both projects to produce saleable Certified Emissions Returns (CERs).

Funding sustainable development from the perspective of the Clean Development Mechanism demands that the structural integrity for the implementation of CDM is technically correct. The technical correctness is measured by the outcomes of reducing baseline emissions and the production of sustainable revenues. The quantitative statistics; the graphical representation of clean energy production and revenue generation; and their effective synergistic structures are indeed the foremost enablers of funding sustainable development within the context of the Clean Development Mechanism. The next section outlines the responses to one-on-one questions directed to the engineer at Durban Solid Waste and then to an Independent Authority on CDM.

4.11 Questions from a Pigouvian Perspective Relating to CDM

Questions were designed to interrogate Clean Development from a Pigouvian perspective and posed to the engineer at Durban Solid Waste and each question was then, in turn, posed to an Independent Authority on the implementation of CDM.

- **Does CDM allows for the existence of externalities in both Annexure 1 and non-Annexure 1 countries?**

The representative from Durban Solid Waste responded as follows:

In order for annex 1 countries to be able to use CERs as offsets, the company has to reduce the pollution levels above the allowed limits by 80% and may only use 20% as offsets. The developing country gets the benefit by not starting on the bottom rung of the ladder, as clean technologies are being introduced without paying school fees on the learning curve. Benefit to both parties.

The Independent Authority on The Clean Development Mechanism provided a very detailed response:

Externalities occur when producing or consuming a good that causes an impact on a third party/s not directly related to the transaction or activity. Externalities can either be negative or positive and they can also occur from production activities or consumption activities.

The impact on Annexure 1 and Non-Annexure 1 countries is as a result of the cap and trade adopted by the EUETS (*European Union Emissions Trading Scheme) and by Annexure 1 parties limiting their emissions under the Kyoto Protocol. The externalities of this system, both positive and negative, take place with or without the CDM mechanism. The positive is a reduction in global emissions and the negative is an increase in goods and or services and potential impact on economic activity and growth. These externalities impact both Annexure 1 and Non-Annexure countries to varying degrees.*

The CDM mechanism allows for the above to take place, but at a lower cost by allowing Annexure 1 countries to procure Carbon Credits (CERs) from projects in Non–Annexure countries that would otherwise not be implemented if they were not able to sell the CERs that they produce from

the project activity. So what is the impact of CDM on externalities if we assume that the cap and trade mechanism and the Kyoto Protocol are the base-line from which we are measuring?

With CDM, the environmental benefit remains the same as the Annexure 1 emitter is only able to offset their emissions by the same number emission reductions produced and procured from a CDM project. The CDM project would not have been implemented and would not have produced the emission reduction without the revenue from the sale of the CERs.

The externalities from the implementation of CDM now include the Host country territory but these are largely positive externalities.

Idealists, however, believe that both a reduction in the Annexure 1 emissions must take place and the implementation of emission reduction in Non-Annex 1 countries should take place and this view, although noble, is void of any legislative or economic drivers which is required for change. Ultimately any drive to change behavior will result in a cost as an externality.

- **Does the implementation of CDM overlook emission levels in the Northern countries while imposing limitations on host countries and thereby frustrating development goals in the Southern countries?**

The response from the representative at Durban Solid Waste:

No limitations are set for developing countries. However, some have chosen to set their own targets. Annex 1 countries still have to take action to be able to utilize CERs as offsets.

Response from the Independent Authority:

The implementation of CDM does not overlook emission levels in the Northern countries because emissions are not restricted to geographical boundaries in the short to medium term and any emissions are a global problem and cannot be viewed in isolation in the long-term.

The implementation of a CDM project does not impose limitations on the developmental goals of the host countries but rather facilitates the host countries objectives by requiring that the CDM project actively comply with host country developmental objectives in order to be approved. In

South Africa this is that the project demonstrated sustainable development and not just emission offsets. This is in additional to the additionality and baseline hurdles.

- **Do the two plants in Durban produce two types of externalities, namely, depletable and non-depletable?**

The response from the representative from Durban Solid Waste:

The landfill gas that is captured would release into the atmosphere if the projects were not implemented. Gas consists of methane, carbon dioxide and impurities such as SOx and NOx. Therefore the project, itself, does not produce externalities. The methane is burnt off and produces heat and the carbon dioxide and impurities pass through the engines, but some impurities are destroyed in the process.

Response from the Independent Authority:

YES! The projects do produce depletable and non-depletable externalities. (With probable reference to the landfills themselves outside of the CDM project.)

- **Would it be considered correct to postulate that the process of burning-off methane produces a depletable externality while the carbon and mixed gas fumes produce non-depletable externalities?**

Response from the DSW (Durban Solid Waste) representative:

As referred to in my previous response, the externality that is produced is in the form of heat which, at this time, we are not capturing as we do not have a use for it. But this could be done at a cost, should a use become apparent.

Response from the Independent Authority:

The answer is YES and NO. It depends on whether you are referring to positive or negative externalities. Below, I will try to answer the question taking both positive and negative externalities and both depletable and non-depletable externalities into account and for the purpose of this

question we will assume the externalities referred to in the question are limited to the project sites (i.e. local) and their surrounds.

Depletable Negative Externalities

Carbon emission can be viewed as a negative externality as this will be a localized increased level of this emission. However, this emission will feed back into the natural carbon cycle and is therefore depletable. The same can be said for a bulk of the other exhaust gases all with varying degrees of impact based on the stability of the compound emitted to resist further oxidation and reaction in the atmosphere.

Depletable Positive Externalities

The CDM project produces renewable electricity which offsets brown power. The offset of the brown power reduces our consumption of fossil fuels and this is a positive e externality. However, the fossil fuel will ultimately still be consumed over time and will therefore be depleted.

Non-depletable Negative Externalities

The impact of the project activity on the availability of resources that could otherwise be used on other projects is a Nondepletable negative externality

Non-depletable Positive Externalities

The impact on the local community's quality of life in terms of the reduction in the odors emitted from the landfill sites is a Nondepletable positive externality as this impact is real and will not diminish over time.

- **Does the act of paying for carbon credits by Annexure 1 countries express an ownership and a liability, thereof, for the emissions?**

Response from DSW representative:

No, one can only register and generate CERs if the project reduces emissions from what they would have been from business as usual, so there has to be a reduced externality from what would have been.

Response from the Independent Authority:

The Annex 1 country is not buying an emission. They are buying an Emission Reduction and therefore are not liable for any emissions at the CDM project site. The CER is a Certified Emission Reduction which is backed by science and which takes into account the actual emissions produced by the project activity and this is netted off before a CER is issued.

For example methane is 25 times more harmful than carbon dioxide as a greenhouse gas. When the methane is combusted the project does not get 25 CERs but only 24 CERs as the project will produce one carbon dioxide emission for every methane molecule combusted. The reaction is detailed below:
$CH4 + 2\ O2 \rightarrow CO2 + 2H2O$

Although there are externalities associated with the activity when producing the CER, the buyer is still buying a net reduction.

- **Methane gas emissions are 25 times more harmful to the environment than carbon emissions. The process of burning-off methane produces two welfare benefits: Firstly, the destruction of every 25 tons of methane leaves a net emission of only one ton of carbon. Secondly, the burning-off of methane produces enough energy to generate and contribute electricity towards the municipal grid. Therefore, the process of burning-off methane converts a potentially harmful externality into one that produces distinct welfare benefits. Please could you comment and elaborate.**

Response from DSW representative:

Methane is 25 times more damaging than carbon dioxide, so the destruction of 1ton of methane is equivalent to saving 25 tons of carbon dioxide equivalent. I would argue that there are three social benefits at least.

- *Reduce greenhouse gases (environmental benefit);*
- *Generate electricity for the grid (social and financial benefit); and*
- *Reduce odor (nuisance).*

We could also argue that this process facilitates job creation.

Response from the Independent Authority:

This is correct but there are also other externalities such as reducing the consumption of fossil fuels, job creation, economic development and skills development. In addition, there is investment into infrastructure development. It also results in net foreign income for the country through the sale of CERs to Annex 1 countries.

- **The emission of carbon dioxide and other impurities from the exhaust constitutes a harmful externality. Which party is liable for the effects of this harmful externality at the two Durban plants? These emissions are the direct outcome from the implementation of CDM.**

Response from the representative at DSW:

The externalities always existed in the landfill gas. By burning the methane this destroys a large percentage of externalities in addition some of the impurities are also destroyed in the combustion, therefore a net reduction in emissions is achieved. The plants belong to the City se we are responsible but monitoring shows that the emissions are below the allowable targets set by the authorities.

Response from the Independent Authority:

This is an interesting question as we would need to ascertain if the externality before or after the CDM project was more or less harmful before you can lay any blame at the feet of the CDM project. I have tried to answer in the section below. However, to answer your question as to who is responsible, I would have to say the people who are serviced by the DSW are responsible to pay (sometimes even demand through protest action) that EThekwini and DSW provide solid waste services.DSW are therefore acting on behalf of the people and are the custodian of the waste on their behalf. Industry has to a greater extent adopt a cradle to grave approach in that we are not able, as creators of waste to simply walk away from the responsibility for creating waste. DSW does not create any waste. The people (the public at large) do and therefore any externalities from the landfill or the CDM project is the liability of the people (the public at large) that DSW serve.

If we ignore carbon dioxide, as this is a natural substance that is essential to life on earth and part of the carbon cycle, and focus on the "impurities" the following needs to be considered. When we look at the negative externality of burning landfill gas in an engine to produce electricity there will be some harmful trace elements that are emitted as a direct outcome of the combustion of the gas. However, to look at this in isolation without understanding the impact of the landfill gas and its trace elements prior to its use and in its "raw" state with its trace elements would be disingenuous. To then further ignore the emissions saved by the project by displacing coal based electricity generation would also be disingenuous as one would need to take holistic view of all externalities both positive and negative and not just some of them. One would then need to compare the baseline prior to the project activity with that after the project was implemented.

- **Does the implementation of CDM depend, to a large extent, on the host country maintaining baseline emission levels below that which would have occurred before the implementation of CDM? The difference in baseline emissions constitutes additionality. Is it correct to state that additionality determines the value of saleable credits?**

Response from the representative at DSW:

No, the market determines the value of the CERs and this value is influenced by several factors such as demand (which is very low at this time as the recession continues to bite), availability of credits out of Europe as these have higher priority / value than CERs from Non-Annex 1 countries.

Response from the Independent Authority:

Additionality determines the permissibility of carbon credits above the baseline and not their value as value is determined in the market. Additionality determines if the carbon credits are permitted to be issued and is a hurdle criteria for registration.

- **What does one carbon credit fetch, in terms of revenue, on the open global market?**

Response from the DSW representative:

This varies with demand. In 2008, we were negotiating at Euro 15 per credit. After the financial crash in 2008, the price dropped as low as .21 Euro per credit and since has climbed back to around Euro 0.64.

My guess is that the value will slowly climb as America and Europe come out of recession and will probably stabilize around Euro 4 to 5 by 2020.

Response from the Independent Authority:

This can range from sixty Euro cents to Thirty Rand.

- **How many carbon credits, in total, are produced by both plants on an annual basis?**

Response from the DSW representative:

This will vary with time as there is a fixed amount of carbon in the waste which will produce a finite volume of methane, however, the rate of production varies with temperature, moisture, health of microbes etc. Currently producing 275 000 per year.

Response from the Independent Authority:

This information will need to be obtained from DSW or the UNFCCC website.

- **What is the potential per annum revenue streams are from the sale of carbon credits?**

Response from the representative from DSW:

Electricity generation provides a revenue of R1.8 million per month. Should carbon tax become a reality in South Africa, the revenues from taxes would be in the region of R2 million per month.

Response from the Independent Authority:

This information will be obtained from DSW.

- **Does the revenue-flow from the sale of carbon credits from Bisasar Road and Mariannhill justify the continuity of both projects?**

The response from the DSW representative:

If one takes the total income, not just CERs then yes one can justify the projects, given that the capital has to be repaid whether the project is running or not.

Response from the Independent Authority:

Information needs to be sourced from DSW.

- **Do Annex 1 countries from the North exploit CDM as a protocol of convenience to allow for the unsolicited emissions to remain as they are in order to maintain the developmental and economy agendas of the North?**

Response from DSW representative:

As previously explained, each country is given a target that cannot be exceeded. That country gives individual industries targets which are then driven down to individual companies who may not exceed their quota. These companies then have to take action to ensure they remain below the target. Thus 80% of the difference between the target and the actual pollution level has to be addressed by the company and other 20%canbe offset through the purchase of CERs. So do not believe so.

Response from the Independent Authority:

No, this is not my understanding. The Annex 1 countries have agreed to cap their emission and have to format a strategy to reduce this over time. It is clear these commitments will have a cost and therefore have a negative impact on the economic agenda of the North.

- **Does CDM promote the agendas of Annexure 1 countries while ignoring the development goals of the South? Please elaborate…**

Response from the DSW representative:

No, not at all. South does not have to participate. It is a free choice. The benefit is that the developing counties get direct access to clean technology without having to go through the learning curve. Therefore, they start off higher up the learning ladder at a reduced learning cost and less pollution.

Response from the Independent Authority:

In terms of the above noted commitment, CDM only provides for an alternate more cost effective mechanism in which to achieve the emission caps and or reduction in the North.

- **Would it be more beneficial for host countries to follow national emission targets rather than geographical targets?**

Response from DSW representative:

Not sure I follow this question.

Response from the Independent Authority:

I am not sure of the purpose of question, as I think it will be a natural progression/assumption for National targets to end up being divided geographically with a weighting applied to the level of economic and industrial activity.

- **Does CDM benefit larger economies like India and China, rather than smaller economies like South Africa?**

Response from DSW representative:

Yes, I would imagine it does as larger economies would generally have more areas where CDM projects could be implemented. Furthermore, both India and China have far larger technical communities than does South Africa and therefore have the capacity to take on these time consuming processes.

Response from the Independent Authority:

Yes.

- **Would it be correct to say that the methodology for determining emission reductions for CDM is dubious at times? Please elaborate…**

Response from DSW representative:

The one thing that the UNFCCC have been very strict on is the methodologies must be conservative and must pass rigorous testing and inspection prior to it being accepted as a methodology that can be utilized, this is in fact what makes it difficult as the monitoring and recording that is required makes implementation quite difficult.

Response from the Independent Authority:

No. having been audited and having gone through the verification process the methodology is sound having been approved by an international panel of experts and number of which are very active environmentalists and the methodology using best practice and a number of check and balances to ensure the emission reductions are genuine.

- **Externalities pave the way for taxes, subsidies and discounting of environmental credits and therefore require proper accounting protocols to quantify the value of social boons or social harm. What accounting protocols are followed at Bisasar Road and Mariannhill?**

Response from the DSW representative:

There is rigorous monitoring that takes place of quality of gas, quantity, temperature of engines, exhaust emissions, air quality in the vicinity of the engines. Audits are carried out and verifications prior to the issuance of any credits. Yet another costly hurdle that must be jumped. There is no partial achievement, either one can prove the destruction or one cannot. So either get 100% of claim or one gets 0% of claim. No averaging percentage will be accepted. I.e. cannot say one has done a reasonable job, but it is not completely accurate so provide say 80% of credits claimed.

Response from the Independent Authority:

I am not sure I understand the question. Firstly, externalities by their very definition are not related to the project activity itself but are external to the project, and in many instances, are subjective. However, if we only focus on the carbon credit reduction, in this case government could choose to tax an emission (emissions Tax) which is currently planning on doing in order to change behavior and achieve their goal of a low carbon economy. But how would government tax be a saving or reduction in an emission and why would it do so if this behavior is already in line with their goals? Government could if they so choose to tax the income from the sale of carbon credits.

Secondly, how do Environmental Credits become a boon or social harm unless they are proven to be such when compared to the baseline scenario?

Either way I agree that a clear, transparent, reliable and auditable process for accounting for any carbon credits needs to be maintained. And for the projects mentioned above, this is the case as it will need to comply with the methodology in terms of monitoring and compliance and will be audited and reviewed before any environmental credits are issued.

- **Would it be correct to assert that externalities produce distortions and the best way to correct these distortions is to impose taxes or pay out subsidies?**

Response from DSW representative:

Not clear on what these distortions are, would need clarity to be able to respond.

Response from the Independent Authority:

One would first need to prove that there is a net increase in Externalities from before the CDM project to after the CDM project taking into account all the positives and negatives of the baseline of venting landfill gas into the atmosphere and using coal based power Vs the emissions form the project activity and displacing coal based electricity generation. This work has all been done by many renowned scientists across the globe and the overwhelming evidence is that the CDM project activity produced a net benefit. However, if one takes a narrow view and only looks at site based externalities then it would be easy to be misled about the balance of Externalities and the project activity.

If we were to entertain this train of thought, I would however pose a question as to who gets paid the subsidies for Externalities and then who fits the bill for these payments. If DSW foot the bill, then this will simply be passed on the client to whom DSW is providing a service. Would it then be safe to say that perhaps a landfill tax would be more appropriate?

- **Do subsidies, taxes and the sale of carbon credits bridge the gap between private and social welfare?**

Response from DSW representative:

CDM is a process to bring clean technologies to developing countries without those countries having to go through the lower learning curve. The projects already bring benefits to the country and the communities. In our case, we have sweetened this even more by providing bursaries to deserving students who take up civil engineering. In addition, a trust is to be set up with 5 % of profits from the project being set aside for community members to motivate for funding to carry out projects of an environmental nature.

Response from the Independent Authority:

Not sure the revenues from any of the above are linked to social welfare. The project activity generates economic activity and this will have some benefit on the private and social environments when compared with doing nothing.

- **Would it be safe to assert that more stringent accounting measures need to be implemented to accurately capture the impact of externalities?**

Response from the representative at DSW:

Yes, but this is already the case. The UNFCCC processes are extremely vigorous and arduous to comply with.

Response from the Independent Authority:

As the externalities are not defined in your question, I am not sure that the Externalities, beneficial or detrimental have a unit of measure required to be accounted for. Externalities can be very subjective and can also be influenced other local factors for example the landfill site no longer smells as a result of the CDM project. If one produced a defined list of externalities and quantified those in their relevant units prior to the CDM project and then quantified them after the CDM, one could produce an accounting systems of these externalities. However, I do not see the point of imposing this type of system on a project seeking to improve the environment and not doing that for the average citizen who uses fuel for vehicle or for businesses who create emissions.

- **Externalities represent the unpaid factors of economic activity and therefore require stringent supervision and monitoring by an accredited, Independent Authority?**

Response from the representative from DSW:

Yes, one has to comply with the requirements of the UNFCCC methodologies. The results are audited and only issuance takes place once the Board is satisfied. In addition, the host country's Designated National Authority (DNA) first have to approve any application prior to submission to UNFCCC. Also, have to comply with Environmental Affair requirements.

Response from the Independent Authority:

Agreed. The same principle could be applied to all aspects of life like those who drive cars to work and create an impact on those who walk (the pedestrians).

- **The implementation of CDM may impact environmental integrity and in, turn may alter the social and economic integrity of communities? Could you comment on this?**

Response from DSW representative:

All CDM projects are beneficial to the environment as this is the sole purpose, these projects will consolidate the community as brings improvement to the environment, and some jobs are created (Albeit quite small) temporary jobs are created for capital projects. Country will generally obtain foreign income.

Response from the Independent Authority:

CDM projects are not permitted to be implemented if they do not first comply with environmental legislation and secondly, if they do not comply with the additionality criteria and the methodology for that project activity in terms of CDM. The above statement is inaccurate in that CDM projects provide a net environmental benefit which is independently audited and has been proven globally to provide net environmental benefits after taking into account the externalities. To then further assert that CDM projects then alter both the social and economic integrity of communities is unfounded. How would implementing an environmentally and scientifically sound project undermine social and economic integrity unless one places undue preference or priority on a particular externality?

- **Does the imposition of Taxes, subsidies and the sale of carbon credits arising from CDM correct social dissonance arising from unsolicited emission?**

Response from the DSW representative:

Yes, to some extent as emissions are reduced from the level they would be at for business as usual.

Response from the Independent Authority:

The route of this question goes back to the basic science. If there is social dissonance, this is a result of a lack of understanding of the science and the CDM mechanism itself. There are a number of organizations that believe that CDM represents a commercialization of our air. However, this is a very narrow view to take as the emissions emitted in Annex 1 countries today are also our emissions tomorrow.

So, we need to agree that the commitment by Annex 1 countries to cap and then reduce their emissions will only produce long-term positive externalities and real environmental improvements over time. We then need to agree that to do this at any cost although idealistic is not economically viable or practical and the option to secure emission reductions at a lower cost through the CDM mechanism is logical and sound approach to achieve the Annex 1 countries objectives detailed above.

CDM is then governed by a very strict set of rules and methodologies which have been developed by the international community and has been proven by science to yield net environmental benefits in order to create an environmental credit.

If all of the above is not understood or at least agreed to in principle, then there will always be a conflict between the perceived weighting of the externalities vs the actual measurable benefits from the project activity.

- **The concept of "*Pareto Optimal*" is a process of allocating resources in such a way in which it is not possible to advantage one individual without making at least one individual worse off. Does CDM contribute to a progressive restoration of the "Pareto *Optimal*"?**

Response from the DSW representative:

Not sure of progressive restoration, but implementing CDM is beneficial to the communities, its beneficial to the environment, beneficial to a country as there is technology improvement and faster learning curve.

Response from the Independent Authority:

The question is does the impact of the CDM project or the externalities form the project increase or decrease with the implementation of the project Vs the baseline scenario? The science says no it does not increase and there is a net environmental benefit. I do not think that the advantage gained through the sale of the carbon credits makes any of the interested and affected parties worse off as the projects creates a far larger amount of net environmental benefits. In terms of resource the landfill gas is not a bankable resource as it will vent into the atmosphere if it is not used. So using this resource does somehow predacious another individual but it actually preserves another resource in the form of coal by displacing coal based electricity generation. I cannot see who would be made worse off by the implementation of the project without first proving the first point in this response.

- **Should the victims and end-recipients of the impact of externalities, be allowed to bargain for compensation?**

Response from the DSW representative:

This is a moral question that I am not skilled in responding to, but this would be difficult to motivate in the case of CDM as such a project would reduce the emission levels and therefore is beneficial to communities / the world as GHG emissions are reduced.

Response from the Independent Authority:

In order for this to apply the weighting of the externalities would have to be elevated to such an extent that it outweighs the benefits of reducing greenhouse gases and mitigating climate change. This is not the case as the science has proven that there is a net benefit.

If we are to assume that a particular externality justified a claim, then there are a host of other factors that need to be taken into account such as the following:
Was the externality there before the CDM project or not?
Has this externality been scientifically proven and its impacts known/quantified.
Was DSW aware of the impacts of the externality in question or not?
Was this communicated to the receiving environment or not?

Was the party making the claim in the area first or was the site there first?
What portion of compensation considering that the claimant is also a contributor to the problem as their waste also creates the landfill gas which is a greenhouse gas and the resultant externalities form the landfill?

- **Who is legally liable for the net effect of externalities arising out of CDM activities at Bisasar Road and Mariannhill?**

Response from the DSW representative:

The City is responsible but these are well below the allowed limits and are far reduced from the direct emissions from the landfills if nothing was done.

Response from the Independent Authority:

This is a strange question in that it requires us to have two sets of standards. Who is liable for our externalities when driving our vehicles past pedestrians who need to live with the externalities of our car fumes? Both the car and the CDM project use internal combustion engines as their power house/prime mover. Does our right to create some externalities using our car remain valid as it is custom and socially accepted while at the same time imposing penalties on a CDM project for its externalities simply because it is less acceptable or custom. This would require that we choose to elevate the externalities of the CDM project to higher level than those of other types of industries to serve some other agenda? If this is not the intention, then we need to look to science to establish if there is a net increase in the externality or not. Even then once this has been proven does the project have the same right to exist and not pay compensation for its externalities as will future generation of drivers who will occupy our roads? The question is if externalities are going to be taxed then it would be unjust to target project that seek to reduce greenhouse gases without including all the other emitters externalities on alike for like basis.

- **Should "*Pareto Optimal*" be restored by State intervention, market solutions or legal interventions?**

Response from the DSW representative:

Think this is a question above my grade, but as previously stated don't think this question comes into the equation for CDM projects as they are implemented as clean/ cleaner technology and reduce emissions.

Response from the Independent Authority:

I do not think that "Pareto Optimal" is evident in this instance for the CDM project.

- **Does the implementation of CDM impact on the process of ecological renewal?**

Response from the DSW representative:

Yes, would say that it impacts positively as it is a helping hand to reduce GHG.

Response from the Independent Authority:

Yes, it has a positive impact as it speeds up the stabilization of the landfill and allows for plant growth on the surface of the landfill, which could otherwise die off due to methane venting to the surface and killing the plant life.

- **Is it possible to monetize the capacity of the ecology to renew itself on a cyclical basis?**

Response from the DSW representative:

Unable to advise on this as we only have one environment with a fixed capacity, and once that is exceeded not sure that it could recover except by God's intervention.

Response from the Independent Authority:

Yes- I would have thought this is what farming is in its broadest term?

The next set of questions are directed exclusively to the engineer at Durban Solid Waste. These questions deal with the aspect of *funding sustainable development*. Although this entire case study seeks to identify enablers and barriers to funding sustainable development within the context of the Clean Development Mechanism as implemented at Bisasar Road and Mariannhill, this study interrogates CDM from its basic and essential implementation to extract data regarding energy production, revenue generation from electricity, and revenue generation from the sale of Certified Emission Reductions. These quantitative statistics, graphs and data direct the study in its assessment of enablers and barriers to sustainable development.

The second set of questions examines the implementation of the Clean Development Mechanism from the perspective of Pigouvian thinking. In this section, the broad conceptualization of enablers and barriers are grounded in the theoretical and philosophical directives of Pigou. This theoretical grounding adds credibility to formatting a framework for sustainable development from developmental state perspective.

In the following set of questions and responses, directed to the engineer at Durban Solid Waste an attempt is made to understand how the implementation of Clean Development funds sustainable development with respect to revenue flows and more specifically profitability and the system of accounting and management of revenue resources.

- **Does the implementation of CDM at Bisasar Road and Mariannhill represent development which meets the needs of the present generation without compromising the ability of future generations to meet their needs?**

Yes, if not implemented it would be business as usual, which would be more detrimental than a CDM project.

- **Does CDM attract optimal capital investment from the sale of carbon credits for the purpose of funding sustainable development?**

CDM was designed as a mechanism to assist developing countries not to go for the cheap / known standard option but to enable them to aim higher up the ladder at cleaner technologies so it was designed as a supplement to a project that would have been implemented.

- **Do the revenues from the sale of carbon credits compensate for any unintended, detrimental effects caused to the environment?**

By the nature of the process, a CDM project has to be more beneficial to the environment so it should be judged against what would have happened if a CDM project was not implemented. So one cannot say whether it can compensate for an unintended detrimental impact without knowing the extent or damage caused. But it will always be less detrimental than the project it has replaced.

- **Do revenues from the actual discounting of carbon credits produce sufficient financial capital reserves to propagate sustainable development?**

In some cases, it may but not in all. Projects that are implemented should be sustainable in their own right. Sale of Carbon Credits should be a top up to go for a slightly better solution than would have been the case.

Is CDM a profitable venture?

As previously stated, CDM is a mechanism to enable one to go for a better, cleaner solution than would have been the case, therefore one of the criteria is additionality.

- **Please elaborate on the effectiveness of the accounting system used to monitor CDM revenue flows.**

The same accounting system is used as that for the running of the City, so is adequate.

- **Do Bisasar Road and Mariannhill utilize a prescribed accounting system?**

No not prescribed, but as stated we use the City's system which is JD Edwards.

- **Does the CDM Executive board play an active role in the activities of Bisasar Road and Mariannhill?**

Not sure understand the question. They play no role in running the project, but the board decides on accepting / approving the registration of the project and it also has the final say in authorizing the issuance of the CERs. So, in that way it could significantly influence the project.

- **Does the Designated National Authority play and active role in the activities of Bisasar Road and Mariannhill?**

DNA has the power to approve a project in terms of its own criteria which can be more onerous than CDM. It also has an oversight role and can withdraw authority at any time. So it too can significantly influence the project.

- **Do the activities at Bisasar Road and Mariannhill place special attention on other environmental variables outside of emission monitoring?**

You will have to explain this question more carefully, what other variables would the project influence other than emissions? What is meant by special attention?

While this section of Chapter Four is purely descriptive, articulating outcomes of revenue generation, energy production, information about the two plants and responses from the various interviews, the next section of Chapter Four embarks upon a detailed analysis of the collected data; information; and responses for the purpose refining and detailing the actual barriers and enablers to funding sustainable development from a sustainable development perspective.

4.12 Chain of Evidence

Table 3: Chain of Evidence for each Research Question from Interview Responses

Research Question	***Interview Question Numbers***
1) Does the implementation of CDM follow the stipulated CDM protocol?	1,5,6,7,8,9,10,11,12,13,17,18,25,27,31,32.
2) Does CDM contribute to funding sustainable development?	2,7,6,8,9, 10, 11, 12,13,14,15,16,18,32,34.
3) What is the impact of externalities?	1,3,4,6,7,8,15,18,19,21,22,33.

4) Is the stipulated accounting system effective in quantifying revenue flows?	2,7,6,8,15,17,18,19,21,22,35,36.
5) Does the imposition of taxes, subsidies and the sale of carbon credits restore *Pareto Optimal?*	5,7,8,10,11,12,17,19,22,25,28.
6) Does CDM restore *ambient welfare standards?*	6,7,8,9,10,11,12,14,17,20,23,24,26,31,32,34.
7) Does the sale of carbon credits, imposition of subsidies and taxes facilitate the reduction of emissions?	5,7,8,9,10,11,17,19,33.
8) Does CDM restore ecological renewal?	6,7,23,24,29,30,33.
9) Does the CDM executive board serve as an effective overseeing authority?	37
10) Does the Designated National Authority oversee the implementation of CDM?	38

4.13 Introduction to the Process and Protocol of Systematic Analysis

The systematic analysis of data, information and responses from the interviews are focused around the stated objectives of this study in order to articulate the barriers and enablers to sustainable development from a Pigouvian theoretical perspective for the purpose of detailing and defining a guideline for the implementation of sustainable development from a developmental perspective, within the specific context of the implementation of CDM at Bisasar Road and Mariannhill in Durban. Analysis is undertaken within the stated ontological and epistemological lenses of this case study.

The ontological directive points to an existential analysis by initially utilizing the inductive logic approach. Eisenhardt's approach informs the process of analysis by generating theory between data collection and data analysis and therefore utilizes both inductive and deductive logics. Systematic analysis in this chapter utilizes a step-by-step approach to elicit information by examining what is operative from the standpoint of empirical observation and drawing conclusions about what is and what isn't with specific focus around the stated objectives of this study. Further analysis extends to examining the framework for the implementation of the Clean Development Mechanism from a deductive logic context and this involves seeking answers to what ought to be by identifying a framework to solve the problem.

In the final analysis towards articulating a framework for sustainable development, this study utilizes integrative thinking as a process to inform the analysis. Integrative thinking employs abductive logic for analysis. Analysis from an integrative logic perspective identifies what features are salient or important. The process of integrative thinking seeks to make sense of what one observes and sees. Integrative thinking defines what tasks need to be undertaken and in what order. From an integrative thinking analysis position, the resolution of analysis concludes by compiling a new model for sustainable development by implementing new found theory and knowledge. Abductive logic therefore adds to the extant model to foster a new innovative model.

According to Martin (2007:144) integrative thinking analysis features the following logics:

- Salience – what features are important?
- Causality- how does one make sense of what one sees?
- Architecture-what tasks will be undertaken and in what order?
- Resolution –compiling or adding new models or new knowledge and theory.

From an epistemological perspective, this study enquires whether reality is outside human consciousness; whether reality becomes verifiable when there is human engagement; or, in fact, whether subjective intervention invokes reality. The stated epistemological interpretative analysis is encased within the framework of Pigouvian ideology. This study conducts its analysis from the premise that Pigouvian thinking imposes a series of economic constructs with the specific aim of producing eco-friendly sustainable development, and that sustainability has certain key components like greening-up the economy; saving resources for future generations; reducing harmful and dangerous emissions; and more specifically, reducing the emission of harmful greenhouse gases.

Pigouvian analysis is based on welfare economics and the basis of welfare economics weighs in on the identification of economic externalities. Hence, analysis focuses on determining whether externalities produce boons or harmful effects. Analysis turns to question how these externalities, arising out of specific economic activities, are realistically factored into the macroeconomic equation. Pigou refers to the aspect of the Pareto Optimo as a realistic means to analyze how taxes and subsidies restore the Pareto Optimo, implying that when an economic entity creates an unsolicited boon, it ought to be compensated; and, in similar fashion, when an economic entity causes harm or pollution, it ought to be penalized by the imposition of taxes on its unsolicited outcomes. Pigou advocates a recognition of externalities for analysis, and that the outcomes of

the impact of externalities need a proper accounting system to quantify and factor into the economic equation for the maintenance of Pareto Optimo. Pigouvian analysis demands that economic activity arising from the identification of externalities must restore ambient welfare standards. In addition, the resolution of actions from the identification of externalities must give rise to restoration of the ecological balance.

4.14 Deductive Analysis and Outcomes

Deductive analysis seeks to define what framework is utilized, in a practical manner, in the implementation of the Clean Development Mechanism from a pre-existing theoretical framework or model. Analysis from deductive reasoning then seeks to uncover how outcomes enable funding or pose barriers to funding sustainable development. Deductive analysis indicates that for the process of CDM to be implemented, there must exist a fully functional landfill with the capacity to generate bio gases for the purpose of flaring and burning methane in order to produce energy to generate electricity. Furthermore, the landfill must have the potential to emit greenhouse gases which may be captured, flared and re-directed to produce electricity. The existence of externalities from the economic activities at the two landfill sites provides the perfect platform to implement CDM by capping and trading Certified Emission Returns. Externalities, in the form of emissions, promote the imposition of baseline emissions prior to the implementation of CDM, and this imposition of baseline emissions is the basis of capping and trading Certified Emission Returns.

The capacity to trade in Certified Emission Returns requires approval from the Prototype Carbon Fund of the World Bank. A memorandum of understanding was signed between the Prototype Carbon Fund and EThekwini as early as 2003. Any Clean Development Mechanism requires approval from the The Clean Development Mechanism Executive Board. In the case of Bisasar Road and Mariannhill, conditional approval was granted in 2002. Reciprocal approval is required and was granted by the Designated National Authority in 2002. Project feasibility finally rests on approval from outcomes of the Environmental Impact Assessment.

After approval by the Prototype Carbon Fund of the World Bank, the Executive Board, The Designated National Authority and The Environmental Impact Assessment the project requires start-up funding to commence operations. Without start-up capital, the project faces failure. Startup capital may be sourced from the state, foreign direct investment, venture capital, public sector funds, private sector funding, crowd-funding, developmental funding or funding from developmental banks. Although it has been proven that The Clean Development Mechanism

projects have the capacity to generate revenues for self-sustainability, the projects do require start-up capital to set the ball rolling.

The protocol and process of implementation of CDM seems to attract start-up funds after approval by the relevant authorities. Approval by the Prototype Carbon Fund of the World Bank, The Executive Board and the Designated National authority almost guarantees access to startup funding. This study examines what aspects of CDM enable and what aspects of the implementation of CDM pose barriers to funding sustainable development outside of startup funding. The study does recognize that startup capital constitutes the basic enabler to funding sustainable development.

Table 4, below, introduces the barriers to and enablers of sustainable development from a deductive analysis perspective as discussed above.

Table 4: Barriers to and Enablers of Funding Sustainable Development from Deductive Analysis

Feature	**Enabler**	**Barrier**
Pre-Existing, Fully Functional Landfill site	√ Potential to generate revenues	
Capacity to Generate Green House and Bio Gases	√ Cap and trade opportunity	
Capacity for Flaring and Burning	√ Burns off methane and carbon emissions	√ Confiscation of carbon by flaring may not be recognized
Potential for Electricity Generation to Grid	√ Burning Bio gases to produce and sell electricity	
Existence of Economic Externalities	√ Produces Boons and tax revenue	√ Produces harmful effects and invites penalties
Approval by Prototype Carbon Fund of the World Bank	√ Capacity to produce revenues from CERs	

Approval by the CDM Executive Board	√ Fully functional CDM capacity	
Approval by the Designated National Authority	√ Endorsement by Local authority	
Approved Start Up Capital	√ Project feasibility	

4.15 Inductive Analysis and Outcomes

Inductive logic is the logic of what is. It is the logic of what is operative in terms of the implementation of the Clean Development Mechanism at Bisasar Road and Mariannhill. The process of induction describes the nature of existential reality. Inductive logic describes the contextual phenomena of CDM by quantifying data outputs; describing events and processes; and by recording empirical observations from an in-depth and clearly defined scope. This discussion is illustrated in the table below. Further discussion follows thereafter.

Table 5: Barriers to and Enablers of Funding Sustainable Development from Inductive Logic or Induction

Feature	**Enabler**	**Barrier**
Capacity to generate electricity	√ Generates reliable funding	
Flaring of gases	√ Useful in reducing GHG Emissions for CERs	√ World Bank does not always Recognize flaring for CER Revenue exchange
Seven year cycle Renewable 2x	√ 14 year revenue generating capacity	
Bisasar Road stopped Receiving waste in 2015 Gas producing capacity Valid till 2030	√ Extends revenue producing Period	√ Places limits to life cycle Of CDM plants
Mariannhill will stop Receiving waste in 2022.	√ Extends revenue producing	√ Places limits to life cycle

Capacity to generate gases Will be valid until about 2037	period	Of CDM plants
Revenue generation from the sale of CERs	√ Welcome additional revenue	√ Unreliable global market
Capacity for Carbon destruction	√ Enormous capacity for carbon destruction provided future Potential for revenue from CERs	
Reduction of GHG	√ Attracts funding potential	
Mariannhill generating Capacity of 1megawatt	√ SA to introduce Tax revenues soon	
Bisasar Rd generating Capacity of 6.5 megawatt	√ SA to introduce Tax revenues Soon Additional Revenue of R2million per month	
Discrepancy between Cost to produce electricity And price offered by Eskom is -22 cents/ Kw hour		√ Recurring shortfall Translates into an expense And barrier
Operational Costs R8million Per annum incl. set-up CDM Transaction Costs	√ Costs are necessary to produce revenues	√ Costs may exceed budgets And result in losses
Total operational costs To Date R135 million	√ Costs are necessary to Produce revenues	√ Costs may exceed Budgetary Constraints
500Kw hour electricity to 7500 homes capacity	√ Enormous reliable capacity Reliable source of revenues	
Revenue Graphs over 91 months indicate +ve upward swing	√ Positive upward revenue growth	
Steady and reliable Power outputs from both	√ Reliable power outputs	

Plants	Assure reliable and Consistent revenue streams	

Stated inductive outcomes complement and lend credibility to the descriptive outcomes of what is observed; what is; and what is existential reality relative to CDM and more importantly, the description of what is highlights features which promote the funding of sustainable development and at the same time, underlines features that offer barriers to the effective funding of sustainable development.

The aim of this research is to critically analyze what is presented and what appears to be. The simple stating of inductive reality has minimal relevance when there is no critical analysis of what appears to be at face value. Whereas quantitative research searches for quantifiable relevance of relationships to arrive at the truth, qualitative analysis and case study research do not have readily available and quantifiable tools to put into place to mathematically quantify what ought to be. While deductive logic seeks to describe the implementation of CDM from the stipulated framework of what CDM ought to be, inductive logic describes what is actually observed.

The extant model of CDM as described within the contextual framework of the Kyoto Protocol and the manner in which CDM is actually implemented poses some critical questions about the claims made that CDM contributes to and funds sustainable development. The mere deductive and inductive statements of what is, within a specific framework, does not necessarily indicate what reality ought to be from the perspective of sustainable development and its capacity to fund sustainable development. The very inductive and deductive analyses pose critical questions relating to the validity of the claim that the implementation of CDM does, in fact, promote sustainable development. Furthermore, the inductive and deductive analyses pose other critical questions as to whether the implementation of CDM at Bisasar Road and Mariannhill do, in fact, facilitate the funding of sustainable development.

The model of analysis as adopted from Eisenhardt and supplemented by integrative thinking points the research in the direction of critically examining the framework within which CDM operates and supposedly funds sustainable development. While case study analysis does not utilize mathematical tools to describe the validity of claims from the perspective of statistically valid correlations and differences between variables, Martin (2007:144) highlights qualitative research to the tool of generative reasoning as a highly versatile tool for the extraction of what

reality ought to be, rather than a passive acceptance of what the stated and superficial description of what reality is. Martin (2007:144) directs qualitative and case study researchers to abductive logic, integrative thinking and generative reasoning as highly useful and iterative tools for analysis.

4.16 Abductive Logic, Integrative Thinking and Generative Reasoning Analysis

Integrative thinking as postulated by Martin (2007:111) informs the study that the existential model of CDM is simply the most convenient model at this time, but is not necessarily what ought to be. There is thus the argument that CDM, presented as it is, does not represent a valid model for funding sustainable development. Secondly, the constructs apparent in what CDM presents at Bisasar Road and Mariannhill invite aspects that may be leveraged to indicate major flaws in the implementation of CDM. Thirdly, this research argues that the apparent model is not an indication of what CDM implementation ought to be. There has to be a better model!

This study asserts that it is not merely hypothetical to assert that a better model exists but arguments are levied to prove that the entire implementation of CDM as it is has a limited impact on the promotion of sustainable development and more specifically, the existing model does not fully subscribe to funding sustainable development. The existing model may, in fact, prevent the effective funding of sustainable development. With respect to the manner in which it is implemented, CDM may actually pose a barrier in itself. Based on the arguments of Martin (2007:112) and applying the tools of abductive logic, integrative thinking and generative logic, this case study seeks to “ferret-out” a new model for the implementation of sustainable development, which includes pathways for the effective funding of sustainable development. This study, therefore, places emphasis, from a generative rationale perspective, on what might be, rather than on what is (for the purpose of analysis).

The process of modal reasoning as prescribed by Martin (2007:146) advocates that the utilization of deductive and inductive logic directs the researcher to abductive logic. Importantly, Martin (2007:146) points out that deductive logic needed a pre-existing theory (of CDM) on which to base its reasoning. Inductive logic, according to Martin (2007:146), draws inferences from “repeated experiences or observations”. Abductive logic, from a critical research perspective, scans the fundamentals of what reality presents so that the best possible explanation becomes pliable and possible. In reality, what abductive reasoning achieves is the capacity to define a new model after deconstructing the causality of the extant model of CDM. For the purpose of interrogating CDM as it is implemented at Bisasar Road and Mariannhill, the logic of causal modelling affiliated to

integrative thinking and generative logic needs to be clearly defined so that the fundamentals of implementing and funding sustainable development is very clearly articulated from a logical, argumentative, and causal-analytical perspective.

Martin (2007:150) advises that in order to build sophisticated models "we need to consciously acquire tools" and to be more specific, these so-called tools refer to causal modelling. Martin (2007:151) states that two forms of causation are relevant to causal modelling. The first is for material causation which states that, under certain conditions, "X causes Y to happen". The second logic of causation seeks to enquire, according to Martin (2007:151), "what is the purpose of Y and why do we want Y to happen"? Martin (2007:151) elucidates very clearly by stating that:

"Material causation is how we know that if we press this button, we shut down the nuclear reactor. Teleological causation is the process by which we understand that if we want to shut down the reactor, we press the button."

The task of this research, in determining whether the Clean Development Mechanism promotes sustainable development and, in fact, funds sustainable development from an integrative knowledge perspective, is to build a causal model from the current status to a desired, sustainable developmental-state model. Therefore, in order to expose the validity of the implementation of CDM from a sustainable development perspective and from the enquiry as to whether the implementation of a Clean Development Mechanism actually funds sustainable development, this study seeks to interrogate the implementation of CDM at Bisasar Road and Mariannhill from a causal modelling perspective. Building new models requires the capacity to conceptualize the totality while honing-into structural components like development, sustainability and funding. Clear model conceptualization, according to Martin (2007: 154), sometimes requires the utilization of a radical metaphor to perceive the inherent non-duality and holistic integrity of any new model. In the instance of this case study that, radical metaphor has to be sustainable development and how the implementation of CDM at Bisasar Road and Mariannhill facilitates the contextual funding of sustainable development from the framework of enablers and barriers. The radical metaphor is therefore an essential tool of integrative thinking, abductive logic and generative reasoning from the standpoint that the radical metaphor drives and directs the individual structural components into a recognizable and integral whole. The next step is to delve directly into the realm of CDM to search for causal irregularities in the fabric of CDM.

Sustainable development as we know it is multifaceted and besides having components of environmental protection, social well-being and economic empowerment, it inevitably has to have a stream of revenues to fund its own inherent sustainability. The argument is therefore tabled that any sustainable development project must have regular streams of revenues to fund its own inherent sustainability. The funding streams of revenue must, of necessity, indicate a net surplus after deducting expenses and costs. The net stream of revenue must show progressive growth over time so that revenues are positively cumulative. A positively cumulative stream of revenue therefore supports a project's intrinsic capacity to, first and foremost, fund its own sustainability. If and when a project lacks capacity to fund its own survival, then that project must be deemed to be unsustainable. A project that lacks the capacity to support its very own survival, arguably, does not have the capacity to support sustainable development in its broadest, multi-faceted dimensions and constructs. The very basis of sustainable development is core economics. Sustainable development is grounded on core economics and from core economics, a project acquires the capacity to fund itself and from sustainable self-funding, other aspects of sustainable development begin to grow. This specifically refers to the outgrowth of environmental protection, social integration and economic empowerment. Core economics as described above, is the basis of interrogating the primary component of causal modelling applicable to the implementation of Clean Development.

The question asked is:

"*What causes the revenue streams at Bisasar Road and Mariannhill to actively fund sustainable development and what is the purpose of wanting sustainable development to be the primary indicator of the Clean Development Mechanism?"*

It must be stated emphatically that the primary source of revenue generation for both Bisasar Road and Mariannhill originates from the sale of electricity to Eskom. As reiterated previously, the combined generative capacities of both Bisasar Road and Mariannhill translates into a costing of 83 cents to produce 1 kilowatt hour of electricity. Eskom, in turn, pays 61 cents to Durban Solid Waste for each Kilowatt hour of electricity added to the municipal grid. There is thus a gaping loss of 22 cents for each kilowatt hour of energy produced.

Stated in another manner, the two CDM projects in question incur a *stated* loss of 22 cents per kilowatt hour of energy/electricity produced. The production of electricity for the municipal grid therefore plunges both CDM projects into spiraling self-destructive costs. The two projects are in

such a situation that their very existence perpetuates self-destructive costs when generating electricity for the municipal grid. This situation, indeed, can never contribute to funding the sustainable development. The cost to produce electricity which at this time is the core economic activity of both projects, is indeed highly unsustainable and does not in any way fund sustainable development. Nor does the production of electricity from both projects have the capacity to fund its own survival. The very basis of electricity plunges the two projects into deeper debt and it seems that these two projects survive just to pay off debt. By this very argument, it is tabled that both the projects are unsustainable and have no capacity at all to fund sustainable development at this time.

This argument is further strengthened when a comprehensive analysis is undertaken of the cost of production of electricity and this cost is then compared to the stated average payment by Eskom in order to highlight the recurring marginal discrepancy. The analysis is undertaken to verify the argument that the implementation of CDM at Bisasar Road and Mariannhill is unable to fund sustainable development because the capacity to generate electricity incurs more loss than profitability and that this constantly recurring cost is not conducive to funding sustainable development. To further simplify the argument, the interviews at Durban Solid Waste have reiterated that Eskom pays 61 cents to Durban Solid Waste for each kilowatt hour of energy generated, thus producing a *stated* shortfall of 22 cents just to break even. This study wishes to further analyze historical payments for seven years to determine whether the two CDM plants have in fact been running at a loss for their entire life span of 91 months up to January 2016.

Analysis will examine how much Eskom has been paying for electricity from September 2009 to December 2015, calculating the actual cost compared to the stated cost of 61 cents and then calculating the shortfall or gain against the cost of production of 83 cents. The excess or shortfall will give a clear indication as to whether the projects generate sufficient revenues to sustain themselves and enough surplus revenue thereafter to fund sustainable development in its broadest context. Analysis is undertaken for both Mariannhill and Bisasar Road and each set are cross appropriated to calculate the overall shortfall or excess over the cost of production of 83 cents. The assessments will be undertaken for each quarter from 2009 to 2015. The analysis and outcomes are described in the tables that follow. The first table describes the outcomes from Mariannhill, while the second table describes the outcomes from Bisasar Road. Costs are calculated from 2009 for each quarter up to 2015.

Table 6: Mariannhill Electricity Production Cost and Shortfall/Excess from Eskom

Date	Cost to produce 1kwH	Amount paid by Eskom for 1kwH	Excess	Shortfall
03/2009	83 cents bmark	18 cents		65 cents
06/2009	83 cents	28 cents		55 cents
09/2009	83 cents	21 cents		62 cents
12/2009	83 cents	19 cents		64 cents
03/2010	83 cents	20 cents		63 cents
06/2010	83 cents	39 cents		44 cents
09/2010	83 cents	32 cents		51 cents
12/2010	83 cents	30 cents		53 cents
03/2011	83 cents	30 cents		53 cents
06/2011	83 cents	47 cents		36 cents
09/2011	83 cents	41 cents		42 cents
12/2011	83 cents	40 cents		43 cents
3/2012	83 cents	39 cents		44 cents
06/.2012	83 cents	69 cents		14 cents
09/.2012	83 cents	45 cents		38 cents
12/2012	83 cents	44 cents		39 cents
03/2013	83 cents	43 cents		40 cents
06/2013	83 cents	80 cents		03 cents
09/2013	83 cents	46 cents		37 cents
12/2013	83 cents	45 cents		38 cents
03/2014	83 cents	45 cents		36 cents
06/2014	83 cents	72 cents		11 cents
09/2014	83 cents	51 cents		32 cents
12/2014	83 cents	50 cents		33 cents
03/2015	83 cents	51 cents		32 cents
06/2015	83 cents	83 cents	0	0
09/2015	83 cents	58 cents		25 cents
12/2015	83 cents	57 cents		26 cents

Table 7: Bisasar Road Electricity Production Cost and Shortfall/Excess from Eskom

Date	Cost to produce 1KwH	Amount paid by Eskom for 1kwH	Excess	Shortfall
03/2009	83 cents bmark	17 cents		66 cents
06/2009	83 cents	27 cents		56 cents
09/2009	83 cents	21 cents		62 cents
12/2009	83 cents	21 cents		62 cents
03/2010	83 cents	20 cents		63 cents
06/2010	83 cents	38 cents		45 cents
09/2010	83 cents	32 cents		51 cents
12/2010	83 cents	32 cents		51 cents
03/2011	83 cents	32 cents		51 cents
06/2011	83 cents	55 cents		26 cents
09/2011	83 cents	41 cents		42 cents
12/2011	83 cents	40 cents		43 cents
03/2012	83 cents	40 cents		43 cents
06/2012	83 cents	69 cents		14 cents
09/2012	83 cents	46 cents		37 cents
12/2012	83 cents	45 cents		38 cents
03/2013	83 cents	44 cents		39 cents
06/2013	83 cents	75 cents		6 cents
09/2013	83 cents	48 cents		35 cents
12/2013	83 cents	47 cents		36 cents
03/2014	83 cents	46 cents		37 cents
06/2014	83 cents	76 cents		7 cents
09/2014	83 cents	51 cents		32 cents
12/2014	83 cents	51 cents		32 cents
03/2015	83 cents	51 cents		32 cents
06/2015	83 cents	82 cents		01 cent
09/2015	83 cents	58 cents		25 cents
12/2015	83 cents	58 cents		25 cents

The tables above indicate that for both Mariannhill and Bisasar Road, the cost to produce electricity is 83 cents for I kilowatt hour of electricity. The stated nominal price that Eskom is supposed to pay is 61 cents per 1 kilowatt hour of electricity. This incurs a loss of 22 cents per

kilowatt hour of electricity generated. However, the analysis above indicates that the actual payment for electricity depends largely on how much electricity is added to the grid. The capacity to supply to the grid seems to be related to demand because when one looks at the prices paid for electricity in June and July, Eskom pays slightly higher tariffs because of demand in winter. This tariff ranges from 58 cents to about 82 cents and then drops off again. From the quarterly readings above, over a seven-year period, Eskom has only once (in June 2015) paid 83 cents per kilowatt hour of electricity supplied to the grid by Durban Solid Waste. Throughout the seven-year period, Durban Solid Waste sold electricity at prices below the cost to produce 1 kilowatt of electricity. Numbers indicated in Red in the tables above indicate the loss in cents incurred by Durban Solid Waste in producing 1 kilowatt hour of electricity. The tables indicate a constant loss throughout the 91-month lifespan of the two projects.

For the 91-month period, Mariannhill produced: 32 621 529 kilowatt hour of electricity
Cost to produce at 83 cents per kilowatt hour : 32 621 528 x 0.83
= R 27 075 868. 24

Eskom paid Durban Solid Waste : R15 221 125.16
Nominal loss over cost of production : R 11 854 743.08

During the same period, Bisasar produced : 297 892 966 kilowatt hour electricity
Cost to produce at 83 cents per kilowatt hour : 297 892 966 x 0.83
= R 247 251 161.78

Eskom paid Durban Solid Waste : R 132 142 116.15
Nominal loss over cost of production = R 115 109 045. 63
Total loss incurred : R 11 854 743.08 + R 115 109 045.63
= R 126 963 788.71

Average cost paid by Eskom to Mariannhill for
1 kilowatt hour of electricity : 47 cents (constant average loss 36 cents)
Average cost paid to Bisasar Rd : 44 cents (constant average loss 39 cents)

Therefore, analysis indicates that the relationship with Eskom to provide electricity to the municipal grid is indeed very costly! The perceived loss of 22 cents per kilowatt hour of electricity sold is far closer to a range between 44 cents and 55 cents. Based on this analysis, the research

indicates that the sale of electricity to Eskom is unsustainable and the losses incurred prevent funding for sustainable development. The implementation of CDM is rendered void because of selling to Eskom. Therefore, causal modeling analysis indicates that in order for CDM to be sustainable, the sale of electricity to Eskom has to be re-directed to alternate private-sector industry outlets that are prepared to pay a better rate (above 83 cents per kilowatt hour generated). The relationship between Durban Solid Waste and Eskom is unsustainable, purely in terms of the implementation of CDM at Bisasar Road and Mariannhill, for all the reasons indicated above and is the *primary barrier* to funding sustainable development.

From a causal modelling perspective and from Abductive reasoning, as well as for the purpose of seeking a new innovative model, this study looks into causal dialectics to establish reasons behind the apparent failure of sales of Certified Emissions Returns to return sustainable revenues to Durban Solid Waste from the implementation of CDM. The very basis for the authorization and granting of permission is based on the project generating substantive revenue from the sale of CERs. The sale of CERs is the primary revenue-generating mechanism from successful implementation of CDM. Yet, the sale of CERs over a period of 91 months only generated a little over R13 million, compared to revenues of over R147 million from the sale of electricity.

It is blatantly obvious that the sale of CERs from Bisasar Road and Mariannhill lack any substantive capacity to fund sustainable development.

Questions for analysis seek answers to what cause CERs to generate revenues. Alternatively, what is the purpose of selling CERs to Annexure 1 countries and why it would have been the preferred option for a successful implementation of selling far more CERs to Annexure 1 countries?

Answers to these questions are encased in the fundamental requirements for the successful implementation of CDM. These requirements are very clearly articulated in the theoretical framework. The core requirements are:

- CDM is regulated by the Executive Board;
- The Kyoto Protocol (UNFCC 2011:1-8) defines CDM as a “mechanism whereby projects incorporate a component that facilitates the reduction or sequestration of Green House Gases”;

- The most important objective of CDM is to promote and encourage sustainable development;
- The Kyoto Protocol (UNFCC 2011:1) stipulates that the emission reductions of the project must be *additional* to those that would have happened had the project not been implemented in the first place;
- The primary benefit of successful implementation of CDM for the project developer is the financial incentive from the sale of carbon credits in the form of CERs;
- The baseline defines what the greenhouse gas emissions would have been prior to the implementation of the CDM project;
- Baseline emission minus project emission represents the addition emission;
- Demonstrating *additionality* is the preliminary step in the development of CDM;
- Gilder and Henk (2011:4) describe a CER as a commodity "that represents the absence of one ton of carbon dioxide that would, in the absence of the CDM project, have been emitted to the atmosphere"; and
- CERs are tradeable commodities and the carbon market is facilitated by the World Bank.

4.17 Discussion of the Results

The theoretical framework informs that in order for CDM to be successfully implemented, there has to be existential additionalities in the global economic system. The principles of CDM acknowledge the overwhelming existential presence of externalities in Annexure I countries. The economic idea of achieving Pareto Optimo from a situation of overwhelming environmental damage rendered by the existence of externalities in Annex 1 countries provoked a formula whereby the developed nations of the North, seeking solutions which would not interfere with the status quo of revenue generating industries that literally spew out tons of carbon into the atmosphere, latched onto the principles of CDM whereby relatively undeveloped countries of the South would be roped into a compromise solution in the name of CDM. Objective reality indicates that externalities which cause damage to the environment have reached epidemic levels in Annex 1 countries. Annexure 1 countries with highly developed economies are literally spewing toxic emissions into the atmosphere and poisoning planet earth with levels of toxicity never seen before.

Yet, for the sake of survival and indeed, for the purpose of maintaining Annex 1 economic hegemony over the South, the countries of the North under the auspices of the United Nations and the World Bank argue that the atmosphere is one coherent, whole entity and therefore, if

nations of the South can be tied down to limiting their emissions, then nations of the developed economies have the opportunity to utilize the marginal advantages in emissions of the South; and then to utilize these marginal advantages to incentivize Southern countries with revenue streams in the form of Certified Emission Returns, to offset pollution and emissions of the North. Not only is this argument nebulous and baseless, it actually provokes Southern countries to initiate emissions from relatively inert landfill sites in the guise of brokering sustainable development.

In reality, CDM as it is implemented at Bisasar Road and Mariannhill have become appendages to the emissions of the north by a very creative economic mechanism that merely promotes the economic interests of the more developed economies. This is another form of economic enslavement. With a massive turnover of R147 million, the two CDM plants are struggling to produce electricity at sustainable thresholds of around 20 cents per kilowatt hour.

It must be reiterated that the cost of production of electricity is higher than the revenue the electricity generates. And …the electricity is generated by forcibly burning gasses and spewing waste into the atmosphere …at a gaping, recurrent financial loss! The financial losses are exemplified because the promised revenues from the sale of carbon credits have never really come to fruition. The entire saga of the World Bank formatting a feasible platform to facilitate the sale and purchase of carbon credits seems to have gone terribly wrong. The United Nations and the World Bank have reneged on the promise to foster sustainable development via the implementation of CDM. At Bisasar Road and Mariannhill, the two CDM plants are not in a position to sustain their own survival, leave alone have surpluses for funding sustainable development.

The mechanism utilized by the World Bank to formalize a platform to facilitate the global transactions in carbon credits is indeed myopic because the World Bank has attempted to literally create value from polluted air without any fundamental resource guarantees. From an economic perspective, the World Bank has created a credit facility from nowhere, without substantive guarantees to trade carbon credits. The World Bank generates transactional revenues for itself and the entire process of CDM from its implementation at Bisasar Road and Mariannhill, is flawed to such an extent that it is virtually impossible for the two plants to survive as viable, sustainable economic entities. The use of very creative clichés like baseline and additionality are also rather nebulous and difficult to quantify. How is it possible to formalize a baseline emission by placing a few pipes into the ground and then stating that a baseline has been achieved? The argument arises because the landfill sites are almost 6 square kilometers in area and are active emitters of

greenhouse gases. How is it scientifically possible that a baseline is quantifiable by the mere implementation of CDM? This is not possible, scientifically! Furthermore, the concept of additionality is simply a mechanism configured to lend credibility to CDM implementation.

On the basis of these arguments, the study declares that CDM as implemented at Bisasar Road and Mariannhill does not fund sustainable development and indeed, is not in a position to sustain its very own survival. Furthermore, it must be emphasized that the implementation of CDM at Bisasar Road does not, in any substantive manner, reduce the emissions from the landfills themselves. It is claimed that the implementation of CDM, at both plants structures a baseline emission and curbs emissions in such a manner that emissions from the two landfills are reduced. This is a false claim because both the plants are active emitters of Greenhouse gases, which are not simply reduced by the implementation of CDM. What CDM does achieve, however, is to marginally reduce methane and carbon dioxide relative to the plants only. These emission reductions, specific to the two CDM plants, are minuscule relative to the emissions for the two landfills in their totality.

In scientific terms, methane is twenty-five times more toxic than carbon dioxide and seeps through the soil as it expands at Bisasar Road and Mariannhill, causing health hazards to clean air and clean water. Although it is beyond the scope of this study, it is common knowledge that methane expansion is not in any way checked by the implementation of CDM at both plants. This argument is tabled because the support for sustainability and environmental protection are closely aligned to sustainable development. It becomes quite apparent that CDM as a process does not achieve the desired levels of environmental protection. Neither does CDM as it is specifically implemented at Bisasar Road and Mariannhill, contribute to funding sustainable development. These arguments, from a causal model perspective, address the fundamental aspects of causality apparent in the implementation of CDM at Bisasar Road and Mariannhill. The arguments address the aspect of determining baseline and additionality and point to the nebulous methodology for determining baseline and for allocating additionality.

The study indicates that baseline calculations may be relevant to the implementation of CDM only, but baseline emission determination cannot, and does not, include any baseline for the landfills themselves. *Additionality* also refers to additionality relative to the implementation of CDM at the two plants only. The methodology for the implementation of CDM at Bisasar Road and Mariannhill is flawed and it seems that the constructs in use for the implementation of CDM at Bisasar Road

and Mariannhill are merely formulated to promote a mechanism to facilitate the possibility of trading in carbon credits and to continue to allow Annex 1 countries to maintain their emission levels so that industrial output in the Northern countries are not in any way compromised from an economic output perspective. CDM as a process does not facilitate sustainable development at the two plants and because the two plants experience an ongoing marginal loss of revenues, the implementation of CDM cannot possibly support the funding of sustainable development.

This study argues that for any sustainable development project to be deemed to be successful, it must, of necessity have the capacity to provide employment for those that critically need some form of revenue-generating activity. For a turnover of over R150 million over 91 months of activity, the two CDM projects can only sustain 11 permanent positions which includes 9 skilled technicians and 2 unskilled staff. There is gaping evidence that the two projects only employ technical staff to keep the project running. The two projects simply do not have the capital resources to employ more staff. The fact that the two projects can only afford to support the employment of 11 permanent staff clearly defines its incapacity to sustain development. **How do the two projects promote social and economic development?** The answer is that the two projects are an economic disaster and whereas the cost to maintain loss-generating projects are indeed enormous, the resources could have been redirected to create sustainable employment and sustainable development. At this stage of social and economic development, the two CDM projects represent an economic loss for Durban. The two CDM projects represent an unsustainable loss to the micro-economy of Durban and therefore represent negative growth towards the overall economic health of South Africa. The Clean Development Mechanism plants, one at Bisasar Road and the other Mariannhill are indeed unsustainable and represent ongoing losses, in terms of resource depletion, for the regional economy of Kwa-Zulu Natal.

Causal modal analysis has therefore addressed the key fundamental issues representing causality and effect for the implementation of CDM. The study addressed the issue of the ongoing marginal loss in the production of electricity for supply to Eskom. Secondly, the study analyzed the circumstances surrounding the ineffective revenue streams from the sale of carbon credits. This study also outlined the nebulous mechanisms for the calculation of baseline emissions and the outcome of stated additionality. The study then argued that the two projects ultimately fail to support sustainable employment in a city where many live below the poverty line. The fact that the two projects waste resources in an environment where there is so much poverty and unemployment provokes the argument that the two projects represent a waste of resources and

an economic disaster. For all the arguments rendered thus far, this study further tables the proposition that the two CDM projects lack capacity for self-sustenance and therefore do not have the capacity to fund sustainable development.

Before embarking on formatting a new developmental model for sustainable development through the Clean Development Mechanism, this study seeks to enquire how the epistemological directive impacts the possible development of a new model. While the ontology stipulates what steps need to be taken to analyze the consequences of the implementation of CDM at Bisasar Road and Mariannhill, the epistemological stance seeks to ground the ontological basis on the economic principles of Pigouvian Social-welfare economics. The implementation of CDM is based on the recognition of existential externalities both in Annex 1 countries and in the host state. Calculations of baseline emission values adds credibility to the existence of externalities in the host country. Baseline calculations are further exemplified by the variable of additionality. Pigou recognizes that the existence of externalities produces some boon or harm in terms of social welfare economics. Pigouvian philosophy indicates that the existence of externalities are, in reality, economic variables. These variables impact the micro and macro-economies of regions and countries. Therefore, there has to be a mechanism to incorporate the impact of these variables into the mainstream economy. Pigou suggests that boons and harmful effects arising out of externalities have to be quantifiable to be incorporated into the economic equation.

With specific reference to Durban Solid Waste and the implementation of CDM, the quantifiable outcome from the implementation of CDM is the production of electricity. Although Pigou advocates that the production of electricity for the municipal grid is a boon and therefore those who are in receipt of the boon are liable to pay taxes to Durban Solid Waste, the payment of taxes for the receipt of electricity has not been implemented by the eThekwini Municipality. Furthermore, payments by Eskom do not even cover the cost of production. In terms of Pigouvian analysis, the implementation of CDM at Bisasar Road and Mariannhill produce economic loss rather than gain. From a Pigouvian social-welfare economics perspective, the implementation of CDM at the two plants is not economically viable. The two CDM plants do not satisfy the Pigouvian directive that boons and harmful effects need to be taxed or alternatively, subsidies have to be granted for the production of electricity, albeit that Eskom does pay some compensation but the compensation produces a recurrent loss.

Therefore, the epistemological stance of this study also points to the directive that the implementation of CDM at both Bisasar Road and Mariannhill does not satisfy the requirements to sustain and fund sustainable development. While the recognition of externalities and their compensation are fundamental to Pigouvian thinking, Pigou viewed these from the totality of correct accounting protocols, ambient environmental outcomes and recovery of the ecology and the ecosystem. Interviews conducted at Durban Solid Waste indicate that much emphasis is placed on following correct accounting protocols and from a Pigouvian perspective, there are no flaws in the accounting protocols. However, very little attention is given to fostering ambient outcomes within and outside the two landfills. No substantive measures are in place to promote recovery of the surrounding ecology. For example, excessive rains produce spills of waste onto informal dwellings. While the ecology and environmental variables do not have a direct bearing on funding sustainable development, these variables do have an indirect impact on the aspect of sustaining development from a Pigouvian perspective.

Pigouvian thinking demands that each outcome is inter-related and therefore, each component of Pigouvian thinking depends on all the others for its authentication and validity, as indicated in the theoretical framework of this study. Interviews with the representative of Durban Solid Waste and the Independent Authority confirm the existence of externalities, both at the two plants and in Annex 1 countries. The interviews confirm the existence of two types of externalities, namely depletable and non-depletable. This serves the basis for the utilization of a Pigouvian theoretical and philosophical analysis.

Responses from the representative at Durban Solid Waste and the Independent Authority describe methane and carbon dioxide as the prime constituents of externalities. Responses from the interviews further confirm that externalities produce boons in the form of renewable electricity and social welfare benefits by reducing carbon emissions through the process of burning-off methane gas. Both the engineer and the Independent Authority reluctantly acknowledge the existence of another negative externality arising from the exhaust of the engines burning-off methane. The interviews further consolidate the point of view that the baseline calculations and the quantification of additionality arises from the recurrent and existential presence of externalities at both plants.

Interviews also consolidate the view that Certified Emission Returns represent a process initiated by the Kyoto Protocol to add monetary value to the cap and trade process. From a Pigouvian

protocol, this represents two relevant issues: Firstly, the quantification of Certified Emission Returns conforms to the Pigouvian principle of incorporating quantifiable components of externalities into the mainstream economic equation. Secondly, the quantification of Certified Emission Returns represent the currency for compensation of boons resulting from externalities. Again this conforms to the basic directives of Pigouvian philosophical outcomes. It becomes apparent from the interviews that the implementation of CDM from a Pigouvian perspective becomes more beneficial when there are massive economies of scale, as in countries like China and India. The scale of operations at Bisasar Road and Mariannhill are miniscule and this places limitations in terms of project benefits, compared to the massive economies of scale in China and India. Larger economies of scale produce more prolific flows of revenue. From an economic perspective, the larger economies of scale produce more revenues to fund sustainable development.

The concept of “Pareto Optimal” refers to a process whereby resources are allocated in such a way that it is not possible to advantage one individual without making at least one individual worse off (Question 25, Annexure 2). Although the respondents include broader society in their response, Pigou actually refers to the process of balancing social welfare and economic gains and harmful effects to induce equity and balance in the economic equation. There is relevance and reliability in the argument that the process of implementation of CDM does, in fact, strive to foster “Pareto Optimo”. The formalization of compensation by means of Certified Emission Returns is one example of compensation to remedy equity and balance within the economic equation. It is not however apparent from the interviews that Durban Solid Waste acknowledges and recognizes the presence of externalities in the form of harmful emissions from the two landfill sites. Although this falls outside the context of CDM implementation, it is stated to question and interrogate the possibility of compensation for harmful emissions to reinstate the Pareto effect. The study is unable to establish this with certainty, although the mechanism for compensation does exist in the CDM protocol.

Both the respondents consider that the implementation of CDM contributes positively to ecological renewables. The one respondent alludes to methane venting and the negative effect it has on the plant life on the surface of the landfill. It is indeed arguable that the implementation of CDM operates from a miniscule surface area on the landfill sites and therefore the implementation of CDM at the two localities cannot possibly prevent the vetting of methane gas which not only

impacts the vegetation but also contributes to very harmful greenhouse gases in the form of methane, which is 25 times more toxic than carbon dioxide.

The Independent Authority responded that the Implementation of CDM curtails the emission of harmful greenhouse gases and therefore contributes to ecological renewal. This is highly controversial because the reduction is so negligible that such a claim cannot be backed with valid ratification. This study makes the assertion, from all the facts at hand, that the implementation of CDM from a Pigouvian perspective does not in any way contribute to ecological renewal in any substantive manner. The respondents have no valid data to substantiate their claims. Again, the CDM process works from inserting extraction pipes in one very small part of the landfill site, while the remaining and substantive area of the landfill continues to emit harmful methane and carbon dioxide unabated which goes against ecological renewal.

Analysis based on the ontological and epistemological lens of this study describes the reality of what CDM is from an inductive, deductive and abductive-causal-modelling perspective. The study outlines the philosophical parameters from a Pigouvian welfare-economics ideology. The study also indicates that CDM as implemented at Bisasar Road and Mariannhill incurs an ongoing financial loss and is, therefore, not in a position to maintain sustainability nor fund sustainable development. The very implementation of CDM, as it is, presents a huge barrier towards funding sustainable development. Analysis also indicates that the failure of the two projects to maintain an ongoing capacity for integral profitability stems from an incapacity to understand global macro-economic trends. In addition, project planners seem to have miscalculated costs and margins. Essential micro-economic analysis before implementation seems to have miscalculated projected profitability margins and cash-revenue flows. The broader implications of the analysis also indicates that very little consideration was given to implementing a sustainability audit before the implementation of CDM at both sites. Although the process of implementing CDM requires a strict implementation protocol, the study has uncovered a level of negligence when it comes to the strict analysis of the critical issues at hand. Critical analysis ought to have directed the implementation towards a series of optional pathways. One of the pathways would have clearly defined the logical option not to embark upon a project that would find itself in a financially compromised position of recurring financial loss. This suggests that the process of implementation of CDM did not follow the sequential analysis protocol, which would have opened-up a series of options before implementation. The protocol for the issuance of Certified Emissions Returns develops from a series of verifiable steps which require a step by step validation process. It is apparent that the

process of validation and verification ignored or neglected to notice circumstances and pointers that motivated against the implementation of CDM at the two sites.

Although start-up capital is crucial for the implementation of CDM, any project can only seek start-up funds after an assessment of critical success factors. These success factors emerge after due consideration of issues that impede successful implementation. Critical success factors must always outweigh any barriers to successful implementation. The motivation behind startup funding for the projects may have been given on the basis of confidence generated from the post 1994 Mandela era, purely for the sake of economic empowerment. Yet the implementation of CDM from a developmental state perspective has failed. The two projects have failed to generate net surplus revenues for funding sustainable development. The reliance on revenue generation from Certified Emission Returns was a gross miscalculation, which resulted in Durban Solid Waste selling clean electricity to Eskom for the purpose of recovering capital expenditure invested into the two projects. The generation of clean energy represents competition for Eskom and therefore, Eskom compensates for the extra energy from the CDM projects by paying marginally less than the cost of production. The fact that the two CDM projects function at an effective loss guarantees a monopolistic advantage for Eskom. There is a very clear understanding that the generation of clean energy threatens the functional integrity of Eskom from a monopolistic, profitability perspective. It therefore suits Eskom to redirect clean energy into the municipal grid on the basis of profitability for itself only. The recurring financial loss experienced from the generation of clean energy by the two CDM projects is of no concern to Eskom. Durban Solid Waste is in a compromised situation and has to accept hand-outs in terms of compensation from Eskom. There is no clear indication that Durban Solid Waste has any intention of redirecting the clean energy to the private sector for more profitable compensation. It is obvious that the relationship between Durban Solid Waste and Eskom motivates against the principles of developmental economics. Developmental economics is the basis of sustainable development.

The protocol to identify enablers and barriers for funding sustainable development is based on establishing the functional integrity of the Clean Development Mechanism as a vehicle for the implementation and funding of sustainable development. Analysis indicates that the functional integrity of the two CDM projects has been compromised and although the successful implementation of CDM is supposed to facilitate and fund sustainable development, the projects at Bisasar Road and Mariannhill present barriers to the successful implementation and funding of sustainable development.

Stated objectives for the successful implementation of The Clean Development Mechanism ought to define a set of indicators that may be used to monitor the implementation of CDM from a developmental state perspective. These stated set of indicators represent valuable guidelines for the establishment and implementation of the Clean Development Mechanism from a developmental state perspective. Epistemological grounding on Pigouvian ideology and the functional integrity of inductive, deductive and abductive reasoning based on integrative thinking has opened up the threshold in this case study analysis for the architecture of a new, innovative model for the implementation and funding of CDM from a developmental state perspective. The New model, the *Systematic Sequential Model* is defined and described in the next chapter.

Chapter Five: Systematic Sequential Analysis

5.0 Introduction

The purpose of the Systematic Sequential Analysis Model is to introduce a series of financial, economic, macro-economic, micro-economic and technical sustainability filters for the implementation of the Clean Development Mechanism in developing countries. These filters overlap in a manner that prevents a seepage of any variable or variables that may lead to unforeseen losses in the implementation protocol. The primary aim of Systematic Sequential Analysis is to offer government officials and project managers a set of indicators to monitor the implementation of CDM from a developmental state perspective.

5.1 The Systematic Sequential Analysis (SSA) Model for Sustainable Development

Designing a new Sequential Analysis Model to inform a Framework for monitoring the implementation of The Clean Development Mechanism from a Developmental State perspective

The Systematic Sequential Analysis (SSA) Model for Sustainable Development comprises the following key components:

- A sustainability pre-audit
- A macro-economic pre-audit
- A core-economics and financial pre-audit
- An implementation pre-audit
- A technical pre-audit
- Deficiency report
- Accept or reject implementation of CDM and motivation report

5.1.1 The Sustainability Pre-Audit

a) Determine the life span of the Landfills in question
b) Clearly and accurately describe the short-term sustainable development goals
c) What are the medium-term sustainable development goals?
d) What are the long-term sustainable development goals?

5.1.2 The Impacts of Sustainable Development

a) Evaluate the forecasted impact on the environment
b) Evaluate the forecasted impact on Society
c) Evaluate the forecasted impact on the core economy and the economy at large
d) Evaluate the forecasted impact on the projected movement of revenues.

5.1.3 Advantages and Disadvantages from the Implementation of CDM

a) Will the foreseeable implementation of CDM advantage or disadvantage society?
b) Does the tradeoff from “cap-and-trade” advantage or disadvantage the project/s? Evaluate.
c) How does the focused channeling of emissions impact on society?
d) What are the advantages and disadvantages of emission reductions?

5.1.4 Transparency and Accountability Provoked by the Foreseeable Implementation of CDM

a) Do the activities in implementing CDM integrate into social, political and economic activities to promote a net sustainable development effect?
b) Assess the overall transparency of the CDM implementation protocol.
c) Is the CDM implementation cost effective in its impact on the environment, society and the economy at large?

5.1.5 Verifiable Benchmarks

a) Set-up and evaluate verifiable benchmarks to assess the impact on the environment
b) Set-up and evaluate verifiable benchmarks to assess the impact on the population
c) Set-up and evaluate verifiable benchmarks to assess the impact on economic activities.

5.1.6 Risks Associated with the Implementation of CDM

a) Constantly assess and reassess Environmental risks
b) Constantly assess and reassess financial risks
c) Constantly assess and reassess societal risks

5.1.7 Mechanisms for the Reversal of Waste

a) Set up mechanisms for the reversal of capital and revenue waste
b) Set up mechanisms for the reversal of environmental degradation

c) Set up mechanisms for the reversal of passing-on negative impacts to future generations
d) Set up mechanisms for the re-appraisal and reversal of improper management decisions

While the sustainability pre-audit sets out to determine the contextual validity and compliance relevance from the perspective of sustainability, it is the macro-economic indicators (Global and Local) that facilitate its implementation. Researchers are critically aware that the prime economic indicators are in a constant state of flux and literally change from hour to hour. A thorough analysis and understanding of economic trends are imperative to the success or failure of the project. It must be reiterated that the two plants at Mariannhill and Bisasar Road failed to achieve an acceptable level of sustainability because of a failure to follow economic trends that preceded the 2008 collapse in the financial markets. The collapse of the financial markets in 2008 had major repercussions for the global economy. The major consequence for the implementation of CDM at Mariannhill and Bisasar Road was an interrupted revenue flow from the sale of Certified Emission Returns. The economic situation in Europe, at that time, negatively impacted the viability of trading in carbon credits. The economic situation presented a major barrier to the successful flow of funding for sustainable development. Current analysis indicates that the situation has not changed much and although there are irregular revenue flows from the sale of carbon credits, these do not scale the threshold to provide a substantive, sustainable flow of revenues at Bisasar Road and Mariannhill. Hence, the assessment, analysis and projections of macroeconomic indicators are mandatory for the implementation of CDM.

5.1.8 The Macroeconomic Pre-Audit

This directive for an analysis and scan of the macroeconomic environment is not prescriptive but it is mandatory to study the trends in order to make an informed decision regarding the feasibility of implementing CDM. The economic trends are never uniform nor predictive. Sequential analysis requires that all key economic variables need to be assessed before any decision for implementation is made.

5.1.9 Scanning the Gross Domestic Product for the Local and Annex 1 Country/Countries

Scanning the Gross Domestic Product growth for the host and the Annex 1 countries over four quarters gives an analyst a clear indication of the direction both economies are taking. The analyst should scan key sectors like agriculture, construction, manufacturing, banking, mining, public administration, transport and utilities. Scanning the GDPs gives the analyst substantive decision-making tools for the implementation of CDM.

5.1.10 Scanning the Money Supply in the Host Country and the Annex 1 Country/Countries

The money supply scan examines the fluctuations in the interest rates as well as the interbank interest rates. An assessment is made of foreign exchange services and loans to the private sector, as well as a quarterly analysis of the central bank money movements. Analysis and scans of the money supply gives the analyst an indication of overall liquidity of the economies in question.

5.1.11 Scanning the Respective Economies for the Movement of Inflation

Inflation is linked mainly to the Consumer Price Index which embraces consumer prices, consumer inflation and production prices. These may be impacted by food inflation and compounded by export and import prices. Scanning the variables associated with inflation conveys the aspect of strength and stability for resilient revenue supplies.

5.1.12 Assessing the Impact of the Unemployment Rate on the Implementation of CDM

The very core of sustainable development resides with human dignity and inevitably, human dignity revolves around the capacity for any state to provide sustainable employment to its population. Analysis must seek answers as to how unemployment, as a modern economic phenomenon, impacts the basis of sustainability. How does sustainable development address unemployment? Indeed, how does unemployment impact sustainable development and the implementation of CDM? These answers are entrenched in the unemployment rate, youth unemployment, sustainable living wages and the costs of labor. Analysis of the unemployment rate in the host country and the Annex 1 country defines the logic of surplus funds for sustainable investment. This must be one of the key decisive factors regarding the availability and utilization of funding for sustainable development.

5.1.13 Examining the Role of Budgets in the Dynamic of Economics

Budgets and budgetary restraints offer a very clear indication of what any given economy can afford; as well as sustain and curtail financial spending to retain an acceptable level of sustainable development. The budgetary restraints in any trading economy represents the availability of scarce resources for sustainability in its broadest perspective. Decisions to implement CDM cannot ignore the substantial impact of budgetary restraints and therefore, these have to be assessed and re-assessed for the purpose of funding sustainable development. Budgets point the researcher to fiscal resilience. Closely associated with budgets and expenditure is the aspect of credit rating and credit worthiness of any country to embark upon the implementation of CDM.

Budgets summarize the openness to purchase and also the openness to fund sustainability and sustainable development.

5.1.14 Assessing the Value of Currency

Currency represents the capacity to trade and fund. Economics bases its value in the capacity for its currency to trade effectively across economically difficult barriers. When the value of currency depreciates in the developed Annex 1 countries, it becomes difficult to convince potential donors to invest in a Clean Development Mechanism.

5.1.15 The Role of Government Bonds

Government bonds display a level of resilience associated with long-term developmental security outcomes for the researcher. Government bonds represent the availability of future funds for the purpose of potentially securing funding for sustainable development. The outcomes of long-term government bonds are the underlying resilience to broker and engage sustainable projects.

The future capacity for revenue generation and funding for sustainable development generates a good credit rating stance and is a sound enabler for the future procurement of funding sustainable development. Project managers for Bisasar Road and Mariannhill did not anticipate what kind of impact the macroeconomic indicators may have had on the generation of revenues from the sale of carbon credits because their analysis did not point them to the collapse of the financial markets in 2008. From a macroeconomic perspective, the project is an absolute failure. The Sequential Analysis Model demands a step-by-step approach to eliminate possible barriers to the implementation of sustainable development projects. The negative outcomes from the macroeconomic analysis provokes decisions to abort the implementation of the Clean Development Mechanism because of poor macroeconomic outlooks. The next step in the Sequential Model Analysis framework is to examine the feasibility of the microeconomic situation.

5.1.16 The Core-Economics and Financial Pre-Audit

Core-economics refers to the aspect of micro-economics within the parameters of the CDM. Barrow (2011:207) defines microeconomics as the study of economics as “it affects small units such as individuals, families, firms and industries”. Core economics searches for the relationships between supply and demand. It provides the mechanisms to survey opportunity costs, marginal revenue and marginal costs related to production. The aspect of core-economics seeks to understand the relationship between marginal revenues and marginal costs. Important questions

are asked about the aspect of marginal utility and price elasticity. Asking these questions provides in-depth answers to the economic feasibility of the project in terms of profitability and sustainability. Scanning the microeconomic environment facilitates and opens-up the process of accessing the financial feasibility of the project.

5.1.17 Examining and Compiling Opportunity Costs

Silbiger (2005:291) describes opportunity costs as “the cost of choice, when output, time and money are limited”. Costs to start-up a project may range from consulting charges, plant, machinery, personal, management and even start–up capital. These need to be documented as part of the opportunity costs. Start-up capital may take the format of a loan, which may take several years to pay off and needs to be incorporated as part of the ongoing project transitional costs.

5.1.18 Examining Marginal Revenues and Marginal Costs

The case study on the implementation of CDM at Bisasar Road and Mariannhill represents an example where the marginal costs exceed the marginal revenues on an ongoing basis, resulting in recurring debt and cost. The motivation behind a thorough preview of macro and microeconomic analysis is to prevent a situation where Marginal revenues are constantly eroded to the extent of financial loss. Silbiger (2005:292) asserts that during the process of production, marginal costs keep increasing to the point where marginal costs equals marginal revenue. Any unit of production after this point of equivalence is a tipping scale for the costs of production. The scale is tipped against revenues. Costs begin to increase for each extra unit of production, thereby increasing costs and losses. When the marginal costs exceed the marginal revenue, the appropriate business decision is to employ measures that reverse the situation to one of revenues exceeding costs.

In terms of any project having the capacity to fund its own sustainability, it is prudent to constantly plot a graph of marginal revenues against marginal costs for the purpose of constantly producing a situation of excess marginal revenues against costs.

Silbiger (2005:294) extends the concept of marginality to define what he refers to as “marginal utility”. Silbiger (2005:294) defines marginal utility as “the usefulness or utility of having an additional unit of a product. At some point a buyer is fully satisfied, and an additional unit is of no value”. Reverting to the case study and the production of electricity for Eskom, it becomes

apparent that the production of electricity for the municipal grid has minimum or zero marginal utility value and Eskom continues to pay less than the cost of production of electricity from Bisasar Road and Mariannhill.

Linked to the concept of marginality, is the idea of price elasticity. Silbiger (2005:294) describes price elasticity as “Buyers responsiveness or sensitivity to changes in price”. According to Silbiger (2005:294) demand is *elastic* when consumers are sensitive to price changes. This implies that consumers will purchase more when prices are adjusted down and purchase less when prices are adjusted upwardly. Silbiger (2005:295) reiterates that when consumers are not sensitive to price changes, as in the consumption of critically essential medical services and products, demand becomes *inelastic*. Projects that aim to be fully sustainable need to closely examine the level of *elasticity* for the product that they set out to produce and when there is no clear indication of demand for that product, production should not take place in the first place. This is the very basis of sustainability!

5.1.19 Searching for Financial Feasibility

The prime concern of the *Sequential Analysis Model* pre-audit is to forecast sales in order to calculate gross margins and relate these to operating expenses. In order to determine the operating income and to calculate earnings before interest and taxes, the project coordinator has to draw up a projected income statement. Silbiger (2005:247) cautions that financial analysis must consider competition, sources of raw material and plant, and factor these into a workable cash flow projection.

Sequential Analysis places primary importance on Cash Flow projections over a period of at least five years, renewable for another five years. The cash flow projection must indicate all revenue generating inlays to indicate the gross margin for each year or for each specific trading period. The cash flow projection must also indicate the operating income for each trading year and the free cash flow available thereof after expenses are deducted. A thorough cash flow projection, indicating inlays and outlays, is critical to the long-term success of the project. It is imperative that aspects of the macroeconomic, microeconomic and funding costs are incorporated into the cash flow projection. A prudently managed cash flow system is an unconditional safety mechanism to promote funding towards sustainable development. An inadequately managed cash flows system or a cash flow projection that does not take into consideration all possible revenue sources and all possible cost outlays is bound to fail because of recurring expenses and debt. The cash flow

projections at Bisasar Road and Mariannhill, as in the case study in question, could not have possibly considered that revenues from the sale of Certified Emission Returns would be so dependent on the global economic and financial system. In 2008, when financial markets crashed, the revenues from the sale of Certified Emission Returns dropped substantially to such an extent that the two CDM plants had to seek alternate sources to supply electricity and therefore to supplement needed cash flows. Eskom has the monopoly for the supply of electricity to the municipal grid and because of the challenge from clean energy sources, Eskom pays very low rates to alternate green sources of clean energy. The obvious decision to keep the prices as low as possible is to prevent the emergence of green and clean energy sources.

Green and clean energy pose a formidable challenge to the very existence of Eskom and the channeling of energy to the municipal grid impacts cash flows in a very substantive manner. There must be a provision to indicate any interruption in the flow of revenues to prevent losses due to suspension of scheduled, regular cash flows. An understated benefit of producing a thorough cash flow projection is its capacity to point to working capital needs arising from cash flow shortages. This indicates to project managers that it may be necessary to source bridging capital for the sustenance of the project. Cash flow analysis and cash flow management are critical elements in making funds available for sustainability and sustainable development.

5.1.20 The Pre-Audit for the Process of Implementing CDM

The pre-audit for the process of implementation of CDM examines the validity of each step in the process of implementing CDM. These steps are clearly articulated, defined and illustrated in figure 1 in Chapter Two and is repeated here, in italics, for the purpose of illustrating the stipulated protocol:

The CDM executive board is responsible for assessing, approving and registering all CDM projects. The board, consisting of ten members, issues CDM credits to duly registered projects and advises, assesses and approves new project protocols. The board approves and accredits independent audit firms to assure compliance and good governance. The project officer makes sure that the CDM develops within the policy framework and objectives of the host country. The Designated National Authority supervises and manages the entire project-approval protocol. The projects officer is responsible for compiling the Project Design Document and calculating baseline emissions, additionality and manages the compilation and claims for Certified Emission Returns (CERs).

The Designated Operational Entity is responsible for monitoring, evaluation, implementing proper accounting protocols, the supervision and prevention of leakages, good governance and overall transparency. The Designated Operational Entity, in consultation with the CDM executive board, negotiates and commits to an Emission Purchase Agreement. The agreement quantifies the number of CERs produced in one financial year, the agreed price per CER, and for what period of time the CERs will be generated.

The pre-audit needs to affirm that the stipulated methodologies for the implementation of CDM are complied with. Of primary importance and relevance is the pre-audit of the project design for the purpose of implementing CDM. The project design needs to be validated within the ambit for the implementation of CDM. Furthermore, it has to be determined whether there has been an official approval for the status of "Host Country". Any pre-audit needs to assess the functional validity of the project registration. The pre-audit needs to investigate whether appropriate mechanisms are in place to monitor and verify emission reductions for the purpose of issuing Certified Emission Returns. The pre-audit should determine whether the project is financially feasible. If there is an overwhelming indication that the project is not in fact feasible, then the project has to be abandoned altogether. It is critically important to determine whether the project can survive and sustain itself without the sale of Certified Emission Returns. The project may indicate that it is profitable without the implementation of CDM. It is also of critical importance for the pre-audit to determine whether the project is profitable from selling Certified Emissions Returns without any other source of revenue stream. If the project is unable to sustain itself by selling Certified Emission Returns alone, then the project must be abandoned. The project can only be implemented if it is possible to make a reasonable and sustainable profit from the sale of Certified Emission Returns when there is no other source of revenue generation.

5.1.21 The Technical Pre-Audit

The Technical pre-audit has to be conducted by an engineer to determine whether the project is technically compliant with basic technical requirements and regulatory issues, as well as safety issues. Compliance is primarily defined within the parameters of clean development and sustainable development. If the pre-audit finds that the project is not technically compliant, measures need to be taken to remedy or else the project has to be abandoned.

5.1.22 The Deficiency Report

The deficiency report is a comprehensive document that systematically identifies and details each and every deficiency in five of the critical areas of concern. The report extracts deficiencies from the sustainability pre-audit; the macro-economic pre-audit; the core-economics pre-audit; the implementation pre-audit; and the technical pre-audit and formats a comprehensive report listing and describing every deficiency in detail. “Deficiency” defines crucial elements that are lacking for the successful implementation of The Clean Development Mechanism as a catalyst for sustainable development. The deficiency report facilitates the decision-making process towards implementing or not implementing CDM by placing all deficiencies in one, common decision-making format. Deficiency reporting highlight two specific outcomes. The outcomes may favor and recommend certain remedies to salvage the project by overcoming the hurdles of deficiencies. Alternatively, the deficiency report may indicate that there are far too many deficiencies and any attempt to remedy these may result in excessive costs. The deficiency reporting may recommend, in the second instance, that the project must be abandoned.

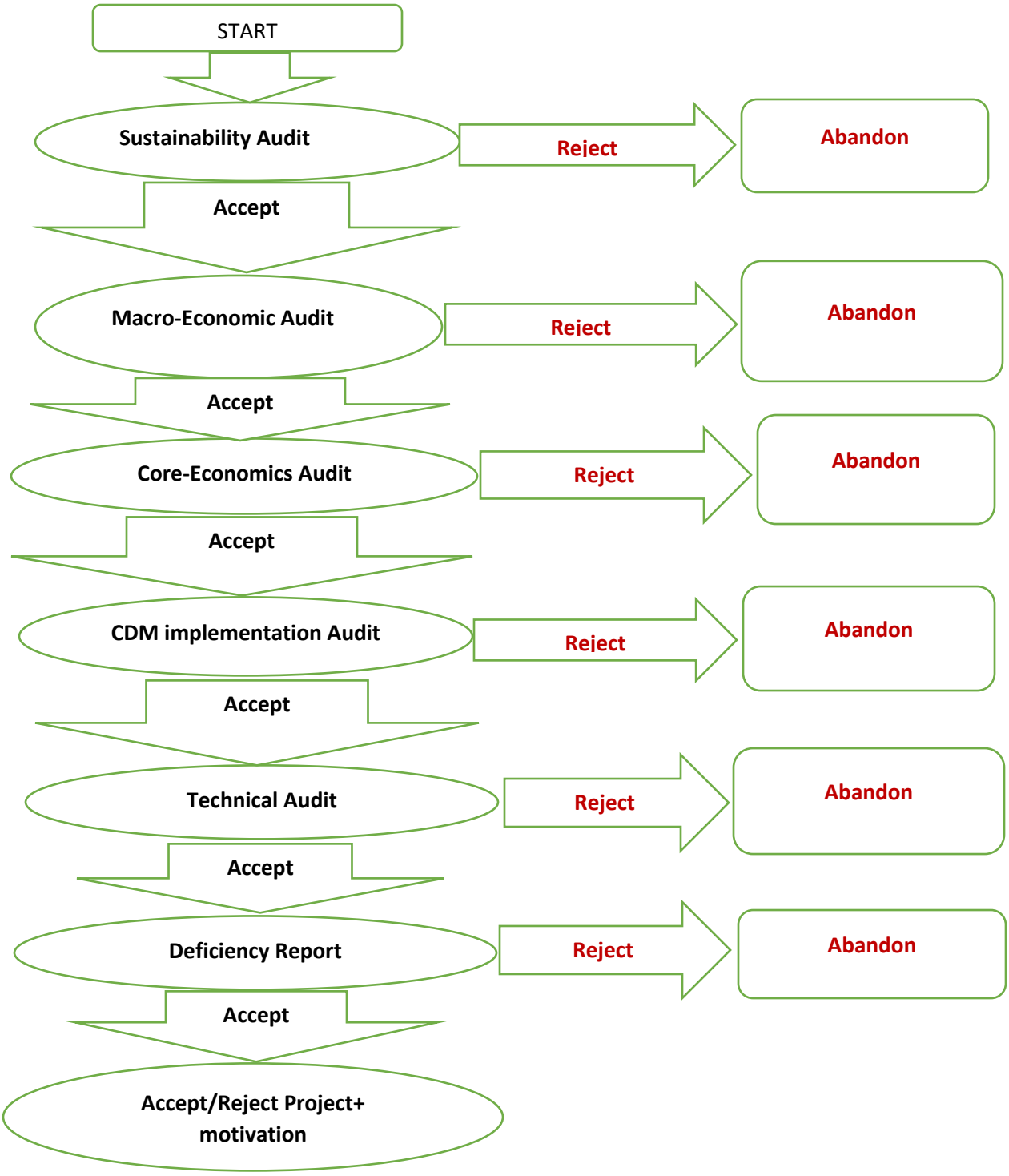
5.1.23 Accept or Reject the Implementation of CDM with a Motivational Report

This final decision recommends implementation or rejection of the Clean Development Mechanism as a viable vehicle for promoting and funding sustainable development. The auditor will provide a detailed report motivating the final outcome. This final decision is made by checking and rechecking every conceivable deficiency according to the Systematic Sequential Analysis protocol.

5.2 Summary and Conclusion

The Systematic Sequential Analysis (SSA) provides a series of filters to prevent any oversight of crucial deficiencies which may hinder the future success of the project. These sequential filters filter-out abnormalities from the aspect of sustainable development, macro-economics, core-economics, CDM protocol and technical protocols. These abnormalities, if not filtered out, tend to become unaffordable costs. The illustration and graphic representation which follows herewith, represents a graphic summary of the flow-sequence for sequential analysis.

Figure 20: Graphic Flow-Sequence for Systematic Sequential Analysis



Note: Each level of the deficiency audit exposes issues that may be corrected for further project advancement and acceptance and are not absolute end points.

CHAPTER SIX: CONCLUSION

6.0 Concluding Remarks

This research undertook a critical evaluation of the Clean Development Mechanism to determine whether CDM, as a mechanism, supports the funding requirements of sustainable development. The research process set out to identify barriers and enablers to funding and implementing sustainable development projects through the theoretical framework of Pigou and through the lens of the Clean Development Mechanism as implemented at Bisasar Road and Mariannhill. Pigouvian ideology guided the enquiry and from the theoretical perspective of Pigouvian-thinking, this study set out to vigorously examine the implementation protocol to establish whether there was conformity to the stipulated protocol. It is a pre-requisite to confirm the functional integrity of CDM because without having established the functional integrity, the two projects would have been unable to participate in trading Certified Emission Returns. Pigouvian-thinking also directed the research to seek answers to the accuracy of the recording and accounting protocols because proper accounting diligence determines whether revenue flows are adequate to fund sustainable development.

From an economics perspective, the study set out to determine whether the imposition of taxes, fines, subsidies and the trading of Certified Emission Returns succeeded in maintaining the *Pareto Optimo*. A balanced *Pareto Optimo* arises from compensating victims of externalities and taxing or fining the perpetrators of unwanted externalities. The emissions of Annex 1 countries represent externalities and the process of paying for carbon credits conforms to the broader principles of Pigouvian theory.

Additionally, Pigouvian ideology dictates that sustainable economic activity must function as a catalyst to promote ecological renewal and to provide sufficient checks and balances to encourage environmental protection. The aspect of sustainable development demands a basic respect for the consumption of resources so that future generations are not disadvantaged. Pigou supports this fundamental directive towards the preservation of essential resources to restore *ambient welfare standards.* The Clean Development Mechanism is grounded on the premise that in order for any one of the many composite benefits to be effectively realized, there must be regular and profitable revenue flows to maintain all the components of sustainability. Bisasar Road CDM and Mariannhill CDM plants were set up and implemented on the principle that the sale of carbon credits would provide the necessary funding for sustaining the projects and producing

additional revenue and additional profit for the purpose of funding the broad requirements of sustainable development. The site interviews and the theoretical framework indicate that the implementation process has been strictly adhered to. There is no doubt that the functional integrity of the CDM process is not lacking in any way, both at Bisasar Road and Mariannhill.

However, the motives, claims and direct advantages of CDM are highly questionable!
Firstly, the motives of the World Bank seem to indicate that its first priority is profit and not sustainable development for Non-Annex 1 countries. Whereas CDM supports the integrity of what emissions Annex 1 countries are allowed, the World Bank has failed to honor its obligations to Non-Annex 1 countries to support sustainable trade in carbon credits. While the World Bank actively promoted and invited South Africa to partake in the Clean Development Mechanism protocol, it has now abandoned the promised support of providing a regular source of revenues from trading in carbon credits. After the 2008 crash of the global financial markets, the World Bank simply stepped away from its obligations of providing an active platform for trading carbon credits. The lack of commitment from the World Bank has had a devastating impact on the capacity of both Bisasar Road and Mariannhill to attract revenues for the purpose of sustaining the two plants. The promised revenues from the sale of Carbon Credits are unreliable, inconsistent and it seems that there is no promise that the lack of revenues from the sale of carbon credits can be reversed in the near future. The complexities of the political and economic situation in Europe indicate that revenue flows from the sale of Certified Emission Returns will continue to slide to unacceptable levels.

Analysis by this study indicates that the two plants are constantly running up debt because of insufficient funds. When the carbon credits market collapsed after 2008, the Plants at Bisasar Road and Mariannhill turned to Eskom to sell their energy inventory into the municipal grid. It costs Bisasar Road and Mariannhill 83 cents to produce one kilowatt hour of electricity. Eskom pays about 44 cents per kilowatt hour. Therefore, Bisasar Road and Mariannhill incur losses of 39 cents and 36 cents per kilowatt of electricity, on average, respectively. The net effect is that the cumulative loss for Bisasar Road is close to R127 million and for Mariannhill the loss is close to R 12 million over their entire operating period. Interesting that the total revenues earned from the sale of Certified Emission Returns amounted to only R13million. Therefore, the plants at Bisasar Road and Mariannhill are running at a loss. The loss is so immense that it can never be claimed that the implementation of CDM supports nor funds sustainable development.

It would be appropriate to state and claim that CDM, as it is implemented at Bisasar Road and Mariannhill, are World Bank scams! There is no financial incentive nor advantage to continue to allow the two plants to operate at such a huge loss. Positive revenue flows are the basis of self-sustainability! Any project that is unable to sustain itself cannot possibly fund nor promote sustainable development. When the two plants themselves cannot support their own sustainability, how can they claim to support sustainable development?

Observations at the two sites quickly remind one of the relatively immense expanse of the landfill sites. The area of each landfill site could easily approximate to about six square kilometers. These are active emitters of carbon, methane and other toxic gases. The entire area of each landfill emits toxic gases for many decades and the argument that any The Clean Development Mechanism plant reduces emissions in any substantive manner is highly questionable. It is not scientifically possible that the simple insertion of pipes with small diameters would reduce emissions in any meaningful way. This study cannot endorse the claims that CDM, and the manner of its implementation at Bisasar Road and Mariannhill, has the capacity to reduce emissions of greenhouse gases in any substantive way. The researcher recommends that more research needs to be conducted to assess the end-points of emissions arising out of the two landfills to compare emission levels before and after the implementation of a Clean Development Mechanism. Baseline calculations for CDM are levels decided upon before the implementation of CDM and more studies need to be done to determine how baseline emissions change after the implementation of CDM. The concept of *additionality* is central to the implementation of CDM and refers to emission reductions relative to an established baseline that would have not occurred were it not for the existence of an incentive provided for by the CDM program. One Certified Emission Return represents the absence of one ton of carbon dioxide equivalent which would have been emitted into the atmosphere had CDM not being implemented.

The contradiction with the CDM protocol is that it decides upon a baseline relative to one miniscule part of the Landfill and then makes a claim that the implementation of CDM actually reduces greenhouse emissions. How can this be possible when the totality of the landfill is still actively emitting greenhouse gases and will continue to emit for years to come? The Rationale of this thinking is based on the principle that the global atmosphere is one coherent entity and the reduction in any one locality of the planet represents a reduction for the entire planet. This logic is flawed because it does not take into consideration what harmful effect the emissions have on the place of emission. In order for CDM to be implemented, there must exist some pre-existing

facility like the landfill, for example that is constantly emitting greenhouse gases. CDM is supposed to reduce the emissions by virtue of its implementation. In reality, this does not happen! The landfill continues to emit greenhouse gases and the implementation of CDM does not alter the overall emission levels relative to the landfills. The Clean Development Mechanism, as implemented at Bisasar and Mariannhill, is merely an excuse to allow the Annex 1 countries to continue to pollute and to maintain their emission levels by buying token Certified Emission Returns*.*

Had CDM not been implemented, the two landfill sites could have been utilized for the purpose of generating clean energy for the supply of electricity to poverty stricken local residents and for industry that supports job creation and employment. The very implementation of CDM incurs set up costs that take years to repay. The source of the loans are always developed economies or subsidiaries of the World Bank. Rather than facilitating development, employment and protection of the environment, CDM as implemented at Bisasar Road and Mariannhill, centers on its very own survival for the purpose of supporting the whims of developed economies. It is ironic that millions of Rand were spent to set-up CDM and millions of Rand are wasted each day to keep the plants functioning just so that the two plants mange to pay off their start-up loans. Site visits to Bisasar Road immediately expose the reality of the hypocrisy of the implementation of CDM. What meets the eye are the thousands of informal shacks around the landfill. Besides all the health hazards that informal dwellers are exposed to, the fundamental economic flaws are glaring. How is it possible that CDM is implemented, with the express purpose of implementing sustainable development and curbing greenhouse gases, when shack-dwellers living beside the landfill are exposed to the dangerous and harmful emissions from the landfill with a CDM facility? The landfill at Bisasar Road stands out as a glaring health hazard to the thousands of informal dwellers living alongside the Landfill. This is indeed criminal! The millions of Rand wasted to keep the Bisasar Road CDM plant active is a contradiction when no resources are spent on the social welfare of informal dwellers living beside the Landfill. The informal dwellers have no electricity, no sanitation facilities, no domestic water supply and no health support facilities. The informal dwellings make a statement of abject poverty. Poverty is so entrenched that it is not uncommon to notice that shack dwellers scavenge to survive and stay alive. Pigouvian thinking is primarily concerned with how externalities impact the economy form a social welfare perspective. The impact of the emissions from the landfill for communities of shack dwellers at Bisasar Road is a social welfare disaster.

Although site audits indicate that the implementation of The Clean Development Mechanism conforms to the basic norms necessary for the implementation, it is glaring that proper pre-audits were not conducted in a manner conforming to the principles of good accounting practice. The specific aim of the suggested sequential analysis provides safety nets for each stage of pre-audit analytics. The failure of CDM at both plants stems from the failure of the core-economics at both plants. Core-economics places emphasis on the management of marginal financial gains. It is the management of core marginality that assures the success of any project. Situational analysis indicates that the recurrent posture of marginal financial loss encourages disaster management for survival, from day to day.

Failure at the core-economics level suggests that the two plants are unable to structure an economic fit at the macro-economic level as well. Pigouvian thinking advocates a situation of *Pareto Optimo* or economic balance between the variables of supply and demand. A dynamic balance between supply and demand ought to produce favorable revenue flows with favorable marginal gains. There is a clear indication that the supply of electricity to Eskom does provide favorable levels of revenue flows, but for each kilowatt hour of electricity produced there is proportional marginal loss as reiterated throughout this analysis. This situation suggests that the economic indicators of supply and demand are imposed upon the plants rather the plants fitting into a macro-economic system of need satisfaction for the production of economic gain. What this suggests is that the two plants do not fit into the macroeconomic infrastructure of EThekwini. Running at a loss, the two plants stand out as economic disasters. The two plants are bleeding the economy of EThekwini.

The core indicator of Sustainable Development is the capacity for any project to create sustainable employment to those in dire need of economic empowerment. The two plants cannot afford to employ personnel because of lack of revenues. One is struck that the two plants have only produced nine permanent positions and the racial mix of employees at both plants suggests the principle of equal opportunity has been conveniently side-tracked to protect positions of staff who maintain the existence of the plants. From a sustainable development perspective, the two plants do not even satisfy the basic requirements of fostering development. The two plants represent a macro-economic disaster but more-importantly, the failure to fit into the macro-economic landscape of the EThekwini Municipality. The two plants cannot, and do not support sustainable development.

Failure to satisfy the micro and macro-economic requirements indicate that the projects at Bisasar Road and Mariannhill represent an economic disaster. The reality that the two plants do not have the very basic indicators of sustainable development point to very myopic pre-launch analytics. The stated aim if this study is to identify and articulate barriers and enablers to funding sustainable development. For all the reasons indicated, the very implementation of CDM at Bisasar Road and Mariannhill represents the greatest barrier to sustainable development and far from having even the basic capacity to fund sustainable development, the two projects are not in a position to fund their own sustainability. Pigouvian ideology maintains that when there is a system of dynamic economic balance between the fundamental principle of supply and demand and proper management of ecological indicators, this should contribute to ecological renewal to foster *ambient welfare standards.* During the site visit to Bisasar Road CDM plant during the rainy season, one could notice that the rain caused the landfill to break its banks and there was a huge overflow of waste material from the landfill to areas adjacent to the plant itself. Raw waste was flowing from the landfill past the plant towards the road. Many informal dwellers were squatting beside the overflow of raw waste from the landfill. Both residents from the squatter camp and staff at the plant seemed totally oblivious to the dangers represented by the overflow. Besides the toxic fumes and awful smell, the overflow represents a huge health hazard in terms of the spread of disease. There were no visible measures to restrain nor stop the overflow of raw refuse.

The unchecked overflow of raw, liquid refuse from the landfill points to neglect and poor management of landfill overflow. The implementation of CDM at Bisasar Road does not blend into the environmental architecture of the Landfill and into the local geographical settings.

The implementation of CDM fails to recognize or check the outpouring of liquid refuse into the street around the Bisasar Road plant. It is difficult to argue that the implementation of CDM at Bisasar Road and Mariannhill promotes ecological renewal. The overflow of liquid refuse from the landfill represents an ecological disaster. From a Pigouvian perspective, the implementation of CDM at Bisasar Road and Mariannhill does not promote *ambient welfare standards* conducive to promoting sustainable development. The study concludes that the implementation of The Clean Development Mechanism at Bisasar Road and Mariannhill does not support the funding of sustainable development.

The study cites that the economic disaster of 2008 worked against the prospect of revenue generation. Furthermore, start-up costs are high and the sale of electricity to Eskom at a constant

loss of revenue works against the implementation process. The level of expertise of staff are unquestionable but the projects are a failure. The projects do not support the environmental recovery; the claim to reducing carbon emissions are highly questionable; and the two projects do not facilitate ecological renewal. Bisasar Road was an apartheid structure and there are thousands of informal dwellers living adjacent to the plant that claims to support sustainable development. This is a glaring anomaly. This research indicates that CDM, as implemented at Bisasar Road and Mariannhill are World Bank scams.

6.1 Limitations and Avenues for Further Research

This study has established that the Implementation of CDM at Bisasar Road and Mariannhill does not fund nor does it effectively contribute to maintaining sustainable development. One of the primary reasons for the failure of CDM (to fund sustainable development) has resulted from the constant loss in revenues due to the collapse of the trade in carbon credits. Secondly, the two projects are producing clean energy but the cost to produce clean energy outweighs the income in revenues, making both projects unsustainable. This is not a valid argument to indicate that the implementation of CDM may not work at other localities. It may have been necessary to conduct parallel studies in other localities to determine whether different circumstances would be more conducive to the implementation of CDM. It would be advantageous for future studies to benchmark CDM against other CDM projects in different localities.

This study questions the motives of the World Bank and the trade in carbon credits. The World Bank promoted the idea that CDM would promote Sustainable Development by producing revenues from the sale of carbon credits. South Africa, a fledgling democracy confronted with poverty, unemployment and under-development had to borrow from various Development agencies and the World Bank to facilitate the implementation of a Clean Development Mechanism. There is a critical need for Developing countries to assess the viability, validity and feasibility of the mechanisms that the World Bank utilizes to raise funds against carbon credits. All sustainable development projects in developing countries need to first examine the motives of the World Bank before committing to unsustainable loans. The limitation of time and costs prevented a parallel and substantive enquiry into the mechanism of fund allocation by the World Bank.

This study has alluded to the hypothesis that the implementation of CDM in non-Annexure 1 countries promotes the developmental goals of the developed Northern countries while showing

little concern for the developmental and sustainability goals of Southern, developing countries. The Clean Development Mechanism, as it is implemented at Bisasar Road and Mariannhill has, up to now, not contributed to sustainable development in any substantive way. Case Studies on the implementation of CDM need to conduct parallel and intensive studies on the validity of CDM as an instrument for the facilitation of Sustainable Development.

Further critical research needs to be conducted on the motives of the World Bank with respect to carbon trading and its impact on developing economies. Critical research is also needed to assess the advantages and disadvantages of carbon trading within the context of developed economies of the North and the underdeveloped economies of the Southern countries.

ANNEXURE 1: Category A Questions

Category A questions (Consolidating and confirming the structural integrity of the CDM protocol)

1) When were the two CDM plants commissioned, registered and established?

2) Do the plants follow a seven-year CDM cycle or a ten-year CDM cycle?

3) What are the production capacities for both plants in terms of handling waste in Metric tons per day?

4) What are the electricity-generating capacities, in megawatts, for both the plants?

5) What is the unit generating cost per kilowatt hour of electricity for both plants?

6) What does ESCOM pay for one kilowatt hour of electricity generated?

7) What is the difference between the cost to produce and the revenue received from ESCOM?

8) What is the Rand value of the discrepancy?

9) What percentage of the emission is methane? What percentage is carbon-di-oxide? What percentage constitutes other impurities?

10) What percentage of the generated electricity goes directly into the EThekwini municipal grid?

11) What are the total operating costs per plant per annum?

12) What are the total operating costs to date, from inception, for both plants?

13) How many cubic meters of gas are captured per hour?

14) What percentage of the captured gas is methane? What percentage is Carbon? What percentage of the captured gas represents impurities?

15) How many metric tons of greenhouse gases have been rerouted or completely destroyed since inception?

16) After combusting the gases, what gases constitute the residual flow out the exhaust into the atmosphere?

17) How many cubic meters of gas emissions are destroyed and how many cubic meters of gas passes through the exhaust systems at both plants?

18) Is it correct to assume that for every 25 tons of methane destroyed by combustion, leaves an emission of one ton of carbon?

19) Do cyclic economic trends affect the costs of Carbon credits?

20) What do Annex 1 countries pay for carbon credits?

21) What levels of employment have the CDM projects brokered? How many permanent staff? How many technicians? How man unskilled staff? How many casual workers?

Annexure 2: Category B Questions

Category B Questions (Questions designed to interrogate CDM from the perspective of a Pigouvian, "welfare-economics" theoretical framework)

1) Please elaborate on the assertion that the process of implementing CDM condones, and allows for the existence of externalities in both Annexure 1 countries and in the specified host countries as well.
2) Does the process of implementing CDM overlook emission levels in the Northern Countries while imposing limitations on host countries and thereby frustrating development goals in the Southern countries?
3) Would it be correct to assert that the two CDM plants in Durban produce two types of externalities: Depletable and Undepletable externalities?
4) Is it correct to postulate that the process of burning-off methane gas produces a depletable externality while the carbon and mixed exhaust fumes produce undepletable externalities?
5) Does the act of paying for carbon credits, by Annexure 1 countries, express an ownership over externalities and a liability, thereof, for emissions?
6) Methane gas emissions are 25 times more harmful to the environment than carbon emissions. The process of burning-off methane produces two welfare benefits: firstly, the destruction of 25 tons of methane leaves a net emission of only one ton of carbon. Secondly, the burning-off of methane produces enough energy to generate and contribute electricity towards the municipal grid. Therefore, the process of burning-off methane converts a potentially harmful externality into one that produces two distinct welfare benefits. Please could you comment and elaborate on this.
7) However, the emission of carbon di oxide and impurities from the exhaust constitute a harmful externality. Which party is liable for the effects of this harmful externality at the two Durban plants, which are the direct outcome from the implementation of CDM?
8) The implementation of CDM depends, to a large extent, on the host country maintaining baseline emission levels below that which would have occurred before the implementation of CDM. The difference in baseline emissions constitutes additionality. Is it correct to state that additionality determines the value of saleable carbon credits?
9) How many carbon credits, in total, are produced by both plants on an annual basis?
10) What does one carbon credit fetch, in terms of revenue, on the open global market?

11) What are the potential revenue streams, per annum, for both CDM plants from the sale of carbon credits?
12) Do the revenue streams from the sale of carbon credits justify the continuity of the CDM projects in Mariannhill and Bisasar Road?
13) Do Annexure 1 countries, from the North, exploit CDM as a protocol of convenience to allow for the unsolicited emissions to remain as they are in order to maintain the developmental and economic agendas of the North?
14) Does CDM promote the agendas of Annexure 1 countries while ignoring the development goals of the South? Please elaborate …
15) Would it be more beneficial for host countries to follow national emission targets rather than Geographical quotas
16) Does CDM benefit larger economies like India and China rather than smaller economies like South Africa?
17) Would it be correct to say that the methodology for determining emission reductions for CDM is dubious at times? Please elaborate …
18) Externalities pave the way for taxes, subsidies and discounting of environmental credits and therefore require proper accounting protocols to quantify the value of social boons or social harm. What accounting protocols are followed at Bisasar Road and Mariannhill?
19) Would it be correct to assert that externalities produce distortions and the best way to correct these distortions is to impose taxes or pay out subsidies?
20) Do subsidies, taxes and the sale of carbon credits bridge the gap between private and social welfare?
21) Would it be safe to assert that more stringent accounting measures need to be implemented to accurately capture the impact of externalities?
22) Externalities represent the unpaid factors of economic activity and therefore require stringent supervision and monitoring by an accredited, Independent Authority.
23) The implementation of CDM may impact environmental integrity and in, turn may alter the social and economic integrity of communities. Could you comment on this?
24) Does the imposition of Taxes, subsidies and the sale of carbon credits, arising from CDM, correct social dissonance arising from unsolicited emissions?
25) The concept of "*Pareto Optimal"* is a process of allocating resources in such a way in which it is not possible to advantage one individual without making at least one individual worse off. Does CDM contribute to a progressive restoration of the "Pareto *Optimal"?*

26) Should the victims and end recipients of the impact of externalities, be allowed to bargain for compensation?
27) Who is legally liable for the net effect of externalities arising out of CDM activities at Bisasar Road and Mariannhill?
28) Should "*Pareto Optimal"* be restored by State intervention, market solutions or legal interventions?
29) Does the implementation of CDM impact on the process of ecological renewal?
30) Is it possible to monetize the capacity of the ecology to renew itself on a cyclic basis?

Annexure 3: Funding Sustainable Development

Funding Sustainable Development

1) Does the implementation of CDM at Bisasar Road and Mariannhill represent development which meets the needs of the present generation without compromising the ability of future generations to meet their needs?
2) Does CDM attract optimal capital investment from the sale of carbon credits for the purpose of funding sustainable development?
3) Do the revenues from the sale of carbon credits compensate for any unintended, detrimental effects caused to the environment?
4) Do revenues from the actual discounting of carbon credits produce sufficient financial, capital reserves to propagate sustainable development at least within the parameters of Bisasar Road and Mariannhill?
5) Is CDM a profitable venture?
6) Please elaborate on the effectiveness of the accounting system used to monitor CDM revenue flows.
7) Do Bisasar Road and Mariannhill utilize a prescribed accounting system?
8) Does the CDM Executive board play an active role in the activities of Bisasar Road and Mariannhill?
9) Does the Designated National Authority play and active role in the activities of Bisasar Road and Mariannhill?
10) Do the activities at Bisasar Road and Mariannhill place special attention on other environmental variables outside of emission monitoring?

Annexure 4: Letter of Information

Durban University of Technology
Institutional Research Ethics Committee
Durban

Letter of Information

Title of Research Study:

"Barriers and determinants to funding Sustainable Development projects in Developing Countries: A case study of EThekwini Municipality."

Principal Investigator/ Researcher: Anilrai Sangham BTech MBA MBP
Supervisor: Professor Pumela Msweli PhD

Brief Introduction and Purpose of the Study

The study seeks to examine barriers and enablers of funding sustainable development projects with a special focus on The Clean Development Mechanism (CDM) projects. There are two CDM cases located at Mariannhill and Bisasar Road in EThekwini Municipality.

The study seeks to develop a comprehensive theoretical framework to help development agencies, policy makers and entrepreneurs understand the determinants and barriers to sustainable development.

Furthermore, the research findings will be published in appropriate journals.

Outline of the Procedures

The researcher will schedule meetings with employees and management of EThekwini Municipality in connection with seeking information regarding their Clean Development Management projects at Bisasar Road and at Mariannhill. The researcher will conduct interviews at the convenience of management, to gather information regarding the mechanism of action of CDM and primarily to gather information about how these projects are funded.

Risk of Discomfort to Interviewees

The researcher will take great care to respect the integrity of all interviewees at all times and will not impose nor demand responses that will cause embarrassment nor discomfort.

Benefits of the study

The outcomes and findings of the study will be published by the Durban University of Technology and the results of the research will be made available to interested staff and management at EThekwini Municipality.

The study will also be published in appropriate journals and publications.

Reasons why Participants may be withdrawn from the study

There will be no adverse consequences should interviewees choose to withdraw from participating in any planned interview due to illness or any personal or work related reasons.

Remuneration

The researcher will consult and seek advice from management at EThekwini Municipality regarding compensation for time taken from employees.

Cost of Study

Participants and interviewees will not be asked to pay costs towards this study

Confidentiality

The researcher will respect requests from management and employees of EThekwini Municipality for confidentiality. However, the researcher wishes to state, uofront, that the findings of the study will be made public.

Researcher related injury

Interviews will not be conducted in any environment that would endanger the interviewee in any way.

Persons to contact

Please contact the researcher at 0783007213, my supervisor Professor Pumela Msweli on 031-3732523 or the Institutional Research Ethics administrator on 031-3732900. Complaints can be reported to the DVC:
Prof. F Otiento on 031-3732382 or dvctip@dut.ac.za

General

This letter serves to confirm that participation for interviews are completely voluntary. The researcher will circulate this letter to all interviewees and participants. The researcher is not in a position, at this stage, to categorically state how many people will be interviewed.
This letter will be translated into isiZulu if the primary language is not English.
Please feel free to consult me at any time. My email address: anilrai.sangham@gmail.com

Yours Sincerely
Anilrai Sangham

Annexure 5: Letter of Consent from the EThekwini Municipality

Please note that signed the letter of consent from Durban Solid Waste of the EThekwini Municipality is in possession of the research in PDF format and can be made available at any time.

Annexure 6: Letter of Introduction

Durban University of Technology
Faculty of Management Sciences
Date:

Dear Participant,

I am a PhD student and currently involved in a research project to determine what conditions facilitate the procurement of funding for sustainable projects and also what conditions present barriers to the process of procuring funding for sustainable development.

My study embraces funding for sustainable development from a broad, global and African perspective. However, I am particularly interested in researching how The Clean Development Mechanism (CDM) projects source their funding. Therefore, my focus is concentrated on the CDM plant at Bisasar Road and also on the CDM plant at Mariannhill.

I would also like to enquire how technical and engineering facilities, at the two plants, facilitate the utilization of effective technology to attract funding.

This letter serves to make a request to you, for your assistance, in allocating some time to me so that I may interview you and engage with you, to get your views on what aspects facilitate the procurement of funding and also, what aspects present barriers to the procurement of funding for CDM projects. My interview should take about an hour but I will tailor the interview to what suits you in terms of availability of time.

The prime purpose of this study is to gather firsthand information to format a theoretical framework for policy makers, financial institutions, intermediaries for private and public sector resources, entrepreneurs, fellow students and industry at large to facilitate the effective procurement of funding for sustainable projects in developing countries in Africa. Furthermore, the research findings will be published in recognized journals and made available to EThekwini municipality staff and management.

I wish to thank you for your time, co-operation and valuable input.

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