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Emissions Trading: A Policy Option for Fighting Climate Change in Africa

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A thesis submitted in partial fulfillment of the requirements for the Master of Laws degree in Law

EMISSIONS TRADING: A POLICY OPTION FOR FIGHTING CLIMATE CHANGE IN AFRICA

by

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Abstract

This thesis shows how an emissions trading scheme can help African countries contribute to the goal of stabilizing the concentration of greenhouse gases in the atmosphere. This is done through an assessment of the gaps in Africa's climate change mitigation policy architecture and the potential benefits of emissions trading as a policy instrument—including lessons learned from emissions trading schemes implemented in the US, the EU, New Zealand, and Chile. The thesis concludes that adopting an emissions trading scheme as a policy instrument in Africa could potentially close the gaps in its policy architecture.

Keywords

Climate Change, Emissions Trading, Carbon Market, Africa, Project Based, Cap and Trade, Rate Based, Greenhouse Gases, Robert Stavins, Thomas Tietenberg, ETS, Carbon Credits

Dedication

I dedicate this work to my late father, Chief Adio Gbolahan Akinwande; and to my family, who have been there for me through it all.

Acknowledgments

I would like to begin by thanking the Faculty of Law at the University of Western Ontario for providing me with this educational opportunity. I would especially like to thank my supervisor Professor Erika Chamberlain for her guidance throughout the course of this project and my second reader, Professor Sara Seck, for her guidance as well. I am also grateful to other members of the faculty for their various contributions. Lastly, special thanks go to Katerina Barton for her help editing this work.

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List of Abbreviations

AAU: Assigned Amount Unit

CDM: Clean Development Mechanism

CER: Certified Emission Reduction

CFCs: Chlorofluorocarbons

CH_4: Methane

CO_2/CO_2e: Carbon Dioxide/Carbon Dioxide Equivalent

COP: Conference of the Parties

EPA: Environmental Protection Agency

ERU: Emission Reduction Unit

ETS: Emissions Trading Scheme

EU: European Union

EUA: European Union Allowance

GHG: Greenhouse Gas

JI: Joint Implementation

LDC: Least-Developed Country

NAMA: National Appropriate Mitigation Action

NAP: National Allocation Plan

NDRC: National Development and Reform Commission

N_2O: Nitrous Oxide

NZ ETS: New Zealand Emissions Trading Scheme

NZU: New Zealand Unit

REDD+: Extends REDD (Reducing Emissions from Deforestation and Forest Degradation) by including sustainable forest management, conservation of forests, and enhancement of carbon sinks

SF_6: Sulphur Hexafluoride

SO_2: Sulphur Dioxide

UN: United Nations

UNEP: United Nations Environment Programme

UNFCCC: United Nations Framework Convention on Climate Change

US/USA: United States of America

USD: United States Dollar

VAT: Value-Added Tax

ZAR: South African Rand

Chapter 1

1 Climate Change and the UNFCCC

1.1 Introduction

This thesis argues for the inclusion of emissions trading in Africa's climate change mitigation policy architecture. Emission trading is a system of environmental regulation that allows polluters flexibility in complying with environmental goals. A firm can comply either by reducing emissions from its own facility or by acquiring emission reductions from another facility, so long as the total allowable emissions is not exceeded. This kind of environmental regulation can help African countries meet their individual obligations to mitigate climate change. It can be a veritable source of carbon finance to African countries that can be used to achieve a low carbon growth.

The global carbon market has been marginal in Africa's fight against climate change. Africa's share in the global carbon market is a meagre 2 percent.[1] The carbon market is important in the fight against climate change, because by placing a market value on emission reduction activities, it will incentivize the need for development along a low emissions pathway. The countries most threatened by climate change are currently on the sidelines of an important revenue source for combating the challenges of climate change, even as carbon is steadily becoming the most traded commodity in the world. The value of the global carbon market grew to 176 billion dollars in 2011 and the market is expected to grow more in the future.[2] An emissions trading scheme can aid in Africa's integration in the global carbon market through the linking of the proposed scheme to the

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[1] World Bank Press Release No: 2012/417/ACF, online: <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:23182183~pagePK:64257043~piPK:437376~theSitePK:4607,00.html?cid=3001_2> Africa currently has 85 registered CDM projects representing just 2 percent of the 4000 projects registered by the CDM Executive Board.

[2] World Bank, *State and Trends of the Carbon Market 2012* (Washington, DC: Carbon Finance, World Bank May 2012) at 9.

global carbon market. Emissions trading can also help Africa reduce its emissions. Historically, Africa's contribution to the global greenhouse pool has been small.

The region was estimated to have contributed only 3.57 percent of the world's total carbon dioxide emissions in 1988.[3] However, there is an upward trend to Africa's greenhouse gas emissions even as countries undergo development. Developing countries in Africa, particularly the least developed countries, are in a phase of massive infrastructure build-up, and failure to immediately leapfrog to low carbon technologies could lead to a lock-in in high-emissions systems for decades to come.[4]

Emissions trading can also help Africa prepare for a carbon-constrained future. At some point in the international climate change negotiations, developing countries may be asked to assume more responsibility in the fight against climate change by assuming quantified emissions limitation obligations and reduction commitments. Emissions trading can help Africa prepare for such a time. Implementing an emissions trading scheme would make African countries cultivate the culture of sustainable development, or climate compatible growth.

The legal questions to be addressed in this thesis are as follows: "What are the gaps in Africa's climate change mitigation policy architecture?" and, "Would adopting emissions trading as a policy instrument close the gaps in Africa's climate change policy architecture?"

The former question will be answered by looking at the mitigation platforms for developing countries under the United Nations Framework Convention on Climate

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[3] The New Partnership for Africa's Development, *Action Plan of the Environment Initiative*, at 62 online: <http://www.nepad.org/system/files/Environment%20Action%20Plan.pdf>. NEPAD is the socioeconomic development framework for Africa adopted by African leaders in July 2001.

[4] AMCEN, *Addressing Climate Change Challenges in Africa: A Practical Guide Towards Sustainable Development* (AMCEN Secretariat 2011), at 91. AMCEN is the African Ministerial Council on the Environment.

Change (UNFCCC),[5] their implementation to date in Africa and the proposed carbon tax in South Africa.

Africa's mitigation policy is not yet developed, as African countries have generally placed less emphasis on mitigation of climate change,[6] with the exception of South Africa.

The latter question will be answered by looking at the nature of emissions trading as a climate change mitigation policy instrument and the potential benefits of its adoption as a greenhouse gas mitigation policy in Africa.

This thesis is divided into six chapters. Chapter one will be introductory; it provides a background for the ideas to be discussed in this thesis. This chapter will address the concept of climate change and its scientific basis. An understanding of the scientific basis of climate change is important in knowing why climate change is a problem and why the world must act to tackle this problem. This will then be followed by a discussion of the legal framework governing climate change. This chapter also highlights the research methodology to be adopted and the scholarly significance of this research work. Chapter Two will be an analysis of CDM and REDD+ implementation in Africa; it will also contain an analysis of the proposed carbon tax in South Africa and NAMA design.

Chapter Three will deal with the evolution of emissions trading as a policy instrument and its theoretical framework. It will also present the potential benefits of the policy and its viability in the African context. Chapter Four will present possible downsides of implementing an emissions trading scheme in Africa. Chapter Five will discuss ETS success stories, along with lessons from ETS reviews. Chapter Six concludes the arguments in the thesis.

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[5] *United Nations Framework Convention on Climate Change*, 9 May 1992, 1771 UNTS 107, 31 ILM 849 (entered into force 21 March 1994).

[6] See AMCEN *supra* note 4 at 84.

1.2 Literature Review

Climate Change is now a recognised problem; scholars have been pontificating on the kind of policy intervention that is needed to solve the challenge. The type of policy intervention recommended by scholars depends on whether the country is a developing country or a developed country. This is important for this study because Africa is a developing region. According to the World Bank, a developing country, "is one in which the majority lives on far less money—with far fewer basic public services—than the population in highly industrialized countries."[7] A developing country can be a middle-income country. A middle-income country is a country that has made great strides entering the world economy and is creating better paying jobs, better and equitable education and health facilities and is investing in infrastructural development; but still faces substantial development challenges.[8] There are currently 22 middle-income countries in Africa; they are Botswana, Cape Verde, South Africa, Mauritius, Namibia, Seychelles, Swaziland, Angola, Congo (Brazzaville), Equatorial Guinea, Gabon, Ghana, Nigeria, Zambia, Sudan, Cameroun, , Cote d'Ivoire, Djibouti, Lesotho, Mauritania, Sao Tome & Principe, Senegal. They have crossed the $1000 GDP per capita threshold.[9] Within the developing country category, there is a subcategory called the "least developed country" category. A least developed country is, "a low income country suffering from the most severe structural impediments to development."[10]

After examining all the policy options available to national governments, Robert Stavins concluded that tradable permit schemes are more suited to the climate change challenge

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[7] *About Development*, online: World Bank <http://web.worldbank.org/WBSITE/EXTERNAL/EXTSITETOOLS/0,,contentMDK:20147486~menuPK:344190~pagePK:98400~piPK:98424~theSitePK:95474,00.html>.

[8] *Ibid*.

[9] F. Wolfgang, "Africa`s MICs" (19 November 2012), online: World Bank Blog <http://blogs.worldbank.org/africacan/africas-mics>.

[10] *LDC Information: Criteria for Identifying Least Developed Countries*, online: United Nations Development Policy and Analysis Division <http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_criteria.shtml>.

than any other policy instrument because of their cost effectiveness, since the cost of reducing greenhouse gas emissions is exceptionally great. He also advocated for an international tradable permit scheme because of the global nature of climate change. Involving all countries in this scheme could lead to transfer of wealth for developing countries.[11] Ackerman and Stewart argued along the same line, positing that emissions trading programs hold great promise as cost effective methods for achieving environmental goals and encouraging technological innovation.[12]

David Dreisen, however, disagrees. According to him, the "cheap fix" metaphor best describes emissions trading, rather than the "free lunch" metaphor (a win-win proposition) ascribed to by its proponents. Also according to him, emissions trading may facilitate the avoidance of initially expensive investments in innovative technology.[13]

Blackman and Harrington shifted the debate to whether market based instruments are suitable for developing countries; they concluded—using the experience of China and Poland—that permit trading is not appropriate for developing countries because of weak institutional capacity to enforce environmental regulation.[14] However, any policy instrument, be it environmental taxes or command and control, would need strong enforcement before it can succeed. They argue that technology standards may be appropriate for developing countries.[15] One limitation of the use of technology standards

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[11] Robert N. Stavins, "Policy Instruments for Climate Change: How Can National Governments Address a Global Problem?" (1997) U. CHI. Legal F. 293 at 309.

[12] Bruce Ackerman & Richard Stewart, "Reforming Environmental Law: The Democratic Case For Market Incentives" (1987-1988) 13 Colum. J. Envtl. L 171.

[13] David Dreisen, "Free Lunch or Cheap Fix? : The Emissions Trading Idea and the Climate Change Convention" (1998-1999) 26 B.C Envtl. Aff. L. Rev 1.

[14] Blackman and Harrington, Use *of Economic Incentives in Developing Countries: Lessons from International Experience with Industrial Air Pollution* (Resources For the Future May 1999) 1 at 2, online: <http://www.rff.org/rff/Documents/RFF-DP-99-39.pdf>.

[15] *Ibid.*

alone is its prohibitive cost. They also argue that the United States' successful experimentation with emission trading cannot be replicated in a developing country.[16]

Still on the point, Bell and Russell posit that technology standards may be more appropriate for building the initial capacity for emissions reduction because economic incentive programmes require more specific and greater institutional capacity, have more stringent monitoring requirements, and may require fully developed market economies to be effective.[17]

Willems and Baumert support this approach, but also note that technology approaches, policies and measures may have greater applicability to the general capacity needs of developing countries interested in pursuing sustainable development strategies.[18]

Russell and Vaughan suggest that a transitional strategy is the appropriate approach for developing countries, whereby technology standards are introduced first, followed by performance standards, and finally experimentation with market-based instruments.[19]

Ellerman contends that a performance standard at the facility level and an overall emissions cap could provide a more effective structure.[20] This type of approach, he argues, could facilitate a transition to a tradable permits programme as the institutions and economies develop over time.[21]

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[16] *Ibid* at 28.
[17] Ruth Greenspan Bell and Clifford Russell, " Environmental Policy for Developing Countries" (Issues in Science and Technology Spring 2002), online: <http://www.issues.org/18.3/greenspan.html>.
[18] Stephane Willems and Kelvin Baumert, *Institutional Capacity and Climate Actions*, (OECD Environment Directorate 2003), online: <http://www.oecd.org/env/cc/21018790.pdf>.
[19] Clifford Russell and William Vaughan, "The Choice of Pollution Control Policy Instruments in Developing Countries: Arguments, Evidence and Suggestions", (2003) International Yearbook of Environment and Resource Economics 331-370, online: <http://www.colby.edu/economics/faculty/thtieten/ec476/Russell.pdf>.
[20] Denny Ellerman, "Designing a Tradable Permit System in China: Principles and Practice", (2002) 23 Energy Journal, online: <http://web.mit.edu/ceepr/www/publications/reprints/Reprint_161_WC.pdf>.
[21] *Ibid*.

Chile has successfully used emissions trading to control particulates matter[22] emissions in the city of Santiago. The Chilean experiment with tradable permit scheme shows that there is no reason to believe that emissions trading cannot succeed in a developing country. Though it is not without its challenges, the program is a strong validation that emissions trading can work in a terrain where the monitoring is not perfect. According to Coria and Sterner,

> The Chilean scheme compares quite favourably with all the early U.S. programs and to the European ETS scheme, which, (despite being launched long after the Chilean scheme) has roughly the same number of flaws related to over-allocation and lack of clear rules for penalties.[23]

Despite the fact Chile has used a tradable permit scheme to control industrial pollution, the question as to what policy instrument is appropriate for developing country remains open because the Chilean example is not enough to conclude that emissions trading scheme is suitable for all developing countries. The question would only be settled as more developing countries develop their climate change mitigation framework. No African country has yet deployed emissions trading as a domestic policy instrument, as at the time of writing. However, countries like Nigeria and South Africa have used, and are still using, environmental tax to mitigate climate change. These two countries' experience with environmental tax will be analysed in this work. It will be argued that, in view of the greenhouse intensity of the two largest economies in Africa, a tradable permit scheme will best serve their environmental and health needs.

1.3 Climate Change and the UNFCCC

What is Climate Change?

There are different definitions of climate change. According to the UNFCCC,

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[22] Particulate matter is the term used for solid or liquid particles found in the air. It is a class of aerosols. Particulate matter is formed when gaseous pollutants such as $S0_2$ and $N0_x$ react to form fine particles. See *Particulate Matter (PM-10)*, online: <http://www.epa.gov/airtrends/aqtrnd95/pm10.html>.

[23] Jessica Coria and Sterner, *Tradable Permits in Developing Countries Evidence From Air Pollution in Santiago, Chile*, (Resources for the Future Discussion Paper December 2008), 1 at 27, online: <http://www.rff.org/documents/RFF-DP-08-51.pdf>.

> Climate change means a change of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.[24]

According to the Intergovernmental Panel on Climate Change (IPCC), Climate Change is:

> A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.[25]

A common idea running through all the definitions of climate change is that it is an increase in the average temperature of the atmosphere at a rate far from normal, caused by the anthropogenic emission of gases that trap the sun's heat in the atmposhere.[26] While weather is closely intertwined with the climate, climate change does not exactly equate to weather change.′ It is statistical changes in weather over time that equates to climate change.[27] There are important differences between weather and the climate. The chaotic nature of weather makes it unpredictable beyond a few days, but projecting changes in climate (long term average weather) is much more manageable.[28]

Long-term variations brought about by changes in the composition of the atmosphere are much more predictable than individual weather events. Climate change can be classified as either natural or anthropogenic; climate change is said to be anthropogenic when the change in climate is human-induced or emanates from human activities.

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[24] *supra* note 5, Article 1.
[25] Field C.B *et al*., eds, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation Glossary of Terms (Cambridge University Press 2012) at 557.
[26] See Crispin Tickell, *Climatic Change and World Affairs*, 2nd ed (Cambridge, Massachusetts: Harvard University Press, 1986).

[27] Letreut *et al*., "Historical Overview of Climate Change Science*"* in Solomon *et al*, eds, *Climate Change 2007,the Physical Science Basis* (Massachusetts: Cambridge University Press, 2007), 94 at 104.
[28] *Ibid*. The major reason why weather is not predictable beyond a few days is the property of the ever-changing atmosphere. The climate also differs from weather in that it covers or impacts the whole earth system, including the atmosphere, land surface, oceans, snow, ice, other bodies of water and living things.

While many factors influence the climate, scientists have determined that human activities have become a dominant force, and are responsible for most of the warming observed over the past 50 years.[29]

According to Crispin Tickell,

> Climate change is accelerating because the human foot is on the accelerator. A periodical visitor from outer space would find more change in the surface of the earth in the last 20 years than he would have found in the last 200, and in the last 200 more than in the last 2000. Since the industrial revolution, we have been using the sky as a waste unit. As a result, carbon dioxide in the atmosphere has now reached its highest level in 400 000 years, and is at a third higher than in pre-industrial times.[30]

Human-caused climate change has resulted not only from changes in the number of greenhouse gases (GHGs) in the atmosphere, but also changes in small particles (aerosols) and changes in land use.[31]

Scientists have explained that greenhouse gases trap the sun's heat by acting like blankets, which absorb heat radiation that should escape to space, thereby heating the atmosphere at a rate far higher than normal. Greenhouse gases (GHGs) that contribute to global warming include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), and halocarbons.

According to scientific studies, the primary effect of these gases in the atmosphere is that they change the equilibrium between incoming radiation from the sun and outgoing radiation from the earth. By blocking some of the infrared radiation from the earth and radiating it back to the earth's surface, the gases warm the lower atmosphere and cool the upper atmosphere. In turn, this increases moisture, which traps more infrared radiation. The effect of rising temperatures is to reduce the areas covered by snow and ice, thereby

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[29] Climate Change 2007 the Physical Science Basis *supra* note 10 at 105.

[30] Crispin Tickell, "The Impact of Climate Change on the Economy", a speech delivered to the Woodhouse Group, University of Leeds, 10 February 2004, online: <http://www.crispintickell.com/page79.html>.

[31] *supra* note 10 at 105.

diminishing the amount of heat reflected back into space and increasing absorption of solar radiation.[32]

These greenhouse gases released by human activities intensify the natural greenhouse effect. The natural greenhouse effect works this way:

> The sun powers Earth's climate, radiating energy at very short wavelengths, predominately in the visible or near-visible (e.g., ultraviolet) part of the spectrum. Roughly one-third of the solar energy that reaches the top of Earth's atmosphere is reflected directly back to space. The remaining two-thirds is absorbed by the surface and, to a lesser extent, by the atmosphere. To balance the absorbed incoming energy, the Earth must, on average, radiate the same amount of energy back to space. Because the Earth is much colder than the Sun, it radiates at much longer wavelengths, primarily in the infrared part of the spectrum. Much of this thermal radiation emitted by the land and ocean is absorbed by the atmosphere, including clouds, and radiated back to Earth. This is called the greenhouse effect…
>
> Without the natural greenhouse effect, the average temperature of Earth's surface would be below the freezing point of water. Thus Earth's natural greenhouse effect makes life as we know it possible.[33]

Scientific studies show that carbon dioxide (CO_2) is produced by the burning of fossil fuels (coal, oil and gas) as well as by land-use activities such as deforestation; methane is produced by cattle, rice agriculture, fossil fuel use and landfills; and nitrous oxide is produced by the chemical industry, cattle feed lots, and agricultural soils.[34]
Since 1750, the time of the Industrial Revolution, CO_2 has increased by 31 percent, methane by 151 percent and nitrous oxide by 17 percent.[35] Developed countries have

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[32] See Crispin Tickell, "The Causes of Climate Change", *supra* note 9 at 79. See also Article 1 of the UNFCCC *supra* note 5.
[33] Climate Change 2007, the Physical Science Basis *supra* note 10 at 115.
[34] P. Forster *et al*., " Changes in Atmospheric Constituents and Radioactive Forcing" in Solomon *et al*, eds, *Climate Change 2007, the Physical Science Basis* (Massachusetts: Cambridge University Press, 2007) 129 at 135.
[35] James E. Hansen, "Defusing the Global Warming Time Bomb" (2004) 3 Sci. Amer. 68-77.

been identified as the major causative agents of climate change and global warming.[36] Studies show that industrialized countries produce more CO_2 per head of population (per capita emissions) than developing countries.[37]

Like greenhouse gases, aerosols also influence the climate.[38] The two major types of aerosols are black carbon and sulphates.[39] Sulphates come primarily from the burning of coal and oil, while black carbon comes from biomass burning, cooking with solid fuels, and diesel exhaust. China and India are the most significant contributors to black carbon in the atmosphere, contributing 35 and 25 percent of black carbon in the atmosphere, respectively.[40] Countries in Europe and elsewhere that rely heavily on diesel fuel for transportation also contribute large amounts of black carbon.

The difference between black carbon particles and greenhouse gases is that black carbon particles remain airborne for weeks while greenhouse gases remain in the atmosphere for years and sometimes even a century, depending on the type of greenhouse gas.[41]

Climate change impacts could be cataclysmic if left unaddressed. According to James Hansen, a renowned United States scientist:

> The Earth's climate is nearing, but has not passed a tipping point beyond which it will be impossible to avoid climate change, with far ranging, undesirable consequences. These include not only the loss of the Arctic as we know it, with all that implies for wildlife and indigenous peoples, but losses on a much vaster scale due to rising seas. Ocean levels will increase

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[36] Williams Chandler *et al.,* "Climate Change Mitigation in Developing Countries"(Pew Center on Global Climate Change October 2002) at 1online: < http://www.c2es.org/docUploads/dev_mitigation.pdf>
See also Crispin Tickell, "Climate change: Warming, Cooling, Dimming and the Consequences" an address delivered to the Manchester Luncheon Club, Freemasons' Hall, Manchester, on 7 April 2005, online: <http://www.crispintickell.com/page79.html>.

[37] *Each Country`s Share of C02 Emissions*, online: Union of Concerned Scientists <http://www.ucsusa.org/global_warming/science_and_impacts/science/each-countrys-share-of-co2.html>.

[38] *Aerosols May Drive a Significant Portion of Artic Warming*, online: NASA <http://www.nasa.gov/topics/earth/features/warming_aerosols.html>.

[39] *Ibid*.

[40] Ramanathan and Carmachiael, "Global and Regional Climate Changes due to Black Carbon" (2008) 1 Nature GeoScience 221 at 222.

[41] *Ibid*.

> slowly at first, as losses at the fringes of Greenland and Antarctica due to accelerating ice streams are nearly balanced by increased snowfall and ice sheet thickening in the ice sheet interiors. But as Greenland and West Antarctic ice is softened and lubricated by melt water, and as buttressing ice shelves disappear because of a warming ocean, the balance will tip toward the rapid disintegration of ice sheets…
>
> This grim scenario can be halted if the growth of greenhouse gas emissions is slowed in the first quarter of this century.[42]

A respected UK scientist, Professor David King also reinforced the calamitous nature of climate change when he said:

> Antarctica is likely going to be the world's only habitable continent by the end of this century, if global warming remains unchecked… the earth is now entering the first hot period since 60 million years ago when there may be no ice on the planet and when the rest of the globe may not sustain human life.[43]

According to the IPCC, the world is already experiencing the effects of rising temperatures and extreme weather.[44]

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[42] James E. Hansen, "The Tipping Point?" during a presentation to the American Geophysical Union (6 December 2005), online: <http://www.nybooks.com/articles/archives/2006/jan/12/the-tipping-point/?pagination=false>.

[43] Geoffrey Lean, "Global Warming could soon make Antarctica the only place to live, says Chief British Scientist" The Independent on Sunday (2 May 2004).

[44] "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). The 100-year linear trend (1906-2005) of 0.74 [0.56 to 0.92]°C is larger than the corresponding trend of 0.6 [0.4 to 0.8]°C (1901-2000) given in the TAR (Figure 1.1). The linear warming trend over the 50 years from 1956 to 2005 (0.13[0.10 to 0.16]°C per decade) is nearly twice that for the 100 years from 1906 to 2005. The temperature increase is widespread over the globe and is greater at higher northern latitudes (Figure 1.2). Average Arctic temperatures have increased at almost twice the global average rate in the past 100 years. Land regions have warmed faster than the oceans(Figures 1.2 and 2.5). Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3000m and that the ocean has been taking up over 80% of the heat being added to the climate system. New analyses of balloon- borne and satellite measurements of lower- and mid-tropospheric temperature show warming rates similar to those observed in surface temperature. Increases in sea level are consistent with warming (Figure 1.1).Global average sea level rose at an average rate of 1.8 [1.3 to 2.3]mm per year over 1961 to 2003 and at an average rate of about 3.1 [2.4to 3.8]mm per year from 1993 to 2003." Pachauri R.K and Reseinger A, eds, *Climate Change 2007: Synthesis Report* (IPCC Geneva Switzerland) 26 at 30.

Kovats and Haines confirmed that the world is already feeling the effects of climate change:

> Global climate change caused by the relentless build-up of greenhouse gases in the earth's atmosphere is already disrupting ecosystems and is already causing about 150,000 additional deaths per year. An average global warming of 2 ^{0}C threatens millions of people with an increased risk of hunger, malaria, flooding and water shortages.[45]

According to the IPCC, even though climate change effects will be felt globally, the impacts will be hardest on poor and developing countries, especially those in Africa.[46]

> The vulnerability of a region to climate change impacts depends to a great extent on its wealth, and as such, poverty limits adaptive capabilities. Socio-economic systems typically are more vulnerable in developing

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According to scientists from the United Kingdom Metrological Office, global warming has been on pause for 15 years. Global average temperatures remain higher than they've ever been since modern records were kept but after a period of rapid increase in the 1980's and 90's, there's been a dramatic delay. The reason for the pause is that the oceans absorbed greater amounts of heat, which prevented people from noticing the difference at surface level. The Earth has been absorbing energy at a rate of 0.6 Watts per square metre - that's equivalent to 300 billion 1KW clothing irons being spread around the world. But during the slowdown, that number fell to 0.48 Watts per square metre. Other factors that could have helped ease the rise include an increase in volcanic eruptions around the world and a slowdown in solar activity. Despite the findings, they stressed that 12 of the 14 hottest years on record have been recorded since 2000. Between 1998 and 2012, the average rate of warming was just 0.04 degrees Celsius per decade, compared with 0.17C per decade from 1970-1998. They project a rise of 2 C above pre-industrial temperatures is expected in the next 50 years, the current slow down will delay that rise by five to ten years. Kevan Karaja, *Scientists believe natural causes briefly paused climate change*, online: Weather Network <http://www.theweathernetwork.com/news/articles/scientists-believe-natural-causes-briefly-paused-climate-change/9866/>.

[45] See: R. Kovats & A. Haines, "Global Climate Change and Health: Recent Findings and Future Steps" (2005) 172 CMAJ at 4. "Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity. The extreme poverty of many Africans, frequent natural disasters such as droughts and floods, and agriculture, which is heavily dependent on rainfall, all contribute. Cases of remarkable resilience in the face of multiple stressors have, however, been shown (high confidence). Africa possesses many examples of coping and adaptation strategies that are used to manage a range of stresses including climate extremes (e.g., droughts and floods). Under possible increases in such stresses, however, these strategies are likely to be insufficient to adapt to climate variability and change, given the problems of endemic poverty, poor institutional arrangements, poor access to data and information, and growing health burdens"

[46] Parry, Canziani, Pautikof, "Technical Summary" in *Climate Change 2007 Impacts, Adaptation and Vulnerability* (Massachusetts: Cambridge University Press 2007), 23 at 48-49. Adaptation is the act of building resilience in the ecosystems to cope with the unavoidable impacts of climate change, while mitigation involves cutting down of human activities that release greenhouse gases to the atmosphere.

> countries where economic and institutional circumstances are less favorable; therefore developing countries, which have lesser capacity to adapt, are more vulnerable to climate change damages, just as they are to other stresses. This condition will be most extreme among the poorest people.[47]

International response to climate change dates back to 1979 when the first World Climate Conference was held and highlighted concerns about the increasing concentration of carbon dioxide in the atmosphere.

In 1988, the UN General Assembly passed a resolution, proposed by Malta, in favour of the protection of the climate for present and future generations.[48]

The evidence of climate change emerging from the scientific community led the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to establish the Intergovernmental Panel on Climate Change (IPCC) in 1988. The mandate of the IPCC was to provide the world with clear scientific view on the current state of knowledge on climate change and its environmental and socio-economic impacts.[49] The IPCC began issuing comprehensive assessment reports in 1990.

The United Nations General Assembly also established an International Negotiating Committee in 1990; its task was to negotiate a framework convention. The first assessment report by the IPCC and the negotiated Framework Convention were deliberated upon at the Earth Summit in Rio de Janeiro, Brazil in 1992. The negotiated Framework Convention known as the United Nations Framework Convention on Climate Change opened for signature at the Earth Summit in 1992.

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[47] Q.K. Ahmad *et al*., "Summary for Policy Makers" in *Climate Change 2001: Impacts, Adaptation and Vulnerability, Contribution* of Working Group to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Massachusetts: Cambridge University Press), 1 at 8.

[48] See: *United Nations General Assembly Resolution A/RES/43/53*, online: <http://www.un.org/documents/ga/res/43/a43r053.htm>.

[49] The IPCC only reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters. See: *IPCC*, online: <http://www.ipcc.ch/organization/organization.shtml#.UQIxpW9QSjQ>.

The UNFCCC entered into force in March 1994 and as of today, 195 countries have ratified the Convention.[50] The Convention has as its objective: "the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".[51]

The Convention seeks to achieve this objective through three major principles: the Principle of Common but Differentiated Responsibility, the Precautionary Principle and the Cost Effectiveness Principle.

Common but Differentiated Responsibility Principle

Article 3(1) of the Convention provides as follows:

> The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.

The Convention places the responsibility of protecting the climate system on all the parties but expects the developed countries to take the lead in the fight for two reasons: countries have limited resources to address the enormity of the risk that climate change poses. Developed countries, however, are more technologically advanced and have more financial resources available to them; so developed countries are better equipped to address the problem than developing countries. They are more technologically advanced and have more financial resources available to them. Since developed countries are in a more advantaged position to address the problem, they are able to assist developing countries with technology and finances to combat climate change.

The second reason is that developed countries have been the major cause of the rising concentration of greenhouse gases in the atmosphere, particularly during the time of the Industrial Revolution. On the other hand, developing countries have contributed little to

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[50] See: *UNFCCC*, online: <http://unfccc.int/essential_background/convention/items/6036.php>.
[51] art 2 *supra* note 5.

the climate change problem, so it would amount to a disproportionate burden if the responsibilities were even.

Through this Principle, the Convention was intended to devise a fair solution to the matter. Since the participation of developing countries is needed in the fight, these countries would only come on board if it represented their interests. Developing countries are still battling with the mundane issues of food security and water supply. In fact, it was when the issue of climate change was framed in the context of the daily needs of food and water that developing countries got on board. The climate change problem was framed at first "as an abstract, global, technological dilemma that could be solved using market-based mechanisms and appropriate technologies; this alienated many developing countries in the climate change discussion".[52] Developing countries believe that developed countries owe an ecological debt because of their historic emissions. There can only be a level playing field if this responsibility is first acknowledged before anything else.[53]

It is said that the Principle of Common but Differentiated Responsibility in the Convention was patterned after the Montreal Protocol on Ozone Depleting Chemicals, after seeing the success of the Protocol.[54]

At the time the international community agreed to phase out several chemicals under the Montreal Protocol on Ozone Depleting Chemicals, the industrialized world used large amounts of these substances as refrigerants and industrial solvents. Developing countries were not prepared to give up domestic industries that use solvents or the future benefit of refrigeration—advantages long enjoyed by developed countries; so the developed countries agreed to lead the effort to solve the environmental problem they had caused by

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[52] Harro Van Asselt & Joyeeta Gupta, "Stretching Too Far: Developing Countries and the Role of Flexibility Mechanisms Beyond Kyoto" (2009) 28 Stan Envtl. L.J 311 at 318.

[53] See also Karin Mickelson " Leading Towards a Level Playing Field, Repaying Ecological Debt, or Making Environmental Space: Three Stories About International Environmental Cooperation" 43 Osgoode Hall Journal 138-168.

[54] David Dreisen, "Free Lunch or Cheap Fix? The Emissions Trading Idea and the Climate Change Convention" *supra* note 9 at 11.

phasing out several ozone-depleting substances during the Montreal Protocol's first decade.

They also agreed to a program of developing and transferring new technology to make it possible for less developed countries to enjoy refrigeration and increased manufacturing capability without relying on ozone-depleting chemicals. The Montreal Protocol authorized some initial increases in developing countries' use of ozone-depleting chemicals but required these countries to reduce consumption of such chemicals; a decade after the developed countries phased them out. Developing countries agreed to a late phase-out because they believed that developed countries would manufacture adequate substitutes as they eliminated their own consumption of ozone-depleting chemicals.

Accordingly, developing countries could help solve the environmental problem without foregoing benefits formerly associated with use of ozone-depleting chemicals. The developed countries did, in fact, develop adequate substitutes for many of these ozone-depleting chemicals.[55]

The Principle of Common but Differentiated Responsibility is operationalized in the form of different legal obligations under the Convention. For example, Article 12 of the Convention allows for different reporting obligations. Parties report their obligations through what is called national communications. Developed Countries, known as Annex 1 Parties under the Convention, are to issue their national communications to the Climate Change Secretariat biennially. They are also expected to update their national inventory of greenhouse gases regularly.[56]

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[55] Barrat-Brown, "Building a Monitoring Regime under the Montreal Protocol" (1991) 16 Yale J. Int'l L. at 519-31, cited in Dreisen's article, *ibid*.

[56] Annex 1 Parties are Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and the United States of America.

Apart from publishing a national inventory of anthropogenic emissions by sources and removals, and impacts of proposed mitigation measures, developed countries must indicate in their national communication their proposed efforts to assist developing countries, as well as their contribution towards data collection and systemic observation of the climate in such countries.

Precautionary Principle

The precautionary principle is contained in Article 3(3) of the Convention. The Convention expects parties to take cautionary measures to anticipate and mitigate the adverse effects of climate change. When there is a doubt as to the effect of a proposed action on the climate system, parties should refrain from taking the step. Lack of scientific evidence establishing the detrimental nature of the proposed action is not a tenable excuse under the Convention.

Dreisen argues that the Precautionary Principle provision is rooted in the science of climate change: scientists fear that climate change may occur quickly and unpredictably, hence, waiting for scientific certainty before taking action may involve suffering through decades or centuries of hurricanes, droughts, ecological destruction, etc.[57]

The value of this principle in the Convention is that it takes into cognizance possible changes in scientific knowledge. It also reflects the reality that decision makers never have all the information they would like to have before making a decision that is likely to affect the environment.[58] The provision also emphasises the role of environmental impact assessment in climate change mitigation.

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[57] Dreisen *supra* note 9 at 16.

[58] UNEP, Training Manual on International Environmental Law: Principles and Concepts of International Environmental Law, 23 at 32 online: <http://www.iucnael.org/en/online-resources/unep-training-manual.html>.

Cost Effectiveness Principle

The cost effectiveness principle is also contained in Article 3(3) of the Convention. It states that policies and measures to deal with climate change should be cost effective so as to ensure global benefits. Policies and measures that are expensive are generally not attractive to decision makers, especially in a world of scarce resources. What is more, expensive measures are generally prohibitive and will preclude the poor countries that are signatories to the Convention from enjoying the benefits of such measures.

In Article 7, The Convention named the Conference of Parties as the supreme organ of the Convention. The Conference of Parties (COP) is to see to the implementation of the objectives of the Convention. In line with Article 7, the Conference of Parties has been meeting and deliberating on how best to achieve the objectives of the Convention.
At the first Conference of the Parties in Berlin in April 1995, a proposal was made for an ancillary instrument to the Convention containing specific and legally binding targets.[59] This proposal led to a subsequent protocol known as the Kyoto Protocol in 1997. The Protocol came into effect on 16 February 2005 with the receipt of the Russian Federation's instrument of ratification by the United Nations on 18 November 2004.

Following the Principle of Common but Differentiated Responsibility entrenched in the Convention, the Kyoto Protocol introduced a legally binding set of obligations for 38 industrialized countries and 11 countries in Central and Eastern Europe mandating them to return their GHG emissions to an average of approximately 5.2 percent below their 1990 levels over the commitment period of 2008-2012.

However, the Protocol allows for some amount of flexibility in the meeting of these obligations. It introduced three flexible (market) mechanisms by which the industrialized countries can meet their obligations. The three flexible mechanisms created under the Protocol were to supplement home grown mitigation efforts by Annex 1 countries. The three market instruments are in line with the Cost Effectiveness Principle contained in the

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[59] Harro Van Asselt & Joyeeta Gupta, "Stretching Too Far: Developing Countries and the Role of Flexibility Mechanisms" *supra* note 35 at 323.

Convention. The idea of the flexibility mechanisms is that Annex 1 countries can meet their obligations in a cost effective way. These market instruments are: International Emissions Trading provided for under Article 6, the Clean Development Mechanism provided for under Article 12 and the Joint Implementation under Article 4.[60] These three mechanisms enable countries to pay for emission reductions anywhere on the planet, based on the idea that climate change is a global problem, and that its reductions are equally good for the climate no matter where they occur.[61]

The Clean Development Mechanism allows the developed countries (Annex 1 countries) to invest in emissions reduction projects in developing countries, which they can use to meet their obligations under the Kyoto Protocol. Under the mechanism, developing countries are to learn sustainable development from their developed counterparts while the developing countries can use the emission reductions units garnered from the CDM projects to meet their obligations under the Protocol.

Joint Implementation gives the latitude to two or more developed countries to collaborate in meeting their emissions limitation obligation under the Protocol. In determining whether the countries involved in such an agreement have met their obligations under the Protocol, recourse will only be had to the their total aggregate emissions so long it does not exceed their individual allowable emissions under the Protocol.

Annex 1 countries are given Assigned Amount Units (AAUs) that limit the tonnes of greenhouse gases they are allowed to emit. Under the International Emissions Trading scheme of the Protocol, a particular Annex 1 country can purchase Emission Reduction Units (ERUs) from another developed country. The idea of this policy is to prevent a particular Annex1 country from exceeding its Assigned Amount Units under the Protocol.

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[60] *Kyoto Protocol*, online: <http://unfccc.int/kyoto-protocol/items/2830.php>.

[61] Jonathan Wiener, "Global Environmental Regulation: Instrument Choice in Legal Context" (1999) 108 Yale L.J. 677 at 691-692.

The detailed rules for operation of the three market mechanisms were not contained in the Protocol. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh, Morocco in 2001, and are referred to as the "Marrakesh Accords". The UN Climate Change Secretariat based in Bonn, Germany keeps an international transaction log to ensure that transactions are in accordance with the Protocol.

The Convention expects parties to remove greenhouse gases by source and by sink.[62] Forests are believed to be sinks of greenhouse gases in that they capture carbon dioxide from the atmosphere and consume it through the process of photosynthesis. In December 2007, at the 13th Conference of the Parties to the UNFCCC held in Bali, Indonesia, signatories to the Convention decided that national and international efforts to mitigate climate change should include the enhancement of forest carbon stock in developing countries.[63] This led to the creation of a mitigation platform known as REDD+ (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries). Parties in Bali noted that deforestation and forest degradation are both major sources of emissions and that, in some cases, forest degradation (e.g. of peat land soils) can generate high emission rates.[64] REDD+ is particularly important for Africa because Africa has a lot of forest carbon potential and its forest reserves have been undergoing degradation. REDD+ is one of the mitigation areas of work identified by the African Union in the Conceptual Framework of African Climate Change Programmes.[65]

The goal of stabilizing the concentrations of greenhouse gases in the atmosphere is a long-term vision, thereby requiring the broad participation of all parties. At COP 16,[66] signatories observed that the pace of mitigation efforts has been slow.

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[62] See Article 4(1)(a) of the *UNFCCC supra* note 5.

[63] United Nations, *Bali Action Plan*, online: <http://unfccc.int/key_documents/bali_road_map/items/6447.php>.

[64] See: the *Draft Declaration on the African Process for Combating Climate Change, at* 10, online: <http://www.unep.org/roa/Amcen/Amcen_Events/3rd_ss/Docs/nairobi-Decration-2009.pdf. >

[65] *Ibid*.

[66] The Climate Change Conference in Cancun, Mexico (December 2010).

Parties noted that:

> …deep cuts in global greenhouse gas emissions are required according to science, and as documented in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2 °C above preindustrial levels, and that Parties should take urgent action to meet this long-term goal, consistent with science and on the basis of equity; also recognizes the need to consider, in the context of the first review, as referred to in paragraph 138 below, strengthening the long-term global goal on the basis of the best available scientific knowledge, including in relation to a global average temperature rise of 1.5 °C.[67]

Parties stressed the need for enhanced action on mitigation by both developed country and developing country parties. Developing country parties were encouraged to formulate nationally appropriate mitigation plans of action in the context of sustainable development supported by technology, finance and capacity building. This gave rise to what is known as NAMA.[68] The Cancun Agreements created a registry for nationally appropriate mitigation plans of action for developing countries. Eighteen African countries have submitted mitigation projects that require financial and technological assistance; they are Benin, Botswana, Ghana, South Africa, Tunisia, Cameroon, Central African Republic, Chad, Congo, Ethiopia, Côte d'Ivoire, Eritrea, Gabon, Madagascar, Mauritania, Morocco, Sierra Leone and Togo.[69]

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[67] *Cancun Agreements*, online: <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2>. Keeping global rise in temperature below 2 °C above preindustrial levels is the only way the world can avoid the cataclysmic effects of climate change. At the Cancun Climate Change Conference, parties agreed that all mitigation efforts should be geared towards keeping global rise in temperature below this range; they made provision for possible changes in scientific knowledge by agreeing that the climate target could be changed to below 1.5°C if scientific knowledge so dictates.

[68] *Ibid*, Decision 53. A Registry was created for Nationally Appropriate Mitigation Actions of developing country parties.

[69] See: *UNFCCC Appendix II*, online: <http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php>.

Kyoto Protocol's first commitment period ended in 2012.[70] In Doha, Qatar, on 8 December 2012 the Doha Amendment to the Kyoto Protocol was adopted. The amendment would only come into force if it were accepted by three fourths of the parties to the Protocol.[71] The amendment was negotiated at a price; the European Union agreed to a second commitment period for the Protocol on the condition that there will be another treaty that will be all inclusive of all the contributing countries to the global greenhouse gas pool, or an agreed outcome with legal force for the post-2020 period[65].[72]

An all-inclusive treaty that covers all the contributing sources to the global greenhouse gas pool has implications for a country like South Africa. Despite being a developing country, it is one of the top emitters of greenhouse gases. South Africa has been under increased international pressure along with China, Brazil and India to assume some form of binding targets; this means its mitigation efforts have to be scaled up. An all-inclusive treaty also has implications for the other 52 countries in the African continent. A timeline in which the emissions of developing countries would peak could be specified in an all-inclusive treaty, meaning that African countries should be prepared for a carbon-constrained future.

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[70] Not much progress was made during the first commitment period of the Kyoto Protocol because the largest per capita emitter of greenhouse gases, the United States of America, decided to pull out of the Protocol, citing the fact that commitments under the Protocol could hurt its economy, and lack of binding targets for key developing countries like China and India. See: the United States Senate Resolution 98 105th Congress 1997 (enacted), cited in Harro Van Asselt and Joyeeta Gupta's article "Stretching too Far" *supra* note 35 at 325. The Protocol was negotiated during the Bill Clinton administration, but in 2001, the Bush administration described the Protocol as fundamentally flawed. Canada, Japan and the Russian Federation have also communicated their decision not to assume quantified emission limitation and reduction commitment (QELRC) during the second commitment period of the Kyoto Protocol. See: *the Doha Amendment*, online: <http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf>. It is expected, however, that the second commitment period of the Kyoto will witness more ambition in the fight against climate change, even as greenhouse gases reached a record high in the atmosphere in 2011. See: WMO press release No 965, online: <http://www.wmo.int/pages/mediacentre/press_releases/pr_965_en.html>.

[71] See: Article 20 of the Kyoto Protocol.

[72] Council of the European Union, Council Conclusions on the EU Position at the 17th Session of the Conference of the Parties of the UNFCCC, 3118th Environment Council meeting (Oct. 2011), online: <http://www.consilium.europa.eu/uedocs/cms_data/ docs/pressdata/en/envir/125026.pdf>.

The new treaty could specify a time when developing countries will assume quantified limitation and reduction commitments.

1.4 Research Methodology

Given the legal and practical nature of the research topic, the methodology to be adopted in this thesis will be analytical and expository. The thesis will utilize orthodox legal methods of research, including the doctrinal, analytical and the case study approaches in providing answers to the research questions.

First, I will expose the possible gaps in Africa's climate change mitigation policy architecture. I will look at the structure of the aforementioned policies with a view to pointing out their limitations. There will a doctrinal analysis of the literature on the nature and possible benefits of emissions trading. This will be followed by a case study approach on how to design a successful emissions trading scheme. This approach will show how emissions trading can cover the gaps in the policy architecture.

1.5 Justification of Choice of ETS Case Studies

In this thesis, there are four ETS schemes to be outlined as models for the proposed scheme. The schemes to be examined include: the U.S. Acid Rain Program, the EU ETS, the New Zealand ETS and the Santiago Particulate Program. The idea behind studying the four ETS schemes is to see what can be transferred or borrowed from these three ETS schemes to enhance the proposed scheme.

The United States of America was the first to experiment with emissions trading as a means of pollution control. After some initial misses, the United States Environmental Protection Agency finally succeeded with the Acid Rain Program. The Acid Rain Program was used to reduce the overall atmospheric levels of sulphur

dioxide and nitrogen oxides, which cause acid rain.[73] The program was the most successful and largest cap and trade program until the EU ETS came into existence.[74]

The cap and trade part of the program is significant for the proposed scheme because one of the problems that bedevilled CDM implementation in general is the problem of "additionality".[75] Baseline trading systems (the form of trading under the CDM) involve making a determination as to whether emissions reductions would have occurred anyway without the project. If the emissions reductions are not additional, it dilutes the environmental integrity of the scheme.[76]

Obtaining data for baseline development is difficult, coupled with the fact that it is impossible to verify baseline data with the necessary degree of certainty.[77] This is exacerbated in a continent where data management is still at its infancy.

The EU ETS is the first multinational cap and trade program for greenhouse gases. It is a scheme involving sovereign nations with diverse historical, institutional, and economic circumstances. It is the largest cap and trade program in operation. Thus, it is a useful model from which to learn. Though the EU ETS was primarily designed to help European nations meet their obligations under the Kyoto Protocol,[78] it also holds important lessons on how to manage a scheme involving countries without QELRCs under the Kyoto Protocol. This will be shown in the course of this work.

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[73] United States Environmental Protection Agency, *What Causes Acid Rain?*, online: <http://www.epa.gov/acidrain/>.

[74] Tom Tietenberg *et al*., International Rules for Greenhouse Gas Emissions Trading, Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability, United Nations Conference on Trade and Development Secretariat, 1 at 27, online: <http://www.unctad.org/en/docs/pogdsgfsbm6.en.pdf>. The program was a success, both environmentally and economically.

[75] Harro Van Asselt and Joyeeta Gupta, "Stretching Too Far" *supra* note 35 at 345.

[76] US EPA, Tools of the Trade: A Guide to Designing and Operating a Cap and Trade Program for Pollution Control (2003), 1-1 at 2-7.

[77] Harro Van Asselt and Joyeeta Gupta, "Stretching Too Far" *supra* note 35 at 345.

[78] European Commission, The EU Action Against Climate Change 2009 Edition, (2009), 1 at 5.

The New Zealand ETS is the first cap and trade program that covers all the Kyoto gases.[79] New Zealand is a small country with modest emissions;[80] it has a lot of carbon potential in the agriculture and forestry industries. Forestry is currently covered in the trading program, with plans to include the agricultural sector in 2015. Africa also has significant carbon potential in the agriculture and forestry industries.

Chile is a developing country. Its experience with tradable permit scheme is apt for the countries in Africa.

1.6 Scholarly Significance

African countries like all other developing countries are inexperienced in greenhouse gas mitigation. It is important African countries build capacity in carbon trading since the global carbon market is at the heart of the world's fight against climate change.

The Stern Review have advocated for creation of a global price on carbon through the linking of emissions trading schemes as a way of fighting climate change in a cost effective manner.[81] Thus, there is a strong probability that emissions trading will continue to play a major role in the fight against climate change.

This work will also aid in the development of Africa's climate policy.

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[79] See: Tom E. Moyes, "Greenhouse Gas Emissions Trading in New Zealand, Trailblazing Comprehensive Cap and Trade" (2008) 35 Ecology L.Q. 911 at 913.

[80] Chris Bougen, "Emissions Trading in New Zealand", *Market Trends* (December 2009) 49.

[81] Nicholas Stern, *Economics of Climate Change the Stern Review*, (Cambridge University Press 2007) 480.

Chapter 2

2 Analysis of Africa's Climate Change Mitigation Policy Architecture

2.1 Introduction

The strength of any policy architecture can only be measured against its overriding objectives. The African Union does not yet have a specific climate change mitigation objective.[82] However, we have seen in the preceding chapter that the Conference of Parties (COP) has set a stabilization target of keeping the total global average warming to no more than 2ºC/3.5ºF relative to pre-industrial levels.[83] This is the standard that will be used to analyse Africa's climate change policy architecture.

According to the Stern review,[84] even if the developed world takes on responsibilities for absolute cuts in emissions of 60-80 percent by 2050, developing countries must take significant action too, in order to avoid temperature increases above 2.0 °C. This chapter seeks to answer the question, "What are the gaps in Africa's climate change mitigation policy architecture?"

First for discussion is the proposed carbon tax in South Africa. This will be followed by the implementation of REDD+ so far in Africa. Thereafter, the discussion will move to CDM implementation in Africa. The chapter ends with a discussion of NAMA.

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[82] The African Union has only identified mitigation areas of need or work and it is contingent on technology transfer, capacity building and finance. See the Conceptual Framework for African Climate Change Programmes contained in the African Process for Combating Climate Change, 1 at 10, online: < http://www.unep.org/roa/Amcen/Amcen_Events/3rd_ss/Docs/nairobi-Decration-2009.pdf> The areas of work are in energy efficiency, renewable energy development investments REDD, land use change and forestry. The areas of work are contingent on capacity building, finance that must be additional to developmental aid and technological transfer.

[83] To avoid temperatures above those levels, atmospheric concentrations of carbon dioxide would need to peak below about 400 to 450 parts per million and stabilize in the long-term at around today's levels.

[84] See the Stern Review on the Economics of Climate Change *supra* note 73 at vii.

2.2 Carbon Tax in South Africa

A few background facts about the country, South Africa, are apposite here. South Africa is a middle-income developing country whose economy is built on the wealth of its mineral resources and its primary sectors;[85] its population was estimated to be roughly 50 million in 2010.[86] South Africa is the most industrialised country in Africa with well-developed mining, transport, energy, manufacturing, tourism, agriculture, and services sectors. The South African economy is powered by coal[87] and its contribution to the global pool of greenhouse gases is 1.8 percent.[88] Its total emissions in 2000 were estimated to be 461 million tonnes of carbon dioxide equivalents (CO_2e).[89] Eighty-three percent of emissions are derived from energy supply and consumption, 7 percent from industrial processes, 8 percent from agriculture, and 2 percent from the waste sector.[90]

In 2011, South Africa formally published its National Climate Change Response Policy. The Policy has two objectives:

- Effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- Make a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner.[91]

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85 *South Africa's Second National Communication under the United Nations Framework Convention on Climate Change* (Department of Environmental Affairs 2011) at 8 online: <http://unfccc.int/resource/docs/natc/zafnc02.pdf>.

86 Statistics SA cited in South Africa's Second National Communication *supra* note 77 at 3.

87 Patrick Bond, "Privatization of the Air Turns Lethal: Pay to Pollute Kills South African Activist Sajida Khan" (2007) 18 CNS 4 at 19.

88 *Ibid*. South Africa is the 17th largest emitter of greenhouse gases in the world. See *Climate Analysis Indicators Tool CAIT Version 5.0* (Washington DC World Resources Institute 2008).

89 South Africa's Second National Communication *supra* note 77 at ix.

90 *Ibid*.

91 South Africa, *National Climate Change Response White Paper* (2011) at 5, online: <http://www.info.gov.za/view/DownloadFileAction?id=152834>.

South Africa has also developed what is called Long Term Mitigation Scenarios (LTMS). The idea behind the LTMS was to develop broad and sound mitigation scenarios that will form the basis of a long-term climate policy.[92] LTMS is a detailed study of South Africa's mitigation potential. Acting on the LTMS, South Africa announced at COP15 (the 2009 climate change conference in Copenhagen Denmark) that its emissions should peak in the period from 2020 to 2025, remain stable for around a decade, and decline thereafter in absolute terms.[93]

As part of its international commitment to fight climate change, South Africa is considering the use of a carbon tax to reduce its emissions; South Africa National Treasury started experimenting with environmental taxes in 2006. In 2010, it published a Discussion Paper on various designs of a carbon tax.

The proposed tax would cover all direct, stationary sources, and process emissions. The tax would apply to methane, carbon dioxide, and nitrous oxide.[94] The implementation was meant to start in October 2014 in two phases: the first running to 2019, and the second to 2025; but it has now been shifted to 2015. The initial proposed rate is ZAR 120 per tCO_2e, applying above a certain threshold of a firm's emissions, and would increase 10 percent annually until 2019-20.[95]

In the first phase, the tax would only apply to 40 percent of total emissions (basic threshold at 60 percent). Trade-exposed sectors with competitiveness concerns and process emissions would receive an additional exemption of 10 percent each. An offset mechanism is also envisaged to offset carbon tax liability up to a maximum of 5 or 10 percent. Revenue would not be earmarked, but consideration given to environmental

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[92] Harold Winker, *Long Term Mitigation Scenario Project Report* at 1,online: <http://www.erc.uct.ac.za/Research/LTMS/LTMS_project_report.pdf>.
[93] National Climate Change Response *supra* note 83 at 27.
[94] Sara Moarif & Namrata Rastogi, *Market based Climate Mitigation Policies in Emerging Economies*, (Center for Climate and Energy Solutions Publications 2012) at 21.
[95] *Ibid*.

issues when determining revenue use, particularly to energy efficiency and assistance to low-income households.[96]

The proposed tax is not the first tax targeted at greenhouse gas emissions in South Africa. There is already in place a levy of ZAR 3.5c/ kWh on electricity generated from fossil fuel.[97] There is also a tax on new vehicles in place;[98] new passenger cars are taxed on carbon dioxide emissions above 120 g/km at a fixed rate of ZAR 75 per g/km. For example, if a new passenger car emits 200 g/km of carbon dioxide, it will be taxed on the 80 g/km emitted above the 120 g/km threshold. At the suggested flat rate of ZAR 75 per g/km, such a vehicle will attract a carbon tax of ZAR 6,000.[99] This particular tax seeks to reduce emissions from the transport sector; it is targeted at the manufacturers as well as buyers of vehicles that are not environmentally friendly. The proposed tax differs from the already implemented taxes because it is a universal carbon tax.

Ideally, for a tax to be environmentally effective, the tax rate should equal the social marginal damages from producing an additional unit of emissions or, more or less equivalently, the social marginal benefit from abating a unit of emissions.[100]

Thus, the optimal tax rate would be where the marginal benefit of abatement equals the marginal cost of abatement.[101] To arrive at the optimal rate, the government would need to estimate both the marginal abatement cost curve and the marginal abatement benefit curve. Estimating the marginal abatement cost curve and the marginal benefit curve is an uncertain science. Climate change as a global problem means that damage costs have to

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[96] *Ibid*.
[97] *Ibid*.
[98] South Africa's Second National Communication *supra* note 77 at 185.
[99] Anja Finnern, ''Carbon Tax'', *Accountancy SA* (December 2010) online: <http://www.accountancysa.org.za/resources/ShowItemArticle.asp?ArticleId=2092&Issue=1099>.
[100] Arthur Pigou**,** *The Economics of Welfare 192-93*, 4th ed (Transaction Publishers 2002) cited in Gilbert Metcalf & David Weisback " The Design of a Carbon Tax" (2009) 33 Harv. Envtl. L. Rev 499.
[101] Gilbert Metcalf & David Weisback: The Design of a Carbon Tax *supra* note 92 at 511.

be assessed globally.[102] Asking local polluters to pay the global damage costs seems unfair. Such a system would probably succeed if there were an international carbon tax. The National Treasury of South Africa seems to appreciate this fact when it said:

> The tax rate should, over time, be equivalent to the marginal external damage costs of GHGs to affect appropriate incentives. However, in the absence of an international climate change agreement and therefore a global emissions pricing system, a partial, rather than full, internalisation of the externality will be considered as an interim measure.[103]

Even if a uniform tax is adopted, the end result is that polluters would undertake to implement those emission reductions that are cheaper than paying the tax, because each emitter weighs the cost of emissions control against the cost of emitting and paying the tax.[104] It does not offer an incentive to polluters that want to make aggressive cuts in emissions.

Another thing that emerges from the literature on environmental taxes is that environmental taxes cannot guarantee environmental certainty. This is due to the fact that, at the time of setting the tax, policy makers do not have all the required information regarding technological progress and price sensitivities;[105] so, setting the tax at the required level to meet the emission target becomes difficult. New entrants into the polluting industry can also upset the whole arrangement, in that their activities could lead to increased emissions.[106] To ensure that the environmental goal is not diluted by reason of new polluting sources, the tax level has to be adjusted.

Environmental certainty is important when considering South Africa's LTMS target, which anticipates a peak, a plateau, and a decline. A peak by 2020 or 2025 and a decline

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[102] *Ibid*.

[103] National Climate Change Response *supra* note 83 at 41.

[104] Gupta S *et al* "Policies, Instruments and Cooperative Arrangements" in Metz, Davidson, Bosch, Dave, LA Meyer, eds, *Climate Change 2007- Mitigation of Climate Change* (Cambridge University Press 2007) 745 at 755.

[105] A Guide to Designing and Operating a Cap and Trade Program *supra* note 68 at 2-6.

[106] *Ibid*.

thereafter mean that the environmental outcome must be certain as of 2015, when tax is meant to be introduced until 2020 or 2025. The policy makers in South Africa are well aware of this point. In the National Climate Response White Paper, the government said:

> Although a carbon tax does not set a fixed quantitative limit on GHG emissions over the short-term, such a tax—at an appropriate level and phased in over a period to the "correct" level—will provide a strong price signal to both producers and consumers to change their behaviour over the medium- to long-term. The National Treasury's carbon tax policy will seek to primarily stimulate behaviour change through the price mechanism, and as a secondary benefit, generate a revenue stream that may allow fiscal decisions over time that support climate change policy and broader sustainable development objectives.[107]

The government's view that the tax will generate revenue and that this revenue will be used to stimulate other sustainable development goals is sound, but claims about the tax instilling a behavioural change may be an overestimation. This claim can only be satisfactorily investigated ex post, but if Nigeria's experience with the use of pollution charges reveals anything, it is that taxes or pollution charges by themselves are not enough to instil behavioural change.

Environmental taxation has, from the onset, been an integral part of the gas flaring legal regime in Nigeria, and has been one of their government's frontline policies in seeking to eliminate flaring. In principle, Section 3 of the Associated Gas Reinjection Act outlaws gas flaring, but allows polluters to continue to flare on payment of a fine. The Section provides as follows:

> **3. Flaring of gas to cease**
>
> Subject to subsection (2) of this section, no company engaged in the production of oil or gas shall after 1 January, 1984 flare gas produced in association with oil without the permission in writing of the Minister [1985 No.7.]
>
> (2) Where the Minister is satisfied after 1 January 1984 that utilisation or re-injection of the produced gas is not appropriate or feasible in a

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[107] National Climate Change Response *supra* note 83 at 41.

> particular field or fields, he may issue a certificate in that respect to a company engaged in the production of oil or gas-
>
> (a) Specifying such terms and conditions, as he may at his discretion choose to impose, for the continued flaring of gas in the particular field or fields; or
>
> (b) Permitting the company to continue to flare gas in the particular field or fields if the company pays such sum as the Minister may from time to time prescribe for every 28.317 Standard cubic metre (SCM) of gas flared:
>
> Provided that, any payment due under this paragraph shall be made in the same manner and be subject to the same procedure as for the payment of royalties to the Federal Government by companies engaged in the production of oil.[108]

The penalty was initially fixed at 2 kobo (equivalent to US$0.0009 in 1985) against the oil companies for each 1,000 standard cubic feet (scf) of gas flared. In 1990, the penalty was increased to 50 kobo/10,000 scf. This was further raised to 10 naira/1000 scf in 1998. In 2008, the penalty was raised to US$3.50 (equivalent to 560 naira today) for every 1,000 scf of gas flared. Nigeria is also planning to raise the penalty to the international market value of the tax flared.[109] In 2012, the Nigerian National Petroleum Corporation (NNPC) confirmed that flare is only down by 15 percent, which means 85 percent of Nigerian gas is still being flared.[110]

The Nigerian situation is relevant to the South African situation because the enactment of the tax in Nigeria followed the "slow ramp-up" approach, which is what the National Treasury of South Africa wants to use as well. In a "slow ramp-up" approach,[111] the tax

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[108] Associated Gas Re-injection Act 1985 (Nig), Section 3.

[109] Petroleum Industry Bill, An Act to Provide For the Establishment of a Legal, Fiscal and Regulatory Framework For the Petroleum Industry in Nigeria and Other Related Matters , 7th National Assembly, 2012, Section 277(3).

[110] Adeola Yusuf, "FG Confirms 85 percent flaring by IOCs" *Daily Independent Newspaper* online: <dailyindependentnig.com/2012/12/fg-confirms-85-gas-flaring-by-iocs/ daily independent newspaper>.

[111] The other approaches for the introduction of an environmental tax are the grandfathering approach and the cold- turkey approach**.** Grandfathering would exempt from taxation a baseline level of emissions, such as an amount equal to emissions in a reference year. A cold-turkey approach would simply introduce the

is introduced gradually over time, starting with a low initial rate or a narrow initial base and then increasing the rate or base at a pre-announced schedule in order to reach the desired system.

Setting the tax at the desired rate is complicated; this is evident in the proposed plan by Nigeria to set the flare penalty to the international market value of the gas flared. The market value of gas varies across continents.[112]

Competitiveness concerns could also weaken the effectiveness of the proposed tax in that trade exposed sectors will seek to be exempted from the tax. There is no danger of this in a cap and trade program because of the opportunity offered by linking. Joining the ETS with the EU ETS and other ETS' in other jurisdictions will ensure that companies that would have sought exemption from the tax will participate in cutting their emissions as the argument of being unduly exposed will no longer be tenable.

What is more, a universal carbon tax is likely going to be regressive. This could aggravate the social inequality in South Africa. As stated in its national communication to the UNFCCC,

> There is high social inequality in a population of about 50 million people, revealed by a Gini coefficient of between 0.66 and 0.69, several poverty and human development indices emphasise this.[113]

Thus, the revenue to be generated from the carbon tax has to go towards addressing the social inequality in South Africa, and not only to carbon mitigation measures. Ultimately, the effect of the proposed tax in South Africa can only be satisfactorily assessed after its implementation, which will start in 2015. This is meant to give

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tax without any special provision for transition. For further reading see Gilbert Metcalf & David Weisback, "The Design of a Carbon Tax" *supra* note 92 at 516.

[112] Gas trades for about $16 in Japan and between about $8.80 and $12 in Europe. See Carrie Tait, ''Natural gas glut seeps into high price market '', *Globe and Mail* (April 12 2012) online: <http://www.theglobeandmail.com/report-on-business/natural-gas-glut-seeps-into-high-price-markets/article4102804/>

[113] South Africa Second National Communication *supra* note 77 at viii.

companies time to adjust to the new fiscal regime on climate change.[114] Carbon tax and a tradable permit scheme are not mutually exclusive. They can complement each other. Carbon tax can be used for certain sectors of the economy, while a tradable permit scheme can cover the rest. This way the country will profit from the unique benefits of both policies.

2.3 REDD+ in Africa

REDD+ discussions within the UNFCCC negotiations had been on for a while, but it gathered momentum in 2005 when the Coalition for Rainforest Nations[115]–led by Costa Rica and Papua New Guinea—presented a formal proposal for reducing GHG emissions from deforestation to the 11th Conference of the Parties (COP) of the UNFCCC and first Meeting of the Parties (MOP) to the Kyoto Protocol (COP 11/CMP 1). At the same meeting, several nongovernmental organizations (NGOs) and scientists, led by Environmental Defense, reiterated earlier calls for inclusion of forests under Kyoto's trading instruments.[116] COP 11 requested that its Subsidiary Body for Scientific and Technological Advice (SBSTA) evaluate the issue of reducing emissions from deforestation and report back to UNFCCC COP 13/MOP 3 in December 2007.[117]

REDD+ is meant to address the perceived gaps in the operation of the Clean Development Mechanism. The list of eligible activities under the CDM includes afforestation and reforestation,[118] but expressly excluded measures to reduce

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[114] Mike Cohen, ''South Africa Delays Implementation of Carbon Tax Until 2015 '', *Bloomberg* (27 February 2013).

[115] Bangladesh, Bolivia, Central African Republic, Cameroon, Chile, Congo, Colombia, Costa Rica, Democratic Republic of Congo, Dominican Republic, Ecuador, El Salvador, Fiji, Gabon, Ghana, Guatemala, Honduras, Indonesia, Kenya, Lesotho, Malaysia, Nicaragua, Nigeria, Panama, Papua New Guinea, Paraguay, Peru, Samoa, Solomon Islands, Thailand, Uganda, Uruguay, and Vanuatu. See: <http://www.rainforestcoalition.org/nations/aspx>.

[116] Griffiths & Martone, Seeing 'REDD'? Forests, climate change mitigation and the rights of indigenous peoples and local communities (Forest Peoples Programme May 2009) at 4.

[117] *Ibid*.

[118] "Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources while Reforestation" is the direct human-induced conversion of non-forested land to

deforestation, and hence did not provide a means for CDM funding to help developing countries tackle deforestation.[119]

REDD+ discussions further gained momentum with the publication of the Stern Review on the Economics of Climate Change.[120] The Stern Review recommended thus:

> Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions and has the potential to offer significant reductions fairly quickly. It also helps preserve biodiversity and protect soil and water quality. Encouraging new forests, and enhancing the potential of soils to store carbon, offers further opportunities to reverse emissions from land use change.[121]

At the 13th Conference of the Parties to the UNFCCC held in Bali in December 2007, discussions on the inclusion of forests in climate change mitigation continued. In the Bali Action Plan, parties decided that national and international actions to mitigate climate change should include:

> Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stock in developing countries.[122]

Parties were urged to:

> …explore a range of actions, identify options and undertake efforts, including demonstration activities, to address the drivers of deforestation relevant to their national circumstances, with a view to reducing emissions

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forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. Definitions taken from *Decision 11/CP7*, online: <http://unfccc.int/resource/docs/cop7/13a01.pdf#page=54 >.

[119] Dave Pritchard, Reducing Emissions from Deforestation and Forest Degradation in Developing Countries-the Link with Wet Lands (Foundation for International Environmental Law 2009).

[120] Griffiths and Martone Seeing REDD *supra* note 107 at 4.

[121] Stern Review on the Economics of Climate Change *supra* note 73 at 537.

[122] Bali Action Plan *supra* note 45 at 3.

> from deforestation and forest degradation and thus enhancing forest carbon stocks due to sustainable management of forests.[123]

The need to reduce emissions from deforestation was again reemphasised at COP 16 in Cancun, Mexico. Parties were urged to "collectively aim to slow, halt, and reverse forest cover and carbon loss, in accordance with national circumstances, consistent with the ultimate objective of the Convention, as stated in Article 2".[124]

What is REDD+?

As stated in the Cancun Agreements, REDD+ includes:

> (a) Reducing emissions from deforestation;
>
> (b) Reducing emissions from forest degradation;
>
> (c) Conservation of forest carbon stocks;
>
> (d) Sustainable management of forests;
>
> (e) Enhancement of forest carbon stocks.[125]

It refers to a suite of interventions that aim to enhance the removal of GHG emissions through forest conservation, sustainable management of forests, and the enhancement of forest carbon stocks in developing countries.[126]

REDD+ is important because deforestation is the second largest anthropogenic source of carbon dioxide after fossil fuels.[127] Plants and trees remove carbon from the atmosphere through photosynthesis as they grow. However, when forest is cleared and soils are

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[123] Bali Action plan *supra* note 45 at 8.

[124] Cancun Agreements *supra* note 48 at 12.

[125] *Ibid*.

[126] African Wild Life Foundation: Making REDD+ work for Africa Lessons Learned from Pilot Forest Carbon Initiatives in Tanzania, Kenya and Democratic Republic of Congo (2011) online: <http://www.awf.org/documents/climatechange/AWF_Mitigation_Final_11242011.pdf >.

[127] Van Der Wherf *et al*., "CO_2 emissions from forest loss" (2009) Nature Geo Science 2 737-738 cited in Cheik Mbow *et al*., *Challenges and Prospects for REDD+ in Africa Desk Review of REDD+ implementation in Africa* (Global Land Report No. 5 2012), online: <http://www.start.org/Publications/REDD_Report.pdf>.

disturbed through ploughing, the stored carbon is released back into the atmosphere. Deforestation is the major singular source of greenhouse gases emissions in Africa. Africa accounts for 20 percent of the global net CO_2 emissions from land-use change.[128]

Forest degradation of peat soils can generate emissions; peat soils generate emissions when they switch from anaerobic conditions to aerobic conditions through human interference. The switch occurs through the deposition of decaying matter in their waterlogged soils. The carbon and methane they sequester is released back to the atmosphere when decaying matter is deposited in them.[129]

Forest degradation is very rampant in Africa and has been most severe in Nigeria, where more than 410,000 hectares of forest are lost to desertification annually.[130] Less than 12.2 percent of the country's land is forested.[131] Ghana also lost an average of 115,000 hectares of forest per year between 2000 and 2005. Over the last 15 years, West Africa has lost almost 12 million hectares of tropical forest.[132] Even though African forests constitute only 16 percent of the world's total, the deforestation rate in Africa is more than six times the world's average.[133]

African forests play a crucial role in the global carbon cycle, since tropical forests store more carbon than other types of forests.[134] African forests account for 17 percent of the world's forest cover with over 582 million hectares of forested land. These include the world's second largest rainforest, covering 180 million hectares across the Congo Basin.[135]

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[128] Canadell *et al*, "Anthropogenic C02 Emissions in Africa" (2009) Biogeosciences 6 463-469.
[129] Peat soils are a class of wetlands. Dave Pritchard REDD+ in Developing Countries *supra* note 110 at 8.
[130] AMCEN Addressing Climate Challenges in Africa *supra* note 4 at 12.
[131] *Ibid*.
[132] *Ibid*.
[133] *Ibid*.
[134] *Ibid*.
[135] *NASA Map reveals tropical Carbon Storage*, online: <http://www.nasa.gov/topics/earth/features/earth20110531.html>.

REDD+ is not only a mitigation measure; it has adaptation as a co-benefit. Tropical forests influence precipitation and can have a cooling effect on a region through increased evaporation and cloud cover.[136] Urban forests and trees provide green infrastructure – shade, evaporative cooling, and rainwater interception, storage and infiltration – in cities.

They can play a significant role in urban adaptation to climate variability and change by reducing temperatures during heat waves.[137] Forests contribute to regulating river flows (base flows during dry seasons and peak flows during rainfall events), thereby minimising risks related to water scarcity and floods.[138] Research in Africa shows that leguminous trees can make agriculture more drought-resilient by improving water infiltration and increasing productivity through nitrogen fixation.[139]

REDD+ also has other benefits, such as protection of biodiversity and economic empowerment for forest dependent communities, in that it offers incentives to protect forest stock.

To participate in REDD+, developing countries are to develop:

> (a) A national strategy or action plan;
>
> (b) A national forest reference emission level and/or forest reference level or, if appropriate, as an interim measure, subnational forest reference emission levels and/or forest reference levels, in accordance with national circumstances;
>
> (c) A robust and transparent national forest monitoring system for the monitoring and reporting of the activities.[140]

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[136] CIFOR, *Forest and Climate Change Adaptation: What Policymakers Should Know* (Factsheet No 1 November 2012), online: <http://www.cifor.org/fileadmin/factsheet/RIO+20_Factsheet percent20-percent20Adaptation.pdf>.
[137] *Ibid*.
[138] *Ibid*.
[139] *Ibid*.
[140] Cancun Agreements *supra* note 48 at 13.

Developed country parties are to support developing country parties' action in this regard through capacity building, technology transfer, and finance and general support for results-based demonstration activities.[141]

The final form of REDD+ is yet to be known, as parties failed to agree on how to measure emissions reductions from REDD+, i.e. monitoring, reporting and verification of carbon emissions from REDD+ at COP 18.[142] This is important for REDD+ demonstration projects to get underway.[143]

The early implementation of REDD+ in Africa, i.e. REDD+ readiness projects, presents a worrying sign. In the fall of 2009, the Ogiek people of Kenya, a forest-dependent community, were forcibly displaced due to the introduction of REDD+ in the Mau Forest.[144] Over 22,000 people were violently evicted from the Mubende and Kiboga districts in Uganda to make way for the UK-based New Forests Company to plant trees.[145] Evicted successful farmers were reduced to becoming poorly paid plantation peons on the land from which they were evicted.[146] Natural forests are also being converted to monoculture plantations in the name of REDD+.[147] This has led some scholars to advocate for the rights-based approach to REDD+, i.e. the recognition of the rights of forest-dependent communities.[148]

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141 *Ibid*.

142 Michelle Kovacevic, "Disappointing outcome for forests in Doha, but REDD+ can still move forward " Cifor Blog (11 December 2012), online: < http://blog.cifor.org/13152/disappointing-outcome-for-forests-in-doha-but-redd-can-still-move-forward/#.UUAXWhysiSo>.

143 *Ibid*. Credits for REDD+ projects are only available currently through the voluntary carbon markets.

144 *Ten of the Worst REDD- projects affecting Indigenous People and Local Communities* (No REDD papers one, Carbon Trade Watch, November 2011) at 46 online: <http://www.redd-monitor.org/wordpress/wp-content/uploads/2011/11/noreddpapers_download.pdf>.

145 *Ibid*.

146 *Ibid*.

147 Plantations store less carbon than natural forests. See: Rita Osarogiagbon, "REDD and its implication on community people" (Presentation made at Cross River State stakeholders forum on Climate change, 1 March 2011).

148 Griffiths and Martone Seeing REDD *supra* note 107 at 9.

The Cancun Agreements sought to remedy this defect by providing that the rights of indigenous peoples must be respected by developing country parties in REDD+ activities;[149] these parties must show how they are going to safeguard the rights of indigenous people in REDD+ implementation.

Another challenge facing REDD+ implementation in Africa is the underlying drivers of deforestation. It is already recognised at the UNFCCC level that a good REDD+ must address these drivers,[150] which are economic and difficult to reverse.

Logging is one of the drivers of deforestation in Africa. Forestry is an important source of livelihood in Africa, as it is a source of employment for approximately 500,000 people.[151] The contribution of forestry to the African economy is still marginal, but the fact that people depend on it for daily survival cannot be discountenanced.

Another driver of deforestation in Africa is fuel wood extraction. Almost two thirds of global fuel wood use is in Africa,[152] where it is a significant source of energy. Current levels of extraction largely exceed the regenerative capacity of the forests. Fuel wood extraction is even greater than industrial wood extraction.[153]

A third driver of deforestation and loss of forest cover is agriculture. Conversion of forested land to cropland by farmers is one of the ways agriculture contributes to deforestation in Africa. Shifting cultivation and use of fire in farming is another way agriculture contributes to deforestation on the continent.[154]

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[149] Cancun Agreements *supra* note 48 at 26.
[150] *Ibid* at 13.
[151] Matieu Henry *et al*., "Implementation of REDD+ in Sub Saharan Africa: State of Knowledge, Challenges, and Opportunities" (2011) Environ Dev Econ 16 381 at 384.
[152] *Ibid* at 385.
[153] *Ibid* at 384.
[154] Global Land Report No 5 *supra* note 119 at 37.

Another driver of forest degradation in Africa is artisan mining. There is a noticeable trend towards "de-agrarianization"[155] in rural households; up to 50 percent of rural incomes in Africa are derived from off-farm sources.[156] Artisan mining is fast becoming a preferred non-farm occupation.[157] In Ghana, the desire to earn foreign exchange from the mining sector conflicts with the objectives of REDD+.[158]

Attempts to address these drivers appear to be failing. The Liquefied Petroleum Gas Policy in Nigeria was designed to address reliance on a fuel wood extraction as a source of energy but it is not producing the desired results. This has been attributed to institutional and policy inefficiencies.[159] The reason why a thriving domestic gas market is yet to develop in Nigeria goes beyond institutional failures. Fuel wood extraction is cheap compared to all other sources; even if gas supply penetrates the hinterlands in Nigeria, people will still resort to fuel wood extraction for their energy needs because it is less costly. In fact, there is no cost involved with fuel wood extraction for energy needs.

From the foregoing, it is clear that the drivers of deforestation are economic; this infers that part of the solution must also be economic. Creating a value for maintaining forest cover can help in changing behaviour. Forest-dependent communities and farmers are key actors in a successful REDD+. They must be actively engaged in the battle to maintain forest cover, and the only way they can be engaged is if they see the practical benefits of REDD+.

Farmers will be better able to internalise concepts such as agro-forestry[160] and better farming practices when they see the monetary incentives for maintaining forest cover. Monetary incentive has proven to be successful in maintaining forest cover in Costa Rica,

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[155] The term " de-agrarianization" connotes the movement of rural dwellers away from agricultural based modes of livelihood.
[156] Mark Hirons, "Locking-in Carbon, Locking-out Livelihoods? Artisanal Mining and REDD+ in Sub-Saharan Africa" (2011) J.Int.Dev 23 1140-1150.
[157] *Ibid* at 1141.
[158] Global Land Report No 5 *supra* note 119 at 25.
[159] Global Land Report No 5 *supra* note 119 at 26.
[160] Agro-forestry is the practice of planting special types of trees and crops, such as the pigeon pea nitrogen-fixing crop, to improve the fertility of the soil.

where land owners were promised 45 dollars for maintaining it. Forest cover increased from 21 percent in 1977 to 51 percent in 2005 as a result of this monetary incentive coupled with other measures.[161]

The monetary incentive should be equal to or greater than the returns from alternative uses of land. This will create enthusiasm among the farmers and cause less friction. Creating economic incentives is the only way REDD+ can attain its objectives of curbing emissions and reducing poverty.[162] If REDD+ results in enhancement of livelihood rather than loss of livelihood, it will face less opposition from rights activists.

2.4 CDM in Africa

The purpose of CDM is as contained in Article 12 (2) of the Kyoto Protocol, which provides as follows:

> The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.

CDM allows developing countries to participate in stabilizing the concentration of greenhouse gases in the atmosphere despite not having QELRCs (Quantified Emission Limitation and Reduction Commitments) under the Protocol. It allows developed countries (known as Annex 1 countries under the Protocol) to identify and invest in emission-reducing projects in developing countries, and to claim credits for the reductions achieved. Conceptually, this investment is meant to reduce compliance costs for developed country parties, and result in transfer of funds and new technology to developing countries. The range of sector and source categories that could be addressed via CDM project activities is indicated in the table found in Appendix A.

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[161] Stern Review *supra* note 74 at 544.
[162] Cancun Agreements *supra* note 48 at 26.

A developing country is at liberty to implement CDM projects without the support of a developed country. All it needs to do is identify a project that will result in emissions reduction and seek registration for the project before the CDM Executive Board; then it will need to source for potential buyers for the certified emissions reduction units (CER). This is called unilateral CDM; project activities that do not have an Annex I party letter of approval at the time of registration are known as "unilateral CDM" projects.[163]

Ratification of the protocol is a condition precedent to participation in CDM.[164] Most African countries have ratified the Protocol. A developing country must also have a Designated National Authority for CDM.[165] According to Manso, the functions of the DNA include: serving as the focal point between investors and the host country government; providing potential projects for investors; processing framework agreements with investors; ensuring that an environmental impact assessment is carried out before approving projects and considering the assessment reports carefully; providing legal advice for project investors; coordinating with other relevant official entities and authorities within the host country; drawing up standardized baselines; monitoring ongoing CDM projects; granting export of emissions rights (CERs); conducting public relations and providing information on CDM implementation in the host country through advertisements in the media and through the web. It is also to design and establish an evaluation procedure that adopts international eligibility criteria to assess the contribution of the prospective CDM projects to sustainable development in the host country.[166]

One of the most important criteria for CDM projects is that it should contribute to sustainable development in a developing country.[167] The CDM Rules and the Kyoto Protocol do not offer any common guidelines or indicators for assessing the sustainable

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[163] *CDM Rulebook*, online: <http://cdmrulebook.org/616>.

[164] Decision 3/CMP 1 Modalities and Procedure for a Clean Development Mechanism - Participation Requirements (10 December 2005) at 12, online: <https://cdm.unfccc.int/Reference/COPMOP/08a01.pdf>.

[165] *Ibid*.

[166] P Manso, Establishing a National Authority for the Clean Development Mechanism (CDM): The Costarican Experience (Paris: OECD, 2003) at 8-9.

[167] art 12 *supra* note 54. See also: Decision 3/CMP 1 *supra* note 155 at 6.

development benefits of a CDM project. It is left for the host country to formulate its own definition of sustainable development.

Another criterion a CDM project has to meet is "additionality". A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.[168] The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity.[169] The alternative scenario may be the "business as usual" scenario (the continuation of current emission levels in the absence of the CDM project), or some other scenario that involves a gradual reduction in emissions intensity.

The CDM project process has been summarised as follows:

> • Obtaining formal written approval from the DNA of the Host Country for the proposed project and an affirmation that the project will assist the Host Country to achieve sustainable development;
> • Obtaining formal written authorization from the Party to the Kyoto Protocol of the voluntary participation of the proposed Project Participants;
> • Creation of a Project Design Document containing details of the project activity, the proposed monitoring methodology and baseline, the crediting period of the project, the Project Participants and the method by which the participants will communicate with the CDM Executive Board;
> • Review and Validation of the Project Design Document by a DOE;
> • Registration of the project as a CDM Project with the CDM Executive Board; operating the project in a manner which reduces, abates or sequesters Greenhouse Gases;
> • Monitoring the emission reductions achieved by the project in accordance with the monitoring plan;
> • Periodic review and Verification of the achieved emission reductions by another DOE; certification to the CDM Executive Board by the second DOE that the project has achieved the number of emission reductions verified and a request to the CDM Executive Board to issue CERs for the

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[168] *Ibid* at 16.

[169] The baseline covers emissions from all gases, sectors and source categories shown in Appendix A. *Ibid*.

> amount of Greenhouse Gas abatement, which occurred during the Verification period;
> • Issuance of CERs by the CDM Executive Board for the Verification period.[170]

The participants in the CDM project process include the following: project developer (who might also be the CER purchaser), the CDM Executive Board,[171] Designated National Authority, Designated Operational Entity,[172] and the CER purchaser (when they are not also the project developer).

There are two CDM project types: the traditional CDM and the programmatic CDM. The traditional CDM involves a single big project that leads to greenhouse gas cuts, while the programmatic CDM involves a series of small scale projects lumped together that lead to greenhouse gas emissions. A programmatic CDM (also called POA) is a voluntary coordinated action by a private or public entity that coordinates and implements any policy/measure or stated goal (e.g., incentive schemes and voluntary programmes) that leads to anthropogenic GHG emission reductions, or to net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the POA, via an unlimited number of CDM program activities (CPAs).[173]

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[170] UNEP Legal Issues Guidebook to the Clean Development Mechanism (UNEP Resource Centre: Roskilde, Denmark, 2004) at 31-32.

[171] The role of CDM Executive Board is to develop procedures for the CDM; approve new methodologies related to baselines and monitoring plans; accredit DOEs; register projects (in accordance with specific procedures); issue CERs (in accordance with specific procedures); make publicly available information on proposed CDM Project activities in need of funding and investors seeking opportunities; maintain a public database of CDM Project activities containing information on registered Project Design Documents, comments received, Verification Reports, CDM Executive Board decisions and information on all CERs issued; and develop and maintain the CDM registry. *Ibid* at 23.

[172] Designated operational entities (DOEs) are independent auditors that assess whether a potential project meets all the eligibility requirements of the CDM (validation) and whether the project has achieved greenhouse gas emission reductions (verification and certification). They are accredited by the CDM Executive Board and designated by the COP/MOP to perform these functions, according to their expertise. *Ibid* at 24.

[173] State and Trends of the World Carbon market *supra* note 2 at 56.

Africa is more involved in the programmatic CDM than the traditional CDM. Four out of every fifth multi-country CDM "program of activity" is hosted in Africa.[174] This is due to the fact that a lot of African countries do not have large-scale single projects that can generate a lot of CERs. Thus, the majority of CDM projects in Africa are programmatic in nature.

One of the limitations of the CDM as a mitigation platform is that it is investment based. The trend is for project developers and financiers to invest in relatively low risk projects. Consequently, if a project can lead to greenhouse gas emissions but has not been tested or proven, investors will be reluctant to invest in such projects. So, CDM projects are in the main low hanging fruit projects. According to the World Bank State and Trends of the Carbon Market 2012,

> Carbon revenues continue to leverage relatively low-risk investments in proven technologies by improving the marginal rates of return and enhance the chances of the projects being developed and remaining operational. As a result, after almost completely exhausting the market for HFCs and N_2O, most primary CERs in recent years have been generated from wind, hydro, and other renewable energy projects.[175]

The shift towards renewable energy investment is very good for the African continent in that it can help solve their energy deficit[176] and can aid in the transition away from fossil fuels. Renewable energy projects generate less carbon credits per output, so it remains to be seen how long investors' appetite in renewable energy projects will be maintained.

Renewable energy projects account for 70 percent of the current CDM projects, but the CERs from them remain small compared to their number. See Figures 2.1 and 2.2 below.

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[174] Carbon Markets and Africa: a Quick Factsheet for Journalists (UNEP Resource Centre, Roskilde, Denmark, 2011) at 6.

[175] *supra* note 2 at 54.

[176] The majority of villages in Africa rely on kerosene lamps and candles for their lighting. These cost the average household US$40–80 each year and they emit pollutants that pose serious health risks and can cause house fires. – Carbon Markets and Africa: a Quick Factsheet for Journalists *supra* note 165 at 9.

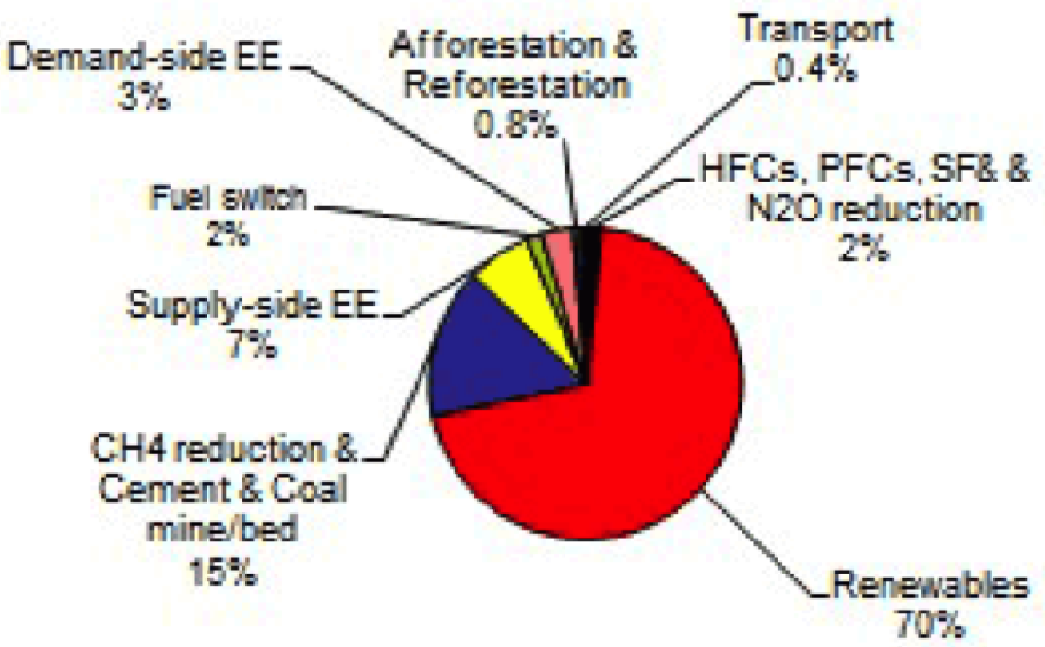

Figure 2.1 Percentage Share of Total Number of Projects in the CDM Categories

Source: UNEP *CDM Pipeline Analysis and Database* (1 August 2013), online: <http://www.cdmpipeline.org>.

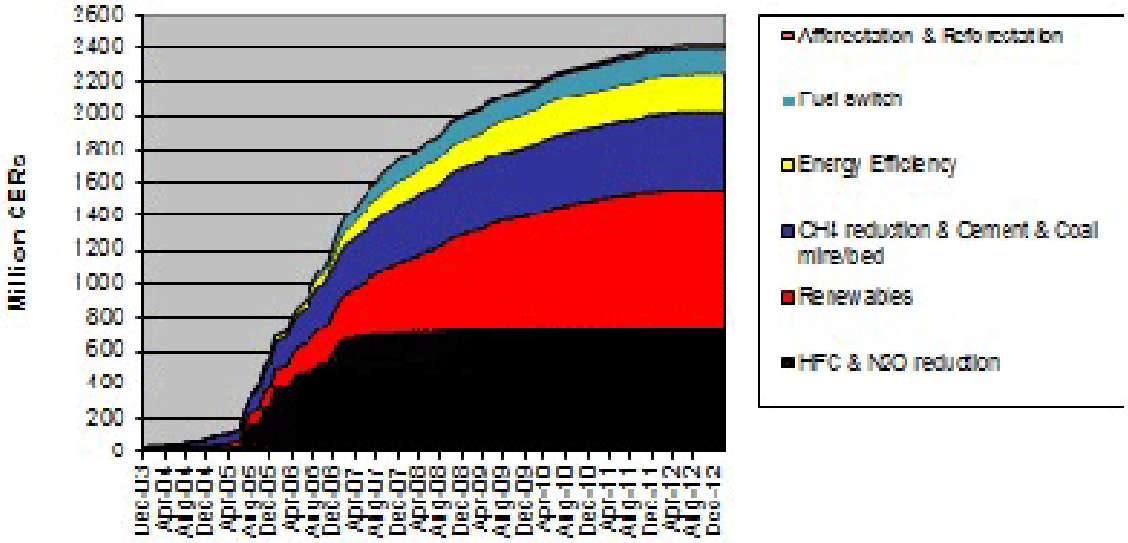

Figure 2.2 Growth of Total Expected Accumulated 2012 CERs

Source: UNEP *CDM Pipeline Analysis and Database* (1 August 2013), online: <http://www.cdmpipeline.org>.

Figure 2.2 shows the total number of CERs that were expected before the end of 2012 for the major project categories, according to the PDDs in all the CDM projects that are alive.

As noted in the World Bank report quoted above, the shift towards renewable energy projects was not deliberate; it was necessitated by the dwindling availability of hydro fluorocarbon and nitrous oxide projects—natural investors' preference.

CDM has not contributed much to greenhouse gas mitigation in Africa, where landfill gas projects top the list of CDM projects. Thirty-six of the currently registered CDM projects in Africa are landfill gas and methane avoidance projects (see Appendix B). Landfill gas projects convert methane from decomposing garbage into power, while methane avoidance projects seek to utilize waste sawdust for pellet/briquette production and are small-scale in nature. Contribution of waste to greenhouse gas emissions in Africa is negligible compared to the emissions from land use change and fossil fuel use. Emissions from the waste sector accounted for just 2 percent of South Africa's total emissions for the year 2000.[177] South Africa has more landfill gas projects and hosts more CDM projects that any other country in Africa.

The project-by-project mitigation under the CDM does not account for the expected growth rate in Africa's emissions. Africa has only hosted 27 biomass cook stove projects thus far (as shown in Appendix B), which are meant reduce black carbon emissions. The projects are meant to replace open fire cooking, which is common in the rural areas in Africa. This is small in view of the fact that Africa is the second highest contributor of black carbon emissions. See Figure 2.3.

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[177] *South Africa's Second National Communication under UNFCCC supra* note 78 at ix. Emissions from the waste sector in Nigeria for the year 2000 was 2,377 CO_2e, less than 2 percent of its emissions for the year 2000. *National Environmental Economic and Development Study (Needs for Climate Change in Nigeria)* (Federal Ministry of Environment Special Climate Change Unit, September 2010), online: <http://unfccc.int/files/adaptation/application/pdf/nigerianeeds.pdf>. Emissions from the waste sector in Egypt for the year 2000 were 19.5 $MtCO_2e$, 10 percent of the country's total emissions for the year 2000. *Egypt's Second National Communication under the UNFCCC* (Egyptian Environmental Affairs Agency, May 2010), online: <http://unfccc.int/resource/docs/natc/egync2.pdf>.

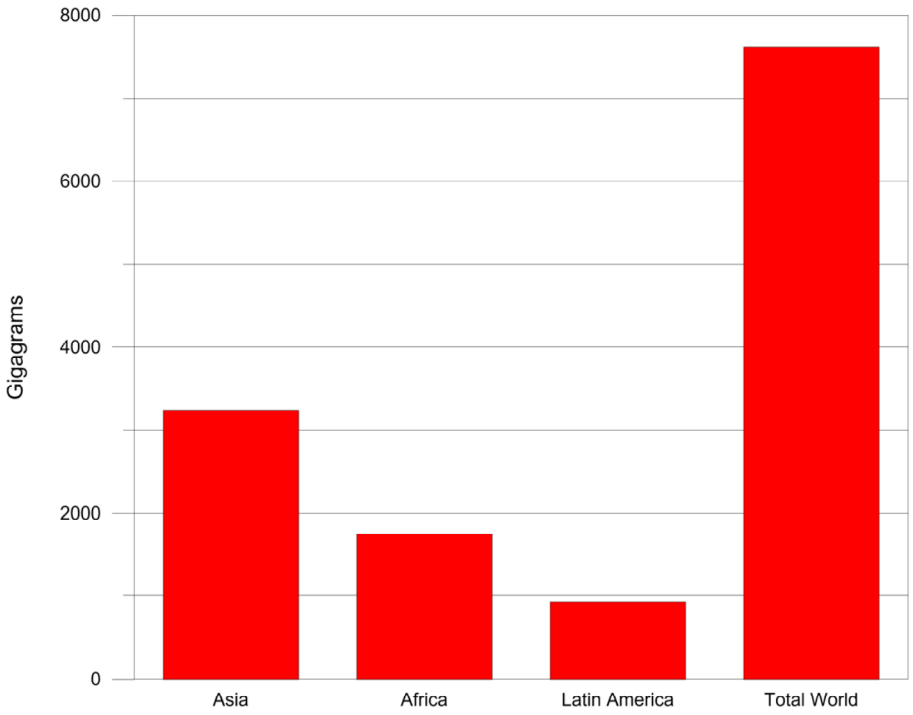

Figure 2.3 Global BC Emissions Based on Year 2000 Estimates

Source: US EPA *Report to Congress on Black Carbon: Department of the Interior, Environment, and Related Agencies Appropriations Act, 2010* (March 2012) at 97.

Currently, South Africa has 16 wind CDM projects and 6 solar CDM projects, which are meant to supply 2,756 megawatts to the national grid.[178] However, the Department of Energy anticipates the introduction of 41,346 MW in the next 17 years to enable South Africa to diversify its electricity generation mix to sources other than coal.[179]

To address this shortcoming, there have been suggestions to reform CDM from its project nature to cover sectors of the economy in developing countries. Conceptually, sectorial CDM can help developing countries participate more in the goal of stabilizing greenhouse gas emissions, but it will be difficult to set a baseline for a sector of the

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[178] UNEP *CDM Pipeline Analysis and Database* (1 August 2013), online: <http://www.cdmpipeline.org>.

[179] *Solving South Africa's Energy Crisis: Renewable Energy Projects Offer New Hope* (15 January 2013) online: Aurecon <http://www.aurecongroup.com/en/about/latest-news/2013/january/solving-south-africas-energy-crisis-renewable-energy-projects-offer-new-hope.aspx>.

economy.[180] It has been suggested that additionality is not needed for sectorial CDM;[181] the effect of this is that certainty of emissions reductions is not guaranteed.

Generally, CDM does not guarantee environmental certainty, as it is very difficult to define with certainty what would have happened in the absence of a project.[182] CDM baselines for some projects do not relate to existing practices but to projections of future use. The Bujugali Dam project in Uganda is one example of this. In this project, CER was calculated on the assumption that Uganda would be afflicted with load shedding (power shortage), which would lead to increased use of diesel generators and automotive oil. While it is true that there was load shedding in Uganda (12 hours per day)[183] before the project, the load shedding scenario was projected to continue indefinitely in the Project Design Document,[184] because the crediting period goes from 8 April 2012 to 8 April 2019. The project is meant to reduce 6,328,000 tCO_2e for the 7-year period. The increased use of diesel generators should ordinarily decline during the first year of the project. As a matter of fact, there is currently no load shedding in Uganda now.[185]
The EU ETS, the biggest buyer of CDM credits, has expressed concerns over the environmental integrity of CDM projects being supplied to it, and has decided to ban credits from industrial gas projects such as hydro fluorocarbons (HFCs) and adipic acid N_2O projects for use in its ETS after April 2013.[186]

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[180] UNFCCC *Compilation of inputs considered by the CDM Executive Board in its review of the CDM modalities and procedures* (8 March 2013), online: <http://cdm.unfccc.int/filestorage/l/q/F02QOJZ359UME6WARCBYX7GI1NPTSL.pdf/eb72_repan01.pdf?t=aGR8bWtpbDF1fDBlUi2QdX7v09frcjIQjSMb>.

[181] *Ibid.* CDM Executive Board is looking to replace project additionality with emission reduction additionality.

[182] US EPA Designing a Cap and Trade for Pollution Control *supra* note 69 at 2-8.

[183] *About the Bujagali Hydropower Project,* (8 October 2012), online: <http://www.akdn.org/>.

[184] *Project Design Document Bujagali Hydropower Project* (16 July 2010), online: <http://cdm.unfccc.int/filestorage/F/U/Y/FUYJ930RA8DIXQNVSM7LBP4ZO6GK2W/Project percent20Design percent20Document.pdf?t=OTV8bWs1bTcxfDDA6BQZYchuIL7GoAB-QBJN>.

[185] *supra* note 174.

[186] Europa Press Release "Emissions trading: Commission welcomes vote to ban certain industrial gas credits" (21 January 2011), online: <http://europa.eu/rapid/press-release_IP-11-56_en.htm>.

CDM does not allow companies in host countries to internalise the cost of greenhouse gas externality. This is important given the role of multinational corporations in the fight against climate change. Apart from the foreign multinational corporations in Africa, the list of homegrown multinational companies is also increasing.[187] According to the Stern Review:

> Project-based carbon finance does not internalise the cost of the greenhouse gas externality for firms and consumers in the host country or for goods exported from the country. Project-based carbon finance acts as a form of subsidy; it reduces the emissions from a particular project, but it does not affect the demand for high carbon goods and services across the economy as a whole, so the overall level of emissions can remain high or increase. It also creates issues of moral hazard and gaming, where there are incentives to manipulate the system to increase the rewards received.[188]

The case of Sasol is apt in this regard; Sasol is a beneficiary of CDM finance for a nitrous oxide abatement project at its Secunda and Sasolburg plants.

While this project will reduce Sasol's emissions by one million tonnes of CO_2e a year, its new plant in South Africa will emit about 30 times that amount per year.[189] CDM is indirectly encouraging multinationals to pollute even more. The CDM Executive Board rejected the application for failing to pass an additionality test. Peter Geek, the supply manager, was reported to have addressed the failed CDM pipeline project at a public meeting:

> Yes, we are indeed trying to get some carbon finance for this pipeline … (But) we have this problem of additionality; we think there's a case to be

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[187] Homegrown multinational corporations like Oando, African Petroleum, Kenya Airways, Conoil, International Trading Oil and Commodities Corporation all in carbon emitting sectors of the economy in Africa experienced 30 percent growth from 2006 to 2009 despite the global economic downturn during the period. See: Dalberg *Pioneers on the Frontier Sub Sahara African Multinational Corporations* (2011).

[188] Stern Review on the Economics of Climate Change *supra* note 74 at 16.

[189] Rehana Dada, "South Africa Country Context" in Trusha Reddy ,ed, *Carbon Trading in Africa a Critical Review* (Pretoria, South Africa Institute of Security Studies 2011) 47 at 50.

> made for that … The biggest issue is additionality; we would have done this project anyway.[190]

Sasol also sought CDM finance for a 645-kilometre natural gas pipeline from Mozambique to its Secunda plant.[191] The Secunda plant project had been conceived since 1999 before the Kyoto Protocol came into effect. The company had already costed the project and did not find it prohibitively expensive. This perverse incentive created by the CDM is also one of the reasons EU ETS placed a ban on CDM industrial gas projects.[192]

More importantly, the European Union wants the CDM to be progressively phased out for advanced developing countries.[193] As a statement of this intention, credits from new CDM projects registered after 2012 can only be used in the EU ETS if they are located in a Least Developed Country (LDC). Credits from CDM projects registered after 2012 in a developing country will only be allowed if the developing country has a bilateral agreement with the EU.[194] This decision is both good and bad for Africa. The majority of the LDCs are in Africa, where there are currently 31;[195] this will encourage CDM investment in LDCs. However, the remaining 23 developed countries (DCs) in Africa—with the exception of South Africa who have not really benefited much from CDM—can no longer rely on CDM as a mitigation platform, as this decision will discourage investors from investing in carbon offset projects in the DCs, in view of the fact the EU ETS is the biggest buyer of offset credits.

Beyond this, as part of reforms of its ETS, the EU has reduced the volume of international credits that are eligible for compliance purposes in the third phase of the

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190 *Ibid* at 57.
191 *Ibid* at 58.
192 Europa Press Release *supra* note 177.
193 *Ibid*.
194 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 O J L 140 5.6.2009 art 11a(4).
195 *List of Least Developed Countries*, online: <http://www.un.org/esa/policy/devplan/profile/ldc_list.pdf>.

scheme.[196] A total of 1,400 million tonnes of CERs and ERUs were eligible for compliance by installations during Phase II of the scheme, representing approximately 13 percent of the average allocation in the period 2008-2012 (about 280 $MtCO_2e$ per year).[197] The import cap for Phase III is 1,700 $MtCO_2e$.[198] This reform, coupled with the fact that the EU ETS is currently oversupplied with CDM credits and declining market prices for CERs,[199] could discourage further investments in CDM.

2.5 National Appropriate Mitigation Actions (NAMAs)

The concept of NAMAs emerged in 2007 at the Bali Climate Change conference. As part of its long term global goal for emissions, the Bali Action Plan reductions called for "[the implementation of] Nationally Appropriate Mitigation Actions by developing country parties in the context of sustainable development, supported and enabled by technology, financing, and capacity building, in a measurable, reportable, and verifiable manner".[200] The Cancun Agreement moved the NAMA process forward by creating a NAMA registry.[201]

Nationally appropriate mitigation actions are voluntary commitments that non-Annex I parties have set up for proposal to the UNFCCC to limit the growth of greenhouse gas emissions by 2020. NAMA is an opportunity for developing countries to green their respective economies while trying to develop themselves; it is meant to help developing country parties avoid the carbon intensive pathways on which developed economies are founded. NAMAs provide guidance for future mitigation policies in developing countries.[202] Due to the intricate link between mitigation and development, NAMAs are explicitly framed in the context of national appropriateness and sustainable

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196 State and Trends of the World Carbon Market 2012 *supra* note 2 at 21.
197 *Ibid*.
198 *Ibid*.
199 The price of CERs is almost completely driven by the EU ETS. *Ibid* at 37.
200 Bali Action Plan *supra* 57 at 3.
201 Cancun Agreements *supra* note 48 at 10.
202 AMCEN Addressing Climate Challenges *supra* note 4 at 184.

development.[203] As part of commitment to NAMA, developing countries are expected to improve the content and frequency of national communications—including inventories—and to create comprehensive, low-carbon sustainable development strategies.[204]

There are two types of NAMAs: unilateral NAMAs, which are financed and supported entirely by the host country, and supported NAMAs, which will be implemented if provided with the necessary international support.[205]

To date, nineteen African countries have identified with the NAMA concept. They are Benin, Botswana, Cameroon, Central African Republic, Chad, Congo Republic, Eritrea, Ethiopia, Gabon, Ghana, Ivory Coast, Madagascar, Mauritania, Morocco, Sierra Leone, South Africa, Togo, Tunisia, and Mali. In September 2012, Mali and Ethiopia sought support by submitting NAMAs to the prototype NAMA Registry.[206] Mali is planning NAMAs in the renewable energy and forestry sectors, while Ethiopia is seeking support for the development of an inter-urban electric rail powered by renewable electricity.[207]

Tunisia is seeking support for electricity generation from concentrated solar power (CSP), solar photovoltaic.[208] Other areas that Tunisia's NAMA seeks to address include reducing N_2O emissions in the phosphate industry, reuse of treated waste water to aid agriculture, increasing forest cover through afforestation and reforestation, development of multimodal transport and transport of trucks by railways, and gas utilization plans in

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[203] Cancun Agreements *supra* note 48 at 9.
[204] *Ibid* at 11.
[205] State and Trends of the World Carbon Market *supra* note 2 at 68.
[206] Gesine Hansel and Donovan Escalante, "NAMA Development" in Gesine Hansel *et al*. (eds). *Annual Status Report on Nationally Appropriate Mitigation Actions* (ECN, 2012) at 9.
[207] *Ibid* at 11.
[208] *Tunisia's NAMA* (17 May 2010) at 9, online: <http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/tunisiacphaccord_app2.pdf>.

the industrial and residential sectors.[209] Tunisia's solar project is projected to avoid 1.5 $MtCO_2e$ per year.[210]

Sierra Leone's NAMA includes development of alternative energy sources such as biofuels, waste incineration programmes for energy production, sustainable agriculture, clean energy utilization, and improving forest governance to maintain the proportion of land area covered by forests to at least 3.4 million ha by 2015.[211]

South Africa's NAMA is also on renewable energy development; the initiative is meant to avoid 60 $MtCO_2$ per year.[212]

Energy efficiency, renewable energy development, conservation farming, and improving forest cover are common threads that run through the submitted African NAMAs. However, there are still significant knowledge gaps on how the submitted NAMAs will contribute to the accelerated cuts in emissions by 2020. To this end, COP 18 has established a work programme to further the understanding of the submitted NAMAs.[213] The work programme starts in 2013 and ends in 2014. The global warming outcome of the submitted NAMAs will be evaluated through the work programme, which is a capacity building exercise for the implementation of the submitted NAMAs.[214]

A key challenge facing the NAMA initiative is that the currently submitted NAMAs of developing country parties are not adequate to reduce emissions to a level consistent with the 2 °C target.[215] To bridge this significant emissions gap, developing countries that are

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[209] *Ibid*.

[210] Kelly Levin *et al*. "MRV of NAMAS" in Gesine Hansel *et al*. (eds). *Annual Status Report on Nationally Appropriate Mitigation Actions* (ECN, 2012) 28 at 30.

[211] Sierra Leone NAMA (2010) at 4, online: <http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/sierraleonecphaccord_app2.pdf>.

[212] *supra* note 201 at 30.

[213] *Decision 1/CP/18* at 6 (2012), online: <http://unfccc.int/resource/docs/2012/cop18/eng/08a01.pdf>.

[214] *Ibid*.

[215] *Ibid* at 4.

yet to identify with the NAMA concept were urged to formulate and submit their respective NAMAs at COP 18.[216]

Another challenge facing NAMA is finance. There are presently no dedicated funds for the implementation of NAMAs. A financial commitment made by developed countries to support the NAMA concept is yet to be delivered.[217] COP 18 also did not resolve the issue; this is important since the majority of NAMAs are supported NAMAs. It is being speculated that the newly created Green Climate Fund will be the channel of support for NAMA, but the fund is yet to come into operation.[218] The goal of NAMA is for aggressive cuts in emissions by 2020, but as of 2013, funding is yet to be delivered for it, with just 7 years to go until the set date.

Leveraging private finance by removing barriers to investment could help in financing NAMA, but the fact that some NAMAs are non-market in nature could prove to be an obstacle in attracting private finance. As stated in the NAMA Report 2012,

> The link between NAMAs and the private sector is much less obvious to entrepreneurs than it was when the CDM and JI mechanisms were introduced. Two reasons are mentioned: First, private sector actors are direct beneficiaries of CDM revenues, while NAMAs support is delivered to governments who decide how to disburse it. This may create uncertainty about how support will be used or accessed. Second, the CDM developed against the background of firm reduction targets that gave an indication of the future market size. For NAMAs, it is not yet clear how efficient the mechanism will be in achieving GHG emission reductions.[219]

2.6 Summary Conclusions

The gaps in Africa`s climate change mitigation architecture identified in this Chapter are as follows:

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[216] *Ibid* at 6.
[217] Tilburg *et al.,* "Where Progress is Most Needed" in Gesine Hansel *et al*. (eds). *Annual Status Report on Nationally Appropriate Mitigation Actions* (ECN, 2012) 43 at 44.
[218] *Ibid*.
[219] *Ibid*.

- A carbon tax does not guarantee environmental certainty unless complemented by a tradable permit scheme; certainty is important if African countries are to effectively contribute to global climate change mitigation.
- The economic drivers of deforestation threaten the successful implementation of REDD+ in Africa.
- CDM does not guarantee environmental certainty and it does not encourage polluting companies in Africa to make cuts in their emissions.
- NAMA implementation is threatened by lack of funds.

The next question to determine is whether the proposed emissions trading scheme can close the gaps in Africa's mitigation policy architecture, as discussed in this chapter. This will be examined in the succeeding chapters.

Chapter 3

3 Emissions Trading as a Climate Change Policy Option in Africa

3.1 Introduction

This chapter will show how the proposed emissions trading scheme can cover the gaps in Africa's mitigation policy architecture. To do this, I will analyse some of the existing literature on the nature of emissions trading as a policy instrument, including its types to its evolution and theoretical framework. I will then show the justification for the policy in Africa.

The justification part of this chapter will demonstrate the environmental need for such a policy within the UNFCCC context and other gains that could be made from implementing the policy. This will be followed by a discussion of the viability of the proposed scheme in Africa, which will answer the question of whether the potential to trade carbon exists in Africa; meaning whether there are enough sources for trading and institutions to support trading of carbon in Africa.

3.2 Evolution of Emissions Trading

An emissions trading scheme, in principle, seeks to fight pollution by setting a price on it. The reasoning behind this concept being that the more costly the government makes pollution, the more likely it is that companies would want to prevent it from happening. It is anchored on the Polluter Pays principle. The Polluter Pays principle states:

> National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.[220]

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[220] *Rio Declaration on Environment and Development*, 13 June 1992, UN Doc. A/CONF.151/26 (vol. I); Principle 16, 31 ILM 874 (1992).

It allows for flexibility in meeting environmental goals by allowing the market to dictate how to comply with environmental targets, as opposed to traditional regulation, which does not give room for flexibility, in that it specifies only one route to compliance.[221] Under an emissions trading scheme, each firm or nation has a binding reduction obligation, but each could meet this obligation either by making reductions itself, or by purchasing them from another firm or nation. Emissions trading equalises the marginal cost of compliance between firms by transferring more of the pollution control burden to firms with low costs of control.[222]

Economists also argue that emissions trading will foster technological innovation, because it creates incentives for firms to develop new technology in order to make more emissions reductions than the regulator requires; this is a result of the opportunity available to over-complying firms to sell the credits to other pollution sources. Stavins argues that emissions trading, "would promote dynamic efficiency", meaning that it would provide continuous incentives for developing better emissions control technologies.[223]

Pigou is the father of pollution economics; he theorised that pollution is an externality, in the sense that those responsible for pollution do not really bear the damage costs associated with their actions. He argued that, in the face of a negative externality such as pollution, the appropriate remedy involves imposing a per-unit tax on the emissions from a polluting activity.[224]

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[221] The traditional form of environmental regulation is *Regulations and Standards*, also known as *Command and Control*. Under this form of environmental regulation, the government issues a mandate for pollution sources to use some type of technology, or meet some specific pollution level. It also includes reduction in output by polluting sources. See: S. Gupta *et al*., "Policies, Instruments and Cooperative Arrangements" in Metz, Davidson, Bosch, Dave, L.A Meyer, eds, *Climate Change 2007 - Mitigation of Climate Change: Working Group III Contribution to the Fourth Assessment Report of the IPCC*. (Massachusetts: Cambridge University Press, 2007) 749 at 754.

[222] Robert Stavins and BW Whitehead, "Pollution Charges for Environmental Protection, a Policy Link Between Energy and Environment" (1992) 17 Annu. Rev. Energy Env. 187 at 191.

[223] Robert Stavins, "Policy Instruments for Climate Change: How Can National Governments Address a Global Problem?" *supra* note 7 at 300.

[224] T.H. Tietenberg, *Emissions Trading: Principles and Practice* (Washington, D.C.: RFF Press, 2006) at 2.

The tax rate would be equal to the marginal external social damage caused by the last unit of pollution, at the efficient allocation. Faced with this tax on emissions, firms would "internalize" the externality. By minimizing their private costs, firms would simultaneously minimize the costs to society as a whole. Rational pollution control policy involved putting a price on pollution.[225]

In 1960, Ronald Coase took a divergent opinion from Pigou; he argued that the market should be left to determine how to internalize the externality that is pollution; he asserted:

> If factors of production are thought of as rights, it becomes easier to understand that the right to do something which has an harmful effect (such as creation of smoke, noise, smell, etc.) is also a factor of production…. The cost of exercising such a right (of using a factor of production) is always the loss that is suffered elsewhere in consequence of that right-the inability to cross land, park car, to build a house, enjoy a view, to have peace and quiet or to breathe clean air.[226]

He argued that, by making property rights—the right to emit—transferable, the market could pay a substantial role in allowing firms to internalize the externality. He pointed out that traditional pollution control regimes based purely on emissions limits provided no means for these property rights to flow to their highest valued use.[227]

Dales took the insight further by arguing that legal regimes imposed by the government for pollution control had, in fact, already established a property right in the right to emit. This property right was not efficient because it was not transferable.[228] According to Dales, the virtues of the market mechanism are that no person or agency has to set the price; it is set by the competition among buyers and sellers of rights.[229]

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[225] *Ibid* at 3.
[226] Coase, "The Problem of Social Cost" (1960) JL & Econ 1-44 cited in *supra* note 221 at 3.
[227] *Ibid*.
[228] J.H Dales*, Pollution, Property and Prices* (Toronto: University of Toronto Press 1968) cited in *supra* note 221 at 4.
[229] *Ibid* at 4.

Crocker added a further insight by noting that this property approach fundamentally changes the information requirements on the bureaucracy, i.e. the pollution control authority's responsibilities will not include the guesswork involved in attempting to estimate individual emitter and receptor preference functions.[230] The authority does not have to know anything about the damage nor cost functions of each individual emitter while setting the level of allowable emissions.

In 1971, Baumol and Oates applied the emissions trading theory to uniformly mixed pollutants, for which only the level, not the location, of the emissions mattered.[231] In 1972, Montgomery extended the theory to non-uniformly mixed pollutants, for which both the level and the location mattered.[232]

It was not long before these insights had practical applications. The United States of America was the first to use emissions trading as an environmental policy instrument.

According to Tietenberg, American scholars who were familiar with the literature on property rights actively canvassed for its use in the United States.[233] They suggested that it might be possible to improve on the traditional approach of promulgating ambient air quality standards that specify the permissible legal threshold for concentrations of pollutants in the ambient air, and selection of desirable technologies by allowing firms to trade pollution control responsibility among themselves.[234] They did this by providing empirical analyses showing Command and Control policy was not cost effective.[235]

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[230] T.D Crocker, "The Structuring of Atmospheric Pollution Control Systems" in H. Wolozin, ed, *The Economics of Air Pollution* (New York: WW Norton & Co 1966) cited in *supra* note 221 at 4.
[231] Baumol and Oates, "The Use of Standards and Prices for the Protection of the Environment" (1971) 73 SWJE 42-54 cited in *supra* note 221 at 5.
[232] David Montgomery, " Markets in Licenses and Efficient Pollution Control Programs" (1972) 5(3) J Econ Theory 395- 418 cited in *supra* note 221 at 5.
[233] *Ibid*.
[234] *Ibid*.
[235] *Ibid* at 6.

The opportunity to explore emissions trading as a pollution control instrument came in 1976. By this time, it had become clear that a number of regions designated as "non-attainment areas" by the Clean Air Act would fail to achieve the ambient air quality standards by the deadlines mandated in the Act.[236] The statute had mandated improvements in air quality in these regions; further economy growth would only make the air quality worse, contrary to the statute. The only recourse was to prohibit new businesses (those that would emit any of the pollutants responsible for the non-attainment in that region) from entering these regions until the air quality came within the ambient standards.[237] This solution was politically unpopular among governors, mayors, and members of congress.

It was at this point that the US Environmental Protection Agency warmed to the idea of emissions trading. Existing sources in the non-attainment areas were encouraged to voluntarily reduce their emissions levels below their current legal requirements. The EPA then certified these excess reductions as emission reduction credits. These credits became transferable to new sources that wished to enter the area. New sources were allowed to enter the non-attainment regions, provided they acquired emission reduction credits from other facilities in the region, and that total regional emissions would be lower (not just the same) after entry than they were before. This was accomplished by asking new sources to secure credits for 120 percent of the emissions they would add; the extra 20 percent of credits secured by new sources were retired as an improvement in air quality.[238]

This offset program later became known as the Emissions Trading Program (ETP) when it was combined with three new policies: Bubble, Banking, and Netting.

The Bubble policy allowed existing sources to buy credits from each other, as opposed to the offset program, which only allowed new sources to buy from existing sources. Banking allowed created credits to be saved for subsequent use or sale in the future.

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[236] *Ibid*.
[237] *Ibid*.
[238] *Ibid* at 7.

Netting allowed sources undergoing expansion or modifications to escape the strict new source technology requirement, or the need to secure offsets for their remaining emissions, so long as any net increase in emissions fell below an established threshold. The government's role in the emissions trading program was to certify each reduction before it qualified as credit. The control authority also approved credit trades on a case-by-case basis.[239]

As part of the solution to phase out lead from refined gasoline, the EPA also used emissions trading; this was in 1985 when a fixed amount of lead rights was allocated to refiners.

Refiners who did not need their full share of authorized rights (due to early compliance) could sell their rights to other refiners.[240] Since then, emissions trading has been used more widely by the United States. It was used to phase out ozone-depleting substances under the Montreal Protocol, and also used to combat acid rain through the Sulphur Allowance Program. Emissions trading is now a very popular concept and this is partly because it was included as part of the Kyoto Protocol. The European Union Emissions Trading Scheme is the backbone of the EU's fight against climate change, and likewise, the New Zealand Emissions Trading Scheme is at the heart of New Zealand's fight against climate change. A nationwide emissions trading scheme will start in Australia in 2015. The scheme is expected to cover 60 percent of the country's 600 million tonnes of CO_2 per year. Mexico and Republic of Korea have also introduced emissions trading schemes with their recently passed climate bills.[241]

3.3 Conceptual Framework

In principle, emissions trading seeks to achieve cost effective allocation of the pollution control responsibility. Emissions trading can result in cost effective allocation of the

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[239] *Ibid*.
[240] *Ibid* at 8.
[241] State and Trends of the Carbon Market 2012 *supra* note 2 at 14.

pollution control burden because plants typically have very different costs of controlling emissions. Emily Richman has best illustrated this concept with the following example:

> Suppose Power Plant A, which emits 1,000 tonnes of carbon, is required to reduce its emissions by 500 tonnes. Plant A already uses high quality pollution reduction technology; to reduce its emissions further, it would have to cut its output or invest in the latest, state-of-the-art technology, which limits emissions even further, but is very expensive. Thus, reductions would cost Plant A $1,000 per tonne. Plant B is also required to reduce its emissions by 500 tonnes. Plant B uses old, out-dated pollution reduction technology and could implement the technology that Plant A already uses at fairly low cost. Thus, Plant B could reduce emissions for $500 per tonne. If Plant A and B each meet their emissions reductions obligations themselves, without any trading, Plant A would spend $500,000 and B would spend $250,000. Overall, 1,000 tonnes of emissions reductions would cost the economy $750,000. On the other hand, under a trading program, Plant A could purchase emissions credits from Plant B at the lower price. Thus, Plant B would make 1000 tonnes of reduction for a total price of $500,000. Plant B could even charge Plant A a premium (anywhere between $501 and $999) and the reductions would still cost less than if Plants A and B each had to make reductions independently.[242]

Price differentials can arise from disparate technology, as here, but can also stem from the development of efficient production processes in Plant B, Plant B's agreement to produce less, or a variety of other situations.

To achieve cost effective allocation of the pollution control burden through traditional regulation, the control authority will need detailed information about the marginal cost of control of each polluting source. This will be used to set the appropriate standard for each source.[243] This information is difficult to obtain and if obtained, it will be at great cost to the control authority. What is more, the information obtained will not be accurate because plant managers (who are familiar with the possible array of pollution control technologies and their associated costs) will not want to disclose their exact control cost to the control authority or to the legislature because the information about cost is part of what the plants

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[242] Emily Richman, "Emissions Trading and the Development Critique: Exposing the Threat to Developing Countries" (2003-2004) 36 N.Y.U. J Inti'l. L & Pol. 133 at 143.

[243] Tietenberg, *supra* note 215 at 26.

are using to maintain their competitive edge. What will usually happen is that plant managers will overstate their control costs to the control authority, which in the end will defeat the motive of cost effective allocation.[244] To get out of this impasse, a market permit system seems to be a plausible solution. The market permit system will act as an incentive to the plant managers to act on the information they know, and it will save the control authority or the legislature the stress of information gathering.

Thus, emission trading solves the problems of information and incentive that are inherent in a command and control approach because there is an existing market for the sale of excess permits.[245]

However, the cost effective allocation of pollution control burden that emissions trading seeks to achieve could be undermined by high administrative costs as well as transaction costs. The ability of an emissions trading system to achieve full cost effectiveness depends on how smoothly the market operates. This is a function of administrative and transaction costs. Administrative costs include the costs of implementing and setting up an emissions trading scheme. Thus, an emissions trading scheme will not be cost effective if the administrative costs are higher than the cost of command and control, i.e. if the increase in administrative costs from moving to emissions trading to command and control policy dwarfs the savings in abatement costs.[246]

Administrative costs could be in the form of setting up new institutions, such as setting up the registry system to keep track of permits or designing a compliance system. They could also come in the form of training for staff, designing rules for trading, monitoring emissions and enforcement of penalties for non-compliance.[247]

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[244] *Ibid*.
[245] *Ibid* at 27.
[246] *Ibid* at 42.
[247] *Ibid*.

According to Tietenberg, transaction costs, "are costs other than price, incurred in the process of exchanging goods and services".[248] Transaction costs in an emissions trading scheme could arise from search and information, bargaining and decision.[249] Search and information connotes costs of researching the market and finding buyers or sellers. Information about sellers and buyers is not readily available, so brokers step in to fill the gap. In the process, brokers absorb some fees. Costs arising from bargaining and decision connote negotiation costs; they come in form of time and fees for brokerage, legal and insurance services.

The presence of high transaction costs in a market permit system will reduce the volume of permit trading and ultimately lead to high abatement costs. According to Stavins, the problem of transaction costs in an emissions trading system can be ameliorated in a market with a relatively large number of sources.[250] As the pool of trading partners increases, it will be easier for sources to locate potential trading partners, thereby lowering transaction costs.

The manner of initial allocation of permits can also play a role in tempering the potential effects of transaction costs. Allowances are generally distributed either through auctioning or for free, on the basis of historical or current emissions. Grandfathering, or endowment, is the distribution of permits for free on the basis of historical or current emissions. The argument for grandfathering is a political one; it is felt that the best way to build a constituency of support for a new ETS is through free allocation, because existing sources in the market can block the success of the program. The argument for auctioning is an economic one; auctioning allowance—apart from raising revenue for the government—will reduce transaction costs because there will be no need to search for potential sellers. The middlemen will be eliminated. There will be no legal fees incurred as a result of negotiation and drawing up contracts.[251]

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[248] *Ibid* at 41.
[249] Robert Stavins, "Transaction Costs and Tradable Permits" (1995) 29 JEEM 133-148.
[250] *Ibid* at 144.
[251] *Ibid* at 146.

The model of emissions trading chosen can also determine the level of cost effectiveness of a tradable permit scheme.

There are three types of emissions trading: cap and trade, project-based trading and rate-based trading. The most popular emissions trading type is cap and trade. In a cap and trade program, an aggregate emissions cap is set specifying the amount of emissions permitted for sources participating in the program. The regulating authority of a cap and trade program creates rights to emit a specific quantity (e.g., 1 tonne) of a pollutant, called an allowance. The total number of allowances equals the level of the cap. To be in compliance, each emission source must surrender allowances equal to its actual emissions.[252] It may buy or sell (trade) them with other emissions sources or market participants.

The cap and trade model is attractive because it guarantees environmental certainty. The cap represents the maximum allowable emissions from sources participating in the scheme; it is the cap that does the work of reducing pollution. The integrity of the cap is very important and must be maintained; it is maintained through penalties and consistent, effective enforcement. Command and control policy does not rely on a cap, but rather on emission rates, which may lead to increased emissions as utilization rises. With a cap and trade program, there is no danger that new entrants into the polluting activity will dilute the emissions goal, as they would receive allowances from the cap set or purchase allowances from existing sources.[253]

The cap and trade model is believed to also guarantee improved accountability because participating sources must account for every tonne of emissions by following protocols to ensure completeness, accuracy, and consistency of emission measurement; unlike other

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[252] A Guide to Designing and Operating a Cap and Trade Program for Pollution Control *supra* note 69 at 1-2.
[253] *Ibid*.

environmental regimes that base compliance on periodic inspections and assume that the equipment is functioning.[254]

Accurate measurement of emissions and timely reporting are integral to a successful cap and trade program. Participants in a cap and trade program must have the ability to measure emissions with sufficient accuracy and consistency. If one source uses a less accurate emission measurement method than another, and consequently underestimates its actual emissions, it could surrender fewer allowances than necessary to offset its emissions. If this scenario occurred, the emission goal (or cap) would not be met and by extension there will no active market for allowances.[255]

Cap and trade programs make the most sense when emission sources have different costs for reducing emissions. This difference in costs makes room for a deal as sources with high marginal abatement costs have incentive to buy from sources with low marginal abatement costs. If sources are homogenous, their marginal abatement cost will most likely be the same and there will be little incentive to trade.[256]

If the sources are few, there will be few opportunities for trading. This will create continued liquidity in the market. There must also be enough sources to create an active market before a cap and trade program can achieve the aim of meeting environmental goals cheaply.

There are a number of different types of trading that must be considered. For example, CDM relies upon project-based trading. Project-based trading (also known as credit trading or offset trading) is generally not used as a standalone program. In a project based trading, emission offsets, or credits, are typically calculated by comparing actual emissions against a baseline.[257] This is the type of trading that occurs in the CDM. The

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[254] *Ibid* at 1-3.
[255] *Ibid*.
[256] *Ibid* at 2-2.
[257] *Ibid* at 2-7.

baseline is an estimate of what emissions would be in a hypothetical situation (e.g., if the project had not been created).

Baseline setting is the greatest challenge with project-based trading. Additionality is the gauge used to measure emission reductions in a project-based trading. Before credits are issued for emission reductions in a project based trading, it must be shown that the emissions reductions would not have occurred without the project. The emissions reductions must not be such that would have happened anyway. Project-based trading does not guarantee environmental certainty, as it is difficult to determine what would have happened in the absence of a project.[258]

For project-based trading to be environmentally effective, the issue of non-additional projects must be tackled. This is usually done through increased regulatory oversight. Since each credit trade is unique, project participants are often required to develop a project-specific emission baseline for review by the regulating authority or other authorized experts. Even after the emission baseline is approved, credit trades will still have to be approved by the regulatory authority to ensure that the project does not dilute the emission goal coupled with continued monitoring of the project. As a result, transaction costs and uncertainty are high (the fear that the credit trade might not be approved is always there). The United States' credit trading systems have generally performed poorly. The programs did not achieve significant economic or environmental benefits, nor did they introduce flexibility into the fairly rigid regulatory system governing criteria pollutants. The disappointing results of these programs have been attributed to their high transaction costs and the uncertainty and risk involved in obtaining the needed government approvals for credit trades.[259]

To reduce administrative and transaction costs and to address additionality concerns, multi- project baselines are set. The multi-project baseline uses performance standards or

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[258] *Ibid* at 2-8.

[259] Tom Tietenberg *et al*. International Rules for Greenhouse Gas Emissions Trading, Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability. *supra* note 67 at 30.

benchmarks for different types of projects. If the project results in emission rates lower than the standard, the project automatically receives credit equal to the difference between the baseline and the actual emissions. Standardizing baseline methodologies in advance can also help reduce transaction costs in project-based trading and limit the subjectivity inherent in a review of a project baseline.[260]

However, standardizing does not guarantee that the emissions reductions are additional. Multi-project baselines may be difficult for some projects. Generally, project-based trading is ideal for sectors in which it is easier to measure an emission reduction than total mass emissions.[261]

A second example to consider is a rate-based trading approach. Under this approach, the regulating authority determines a performance standard.[262] It sets an emissions limit per unit of production, for example, 1,000 tonnes of carbon dioxide per kilowatt of electricity generated. Trading occurs when sources with emissions rates below the performance standard sell to sources whose emissions exceed the performance standard set. One drawback of rate-based trading is that if the activity level increases at a rate faster than the emission rate declines, sources can earn credits while total emissions increase. New entrants into the polluting activity can increase the pollution load.[263]

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[260] A Guide to Designing and Operating a Cap and Trade for Pollution Control *supra* note 69 at 2-8:
A standard baseline is a single, standard estimation of the greenhouse gases that would have been emitted if certain types of CDM projects were not implemented. The aim of standardizing baselines is to reduce the time and costs associated with designing CDM projects and preparing the PDD. See: *cdmrulebook.org*.
Administrative and transaction costs per unit of emission reduction are higher in project-based trading than in a cap and trade program. One of the criticisms of CDM is its high administrative and transaction costs for project developers and financiers. The CDM Executive Board is looking to tackle the problem by removing the administrative share of CDM proceeds and fast tracking the appeal process for deficient processes.
See: Compilation of Inputs considered by the Board in its Review of CDM modalities and procedures *supra* note 171 at 8.

[261] It is easier to measure the gas captured in a methane recovery project.

[262] A Guide to Designing and Operating a Cap and Trade Program for Pollution Control *supra* note 69 at 2-9.

[263] *Ibid*.

Rate-based trading is similar to environmental tax in that the regulating authority must periodically impose new rate standards to achieve and maintain an emission target and prevent additional emissions that may result from increased production. The data requirement in a rate-based trading tends to be more because the regulating authority has to collect activity level data. Activity level data gathering is essential in a rate based trading in order to revise the rate standard and to ensure that the emission goal is not diluted.[264]

3.4 Economic Gains of the Policy

A well-designed emissions trading policy can ensure the transfer of wealth from developed countries to Africa to the rural poor, to the government, as well as to private companies. Implementing REDD+ as an emissions trading scheme will not only address the economic drivers of deforestation in Africa, it will also help address rural poverty in Africa. REDD+ has been described earlier as performance-based financial incentive system for developing countries to reduce the rate of emissions from deforestation and forest degradation. It has also been shown earlier (in Chapter Two) that the drivers of deforestation threatens REDD + implementation in Africa. Putting a value on forest cover through an emissions trading policy that engages small holder farmers and forest dependent communities in Africa will not only manage the tension that REDD+ would ordinarily generate but help ensure the flow of wealth to the rural areas in Africa.

Emissions trading policy can ensure a proper benefit sharing between the government and forest dependent communities from the gains of REDD+. This benefit sharing can be accomplished through an emissions trading policy when avoided deforestation achieved by farmers are denoted as carbon credits or units and these credits are then sold on behalf of the farmers by the government.

Governments retain a percentage from the money realised from the sale and a percentage is given to the farmers. If farmers know also they can make money through avoided

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[264] *Ibid*.

deforestation, they will better internalize concepts such as agro forestry. They will also put an end to shifting cultivation, otherwise known as slash-and-burn agriculture.

This will raise the profile of farming as a profession and stop the trend towards de-agrarianisation. Erstwhile farmers who are now artisan miners would want to go back into farming, thereby addressing the driver of deforestation known as artisanal mining. Emissions trading schemes can also ensure that forest-dependent communities play their role in monitoring the progress of REDD+. While satellite analysis is important in MRV of REDD+, community involvement in the MRV of REDD+ must not be discountenanced, as forest degradation is very difficult to monitor remotely.[265] Thus, forest owning families have to be involved in the process. Emissions trading can help ensure that they report to the government the forest degradation noticed in their communities.

A regional emissions trading scheme involving polluting companies in Africa can lead to the transfer of wealth from developed countries to African companies. Carbon is steadily becoming the most traded commodity in the world. The value of the global carbon market grew to 176 billion dollars in 2011. The global carbon market is divided into two market segments: the compliance market and the voluntary market. The compliance market is regulated by mandatory national, regional, or international reduction regimes.

The voluntary carbon market includes any sectors and geographies not covered by mandatory cap-and-trade schemes or other regulation of greenhouse gas (GHG) emissions. Individuals, companies and governments purchase carbon offsets to mitigate their own greenhouse gas emissions, to cover some or their entire carbon footprint for particular activities or businesses, or just to display their concern for the environment.

The voluntary carbon market value increased to 576 million dollars in 2011.[266] The market value of EU ETS, the backbone of the global carbon market, increased to 148

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[265] Mark Hirrons Artisanal Mining and REDD in Sub-Saharan Africa *supra* note 167 at 1144.

[266] State and Trends of the World Carbon Market *supra* note 2 at 10.

billion dollars in 2011.[267] The market is expected to grow all the more with new players entering the market. Though the EU ETS is currently oversupplied, there will be demand for international credits in the third phase of the scheme. This demand will come from government buyers as well as private buyers because EU member countries committed to the second commitment period of the Kyoto Protocol. The fact that the coverage of the scheme has been expanded to include all the major greenhouse gases will fuel the demand for international credits in the third phase. Other players are also coming in: Australia will start a nationwide cap and trade program in 2015. In November 2011, the Australian Parliament passed the Clean Energy Legislative Package as part of an effort to comply with Australia's unconditional target of reducing net emissions by 5 percent below 2000 levels by 2020. The legislative package, known as the Clean Energy Future Package, includes a Carbon Price Mechanism (CPM) that was to take effect July 2012 and link with international offset markets from July 2015.[268] The scheme will cover approximately 500 businesses representing 60 percent of Australia greenhouse gas emissions from electricity generation.[269] Under the scheme, participants can meet 50 percent of their emissions obligation with international credits. Africa can take advantage of the scheme's liberal linking provisions.

China has also decided to launch a nationwide emissions trading scheme by 2015. As a form of testing the waters, it has launched seven pilot carbon-trading schemes in preparation for the take off of the nationwide emissions trading scheme in 2015.

In November 2011, the National Development and Reform Commission ordered seven Chinese cities and provinces to set up pilot carbon trading systems during the 12th Five-Year Plan, including Beijing, Shanghai, Tianjing, Chongqin, Shenzhen (the five cities)

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[267] *Ibid*.
[268] *Ibid* at 74.
[269] Australian Government, Clean Energy Future Fact Sheet, *Carbon Pricing Mechanism: Who is Liable?* Cited in State and Trends of the World Carbon Market *supra* note 2 at 74.

and Guangdong and Hubei provinces.[270] Given China's emissions intensity, there will most likely be a provision for linking when the nationwide emissions trading scheme is launched in 2015.

Japan is also planning to introduce a domestic emissions trading scheme, where there is currently a Basic Law on Climate Change Countermeasures, which contains a provision for the adoption of a domestic emissions trading scheme.[271] Though it has not been approved yet, it will be approved once the highly political issues of tax reform and pension reform are settled. There will most likely be a provision for linking once the law is passed.

It is also believed that if the new California cap and trade program succeeds, the US will have a national cap and trade program by 2016.[272] The New Zealand ETS also allows for linking with international credits.

Linking the proposed scheme to several ETS in other jurisdictions in a non-reciprocal manner can be a source of massive financial flows to Africa companies who cut their emissions beyond and above the allowances given to them.[273]

A regional ETS can also fetch revenue for African countries through the auctioning of allowances to the highest bidder. This revenue can be used to fight the overwhelming challenges of climate change in Africa.

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[270] IETA, *Greenhouse Gas Market 2012 New Market, New Mechanism, New Opportunities* (IETA 2012) at 27, online: <http://www.ieta.org/assets/reports/ieta%20greenhouse%20gas%20market%202012.pdf>.

[271] *Ibid* at 25.

[272] See Jim Pierobon, *US could have cap and trade by 2016*, online: Energy Collective <http://theenergycollective.com/jimpierobon/142396/us-could-have-cap-and-trade-2016-if-california-succeeds-starting-wednesday>.

[273] Generally, carbon markets can be linked either directly or indirectly. Direct Linking happens when two trading systems recognise each other's allowances. Direct Linking can be one way in that recognition is only from one system. It is two-way when the recognition is mutual. Indirect Linking happens when two trading systems do not recognise each other's allowance but are linked to a common third system. For further reading on linking, see Behr *et al*., *Towards a Global Carbon Market*? *Potential and Limits of Carbon Market Integration* (GPPI Policy Paper No 5) at 41. The linking that will bring the most benefit to Africa is Multilateral Linking, i.e. linking the ETS in Africa to several other ETS in a one-way direct manner.

The challenges posed to Africa by climate change are considerable and there are no matching funds available. The Human Development Report 2007-2008 confirms that adaptation aid to Africa is flat. To date, the Least Developed Country Fund—one of the sources of adaptation funding under the UNFCCC—has received pledges from 17 donors amounting to just under US$157 million. Less than one-half of this has been delivered to Global Environment Facility accounts. Actual spending in terms of delivery through projects amounts to US$9.8 million.[274] In total, $350 million has been pledged to Africa to support adaptation plan of actions. Out of the pledged sum, only $130 million has been delivered.[275] Yet, World Bank adaptation cost studies suggest that Africa will need close to $30 billion between now and 2030 to effectively adapt to climate change.[276]

As evident in Chapter One, the poorest countries of the world will be the hardest hit by the impact of climate change. According to the Stern Review, to stabilise the level of greenhouse gas emissions in the atmosphere at even 500 ppm CO_2, a level that would still carry a significant risk of dangerous climate change, would cost around two percent of global GDP annually—close to US$1 trillion.[277] The African Group of Negotiators has also argued that Africa will need at least US$267 billion a year for mitigation and adaptation.[278]

The African Union has rightly identified finance as a major constraint, both to adaptation and mitigation actions in Africa. The approach of the African Union to the half-hearted commitment to climate change aid by developed countries is to demand compensation for Africa in the interest of climate justice at UNFCCC negotiations; that the North must pay the climate debt owed to the South.[279] This approach is commendable, as developed

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[274] UNDP, Human Development Report 2007-2008 (Fighting Climate Change: Human Solidarity in a Divided World) (UNDP New York, NY) at 188.
[275] AMCEN Guidebook *supra* note 4 at 55.
[276] *Ibid*.
[277] Stern Review *supra* note 72 at 234.
[278] Alyster Doyle. *Africa says poor need billions to fight climate fight* (2009), online: Reuters <http://www.reuters.com/article/2009/04/20/us-climate-africa-idUSTRE53J2RG20090420>.
[279] Conceptual Framework of African Climate Change Programmes *supra* note 75 at 3.

countries can do more than they are currently doing (as they are obligated under the principles of international environmental law).[280]

The need is acute, but total reliance on foreign aid cannot solve the problem, especially in view of the economic downturn in developed economies. Other sources of funding should be explored. A regional ETS can help African countries attract additional funding to implement climate change programmes.

CDM cannot ensure the transfer of wealth from developed countries to Africa in the manner a national and regional ETS with linkage to other ETS would achieve. Less than 30 per cent of the revenue from CDM goes to developing countries. The rest goes to brokers, bankers, investors, and consultants in rich countries, as well as to fees and taxes.[281] Most CDM finances are absorbed by project developers as transaction costs.

A graphic example of this is the Trees Farm project in the Bukaleba Forestry Reserve in Uganda. The project is meant to offset the GHG emissions of a coal-fired power plant to be built in Norway. The Ugandan government received a meagre one-off fee of US$410 and an annual rent of about US$410 for each hectare of plantation, which is an incongruously low lease price compared to the huge carbon credits the Norwegian company (Tree Farms) was aiming to sell.[282] What is more, Certified Emission Reduction units (CERs) are sold at a discounted rate in the carbon market compared to the EUAs (European Union Emission Allowances). The designated carbon unit of the scheme will attract more value than CERs.

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[280] Christina Voigt, "State Responsibility for Climate Change Damages" (2008) 77 NJIL 1. In Doha (COP 18), developing countries won the historic recognition for the plight they face from the ravages of climate change. The phrase, "loss and damage from climate change" was included as part of COP 18 resolutions. See Fiona Harvey*, Doha clears the way for 'damage aid' to poor nations*, online: <http://www.euractiv.com/climate-environment/doha-climate-change-deal-clears-news-516547>.

[281] Sarah-Jayne Clifton, *A dangerous obsession – the evidence against carbon trading and for real solutions to avoid a climate crunch.* (Friends of the Earth, 2009) at 32, online: <http://www.foe.co.uk/resource/reports/dangerous_obsession.pdf>.

[282] Yacob Mulugetta, "Climate Change and Carbon Trading in Africa" in Trucha Reddy ed *Carbon Trading in Africa: A Critical Review* (Pretoria, South Africa, 2011) 13 at 21.

3.5 Contribution to the Stabilisation of Greenhouse Gases in the Atmosphere

An understanding of the contributions and trends of greenhouse gas emissions in Africa is important in knowing what mitigation strategy or policy to adopt.

Africa's contribution to the global pool of greenhouse gases is currently modest but like all other developing regions, its emissions are expected to increase in the future. There is an upward trend to Africa's greenhouse gas emissions. Canadell et al. show that emissions from Africa have grown at a faster pace than the global average for the period 2000-2005.[283] In its Energy Outlook 2011, the US Energy Information Administration projects that Africa's carbon dioxide related emissions will grow by 1.8 percent per year between 2008 and 2035.[284]

According to US EPA,

> Non-CO2 emissions from Africa grew 17 percent between 1990 and 2005. GDP in Africa grew 57 percent over the same period. The pattern of emissions is quite different in Africa than other regions. Sources with significant emissions and growth over this period include savannah burning (included in other agricultural sources), biomass burning, natural gas and oil, stationary and mobile combustion, landfills and wastewater. Emissions from Africa are projected to increase 34 percent from 2005 to 2030, while GDP is expected to triple over this time.[285]

Figures 3.1 and 3.2 show the global total non-CO_2 emissions between 1990 and 2030, according to the US EPA.

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283 *supra* note 120 at 468.

284 *International Energy Outlook*, (US Energy Information Administration, 2011), online: <http://www.eia.gov/forecasts/ieo/pdf/0484(2011).pdf>.

285 US EPA, *Summary Report: Global Anthropogenic Non CO_2 Emissions 1990-2030* (Office of Atmospheric Programs, Climate Change Division, Washington, DC, 2012).
The non-$C0_2$ gases evaluated in the report are nitrogen trifluoride (NF_3), methane (CH_4), sulphur hexafluoride (SF_6), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). The sectors covered are agriculture, industrial processes, waste and energy.

Three variables influence emissions growth: population; income, measured as per capita gross domestic product; and intensity of emissions, (tonnes of greenhouse gas emissions per million dollars of GDP).[286] Population x per capita GDP x Intensity_{ghg} = Emissions_{ghg}.

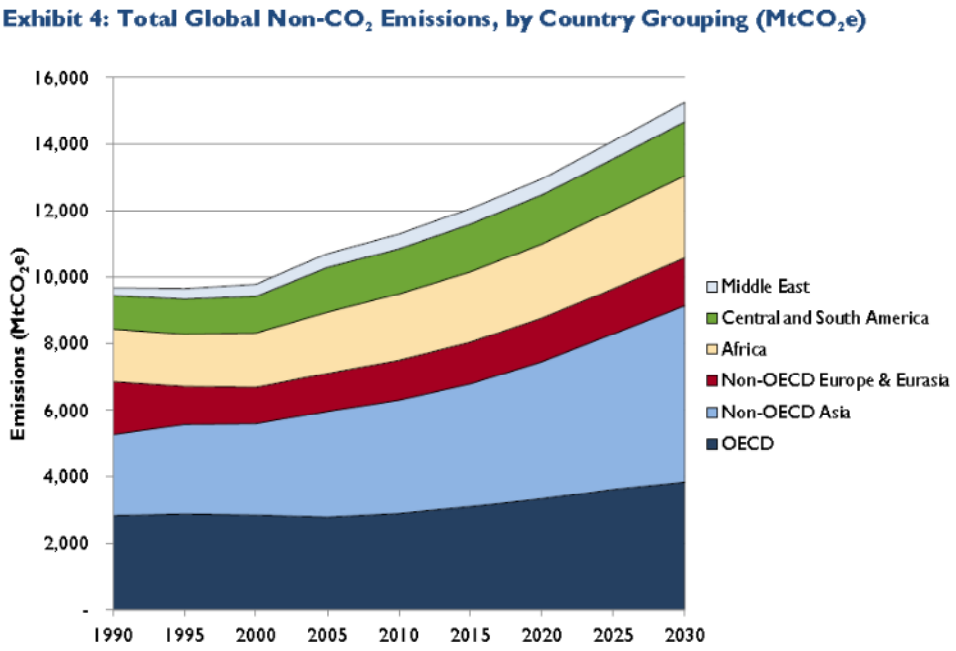

Figure 3.1 Total Global Non-CO_2 Emissions by Country Grouping

Source: US EPA, *Summary Report: Global Anthropogenic Non CO_2 Emissions 1990-2030* (Office of Atmospheric Programs, Climate Change Division, Washington, DC, 2012).

Region	1990-2000	2000-2010	2010-2020	2020-2030	1990-2030
OECD	0.6%	1.6%	14.9%	15.2%	35.3%
Non-OECD Asia	13.0%	24.1%	20.9%	28.7%	118.1%
Non-OECD Europe & Eurasia	-31.6%	9.2%	10.6%	9.1%	-9.7%
Africa	3.5%	23.5%	10.6%	11.3%	57.2%
Central and South America	8.9%	20.3%	10.3%	9.1%	57.7%
Middle East	47.4%	16.0%	20.6%	18.1%	143.4%
Total	1.3%	15.1%	15.2%	17.6%	58.0%

Figure 3.2 Percent Change in Total Global CO_2 Emissions by Decade and Region

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286 John Blodget & Larry Parker, *Greenhouse Gas Emissions Drivers*: *Population*, *Economic Development*, *and Growth and Energy Use*. (Congressional Research Service Report for US Congress, 2010).

Source: US EPA, *Summary Report: Global Anthropogenic Non CO_2 Emissions 1990-2030* (Office of Atmospheric Programs, Climate Change Division, Washington, DC, 2012).

The World Energy Council estimated that in the period 1980 to 2001, Africa's energy intensity increased slightly between 1980 and 2001, from 5,953 Btu per $1995-PPP to 6,555 Btu per $1995-PPP.[287] Nigeria and South Africa accounted for the bulk of this increase, as they consume the bulk of the region's energy and constitute the largest economies. African carbon dioxide intensity grew slightly; from 0.49 metric tonnes per thousand $1995-PPP to 0.51 metric tonnes per thousand $1995-PPP. Africa is the only world region where carbon dioxide intensity increased during this period.[288]

Africa has the fastest population growth rate in the world. Most of the high fertility countries are in Africa. Africa's population was estimated to be 943 million in 2006.[289] According to the Population Reference Bureau, developed countries will experience little or no population growth in this century. The population growth expected in this century will come from the world's poorest countries. By 2050, the population of the world's LDCs will number over 8 billion, 86 percent of the world's population.[290] Appendix C shows the most populous countries in 2012 and 2050, and the countries with the highest fertility rates in 2012.

According to the report, Nigeria will be the fourth largest country in the world by 2050. With only 10 percent landmass, this would mean increased pressure on the environment. The environment cannot keep up with the pace of this population growth.

Africa also has the highest rate of urbanization in the world, ranging between 3-5 percent per year. In 2000, one in three Africans lived in cities; by 2030 one in two will live in

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[287] AFREC Approach to Energy Efficiency in Africa: Policy Framework and Technical Programs, WEC Regional Workshop on Energy Efficiency. 2009.

[288] *Ibid* at 4.

[289] United Nations Statistics Division, *Demographic Year Book 2006* (4 August 2008) at 32.

[290] Population Reference Bureau *World Population Data Sheet 2012* (2012) at 5, online: <http://www.prb.org/publications/datasheets/2012/world-population-datasheet.aspx>.

cities.[291] Almost two thirds of all vehicle fleet growth will be in non-OECD countries.[292] This translates to increased emissions from the transport sector.

Africa's economic growth rate is expected be to 4.5 percent in 2013 and rising to 5 percent by 2014.[293] The economic prospects for the future look bright as well. This is due to increasing trade and investment ties with developing economies. The new oil discoveries in Africa mean that Africa's GDP will increase. The new oil discoveries are in Kenya, Ghana, Sierra Leone and Uganda. These discoveries add to the ten existing major oil-exporting countries (Algeria, Angola, Cameroon, Chad, Congo, Egypt, Equatorial Guinea, Gabon, Libya and Nigeria) in Africa.[294] Ghana's Jubilee field has an estimated total reserve of 490 million barrels of high quality oil and is expected to yield government revenues of $1 billion on average per year between 2011 and 2029, based on a long-run price assumption of $75 per barrel. Oil production had already started in Ghana in 2010.[295]

The above statistics suggest that Africa is set to have a major influence on the global pool of greenhouse gases. Consequently, increased action on mitigation is needed. A piecemeal approach to mitigation will not suffice in the circumstance. A cap on emissions will do more environmentally than the current project-by-project nature mitigation under the CDM. A cap and trade program conceptually guarantees environmental certainty more than project-based trading.

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[291] Jane Akumu, "Reducing Emissions from Transport" (delivered at SUSTRAN National Workshop, 2012), online: <http://www.unep.org/transport/pcfv/pdf/icct_2012/reducingemissionsfromtransports_jane%20akumu_unep.pdf>.

[292] *Ibid*.

[293] United Nations, *World Economic Situation and Prospects 2013* (New York, NY, 2013) at 120.

[294] *Ibid* at 121.

The ten existing major oil-exporting countries are among the top flarers of associated gas, a major contributor to climate change. See: National Geophysical Data Center, *Twelve year Record of National and Global Gas Flaring Volumes Estimated Using Satellite Data* (World Bank, 30 May 2007), online: <http://www.ngdc.noaa.gov/dmsp/interest/flare_docs/DMSP_flares_20070530_b.pdf>.

[295] *supra* note 281 at 121.

The greenhouse gas emissions intensity of some countries in Africa is already significant. Africa's environmental impact intensity in relation to the level of industrialisation is among the highest in the world.[296] Algeria emitted a total of 117.3 million tonnes of greenhouse gases in the year 2000.

The energy sector was responsible for about 75 percent of these emissions, with 20 percent of that figure coming from the production, processing and transport of hydrocarbons, and 47 percent down to the electricity generation. Of total emissions, agriculture accounted for 11 percent, waste emitted 10 percent and industrial processes 5 percent.[297] In Egypt, total emissions for 2000 amounted to about 193 $MtCO_2$. Fifty-five percent of the emissions came from fuel combustion, 6 percent from fugitive fuel emissions, 16 percent from agriculture, 14 percent from industrial processes and 9 percent from the waste sector.[298]

In 2000, the total greenhouse gas emissions from the five main sectors (energy, industry, agriculture, land use change and forestry, waste) in Nigeria were about 330,946 Gg CO_2.[299]

South Africa's total emissions in 2000 were estimated to be 461 million tonnes of carbon dioxide equivalents (CO_2e).[300] Eighty-three percent of emissions are derived from energy supply and consumption, 7 percent from industrial processes, 8 percent from agriculture, and 2 percent from the waste sector.

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[296] UNEP, *Sustainable Consumption and Production in Africa* (Nairobi, Kenya, 2009) at 32. CO_2 emissions from Africa totalled 928 Mt. UNCTAD, Economy Development in Africa Report (New York, NY, 2012) at 131.

[297] UNFCCC, *Algeria's Second National Communication* (Ministry of Environment, 2010) at 65.

[298] UNFCCC, *Egypt's Second National Communication* (Egyptian Environmental Affairs 2010) at 30.

[299] *NEEDS for Climate Change in Nigeria* (Federal Ministry of Environment, 2010) at 14.

[300] *supra* note 78 at ix.

An emissions trading scheme can help reduce Africa's emissions. African fuels are known to be of poor quality and high in sulphur levels,[301] a major contributor to global warming. A regional cap and trade scheme covering the downstream sector in Africa, for instance, will not only reduce emissions from the sector but also reduce emissions from the transport sector. Cleaner fuels will mean fewer emissions from the transport sector. This will also translate to better air quality in African cities.

3.6 Preparing Africa for a Carbon Constrained Future

The future of the world is likely going to be carbon constrained. The principle of Common but Differentiated Responsibility (the main pillar of the UNFCCC) envisages a time when developing countries will also assume quantified emissions limitation obligation and reduction commitments (QELRCs). Not much progress has been made in the fight against climate change, even as greenhouse gases continue to rise in the atmosphere.[302] A reason for this failure is because of the problem of burden sharing; how to allocate climate change control responsibility between developed country parties and developing country parties.[303]

Since broad partnership is needed in the goal of stabilizing the concentration of greenhouse gas in the atmosphere, a process has begun to devise fair solutions to all parties concerned. At the 2012 UN Climate Change Conference in Doha, Qatar, parties agreed to speedily work toward a universal climate change agreement covering all countries from 2020, to be adopted by 2015.

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[301] Jane Akumu. Reducing Emissions from Transport *supra* note 279 at 5.
Emissions from the transport sector are the major cause of air pollution in many African cities. *supra* note 284.

[302] According to the WMO, the amount of CO_2 in the atmosphere reached 390.9 parts per million in 2011. The amount of methane reached 1813 parts per billion in the atmosphere in 2011. Nitrous oxide reached 324.2 parts per billion in the atmosphere in 2011. See: WMO Press Release No. 965, online: <http://wmo.int/pages/mediacentre/press_releases/pr_965_en.html>.

[303] United States insisted it would only accept binding emissions cuts under the Kyoto Protocol if they apply to developing countries as well. Developing countries like China and India refused to accept binding emissions targets, asking rather that developed countries like US show leadership in curbing its emissions.

The international negotiation to build a new global climate agreement and to drive greater immediate climate action has started. The negotiating team is looking at:

> an innovative set of ways for all countries to commit to climate actions that are compatible with their national circumstances; that the contours of the new agreement must integrate action across all levels (international, national, sub-national and private sector); and that a mechanism must be created to regularly ratchet up ambition to stay below a 2 degrees Celsius temperature rise.[304]

An agreement that is compatible with national circumstance could mean quantified emissions limitation obligations based on per capita emissions. Implementing emissions trading as a policy before the agreement is reached can help institutions adjust early to new obligations of the UNFCCC, so that when African countries assume additional responsibility under the UNFCCC, meeting the obligations will not be so burdensome.

Naturally, increased obligations for African countries would be demanding on the government as well as industries in Africa. Implementing emissions trading as a policy could make the transition to a carbon constrained environment less painful because, in principle, it seeks to reduce greenhouse gases emissions at the lowest cost to the society. The fact that emissions trading allows for trans boundary cost sharing will make the transition to a carbon constrained environment less difficult.

3.7 Viability of the Policy in Africa

The next issue to be considered is the issue of institutional feasibility. It is argued that the fundamental criterion for a policy to exist in the real world is that it must demonstrate or gain institutional feasibility.[305] Feasibility consists of being publicly acceptable (political feasibility) and having administrative capacity available to implement it. Institutional

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[304] *UNFCCC Press Release* (3 May 2013), online: <http://unfccc.int/files/press/releases/application/pdf/20130305_adpclose.pdf>.

[305] S. Gupta *et al*. Policies, Instruments and Cooperative Arrangements *supra* note 97 at 752.

feasibility also includes factors such as plausibility and time requirements to develop or enable institutions to implement a policy.[306]

The presence of multinationals with experience in emissions trading favours the implementation of an emissions trading scheme in Africa. Multinationals like Shell, ExxonMobil and Lafarge Cement have substantial experience in emissions trading.

These multinationals are active participants in the emissions trading scheme in Europe. Before the introduction of the trading scheme in Europe, Royal Dutch/Shell launched its own internal emissions trading to learn the intricacies of emissions trading schemes. The Royal Dutch/Shell Group developed and used a pilot internal emissions trading system (STEPS) to gain experience and understanding in the use of, and structure for, emissions trading. The system, which ran from 2000 to 2002, allowed trading between Shell Group entities located in Annex 1 countries. The system covered over 33 million metric tonnes of CO_2e from over 22 separate sites, accounting for almost two-thirds of its global emissions.[307] The presence of these multinationals will ensure the policy's smooth takeoff. Their experience will also rub off on the local African companies in the carbon intensive sectors of the economy who have no experience in emissions trading.

For an active emissions market to emerge in Africa there must be enough pollution sources. There are enough polluting industries in Africa to make trading of permits possible. The polluting industries cut across various sectors of the economy with different marginal abatement cost to act as an incentive to trade. Appendix D shows some of the polluting sources in Africa.

The fact that the polluting sources are not homogenous means there is room for a market to develop. The Moroccan industry alone burns 1 million tonnes of fossil fuels each year,

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[306] *Ibid*.

[307] *Shell launches its own emissions trading scheme* (28 January 2000), online: Edie Newsroom <http://www.edie.net/news/0/Shell-launches-its-own-emissions-trading-scheme/2271/>.

generating 2 million tonnes of CO_2.[308] The cement industries and fertilizer industries in Egypt are very energy intensive. They contribute about 28 Mt of CO_2e per year, representing more than 99 percent of the total emissions of Egypt's industrial sector.[309]

The institutions in Africa have also been building capacity in carbon trading. Kenya opened the first carbon exchange in Africa in 2011.[310] The goal of the exchange is to facilitate the trading of carbon credits generated through the Clean Development Mechanism. The exchange is called the African Carbon Exchange (ACX). It is based in Nairobi, Kenya. The ACX is an electronic trading platform for the trading of carbon credits and environmental derivatives. Since 2008, the Johannesburg Stock Exchange[311] has been using its platform to sell carbon credit notes. Carbon credit notes are listed tradable securities designed to provide holders with the opportunity to gain exposure to carbon credits that will be generated from greenhouse gas mitigation projects. There is another carbon trading platform in Zambia, called the African Carbon Credit Exchange.[312] The South African government is also considering introducing an emissions trading scheme.[313]

While an active homegrown carbon market can develop in Africa, some institutional barriers will have to be addressed. This will be the focus of the next chapter.

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[308] UNEP, African Regional Implementation Review for the 14th Session of the Commission on Sustainable Development (UNEP) at 2, online: <http://sustainabledevelopment.un.org/content/documents/ecarim_bp2.pdf>.

[309] Egypt's Second National Communication to the UNFCCC *supra* note 286 at 35.

[310] *African Carbon Exchange*, online: <http://www.acxafrica.com/>.

[311] *Johannesburg Stock Exchange*, online: <http://www.jse.co.za/products/all-products/product-details/carbon_credit_notes_ccns.aspx>.

[312] *African Carbon Credit Exchange*, online: <http://www.africacce.com/>.

[313] South Africa's Second National Communication to the UNFCCC *supra* note 78 at 186.

Chapter 4

4 Institutional Barriers Against a Homegrown Emissions Trading Scheme in Africa

Conditions are hardly ever perfect for the introduction of a new policy. In this chapter, I will look at the institutional barriers that must be addressed before there can be a homegrown emissions trading scheme in Africa. Some of the barriers that will be discussed are challenges facing mitigation of climate change in Africa. This chapter will also proffer solutions to these institutional barriers.

4.1 Greenhouse Gas Inventory Constraint

An inventory of greenhouse gases is important in mitigation of climate change. Developing a national inventory of greenhouse gases is part of the obligations of African countries to the UNFCCC.[314] A national GHG inventory is a comprehensive listing, by source of annual GHG emissions.[315] National inventories include greenhouse gas emissions and removals, taking place within national territory and offshore areas over which the country has jurisdiction. A GHG inventory report should cover all the relevant gases and source categories of the gases. National GHG inventories provide a baseline of data and, if regularly updated, a tracking mechanism for assessing how domestic policies impact emissions.[316] The guideline to follow in the emissions development process by parties to the Convention is the Intergovernmental Panel on Climate Change guidelines. The basic approach for calculating emissions under the IPCC guidelines is summed in the equation: Emissions = Activity Data x Emissions Factor.[317]

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[314] art 12 of the Convention *supra* note 5.

[315] *Ibid*.

[316] Thomas Damassa, *National Greenhouse Gas Inventories Can Help Countries Curb Climate Change*, online: <http://insights.wri.org/news/2012/05/national-greenhouse-gas-inventories-can-help-countries-curb-climate-change>.

[317] Kristin Rypdal and Newton Paciornik, "Introduction to the 2006 Guidelines" in Eggleston *et al*, eds *IPCC Guidelines for National Greenhouse Gas Inventories Volume 1 General Guidance and Reporting* (Hayama, Kanagawa: Japan Institute for Global Environmental Strategies, 2006) 1.1 at 1.6.

Activity Level Data is the extent to which an activity that leads to emissions of GHG takes place, while Emissions Factor refers to the ratio between the emissions generated and the outputs of production processes. Fuel consumption would, for instance, constitute activity level data in the energy sector, while the mass of carbon dioxide emitted per unit of fuel consumed would constitute an emission factor.[318]

One of the qualities of a good inventory is consistency. Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and categories reflect real differences in emissions.[319] A good inventory must also be accurate, must not contain underestimates,[320] and must be complete. Estimates are reported for all relevant categories of sources and sinks, and gases.[321]

Inventory preparation has proven to be a challenge for African countries, as there is so much uncertainty in the process. The authors and compilers of South Africa's GHG Inventory (1990 to 2000) said:

> The GHG inventory process continues to face a number of challenges, the most significant of which is the availability of activity data for computation of the emissions. The most challenging sectors for data collection were AFOLU (Agriculture, Forestry and Other Land Use) and IPPU (Industrial Processes and other Product Use). For the AFOLU sector, spatial data, in-depth research and modelling studies are required in order to create a robust database for land use and land use changes. Data for the agriculture sector had to be obtained from international sources (FAO) for this 2000 inventory. For the IPPU sector, one reason given for the difficulty in collecting data was lack of cooperation by some industrial companies connected to the protection of confidentiality. There is an urgent need for government assistance here. Government can consolidate the agreements it has entered into with industry so that industry provides

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[318] *Ibid*.
[319] *Ibid* at 1.8.
[320] *Ibid*.
[321] *Ibid*.

> the required data, and in a format that is commensurate with the data requirements for preparations of national GHG inventories.[322]

Challenges facing African countries in inventory preparation include incomplete or non-existent activity data, lack of country specific emission factors, and difficulty in retaining experts. The west African countries of Benin, Burkina Faso, Cote d'Ivoire, Gabon, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Chad, and Togo have identified several difficulties in inventory preparation; including inconsistencies and lack of coherence in data provided by sources, lack of forest surveys, limited national coverage in some data items, and predominance of informal (unregulated) sectors.

In east African Ethiopia,

> Even though Ethiopian environmental policy states that there should be a policy to 'promote a climate monitoring program as a country is highly sensitive to climate vulnerability', there are two problems with this law: first, it doesn't give the responsibility to any single agency but the National Metrological Agency is doing it. Second, it only refers to vulnerability data and looks at how Ethiopia is affected by the world with GHG emissions rather than looking at domestic GHG emissions. Industries, sectors and government agencies don't have any mandate to collect data or have ownership of data. Government agencies and sub-national administration also don't have any government mandate to monitor GHG by industries. As these agencies don't have any governmental mandate or authority, they face challenges in collecting data from industries. Furthermore, without any mandate, allocation of resources including financial and personnel by the government agency to monitor GHG emission won't be possible. There is an absence of locally applicable data collection tools and methodology. Even though IPCC guideline should be used to collect data, some of the tools and methodologies need to be locally adapted so that it can properly reflect the local environment. National, sub-national and government agencies, which should be monitoring GHG emissions, don't have the necessary technological infrastructure collect and store data. Financial constraint is also one of the challenges that agencies have in creating data collection mechanisms and maintaining the system. As the government currently doesn't have the

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[322] Department of Environmental Affairs and Tourism Republic of South Africa, *Greenhouse Gas Inventory South Africa 1990 to 2000* (2009) at v- vi, online: <http://rava.qsens.net/themes/theme_emissions/government-publications/SA%20GHG%202000.pdf>.

> policy to monitor GHG emission, it doesn't allocate any budget to set up and maintain the necessary system.[323]

The lack of activity data is because priority is not given to environmental accounting in African countries, and also due to poor data management. Low quality inventory is not peculiar to African countries alone; it is a general phenomenon common to all developing country parties' inventory under the UNFCCC.[324]

A good inventory is very important to an emissions trading scheme because it is from the inventory that a decision will be made about which sectors to include, and where to apply the obligation to hold allowances (e.g., at the fuel distributor or the emission source). It is also from the inventory that a decision will be made about the aggregate cap. In addition, emissions inventory is sometimes used to project future emissions.[325]

The minimum data requirements for the emission inventory necessary for a tradable permit scheme include individual emission source characteristics (e.g., size, location, name-plate capacity, process type, boiler type, fuel type) and emission levels for individual sources based on output, fuel use, and/or emission data.[326]

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[323] Todd Ngara, Some African experiences in GHG inventory preparation, online: <http://www-gio.nies.go.jp/wgia/wg6/pdf/1-7%20Todd%20Ngara.pdf>. See also: Echnoserve Consulting, Measurement and Performance Tracking Scoping and Survey Results Ethiopia Report at 6-8 online: <http://prod-http-80-800498448.us-east-1.elb.amazonaws.com/w/images/b/be/MAPT_Consultant_Scoping_Report_Ethiopia.pdf>.

[324] The Government Accountability Office of the United States in 2009 compared 2009 inventories from various industrialized countries listed in Annex I of the UNFCCC (Australia, Canada, Germany, Japan, Russia, the United Kingdom and the United States) to the inventories submitted by a set of high-emitting countries not listed in Annex I (Brazil, China, India, Indonesia, Malaysia, Mexico and South Korea). It found out that the seven Annex 1 nations produced generally high-quality inventories whereas the inventories for the selected Non-Annex 1 countries were out-dated and of lower quality. Ivan Valencia, "Report on International Emissions Inventories Compare Apples and Oranges" WWF Climate Change Blog (12 August 2010), online: http://www.wwfblogs.org/climate/content/congressional-agency-reviews-international-greenhouse-gas-emissions-inventories.

[325] A Guide to Designing and Operating a Cap and Trade *supra* note 69 at 3-3 to 3-4.

[326] *Ibid* at 3-4.

Some polluting companies in Africa voluntarily report their emissions. For instance, in its annual sustainability report, Shell publishes its greenhouse gas emissions.[327] Some polluting companies in Africa are involved in the Carbon Disclosure Project.[328] Companies like Eskom, Transnet, Sasol, Anglo American PLC, Barloworld, FirstRand Ltd., Gold Fields Ltd., Mondi PLC, and Woolworths are active participants in the Carbon Disclosure Project.[329] However, the problem with voluntary reporting by companies is the risk of underreporting. For instance, in its Sustainability Report 2012, Shell did not provide emission data on specific locations and facilities. The level of reporting of gas flaring of other oil companies in Nigeria is also not up to the standard required.[330]

To solve this challenge, there should be a legislative framework for greenhouse gas reporting in African countries. Regulation should require reporting of GHG emissions at the facility level and then roll up to the corporate level. Companies should state GHG emission source categories such as from stationary combustion mobile construction, process emission, and fugitive emissions. African countries whose emissions primarily emanate from the forestry sector should mandate farmers and other forest-dependent professions to report their activity-based emissions. This would involve training in the reporting guidelines of the IPCC.

To this end, the Department of Environmental Affairs in South Africa is contemplating making emissions reporting mandatory for all entities (companies and installations) that

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[327] In its Sustainability Report of 2012, it reported that emissions from its facilities were 72 million tonnes equivalent on a CO_2 equivalent basis in 2012. Nigeria accounted for around 65 percent of flaring from its facilities during the period under review. *Shell Sustainability Report* (2012), online: <http://reports.shell.com/sustainability-report/2012/servicepages/downloads/files/entire_shell_sr12.pdf>.

[328] The Carbon Disclosure Project encourages companies and cities to disclose their impacts on the environment and the measures they are taking to reduce them. *Carbon Disclosure Project* (2013), online: <https://www.cdproject.net/en-US/Pages/HomePage.aspx>.

[329] Sipho Kings, *SA Companies come out tops in Carbon Disclosure Project,* (22 November 2012), online: Mail and Guardian http://mg.co.za/article/2012-11-22-carbon-disclosure-project-south-african-companies-doing-well.

[330] A survey of oil companies conducted by Ayoola Tajudeen reveals that very few companies provided data on global GHG emissions. None provided data on specific locations, facilities and impact of emissions on the environment. Ayoola Tajudeen, "Gas Flaring and Its Implication for Environmental Accounting in Nigeria" (2011) 4 JSD 244 at 246.

emit more than 0.1 Mt of GHGs annually, or that consume electricity that results in more than 0.1 Mt of emissions from the electricity sector. Qualifying entities will be obliged to report energy use by energy carrier and other data, as may be prescribed. The emissions inventory will be a web-based GHG Emission Reporting System.[331] The fact that it is a web-based system will make for more transparent reporting.

Through its Consultative Group of Experts on National Communication, the Conference of Parties has also been organising training workshops to improve the inventory preparation process in Africa, one of which was recently organised in Namibia for African experts involved in the inventory preparation process.[332]

This is important because, even if there is a legislative framework for emissions reporting in Africa, there is need for well-trained experts who would be able to evaluate and ensure that the reporting format followed the IPCC standards for GHG reporting.

4.2 Monitoring and Enforcement Constraint

This constraint is closely intertwined with the earlier constraint discussed in this chapter. The goal of any tradable permit scheme is to control pollution, albeit through cost effective means. This goal can only be achieved if the environmental goals of the program are strictly adhered to. This can only be done through an effective enforcement regime, but African countries have weak environmental enforcement capacity.
For instance, in Nigeria, it was recently reported that, in 2012, none of the oil firms in Nigeria paid the new gas flare penalty of $3.50 per standard cubic foot because they disagreed with the penalty. The Department of Petroleum Resources, charged with the task of enforcing the flare penalty, failed to enforce the penalty on oil companies.[333] This

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[331] National Climate Change Response White Paper *supra* note 83 at 29.

[332] Subsidiary Body for Implementation, Progress Report on the work of Consultative Group of Experts on National Communications from Parties not included in Annex 1 to the Convention: report on hands-on training workshop for the African region on national greenhouse gas inventories, UNFCCCSBIOR, 37th Session, FCCCSBI/2012/25.

[333] Soni Daniel, *Oil firms shun gas flare penalty payment for 2012*, (7 November 2012), online: Vanguard <http://www.vanguardngr.com/2012/11/oil-firms-shun-gas-flare-penalty-payment-for-2012/>.

weak enforcement capacity is partly due to the fact that environmental protection is yet to assume the importance it deserves in the public space.

Enforcement of emissions trading generally involves four steps: detecting violation, notifying the source, negotiating a compliance schedule, and applying sanctions for non-compliance when appropriate.[334] Detecting violation involves determining that a plant is in compliance when it commences operation, and during continuous normal operation.[335]

Normally, a single set of tests, conducted at installation, will suffice to determine that a source is initially in compliance, but it is inherently harder to verify continuous compliance. Several means are used to detect violations, including self-certification by sources,[336] on-site inspections, and direct monitoring of pollutant flows. Thus, the ability to measure emissions by participating facilities is very important in an ETS.

Measuring compliance can be difficult for GHGs. Carbon dioxide is easier to monitor because of the close link between the carbon content of fuel and the amount of carbon dioxide emissions. Thus, monitoring the flow of fuels could substitute for monitoring emissions.[337]

However, monitoring methane is difficult. Agricultural sources of methane, such as ruminant animals and animal wastes, sources of nitrous oxide and carbon sinks, are also difficult to monitor accurately.[338]

One way of dealing with unreliable emissions monitoring would be to limit trading to GHG sources that can be readily and accurately monitored.[339] For gases that are difficult to monitor, such as methane, emission factors may be developed.[340]

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[334] Emissions Trading Principles and Practice *supra* note 215 at 165-166.
[335] *Ibid* at 166.
[336] Self- certification means self- reporting by the polluting source as to whether it is in compliance. *Ibid.*
[337] *Ibid* at 169.
[338] International Rules for Greenhouse Gas Emissions Trading *supra* note 249 at 59.
[339] *Ibid*.
[340] *Ibid* at 60.

Determining compliance in emissions trading involves comparing actual emissions with authorized emissions. If actual emissions are estimated imperfectly, the environmental goal of the ETS is diminished. The two known options for showing compliance are through modeling and monitoring. However, modeling does not guarantee continuous compliance because it is an estimate accomplished before the fact.[341] Technology could help solve this monitoring concern; for instance, asking facilities to install and pay for a Continuous Emissions Monitor (CEM). A CEM would make it easier to verify continuous compliance.[342] A CEM would also transfer the monitoring burden to polluters, especially in a terrain where the environmental enforcement capacity is weak.

Another way of dealing with monitoring concerns is to use permits in some markets and to combine permits and standards in others.[343] As part of compliance, facilities or firms must show that monitored emissions match allowances.

The allowance monitoring system should be sufficiently harmonized with the emissions monitoring system to allow matches between the two to be easily obtained. A registry is needed to ensure this. The registry is an automated database that keeps track of all permits and changes to the permits either through transfer or use.[344]

4.3 Corruption

Another institutional constraint is corruption. For an emissions trading scheme to succeed, the regulator must be corruption-free; the participants in an emissions trading

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341 Emissions Trading Principles and Practice *supra* note 249 at 178. When a facility makes an application for a certificate of approval to install, operate, or modify any device that emits contaminants into the air, it has to prepare what is called an Emission Summary Dispersing Modelling Report (ESDM) summarizing all air emissions from a facility and assessing their impacts against the regulator standards and guidelines. Though this report is regularly updated, it does not guarantee accurate monitoring. See also: *Emission Summary and Dispersion Modelling Reports*, online: <http://www.ene.gov.on.ca/environment/en/industry/standards/industrial_air_emissions/air_pollution/STDPROD_078056>

342 The CEM is the gold standard for source monitoring. It is attached to a smoke stack and records all the emissions from the stack. See: "Use of Economic Incentives in Developing Countries" *supra* note 10 at 7-8.

343 Pablo Montero, "Pollution Markets with Imperfectly Observed Emissions" (2005) 36 Rand 645 at 657.

344 *Ibid* at 179-180. The Acid Rain Program, discussed in the next chapter, had an Allowance Tracking System. The ATS records the holdings of all allowance holders, including regulated entities and brokers.

scheme must have confidence in the regulator. Emissions trading will thrive in an environment where rule of law is respected and enforcement is consistent, impartial, transparent, and independent of political considerations. Participating firms or facilities should clearly understand from the onset how the program works, and how regulating authorities will measure and enforce compliance. Interest in a trading program will diminish significantly if firms believe that rules are unfair, arbitrary, or unpredictable.[345]

The role of the ministry of environment, or agencies charged with environmental protection, is crucial because it is the ministry or agency that will monitor and enforce the scheme locally. While corruption is a global vice, it appears more predominant in Africa. Ninety percent of countries in Sub-Saharan Africa scored below 50 (the average score) in the Corruption Perception Index 2012 of Transparency International.[346]

This perception is capable of eroding the confidence of participants in the process, but it can, however, be remedied if public participation in environmental governance is allowed. Public inputs on what the emissions cap should be and public access to data on trades, violations and actual emissions will enhance the credibility of the program. Evaluation of compliance by rights groups should be factored into the implementation design. Rights groups can exert a lot of pressure on companies that want to dilute the emissions goal and on impartial regulators.

4.4 Summary Conclusions

Despite the aforementioned institutional barriers, emissions trading can thrive in Africa. The literature on emissions trading schemes reveals that conditions must not necessarily be ripe for trading before the policy is deployed. Chile has already experimented with tradable permits for total suspended particulates. Montero et al. found that the allocation process associated with a tradable permit scheme created, "economic incentives for incumbent sources to more readily declare their emissions and claim the corresponding

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[345] A Guide to Designing and Operating a Cap and Trade *supra* note 69 at 2-4.

[346] 70 percent of all the countries in the world scored below 50. *Corruption Perception Index 2012*, online: <http://issuu.com/transparencyinternational/docs/cpi_2012_report?e=2496456/2010281>.

emissions rights (i.e., capture scarcity rents), helping the authority complete its inventory of sources and emissions more quickly".[347]

Setting up an emissions trading scheme is always challenging; it proved challenging for the developed countries as well. According to Ellerman,

> The problems that are likely to be encountered in setting up a cap-and-trade system should not be minimized. Institutionally, the Member States of the European Union must be considered more prepared and capable of implementing such a system than many of the prospective participants in a global system. Yet, there was no end of difficulties in setting up the system in Europe. The biggest problem was data at the installation level which was needed both for the allocation of allowances to covered installations and more importantly for setting an appropriate cap. The data deficiencies in Eastern Europe were greater than they were for the EU15 and most of the East European governments required more time to set up the requisite infrastructure for trading and enforcement. Poland's registry did not go on line until eighteen months after the start of the EU ETS; and Romania and Bulgaria, who became participants in the trial period in its last year, did not have everything in place in time to participate effectively in trading in 2007.[348]

Another challenge that the EU ETS faced is corruption. So, how did EU overcome all the challenges associated with setting up a tradable permit scheme? What lessons can Africa learn from existing successful tradable permit schemes? This will be the focus of the next chapter.

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[347] Pablo Montero *et al*., "Market Based Environmental Policy Experiment in Chile" (2000) 00-005 WP CEEPR 1 at 23.

[348] Denny Ellerman, "The EU Emissions Trading Scheme: A Prototype Global System?" 1 at 5-6, online: <http://belfercenter.ksg.harvard.edu/files/Ellerman11.pdf>.

Chapter 5

5 Emissions Trading Scheme Success Stories

There have been several experiments with tradable permit schemes, both in developed and in developing countries. Tradable permit schemes have been deployed to address climate change and conventional pollution control. This chapter will examine the United States Acid Rain Program, the EU ETS, the New Zealand ETS, and the tradable permit scheme in Chile.

5.1 The United States Acid Rain Program

The Acid Rain emissions allowance trading program was enacted through Title IV of the 1990 Clean Air Act Amendments (CAAA).[349] In 1980, prior to the enactment of the Amendment and due to public concern about acid rain, the US Congress commissioned a ten year study of the causes and effects of acid rain. The result of the study led to the introduction of emissions trading under the Clean Air Act.[350] The goal of the program was to achieve a 10 million-tonne annual reduction in sulphur dioxide (SO_2) emissions from 1980 levels by the year 2010, and a 2 million tonne annual reduction in nitrogen oxide (N_2O) emissions, also below 1980 levels.[351] Phase 1 of the program, which began in 1995, included mostly coal-burning electric utility plants located in 21 eastern and midwestern states. Phase II of the program, which began in 2000, tightened the annual emissions limits imposed on large, higher-emitting plants and also set restrictions on smaller, cleaner plants fired by coal, oil, and gas.[352]

Utilities have the freedom in meeting their compliance obligations. They could decide to employ energy conservation measures (i.e. increasing reliance on renewable energy and

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[349] Clean Air Act (1990) § 401-416.

[350] Timo Behr *et al*., *Towards a Global Carbon Market? Potential and Limits of Carbon Integration* (Global Public Policy Institute) 1 at 22, online: <http://www.gppi.net/fileadmin/gppi/GPPiPP7-Carbon_Markets.pdf>.

[351] *Ibid*.

[352] *Ibid*.

reducing usage), or adopt pollution control technologies like switching to lower sulphur fuels.[353] Utilities that reduce their emissions below the number of allowances they hold may trade with other utilities or bank them to cover emissions in future years.[354]

Each allowance is defined for a specific calendar year. They are transferable among the affected sources; any plants reducing emissions more than required by the allowances could transfer the unused allowances to other plants.

A source must hold enough allowances to equal its emissions in a calendar year. If a source emits 8,000 tonnes of sulphur dioxide in a year, it must hold 8,000 allowances in that same year. Emissions cannot exceed the levels permitted by the allowances, whether acquired or allocated. Utilities are required to pay a penalty per tonne if they emit more than their authorized holdings. This penalty was $2,000 per tonne in 1990 and is indexed to inflation.[355] Secondly, excess tonnes in one year are subtracted from the allocation the following year. The penalty of $2,000 per excess tonne was effective in ensuring compliance because it was greater than the cost of buying an allowance.[356] If the penalty is not greater than the cost of an allowance, there will be a lot of violations by firms.

The US Environmental Protection Agency allocated allowances at an emission rate of 2.5 pounds of SO_2/mmBtu (million British thermal units) of heat input, multiplied by the unit's baseline mmBtu (the average fossil fuel consumed from 1985 through 1987).[357]

These allowance allocations are listed in Table A of the Clean Air Act and codified in the Allowance System Regulations (Part 73, Table 1). Alternative or additional allowance allocations were made for various units, including affected units in Illinois, Indiana, and Ohio, which were allocated a pro rata share of 200,000 additional allowances each year

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353 *EPA Clean Air Markets*, online: <http://www.epa.gov/airmarkets/progsregs/arp/s02.html>.
354 *Ibid*.
355 Emissions Trading Principles and Practice *supra* note 215 at 11.
356 *Ibid* at 181.
357 *EPA Clean Air Markets*, online: <http://www.epa.gov/airmarkets/trading/factsheet.html#whatis>.

between 1995 and 1999.[358] In the second phase, allowance calculations were made for various types of units, such as coal- and gas-fired units with low and high emissions rates or low fuel consumption. The EPA allocated allowances to each unit at an emission rate of 1.2 pounds of SO_2/mmBtu of heat input, multiplied by the unit's baseline.[359] Beginning in 2010, the Act places a cap at 8.95 million on the number of allowances issued to units each year. This caps emissions at 8.95 million tonnes annually and ensures that the mandated emissions reductions are maintained over time.[360]

In addition to annual allocations, allowances could also be obtained by application to the US EPA reserves. Utilities were allowed to obtain additional allowances in Phase 1 by installing qualifying Phase I technology (a technology that can be demonstrated to remove at least 90 percent of the unit's SO_2 emissions) or by reassigning their reduction requirements among other units employing such technology.[361] A second reserve provides allowances as incentives for units achieving SO_2 emissions reductions through customer-oriented conservation measures or renewable energy generation. Sources were required to submit information regarding their energy savings and renewable generation to the EPA. In turn, the EPA awarded allowances at a pre-determined rate of one allowance per 500 megawatt hours of energy saved or renewable energy generated.[362] The third reserve contains allowances set aside for auction, which are sponsored yearly by EPA. Utilities that began operating in 1996 or later were not allocated allowances. They are meant to purchase allowances from the market.[363]

To ensure compliance with the cap set, utilities must install Continuous Emissions Monitors (CEMs) to accurately monitor their actual emissions. Each utility must show that it holds at least as many allowances for its emissions that year as measured by its

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[358] *Ibid*.
[359] *Ibid*.
[360] *Ibid*.
[361] *Ibid*.
[362] *Ibid*.
[363] *Ibid*.

installed CEM. Sources must finalise allowance transactions and submit them to the EPA by March 1st (or by February 29th if it is a leap year) so that they can be recorded in their compliance account.[364] The EPA also has an auditing team; the audit is meant to verify that the testing is completed according to standard procedures and accurately represented in the reports to EPA.[365] The auditing team performs both random and targeted field audits. They visit facilities to inspect the CEM and the on-site records to verify that data reported to the EPA are actually a reflection of what is going on at the facilities.[366]

One of the innovations of this program was the creation of an auction market. The auction market helped in achieving the low cost compliance objective of the program. Previous emissions trading markets did not work well because of high transaction costs. This was due to the fact that allowances could only be purchased through private sale. Prices of allowances were confidential because the sale was private and there was scarce information about potential buyers and sellers of emissions.[367] Though the auction market was meant to reduce transaction costs, it could ostensibly raise the cost of compliance significantly.

The US EPA established a zero revenue auction to solve this problem. Each year, the EPA withholds from its allocation to utilities less than 3 percent of the allocated allowances and auctions them off. These allowances are allocated to the highest bidders, with the successful buyers paying the actual bid price. Proceeds are refunded on a proportional basis to the utilities from which the allowances were withheld.[368] Private allowance holders other than utilities can also sell at the auction market.[369]

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[364] *Ibid*.
[365] A Guide to Designing and Operating a Cap and Trade *supra* note 69 at 4-5.
[366] *Ibid*.
[367] Emissions Trading Principles and Practice *supra* note 215 at 11.
[368] *Ibid*.
[369] *Ibid*.

Another innovation of this program is that it allows anyone to purchase allowances. Thus, environmental groups and private citizens can purchase allowances for the purpose of retiring them.[370] Any retired allowance can no longer be used to emit pollution. Environmental and student groups acquired up to 934 allowances between 1994-1997.[371]

Any person or group—including brokers and investors—wishing to purchase allowances may open a general Allowance Management System (AMS) account. AMS accounts track issuance of all allowances, how many allowances an account holds, how many allowances are held in various allowance reserves such as the EPA Auction Reserve and the Conservation and Renewable Energy Reserve, deduction of allowances for compliance purposes, and transfer of allowances between accounts. Information on emissions allowances and transactions is available to the public.[372]

The Program is regarded to be a success. It is said to have reduced emissions by thirty-five percent more than the pre-existing command-and-control emissions cap, with a cost savings of twenty-five to thirty-five percent (about $225-375 million) each year.[373] Data from 1988 show that ambient SO_2 concentrations in the air are declining.[374] Field data collected by the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) also reveal that sulphate levels in precipitation have dropped sharply since the SO_2 Emissions Trading Program began in 1995.[375] According to the Clean Air and Status and Trends Network (CASTNET), dry deposition sulphur concentration levels have also declined by approximately 30 percent in the northeast and Mid-Atlantic States.[376] A study examining surface water quality in the acid sensitive regions of the

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[370] *Ibid* at 12. The opt- in provision is also an innovation of the program. It allows sources not required to participate in the program to enter on a voluntary basis. Clean Air Act 1990 § 410.
[371] A Guide to Designing and Operating a Cap and Trade *supra* note 69 at 4-3.
[372] *EPA Clean Air Markets*, online: <http://www.epa.gov/airmarkets/trading/factsheet.html#whatis>.
[373] Emissions Trading and the Development Critique *supra* note 232 at 146.
[374] A Guide to Designing and Operating a Cap and Trade *supra* note 69 at 5-6.
[375] *Ibid*.
[376] *Ibid*.

United States found that sulphur concentrations in lakes and streams have declined significantly in all monitored regions of the Eastern United States, except Virginia. Nitrate concentrations have decreased significantly in the Catskill and Adirondack Mountains, and in Vermont since 1990.[377]

According to the EPA, the program has led to 67 percent annual SO_2 emissions compared to 1980 levels, and 64 percent compared to 1990 levels.[378] In 2009, sources involved in the program emitted 5.7 million tonnes of SO_2, well below the 9.5 million tonne cap for the year.[379] The 3,572 electricity-generating units involved in the program in 2009 complied with the requirement to hold enough allowances to cover their SO_2 emissions.[380]

N_2O emissions were 2.0 million tonnes in 2009, well below the projected number of 8.1 million tonnes. Though other factors such as low demand for electricity contributed to reduction in N_2O emissions, the program was largely responsible for the reduction.[381] Figures 5.1 and 5.2 show the reduction in SO_2 and N_2O emissions.

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[377] *Ibid* at 5-7.
[378] United States Environmental Protection Agency, *Acid Rain and Other Programs: 2009 Highlights* (Clean Air Market Division: Washington, DC, 2010) at 3.
[379] *Ibid*.
[380] *Ibid*.
[381] *Ibid* at 5.

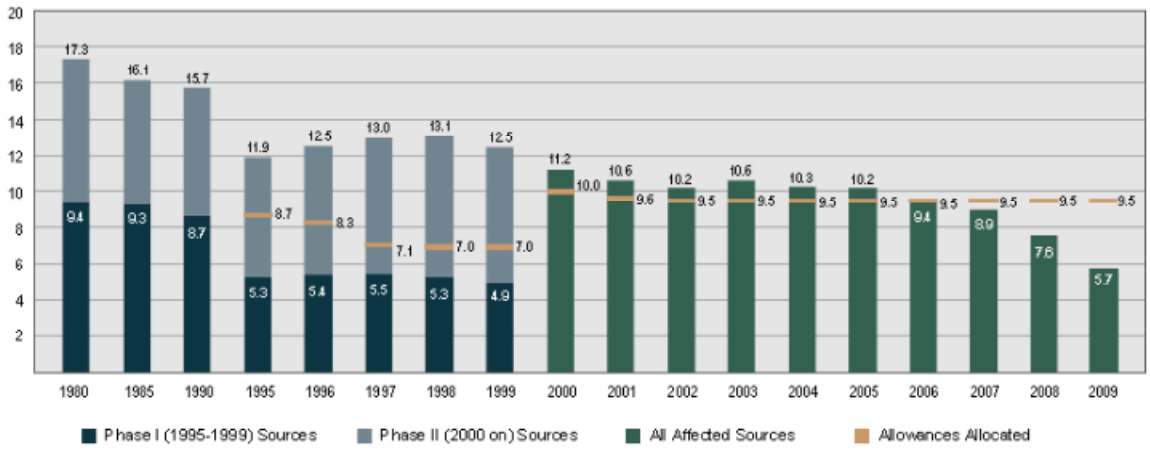

Figure 5.1 SO_2 Emissions from Acid Rain Program Sources, 1980-2009

Source: United States Environmental Protection Agency, *Acid Rain and Other Programs: 2009 Highlights* (Clean Air Market Division: Washington, DC, 2010) at 3.

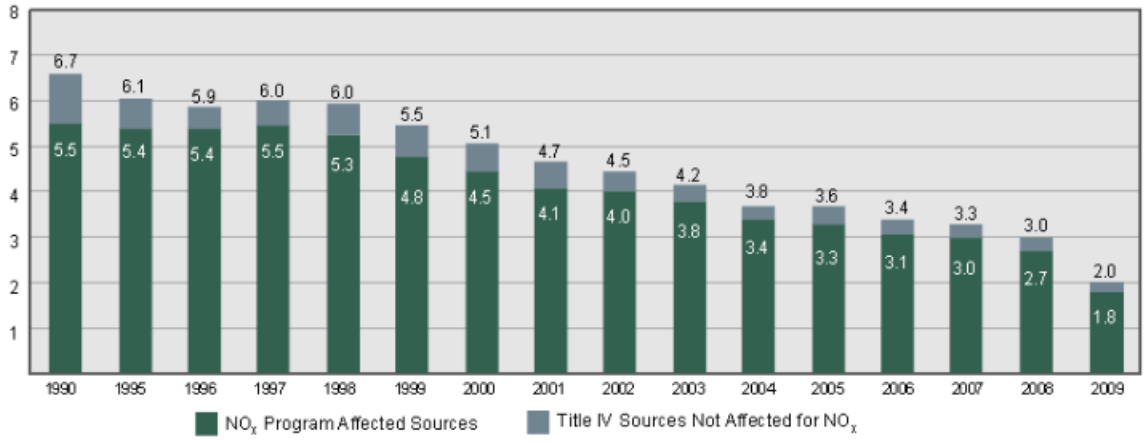

Figure 5.2 N_2O Emission Trends for All Acid Rain Program Units, 1990-2009

Source: United States Environmental Protection Agency, *Acid Rain and Other Programs: 2009 Highlights* (Clean Air Market Division: Washington, DC, 2010) at 3.

The EPA posits that the program has also fostered innovation, because sulphur removal technology has become radically more effective and less expensive during the life of the program.[382]

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[382] Emissions Trading and the Development Critique *supra* note 232 at 146.

5.2 Lessons and Transferable Ideas from the US Acid Rain Program

Emissions trading does not work in vacuum; it must be complemented by other policy initiatives. The success of the Acid Rain Program was due to the sulphur dioxide regulation, which specified National Ambient Air Quality Standards.[383] Thus, there must be a strong regulatory framework for pollution control in place before emissions trading can work. This will give sources the opportunity to choose how they intend to meet environmental goals. Sources that prefer a tradable permit scheme can opt for it, while sources that prefer standard setting can opt for that instead. This flexibility in choice can also help address institutional feasibility concerns that come with tradable permit schemes.

Public participation is very important if a tradable permit scheme is to achieve success. Emissions trading is generally viewed with skepticism by the human rights community. The Institute of Security Studies in South Africa specifically called for the abolition of the CDM.[384] Allowing inputs from the human rights community will allay some of their fears about carbon trading. Under the Acid Rain Program, the US EPA initiated a stakeholder process to solicit input on the implementation and experience with the emissions measurement requirements of the program.[385]The process involved regulated power plants under the program, the state and local environmental agencies that carry out audits for the EPA, and rights groups interested in the integrity of the program. The EPA used the input from the stakeholder process to revise the emission measurement requirements of the program.[386]

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[383] Emissions Trading Principles and Practice *supra* note 215 at 53.

[384] *Carbon Trading in Africa A Critical Review supra* note 180 at 176. See also: Patrick Bond, "Privatization of the Air Turns Lethal: Pay to Pollute Kills South African Activist Sajida Khan" *supra* note 80.

[385] A Guide to Designing and Operating a Cap and Trade Program *supra* note 69 at 5-6.

[386] *Ibid*.

Emissions trading can help a country like South Africa transform the carbon intensive nature of its energy production. The feature of the Acid Rain Program that encourages energy conservation and renewable energy generation appears suitable for such a country. A country like Nigeria can use it to combat acid rain, which has been prevalent in the Niger Delta region of Nigeria due to gas flaring.[387] Acid rain also occurs regularly in the Eastern Transvaal Highveld, the industrial hub of South Africa, where it can average a pH of 4.2.[388] Industrial activity is the cause of acid rain in both Nigeria and South Africa. This makes emissions trading a suitable policy option.

The opt-in provision in the Acid Rain Program can be used by African countries to ensure that there are enough participating sources in the scheme. This will encourage unregulated sources that want to cut their emissions to be involved in the program.

Another feature of the Acid Rain Program that can be copied by African countries is the provision that specifies that allowances are not property rights.[389] This is important in case a decision is made to alter the emissions cap, and will avoid a litigation backlash if such a decision is made.

5.3 The European Union Emissions Trading Scheme

On 1 January 2005, the largest emissions trading scheme (EU ETS) came into existence. Like the Acid Rain Program, it came about via legislation[390] proposed by the European Commission and approved by the EU member states and European parliament. The EU decided to implement a tradable permit system when its carbon tax proposal was rejected by businesses in the EU, and it became apparent that it would be difficult to meet its obligation to reduce its GHG emissions by 8 percent (below 1990 levels) by 2012 under

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[387] Efe Sunday, "Spatial Variation of Acid Rain and its Ecological Effect in Nigeria" delivered at the Environmental Management Conference, Federal University of Agriculture (2011).

[388] *Acid Rain*, online: <http://www.botany.uwc.ac.za/envfacts/facts/acidrain.htm>.

[389] Clean Air Act, §402.

[390] Emissions Trading and the Development Critique *supra* note 232 at 146.

the Kyoto Protocol.[391] The program is a cap and trade program. Participation is mandatory for companies in the sectors covered. The market is EU wide, but it also accepts credits from emission reduction projects under the Clean Development Mechanism and Joint Implementation of the Kyoto Protocol. The program covers some 11,500 facilities owned by 5,000 companies in 31 countries.[392]

Companies have several options in meeting their obligations; they could invest in more efficient technology, use a less carbon intensive source, or buy EU allowances and/or CDM/JI credits.

Like the Acid Rain Program, the EU ETS is being implemented in phases. Phase 1 ran from January 2005 to December 2007. This phase was meant to allow EU countries and businesses to gain practical experience in emissions trading. EU countries, apart from the United Kingdom and Denmark,[393] were inexperienced in emissions trading. Thus, it was necessary to develop the institutional capacity that would make emissions trading thrive. According to Ellerman et al., this phase was meant, "to establish the infrastructure and institutions and to gain the experience to make the subsequent 'real' periods a success, as opposed to achieving significant emissions reductions".[394]

The pilot phase was focused on CO_2 and it covered all facilities with a thermal output of 25 megawatts. The iron and steel sector, energy production, mineral industries, and paper and pulp production were the sectors covered in the pilot phase.[395] The overall cap was made up of individual country caps set by each nation's National Allocation Plan

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[391] Directive/2003/87/EC of the European Parliament and of the Council, 13 October 2013 L/275/32.

[392] "The EU Emissions Trading Scheme: A Prototype Global System?" *supra* note 336 at 3.

[393] European Union, *EU ETS Fact Sheet* (European Union 2013) at 1.

[394] The Danish scheme only covered eight companies in the electricity generation industry. The UK ETS was a voluntary cap and trade scheme. See: Aishwarya Padmanabhan , "Emissions Trading Under the Kyoto Protocol A detailed study of the UK ETS and the lessons learnt" *SSRN* (October 1 2008), online: <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1627700>.

[395] Denny Ellerman *et al*., Pricing Carbon: the European Union Emissions Trading Scheme cited in Juha Siikamaki *et al*, "The European Union Emissions Trading Scheme, *Resources for the Future* (November 2012) 1 at 2, online: <http://www.rff.org/RFF/Documents/RFF-Bck-EUETS.pdf>.

(NAP).[396] The NAP is meant to detail a member state emission target for ETS and non-ETS sectors, and how a member state will allocate its allowances.[397] The decentralised nature of the EU ETS meant that each member state had its own cap and trade while still being linked with one another.[398]

Ninety-five percent of allowances in the first phase were allocated for free or grandfathered.[399] The allocation process in the first phase was not without some tension. There was over-allocation of allowances during this phase, especially in the accession countries of the EU.[400]

The pilot phase successfully established a price for carbon and free trade in emission allowances across the EU.[401] The verified emission reports for the first year of the program became the benchmark by which the European Commission judged the acceptability of proposed caps for the second phase. The verified annual emission report filled the data gap that was present when the program came into existence.

The second phase of the program (2008-2012) was used by EU member states to meet their obligations under the Kyoto Protocol. Ninety percent of the allowances in the second phase (first commitment period) were allocated for free.[402] Two EU countries—Bulgaria and Romania—and three non-EU countries—Norway, Iceland, and Liechtenstein—joined the scheme in the second phase. GHGs covered in the scheme extended to nitrous oxide emissions from the production of nitric acid.[403] Phase III of the program started in January 2013. The cap for 2013 has been set at 2,039,152,882 EUAs.

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396 *Ibid*.

397 *The European Union Emissions Trading Scheme (EU ETS) Insights and Opportunities* (Pew Center on Global Climate Change) 1 at 11, online: <http://www.c2es.org/docUploads/EU-ETS%20White%20Paper.pdf>.

398 *Ibid*.

399 Siikamaki *et al*. *supra* note 375 at 3.

400 EU Action Against Climate Change *supra* note 71 at 9.

401 EU ETS Insights and Opportunities *supra* note 377 at 12.

402 EU Action Against Climate Change *supra* note 71 at 8.

403 *Ibid* at 9.

The aviation sector has been included in this phase; it represents the largest emitting sector covered by the scheme. All airlines from all nationalities will need EUAs (EU allowances) to cover the emissions from their flights to, from, or within the EU.[404] The new phase includes installations undertaking the capture, transport, and geological storage of greenhouse gases (CO_2 emissions from the petrochemicals, ammonia and aluminum sectors, nitrous oxide emissions from the production of adipic acid and gloxylic acid, and perflourocarbon emissions from aluminum production).[405]

Individuals and non-government organisations are free to buy and sell allowances in the market.[406] Governments involved in the program are at liberty to exclude small installations from the program, so long as they have measures in place that will achieve an equivalent reduction in emissions. The revision to the program is expected to result in an emissions reduction of 120-130 million tonnes of CO_2 per year.[407] The program currently covers around 45 percent of EU emissions.[408] It only focuses on sectors in which emissions can be measured, reported, and verified with a high level of accuracy. This is meant to minimise the MRV problems that can arise from adopting emissions trading as a climate policy instrument.

The decentralised nature of the program will give way to a centralised approach. The 27 national caps under the NAPs will give way to a single, EU-wide cap. It is believed that this centralised approach will enable the EU to achieve its emission reduction goals for 2020.[409] It is projected that the number of allowances that will be available in 2020 will be 21 percent below the level of the verified emissions in 2005.[410]

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404 Siikamaki *et al*. *supra* note 375 at 2-3.
405 State and Trends of the Carbon Market *supra* note 2 at 18. See also Action Against Climate Change *supra* note 71 at 13.
406 *Ibid* at 11.
407 *Ibid* at 9.
408 *Ibid* at 15.
409 EU ETS Fact Sheet *supra* note 373 at 1.
410 EU Action Against Climate Change *supra* note 71 at 12.

From 2013, 80 percent of the allowances in the manufacturing will be distributed for free while the rest will be auctioned. The number of allowances distributed free will reduce annually to 30 percent by 2020. In the aviation sector, 15 percent of the allowances would be auctioned for the period 2013- 2020.[411] Installations of a given type will now be treated equally across the EU. The method of distributing allowances to the manufacturing sector is now based on harmonised rules. This is different from what was obtainable in the second phase, when member states were at liberty to distribute allowances the way they deemed fit.[412]

All allowances in the power sector will be auctioned. The idea is that power companies can easily pass the cost of the allowances to consumers, unlike other sectors.[413] However, countries like Cyprus, Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Poland, and Romania will continue to distribute a certain percentage of allowances for free until 2019. The power industries in these countries are meant to reciprocate the gesture by investing in the modernisation of the sector.[414] Installations undertaking the capture, transport, and geological storage of greenhouse gases will also have to buy their allowances.[415]

Auctions are held by companies appointed by national governments, but are open to buyers from any country participating in the EU ETS. Most governments use a common 'platform' for their auctions, but Germany, Poland, and the UK have opted to use their own platforms. It is estimated that auctioning will generate 20-30 billion euros per year by 2020. Governments have agreed that the revenue generated from the auctions will be used to combat climate change in Europe and in developing countries.[416]

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411 *Ibid*.
412 EU ETS Fact Sheet *supra* note 373 at 4. Croatia joined the EU ETS in January 2013.
413 *Ibid*.
414 EU Action Against Climate Change *supra* note 71 at 17.
415 EU ETS Fact Sheet *supra* note 373 at 3.
416 EU Action Against Climate Change *supra* note 71 at 17.

As part of compliance, businesses must monitor and report their EU ETS emissions for each calendar year and have their emission reports checked by an accredited verifier.[417] A calculation-based approach (using emission factors), as well as a CEM system, is allowed for monitoring and reporting emissions. Each installation involved in the program must have a permit[418] from its competent authority for its emissions of all greenhouse gases covered by the Kyoto Protocol. The operator of any installation must satisfy the competent authority that it is capable of monitoring and reporting its emissions.

Operators whose emission reports for the year are adjudged as unsatisfactory by the independent verifier would not be allowed to sell allowances until a revised report is approved.[419] Aircraft operators within the EU must have a monitoring plan. A new monitoring and reporting guidelines is now in effect; this is meant to check the noticeable divergence in member states' monitoring, reporting, and verification practices.[420]

Companies must surrender enough allowances to cover their total emissions by April 30th of the following year. These allowances are then cancelled so they cannot be used again. A company is penalised if it does not surrender enough allowances to cover its emissions. They will have to obtain additional allowances in the following year to make up for the shortfall.

The defaulting company's name will also be published;[421] this is meant to embarrass the company. In addition to the above, the defaulting company will pay a fine for each excess tonne of CO_2 emitted. The fine, initially set at 40 euros per tonne, is now 100 euros per tonne. The fine will continue to rise in line with the annual rate of inflation in the

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417 *Ibid* at 18.

418 EU ETS Fact Sheet *supra* note 373 at 4.

419 *EU Action Against Climate Change supra* note 71 at 20. A permit is different from an allowance; a permit sets out the emission monitoring and reporting requirements for an installation, while an allowance is the tradable unit of the scheme.

420 *Ibid*.

421 *Monitoring, reporting and verification of EU ETS emissions,* (European Commission) online: <http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm>.

Eurozone.[422] Some member states also have additional dissuasive sanctions for any infringement of the program rules.[423]

A single EU registry with strong security measures ensures the accurate accounting of allowances. The registry keeps track of the ownership of allowances held in electronic accounts. Trading can be done directly between buyers and sellers, through several organised exchanges, or through the many intermediaries active in the carbon market. In 2011, some six billion allowances were traded, worth a total value of 77 billion euros.[424]

Most accounts suggest the program is a success story. Ellerman and Buchner tentatively estimate that, in both 2005 and 2006, the EU ETS abated 85 million metric tonnes, or 4 percent, of annual emissions.[425] According to Grubb et al., the program has achieved a 2.5 to 5 percent reduction in emissions below baseline levels.[426] In April 2012, the European Commission published 2011 verified emissions data. Emissions fell from 1,938 Mt in 2010 to 1,896 Mt in 2011, representing a 2.2 percent decline.[427] Extraneous factors such as the economic crisis contributed to this reduction. Following the 2008 financial crisis, Europe entered into a recession and industrial activity fell strongly. European emissions from the industrial sector decreased drastically, generating an oversupply of allowances.[428] The surplus in allowances could undermine the ability of the scheme to achieve more demanding emissions reductions in a cost effective manner.[429] The EU would need an average annual 4.3 percent growth in its Gross Domestic Product (GDP)

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[422] EU Action Against Climate Change *supra* note 71 at 19.
[423] *Ibid*.
[424] *Ibid*.
[425] EU ETS Fact Sheet *supra* note 373 at 6.
[426] Denny Ellerman and Barbara Buchner, "Over-allocation or Abatement? A Preliminary Analysis of EU ETS Based on 2005-06 Emissions Data" cited in Siikamaki *et al*., at 9.
[427] Grubb *et al*., "Climate Policy and Industrial Competitiveness: Ten Insights from Europe on the EU Emissions Trading System" cited in Siikamaki *et al*., at 9.
[428] State and Trends of the Carbon Market 2012 *supra* note 2 at 18.
[429] *Ibid*.

from 2013 to cancel out the excess.[430] The European Commission wants to postpone the auctioning of allowances until late in the third trading period as a way of addressing the glut.[431] The European Parliament is currently considering a proposal to withhold 900 million permits from the market between 2013 and 2015, known as "backloading".[432] There has also been suggestion of setting a price ceiling and floor to address the oversupply in the scheme.[433]

In addition, a stringent cap has been proposed as a way of getting out of the problem, because rendering the program more stringent will increase allowance prices.[434] Emissions reductions are still being met despite the current low price of allowances.[435] All in all, the evidence suggests that the EU ETS has succeeded in reducing emissions below what would be expected from the recession alone.[436] See Figure 5.3.

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[430] EU ETS Fact Sheet *supra* note 373 at 5.

[431] State and Trends of the Carbon Market 2012 *supra* note 2 at 25.

[432] EU ETS Fact Sheet *supra* note 373 at 6.

[433] Mat Hope, *Saving the EU Emissions Trading Scheme may mean abandoning key principles* (Carbon Brief Blog, March 2013), online: <http://www.carbonbrief.org/blog/2013/03/saving-the-eu-emissions-trading-scheme-may-mean-abandoning-key-principles>.

[434] Robert Stavins, *Low Prices a Problem? Making Sense of Misleading Talk about Cap and Trade in Europe and the USA* (Robert Stavins' Blog, 25 April 2012), online: <http://www.robertstavinsblog.org/2012/04/25/low-prices-a-problem-making-sense-of-misleading-talk-about-cap-and-trade-in-europe-and-the-usa/>.

[435] *Ibid*.

[436] See Brown, Hannafi & Petsnok, EU *Emissions Trading System Results and Lessons Learned* (Environmental Defense Fund 2012) for more information.

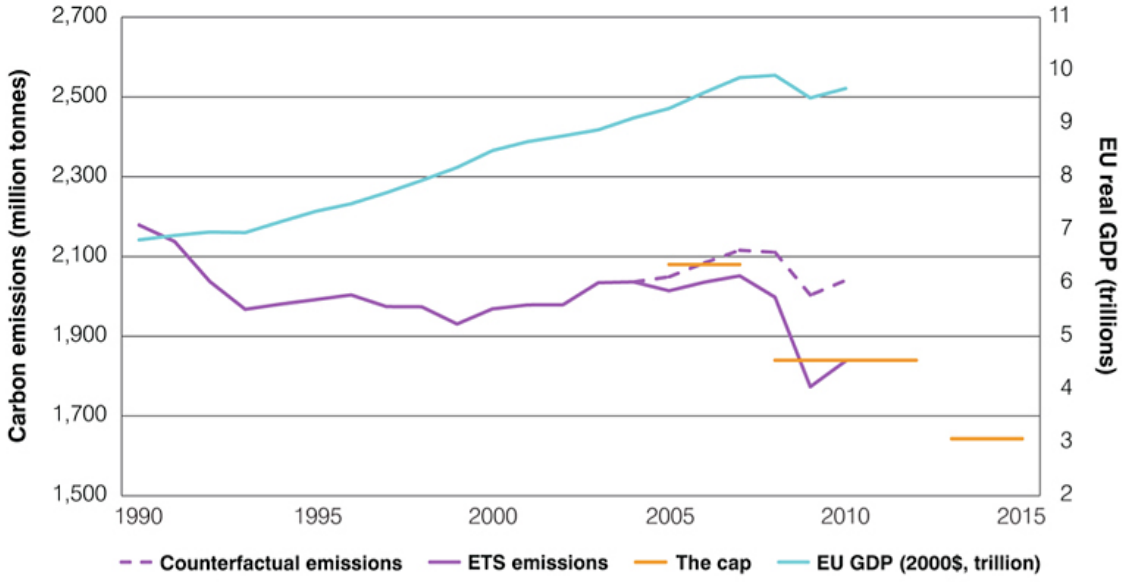

Figure 5.3 EU Emissions Data

Source: Brown, Hannafi & Petsnok, EU *Emissions Trading System Results and Lessons Learned* (Environmental Defense Fund 2012).

Apart from price concerns, the EU ETS have had to contend with fraudsters. In 2010, the European authorities uncovered several cases of "carousel fraud", which amounted to an estimated US$6.45 billion in lost revenues across at least 11 countries.[437] Carousel fraud is a form of missing trader fraud, wherein the trader facilitating the carbon credit exchange keeps the value-added tax (VAT), rather than paying it to the tax authorities and government treasuries.[438] Emission credits were initially purchased without adding the VAT, but then sold with the VAT added. This prompted changes in the tax law in EU countries that the

[437] UNEP, *The Impact of Corruption on Climate Change: threatening emissions trading mechanisms?*(UNEP-GEAS March 2013)
[438] *Ibid.*
[439] *Ibid.*

VAT fraud occurred.[439] In 2011, due to lax security, three million units were stolen from national registries involved in the EU ETS. The fraudsters used classic cyber-criminality techniques to access accounts in several national registries and to transfer allowances.[440] To prevent further attacks, the European Commission suspended all registries on 19 January 2011. The registries were reopened after each registry provided sufficient evidence that it met minimum-security criteria. The EU also wants to fully decouple its registry operations from the National Registries established under the Kyoto Protocol and centralize technical management in a Union Registry (UR), built as a single infrastructure and operated by single software as an additional measure to check this.[441]

5.4 Lessons and Transferable Ideas from the European Union Emissions Trading Scheme

The cap is very important in a cap and trade program. The environmental integrity of the cap is dependent on the stringency of the cap. Usually, in a new program, the cap is moderate, but becomes more stringent over time. The cap can also be used to address the low price of allowance. If the price is too low, it will not act as an incentive to participants.[442] The price must not be too low or too high, so that trading can occur. The cap and trade model appears suitable for countries like Egypt, Algeria, South Africa, and Nigeria, whose emissions are already significant and might likely resemble those of a developed country under a "business as usual" scenario in a few years' time.

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[440] State and Trends of the Carbon Market *supra* note 2 at 26

[441] *Ibid.*

[442] Severein Borestein, Putting a collar on carbon prices (The Berkley Blog, 6 April 2013), online: <http://blogs.berkeley.edu/2013/06/04/putting-a-collar-on-carbon-prices/>.

To build the necessary institutional capacity for emissions trading, African countries can copy the pilot phase of the EU ETS. The transition phase can be used to set up registry and the necessary enforcement regime of the policy.

African countries can also copy the feature of the program that requires installation to have permits for its emissions. This will ensure that emitting installations or facilities build the capacity to monitor and report their emissions. The permit requirement would be part of the approval process for a new emitting installation or facility.

The EU ETS shows the importance of mainstreaming corruption into climate change governance. The registry is very important in a tradable permit scheme; the integrity of the registry must be maintained at all times. Linking the registry of the proposed scheme to the International Transaction Log established under the Kyoto Protocol can help check possible phishing attacks on the registry.

5.5 The New Zealand Emissions Trading Scheme

The New Zealand ETS came into existence via the Climate Change Response Act.[443] The ETS is New Zealand's primary way of meeting its obligations under the Kyoto Protocol. New Zealand's per capita emissions are the twelfth highest in the world and its gross emissions keep rising due to increasing emissions in transportation and electricity generation.[444] After some initial discussion about carbon tax, the New Zealand government decided to set up an ETS.[445] The choice was informed by the belief that emissions trading is the lowest cost way of reducing emissions. It was also adopted as a climate change mitigation instrument in order to maintain New Zealand's eco-friendly brand.[446]

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[443] *Ibid*.

[444] Legislation was passed for the NZ ETS on 10 September 2008. See World Bank, *State and Trends of the Carbon Market 2010* (Washington, DC: 2012) 1 at 23. Tom Tietenberg *et al*, *supra* note 67 at 29.

[445] Moyes "Trail Blazing Comprehensive Cap and Trade" *supra* note 72 at 915. David Venables, "NZ Emissions Trading Scheme fact sheet" (Greenhouse Policy Coalition, 2010) at 1.

[446] *Ibid.*

This is not the first time New Zealand will be using emission trading for environmental purposes. Before now, New Zealand used a cap and trade program to move commercial fishing towards sustainable levels. Under the program, the government sets total allowable annual catch limits for each fish species in defined management areas, based on sustainable harvest considerations.[447] The program began in 1986. The government created individual transferable quotas (ITQs) to approximately 2,500 commercial fishing permit-holders based on their historic catch levels. ITQs are permanent rights to harvest fish from a particular area. If the sum of the individual quotas exceeded the total allowable commercial catch (TACC) for a fish stock, the Government will make a one-time purchase of the difference, and retire that portion of the quota.

The ITQ system has led to heavy trading, as it is estimated that 77 percent of the initially allocated ITQs have changed hands. Under the program, the first receiver of the fish must attest to the fact that the fish products received are covered by ITQs. The Government investigates the paper records to detect inconsistencies. So, it is not surprising that New Zealand opted for emissions trading to mitigate climate change.

New Zealand's emissions profile resembles most of the countries in Africa because of its high dependence on agriculture. On average, emissions in developed countries and economies in transition are 83.2 percent CO_2, 9.5 percent methane (CH_4), and 5.9 percent nitrous oxide (N_2O), but New Zealand's emissions are 46.5 percent CO_2, 35.2 percent CH_4, and 17.2 percent N_2O.[448]

The program started in 2008 with only forest owners included. The inclusion of forestry in the scheme is an attempt to address deforestation because, as part of its obligations under the Kyoto Protocol, New Zealand must account for emissions that occurred from deforestation.[449]

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[447] *Supra* note 74 at 29.
[448] Moyes "Trail Blazing Comprehensive Cap and Trade" *supra* note 72 at 915.
[449] *Ibid* at 198.

Under the scheme, all major owners of pre-1990 forests, or vested third parties, incur a deforestation liability for harvesting and not replanting.[450] Owners of post-1989 forests can voluntarily opt in to participate in the scheme. They would receive NZUs for any increase in carbon stocks from 1 January 2008.[451] However, they would face liability if carbon stock fell below a previously reported level.[452]

The NZUs can be sold either at home or abroad. In 2009, public and private buyers purchased up to 600,000 forestry NZUs on the spot market.[453] The Government of Norway purchased about 520,000 NZUs in 2009.[454]

In 2010, industrial processes, stationary energy sources, and liquid fossil fuel installations were included in the scheme. Beginning 1 January 2015, the program will cover nearly all emission sources of the New Zealand economy, and all greenhouse gases covered by the Kyoto Protocol.[455] The program has no domestic cap; it operates within the global cap on emissions set by the Kyoto Protocol.[456] The scheme has a price cap set at $25 per unit of $CO_{2.}$

For compliance, regulated entities have the choice of surrendering the free NZUs allocated to them if they are eligible, purchasing NZUs in the market or purchasing government-issued allowances at the fixed NZ$25 price. The government-issued NZUs are available in unlimited supply. They can only be surrendered; they cannot be banked or sold.[457] Regulated entities have to surrender one NZU per two tonnes of CO_2

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[450] State and Trends of the Carbon Market 2010 *supra* note 418 at 23.
[451] *Ibid* at 26.
[452] *Ibid*.
[453] *Ibid*.
[454] *Ibid*.
[455] *Ibid*.
[456] *Ibid*.
[457] David Venables, "NZ Emissions Trading Scheme fact sheet" *supra* note 419 at 3.

emitted.[458] This is known as the one-for-two obligation. The one-for-two obligation and price cap are intended to reduce some of the distributional effects of the program.[459] Certain international units can also be surrendered for compliance in unlimited quantities, such as CERs or ERUs. In 2011, scheme participants secured enough secondary CERs to achieve compliance for the next two to three years.[460]

There are penalties for noncompliance. If a participant fails to surrender NZUs when it is meant to, or surrenders fewer NZUs than required, the units will be cancelled and the participant will pay a penalty of $30 for each NZU. A participant could be fined up to $24,000 if it knowingly fails to file its emission return.[461] In addition, a participant that deliberately lies about its obligations could be fined up to $50,000, or be imprisoned for 5 years.[462]

Emission-intensive, trade-exposed industries (including agriculture) received free allowances on an intensity basis during the transition period of the program (2010-2012).[463]

The intensity-based free allocation is meant to encourage efficiency improvements without penalizing increases in production or putting businesses at a competitive disadvantage in the international market.[464] Free allowances were not granted to industries that are not trade-exposed, such as electricity generation and liquid fossil fuels.[465]

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[458] State and Trends of the Carbon Market 2010 *supra* note 418 at 24.
[459] *Ibid*.
[460] *Ibid*.
[461] *What does the NZ ETS mean for me*?, online: Climate Change Information New Zealand <http://www.climatechange.govt.nz/emissions-trading-scheme/about/what-it-means-for-me/>.
[462] State and Trends of the Carbon Market 2012 *supra* note 2 at 79.
[463] *Questions and answers about the emissions trading scheme*, online: Climate Change Information New Zealand <http://www.climatechange.govt.nz/emissions-trading-scheme/about/questions-and-answers.html>.
[464] State and Trends of the Carbon Market 2010 *supra* note 418 at 24.
[465] *Ibid*.

Some changes are being proposed to make the program more effective, including setting an absolute cap on covered emissions, limiting the use of international offset credits, maintaining the NZ$25 price ceiling beyond 2015, and allocating allowances through auction from 2014 or 2015.[466] Agriculture participants (fertilizer suppliers and processors) have started reporting their emissions from January 2012 in preparation for the inclusion of agriculture in the scheme in 2015.[467] They are to collect and retain data, and to use that data to calculate and annually report calendar year emissions. In the NZ ETS, emissions must generally be calculated by multiplying the quantity of a product by an "emissions factor". The emissions factors used within the scheme represent the average tonnage of CO_2-equivalent emissions of methane or nitrous oxide associated with one unit of the product, such as one tonne of meat produced.[468]

Despite the NZU falling from NZ$13 per tonne of CO_2 in late 2011 to NZ$0.19 in January 2013, the program appears to be a success.[469] The New Zealand Greenhouse Gas Inventory and "net position" show that New Zealand is on track to meet its Kyoto obligations for the period 2008-2012.[470] The report shows that New Zealand will have a surplus of 29.6 million emission units.[471] The report is only a tentative assessment of the program, as it is still in its transitional phase.

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466 *Ibid*.

467 State and Trends of the Carbon Market 2012 *supra* note 2 at 79.

468 New Zealand Ministry of Agriculture and Forestry, *A Guide to Reporting for Agricultural Activities under the New Zealand Emissions Trading Scheme* (Ministry of Agriculture and Forestry, April 2011) 1 at 6.

469 *Ibid*.

470 *New Zealand's net position under the Kyoto Protocol,* online: Ministry for the Environment <http://www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/index.html>.

471 *Ibid*. The net position is the New Zealand Kyoto Protocol Target Emissions Level minus its Actual Emissions Level. For the period 2008-2011, the ETS contributed to afforestation. They were new plantings of trees spanning 12,000 hectares in 2011. See Sopher and Manswell, *New Zealand The World`s Carbon Market: A Case Study Guide to Emissions Trading* (Environmental Defense Fund and International Emission Trading Association May 2013).

5.6 Lessons and Transferable Ideas from the New Zealand Emissions Trading Scheme

African countries (Democratic Republic of Congo, Nigeria, Zambia, Cameroon, Tanzania and Zimbabwe who have considerable emissions from the forestry sector)[472] can use emissions trading to combat deforestation and enhance forest cover. New Zealand, a country that has commitment under the Kyoto Protocol to combat deforestation, has deployed emissions trading to halt the loss of forest cover and has achieved success, given the fact that the country is on course to meet its Kyoto commitment. African countries can follow the example set by New Zealand in this regard.

Criminal sanctions for noncompliance, inherent in the New Zealand scheme, are a laudable provision that can be copied by African countries to ensure that erring participants do not sabotage the environmental goal of the program.

5.7 Santiago Tradable Permit Program

The Santiago Tradable Permit Program came into existence via the Supreme Decree 4 (passed in 1992) and the Supreme Decree 16 (passed in 1997). Though the program was legislated as far back as 1992, it only became active in 1997.[473] The program is meant to control total suspended particulate (TSP) emissions from the largest stationary sources (industrial boilers, industrial ovens, and large residential and commercial heaters discharging emissions from a duct or a stack at a flow rate higher than 1,000 m^3/hour) in Santiago.[474] The program was not designed on the basis of actual emissions, but on a proxy variable equal to the maximum emissions that a source could emit in a given

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[472] OECD, *Climate Compatible Growth: Seizing the Opportunity for Africa* (2011), at 6, online: <http://www.oecd.org/daf/inv/investmentfordevelopment/47636989.pdf>.

[473] Coria and Sterner, "Tradable Permits in Developing Countries Evidence From Air Pollution in Santiago, Chile" *supra* note 18 at 8.

[474] Pablo Montero, *Tradable Permits with incomplete monitoring: Evidence from Santiago particulate's permit program* (23 August 2004) 1 at 18, online: <http://www.economia.puc.cl/images/stories/profesores_jornada_completa/jmontero/papers/imperfectmonitoring.pdf>.

period of time; sources were too small to require a sophisticated monitoring procedure[475] The observable firm's emission rate (mg/m^3) is multiplied by its maximum possible output (m^3/year) to infer its maximum emissions (mg/year) for which the firm must buy permits.[476]

Sources operating by March 1992 were designated as existing sources and received grandfathered permits equal to the product of an emissions rate of 56 mg/m^3 and their flow rate at the moment of registration. New sources receive no permits; they must cover their emissions by buying permits from existing sources.[477] The total number of permits distributed was 64 percent of aggregate (proxied) emissions from existing sources prior to the program. After each annual inspection, the authority proceeds to reconcile the estimated emissions with the number of permits held by each source.[478]

The program is credit based, in that all trades require approval by the regulatory agency, even trades among large boilers that share common ownership.[479] A participant that wants to offset its emissions must request an offset and find a partner who is willing to sign an offsetting agreement. The offsetting agreement must specify the emissions to be compensated and the sources involved in the transaction. This is followed by certification of the emissions of the sources involved in the transaction through formal monitoring procedures. After all this procedure, the environmental agency accepts or rejects the transaction. In some other instances, it requests additional information.[480]

There is no banking provision in the scheme; permits are given in perpetuity and large boilers are restricted to trading permits on a permanent basis. According to Montero et

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[475] Coria and Sterner, "Tradable Permits in Developing Countries Evidence From Air Pollution in Santiago, Chile" *supra* note 18 at 8.
[476] Pablo Montero, "Tradable Permits with incomplete monitoring: Evidence from Santiago particulate's permit program" *supra* at 3.
[477] *Ibid* at 19.
[478] *Ibid*.
[479] Coria and Sterner *supra* note 18 at 10.
[480] *Ibid*.

al., this has created an illiquid market where sources are uncertain about the availability of permits in the future, and where buyers pay prices close to their top prices.[481]

Like most ETS, the program relies on self-reporting by regulated entities. Existing and new boilers report emissions once a year to the authorities.[482] As part of the reporting requirements of the program, sources must contact an independent and certified laboratory to monitor the flow and the concentration of emissions discharged through their stacks.[483] Sources that fail to meet the reporting requirement face sanctions ranging from $4.50 to $90,000.

According to Montero, the program proved to be more cost effective than traditional regulation.[484] Coria and Sterner's evaluation of the program showed that the program has been met with aggregate over-compliance, but this was massively aided by the switch to natural gas.[485] See Appendix E.

The authors' review shows that the program's development has been hampered by high transaction costs due to the credit nature of the program and the lengthy time it takes to reconcile permits.[486] The program suffers from design issues, one of its limiting factors being the lack of public participation.[487]

All in all, the Santiago program shows that emission trading can achieve some measure of success in a developing country. The program has successfully achieved emissions

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[481] Montero *et al*., "A Market Based Policy Experiment in Chile" cited in Coria and Sterner *supra* note 18 at 10.
[482] *Ibid* at 11.
[483] *Ibid*.
[484] Pablo Montero *supra* note 454 at 26.
[485] Coria and Sterner *supra* note 18 at 16.
[486] *Ibid* at 23.
[487] *Ibid* at 26.

reduction. Chile now has a complete inventory of pollution sources in Santiago. Trading activity has also increased over time.[488] The program has been cost effective thus far.

5.8 Lessons and Transferable Ideas from the Santiago Tradable Permit Program

Africa can use emissions trading (though not the credit based model adopted by Chile, because of its high transaction costs) to combat air pollution. It is now clear that climate change and air pollution are closely coupled. According to a report by the US EPA,[489] ozone is a significant contributor to climate warming. The climate impacts of ozone are greatest when it is located in the upper part of the troposphere. Particle pollution can also have significant effects on the climate because of its ability to absorb and scatter light.[490] In addition to greenhouse gases already in the scheme, including regular pollutants such as Volatile Organic Compounds (VOCs), CFCs, and HFCs, will be good for the climate. African countries can use emissions trading to achieve a complete inventory of greenhouse gases, just like Chile used it to achieve a complete inventory. Having this inventory will aid in the formulation of other climate change mitigation policies.

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[488] *Ibid*.

[489] EPA, *Our Nation's Air Status and Trends Through 2010*, (February 2012) at 23, online: <http://www.epa.gov/airtrends/2011/report/fullreport.pdf>.

[490] *Ibid*.

Chapter 6

6 Conclusion

This thesis has demonstrated how African countries can contribute to UNFCCC's goal to stabilize the concentration of greenhouse gases in the atmosphere. Cooperation is necessary between developed countries and developing countries if the goal of the UNFCCC is to be realised. Two research questions were formulated for this study: "What are the gaps in Africa's climate change mitigation policy architecture?" and, "Would adopting an emissions trading scheme as a policy instrument close the identified gaps?"

In resolving the first question, reference was made to the proposed carbon tax in South Africa, the REDD+ initiative, the CDM implementation in Africa, and the NAMA initiative.

This thesis concludes that, going forward, the existing mitigation initiatives are inadequate and will not allow African countries contribute effectively to the goal of the Convention.

This thesis also highlights the ways in which a domestic emissions trading scheme can assist. A cap on emissions can achieve more than the current piecemeal approach under the CDM. A cap on the downstream sector, for instance, will not only reduce emissions from the sector, but also reduce transport emissions, because low quality fuels produced from the refineries are one of the causes of increased transport emissions. What is more, the emissions of the continent are expected to grow in the future as countries undergo development.

The drivers of deforestation in Africa threaten to undermine the new mitigation initiative (REDD+) for developing countries. It has been shown that the drivers of deforestation are economic, which makes the incentive-based system, inherent in a tradable permit scheme, an appropriate remedy. A tradable permit scheme involving farmers and other forest-dependent communities will put a value on forest cover and thus halt the loss of such.

The success of REDD+ implementation will ensure that Africa contributes its fair quota of diminishing the rising concentration of greenhouse gases in the atmosphere. It has been argued that emissions trading could be a source of revenue for African countries, which can be used to implement other mitigation measures. Revenues generated from auctioning allowances can be used to finance renewable energy development.

For this to happen, auctioning has to be part of the design of the scheme. However, auctioning has distributional implications. For instance, auctioning off allowances to companies in the power sector could lead to increased electricity tariffs, as power companies will want to shift the burden to the consumers. If the revenue generated from auctioning is invested in generating electricity from renewable sources, this will address the energy deficit in Africa. More people will have access to electricity. If the revenue realised from auctioning is adequately invested in energy generation, consumers will have the option of choosing between clean and unclean energy sources.

As discussed in Chapter Three, the policy is already under consideration in South Africa. If the government of South Africa goes ahead with the introduction of the policy, the program will mostly likely cover its energy generation sector, as it accounts for the bulk of its emissions. The design of the program should have a price ceiling and floor.[491] This will address price crashes due to outside factors such as economic crises, which determine the supply and demand for allowances. The price ceiling is normally set at a rate considered to be harmful for economic productivity, while the floor is set at a rate where it would become impossible for companies to stop reducing emissions effectively. If the price gets too high, more allowances will be supplied to keep the price down. If the price gets too low, some allowances will have to be withdrawn. This is why it is very important that allowances are not made to be property rights. If they are property rights, they inure to the benefits of the holders until disposed of. This will prevent a litigation backlash due to the withdrawal of allowances.

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[491] *supra* note 430, 431, and 434.

Over-allocation of allowances should be avoided. Over-allocation can also lead to a price crash. Allocating 50 percent of the allowances for free, and the remainder through auctioning, from the inception of the program can help avoid an oversupply of allowances as well.

South Africa can decide to implement the scheme alone, or partner with other high emitting countries like Egypt, Algeria, and Nigeria to form a regional scheme. The larger the sources, the more cost effective the scheme will be.

A lot of capacity building needs to be done before the policy can thrive in Africa. Any country in Africa that wants to implement a tradable permit scheme could partner with the European Union in setting up—and preventing cyber-attacks on—the registry. What is more, the climate change secretariat will be more than willing to assist in capacity building if the policy makers in Africa see its merit. Linking the registry of the scheme to the international registry established under the Kyoto Protocol will ensure that transactions under the scheme are transparent and that the scheme meets UNFCCC's overall objective of stabilizing greenhouse gas concentration in the atmosphere. In conclusion, emissions trading is a viable policy option for fighting climate change in Africa.

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Appendices

Appendix A: Sectors and Source Categories for CDM Project Activities.

Greenhouse gas emission reductions			
Energy	Industrial processes	Agriculture	Waste
$CO_2 – CH_4 – N_2O$	$CO_2 – N_2O$ – HFCs – PFCs – SF_6	$CH_4 – N_2O$	CH_4
Fuel combustion Energy industries· Manufacturing industries Construction Transport • Other sectors Fugitive emissions from fuels Solid fuels Oil and natural gas	Mineral products· Chemical industry Metal production Production and consumption of halocarbons and sulphur hexafluoride Solvent use Others	Enteric fermentation • Rice cultivation Agricultural soils Prescribed burning of savannas (cerrado) Filed burning of agricultural residues • Others	Solid waste disposal Wastewater handling Waste incineration· Others
CO2 removals			
Reforestation/afforestation			

Source: Nederberger, Anne and Raymond Saner, "Exploring the relationship between FDI flows and CDM potential" (2005) 14 Transnational Corporations 1.

Appendix B: Types and Numbers of CDM Projects in Africa

Types of CDM projects in Africa	Number of projects
Landfill gas	29
Wind	27
Biomass energy	27
Reforestation	17
Hydro	16
Fossil fuel switch	11
EE households	10
N2O	8
EE own generation	8
Fugitive	8
Methane avoidance	7
Solar	7
Afforestation	4
Cement	3
EE industry	3
EE supply side	2
Geothermal	2
Coal bed/mine methane	1

Source: *Carbon Markets and Africa: a Quick Factsheet for Journalists*, online: <http://www.unep.org/climatechange/Portals/5/cop17/docs/Carbon_Markets_and_Afria_Resource_Guide_for_Journalists.pdf>.

Appendix C: Most Populous Countries and Total Fertility Rates, 2012

2012		2050	
Country	**Population (Millions)**	**Country**	**Population (Millions)**
China	1350	India	1691
India	1260	China	1211
United States	314	United States	423
Indonesia	241	Nigeria	402
Brazil	194	Pakistan	314
Pakistan	180	Indonesia	309
Nigeria	170	Bangladesh	226
Bangladesh	153	Brazil	213
Russia	142	Dem. Rep. Congo	194
Japan	128	Ethiopia	166

Countries with the Highest Total Fertility Rates 2012

Country	TFR
Niger	7.1
Somalia	6.4
Burundi	6.4
Mali	6.3
Angola	6.3

Dem. Rep. Congo	6.3

Source: *Population Reference Bureau*, online: <http://www.prb.org/pdf12/2012-population-data-sheet_eng.pdf>.

Appendix D: Facilities Used for Mining/Drilling, Processing, and Refining of Petroleum in Africa

Country	Location/Name	Owner/Operator
Angola	Lobito	Sociedade Nacional de PetrÃ³leos de Angola (Sonangol)
Angola	Luanda	Sociedade Nacional de PetrÃ³leos de Angola (Sonangol)
Benin	SÃ¨mÃ¨ Kpodji	Zetah Oil Company of CÃ´te d'Ivoire (private, 100 percent)
Cameroon	About 21 oilfields, which included Bavo, Ekoundou Horst, Eloundou,Eloundou Nord Marine, Ekoundou Sud, Itindi, and Kombo Centre	Total Exploration and Production Cameroun (Total S.A., 100 percent)
Cameroon	Makoko Northeast, Makoko-Anana and makoko South Marine Fields; Lipenja	Pecten Cameroon Co. (Pecten International, 80 percent)
Cameroon	Moudi and Kribi Fields	Pecten Cameroon Co.
Cameroon	Refinery at Limbe	Societa Nationale de Raffinage (Government, 66 percent)
Chad	Bolobo, Kome, and Miandoum Fields	Esso Exploration and Production Chad Inc. (Exxon Mobil Corp.,40 percent)
Congo – Kinshasa	East Mibale and 5 other offshore wells	Societe de Recherche et d'Exploitation des petroles au Congo, Perenco plc (France and Uunited Kingdom)
Congo – Kinshasa	Muanda	Societe Congo-Italienne de Raffinage (SOCIR), (Government, 50 percent, Agip SA, 50 percent)

Congo – Kinshasa	Offshore Wells (y)	ChevronTexaco Oil Congo (DRC) Ltd. [Muanda International Oil Co. (Perenco plc (Europe) 50 percent)]
Congo – Kinshasa	Onshore wells	TotalFinaElf
Cote D'Ivoire	Abidjan	SociÃ©tÃ© Ivorienne de Raffinage
Egypt	Ain al-Sokhna to Sidi Kir	Arab Petroleum Pipeline Co. (Egypt, 50 percent)
Egypt	Alexandria	Alexandria Petroleum Co. (Government, 100 percent)
Egypt	Ameriya	Ameriya Petroleum Refining Co. (Government, 100 percent)
Egypt	Asyut	Asyut Petroleum Refining Co. (Government, 100 percent)
Egypt	Belayim, Suez Gulf	Belayim Petroleum Co. (EGPC, 50 percent; International Egyptian Oil Co. 50 percent)
Egypt	Gulf Of Suez, October	Gulf of Suez Oil Co. (EGPC , 50 percent; Amoco, 50 percent)
Egypt	Gulf of Suez, Ras Budran	Suez Oil Company (EGPC, 50 percent)
Egypt	Mostorod, Tanta	Cairo Petroleum Refining Co. (Government, 100 percent)
Egypt	Suez	El-Nasr Petroleum Refining Co. (Government, 100 percent)
Egypt	Suez	Suez Petroleum Processing Co. (Government, 100 percent)
Equatorial Guinea	Alba Field, Alba Block	Joint Venture of Marathon Oil Co.(63 percent)
Equatorial Guinea	Ceiba Field, Block G	Triton Equatorial Guinea, Inc.(80.75 percent)

Equatorial Guinea	Punta Europa	Marathon Oil Co.(52 percent)
Equatorial Guinea	Zafiro Field, Block B	Joint Venture of Mobil Equatorial Guinea Inc.(71.25 percent)
Eritrea	Assab	Petroleum Corp. of Eritrea
Gabon	15 km South of Mayumba	Perenco Plc.
Gabon	60 km Southwest of Port Gentil	Perenco plc.
Gabon	Anguille field	Total Group, 100 percent
Gabon	Atora field	Total Group, 40 percent (Total is the operator.)
Gabon	Avocette field	Total Group, 57.5 percent (Total is the operator)
Gabon	Avocette, Coucal, and Hylia fields	Elf Gabon
Gabon	Baudroie Nord field	Total Group, 50 percent (Total is the operator)
Gabon	Gamba-Ivinga Field, Onshore Gamba	Shell Gabon
Gabon	Gonelle Field	Total Group, 100 percent
Gabon	Oguendjo Offshore Field, 85 km Southeast of Port Gentil	Perenco Plc.
Gabon	Port Gentil	SociÃ©tÃ© Gabonaise de Raffinage
Gabon	Rabi-Kounga Field, 100 km North of Gamba	Total Group, 47.5 percent (Total is the operator.)

Ghana	Saltpond and Tano Fields	Ghana National Petroleum Corp. (Government, 100 percent)
Ghana	Tema	Tema Oil Refinery (Government, 100 percent)
Kenya	Mombasa	Kenya Petroleum Refineries Ltd. [Government, 50 percent;
Libya	Az Zawiya	Az Zawiya Oil Refining Co.
Libya	Marsa el Brega	Libyan National Oil Co.
Libya	Ras Lanuf	Ras Lanuf Oil and gas Processing Co.
Libya	Sarir	Arabian Gulf Oil Co.
Libya	Tobruk	Arabian Gulf Oil Co.
Madagascar	Toamasina	Galana International, Groupe Trimeta, Gulf
Mauritania	Nouadhibou refinery	SociÃ©tÃ© Mauritanienne d'Industrie de Raffinage
Morocco	Bouhoua, Nador	SociÃ©tÃ© d'Exploitation des Mines du Rif (SEFERIF) (BRPM, 100 percent)
Morocco	Mohammedia	SociÃ©tÃ© Anonyme Marocaine de l'Industrie du Raffinage (SAMIR) (Group Corral Petroleum, 64.7 percent)
Morocco	Sidi Kacem	SAMIR
Nigeria	Kaduna refinery	Kaduna Refinery and Petrochemicals Co. Ltd.
Nigeria	New Port Harcourt	-
Nigeria	Niger Delta	Various joint ventures with Nigerian National Petroleum Corp.
Nigeria	Old Port Harcourt	-

Nigeria	Warri Refinery	Warri Refinery and Petrochemicals Co. Ltd.
Senegal	Dakar	SociÃ©tÃ© Africaine de Raffinage (private, 100 percent)
Sierra Leone	Freetown	Sierra Leone Petroleum Refining Co. Ltd.
Somalia	Mogadishu	Iraqsoma Refinery Co.
South Africa	Cape Town	Caltex Oil SA Pty. Ltd. (private, 100 percent)
South Africa	Gencor, Durban	Engen Ltd. (62 percent)
South Africa	Johannesburg area	Africa Pty. Ltd. (Sasol Ltd., Total SA)
South Africa	Mossel Bay	Mossgas (Pty) Ltd. (Government, 100 percent through Central Energy Fund)
South Africa	Natref, Secunda	National Petroleum Refiners of South
South Africa	Oribi field area, Mossel Bay	Southern Oil Exploration Co. (Soeker)(Government, 100 percent)
South Africa	Oryx field	Southern Oil Exploration Co. (Soeker)(Government, 100 percent)
South Africa	Sanref, Durban	Shell and BP Refineries Pty. Ltd. (Shell International B.V., 50 percent; BP Plc, 50 percent)
Sudan	Abu Jabra	Government
Sudan	Block 1, Unity, El Toor, Tooma South Fields; Block 1a, Munga, Khairat Fields; Block 2, Grand Heglig Field (Heglig, Barki, Hamra, Kanga Laloba, Rihan, and Toma Fields); Block 2a,	Greater Nile Petroleum Operating Co. [China National Petroleum Corp. (CNPC), 40 percent]

	Bamboo, Garaad Fields	
Sudan	Block 3 – Adar-Yale Field	Petrodar Consortium (China National Petroleum Corp. 41 percent)
Sudan	Block 6 – Abu Gabra	China National Petroleum Corp.
Sudan	El Obeid	Government
Sudan	Jali	Khartoum Oil Refinery (China National Petroleum Corp., 50 percent; Sudan Petroleum Corp., 50 percent)
Sudan	Port Sudan	Port Sudan Refining Ltd. (Government, 100 percent)
Sudan	Shajirah	Concorp Ltd.
Tanzania	Dar es Salaam	Tanzanian & Italian Petroleum Refining Co.
Tunisia	Bizerte	Societe Tunisienne des Industries du Raffinage

Source: *Petroleum Facilities in* Africa (6 June 2010), online: Afribiz <http://www.afribiz.info/content/petroleum-facilities-in-africa>.

Cement Facilities in Africa

Country	**Location/Name**	**Owner/Operator**
Algeria	Aïn Touta	Société des Ciments d'Aïn-Touta (Enterprise des Ciments et Derives de l'Est, 100 percent)
Algeria	Aïn-Kébira	Société des Ciments d'Aïn-Kébira (Enterprise des Ciments et Derives de l'Est, 100 percent)
Algeria	Bekkouche	Société des Ciments de Tébessa (Enterprise des Ciments et Derives de l'Est, 100 percent)
Algeria	Beni-Saf	Entreprise des Ciments et Dérivés de l'Ouest
Algeria	Chlef	Entreprise des Ciments et Dérivés d'Ech

Algeria	Hamma-Bouziane	Société des Ciments de Hamma-Bouziane (Enterprise des Ciments et Derives de l'Est, 100 percent)
Algeria	Meftah	Entreprise des Ciments et Dérivés du Centre
Algeria	M'Sila	Algerian Cement Co. (Orascom ConstructionIndustries S.A., 100 percent)1
Algeria	Raïs-Hamidou	Entreprise des Ciments et Dérivés du Centre
Algeria	Saïda	Entreprise des Ciments et Dérivés de l'Ouest
Algeria	Sour-El-Ghoziane	Entreprise des Ciments et Dérivés du Centre
Algeria	Tébessa	Société des Ciments de Tébessa (Enterprise des Ciments et Derives de l'Est, 100 percent)
Algeria	Zahana	Entreprise des Ciments et Dérivés de l'Ouest
Angola	Luanda	Nova Cimangola S.A.R.L.(Scanang Holding Co., 49 percent, Government, 39.8 percent, and Bank BAI, 9.5 percent)
Benin	Cotonou Plant	Ciments du Benin S.A. (Lafarge Group significant minority holder)
Benin	Do.	Société des Ciments du Benin (Government, 50 percent, and private, 50 percent)
Benin	Onigbolo plant	Société des Ciments d'Onigbolo (Amida Group, 100 percent)
Burkina Faso	Ouagadougou plant	Ciment du Burkina (Holcim Ltd. of Switzerland, 100 percent)
Burundi	Bujumbura	Burundi Cement Plant
Cameroon	Bonaberi near Douala and Figuil at Garoua	Cimentaries du Cameroun (Lafarge Group, 57 percent)

Congo – Brazzaville	Loutété	Nouvelle Société de Ciments du Congo
Congo – Kinshasa	Kabimba in theLubumbashi area, Katanga Province	Interlacs (The Forrest Group)
Congo – Kinshasa	Kimpese	Cimenterie Nationale SARL
Congo – Kinshasa	Lubudi , in the Likasi and Kolwezi area, Katanga Province	Cemenkat, (The Forrest Group, and Gecamines)
Congo – Kinshasa	Luena	La Générale des Carrières et des Mines (Gécamines).
Congo – Kinshasa	Lukala in the Kinshasa area in Bas-Congo Province	Lukala Cements Company, (The Forrest Group)
Cote D'Ivoire	Abidjan Plant	Société des Ciments d'Abidjan (Government, 40 percent)
Cote D'Ivoire	Abidjan Plant	Société Ivorienne de Ciment et Materiaux (Holcim and Origny, 80 percent)
Cote D'Ivoire	San Pedro	Société des Ciments du Sud-Ouest (Government and Omnium Tropical)
Egypt	Ain Sukhna	Suez Cement Co.
Egypt	Ameriyah	Ameriyah Cement Co.
Egypt	Assiut	Asiut Cement Co.
Egypt	Beni Suef	National Cement Co.

Egypt	El Mex	Alexandria Portland Cement Co.
Egypt	El Minya	Helwan Portland Cement Co.
Egypt	El Tabbin	National Cement Co.
Egypt	Helwan	Helwan Portland Cement Co.
Egypt	NA	Egyptian Cement Co. (Orascom Group, 40 percent; private
Eritrea	Massawa	Eritrea Cement Works
Ethiopia	Addis Ababa	Mugher Cement Enterprise (Government-
Ethiopia	Dire Dawa	Mugher Cement Enterprise (Government-
Ethiopia	Mekele	Messebo Building Materials Production
Ethiopia	Mugher	Mugher Cement Enterprise (Government-
Gabon	Franceville	Ciments du Gabon
Gabon	Owendo	Ciments du Gabon
Ghana	Takoradi	Ghana Cement Works Ltd. (Heidelberg Zement AG of Germany)
Ghana	Tema	Ghana Cement Works Ltd. (Heidelberg Zement AG of Germany)
Guinea	Conakry	Ciments de Guinee
Kenya	Athi River	East African Portland Cement Co. Ltd.
Kenya	Kaloleni	Athi River Mining Ltd.
Kenya	Mombasa	Bamburi Cement Ltd.

Kenya	Nairobi	Bamburi Cement Ltd.
Liberia	Monrovia	Liberia Cement Corp
Libya	Al Margab (Homs 1)	Arab Cement Co.
Libya	El Hawari, Benghazi Province	Libyan Cement Co.
Libya	Fataih, Derna	Libyan Cement Co.
Libya	Libda (Homs 2)	Arab Cement Co.
Libya	Souk el Khamis, Tripoli	Arab Cement Co.
Libya	Zliten	Arab Cement Co.
Madagascar	Ibity	Holcim Madagascar S.A.
Madagascar	Mahajanga	SA Nouvelle Cimenterie Amboanio
Malawi	Blantyre	Portland Cement Co. Ltd.
Malawi	Changalume	Portland Cement Co. Ltd.
Malawi	Livwezi	Shayona Cement Corp.
Mali	Bamako	Société Lou Kouma (private, 100 percent)
Mali	Bamako area	Diamou Cement (private, 100 percent)
Mauritania	Nouakchott grinding plant	Ciment de Mauritanie (private, 100 percent)
Morocco	Agadir	Société les Ciments du Maroc S.A. (CIMAR)

Morocco	Cadem, at Meknes	Asment de Temara
Morocco	Douar Laaouameur, south of Casablanca	Société Lafarge Ciments S.A. (Lafarge Maroc, 69.2 percent)
Morocco	Fès, at Doukkarat	Société Holcim (Maroc) S.A
Morocco	Fès, at Ras El Ma	Société Holcim (Maroc) S.A
Morocco	Kiln and mill at Oujda	Société Holcim (Maroc) S.A. (Holcim Ltd. of Switzerland, 51 percent)
Morocco	Layoune	Société les Ciments du Maroc S.A. (CIMAR)
Morocco	Marrakech	Société les Ciments du Maroc S.A. (CIMAR)
Morocco	Nador	Société Holcim (Maroc) S.A
Morocco	Safi	Société les Ciments du Maroc S.A. (CIMAR)
Morocco	Tamuda, at Tétouan	Asment de Temara
Morocco	Tangier	Asment de Temara
Morocco	Temara	Asment de Temara (Cimentos de Portugal, 57.4 percent)
Morocco	Tétouan II	Asment de Temara
Mozambique	Dondo	Cimentos de Mocambique, SARL
Mozambique	Matola	Cimentos de Mocambique, SARL
Mozambique	Nacala	Cimentos de Mocambique, SARL
Niger	Malbaza plant	Société Nigeriénne de Cimenterie (Holderbank, 77 percent)

Nigeria	Ashanka	Ashanka Cement Co. plc
Nigeria	Benue State	Benue Cement Co. p.l.c.
Nigeria	Calbar	United Cement Co of Nigieria
Nigeria	Ewekoro	West Africa Portland Cement Co.
Nigeria	Ibese	Dangote Cement Works
Nigeria	Nkalagu	Nigeria Cement Co.
Nigeria	Okepella	Bendel Cement Co. Ltd.
Nigeria	Shagamu	West Africa Portland Cement Co.
Nigeria	Sokoto	Cement Co. of Northern Nigeria
Reunion	Bourbon	Ciments de Bourbon SA
Rwanda	Plant at Cyangugu	Cimenterie du Rwanda
Senegal	Kirène	Les Ciments du Sahek S.A. of Senegal (private, 100 percent)
Senegal	Rufisque	Société Ouest Africaine des Ciments (private, 100 percent)
Sierra Leone	Freetown	Sierra Leone Cement Corp. Ltd. (HeidlebergCement, 50 percent)
Somalia	Berbera	Berbera Cement Agency
South Africa	De Hoek, Dwaalboom, Herculese, Jupiter, Slurru, Riebeeck West, Port Elizabeth	Pretoria Portland Cement Co. Ltd. (Barlworld Trust Co. Ltd., 60.3 percent)

South Africa	Dudfield, Lichtenburg area, Roodepoort	Alpha Ltd. [Holcim Ltd. (Switzerland)]
South Africa	Durban area	Lafarge South Africa Ltd. [Lafarge (France)]
South Africa	Lichtenburg, North West Province	Lafarge South Africa Ltd. [Lafarge (France)]
South Africa	Simumu plant, 125 kilometers southwest of Durban; also grinding mills at Durban and Newcastle	Natal Portland Cement Co. (Pty.) Ltd. [Cimentos de Portugal SGPS, S.A. (CIMPOR)]
South Africa	Ulco	Alpha Ltd. [Holcim Ltd. (Switzerland)]
Sudan	Atbara	Atbara Cement Company Ltd. (LaFarge Group of France and Dal Group of Sudan)
Sudan	Rabak	Nile Cement Company (Government, 100 percent)
Tanzania	Mbeya	Mbeya Cement Co. Ltd. (LaFarge Group)
Tanzania	Tanga	Tanga Cement Co. Ltd. (Holcim Ltd., 60 percent)
Tanzania	Wazo Hill	Tanzania Portland Cement Co. Ltd.
Togo	Lomé	Ciments du Togo S.A.
Togo	Tabligbo	West African Cement S.A.
Tunisia	Ben Arous	Société de Ciments Artificiels Tunisiens
Tunisia	Bizerte	Société de Ciment de Bizerte

Tunisia	Enfida	Société de Ciment d'Enfida
Tunisia	Feriana	Société Tuniso-Algérienne de Ciment Blanc S.A.
Tunisia	Gabès	Société de Ciment de Gabès
Tunisia	Jbel Oust	Société de Ciment de Jbel Oust
Tunisia	Le Kef	Société de Ciment d'Oum el Kélil
Uganda	Kasese	Hima Cement Industries Ltd. (Bamburi Cement Ltd., 70 percent)
Uganda	Tororo	Tororo Cement Industries Ltd.
Zambia	Lusaka	Chilanga Cement plc (Lafarge, 51 percent)
Zambia	Ndola	Chilanga Cement plc (Lafarge, 51 percent)
Zimbabwe	Bulawayo	Portland Holdings Ltd. (Pretoria Portland Cement Co. Ltd.)
Zimbabwe	Gwanda	Portland Holdings Ltd. (Pretoria Portland Cement Co. Ltd.)
Zimbabwe	Harare	Circle Cement (Pvt.) Ltd.
Zimbabwe	Indiva	Sino-Zimbabwe Cement

Source: *Cement Operations in Africa* (1 June 2010), online: Afribiz <http://www.afribiz.info/content/cement-operations-in-africa>.

Appendix E: Compliance in the Santiago Tradable Permit Program

Table 3. Compliance in the Santiago Tradable Permit Program

Variable	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AccumulatedViolation (Kg*/day)	1255.19	811.03	289.11	246.55	156.07	112.32	198.18	153.84	**175.05**	**197.93**	**221.26**
Existing sources	505.88	255.58	88.80	48.29	12.49	6.86	15.16	58.82	**92.55**	**114.78**	**124.89**
New sources	749.31	555.45	200.31	198.26	143.57	105.47	183.02	95.01	82.50	83.15	96.37
Average Violation (Kg/day)	4.61	3.41	1.50	1.27	1.11	0.90	1.62	1.27	**1.58**	**1.66**	**1.80**
Existing sources	3.28	1.59	0.59	0.32	0.10	0.06	0.14	0.56	**0.94**	**1.20**	**1.30**
New sources	4.87	3.45	1.34	1.30	1.21	0.94	1.71	0.90	0.84	0.87	1.00
Maximum Violation (Kg/day)	89.19	89.19	28.3	25.63	21.60	9.12	92.8	40.74	45.09	56.96	45.09
Existing sources	89.19	89.19	28.3	25.63	2.78	3.14	9.16	40.74	45.09	56.96	45.09
New sources	65.60	45.14	18.48	21.60	21.60	9.12	92.8	7.0	23.76	14.16	15.49
Minimum Violation (Kg/day)	0.008	0.008	0.010	0.006	0.006	0.002	0.036	0.030	0.018	0.005	0.030
Existing sources	0.08	0.012	0.248	0.58	0.42	0.19	0.19	0.16	0.06	0.03	0.06
New sources	0.008	0.008	0.010	0.006	0.006	0.002	0.036	0.030	0.018	0.005	0.003
Number of non complying sources	272	238	193	194	140	125	122	121	**111**	**119**	**123**
Existing sources	118	77	43	41	21	13	15	16	**13**	**23**	**27**
New sources	154	161	150	153	119	112	107	105	98	96	96
% of non complying sources	46%	41%	37%	36%	28%	24%	23%	23%	21%	23%	24%
Existing sources	20%	13%	8%	8%	4%	3%	3%	3%	3%	4%	5%
New sources	26%	28%	29%	29%	24%	22%	21%	20%	19%	18%	19%

* Sources violate the program when their emissions exceed their permits. Added violation corresponds to the addition of sources's violations.

Source: Taken from PROCEFF databases.

Source: Coria and Sterner, *Tradable Permits in Developing Countries Evidence From Air Pollution in Santiago, Chile*, (Resources for the Future Discussion Paper December 2008), 1 at 27, online: <http://www.rff.org/documents/RFF-DP-08-51.pdf>.

Curriculum Vitae

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