



**University of Cape Town
Faculty of Science
Department of Environmental and Geographic Sciences
Africa Climate and Development Initiative**

**Zero Emissions, Zero Poverty in Kenya:
*A review of whether Lamu Coal Power Plant promotes a pro-poor
low carbon development pathway.***

By:

Joan Momanyi
MMNJOA001

Supervisor:

Dr Britta Rennkamp
(Energy Research Centre)

Co-Supervisor:

Hilton Trollip
(Energy Research Centre)

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ABSTRACT

“Zero emissions, zero poverty” has become an ambitious target to fight climate change and reduce poverty at the same time. In Kenya, eradication of extreme poverty through economic growth is one of the aims to be achieved by the Government of Kenya by 2030. Historically, economic growth has been directly linked to increased emissions. Poverty eradication through economic growth is proving to be challenging due to the fact that both developed and developing countries are expected to mitigate climate change through emissions reduction. Despite the challenge, Kenya has prioritised low carbon development as a means to eradicate poverty and mitigate climate change. “Clean coal” is one of the low carbon developments that the country has proposed.

This study investigates how “clean coal” can assist Kenya to remain low carbon and develop properly. The analysis of the literature and qualitative data consists of three parts: the first analysis establishes the relationship between emissions and poverty in Kenya. The second part of the analysis assesses the literature on cost, environmental, social and economic consequences of clean coal as a low carbon development. The third component analyses the discourse of the actors involved in the decision-making process to understand the controversy for and against clean coal in Kenya.

The study finds that there is possibly a link between poverty and emissions in Kenya and that improved socio-economic development results in increased emissions. The study also suggested that efforts to develop may be hindered by the increasing rate of inequality. The discourse analysis highlighted that Lamu Coal Power Plant may lead to economic development through employment and economic growth.; which comes at a high cost on environmental degradation (increased emissions and pollution) and increased deprivations (negatively impacted livelihood, health deterioration and displacement) that are likely to result in increasing poverty.

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ACRONYMS AND ABBREVIATIONS

AfDB	African Development Bank
CH₄	Methane
CO₂	Carbon dioxide
GDP	Gross Domestic Product
GHG	Greenhouse gases
GoK	Government of Kenya
HDI	Human Development Index
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
KNBS	Kenya National Bureau of Statistics
Kwh	Kilowatt hour
LCD	Low Carbon Development
LCOE	Levelised Cost of Electricity
LULUCF	Land use, land use change and forestry
MENR	Ministry of Environment and Natural Resources
MoEP	Ministry of Energy and Petroleum
MoPD	Ministry of Planning and Development
MPI	Multidimensional Poverty Index
MtCO₂	Metric tonnes of carbon dioxide equivalent
MW	Megawatts
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NO₂	Nitrous oxide
°C	Degrees Celsius
OPHI	Oxford Poverty and Human Development Initiative
PAMA	Poverty Alleviation Mitigation Action
SDG	Sustainable Development Goals
SNC	Second National Communication
SO₂	Sulphur Oxide
UN	United Nations

UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USC	Ultra- Super Critical Coal

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Chapter 1: Introduction

1.1 Background

There is a wide consensus that global warming is occurring due to emissions of greenhouse gases (GHG's) (McGuigan, Reynolds & Wiedmer, 2002). It has been debated that temperature beyond 2 °C is the limit in which the world is likely to experience irreversible and catastrophic climatic events and global damages (Granoff, Eis, McFarland & Hoy, 2015). This has led to the goal of maintaining the temperature rise below 2°C by targeting near zero emissions by 2100 (IPCC, 2014c; UNFCCC 2015). At the 21st Conference of Parties (COP 21) held in Paris from the 30th of November to the 11th of December 2015, the Paris Agreement was adopted. The Paris Agreement emphasised on the urgent need “to address the significant gap between the aggregate effects of the mitigation pledges of the parties in terms of global annual emissions of greenhouse gases by 2020 and aggregate emission pathways consistent with holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels” (UNFCCC, 2015, p.2).

Eradication of extreme poverty is the first Sustainable Development Goal (SDG) (UN, 2015). The urgent need to mitigate climate change poses a challenge to the efforts to eradicate poverty. This is because according to Hull (2009) extreme poverty eradication can be achieved through economic development. In the past, economic development has directly been linked to increased emissions which subsequently result in climate change (Granoff *et al.*, 2015; Heil & Selden, 2001).

A trade-off exists between climate change mitigation and socio-economic development (Rennkamp & Wlokas, 2012). Rennkamp & Wlokas (2012) and Wlokas, Rennkamp, Torres, Winkler, Boyd, Tyler & Fedorsky (2012) allude that the simultaneous eradication of poverty and reduction of emissions can be achieved by embracing low-carbon development (LCD). In addition, they identified three concepts that attempt to link climate change objective and development; sustainable development policies and measures, Clean

Development Mechanisms (CDM) and National Appropriate Mitigation Actions (NAMAs) (Rennkamp & Wlokas, 2012; Wlokas *et al.*, 2012).

The trade-offs involved with climate change mitigation and poverty eradication are complex. Granoff *et al.* (2015) point out that climate change mitigation and sustainable socio-economic development can be achieved if developed countries shift to LCD and if developing countries embrace LCD. Wlokas *et al.* (2012) correspondingly argue that climate change mitigation and climate change can only be achieved if countries comprehend the benefits that arise from low carbon development fully. The next section looks at the rationale of this study in the Kenyan context.

1.2 Research focus

The eradication of poverty by 2030 through the promotion of equality and economic growth is one of the main objectives to be attained by the Government of Kenya (GoK) in its vision 2030 blueprint (UN, 2015; MoPD, 2007). The ease in which this objective can be met has proved to be a challenge due to the fact that Kenya's economy is highly dependent on climate sensitive sectors such as agriculture, tourism, energy, health and water (GoK, 2015). AfDB (2014) points out that the impact of climate change has resulted in droughts, floods, changes in rainfall and temperature patterns, rising of the sea level, reduced crop yield, increased food insecurity, reduced access to water and reduced health.

Kenya is highly vulnerable to the impacts of climate change due to increased exposure to climate change impacts, highly sensitive climate-driven economy and their poor capacity to adapt (AfDB, 2014). Increased vulnerability as a result of the impacts of climate change has negatively affected Kenya's economy. Climatic hazards such as floods in Kenya have contributed to economic losses that are estimated at 3% of its GDP as reported by the Government of Kenya GoK (2015). Unless appropriate interventions mechanisms are put in place, the afore losses are expected to increase.

Despite the fact that Kenya historically contributes to 0.1% of the total global emissions, the country has greatly been affected by the impacts of climate change (GoK, 2015; MENR, 2015). The impacts of climate change on Kenya's climate-driven sectors have resulted to

the country placing climate change response as a priority. Kenya developed the Intended Nationally Determined Contribution (INDC) in response to verdicts agreed at the 19th and 20th sessions of the Conference of the Parties to the UNFCCC that invited Parties to communicate to the Secretariat their INDC (MENR, 2015). Kenya signed the Paris Agreement on the 22nd of April 2016 and it was ratified on the 28th of December 2016 (UNFCCC 2016). The country has committed to reducing its emissions by 30% by 2030 (GoK, 2015). The GoK states that “in order to meet the 2^oC objective, all countries will need to undertake mitigation based on the common but differentiated responsibilities and respective capabilities in accordance with the Convention” (MENR, 2015, p.6).

The need for climate change mitigation as a global effort comes at a challenging time for Kenya. This is because the country aims to move from a lower middle-income country to an industrialised middle-income country as well as eradicate extreme poverty by 2030 (World Bank, 2016; MENR, 2015). Economic development in the past has been emissions-intensive. It is thus, evident that the simultaneous eradication of poverty and mitigation of climate change for a developing country like Kenya poses a serious challenge. This is in line with Wlokas *et al.* (2012) who state that slowing climate change and promoting socio-economic development(poverty eradication) poses a challenge for developing countries. This means that if poverty eradication is achieved through emissions intensive development, climate change impacts are expected to worsen and thus affecting the poor who are highly dependent on climate-driven sectors.

This thesis argues that zero emissions zero poverty is achievable through sustainable economic development. To sustainably eradicate poverty, it is thus necessary to reduce emissions and poverty concurrently in order to avert the possibility of the population that has been removed from extreme poverty being drawn back to poverty due to increased vulnerability to extreme climate change impacts (Granoff *et al.*, 2015). For Kenya to address her poverty and climate challenges, climate change mitigation and poverty eradication efforts should be aligned and integrated into both international and national goals to make use of synergies (GoK, 2015; Wlokas *et al.*, 2012; MoPD, 2007).

The GoK has developed mitigation interventions in each sector (agriculture, forestry, electricity, energy demand, transport, industrial processes and waste) that promote low carbon development (GoK 2013; GoK 2015). This study focused on the electricity generation sector. It focused further on the proposal of “clean coal” as a contributor to low carbon development.

1.3 Aim and objectives

This research is an appreciation of existing literature. Its purpose is to answer the research question; does clean coal in Kenya as a low carbon development promote climate change mitigation and poverty eradication?

1.3.1 Aim

The overall aim of this research is to determine whether “clean coal”- as a low carbon development and a climate mitigation intervention- will assist Kenya to remain low carbon and prosper through climate change mitigation and poverty eradication.

1.3.2 Objectives

Consistent with the aim outlined, the objectives of this research are:

- a) To establish whether there is a relationship between poverty and emissions in Kenya;
- b) To determine the socio-economic and environmental consequences of “clean coal” as a pro-poor mitigation action in Kenya;
- c) To understand the rationale for and against “clean coal” as a low carbon development.

1.4 Thesis outline

This dissertation is structured as follow:

Chapter 1: This chapter gives an introduction to the study by giving a background of the rationale for this study. This chapter also outlines the focus for this study as well as the aim and objectives of this study.

Chapter 2: This chapter outlines the various literature existing on emissions and poverty. This chapter includes a literature review on the concept of zero poverty zero emissions. It also looks at the structure of poverty and the emissions profile in Kenya. It finally investigates previous research on the impacts of coal power plants on poverty and emissions.

Chapter 3: This chapter describes the geographical and demographics background of the research area. It further describes the methods that were used to collect and analyse data. It also outlines the limitations of the methodology selected.

Chapter 4: This chapter presents the three analyses and findings that were derived from this study. First, an emissions analysis was used to determine whether there is a correlation between emissions and poverty in Kenya. Second, a socio-economic analysis was used to determine the consequences of clean coal as a low carbon development. Third, a discourse analysis was carried out to understand the rationale for and against clean coal.

Chapter 5: This chapter presents the conclusion of the findings from the analysis and provides a discussion that synthesises the findings of the analysis vis-à-vis the literature review.

Chapter 6: This section provides the main findings and the conclusion as to whether Lamu coal power plant promotes a low carbon, pro-poor development pathway. This chapter also provides recommendations for future studies.

Chapter 2: Literature review

2.1 Introduction

This literature review will examine the concept of zero emission zero poverty and whether clean coal as a low carbon development achieves climate change mitigation as well as poverty eradication. This chapter explores the link between poverty eradication and climate change mitigation as defined in the literature. It further looks at the structure of poverty and the emissions profile in the context of Kenya. It also gives insight to the mitigation measures put in place in Kenya with a focus on “clean coal” as a mitigation action. Finally, this chapter will look at the impact of coal power plants on emissions and poverty and identify the existing gap. The importance of reviewing the aforementioned literature will be to provide a profound analysis and discussion to determine whether Lamu coal power plant promotes a low carbon pro-poor pathway.

2.2 Definitions

2.2.1 Climate change

The UNFCCC defines climate change as “a change of climate which is attributed directly or indirectly to human activities that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (United Nations, 1992, p.3).” To understand the links between climate change mitigation and poverty eradication clearly, it is necessary to consider prominent definitions of climate change mitigation and poverty from literature.

2.2.2 Climate change mitigation

Mitigation is defined as an anthropogenic intervention that seeks to prevent, reduce or slow down the increase of atmospheric GHG emissions concentration by limiting current and future emissions as well as enhancing potential sinks of GHG (NCCRS, 2010; IPCC, 2007). Emissions are defined as “the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time” (UNFCCC, 1992, p.3). “GHG are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation and they include; Carbon dioxide (CO₂), Methane

(CH₄), Nitrous Oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF₆)” (UNFCCC, 1998; UNFCCC, 1992, p3).

2.2.3 Poverty

The definition of poverty is not only complex but has also evolved with time. Nevertheless, understanding the definition and measurements of poverty is important because it has an implication on policies (Ehrenpreis, 2006). In the past, poverty was associated with income deprivation (Ehrenpreis, 2006). The definition of poverty has changed to not only incorporate economic needs but social and cultural needs as well. UNESCO (2012) defines poverty in relative and absolute terms. Absolute poverty, on one hand, is the measure of poverty in relation to the amount of money required to meet one’s basic needs (food, shelter and clothing); on the other hand, relative poverty is defined as a form of poverty that is related to the economic status of other members of the society; for example, where a person is poor if their income and consumption falls below a certain level of living standards (UNESCO, 2012).

OPHI developed a new international measure of poverty, the Multidimensional Poverty Index (MPI), that not only measures income but also the multiple overlapping deprivations that a poor person faces that declines their living standard (Alkire & Santos, 2010). The MPI has 3 dimensions (education, health and living standards) that are measured using 10 indicators (Figure 2-1) (Alkire & Santos, 2010). Alkire & Santos (2010) describe that the dimensions and indicators are equally weighed to measure acute multidimensional poverty and one is rendered poor if they are deprived in more than one-third of the weighted indicators. The MPI is the product of two numbers ($MPI = H * A$) whereby, (H) is the percentage of people who are poor whereas (A) is the average percentage of simultaneous deprivations poor people experience (Alkire & Santos, 2010).

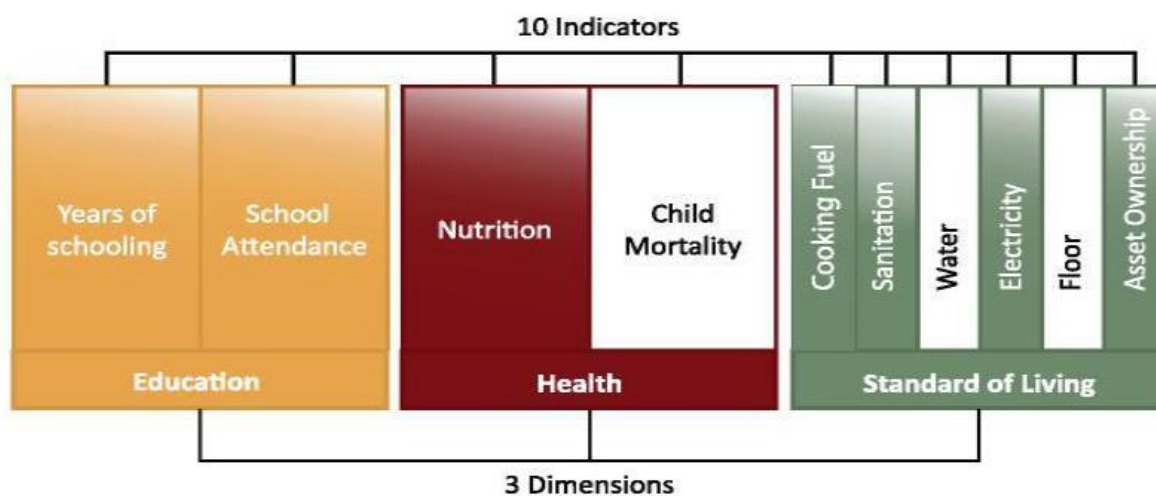


Figure 2-1: Multidimensional Poverty Index (MPI) (Alkire & Santos, 2010)

2.3 Link between poverty eradication and emissions reduction (climate change mitigation)

The first Sustainable Development Goal (SDG) is to “end poverty in all its forms everywhere”. This goal aims at “eradicating extreme poverty (people living on less than \$1.25 a day) by 2030 through the reduction of the proportion of men, women and children living in extreme poverty by half as well as ensure that all men and women have equal rights to economic and natural resources, access to services, ownership of property, technology and financial services by 2030” (UN, 2015, pp.12-13). It appears that in order to eradicate extreme poverty, equality, as well as social and economic development, should be encouraged (Wlokas *et al.* 2012).

Wlokas *et al.* (2012) also agree that poverty eradication and equality is achieved through economic development. They note that in the past, economic development has been both energy consumptive and emissions intensive (Wlokas *et al.* 2012). In addition to Wlokas *et al.* (2012) argument, other sources argue that the need for countries to economically prosper has resulted in increased emissions (Granoff *et al.*, 2015; IPCC, 2014c; UNFCCC 2015). Unfortunately, increased emissions have led to an increase in temperatures in the world, consequently resulting in climate change (Granoff *et al.*, 2015; IPCC, 2014c; UNFCCC 2015). Granoff *et al.* (2015) explicate that climate change impacts have mostly affected the

poor due to the fact that the poor are highly dependent on climate-driven sectors (Granoff *et al.*, 2015). The poor are also vulnerable to climate change as they are more exposed to the impacts of climate change and they have poor capacity to adapt to the changing climate.

The UN (2015) advised that the resilience of the poor should be built to reduce their exposure and vulnerability to climate-related extreme events and disasters. This can be achieved through mobilisation of resources, development of policies and frameworks at local, regional, national and international levels that promotes equality and poverty eradication (UN, 2015). The resilience of the poor can be built through adaptation. Adaptation is an effective measure in reducing climate change impacts on poverty eradication effectively through improving the capacity to cope by reducing vulnerability, sensitivity and exposure to climate variability (Granoff *et al.*, 2015; Parnell, 2014).

Despite adaptation being an effective tool in reducing poverty and coping with the impacts of climate change, Parnell (2014) reports that adaptation is a very expensive process as a coping mechanism to climate change. In addition, Granoff *et al.* (2015) point out that adaptation is a short term coping mechanism and with an increase in temperatures and extreme events, adaptation practices may be inadequate. In the global south, climate adaptation has overshadowed mitigation. In the past, it has been viewed that adaptation rather than mitigation will realise poverty reduction; however, it has been noted that poverty and mitigation need to co-exist as a national response to poverty and inequality (Parnell, 2014).

Although both adaptation and mitigation can be used as measures to eradicate poverty, it is important to note that adaptation is a short term coping mechanism while mitigation is a long-term mechanism. Granoff *et al.* (2015) argue that if climate change is not dealt with, it poses the risk of the population that was removed from extreme poverty reverting back into poverty. The actions/strategies put in place to eradicate extreme poverty should be sustainable even after 2030. As such, in keeping with Wlokas *et al.* (2012), it can be argued that sustainable poverty eradication can be achieved if both developed and developing countries incorporate the concept of low carbon economy (mitigation) in their development process.

2.4 Pathways to zero poverty zero emissions

2.4.1 What is the likelihood of eradicating poverty by 2030?

As earlier, eradication of extreme poverty by 2030 is the first SDG. Poverty being a complex term to define and understand, eradicating it becomes a complex process that requires an approach that cuts across a series of dynamics. Despite the challenges of poverty eradication in developing countries in the past, Granoff *et al.* (2015) explicate that the eradication of extreme poverty is achievable by 2030; especially in light of success from the last decade where poverty has reduced from 43% to 17%. They also note that despite the fact that poverty has reduced in the past, achieving sustainable poverty eradication with increasing climate change impacts is still a challenge.

Granoff *et al.* (2015) also argue that the eradication of poverty is directly linked to economic growth, therefore, rendering poverty rates sensitive to economic growth rates (Granoff et al. 2015). For example, if the global economic growth is dropped by 3%, an additional half a billion people will be living in extreme poverty. In spite of economic growth reducing the rate of poverty, it may also increase inequality (the gap between the rich and poor).

Granoff *et al.* (2015) explain that equitable growth can be achieved through boosting human capital, asset accumulation by the poor, increasing employment opportunities, improving pro-poor services and infrastructure and improving governance. Furthermore, the 10th goal in the SDG is reducing inequality through “achieving and sustaining the income growth of the bottom 40% of the population at a rate higher than the national average, promote the social, economic and political inclusion of all citizens, equal opportunities to all citizens, adopt policies that achieve greater equality and enhance the voice of developing countries in decision-making in global institutions among others” (UN, 2015, p18). Therefore, eradication of poverty is possible by tackling inequality through the distribution of wealth and economic growth.

2.4.2 What is the impact of climate change on poverty eradication?

Wlokas *et al.* (2012) explain that inequality and poverty are the main problems in the developing world and they are expected to worsen with an increase in climate change

impacts. The climate change impacts currently being experienced are as a result of historic GHG emissions that have been released resulting in an increase in temperature by about 0.85 °C above pre-industrial era (Granoff *et al.*, 2015).

IPCC (2007) and UNFCCC (2007) point out that Africa is expected to experience a change in climate. . This change in climate is expected to bring about extreme events such as increased frequency and intensity of floods and droughts. (IPCC, 2007; UNFCCC, 2007). Kenya has recorded an increasing trend in temperatures in many parts of the country from 1960s with decreasing trend and increased variability and irregularity in annual rainfall over most areas (GoK 2014). Furthermore, “Kenya has noted higher intensity and frequency in droughts and floods with the country’s famine cycle reducing from 20 years (1964-1984), to 12 years (1984-1996), to two years (2004-2006) to yearly (2007-2008-09-10-11-12) (GoK, 2014, p.10)

The vulnerabilities likely to be faced are increased water stress for many countries, compromised agricultural productivity worsening food security situation, increased forest fires, deforestation, desertification, degradation of grassland, degradation of ecosystems, loss of biodiversity and alteration of spatial and temporal transmission of diseases such as malaria and cholera (IPCC, 2007; UNFCCC, 2007). The coastal zones are vulnerable to rise in sea levels, coastal erosions and degradation of the marine ecosystem. The extreme events are likely to damage infrastructure and housing. Parnell (2014) explains that it is unfortunate that the economic and social costs of climate change impact are most often borne by the poor.

Developing countries have low adaptive capacities to climate variability due to existing development challenges such as endemic poverty, low GDP, weak institutions, low level of education and primary health care, poor gender balance, ecosystem degradation, conflicts and limited access to market, infrastructure and technology (UNFCCC, 2007). Education and health are two of the three dimensions that are used in the measure of Multidimensional Poverty Index.

Increased GHG emissions will lead to increased temperatures resulting in increased climate change variation, increased climate change impacts, increased vulnerabilities and in the

long run less capacity to adapt. Granoff *et al.* (2015) expound that if emissions are not regulated (Business as Usual emissions) it is predicted that by 2050 the population that is pulled out of extreme poverty by 2030 will be pulled back into extreme poverty thereby reversing the gains. As such, sustainable poverty eradication is achievable by 2030 but not in the Business as Usual (BAU) scenario.

In developing countries, adaptation is commonly used to reduce climate change impacts and eradicate poverty. As discussed earlier, adaptation is costly and it may not be sustainable with BAU scenario that is likely to result in catastrophic impacts. Granoff *et al.* (2015) raise concern that when adaptation fails, poor people are the most affected as the climate impacts affect their livelihood from which poor people lack the capacity to diversify or search for an alternative livelihood.

2.4.3 How can we achieve zero poverty on the path to zero emissions?

Most of the actions required for zero net emissions pathway have a negative cost because they provide more economic benefits than the cost (Granoff *et al.*, 2015). Therefore, developing countries have the potential to move to zero net emissions without compromising their growth trajectory. Countries with extreme poverty have the opportunity to sustainably develop achieving a low emissions pathway. Even though emissions in countries with extreme poverty are expected to peak, they will gradually reduce (Granoff *et al.*, 2015). IPCC (2007) argues that developed countries have a responsibility (common but differentiated responsibility) to assist developing countries to adapt to and mitigate climate change. Therefore, developing countries should embrace mitigation as an opportunity for them to eradicate poverty.

Wlokas *et al.* (2012) also point out that developing countries urgently need to understand the risks and opportunities that mitigation activities and Low Carbon Development raise on fighting poverty. Also, the concept of low carbon emissions should be incorporated in the development process of developing countries (Rennkamp & Wlokas, 2012; Wlokas *et al.*, 2012).

Rennkamp & Wlokas (2012) and Wlokas *et al.* (2012) indicate that there are three main concepts that are identified to attempt the link between climate change objective and

development: They are sustainable development policies and measures, Clean Development Mechanisms (CDM) and National Appropriate Mitigation Actions (NAMAs). The three concepts could assist developing countries to achieve zero poverty, zero emissions.

Brundtland (1987, p. 43) defines sustainable development as “development that meets the needs of the present without compromising the ability of the future generations to meet their own needs”. The Sustainable Development Policies and Measures addresses socio-technical systems that identify the link between climate change objectives and a policies of sustainable development, CDM involves mitigation projects that generate internationally tradable carbon credits and NAMAs are “an emerging institutional mechanisms, which tries to capture the priority to promote development as a vehicle to address climate change” (Rennkamp & Wlokas, 2012). Therefore, to achieve zero poverty and zero emissions, economic and social development should be low carbon and pro-poor. Achieving zero poverty zero emissions is a complex process and it involves various trade-offs.

2.4.4 Trade-offs

Poverty eradication and equality are achieved through economic development (Wlokas et al. 2012). From history, economic development has been linked to increased emission; two parameters that have resulted in climate change (Wlokas *et al.*, 2012; Granoff *et al.*, 2015). The impacts of climate change have resulted in the urgent need to mitigate emissions (UNFCCC, 2015). This poses a challenge to developing countries that plan to develop yet are expected to reduce their emissions.

The aim to reduce emissions while contributing to poverty reduction and socio-economic development has an impact on developing countries (Wlokas *et al.* 2012). Granoff *et al.*(2015) explain that mitigation in extremely poor countries could have synergies with poverty goals. In order to achieve both, the potential trade-offs need to be better understood so as to achieve the pathway to zero net emission and zero extreme poverty. Understanding the trade-offs involves understanding opportunities that promote low carbon development (Wlokas *et al.* 2012). This is challenging because even if the 2 °C goal is achieved, the impacts of climate change will still pose a challenge on poverty eradication.

This is because as earlier, most poor countries are dependent on climate-driven sectors and Granoff *et al.* (2015) also point out that most communities, ecosystems and production systems are sensitive to the smallest changes in weather and climate. Kenya is one of the developing countries that is affected by the impacts of climate change. The country has prioritised climate change mitigation as well as poverty eradication by 2030.

2.5 Poverty and emissions in Kenya

2.5.1 Structure of poverty in Kenya

Kenya's development efforts since independence have put emphasis on poverty reduction through economic development, provision of basic social services and the creation of employment (Kristjanson *et al.*, 2010; MoPD, 2007). This has not yet been achieved as 45.9% of the population is still living below the national poverty line indicator with 43.4% of the population surviving on less than US\$ 1.25 a day (OPHI, 2016; OPHI, 2013).

The Multidimensional Poverty Index (MPI) is used as an international measure of acute poverty (OPHI, 2016). According to OPHI (2016), 39.9% of the population is poor, that is, they are deprived of one-third of the indicators. OPHI (2013) also illustrates that 33% of the urban population and 51% of the rural population live below the national poverty line. Gakuru & Mathenge (2012) point out that urban poverty is more varied in ways in which income is generated, whereas rural poverty is defined by its common connection to agriculture and land.

Poverty in Kenya has been driven by inequality that is manifested in various dimensions such as inequalities in income levels, inequality in gender bias and unequal access to basic social amenities (Gakuru, 2012; Wlokas *et al.*, 2012). Poverty is also caused by dependency on agriculture (lack of diversity), few job opportunities, corruption and climate change. Nevertheless, other factors that have driven people to poverty are poor health and heavy expenses related to health care and impacts of climate change such as droughts and floods on agricultural land and livestock, crop and livestock diseases, tribal clashes (Mathenge, 2012).

Kristjanson, Mango, Krishna, Radeny & Johnson (2010) explains that the GoK has put in place poverty reduction strategies that have failed due to historical, technical and implementation problems. Moreover, there was a lack of participation by the poor people and thus the strategies did not reflect the concerns of the poor population (Kristjanson *et al.*, 2010). Nevertheless, a certain percentage of the poor population have strived to eradicate poverty through diversification of income sources, formal sectors for employment, crop and livestock diversification, social factors such as assistance from friends and relatives through jobs, providing education/ paying for school fee, provision for housing, provision of capital for businesses and inheritance (Kristjanson *et al.*, 2010). As discussed earlier, in the past, development with the efforts to eradicate poverty has resulted in increased emissions. The case might be similar for Kenya.

2.5.2 Emissions profile in Kenya

As at 2015, the GoK (2015) reports that the total baseline emissions in Kenya are at 80 MtCO₂e... Emissions in Kenya are generally low. Nevertheless, Kenya is a developing country growing at a very fast rate and its emissions are expected to increase. Kenya's historical contribution is less than 0.1% of the total global emissions with its share of global CO₂ emissions from fuel combustion at 0.03% (MENR, 2015; UNFCCC 2014). MENR (2015) explains that Kenya's emissions per capita are 1.26t CO₂ which is less than the global average of 7.58 t CO₂.

In 2015, agricultural sector emitted 32 MtCO₂e (GoK, 2015). UNFCCC (2014) point out that emissions from the agriculture in Kenya are from by enteric fermentation, manure management and the burning of agricultural fields and savannas, rice cultivation and agricultural soils. Mommers (2015) explicates that emissions in agriculture have increased due to increased agricultural land to satisfy the demand of the growing population and the increased use of fertilisers to increase the yield for the growing population.

As at 2015, Land Use, Land Use Change and Forestry (LULUCF) are responsible for 26 MtCO₂e of GHG emissions (GoK, 2015). The land types in Kenya consists of bushlands, farms without trees, farms with trees, mangroves, grasslands, forests, private plantation, public plantation, woodland and settlements and their carbon stock is used to determine

their carbon emissions (Stiebert, 2012). Duraiappah (1998) explains that sustainable deforestation may aid economic development but unsustainable deforestation done in large scale is what leads to deforestation. Duraiappah (1998) explained that the main drivers of deforestation were commercial logging, clearing forests for agriculture/ pastoral due to food insecurity and for firewood to satisfy the basic energy demand.

The energy sector as at 2015 emits 8 MtCO_{2e} of GHG emissions, in which 1 MtCO_{2e} is from electricity generation and 7 MtCO_{2e} is from energy demand (GoK, 2015). UNFCCC (2014) explains that the emissions are from the combustion of renewables and waste, oil, renewable energy (geothermal, wind and solar) and coal. This is expected to change with an increase in the demand for electricity and energy due to the growing population, electricity and energy generation is also expected to increase through hydropower, gas turbines, geothermal, wind and future coal (Stiebert, 2012).

As at 2015, transport in Kenya is through rail, marine, road and aviation and it is responsible for 9 MtCO_{2e} of emissions with the majority of the emissions emanating from road transport (Stiebert, 2012; GoK, 2015). The population of vehicles was 600,000 in 2000 and it doubled to 1,200,00 in 2010 and this is expected to increase with increasing demand (Stiebert 2012). Stiebert (2012) also highlights that transport is the biggest emitter of CO₂. Manufacturing and construction are responsible for 3 MtCO_{2e} of emissions and the main industries involved are cement, charcoal production, soda ash, lime, pulp and paper (Stiebert, 2012; GoK, 2015). Waste is responsible for 2 MtCO_{2e} of GHG emissions in Kenya (GoK, 2015).

Kenya is currently a lower Middle Income Country (MIC) and it is striving to become an industrialised upper middle-income country by 2030 (World Bank, 2016; MENR, 2015). Emissions are expected to increase especially in the energy sector (MENR, 2015). Despite the fact that Kenya contributes to 0.1% of global emissions, the country has prioritised climate change mitigation as a global effort to curb climate change.

2.5.3 Mitigation efforts

Kenya has responded to Climate Change and its predicted impacts by developing a National Climate Change Response Strategy (NCCRS 2010) and a National Climate Change Action

Plan (NCCAP 2013) which promotes low-carbon and climate resilient development (MENR 2015). MENR (2015, p6) also states that “a National Climate Change Framework policy and legislation are in the process of enactment and the climate change action plans and policies to be implemented are such as afforestation and reforestation, geothermal and other clean energy development, climate-smart agriculture, energy efficiency and drought management”.

The National Climate Change Response Strategy (NCCRS, 2013) and NCCAP outline the mitigation action put in place in various sectors. The NCCAP has a mitigation report with detailed mitigation actions according to the various sectors. The National Climate Change Mitigation Action Plan identifies that Kenya’s low carbon development opportunities are in the following sectors; Energy, transport, industrial processes emissions, agriculture, forestry and other land use and waste (GoK, 2013).

Kenya submitted its Intended Nationally Determined Contribution (INDC) in 2015 (MENR, 2015). The country then signed the Paris agreement in April 2016 and they ratified the agreement in December 2016 (UNFCCC, 2016). “The country is currently obligated to abate its GHG emissions by 30% by 2030 relative to the Business As Usual (BAU) scenario” (MENR, 2015, p.2). Emissions from the electricity sector are expected to increase drastically by 2030. This might jeopardise efforts that are put in place by the GoK to reduce emissions by 30% by 2030.

2.5.4 Electricity sector in Kenya

Development and increased population have led to an increased demand for energy and specifically electricity. Stiebert *et al.* (2012) explains that the growth rate of emissions will be greatest from the electricity sector by 2020. The electricity sector in Kenya is diverse and it comprises of a mix of renewable sources (hydropower, geothermal power and a very small portion of wind and solar) and fossil sources (oil, diesel and coal) (Odera, 2016).

60% of the electricity generated is consumed by the industrial and commercial sector and the remaining 40% by the residential consumers (Cameron, Wurtenberger & Stiebert, 2012). With only 29% of Kenya’s population having access to electricity, predominantly the

upper and middle class, the Government of Kenya has a plan to increase electricity generation and improve electricity connection (Langat, 2016; Cameron *et al.*, 2012).

Since 2012, the government has increased electricity generation from geothermal, wind, hydropower and currently coal to meet the growing demand for electricity as a result of increased continued economic development, a growing share of the population gaining access to electricity from the national grid and rural electrification (Cameron *et al.*, 2012; GoK 2013). It is expected that increased demand and increased generation of energy could increase emissions in the energy sector from 10MtCO_{2e} in 2010 to 25MtCO_{2e} in 2030 with emissions from electricity projected to grow from 2.2MtCO_{2e} to 18.4 MtCO_{2e} representing 11% growth rate (GoK, 2013; Cameron *et al.*, 2012).

NCCRS (2010) argues that emissions can be reduced by embracing low-carbon development (LCD). The GoK states that the six low carbon development options for the electricity generation sector are; wind generation expansion, geothermal generation expansion, hydroelectricity expansion, Solar PV, landfill gas generation and clean coal (Cameron *et al.*, 2012). This study focuses on “clean coal” as a low carbon development and whether it achieves emissions reduction and poverty eradication in Kenya. As such, it is necessary to consider the literature on clean coal and its impact on poverty and emissions.

2.6 Clean coal

According to Chikkatur & Sagar (2007), “the availability of, and access to, electricity is a crucial element of modern economies and it helps to pave the way for human development”. Coal being an abundant source of energy with a lower cost than other different fossil fuels has been opted for by most growing economies (Chen & Xu, 2010; Liang, Wang, Z. Zhou, Huang, J. Zhou & Cen, 2013; Franco & Diaz, 2009). Coal presents 70% of the world's fossil fuel resources in 2013, it accounted for 29.6% of global energy consumption (Liang *et al.*, 2013; Franco & Diaz, 2009).

Coal is reported to cause environmental and human health problems (Finkelman & Gross, 1999; Chen & Xu, 2010). Additionally, Menyah & Wolde-Rufael (2010) points out that coal is the major contributor to rising GHG that has resulted in climate change. Coal has played a

role in contributing to climate change. Haines *et al.*, (2007) explains that the world faces unprecedented challenges from anthropogenic climate change that is mainly due to accumulation of GHG from industrialized countries from utilization of fossil fuels. In China, coal is responsible for 90% of the SO₂ emissions, 70% of the dust emissions, 67% of the NO₂ emissions and 70% of the CO₂ emissions whilst in South Africa, coal is responsible for 87% of CO₂ emissions, 94% NO₂ and 96% SO₂ (Chen & Xu, 2010; Menyah & Wolde-Rufael, 2010). The negative impact of coal on the environment and health has compelled countries to opt for alternative sources of electricity generation. Finkelman & Gross (1999) argues that environmental and human health problems from coal can be reduced if those people who make decisions on coal use have accurate and comprehensive information on the quality of coal.

The negative impacts associated with coal have led to the development of technologies that reduce emissions of coal and increase its efficiency. This technology is referred to as Clean Coal Technologies (CCT). Clean coal technology is described by Franco & Diaz (2009) and Chikkatur & Sagar (2007) as the technology that reduces the environmental and health impacts of coal through reduced emissions and increased efficiency. The development of clean coal technology has revived the interest in coal as an energy source (Franco & Diaz, 2009). "Higher efficiency in coal power plants is an important element of energy security because it lowers the cost of electricity and reduces environmental impacts (Chikkatur & Sagar, 2007). Clean coal technologies can be used to reduce the environmental impact of coal as well as improve the utilisation efficiency of coal (Charpentier & Tavoulareas, 1995; Chen & Xu, 2010).

"Clean coal" is one of the mitigation actions outlined by the GoK. The GoK refers to clean coal as a mitigation action in the sense that it will produce "lower carbon" by using an ultra-supercritical coal plant (USC) that allows coal plants to operate at higher temperatures in order to achieve higher efficiencies (Cameron *et al.*, 2012). Franco & Diaz (2009) explains that the three stages to achieve clean coal are through; control and reduction of pollutants (SO₂, NO₂ and mercury (excluding CO₂)), advanced technologies (efficiency pathway) and long-term vision of CO₂ capture and storage (Franco & Diaz, 2009). The GoK scenarios used for this study assume that all coal installed in Kenya uses USC technology rather than

supercritical technology. USC coal power plants are similar to supercritical technology coal power plants but operate at higher temperatures that allow them to achieve five percent efficiency (Cameron et al., 2012). Li & Fan (2008, p.250) refers to the ultra-supercritical condition as “operating steam cycle conditions above 565 °C and pressure of 32 MPa corresponding to an energy conversion efficiency of over 43%”. In China, USC has been reported as the most promising technology that has higher efficiency and lower emissions (Liang *et al.*, 2013). It is for this reason that the GoK proposes clean coal (USC) as a low-carbon development for Kenya.

Although the transfer of environmentally sound technologies in the context of climate change is a really complicated problem, clean coal technologies aim at efficiently converting coal into useful products while controlling CO₂ emissions (Li & Fan, 2008; Karakosta, Doukas & Psarras, 2009). Although it is argued that clean coal controls CO₂ emissions, Geels (2014) argues that introduction of clean coal is an excuse used to resist pressures to address climate change. “Clean coal is viewed as a technological fix for our nation’s “carbon problem” while others view it as nothing more than a corporate greenwashing campaign” (Fitzgerald, 2012, p.438). The debate as to whether clean coal is a means to climate change mitigation is one difficult to tackle. With that understanding of clean coal, it is important to explore literature on the impacts of coal power plant on emissions and poverty.

2.7 Impact of coal power plants on emissions and poverty

Coal means different things to different people. It is viewed as a low-cost fuel that has improved living standards of the poor or as the world's dirtiest fuel that has undermined the livelihood of the poor through climate change impacts (Dornan, 2016). The impact of clean coal on poverty and emissions is complex to understand. Newell, Phillips, Pueyo, Kirumba, Ozor & Urama (2014) explain that it is challenging to transition to a low carbon economy that delivers climate resilience and poverty reduction concurrently.

Historically, coal has been used in the industrialisation and development of certain countries contributing to rapidly increased economic productivity, income levels and employment; nevertheless, the consumption of coal has contributed significantly to global

warming and climate change (Granoff *et al.*, n.d.; Dornan, 2016; Sanzillo, 2016). Climate change has led to discussions necessitating the shift from coal but this has been contested as a result of coal providing poor households with electricity, promoting economic growth through the provision of jobs and improved income especially in developing countries (Granoff *et al.*, n.d.).

It is reported that energy is required for economic growth. The big question however, is whether it is necessary to acquire energy from coal or should other options be sought? Bezdek (n.d.) states that only coal can provide large, reliable and affordable energy to meet the world's need for economic growth to achieve the UN development goal and to reduce energy poverty. Granoff *et al.*, (n.d.) describe that the relationship between economic growth and poverty is very complex because one cannot reduce poverty sustainably without economic growth.

There are countries that have reduced poverty with moderate economic growth. For example, In China, coal has promoted economic growth that may have led to poverty eradication (Chen & Xu, 2010; Granoff *et al.*, n.d.). On the other hand, there are countries that have a rapidly growing economy with little impact on poverty. For example, South Africa's economy is coal and emissions intensive and this has improved its economic growth with more than 90% of the country having access to electricity services. 43% of South Africa, however, is still energy poor and a greater majority can barely afford electricity (Sanzillo, 2016). World Bank further made it clear by stating that coal is not a cure for poverty and instead of coal reducing poverty, it increased the burden of the world's poorest countries as a result of climate change (Goldenberg, 2015; Sanzillo, 2016).

The pragmatic middle ground which acknowledges the urgency for both energy and the devastating impacts of coal has been challenging as coal generated electricity is relatively cheap but highly polluting (Granoff *et al.*, n.d.). Bezdek (n.d.) argues that coal power generation has been improving and it is better and cleaner and with technological advancements, it is expected to get better considering that from 1970, coal power generation has improved efficiency by 170% with emissions-reducing by 90%. Coal Industry Advisory Board (2014) also explains that coal power plants have evolved and are

more efficient with reduced emissions, unlike prior technologies. Although clean coal reduces emissions of SO₂ and NO₂ by 50 to 99 percent, CO₂ cannot be reduced by clean technologies (Charpentier & Tavoulareas, 1995). Steynberg & Nel (2004) report that one fact that cannot be avoided is that every tonne of carbon in mined coal will sooner or later end up as 3.67 tonnes of carbon dioxide in the atmosphere.

World Coal Association (2013) and Bezdek (n.d.) explains that 80% of the world's energy is from fossil fuels and coal currently provides 40% of the world's electricity needs and it has been the fastest growing source of energy driving many economies: Coal power generation has been one of the most successful poverty alleviation strategies. In China, coal has provided 99% of its population access to the national electricity grid lifting the 662million of its population above the poverty line while in South Africa and India, electricity generated from coal is expected to improve the lives and address poverty (World Coal Association, 2013). Granoff *et al.* (n.d.) debate that the link between energy from coal and economic development is not always direct. Granoff *et al.* (n.d.) argue that in China, poverty reduction is associated with economic growth gained from coal power generation while in actual sense poverty alleviation was a result of the growing agriculture sector.

Poor nations need to develop but a coal power plant for generation of electricity has negative environmental and social impacts that can damage the prospects of economic development and jeopardise any efforts for poverty eradication (Granoff *et al.*, n.d.). In India, coal power generation has resulted in air pollution, pollution of local water streams, rivers and groundwater from effluent discharges, noise pollution during operation and degradation of land used for storing fly-ash (Chikkatur & Sagar, 2007). In India, particulate emissions have resulted in respiratory problems(asthma, bronchitis, decreased lung function and premature death) (Chikkatur & Sagar, 2007).The situation is similar in China. In China, the coal power plants have resulted in local air pollution that has resulted in acid rain, ecological damage and health complications (Chen & Xu, 2010; Liang *et al.*, 2013).

In the past, coal power plants were viable because the economies could absorb the financial and environmental costs but that is not the case in the current economy as it is economically and environmentally dysfunctional as a result of high pollution (Sanzillo,

2016). Granoff *et al.* (n.d.) contend that there are numerous substitutes to coal power that are cost competitive and have little impact on health and the environment. Renewable energy is suggested as a better alternative to coal power plants.

Renewable energy such as solar and the wind, once installed, have almost zero marginal costs for generating electricity and they have little impact on the environment and health, therefore, boosting economic growth rather than hindering it (Granoff *et al.*, n.d.). Granoff *et al.* (n.d.) also claim that the use of other alternatives such as biogas and natural gases reduce emissions from industries such as steel and cement, which are growing industries in Kenya, reducing climate change and its impacts. Renewable energy has economic benefits with minimal economic, political and environmental risks (Wei, Patadia, & Kammen, 2010).

Current technology allows renewable energy from solar, wind, biomass, geothermal and ocean energy to supply enough energy to meet the growing demand (Granoff *et al.*, n.d.). Nonetheless, the demand for electricity is growing and there is currently a backlog in access to energy and coal can address this challenge as for every individual who gained access to electricity from solar or wind, 13 other individuals gained access to electricity from coal (Bezdek, n.d.). This potentially means that coal is opted for as a source of energy contrary to renewable energy due to its electricity generating potential.

There has been a great debate as to whether coal is a driver of poverty or rather it provides cheaper electricity that benefits the poor. Goldenberg (2015) illuminates that coal is a cheaper option for electricity; however, it has a social and environmental cost and the burden is mostly carried by the poor. Clean energy is targeted as an investment opportunity for both economic and environmental option reasons (Wei *et al.*, 2010). According to literature, it is evident that clean coal as a Poverty Alleviating Mitigation Action (PAMA) is quite controversial. The PAMA's framework is explored as it is in this context that this study is based.

2.8 Poverty Alleviating Mitigation Actions (PAMAs)

PAMAs is a framework that “allows for a more conceptual and practical debate about how to combine efforts to reduce emissions and improve people’s livelihoods at the same time”

and it looks at mitigation actions from a poverty perspective (Table 2-1) (Rennkamp & Wlokas, 2012, p.3; Wlokas *et al.* 2012). Rennkamp & Wlokas (2012) explain that PAMAs help in focusing the attention in the policy planning process on mitigation and poverty and they also identify and inform on the trade-offs in choosing mitigation actions. According to this, it appears that it is possible to eradicate poverty through embracing mitigation intervention as opportunities.

Poverty and mitigation are perceived as conflicting public policy objectives and it is difficult to implement both as it means a change in the economy and distribution of wealth (Rennkamp & Wlokas, 2012). Nevertheless, PAMAs assist in rethinking and redesigning mitigation actions to find opportunities to convert mitigation actions and conventional actions to PAMAs and this involves not only one intervention rather a series/ combination of interventions (Rennkamp & Wlokas, 2012)

In the PAMA typology, there are four ideal types of PAMA as seen in the figure below

Table 2-1: PAMA framework (Adopted from Wlokas *et al.*, 2012)

TYPOLOGY		Poverty alleviation potential	
		High	Low
GHG Reduction Potential	High	<p>Type 1: Poverty alleviating mitigation action</p> <p>Poverty driven mitigation action?</p>	<p>Type 2: Conventional mitigation action, with no explicit focus on poverty (and possible opportunity cost</p> <p>Climate-driven mitigation action?</p>
	Low	<p>Type 3: Conventional action for poverty alleviation, with no explicit focus on reducing emissions (and possible increase in emissions).</p> <p>Non climate driven poverty action?</p>	<p>Type 4: Failed/low impact mitigation action, failed poverty action, conventional industrial/economic/ environmental policy without explicit focus on mitigation and poverty (this will surely partly depend on the scale and cost of the action in terms of what impact it can achieve)</p>

Rennkamp & Wlokas (2012) and Wlokas *et al.* (2012) explain the four types of interventions/ actions illustrated in the table above as follows:

Type 1: Poverty-alleviating mitigation actions- The objective of these interventions is to reduce poverty and emissions at the same through a single or a combination of interventions to reduce emissions in a pro-poor way.

Type 2: Conventional mitigation actions- The objective of these interventions is to reduce emissions without considering poverty reduction; it is focused on mitigation with no pro-poor incentives.

Type 3: Conventional actions from poverty alleviation-These interventions are pro-poor and their primary objective is poverty alleviation with insignificant mitigation potential.

Type 4: Failed (mitigation) action- These interventions neither reduce poverty nor emissions.

2.9 The gap

Efficient/ clean coal is a strategy that the Government of Kenya has incorporated as one of the mitigation strategies towards achieving low carbon development.

However, an efficient coal power plant is questionable as to whether it can concurrently contribute to fuelling a low emissions intensive economy and reduce poverty. The aim of this study is to determine whether clean coal as a mitigation action promotes a pro-poor, low carbon development pathway.

Chapter 3: Methodology

3.1 Introduction

This chapter describes the methodology used to collect and analyse data for this research. This study adopted a qualitative approach to resolve the argument as to whether the proposed Lamu coal power plant is a low carbon, pro-poor development through the appreciation of existing literature. This study concentrated on identifying whether there is a relationship between emissions and poverty in Kenya, identifying whether Lamu coal power plant promotes a low carbon pro-poor development pathway and finally, understanding the rationale for and against the proposed Lamu coal power plant.

This chapter gives a geographical and demographics background of the research area so as to familiarize the reader with the study area. It further provides the particulars of the methods used to collect data, the framework for data analysis and finally the limitations of the methodology that was used. This chapter is approached in a highly structured way that is based on the data analysis framework that is in line with the objectives of this study (Figure 3-1).

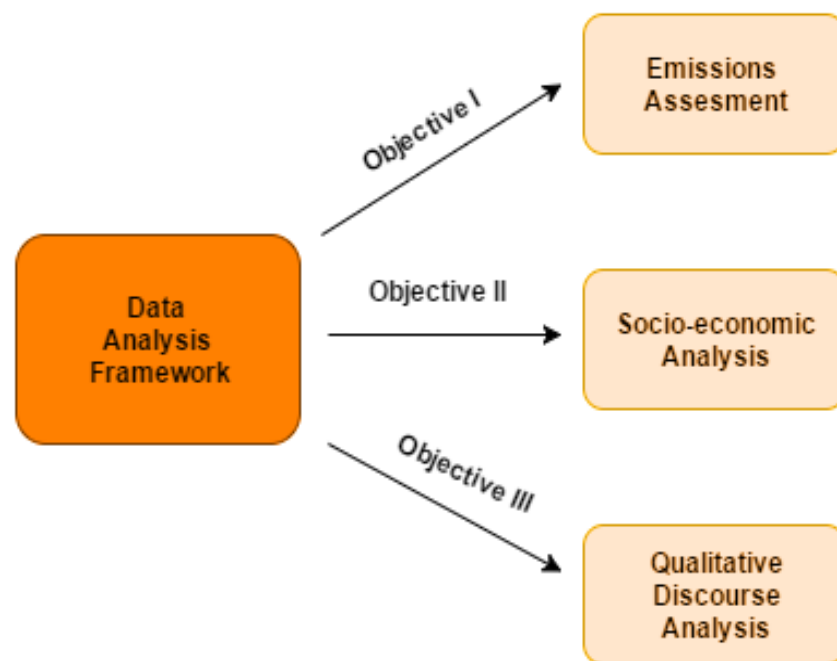


Figure 3-1: Data analysis framework (Source: Author)

3.2 Study area

Kenya is a country located in the Eastern part of Africa. It is divided into 47 counties, with Nairobi as its capital city (KNBS, 2015). It is bordered by Ethiopia to the North, Somalia to the North East, the Indian Ocean to the East, Tanzania to the South, Uganda to the west and Sudan to the North West and it lies between the latitude of 4.5°N and 4.5°S and longitude of 34°E and 42°E(KNBS, 2015).

Kenya covers a total surface area of 591,971 square kilometres, in which 11,362 square kilometres is covered by water and 580,609 square kilometres of land supporting a population of 42,961,187, consisting of 21,289,752(49.6%) male and 21, 671,435(50.4%) female (KNBS, 2015). The population density is 78 people per kilometre squared and the population is projected to increase to 97,173,000 people by 2050 which is more than double the current population (AfDB 2014). Kenya's GDP was 55.101 billion USD in 2013, 61.395 billion USD in 2014 and 63.398 billion USD in 2015 with the GDP growth rate at 5.687% in 2013 which dropped to 5.328% in 2014 and increase in 2015 to 5.574% and it is projected to increase to 5.9% in 2016(World Bank, 2015).

The Kenyan government proposes to build a multi-billion dollar coal power plant in Lamu (Figure 3-2). Lamu is situated in Lamu County, 02°09'13"S latitude and 40°54'12"E longitude along Kenya's Indian Ocean coast (UNESCO, n.d.). The Coal Power plant is to be constructed on 350 hectares of land in Kwasasi village which is located 21 km north of Lamu (EJAtlas, 2016; Kurrent Technologies, 2016; Langat, 2016; Njoroge, 2016).

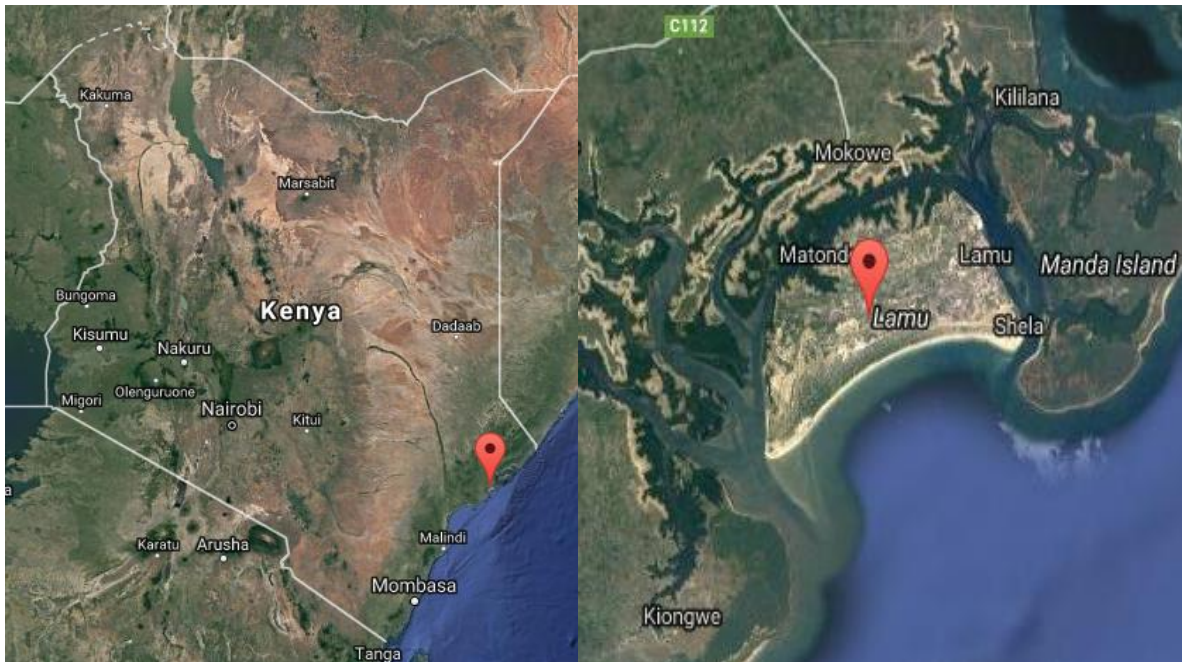


Figure 3-2: Proposed location for Lamu Coal Power Station (Google Maps, 2016)

Lamu is the oldest and most preserved Swahili settlement in East Africa and it is listed by UNESCO as a world heritage site as it has preserved its cultural and social integrity while retaining its authentic building fabric (Langat, 2016; UNESCO, n.d.). The town is built in mangrove timber and coral stone with verandas, courtyards and carved wooden doors (UNESCO, n.d.). The town has been significant for the study of Swahili and Islamic culture and it has retained its traditional functions (UNESCO, n.d.). UNESCO (n.d) explains that up to date, Lamu has succeeded in sustaining their traditional values as a result of social unity and cohesion. Infrastructure and industrial development in the past have been considered as a threat to Lamu's integrity and this resulted in the existence of a conservation plan for Lamu Old Town to monitor and create a balance between the community needs for the development and sustenance of the architectural values of the town (UNESCO, n.d.).

The description above familiarised the reader to the study area. The following sections will explore the methods used to collect and analyse data, as well as provide the reader with a brief description of the opportunities and limitations encountered whilst collecting data for the study.

3.3 Emissions analysis

The purpose of emissions assessment was to identify the trend in emissions in Kenya as well as to determine whether there is a relationship between emissions and poverty in Kenya (Objective I). The relationship between emissions and poverty was determined by calculating the correlation coefficient. The purpose of the correlation coefficient is to quantify the extent and degree to which energy and poverty are related. The trend in emissions (past and future) in the various sectors in Kenya was established. Subsequently, the relationship between emissions and poverty was determined by comparing the trend in emissions to trends in Gross Domestic Product (GDP), Human Development Index (HDI) and GINI Index in Kenya.

GDP was used as an indicator of poverty based on Hull (2009) study that indicated that economic growth translates into a reduction of poverty and that a change in GDP translates into a corresponding change in poverty. HDI was also used as an indicator of poverty based on OPHI (2016) explanation that poverty is multidimensional and it not only looks at income deprivation but also deprivations in living standards, health and education. HDI was used as it is an average of key human development dimensions such as a long and healthy life, being knowledgeable and having a decent standard of living (United Nations Development Programme, 2015). Additionally, GINI index was used as an indicator of poverty based on Gakuru (2012) who points out that poverty in Kenya is driven by inequality. Gastwirth (1972) defined GINI index is defined as the best single measure of inequality. This study aimed at establishing a trend in development/ poverty in the past. MPI data was limited to two years rendering it difficult to establish a trend (OPHI, 2013; OPHI, 2016).

3.3.1 Data collection

The nature of data required in achieving Objective I of this study necessitated the use of secondary sources for data collection. Data was collected from the following sources:

- i. World Development Indicators- World Data Bank (Appendices I and Appendix IV)
- ii. Kenya's Second National Communication (SNC) (Appendix II)
- iii. United Nations Development Programme Development Report (Appendix III)

3.3.2 Data analysis

First, a graph was plotted to determine emission trends from electricity generating sector vis-à-vis emissions from other sectors. A graph was plotted to illustrate the past and predicted (business as usual scenario) GHG emissions from the various sectors in Kenya (Data in Appendix II).

Second, the trend in GDP was compared to total baseline GHG emissions in Kenya. A scattered line graph was plotted to determine whether there is a relationship between emissions and GDP in Kenya (data in Appendix I and II). The correlation coefficient was then computed to determine the extent of relationship between emissions and economic growth.

Third, the trend in emissions was also compared to the trend in HDI as it also a measure of development. A scattered line graph between total GHG emissions (Data in Appendix II) and HDI (Data in Appendix III) was plotted to determine the relationship between emissions and HDI. In addition, the correlation coefficient was computed to understand the degree of the relationship between emissions and HDI in Kenya.

Finally, the trend in emissions was also compared to GINI Index. Microsoft Excel 2010 was used to plot a scattered line graph to determine the link between total GHG emissions (data in Appendix II) and GINI Index (data in Appendix IV). The correlation coefficient was also computed to determine the extent of the relationship between emissions and inequality in Kenya.

3.3.3 Opportunities and limitations

The limitations of emissions analysis are majorly due to the scarcity of data. The data that was used for emissions and GDP were available and reliable while those for HDI and GINI were limited to a few years.

3.4 Socio-economic analysis

Socio-economic analysis investigated the social, environmental and economic consequences that would be derived from the development of the proposed Lamu coal power plant and whether it is a pro-poor low carbon development (Objective II). The

analysis focused on cost, environmental benefits and socio-economic benefits.

3.4.1 Data collection

This analysis was achieved by comparing the outcome of studies that were previously carried out. The data was collected from;

- i. Kenya's National Climate Change Action Plan- Electricity sector mitigation report
- ii. Kenya's power generation and transmissions Master Plan- Ministry of Energy and Petroleum
- iii. Future of Kenyan Electricity Generation – An individual study

3.4.2 Data analysis

Environmental, social and economic consequences were derived by comparing two studies. One of the studies was carried out by the GoK to determine the development consequences of clean coal as a low carbon development (Cameron *et al.*, 2012). The other study was carried out by the Ministry of Energy and Petroleum (MoEP) to determine the benefits of proposed generational mix for electricity in Kenya (MoEP, 2016). The findings from the two studies were used to derive environmental, social and economic consequences of Lamu coal power plant.

The cost of coal as a source of electricity generation was determined by comparing two studies. The first study was an economic assessment carried out by MoEP to evaluate the cost per unit of electricity that is produced by different sources (MoEP, 2016). The second study was carried out by Torrie (2014) to identify the economic potential of the different electricity sources in Kenya. The findings from the two studies were used to understand the cost of coal.

3.4.3 Opportunities and limitations

The time allocated for the completion of this research was also limited to one year. As a consequence, there was insufficient time to carry out complex analysis. Nevertheless, socio-economic analysis utilised information from studies that were carried out by the Government of Kenya. The studies used to derive the cost and socio-economic consequences for this research are, therefore, reliable.

3.5 Discourse analysis

A qualitative discourse analysis, which was the main analysis for this study, was carried out to understand the rationale for and against Lamu coal power plant (Objective III). The discourse analysis was the main analysis of this study as it presented the rationale for and against Lamu Coal Power Plant from all key stakeholders (government, project proponent, local community and environmentalist). The purpose was to extract climate and development discourse between supporters and opponents of the plant.

3.5.1 Data collection

Data was collected from the following secondary data sources; Environmental and Social Impact Assessment Report (Public Participation Chapter), Newspaper articles (from the Daily Nation, the Business Daily (Kenya), The Nation (Kenya), East Africa Business Week (Uganda), The Star (Kenya), Business Day (South Africa), The Christian Science Monitor, The Guardian, Korea Herald, The Mercury (South Africa), Palestine News and Information Agency (WAFA), Newswires, web-based publications and company directories.

After reviewing 108 secondary data sources, the sources were narrowed down based on Objective III. The data from 22 sources was selected. The secondary data selected was used for data analysis (Appendix V).

3.5.2 Data analysis

The data from 22 selected sources (Appendix V) were analysed using the Miles & Huberman (1994) approach of qualitative research analysis whereby data was reduced through first level coding and second level coding. The data from the 22 sources was colour coded with a focus on identifying text that was related to the research objectives. The colour coded text went through two levels of coding; first, the colour codes were identified, sorted and categorised to different codes and finally, the categorised codes were used to identify seven themes that are explained in detail in Chapter five.

3.5.3 Opportunities and limitations

The discourse analysis used some data from articles and blogs that may be unreliable and biased. In spite of this, Jones & Alony (2008) explain that blogs play a role as a valuable

source of data as it provides convenient and accessible data that is codified, the information has richness and depth as the writer exercises the freedom of expression and the information is usually unbiased by research processes.

Chapter 4: Analysis

This chapter presents the analysis that assists in answering the main study question of whether Kenya can remain low carbon and prosper as it is in this context that this study is implemented. This chapter reviews the argument whether clean coal in Kenya promotes climate change mitigation as well as poverty eradication. This chapter presents the finding and analysis of this study and it is structured based on the data analysis framework (Figure 4-1). First, the analysis will reveal whether there is a relationship between emissions and poverty in Kenya. Second, the analysis will identify the social, environmental and economic consequences of clean coal as a low carbon development. Third, the analysis will point out the themes identified from the discourse analysis that aimed in understanding the rationale for “clean coal” as a development.

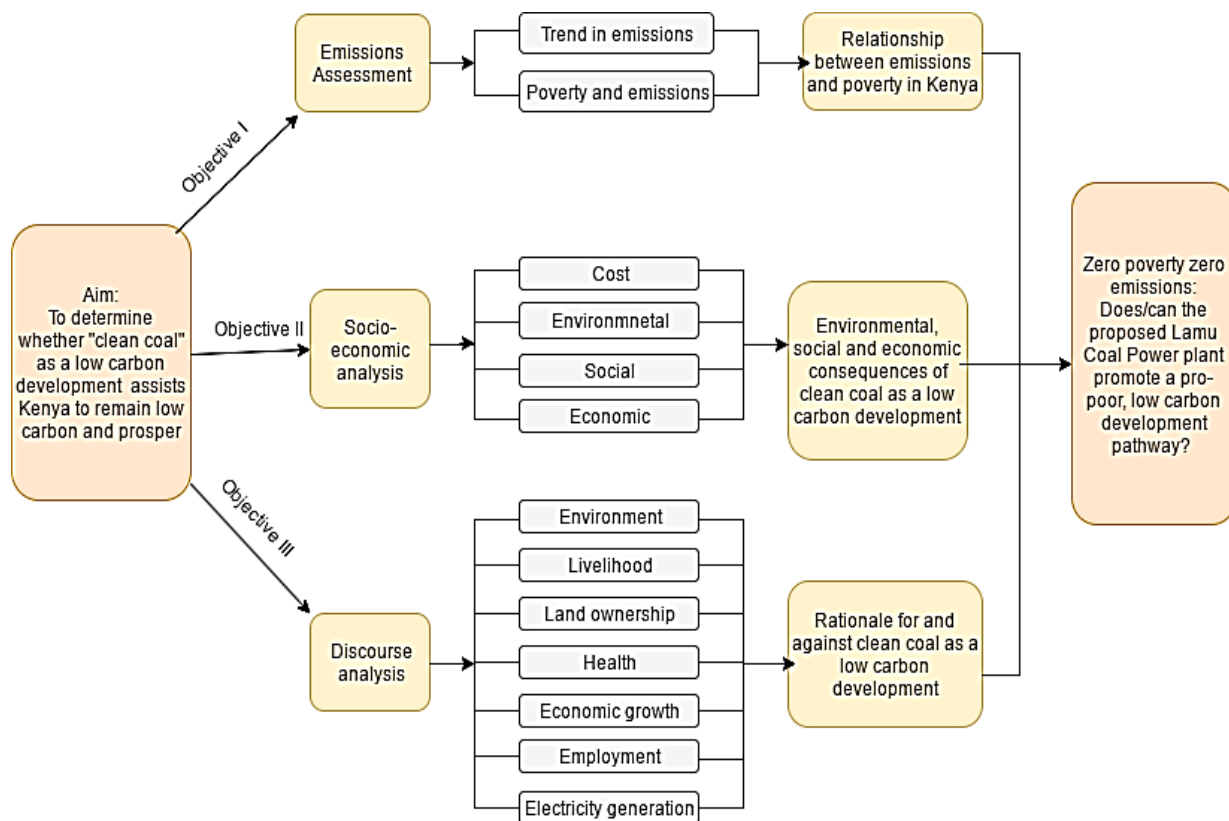


Figure 4-1: Conceptual framework (Source: Author)

4.1 Emissions assessment

The GoK has put efforts to eradicate extreme poverty in Kenya through promoting economic growth as well as promoting equality (UN, 2015; MoPD, 2007). The country plans to improve its economic growth and intends to improve from a lower middle-income country to an industrialised middle-income country by 2030 (MENR, 2015; World Bank, 2016). Due to the fact that in the past development has been directly linked to increased emissions, Kenya is faced with the challenge of mitigating climate change without compromising her social and economic development. The emissions analysis was carried out to achieve objective I which was to establish whether there is a link between poverty and emissions in Kenya. This analysis also determined emissions in the various sectors in Kenya.

4.1.1 Trends in emissions in Kenya

Kenya contributes to 0.1% of global emission. These emissions are expected to increase considering the fact that the GoK plans to transform from a lower-middle income country to an industrialised middle-income country. The GoK (2015) argues that in order to achieve economic growth and for its citizens to have better quality of life, reliable and adequate energy supply is required. The GoK plans to introduce “clean coal” to its electricity generational mix therefore contributing to approximately 55% of Kenya’s power production measured by today’s installed generating capacity (GoK, 2015). Coal is the major contributor to rising GHG that has resulted in climate change (Menyah & Wolde-Rufael, 2010). This could mean that with Kenya developing a coal power plant, it’s emissions from electricity generation are expected to increase.

The purpose of the analysis was, therefore, to determine emission trends from electricity generating sector vis-à-vis emissions from other sectors in Kenya. The analysis shows that emissions from the electricity generation sector are generally low between 1995 and 2015; however, between 2015 and 2030, the emissions drastically increase (Figure 4-2). According to Cameron *et al.* (2012), as from 2015, the GoK plans to introduce coal and increase the capacity of hydropower, medium-speed diesel (MSD), gas turbines, geothermal and wind technology for electricity generation. The above mentioned technologies are projected to contribute to the drastic increase in emissions (Cameron *et al.* 2012). Emissions from the other sectors, except land use, land use change and forestry

(LULUCF), are expected to increase. The trend in emissions in Kenya is constant with Heil & Selden (2001) who predicted that by 2025-2100, emissions from low- and lower-middle-income countries are expected to increase and in some cases double as a result of rapid GDP growth. This perhaps means that if Kenya fails to reduce its emissions, especially in the electricity generation sector, its efforts to mitigate climate change will not be achieved. In addition to that, the electricity generation sector should integrate cleaner options to reduce emissions (Li & Fan, 2008). Renewable energy is suggested by Li & Fan (2008) as cleaner options that assist in reducing anthropogenic CO₂ and thus reduce global warming.

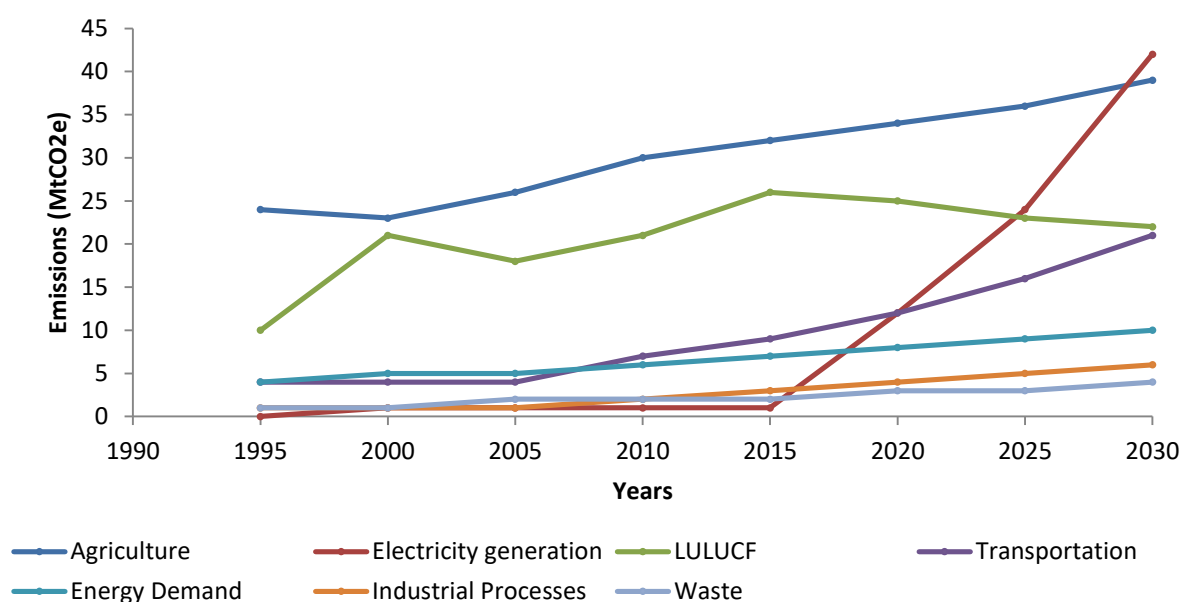


Figure 4-2: Emissions from the different sectors in Kenya (Source: Author)

4.1.2 Link between emissions and GDP

GDP was used as an indicator of poverty based on Hull (2009) study that indicated that economic growth translates into a reduction of poverty. According to Hull (2009), a change in GDP translates into a corresponding change in poverty. The trend in GDP and the trend in total GHG emissions in Kenya were linked to determine whether a relationship exists.

The analysis established that there is possibly a positive correlation between CO₂ emissions and GDP in Kenya (Figure 4-3). The correlation coefficient of the relationship between emissions and GDP is 0.96. This potentially means that an increase in economic growth in the past may have resulted in an increase in emissions. According to Raupach *et al.* (2007),

an increase in GDP is one of the main factors that have resulted in the growth of global emissions since 2000. This may be consistent with the case in Kenya. The findings suggest that economic growth has likely resulted in an increase in GHG emissions. If Kenya fails to incorporate a low carbon development pathway, there is the likelihood that with a growing economy, its emissions are expected to increase.

In line with Heil & Selden (2001) explanation on developing countries need to change their CO₂-GDP trajectory to curb climate change, the case is similar for Kenya. This means that to curb climate change, Kenya as a developing country plays a role in reducing emissions while developing.

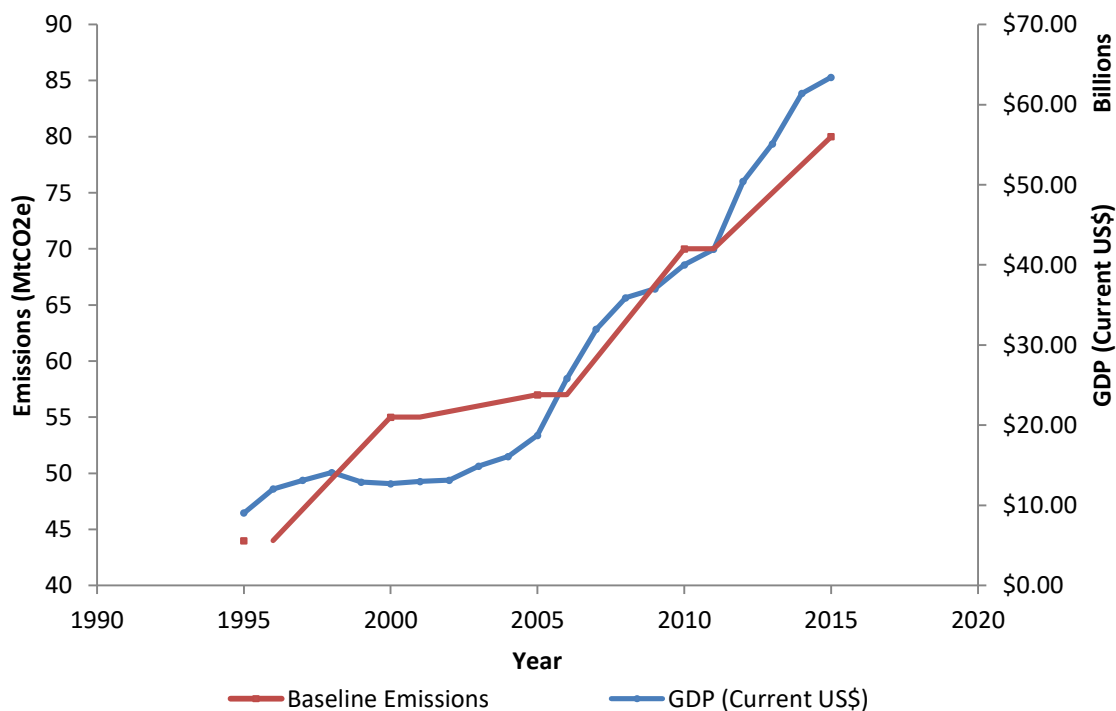


Figure 4-3: Link between total GHG emissions and GDP in Kenya (Source: Author)

4.1.3 Link between emissions and HDI

The trend in emissions was also compared to the trend in Human Development Index (HDI) as it also a measure of development. HDI is defined as “a summary of average achievements in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living” (United Nations Development Programme, 2015).

Poverty is multidimensional and it not only looks at income deprivation but also deprivations in living standards, health and education (OPHI, 2016).

The analysis demonstrated that there is a positive correlation between emissions and HDI (Figure 4-4). The correlation coefficient of the relationship between emissions and HDI is 0.98. This potentially means that as Human Development Index improve, emissions increase. There is a likelihood that efforts put in place to improve HDI may lead to an increase in emissions. This is consistent with a study conducted by Spierre, Seager & Selinger (2010) in which they suggested that a country cannot improve its HDI beyond a certain threshold without increasing the quantity of CO₂ it emits. There is a likelihood that in the past, improvement in HDI in Kenya has resulted in increased emissions. This potentially means that efforts put in place to eradicate poverty through improvement of HDI may result in increased emissions.

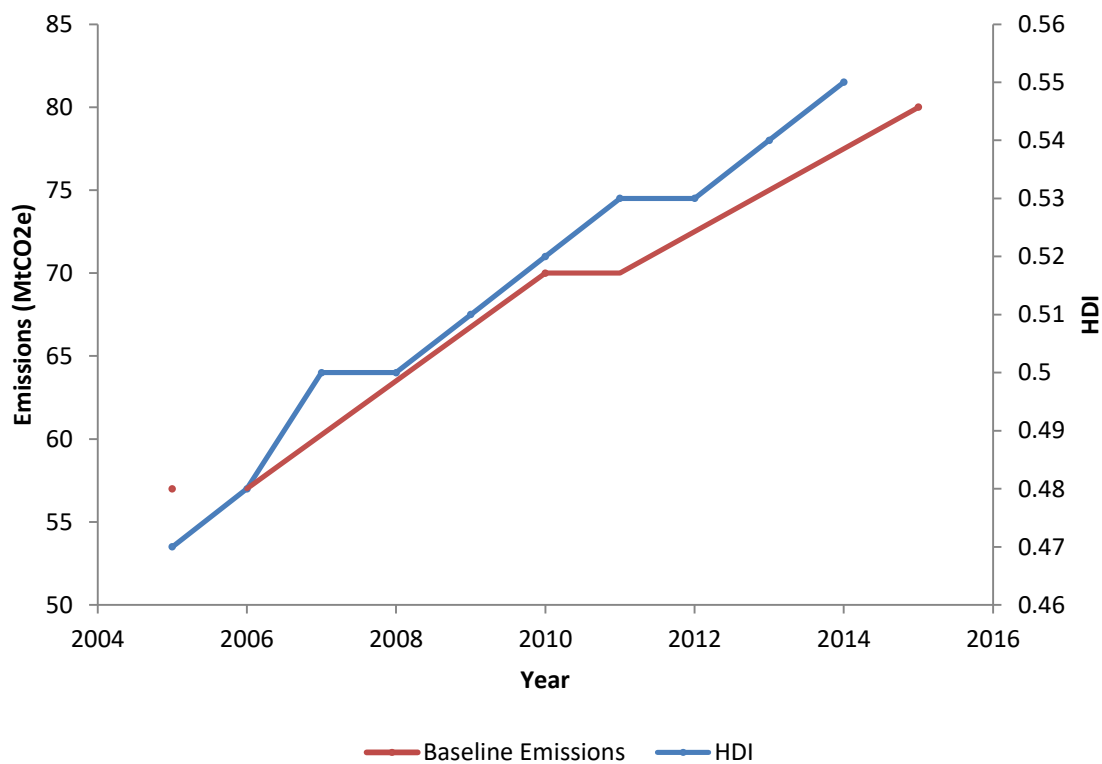


Figure 4-4: Link between GHG emissions and HDI in Kenya (Source: Author)

4.1.4 Link between emissions and GINI Index

Finally, the trend in emissions was also compared to GINI Index. Gastwirth (1972) defined GINI Index as the best single measure of inequality. According to Gakuru (2012), poverty in Kenya is driven by inequality. Hence, in order for the GoK to tackle poverty effectively, they have to address inequality. This study looked at the relationship between emissions and inequality based on Gakuru (2012) who reports that poverty in Kenya is driven by inequality.

The analysis showed that there is possibly a weak positive relationship between emissions and GINI index in Kenya (Figure 4-5). The correlation coefficient of the relationship between emissions and GINI Index is 0.44. This means that as inequality increases there may be an increase in emissions. Heil & Selden (2001) findings suggest that inequality and distribution of income play a role in mitigating emissions. This potentially means that a trade-off possibly exists between achieving economic and social equality and climate change mitigation. Moreover, since the findings suggest that there could be a relationship between emissions and economic growth, we could argue that as economic growth improves in Kenya it may lead to increase in inequality. The GoK (2015, p.2) similarly state that “The economic gains in Kenya have largely benefited the wealthiest quantile contributing to the economic and social gap (inequality) that exists, with greater disparities between the urban and rural”. It seems that in Kenya, economic growth has benefited the rich more than it has benefited the poor. Similarly, the GoK (2015) highlight that despite the efforts by the GoK to eradicate poverty through economic growth, the poor continue to lack critical and basic services such as access to water, access to health care and education.

On the evidence available, it reasonable to assume that economic growth in Kenya doesn't necessarily mean that there is poverty reduction. Increased inequality is also evident

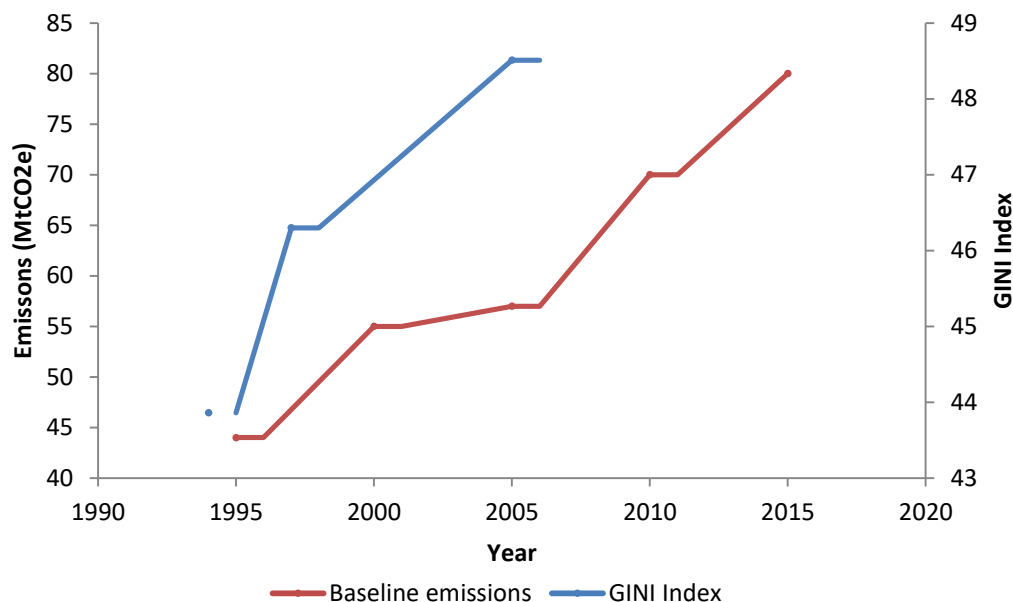


Figure 4-5: Link between emissions and GINI Index in Kenya (Source: Author)

4.1.5 Conclusion

The findings from the emissions analysis point out that emission from the various sectors in Kenya are expected to increase based on the trends that have been presented. Emissions from the electricity generation sector are expected to drastically increase likely due to emissions from the proposed coal power plant. The analysis suggests that there might be a relationship between emissions and poverty in Kenya. This means that the efforts to improve economic growth (GDP) and HDI may have possibly resulted in increased emissions. The analysis also suggests that there might be a possibility that inequality in Kenya potentially increases with increase in emissions. It is reasonable to assume that the benefits of economic and social development are not equally distributed in Kenya. It is plausible that increased economic development in Kenya may have resulted in increased emissions. Then again, due to increasing inequality, increasing economic development may unlikely have an impact on poverty eradication.

4.2 Socio-economic analysis

Clean coal was proposed as a low-carbon technology by the GoK. The GoK refers to it as clean coal in the sense that it will produce “lower carbon” by developing a ultra-

supercritical coal plant (USC) that allows coal plants to operate at higher temperatures in order to achieve higher efficiencies (Cameron *et al.*, 2012).

This study focused on identifying the developmental benefits of clean coal and whether it promotes emissions and poverty reduction (objective II). The findings were based on emissions, environmental and socio-economic development benefits and cost.

4.2.1 Environmental, social and economic consequences of clean coal

The analysis identified the environmental, social and economic benefits by comparing two studies that were carried out by different ministries in the GoK.

First, a study was carried out by the Government of Kenya to “determine the development benefits of clean coal and other low-carbon development options in the electricity sector in Kenya” (Cameron *et al.*, 2012, p.23). Cameron *et al.* (2012) further explain that “the development benefits were qualitatively described and tested with various stakeholders at workshops, expert panels and individual interviews”. The findings are presented in Figure 4-6.

	Climate		Development			Environment
	Abatement potential 2030 (Mt CO ₂)	Abatement cost 2030 (USD/ tCO ₂)	Energy security	GDP growth	Employment	Environmental Impacts
Clean coal (USC)	1.1	11.1	Neutral	Positive	Neutral	Negative

Figure 4-6: “Overview of development benefits of low-carbon options in the electricity sector”
(Adapted from Cameron et al., 2012, p.23)

Secondly, a study was also carried out by the Ministry of Energy and Petroleum (MoEP) to determine benefits of the proposed future generational mix for electricity in Kenya. The MoEP carried out a prioritisation assessment by means of a PESTEL analysis from qualitative data that was collected and analysed (MoEP, 2016). The PESTEL framework provides a comprehensive list of influences on the possible failures or successes of projects. The acronym PESTEL covers the following forces:

P-Political forces (Power plants operating behaviour)

E- Economic forces (exploits economies of scale, cost)

S-Social forces (Compensation or resettlement issues)

T- Technological forces

E-Environmental forces (direct environmental impacts)

L-Legal forces (contracts, tendering process, secured funding and land use rights)

The findings are illustrated in table 4-1 below.

Table 4-1: PESTEL evaluation of coal powered plants (Adapted from MoEP, 2016)

	Power plant name	Net Capacity Addition (MW)	P	E	S	T	E	L
1	Lamu Coal Plant- Unit 1	327	+	+	--	0	--	-
2	Lamu Coal Plant- Unit 2	327	+	+	--	0	--	-
3	Lamu Coal Plant- Unit 3	327	+	+	--	0	--	-

++ very good + good 0 satisfactory - sufficient -- insufficient

The analysis from the two studies recognised the economic, environmental, social, technological, legal and political consequences of clean coal as a low carbon development.

The analysis established that clean coal contributes to the overall economic growth of a country with minor impact on employment opportunities. This potentially means that clean coal has a positive impact on the GDP but little to no impact on employment and/or reduction of poverty. Historically, coal has been used in the industrialisation and development of certain countries contributing to rapidly increased economic productivity, income levels and employment (Granoff *et al.*, n.d.; Dornan, 2016; Sanzillo, 2016). This scenario could be similar to that in Kenya. According to Bezdek (n.d.), coal is the only source of energy capable of providing large, reliable and affordable energy to meet the world's need for economic growth to achieve the UN development goal and to reduce energy poverty. It seems that clean coal has the potential to assist Kenya to move from a lower-middle income country to an industrialised middle-income country; however, whether clean coal aids in the eradication of poverty is yet to be established.

The analysis also established that clean coal has a negative impact on the environment and social aspect. There is the likelihood that pollution from clean coal on the environment might result in social impacts. This is similar in India whereby coal power plant has resulted in environmental and social impacts (Chikkatur & Sagar, 2007). The literature points out that environmental and social impacts derived from coal in the past have resulted in the urgent need to move into alternative sources of energy. Kenya needs to understand the social and environmental impacts vis-à-vis economic benefits before the proposed clean coal project is developed.

The analysis also highlighted that the study revealed that the technology selected for the development of Lamu coal power plant is satisfactory. This potentially means that the technology selected will not mitigate all the social and environmental impacts of clean coal. The GoK intends to invest in USC which is argued to have lower GHG emissions than less-efficient coal-fired power generation (Cameron *et al.*, 2012). Despite the fact that it has lower GHG emissions, USC still generates local air pollution through emissions of sulphur dioxide and nitrous oxide thus having a negative environmental impact. Although the study revealed that the USC technology in Kenya is satisfactory, Liang *et al.* (2013) argue that USC is the most promising technology that achieves higher efficiency and lower emissions.

4.2.2 Cost of clean coal

The low cost of coal is one of the reasons why growing economies opt for it to generate electricity. The purpose of this analysis was to establish the cost of clean coal.

The MoEP carried out an economic assessment to evaluate the cost per unit of electricity produced in Kenya by different sources using the concept of Levelised Cost of Electricity (LCOE) (MoEP, 2016). Renewable Energy Advisors (2015) define LCOE as “The primary metrics for the cost of electricity produced by a generator and it is calculated by accounting for all of a systems expected lifetime costs (including construction, financing, fuel, maintenance, taxes, insurance and incentives) which are divided by the systems lifetime expected power output (kWh)”. The findings are presented in Figure 4-7 below.

The figure presents the LCOE of different technologies based on varying discount rates that are used to convert the future economic value of the different technologies into present economic value (MoEP, 2016). The LCOE of Lamu Coal Power Plant increases with increase in discount rates. The LCOE of Lamu Coal Power Plant is higher than geothermal, wind and natural gas.

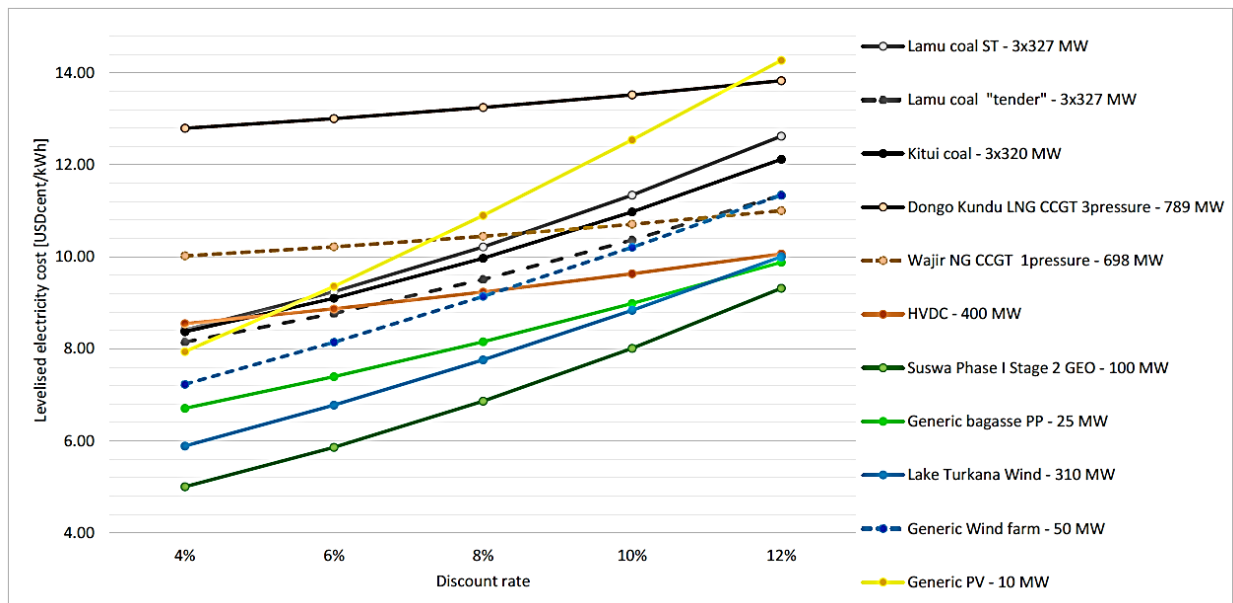


Figure 4-7: LCOE as a function of discount rates for various electricity generation options in Kenya (MoEP, 2016)

The above study was compared to a study that was carried out by Torrie (2014) to identify the economic potential of eight (coal, geothermal, solar, wind, nuclear, biomass, diesel and gas) electricity sources in Kenya. The findings are presented in Table 4-2 below.

Table 4-2: Cost of generating electricity in Kenya based on LCOE (Adopted from Torrie, 2014)

	Low Scenario	High Scenario	Carbon Tax (\$30)
Wind	\$0.08	\$0.11	\$0.11
Nuclear	\$0.08	\$0.12	\$0.12
Biomass	\$0.11	\$0.13	\$0.13
PV Thin film	\$0.10	\$0.14	\$0.14
Geothermal	\$0.13	\$0.17	\$0.17
Gas Combined Cycle	\$0.12	\$0.14	\$5.57
Coal	\$0.12	\$0.17	\$9.96
Solar Thermal	\$0.16	\$0.27	\$0.27
Diesel	\$0.42	\$0.46	\$5.89

The analysis established that Lamu coal power has a relatively high LCOE. In addition, the analysis established that LCOE increases considerably when the carbon (cost for polluting the environment) is included in the cost rendering it the most expensive source of electricity. It appears that the LCOE of coal, less the carbon tax, renders it favourable for economies to utilise coal for electricity generation. Conversely, there are other cheaper options such as wind, nuclear and biomass. The power plant comes at a difficult time whereby both developed and developing countries are expected to reduce carbon emissions and imposing carbon tax on emissions is a proposal to assist curb carbon emissions output (Guguyu, 2015). . The CEO of Kurrent Technologies stated that if the carbon tax is approved, it may have an unknown impact on the power plant (Guguyu, 2015).

In contrast with the findings, the MoEP (2016) argues that coal is an important fuel option for the expansion of the electricity sector in Kenya due to its widespread deposits as well as its relatively low cost. Moreover, Goldenberg (2015), Chen & Xu (2010), Liang *et al.* (2013) and Franco & Diaz (2009) illuminate that coal has been opted for by most growing economies as it is argued it is a cheaper option for electricity. Similarly, Dornan (2016) and

Bezdek (n.d.) agree that coal provides affordable energy to meet the world's need for economic growth.

One of the purposes for the proposed Lamu coal power plant is to provide affordable electricity. This means that if the cost of coal is expensive, it defeats the objective of the development. In addition, an increase in the cost of coal will translate into an increase in the overall cost of electricity; consequently denying the poor access to electricity owing to the prohibitive costs. The GoK ought to invest in the cheapest electricity. Granoff *et al.* (n.d.) argue that renewable energy such as solar and wind once installed has almost zero marginal costs for generating electricity.

4.2.3 Conclusion

On the evidence from the above studies, it reasonable to assume that there is a conflict between economic benefits vis-à-vis the social and environmental benefits. There is a likelihood that clean coal will lead to economic growth. In spite of this, clean coal has a negative social and environmental impact. It also appears that ideally, coal is considered to be a cheap source of electricity; nevertheless, it is an expensive source of electricity when all costs (LCOE and carbon tax) are considered.

The emissions analysis and the socio-economic analysis discussed above assessed the existing literature and highlighted the environmental, social and economic impacts of clean coal on poverty reduction and emissions reduction. The discourse analysis, which is the main analysis of this study, reveals the impacts highlighted above in detail and their role in climate change mitigation and poverty eradication.

4.3 Discourse analysis

The discourse analysis is the main analysis of this study. This qualitative discourse analysis focuses on understanding the rationale for and against the proposed Lamu Coal Power Plant. The purpose was to extract the climate and development discourse between supporters and opponents of the plant. The analysis led to the emergence of various themes that were used to classify the opinions of Lamu coal power plant proponents and opponents (Figure 4-8). The themes from the discourse analysis will be used to present the

analysis. The themes will aid in addressing the main argument of this study which is whether Lamu coal power plant promotes zero emissions zero poverty.

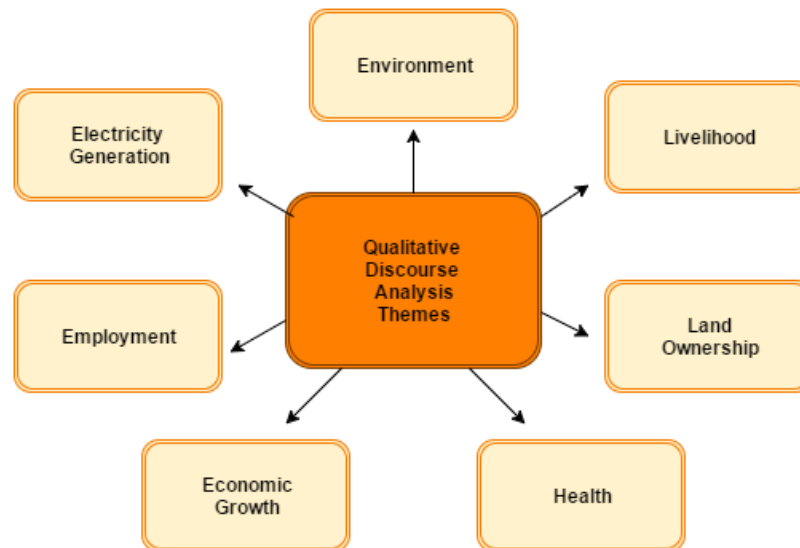


Figure 4-8: Qualitative discourse analysis themes (Source: Author)

4.3.1 Employment

This analysis found that the local community has expectations that Lamu coal power plant will create employment opportunities. Amu Power points out that the coal-fired power plant will require about 3500 workers during its peak construction and 500 workers during its operation (Njoroge, 2016). Njoroge (2016) explains that Amu power gave assurance that 60% of the jobs will be taken up by Kenyans and the remaining 40% will be Chinese technicians. “The Chinese prefer to bring in technical personnel from their country due to a shortage of technical staff in Kenya and the need to have a healthy mix of workers who are conversant with the Chinese standards for the projects” (Njoroge, 2016).

Lamu county government officials raised the issue of employment of the locals (Kazungu, 2016). The locals are concerned that currently, there is the poor distribution of schools, poor academic performance and therefore the local youth have low education levels and lack marketable skills (Kurrent Technologies, 2016). The locals demand a clear outline of the percentage of local employment and business opportunities dedicated to local communities (Kurrent Technologies, 2016). The local community urged the proponent to prioritise local communities empowerment through building capacity, employment and

business opportunities so as to provide an opportunity for the locals to participate in and benefit from available opportunities (Kurrent Technologies, 2016).

The farmers are positive that the power plant will provide jobs for the youth; however, they appealed that Lamu youth to be given first priority during employment and that there should be equitable access to all available opportunities including consideration for the extremely poor and vulnerable groups (Kurrent Technologies, 2016; Kazungu, 2015).

The locals are for Lamu coal power plant as they argue that the development of the plant will create job opportunities for them. They are worried that due to their educational level, they will not have opportunities to work at the coal power plant. Hull (2009) explains that reduction of poverty is determined by the quality of jobs, level of employment and the accessibility to decent earning opportunities by the poor. This potentially means that in order to eradicate poverty through employment, the employer should consider the quality of jobs, level of employment and the accessibility to decent earning opportunities by the local community.

4.3.2 Electricity generation

The analysis discovered that one of the rationales for constructing the proposed Lamu coal power plant is to increase the supply and reduce the cost of electricity (Ngirachu, 2014). According to the world bank, only 23% of Kenya's citizen have access to electricity (Langat, 2016). The coal power plant is expected to generate 1050 MW of electricity once it is complete. This generation will account for approximately 55% of Kenya's power production measured by today's installed generating capacity (Kazungu, 2016a; Kazungu, 2015; Intelli News, 2014). The power plant will constitute 20% of the government's planned injection of 5,000MW by 2018 (Njoroge, 2016; Njagi, 2015).

The sponsors and deputy president reveal that the purpose of the project is to provide affordable electricity as well as address increased anticipated demand that would emanate from the proposed industrial park, resort cities, the standard gauge railway (SGR), the Lamu Port South Sudan Ethiopia Transport Corridor (Lapsset) project and the iron and steel smelting industries (Kazungu, 2016; Kazungu, 2016a; Kazungu, 2015).

It is proved that the cost of electricity in Kenya is costly and the country's electricity bills are six times higher than South Africa and nine times more expensive than Egypt (Ngirachu, 2014). Kenya's power production is mainly from hydroelectric dams that are unreliable especially in times of drought forcing the country to shift to thermal power which results in an unanticipated boost in production costs and extra cost to consumers. (Intelli News, 2014). The electricity from the coal power plant will be cheaper as it will be priced in the same range as geothermal energy at US\$7.5 per unit which is a third of the price of diesel-fired plants generated electricity (Njoroge, 2016; Otuki, 2016b; Ngirachu 2014).

Notwithstanding cheaper and increased electricity capacity, the county leadership argues that Lamu is already connected to the national grid and there would no longer be any benefit to reap from coal powered electricity other than its inherent environmental hazards (Kazungu, 2016; Kazungu, 2016c). Dolan (2016) contends that "Kenya is currently producing 2,300 MW but only using 1,600 MW at peak demands; therefore, there is no urgency in generating more electricity and hence there is enough time to explore cleaner renewable sources of energy".

The analysis recognised that Lamu coal power plant is expected to increase electricity generation for the country. Conversely, it is still questionable who is to benefit from the increased electricity generation. The analysis point out that electricity generation is expected to meet the demand of the growing industries. Considering the fact that the electricity generated in Lamu is expected to be connected to the grid, the rest of the 80% of the population who are not connected to the grid are unlikely to directly benefit from the development of Lamu coal power plant.

4.3.3 Environment

The analysis presented various controversies regarding the environment and Lamu coal power plant. One opponent explains that coal is a notorious polluter as it results in devastating impacts such as air and water pollution, land degradation and diseases that persist long after mining and operation cease (Kaaria, 2016). A scientist stated that coal is

hazardous to the environment and termed the power project a big mistake because of its negative impacts on the environment (Kazungu, 2015; Kazungu, 2016).

The leaders, activists and residents in Lamu are accusing the National environmental Management Authority (NEMA), the Energy Regulatory Commission (ERC) and the county government of Lamu for forcing the project on despite the fact that it is argued to be hazardous to the environment (Kazungu, 2016c). The health committee chairman of Lamu County demanded that Amu power to disclose the effects of coal fumes on the environment and livestock (Jenje, 2015).

The CEO of Kurrent Technologies sought to assure the residents of Lamu that the coal power plant will use clean technology and recycle up to 90% of the expected waste (Guguyu, 2015). The CEO further explained that the plant will have the ability to reduce sulphur emissions by converting the sulphur emissions to gypsum for making wall boards and they will also convert fly-ash into asphalt that will be used during road construction (Guguyu, 2015).

According to the executive officer in charge of Health and Environment in Lamu County, “Lamu is home to the largest wildlife concentrations and critical marine biodiversity, livestock, forest and other critical national assets” (Kazungu, 2016). The opponents are concerned that the coal power plant will have harmful and irreversible impacts on ecosystem resulting to loss of landscape and aesthetic degradation (Sunday, 2016; EJAtlas, 2016). Save Lamu, an organization in Kenya, organised a trip to South Africa’s coal mines in Mpumalanga and the chair of Save Lamu explains that in Mpumalanga the ground is bare and plants have dried up (Langat, 2016).

The locals are also concerned that the coal power plant will result in air pollution that is irreversible (Sunday, 2016). Civil society activists have protested the coal plant saying that its emission would pollute the pristine air of Lamu (Otuki, 2016a). Dolan (2016) explicates that “generating 1,050 MW will generate 7.5 million tonnes of Carbon Dioxide each year which is equivalent to cutting down 320 million trees Kenya’s. Also, the country’s GHG emissions are expected to increase from 6% to 10%” (Dolan, 2016).

Kaaria (2016) argues that the coal power plant also poses threat to the marine ecosystem. The opponents claim that the coal power plant will result in surface water pollution, decreased water quality, ground water pollution/ depletion as well as reduced ecological/ hydrological connectivity (EJAtlas, 2016). Desalination system from the water cleanings also has the potential to destroy the rich sea life (EJAtlas, 2016). Save Lamu Chairman is concerned that waste-water at significantly high temperatures will be drained into the ocean and the impact on marine life (Kazungu, 2016c).

The Environmental and Social Impact Assessment (ESIA) assures the locals that “the sea water that will be used to condense the steam will be discharged back to the sea 600meters from the shore where the recommended temperatures will be achieved to prevent harm to marine life” (Njoroge, 2016). Despite assurance, the opponents argue that water pollution from the coal power plant is irreversible (Sunday, 2016). Sunday (2016) further points out that Lamu coal power plant has the potential to result in sub-surface contamination of soil from fuels. Also, soil excavation and clearing will increase erosion and runoff (Sunday, 2016).

The county government’s head of health, sanitation and environment is hoping that the ESIA will lay out how Amu Power will mitigate against the damaging effects of the plant (Langat 2016b). Conversely, it is reported that there is no form of technology that can eliminate impacts of coal and he strongly argues that if Kenya is importing coal, they are importing pollution (Langat 2016b). The opponents are concerned that Kenya is investing in coal yet the country has huge potential in renewable energy (Langat 2016b).

The analysis confirmed that the coal power plant will have irreversible impacts on the environment through air, water and soil pollution. According to literature, coal power plants have cause adverse impacts on the environment. In China, the coal power plants have resulted in local air pollution that has resulted in acid rain, ecological damage and health complications (Chen & Xu, 2010; Liang *et al.*, 2013). This has also been observed in India. In India, the particulate matters have been deposited in the air, soils, lakes and streams have led to poor visibility in areas surrounding power plants, changes in nutrient balance, affecting regional ecosystem diversity and damaging forests and farms (Chikkatur

& Sagar, 2007). Furthermore, the construction of power plants has adverse impacts on the land and the local environment through excavation, clearing, de-watering and impounding water bodies (Chikkatur & Sagar, 2007). Chikkatur & Sagar (2007) also explain that though the cooling water has little or no contaminations, the introduction of waste into water bodies can strongly affect aquatic plants and animals. There is the likelihood that the proposed Lamu Coal Power plant will have negative impacts on the environment.

4.3.4 Livelihood

The discourse shows that the proposed Lamu coal power plant may improve their livelihoods through the creation of jobs and business opportunities; on the other hand, it may negatively impact their livelihood through the interference of the environment that local community depends on for a living.

The local community depends on tourism, fishing and agriculture for their livelihood (EJAtlas, 2016). The locals and environmental activists are concerned that the coal power plant will have irreversible and harmful impacts on the livelihoods of thousands of farmers and fishermen as a result of pollution to the environment (Sunday, 2016). There is a potential loss of livelihoods as a result of project activities on fishing and agriculture industries. There are also health implications from pollution that are expected to threaten human life potentially compromising their livelihood. Opponents are also concerned that the coal power plant will increase climate change impacts that are already affecting the livelihood of the local communities (350.org, 2016). The chairman of the Health Committee of Lamu demanded that the company should disclose the impacts of the coal power plant on the environment and livestock (Jenje, 2015)

The local community urges the developer to compensate the affected and furthermore, train the compensated persons on financial literacy skills for prudent utilisation of funds (Kurrent Technologies, 2016). The local communities also urge the developer to create job opportunities for the locals so that they can improve their livelihood: The farmers argue that through compensation and job provision, the coal power plant would improve their livelihood (Kazungu, 2015; Kurrent Technologies, 2016). Finally, the local community advised that the vulnerable groups such as the disabled, widowed, women and orphans

should not be discriminated during employment so that they can also use the project to improve their livelihood (Kurrent Technologies, 2016).

The analysis found that the local community depends on tourism, fishing and agriculture for their livelihood that is heavily dependent on the environment. This means that if the coal power plant negatively affects the environmental, it will have a ripple effect on the livelihoods of the local community.

4.3.5 Land ownership

The analysis established that some of the social issues that have resulted in the opposition of the development of Lamu coal power plant are land related issues. The local communities are concerned that the developer will acquire their land without compensation.

In the discourse analysis, it was found that the National Land Commission (NLC) has handed over land rights to Amu Power and the chairman of NLC explained that the investor had fulfilled all requirement required for the acquisition of land (Kazungu, 2016a). The leaders expressed that there is potential for displacement and land dispossession (EJAtlas, 2016). The county government leaders also raised the issue of more than 600 residents of Kwasasi whose land will be acquired during the project (EJAtlas, 2016; Kazungu, 2016). The Minority Leader asked that Amu Power to explain the fate of the 60,000 people living on the land that the company is targeting for the power plant and their compensation plan (Jenje, 2015). Njagi (2015) explains that Lamu governor wants the compensation of people whose land had been taken by the project addressed.

The residents are infuriated that the license has been given before the Resettlement Action Plan (RAP) had not been issued to the affected communities. The leaders demanded that Amu Power to provide a resettlement plan for residents who will lose their land (EJAtlas, 2016). The proponent explains that landowners lack title deeds; a situation that could become an issue of contention during resettlement and compensation (Kurrent Technologies, 2016).

The farmers whose land will be acquired for the establishment of the coal power plant have demanded compensation of KES 5 million per acre (Kazungu, 2015). Kazungu (2015) further explains that the farmers were pro-development for the project in Lamu and they were willing to pave way for the power plant; however, they demanded the 5million per acre compensation before the work started.

The Director of Valuation at the Nation Land Commission proposed that the residents to be given separate land by the county for resettlement and she indicated that the best option is that if the county could avail land but if it is not possible, they would consider monetary compensation (Guguyu, 2015). The technical, steering and community committees are carrying out a baseline survey to identify those that are eligible for compensation (Guguyu, 2015).

It seems that Lamu coal power plant is likely to affect the displaced. According to literature, coal power plants mostly affect those who are displaced from their lands (Chikkatur & Sagar, 2007). This probably means that if the displaced locals are not resettlement, they will be deprived of land and housing and this might increase poverty.

4.3.6 Health

The analysis determined that the proposed Lamu coal power plant might have a negative impact on the environment. Coal is hazardous to health (Kazungu, 2016). Lamu woman representative expresses that coal is harmful to the health of citizens (Kazungu, 2016c). The civil society activists have protested that pollutants from the coal plant will pose health hazards (EJAtlas, 2016; Otuki, 2016a). Dolan (2016) also points out that there are health risks involved with living near coal plant: nitrogen oxides destroys lungs and sulphur dioxide promotes heart disease and asthma

The locals are concerned about the health implications of the coal power plant (Langat, 2016). The project coordinator of Save Lamu said that one of the fishermen during a meeting expressed that the freezers they were being given by Amu Power for their fish would be used as freezers in mortuaries due to death from the effects of coal (Langat 2016b). A scientist stated that the plant is a mistake because of its negative effects on health (Kazungu, 2015). However, despite the reservations raised by the opponents, Amu

officials have sought to allay the fears stating that they have lined up safety technologies (Kurrent Technologies, 2016)

Lamu Member of County Assembly (MCAs) and the health committee chairman demanded that the Amu Power should disclose any health effect the power plant will have on the health of the local (Jenje, 2015). Lamu's Governor wants to ensure that people are not exposed to pollution or other industrial hazards (Njagi, 2015). The health committee chairman stated that they will not compromise the lives of the people as a healthy community is better than wealth (Jenje, 2015).

The analysis clearly outlined that there is a possibility of Lamu Coal power plant causing negative impacts on the locals. This is consistent with the literature discussed above. In India and China, coal power plants have affected the health of the local community resulting in respiratory problems (asthma, bronchitis and decreased lung function) and premature death (Chikkatur & Sagar, 2007; Chen & Xu, 2010; Liang *et al.*, 2013). There is a possibility that the Lamu coal power plant will negatively impact the health of the local communities. Considering the fact that health is an indicator of poverty, there is the likelihood that deprivation in health as a result of the coal power plant will increase the MPI of Kenya.

4.3.7 Economic growth

The analysis identified that the development of Lamu coal power plant will result in the economic growth of Lamu County and Kenya as a whole. The project is part of the efforts to develop Lamu as a trade and commercial hub to serve the area and neighbouring countries (Jenje, 2015). The deputy president assures the locals of Lamu that the coal-fired power plant will change the course of Lamu's economy as well as that of the entire country (Kazungu, 2016a). On the other hand, the leaders, activists and residents in Lamu argue that the power plant will negatively affect the economy (Kazungu, 2016c)

Lamu MCAs are demanding that up to 30% of the profits of the coal power plant should benefit the locals (Kilonzo, 2015). One of the MCA said that there should be a Memorandum of Understanding signed amongst the Governor of Lamu, the local community, the company and the county assembly on how profits will be shared out to ensure that the local

community benefits from the project (Kilonzo, 2015). The governor of Lamu stated that the project must benefit the locals (Njagi, 2015).

According to literature, Granoff *et al.* (n.d.) debate that the link between energy from coal and economic development is not always direct linked. This potentially means that although the economy is growing there is potential that poverty is not being eradicated. This is evident in South Africa, whereby although the economy is growing as a result of a coal driven economy, 43% of South Africa is still energy poor and a greater majority can barely afford electricity (Sanzillo, 2016). Kenya needs to understand the thin line between economic growth and poverty eradication in order to achieve their efforts on poverty eradication.

4.3.8 Conclusion

This chapter highlights that there is a likelihood that clean coal could potentially result in economic growth as well as the creation of job and business opportunities that may result in improved livelihood. Furthermore, this study found that the local community depends on tourism, fishing and agriculture for their livelihood that is heavily dependent on the environment. This means that if the coal power plant negatively affects the environmental, it will have a ripple effect on the livelihoods of the local community. Pollution has the potential to also affect the health of the local community. The opponents are also concerned that displacement of locals may result in loss of land and this may potentially increase the rate of poverty.

Chapter 5: Discussion

This chapter presents the discussion of this study based on the conclusions from the three analyses discussed above (emissions assessment, socio-economic analysis and discourse analysis). This section will synthesise findings from the analysis against literature exploring the impacts of clean coal on climate change mitigation and poverty eradication.

5.1 Impact of clean coal on climate change mitigation (zero emissions)

The findings established that emissions from the various sectors have been increasing and they are projected to increase by 2030. The findings also revealed that due to the possible relationship between emissions and GDP, there is a likelihood that the efforts for Kenya to grow economically will result in increased emissions. This is in line with Wlokas *et al.* (2012) who argue that the need for countries to economically prosper has resulted in increased emissions. Kenya is no exception as it is clearly seen that in the past, economic growth has resulted in increased emissions.

The findings also showed that emissions from the electricity generation sector are expected to drastically increase. The GoK argues that it can achieve economic growth through adequate energy supply (GoK, 2015). The country plans to meet its energy supply through the introduction of coal to its energy generational mix (MoEP, 2015). Nonetheless, the coal power plant has come at a difficult time for the coal industries whereby countries are expected to reach an agreement to reduce emissions (Granoff *et al.*, 2015). Due to the urgent need to mitigate climate change, the GoK plans to invest in clean coal as an LCD in order to achieve climate change mitigation as well as provide adequate energy supply.

The analysis revealed that clean coal using USC technology is still emission intensive. According to Charpentier & Tavoulareas (1995), clean coal reduces emissions of SO₂ and NO₂ by 50 to 99 percent but clean technology barely reduces CO₂ emissions. Steynberg & Nel (2004) further reveal that “One fact that cannot be avoided is that every tonne of carbon in mined coal will sooner or later end up as 3.67 tonnes of carbon dioxide in the atmosphere”. This means that clean coal increases the efficiency of coal; however, emissions are not fully mitigated. In contrast, Bezdek (n.d.) and Coal Industry Advisory

Board (2014) argue that coal power generation has been improving and it is better and cleaner and with technological advancements. They explain that it is expected to get better considering that from 1970, coal power generation has improved efficiency by 170% with emissions reducing by 90% (Bezdek, n.d.; Coal Industry Advisory Board 2014). Similarly, Chen & Xu (2010) also argue that the improved efficiency in clean coal technologies can be used to reduce emissions emanating from the coal power plant. It is evident that clean coal as a low carbon development assists in reducing emissions through improved efficiency; however, clean coal still produces emissions that result to climate change.

The impact of clean coal on climate change impact is complex to understand. Li & Fan (2008) points out that energy and global warming are two intertwined issues of significant magnitude in the modern era. This means that in order to mitigate climate change, it is important to select not just cleaner but purely clean sources of energy. According to Li & Fan (2008), renewable energy sources will assist in reducing anthropogenic CO₂ and thus reduce global warming. Chikkatur & Sagar (2007) also suggest that “climate change mitigation requires the implementation of a range of technologies and practices that are efficient and low carbon”. In order for Kenya to mitigate climate change and meet its abatement obligations, the country needs to promote economic growth through investing in other electricity generational mix that targets zero emissions. For example, geothermal, wind, solar and biomass sources of energy.

5.2 Impact of clean coal on poverty eradication (zero poverty)

This study not only looked at income deprivations as a measure of poverty but also deprivations in living standard, health and education. This study explored the economic, social and environmental consequences of clean coal as well as the rationale for and against the development of clean coal in Kenya so as to establish the impact of clean coal on poverty eradication.

The study established that clean coal as an LCD will result in economic growth through increasing energy supply, creating employment and business opportunities and providing cheaper electricity. Although Granoff *et al.* (n.d.) debated that the link between energy from coal and economic development is not always directly linked, literature confirms that

developed countries like China and India have economically developed as a result of coal (Chen & Xu, 2010; Liang *et al.*, 2013; Franco & Diaz, 2009). The findings illustrate that this is also the same case in Kenya. Clean coal in Kenya might result in economic growth but its benefits are likely to stick in the higher income quartile. The findings illustrated that inequality in Kenya has been increasing with economic growth. This suggests that even though clean coal is expected to result in economic growth, there is the likelihood that it will have little effect on poverty eradication. This is in line with Granoff *et al.* (n.d) who argues that economic growth may reduce the rate of poverty but it may also increase inequality. It seems that the economic growth has resulted in an increase in the gap between the rich and the poor. In order to eradicate poverty in Kenya through economic growth, efforts should be put in place to reduce inequality.

Coal is argued to be a cheap source of electricity (Chen & Xu, 2010; Liang *et al.*, 2013; Franco & Diaz, 2009). This study, however, has attempted to disprove this predominating notion by showing that coal is not the cheapest source of energy. In fact, if the cost of coal is inclusive of the carbon tax, it is the most expensive source of energy. There is a possibility that if the carbon tax is included, the poor who are connected to the grid will barely afford electricity. Bearing in mind that one of the purposes of coal was to provide affordable electricity, increasing the cost of electricity will affect the poor due to affordability.

The study confirmed that clean coal results in air, water and soil pollution that has a negative impact on the environment. Pollution of the environment from coal is evident in China, India and South Africa (Menyah & Wolde-Rufael, 2010; Chikkatur & Sagar, 2007; Li & Fan, 2008). This study confirmed that the locals of Lamu County depend on fishing, agriculture and tourism for their livelihood. Therefore, interference with the environment threatens their livelihood. If their livelihood is compromised so are the efforts of clean coal in eradicating poverty.

Clean coal has a negative social impact on the local community. The analysis revealed that the development of clean coal might have social issues such as interference of livelihood, deterioration of health and displacement of the locals from their land. This is consistent with literature by Chikkatur & Sagar (2007) who describes that coal power plants affect

mostly those who are displaced from their land, as well as those who's health and agriculture will be affected by air and water pollution emanating from the coal plant. Referring to the social issues discussed above, clean coal as a pro-poor development is debatable.

It is evident that clean coal in Kenya will lead to economic growth; however, due to high inequality, there is a high likelihood that clean coal will barely eradicate poverty. Also, the social and environmental impacts have a negative impact on the efforts to eradicate poverty. Goldenberg (2015) illuminates that coal has a social and environmental cost and the burden is mostly carried by the poor. Granoff *et al.* (n.d.) argue that renewable energy such as solar and wind once installed have almost zero marginal costs for generating electricity and they have little impact on the environment and health, therefore, boosting economic growth rather than hindering it. On the evidence available, it is reasonable to conclude that in order for Kenya to eradicate extreme poverty, the country should invest in sources of energy that is environmentally friendly as well as promote the living standards, health, education and income of the locals.

5.3 Conclusion

The aim of this study was to determine whether clean coal as LCD promotes a low carbon, pro-poor development pathway. Based on the findings from the analysis, it can be debated that Lamu coal power plant (clean coal in Kenya) falls under type 4 in the PAMAs framework (Table 5-1). Focusing on emissions, findings from the analysis and the discussion suggest that clean coal increases emissions in Kenya. Despite the fact that clean coal is less emission intensive and more efficient, Kenya currently does not have a power plant. This means that if Kenya introduces clean coal, they are introducing new emissions rather than mitigating existing emissions. Focusing on poverty, although clean coal promotes economic growth, it is apparent that clean coal will result in negative social and environmental impacts.

Clean coal as a pro-poor low carbon development is a struggle between economic development vis-à-vis social and environmental development. In spite of this, Granoff *et al.* (2015) argue that developing countries have the potential to move to zero net emissions

without compromising their growth trajectory. Wlokas *et al.* (2012) suggest that this can only be done once developing countries understand the risks and opportunities that mitigation activities and Low Carbon Development raise on fighting poverty. Kenya has the potential to develop in a low carbon, pro-poor development pathway. This can be achieved if the country embraces an electricity generational mix that eliminates economic, environmental and social trade-offs.

Table 5-1: PAMAs framework (Adapted from Wlokas *et al.* 2012)

TYPOLOGY		Poverty alleviation potential	
		High	Low
GHG Reduction Potential	High	Type 1: Poverty alleviating mitigation action Poverty driven mitigation action?	Type 2: Conventional mitigation action, with no explicit focus on poverty (and possible opportunity cost Climate-driven mitigation action?
	Low	Type 3: Conventional action for poverty alleviation, with no explicit focus on reducing emissions (and possible increase in emissions). Non climate driven poverty action?	Type 4: Failed/low impact mitigation action, failed poverty action, conventional industrial/economic/ environmental policy without explicit focus on mitigation and poverty (this will surely partly depend on the scale and cost of the action in terms of what impact it can achieve) “Clean coal in Kenya”

5.4 Research contribution

This study contributes to the wider literature and knowledge on the role “clean coal” plays in poverty eradication and climate change mitigation in Kenya. It aims to be useful to researchers, policy makers and implementers in the goal towards zero poverty, zero emissions.

This study also highlights the current gaps and makes recommendations on the process of using mitigation interventions as not only an emissions reduction mechanism but also as a poverty reduction mechanism. It will also present a concept that can assist the GoK in

achieving their Sustainable Development Goals, Vision 2030, INDC pledges among other national goals.

5.5 Limitations

The limitations of this dissertation are majorly due to the unavailability of data. The data that was used for emissions and GDP were reliable and available; nevertheless, the data for HDI and GINI were limited to a few years.

The discourse analysis used some data from blogs that may be unreliable and biased. On the other hand, Jones & Alony (2008) explain that blogs play a role as a valuable source of data as it provides convenient and accessible data that is codified, the information has richness and depth as the writer exercises the freedom of expression and the information is usually unbiased by research processes.

5.6 Further Research

This dissertation was a review of literature. A gap existed on the availability and consistency of data. Further research should be done to collect, verify and align data. Data can be collected from interviews with lead expert, government officials, local communities and other key stakeholders. Data can also be collected from panels and workshops with local, regional and national officials as well as social justice and environmental organizations. The Delphi method could be used to analyse data from the workshops and panels. The data from interviews, panels, consultations and workshops could be supported by computing models.

Chapter 6: Conclusion and recommendation

6.1 Introduction

This chapter will point out the main findings of this study in relation to the objectives and provide a conclusion to this study. The conclusion of this study aims at addressing the main argument of this study which is whether clean coal as a low carbon development promotes zero emissions zero poverty. This chapter will also suggest recommendations for future studies in this field.

6.2 Summary of findings in relation to the objectives of the study

The findings from emissions analysis, socio-economic analysis and discourse analysis are presented in relation to the objectives of this study.

6.2.1 Objective I: To establish the relationship between poverty and emissions in Kenya

This study suggested that there is a relationship between poverty and emissions in Kenya. It was indicated that in the past, the trend in economic growth directly proportional to emissions. This means that if trends continue as in the past and mitigation actions are not taken, the country's effort to transform from a lower middle-income country to an industrialised is projected to result in increased emissions in Kenya. The findings also revealed that there is a relationship between HDI and emissions and GINI index and emissions. The findings indicated that as emissions increased as a result of economic growth and improvement of living standard, inequality increased in Kenya. This hypothetically means that the development of clean coal may result in increased emissions as well as improved GDP and HDI. In spite of this, the increasing rate of inequality in the country may render the efforts to eradicate poverty unattainable.

It is reasonable to assume that socio-economic development in the past in Kenya has resulted in increased emissions. There is a likelihood that emissions are projected to increase with increased development due to efforts to eradicate poverty. It is also clear that efforts to eradicate poverty through economic development in Kenya may be hindered by the increased rate of inequality.

6.2.2 Objective II: To determine the socio-economic and environmental consequences of “clean coal” as a pro-poor mitigation action in Kenya

The study revealed that “clean coal” in Kenya is likely to have positive economic benefits through GDP growth and creation of employment opportunities. On the other hand, this study found that “clean coal” as a low carbon development has a negative impact on the environment as a result of water and soil pollution. This study also found that coal results in increased GHG emissions resulting in an increased GHG profile for Kenya. Furthermore, the development of clean coal is expected to have negative social impacts. The study also revealed that based on LCOE as well as a carbon tax, “clean coal” is not a cheap source of electricity.

On one hand, it is clear that “clean coal” as a low carbon development may assist Kenya in achieving economic growth. On the other hand, the negative social and environmental impacts suggest that “clean coal” barely attains the efforts to reduce emissions and eradicate poverty.

6.2.3 Objective III: To understand the rationale for and against “clean coal” as a low carbon development

The research revealed that the rationale for “clean coal” as a low carbon development was driven by the possibility that development will promote economic growth, provide affordable electricity, create jobs and business opportunities as well as improve the livelihoods of the locals through employment. On the other hand, the study exposed that the rationale against “clean coal” was driven by the negative impacts of the development on the environment as a result of air, water and soil pollution. Pollution of the environment will have a ripple effect on the livelihood of the local community due to the fact that the community depends on the environment (agriculture, fishing and tourism) for their livelihood. Most importantly, pollution of the environment impacts negatively on the health of the local community.

“Clean coal” potentially achieves economic growth that may assist Kenya in poverty reduction. The environmental and social impacts consequential from the development might result in increased poverty due to increased deprivations in various indicators of

poverty (MPI). The study also found that although USC technology reduces emissions and increases efficiency, “clean coal” still produces emissions. There is a possibility that development of clean coal may barely achieve efforts to mitigate climate change in Kenya.

6.3 Conclusion

This study showed that in the past, emissions in Kenya have been increasing and they are projected to further increase in the future. Literature shows that in the past, improved development has resulted in increased emissions. The findings of this study suggest that there is a possibility that economic growth in the past may have resulted to increased emissions in Kenya. Furthermore, improvement in HDI may have resulted in increase in emissions. On the other hand, the finding suggests that as emissions, HDI and economic growth increase, it may result in increased inequality. Literature explains that the gap between the wealthiest quantile and poor quantile in Kenya is increasing. This may render efforts put in place to eradicate poverty through development inefficient.

Kenya as a country is obligated to reduce its emissions by 30% by 2030. However, this is difficult for the country as it strives to become a middle income country by 2030 through economic development and yet in the past economic development has been directly linked to increased emissions. Kenya strives to reduce emissions and poverty through embracing low carbon development.

Clean coal is one of the low carbon development options proposed by the government of Kenya to reduce both emissions and poverty. The socioeconomic analysis and the discourse analysis highlight that there exist two sides of the coin as to whether clean coal promotes a zero poverty zero emissions. It is argued that the coal power plant has the potential to improve the country's economy through increased electricity supply and creation of business opportunities. Additionally, it will also create employment for the locals thus improving the livelihood. However, it is also argued that clean coal has a negative impact on the environment. The impact on the environment has a ripple effect on the health, livelihood and asset ownership of the locals.

This study suggests that although clean coal is suggested as a low carbon development option for Kenya, it may play an insignificant role in achieving zero poverty zero emissions. Firstly, clean coal is a cleaner and more efficient technology but it still emits emissions. Secondly, although clean coal may increase economic growth and create employment and business opportunities, the environmental and social impacts may reverse the efforts to eradicate poverty. Thirdly, the increasing rate of inequality may result in the wealthy benefiting more than the poor from the electricity generated and thus rendering efforts to eradicate poverty poor. The country needs to understand the role and opportunities of low carbon development on poverty eradication and climate change impact so as to integrate an electricity generational mix that promotes zero emissions and zero poverty.

6.4 Recommendations

In accordance to the findings of this study, the following recommendations are suggested:

- a) There is need for more studies to explore the link between poverty eradication and climate change mitigation in Kenya. Additionally, further research should be done to determine opportunities Kenya has to remain low carbon and prosper.
- b) The scarcity of data from government sources should be addressed. There was limited data on GINI index and HDI.
- c) The GoK should also align the available data across its ministries. The government ought to make provisions on aligning data.

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Appendices

Appendix I: Kenya's Gross Domestic Product

Source: (The World Bank Group, 2014)

Year	GDP (Current US\$)
1960	791,265,458.00
1961	792,959,472.00
1962	868,111,400.00
1963	926,589,348.00
1964	998,759,333.00
1965	997,919,319.00
1966	1,165,000,000.00
1967	1,233,000,000.00
1968	1,353,000,000.00
1969	1,458,000,000.00
1970	1,603,000,000.00
1971	1,778,000,000.00
1972	2,107,000,000.00
1973	2,502,000,000.00
1974	2,973,000,000.00
1975	3,259,000,000.00
1976	3,475,000,000.00
1977	4,494,000,000.00
1978	5,304,000,000.00
1979	6,234,000,000.00
1980	7,265,000,000.00
1981	6,854,000,000.00
1982	6,432,000,000.00
1983	5,979,000,000.00
1984	6,191,000,000.00
1985	6,135,000,000.00
1986	7,239,000,000.00
1987	7,971,000,000.00
1988	8,355,000,000.00
1989	8,283,000,000.00
1990	8,572,000,000.00
1991	8,151,000,000.00
1992	8,209,000,000.00
1993	5,752,000,000.00
1994	7,148,000,000.00

1995	9,046,000,000.00
1996	12,046,000,000.00
1997	13,116,000,000.00
1998	14,094,000,000.00
1999	12,896,000,000.00
2000	12,705,000,000.00
2001	12,986,000,000.00
2002	13,148,000,000.00
2003	14,905,000,000.00
2004	16,095,000,000.00
2005	18,738,000,000.00
2006	25,826,000,000.00
2007	31,958,000,000.00
2008	35,895,000,000.00
2009	37,022,000,000.00
2010	40,000,000,000.00
2011	41,953,000,000.00
2012	50,410,000,000.00
2013	55,101,000,000.00
2014	61,395,000,000.00
2015	63,398,000,000.00

Appendix II: Kenya's Baseline Greenhouse Gas Emissions

Source: (GoK, 2015)

Sector	Baseline Emissions (MtCO ₂ e)							
	1995	2000	2005	2010	2015	2020	2025	2030
Agriculture	24	23	26	30	32	34	36	39
Electricity Generation	0	1	1	1	1	12	24	42
LULUCF	10	21	18	21	26	25	23	22
Transportation	4	4	4	7	9	12	16	21
Energy Demand	4	5	5	6	7	8	9	10
Industrial Processes	1	1	1	2	3	4	5	6
Waste	1	1	2	2	2	3	3	4
TOTAL	44	55	57	70	80	96	115	142

Appendix III: Kenya's Human Development Index (HDI)

6.5 Source:(United Nation Development Programme, 2016)

Year	Human Development Index (HDI)
1980	0.44
1985	0.45
1990	0.473
2000	0.447
2005	0.47
2006	0.48
2007	0.5
2008	0.5
2009	0.51
2010	0.52
2011	0.53
2012	0.53
2013	0.54
2014	0.55

Appendix IV: Kenya's GINI Index

Source: (The World Bank Group, 2014)

Year	GINI Index
1994	43.86
1997	46.3
2005	48.51

Appendix V: Discourse Analysis Sources

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17. Ngirachu, J., 2014. Dream of cheap, coal-generated electricity could be put off as giants battle over plant. *Daily Nation (Kenya)*.
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19. Njoroge, K., 2016. 1,400 Chinese to build Lamu coal plant. *Daily Nation (Kenya)*.
20. Otuki, N., 2016a. Coal power firm seeking regulator nod. *Daily Nation (Kenya)*.
21. Otuki, N., 2016b. Firm seeks Nema nod to set up Sh200bn coal-fired plant. *Daily Nation, Kenya*, pp.1–2.
22. Sunday, F., 2016. Lamu coal plant fuels fierce clash of interests. *The Standard*.

Appendix VI: Ethics clearance

Application for Approval of Ethics in Research (EiR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

APPLICATION FORM

Please Note:

Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data. The objective of submitting this application *prior* to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook** (available from the UCT EBE, Research Ethics website) prior to completing this application form: <http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf>

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Joan Momanyi
Department		ERC
Preferred email address of applicant:		joan.momanyi@gmail.com
If a Student	Your Degree: e.g., MSc, PhD, etc.,	MSc
	Name of Supervisor (if supervised):	Britta Rennkamp
If this is a research contract, indicate the source of funding/sponsorship		N/A
Project Title		Zero Poverty, Zero Emissions? Does/ Can the proposed Lamu coal power plant promote a pro-poor, low carbon development pathway?

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY		Full name	Signature	Date
Principal Researcher/ Student/External applicant		Joan Momanyi	Signed	23 Nov 2016
APPLICATION APPROVED BY		Full name		Date
Supervisor (where applicable)		Britta Rennkamp		24 Nov 2016
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section 1; and for all Undergraduate research (Including Honours).		<i>Sarah-Ann Koehn</i> Click here to enter text.		20/2/2017 Click here to enter a date.
Chair : Faculty EIR Committee For applicants other than		Click here to enter text.		Click here to enter a date.