CONSIDERATIONS FOR IMPLEMENTING MARKET BASED MECHANISIMS IN COMBATING CLIMATE CHANGE IN SOUTH AFRICA

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ABSTRACT

Since the first period of the Kyoto Protocol, there has been a growing concern that the burden of reducing greenhouse gas emissions should not only be borne by developed countries, but developing countries as well. South Africa, as the 18th highest emitter of greenhouse gases in the world and highest in Africa, has a significant responsibility to reduce its emissions levels. The South African government is currently in the process of implementing a carbon tax for its short term response to climate change and considering the implementation of a carbon market as a medium to long term response to climate change. Both of these market based mechanisms are widely deemed effective in the mitigation of greenhouse gas emissions by economists, however are also known to have negative social and economic implications upon an economy. This study identifies these implications and attempts to provide considerations on how to alleviate the implications through the most appropriate process of revenue recycling.

The negative effects of Implementing a carbon tax or carbon market could be severe as and not limited to: a significant decline in GDP, a reduction in the standard of living for certain households, a fall in a country's exports and even an increase in poverty. South Africa's environmental and development policies place a strict precedence on the protection of the poor and the prevention of economic hardship induced by such policies. This places significant importance on the prevention of these externalities from occurring. A primary means of doing so is through the process of revenue recycling, however, certain channels of revenue recycling are by no means helpful, hence the most appropriate channel needs to be identified.

The study carried out a multiple case study analysis on Ireland, Mexico, New Zealand and Norway, to determine what effects a carbon tax had on their economies and how these effects were mitigated through carbon tax revenue recycling. An additional analysis of the EU ETS was carried out to determine how the EU ETS was implemented and the controversies and concerns that arose during its implementation. The findings of this analysis were then compared to a number of South African economist's case studies, and the most appropriate method of revenue recycling identified and possible solutions to the EU ETS controversies found.

The study concludes that a food subsidy has the potential to provide positive effects on welfare employment and GDP; therefore could be considered to be the most appropriate method of revenue recycling. However, these effects are limited to be experienced only at low levels of a carbon tax, hence, short term in nature. The study therefore provides a further consideration that the use of multiple channels for revenue recycling needs to be explored that could provide stable longer term effects. In addition, in the implementation of a carbon market, the study concludes that government should consider using an auction approach in the initial allocation phase of an ETS and the use of a centralized registry for monitoring and controlling of information and transactions.

DECLARATION

I, Frans Marais, hereby declare that this thesis is a result of my research investigations and findings. All the work that was written by other authors and used in the thesis is fully acknowledged and a reference list is included. This work has not been previously submitted in part or entirety for degree purposes to any other university.

Submitted in partial fulfilment of the Master of Commerce degree in Economics (Financial Markets) at Rhodes University.

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Date________________________

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Chapter 1
Introduction

In August 1997, SA ratified the United Nations Framework Convention on Climate Change (UNFCCC) and acceded to the Kyoto Protocol in March 2002 (Scholtz and De Villiers 2011: 23). This provided South African industries with an opportunity to reduce their carbon emissions by contributing to the Clean Development Mechanism (CDM) projects and, through Carbon Emissions Reduction (CER) trading with more developed nations, provide cleaner technology and extra income as benefits to South Africa (Tucker and Gore 2008:1). The Kyoto Protocol places a legal constraint on countries to reduce their emissions to their 1990 levels (Winkler, Marquard and Jooste, 2010: 136; Spash, 2009: 2; De Perthuis, 2007: 13). Although this constraint is placed only on developed countries that have acceded to the Kyoto Protocol, as the country with the highest carbon emissions in Africa, South Africa has a responsibility to reduce its carbon emissions, which requires an effective mitigation strategy (Linacre, Kossoy and Ambrosi, 2011: 36).

Government announced in the 2010 Budget Review its intention to investigate the feasibility of a comprehensive carbon pricing regime for South Africa with a focus on carbon taxes (National Treasury 2010: 12). However, after considering public responses to the 2010 discussion paper for public comment released by the national treasury, government submitted the White Paper on National Climate Change Response, which revises governments approach to make use of carbon taxation in the immediate future (potentially by 2013) and implementing a carbon market as a medium to long term approach, as part of governments mitigation strategy (Department of Environmental Affairs and Tourism (DEAT) 2011: 40 - 141). The use of both a Pigouvian tax and an emissions trading system (ETS) can be effective in reducing emissions, however, both have potential negative and positive economic and social impacts that need to be considered before being implemented.

Chameides and Oppenheimer (2007: 1670) explain the benefits of an ETS as; lowering deforestation, preserving irreplaceable ecosystems and providing income to developing economies. Furthermore, an ETS assures that environmental goals are achieved by a certain date through the caps it places on industries (Gilbertson and Reyes, 2009: 10). ETS's are also supported by the Kyoto Protocol as a primary means of reducing carbon emissions and have been implemented by a number of annex 1 (developed) countries (O'Donnell, 2012:5). This implies that an ETS could be a useful policy which would help developing countries such as South Africa, to become more proactively engaged in CER trading over a long term basis, effectively helping limit its emissions if implemented (Wen-Cen, 2011: 116-118). On a similar note, an early carbon tax, although not being capable of placing a cap on emitters' carbon emissions, could still supplement mitigation by providing incentives to reduce emissions through tax penalties (Andrew, Kaidonis and Andrew, 2010: 613; Nauclér and Enkvist 2009: 17; Sathre and Gustavsson, 2007: 488).

Delbosc and De Perthuis (2009: 20-25) provide a framework on four pillars for implementing an ETS, namely: 1) the allocation process; 2) establishing a reliable measure and control of emissions; 3) implementing registries and market transparency for the trading and control of emissions; and lastly, 4) introducing flexibility to help reach capped targets. Furthermore, Flachsland, Edenhofer, Jakob and Steckel (2008) provide insight into developing an international carbon trading market, in particular, linking carbon markets such as New Zealand's, Australia's and the United States of America's carbon trading schemes and other developing ETS to the European Union's Emissions Trading Scheme (EU ETS).

Gilbertson and Reyes (2009: 7), on the other hand, highlighted some of the negative impacts that an ETS has on economies. Gilbertson and Reyes (2009: 7) identified carbon trading as a capitalist ploy to make more money through charging polluters to clean up their own mess. The House of Lords (2006: 102), in their paper presented in London, explained how an ETS may inappropriately set a cap on emissions at a volume to low or too high, rendering the cap ineffective (House of Lords 2006: 102).

The consensus made by most economists regarding the use of market based mechanisms (usually carbon taxation or an ETS) to mitigate climate change, is that they are indeed effective in reducing greenhouse gas emissions, however, are also considered to be regressive by impacting low income households and economies negatively. Given this, it is unclear as to how a carbon tax or an ETS would impact upon South Africa both economically and socially and therefore, how these market based mechanisms should be implemented. By exploring how these policies have been implemented in other countries, along with their successes and failures, a better representation can be created of the most suitable direction for South Africa to proceed and implement these policies in such a way as to minimize their regressive tendencies.

Considering South Africa's current economic hardships, specifically its high levels of inequality and poverty, the negative implications of a carbon tax could be detrimental to low income households and increase income inequality levels, while an ETS could possibly be ineffective and fail if not implemented correctly. However, if revenues from a carbon tax and ETS are recycled correctly in their implementation, these negative implications may be avoided or at the least, reduced. Hence further research is required on the topic.

1.1 Goals of the Research

The main objective of this thesis is to recommend an appropriate method of recycling carbon tax and ETS revenues, in such a way as to minimize externalities that may arise in implementing these market based instruments.

1.2 Procedures and Techniques

The primary objective of this thesis is to be achieved through the form of a qualitative study. The study will identify the advantages and disadvantages of both an ETS and a carbon tax policy in their effectiveness of mitigating carbon emissions and their social implications of implementing them.

A comparative analysis will be conducted, using multiple case studies, to determine the welfare impacts of implementing a carbon tax in four different countries, namely: Ireland, New Zealand, Norway and Mexico. The analysis will be carried out through a Hermeneutic tradition. Each case study will be subjected to an interpretive understanding of the redistribution effects caused by a carbon tax, and how in each case this was overcome through revenue recycling.

Similarly, the difficulties experienced by the EU ETS during the EU ETS's three phased implementation will be looked at through the same method.

This qualitative data from the above case studies will then be applied within a South African context to create considerations in implementing a carbon tax and an ETS in South Africa. Particularly focussing on how a carbon tax and ETS revenues may be recycled in SA and in such a way as to minimize the potential negative implications that a carbon tax or ETS may cause.

1.3 Outline of the Thesis

The study is comprised of six chapters, beginning with this introduction as the first. The second chapter presents a background into the understanding and mitigation of climate change, including a discussion of the merits and demerits of market based mechanisms in mitigating climate change. The third chapter explains South Africa's socioeconomic and emissions profile in brief. This chapter also includes a brief description of South Africa's current and past environmental policies, including the White Paper on

National Climate Change Response (2011), that aims to help to mitigate climate change in South Africa.

Chapter four provides a multiple case study scenario of the implementation of carbon taxes in New Zealand, Mexico, Ireland and Norway. Specifically how each country was impacted upon by the tax and how these regressive impacts were mitigated though different channels of revenue recycling. The chapter continues to discuss the European Emissions Trading System (EU ETS), how it was implemented, the problems the European Union incurred in implementing it and how these problems were then resolved. This chapter carries over into chapter five through the application of the case studies in a South African context. The issues and concerns raised by each country in their implementation of a carbon tax are compared to the potential impacts that they may have on South Africa economically and socially. This is addressed through the potential methods of revenue recycling identified in chapter four. Each channel that revenues are recycled through, impacts upon South Africa both economically and socially in a unique fashion. These impacts are discussed in an attempt to isolate the channel or channels that most effectively reduces the regressive nature of a carbon tax or ETS and potentially provides positive dividends (positive externalities). Chapter five also provides further considerations for implementing an ETS as a medium to long term solution for the mitigation of climate change, specifically regarding the initial allocation of allowances and registries for the transactions of carbon credits.

The summary and conclusions of the study are presented in chapter six. Chapter six summarises the main findings of chapters two, three, four and five and concludes with considerations for the implementation of a carbon tax or an ETS in the mitigation of climate change in South Africa.

Chapter 2
Understanding and Mitigating Climate Change

2.1 Defining and Understanding Climate Change

Hegerl*et al* (2007:667) explains climate change as “a change in the state of the climate that can be identified (e.g. 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”. There exists an undisputed fact that the earth’s climate is warming up. “Present day global climate models predict a warming of 1.5 degrees to 4.5 degrees Celsius for a $C0_2$ doubling within the next century. In contrast, the earth's temperature has risen only 0.5-0.7 degrees Celsius in the last century, and probably has not varied more than 1-2 degrees Celsius in the last ten thousand years, or 6-7 degrees Celsius in the last million years” (Arrenhius and Waltz 1990:2). Staudt *et al*, (2008:3) states the following: “temperatures have already risen 1.4°F since the start of the 20^{th} century—with much of this warming occurring in just the last 30 years—and temperatures will likely rise at least another 2°F, and possibly more than 11°F, over the next 100 years”. Hence, it is clear to see the world is indeed experiencing a period of climate change.

Physical changes to the earth’s systems are observable and for this reason, make it easy for scientists to agree on the reason for the cause of these changes, i.e. global warming causing climate change. However, there has been an ongoing dispute with regards to the causes of global warming. Delbosc and De Perthuis, (2009: 9) stated that it is the leading role of human emissions causing global warming. Rosenzweig *et al* (2007: 83) identified that “Most of the observed increases in globally averaged temperatures since the mid-20th century are very likely due to the observed increase in anthropogenic greenhouse gas concentrations”. These two views highlight the actions of human activities as the primary cause of global warming and hence climate change. Actions such as fossil fuel burning and deforestation lead to a build up of green house gas (GHG) emissions and thus, a warming of the earth’s atmosphere. This implies that, in order for global warming to be reduced and the effects of climate change to be mitigated, there has to be a reduction in GHG emissions.

Hansen *et al* (2000: 1) share a different view to that of Delbosc and De Perthuis (2009). Hansen *et al* (2000:1) argued that global warming is not a result of a CO_2 build up, but rather an increase in the concentration of non CO_2 greenhouse gasses. Examples used by Hansen *et al* (2000: 1) are: chlorofluorocarbons, CH_4, and N_2O. The crux of Hansen *et al* (2000) argument lies in the fact that if sources of CH_4 and O_3 were reduced in the future, climate change could be reduced to an acceleration rate of zero within the next fifty years. Thus, the conflicting argument lies around what the current causes of global warming are, whether they are anthropogenic in nature or a natural phenomenon. Figure 2.1 helps depict the differences between natural warming and amplified warming, i.e. atmospheric warming induced by human activities:

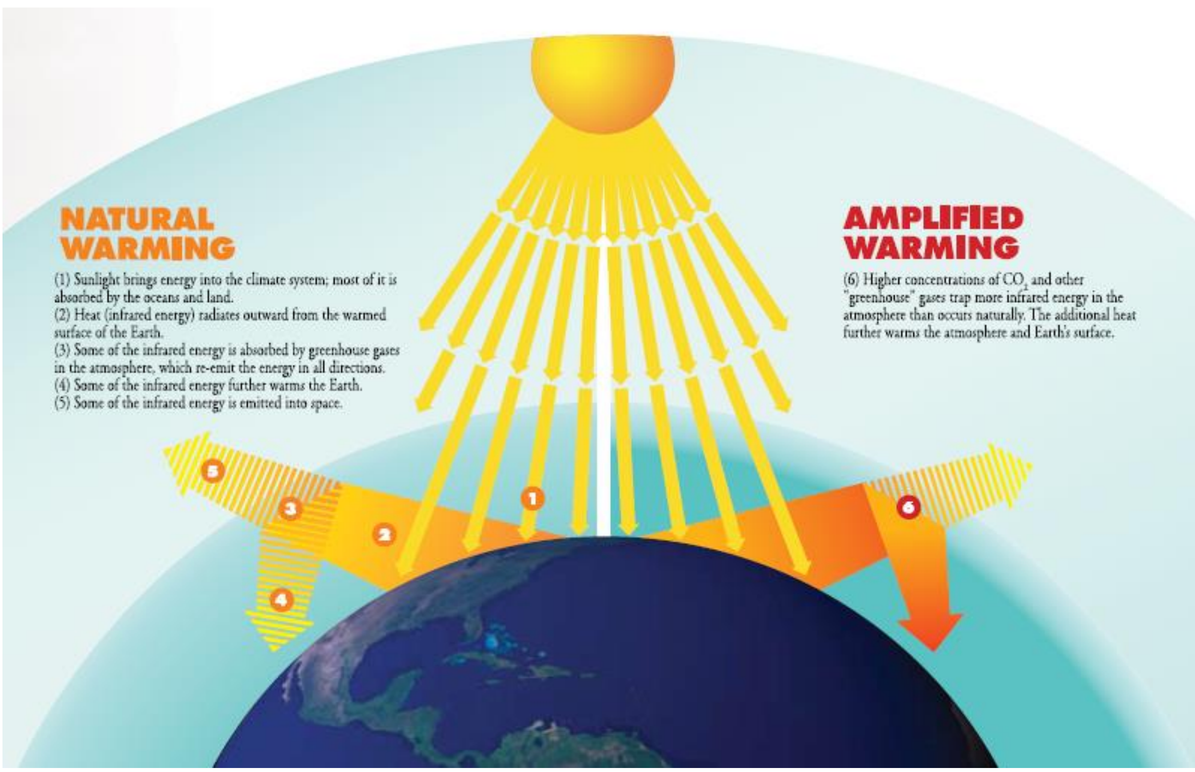


Figure 2.1 Natural and Amplified Warming
(Staudt*et al*, 2008:3)

Between Kannberg *et al*, (2009: 7) and Delbosc and De Perthuis (2009: 9), an approximation of between 60% - 65% of global anthropogenic GHG comes from energy-related activities. The remaining 30%-35% are acclaimed to come primarily from agricultural and land-use practices.

Hansen *et al* (2000: 9877) are able to separate these GHG emissions into three large distinctive categories, namely: methane (CH_4), chlorofluorocarbons (CFC's) and carbon dioxide (CO_2). CH_4 is produced naturally through "microbial decay of organic matter under *anaerobic* conditions in wetlands" (Hansen *et al* 2000: 9877). However, it is also identified as being produced artificially through human activities i.e. "including: rice cultivation, domestic ruminants, bacterial decay in landfills and sewage, leakage during the mining of fossil fuels, leakage from natural gas pipelines, and biomass burning" (Hansen *et al* 2000: 9877). The anthropogenic GHG emissions of CH_4 are said to be twice as large as the natural emissions of CH_4, but if global warming persists, it will cause these natural wetlands to expand (Hansen *et al* 2000: 9877). CFC's are mainly produced through the use of aerosols, "detrimental effects of aerosols, include acid rain and health impacts and will eventually limit the permissible atmospheric aerosol amount and thus expose latent greenhouse warming" (Hansen *et al* 2000: 9878). However, Hansen *et al* (2000: 9877) explain that since the Montreal Protocol, the growth rate of the two principal CFCs is estimated to be near zero and may be the largest source of uncertainty about future climate change. This simply means that more knowledge and research is required on aerosol GHG emissions.

Of the three categories of GHG emissions, $C0_2$ is identified to be the largest and most concerning GHG. "Since the onset of the industrial revolution around 1850, the concentration of carbon dioxide (CO_2) has increased by 31%" (Rattan L 2007: 815). Hegerl *et al* (2007: 2) agrees with this by stating that "the annual carbon dioxide concentration growth-rate was larger during the last 10 years (1995 – 2005 average: 1.9 ppm per year), than it has been since the beginning of continuous direct atmospheric measurements (1960 – 2005 average: 1.4 ppm per year). Kannberg et *al*, (2009: 7), claims that "globally, 89 percent of primary energy consumed comes from fossil fuels, (85 percent in the U.S.)". Kannberg et *al* (2009: 7) explained that "carbon dioxide emissions have an estimated atmospheric half-life of 27 years, which means almost one-third of today's emissions will remain in the atmosphere for 100 years". This means that the more anthropogenic $C0_2$ emissions produced, the warmer the atmosphere and ocean will become over longer periods, i.e. over the next 100 years. The following diagram by Stern, (2006:4) helps depict the different volumes of GHG and their contributions to global warming and hence climate change.

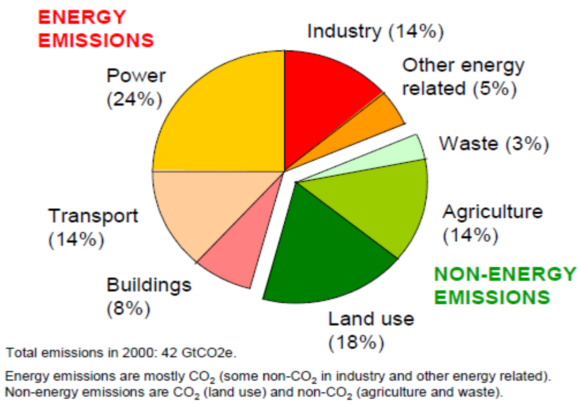


Figure 2.2 Energy Emission

Stern (2006:4)

Staudt *et al* (2008: 6) explained that the amount of carbon dioxide released into the atmosphere was precisely in equilibrium with the quantities absorbed by plant life before the industrial revolution. However, anthropogenic actions, such as the burning of fossil fuels have caused a disruption in this balance that has made a build of carbon dioxide in the atmosphere. This build up of CO_2 has resulted in the amplification of the natural greenhouse effect and lead to a number of physical and economic consequences that will be addressed below.

2.1.1 Physical Impacts and Effects of Climate Change

Rosenzweig *et al* (2007: 83) and the Pew Centre of Global Climate Change Report (2007:3): provide the following observable changes with regards to the extent of climate change on the earth's physical systems:

Changes in the global and ocean temperatures; a rise in global sea level, a decline in the northern hemispheres snow cover and increase in its snow melt and runoff; a decline in lake and river duration of ice cover; and lastly a decline in northern hemisphere mountain glacier and snow cover.

2.1.2 Economic Impacts and Effects of Climate Change

These physical impacts have deeper and more devastating possible impacts on various countries populations. "Climate change threatens the basic elements of life for people around the world – access to water, food, health, and use of land and the environment" (Stern 2006:56). The bases on which many of these economic problems arise are often mediated by water. Severe impacts such as droughts and floods may have drastic impacts upon peoples' lives and livelihoods. The following table provided by Stern, (2006:56) helps to explain a number of these concerns:

Table2.1: Economic Impacts of Climate Change

Melting glaciers	Will increase flood risk during the wet season and strongly reduce dry-season water supplies to one-sixth of the world's population, predominantly in the Indian sub-continent, parts of China, and the Andes in South America.
Declining crop yields	Especially in Africa, are likely to leave hundreds of millions without the ability to produce or purchase sufficient food - particularly if the carbon fertilisation effect is weaker than previously thought, as some recent studies suggest. At mid to high latitudes, crop yields may increase for moderate temperature rises (2 – 3°C), but then decline with greater amounts of warming.
Ocean acidification	A direct result of rising carbon dioxide levels will have major effects on marine ecosystems, with possible adverse consequences on fish stocks.
Rising sea levels	Will result in tens to hundreds of millions more people flooded each year with a warming of 3 or 4°C. There will be serious risks and increasing pressures for coastal protection in South East Asia (Bangladesh and Vietnam), small islands in the Caribbean and the Pacific, and large coastal cities, such as Tokyo, Shanghai, Hong Kong, Mumbai, Calcutta, Karachi, Buenos Aires, St Petersburg, New York, Miami and London.
Climate change	Will lead to increased worldwide deaths from malnutrition and heat stress. Vector-borne diseases such as malaria and dengue fever could become more widespread if effective control measures are not in place. In higher latitudes, cold-related deaths will decrease. By the middle of the century, 200 million more people may become permanently displaced due to rising sea levels, heavier floods, and more intense droughts, according to one estimate.

Source: Stern, (2006:56)

Rosenzweig *et al* (2007: 83) explained that the economic impacts of climate change will vary from country to country, from one climate region to the next. However, not all of these impacts will have negative effects. McKibbin and Wilcoxen (2002: 109) stated that these economic impacts may be uncertain and difficult to interpret in terms of specific temperature increases and when or how these temperature changes may affect each region. McKibbin and Wilcoxen (2002: 109 – 112) continued to discuss how climatologists have difficulty in accurately measuring and predicting the effects of certain elements in the atmosphere and how they affect global temperature change.

These uncertainties mean that climatologists cannot accurately predict the economic impacts and costs that climate change will have globally. This means that proposed impacts such as the mentioned by Stern (2006: 56) may not be as severe as initially proposed, and would have different effects in each region of the globe. Tol (2009: 6) provides a table of fourteen studies (table 2.2), that displays estimates of the welfare loss due to climate change". The table helps depict how different global regions will be affected by climate change, both positively and negatively given different scenarios of global warming, and which regions would be worst off or best off in each given scenario. Tol (2006: 9) states three important findings with regards to these studies:

1) There is an understanding that an increase in the concentration of greenhouse gas emissions would only affect the current global economy by a few percentage points.
2) Economic gains due to climate change are substantially smaller compared to the losses that would be experienced.
3) Low income countries generally impact climate change greater than high income countries that have a higher greenhouse gas emission per person.

McKibbin and Wilcoxen (2002: 113) agree with Tol's (2006: 9) third finding, by stating that developing countries are more at risk to the adverse effects of climate change. Whereas developed countries would tend to experience more of a positive impact.

Table 2.2: Welfare Impacts of Climate Change on GDP in Different Regions

Study	Warming	Impact	Worst-off region		Best-off region	
	(˚C)	(%GDP)	(%GDP)	(Name)	(%GDP)	(Name)
(Nordhaus, William D. 1994)	3.0	-1.3	-4.7			
(Nordhaus 1994)	3.0	-4.8 (-30.0 to 0.0)				
(Fankhauser, Samuel 1995)	2.5	-1.4	-4.7	China	-0.7	Eastern Europe and the former Soviet Union
(Tol 1995)	2.5	-1.9	-8.7	Africa	-0.3	Eastern Europe and the former Soviet Union
(Nordhaus and Yang 1996)	2.5	-1.7	-2.1	Developing countries	0.9	Former Soviet Union
(Plamberk and Hope 1996)	2.5	-2.5 (-0.5 to – 11.4)	-8.6 (-0.6 to -39.5)	Asia (w/o China)	0.0 (-0.2 to 1.5)	Eastern Europe and the former Soviet Union
(Mendelsohn *et al*. 2000a)	2.5	0.0 0.1	-3.6 -0.5	Africa	4.0 1.7	Eastern Europe and the former Soviet Union
(Nordhaus, William D. and Boyer, Joseph G. 2000)	2.5	-1.5	-3.9	Africa	0.7	Russia
(Tol 2002a)	1.0	2.3 (1.0)	-4.1 (2.2)	Africa	3.7 (2.2)	Western Europe
(Maddison 2003)	2.5	-0.1	-14.6	South America	2.5	Western Europe
(Rehdanz and Maddison 2005)	1.0	-0.4	-23.5	Sub-Saharan Africa	12.9	South Asia
(Hope 2006)	2.5	0.9 (-0.2 to 2.7)	-2.6 (-0.4 to 10.0)	Asia (w/o China)	0.3 (-2.5 to 0.5)	Eastern Europe and the former Soviet Union
(Nordhaus 2006)	2.5	-0.9 (0.1)				

(Tol 2009:6, 8)

The significance of these findings is the effects that they have on policy decisions for abatement. The question to the degree of abatement rests on the undisputed fact that climate change is happening, but to what extent do countries need to mitigate and given the fact that the costs of abatement now will be very high, which countries should bear these costs? Should the developed or developing countries bear abatement costs? Overall, the Intergovernmental Panel on Climate Change (2007) concluded that these impacts may only be either a small increase or decrease in the world's GDP. Hence, are a few percent changes worthwhile causes to implement a complex abatement strategy, or is the world better off suffering the effects of climate change. Stern (2007) argues that unless greenhouse gasses are cut today, the world's economic growth and well-being may suffer severely in the future (up to 5% of global Gross Domestic Product). Whereas economist Mendelsohn (2009:8) argued that climate change may be a serious problem and require attention; however, society's current actions and decisions are highly unlikely to lead to any cataclysmic consequences.

Watkins (2008:1) placed the true costs of climate change into context through his proclamation that although climate change may only cost the world a few basis points in terms of GDP, however, to some of the world's poorest people, the consequences could be catastrophic. In a paper presented to the House of Lords (2006:7), an alternative view was taken, it was explained that although the costs and penalties of the abatement of climate change should be borne now as opposed to being left to future generations, there are considerable time lags and opportunity costs that would be forgone in not addressing other significant current issues such as global poverty, hunger, war and HIV now. Therefore, there exists a debate on whether to make use of all available resources now to install preventative measures on climate change, or to make use of resources on more pressing matters, such as global poverty mentioned above. McKibbin and Wilcoxen (2002; 116) sum up this argument in their explanation that the current knowledge on climate change is sufficient to validate the abatement of climate change. However, McKibbin and Wilcoxen (2002; 116) do go on to state that not enough is known to justify drastic CO_2 emission cuts and that there still exists a level of uncertainty that only warrants a prudent but modest approach to mitigation.

2.2 Abatement of Climate Change

Kannberg *et al*, (2009:4), provides two alternatives for abatement. First is the idea of adaptation to climate change, described as the alteration of one's lifestyle to reduce their impact on climate change.

Mendelsohn (2000: 583) explained that every country's government in the world should seek to implement strict adaptation policies, regardless of whether or not their government implements an abatement policy. Kannberg *et al* (2009:4-5) provide the following examples of adaptation measures including: "promoting efficient use of water resources; developing low-cost technologies for desalinating seawater; improving health care and pest control; developing and using drought-resistant crops; and constructing disaster-resistant buildings and infrastructures".

Although adaptation seems a suitable means of abatement, Kannberg *et al* (2009:5) explained that although adaptation is effective and can be implemented globally and encourage global cooperation, it only really needs to be implemented by those that are in harm's way. Hence countries that are not affected negatively by climate change may have little motivation or incentive to implement adaptation policies. Furthermore, Mendelsohn (2000: 585) argues two important points with regards to adaptation. The first is that in order for adaptation to work, it must be effective. This implies that the benefit of adaptation must be greater than the cost. The second point is the need to distinguish between private and public adaptations. Private adaptations are done out of self-interest and hence are always efficient. However, public adaptations incur political pressures which may encourage governments to engage in inefficient adaptation behaviours.

Kannberg *et al*'s (2009:4) second abatement alternative is the mitigation of climate change through the reduction of GHG concentrations. Kannberg *et al* (2009: 4-16) provided a variety of methods and ideas of how to reduce GHG emissions, some of which are:

1) Reducing CO_2 emissions for electricity – more specifically by substituting to fuels that have a lower CO_2 emission per unit of electricity produced; by efficiency improvement of the production and end use of electricity and through carbon sequestration (capturing and permanently storing carbon emissions).
2) Focussing and realizing the potential of renewable electric power- Specifically Hydropower (particularly rivers, reservoirs, ocean, wave and tidal hydrokinetic energy usage); Biomass (mainly the firing of post-consumer residues of the forest industry – pulp and paper industries); Wind power (which is today's fastest growing renewable energy source); Solar Power (parabolic troughs, dish engines systems, and heliostat-based power towers); Photovoltaic's (Photovoltaic (PV) modules can be used for utility-scale electricity generation) and lastly Geothermal Power (practical only where underground steam or water exists at temperatures greater than 100°C).

3) Increasing the use of Nuclear Power – It is a fact that nuclear energy is a low emissions and low climate impact technology, however, there is high controversy regarding waste disposal and the safe guarding against weapons proliferation. Regardless of these political issues, nuclear energy is still regarded as one of the best sources for clean and efficient energy.

Stern (2006:12- 114) is of the same opinion as Kannberg *et al* (2009) regarding GHG reduction methods. Stern (2006: 12), challenges that GHG need to be reduced by 25%, and highlights four ways in which to do so, which are very similar to the Kannberg et *al* (2009) methods. Notably:

1) Reducing demand for emissions-intensive goods and services.
2) Increased efficiency, which can save both money and emissions
3) Action on non-energy emissions, such as avoiding deforestation
4) Switching to lower-carbon technologies for power, heat and transport. Estimating the costs of these changes can be done in two ways. One is to look at the resource costs of measures, including the introduction of low-carbon technologies and changes in land use, compared with the costs of the business as usual (BAU) alternative. This provides an upper bound on costs, as it does not take account of opportunities to respond involving reductions in demand for high-carbon goods and services.

Watkins (2008:5) shared a different approach regarding the abatement of GHG emissions, which is primarily that developed countries have to take the lead. Developed countries have polluted and damaged the earth's atmosphere on a greater scale and for a longer period than all developing countries' contributions put together. Thus, it could be said that developed countries should take responsibility and bear the burden and costs for the mitigation of climate change. Furthermore, developed countries have the financial resources and technological capabilities to commence with an early effort to minimize their CO_2 emissions.

Pricing carbon through a carbon tax or cap and trade system are common methods involved in a government market based approach to reducing GHG emissions. Stern (2006: 18) proposed three essential elements in the mitigation of greenhouse gas emissions. The elements were necessary for an effective mitigation policy that could be used to combat climate change, namely a carbon price, a technology policy, and the removal of barriers to behavioural change. This implies that governments need to create an effective policy that not only prices carbon, but encourages the development of low carbon emission technology and encourages behavioural change (particularly carbon reducing lifestyle changes) in order to overcome market imperfections (global warming). Nauclér and Enkvist (2009: 17) encouraged a similar policy through the establishment of long-term incentives that encourage power producers and industrial companies to develop and deploy greenhouse gas efficient technologies, e.g., in the form of a CO_2 price or a CO_2 tax.

Overcoming market imperfections (as mentioned above) implies that global warming and climate change is a result of market failure. This market failure is the result of pollution created by anthropogenic greenhouse gas emissions. Since the industrial revolution, developed countries, and more recently, developing countries have been polluting the atmosphere by increasing their greenhouse gas emissions (particularly through burning coal and oil), which has had a negative impact on each and every person in the world (Watkins 2008:7). From the above, it is conceivable that the derived solution to this negative externality, proposed by Stern (2006), Watkins (2008) and Nauclér and Enkvist (2009), is to employ a policy/regulation, which reduces emissions and encourages emission reducing technology development. Two policies which fulfil these criteria and have been used in practice for decades now are the Pigouvian carbon taxation and the carbon cap and trade systems.

2.2.1 Pigouvian Carbon Taxation

To understand the concept of a Pigouvian tax, public goods and externalities have to be addressed first. Perman, McGilvray and Common (2003:126) describe a public good as one that is non excludable (people cannot be prevented from consuming the good), and non rivalrous (one person consuming the good is not done at the expense of another person's ability to consume the good). Examples of public goods are: air, sunlight and defence services provided by government. Perman et *al* (2003: 134) described an externality as occurring when the production or consumption of a person or industry, otherwise known as an "agent", directly or indirectly affects the utility or income/profits of another agent (creates a negative or positive externality), and when no recompense is made to the affected agent by the "generating agent". From the above mentioned, it should be clear now that the generation of air pollution by developed countries since the industrial revolution and more recent developing countries are in fact negative externalities. The pollution generated by these countries affects the earth's atmosphere (a public good) and hence is a source of market failure, requiring compensation to all afflicted parties.

Carlton and Loury (1980: 559) explained that the most common market based mechanism for the abatement of carbon emission is through the imposition of a Pigouvian tax, (a per unit tax) on externality produced activities. Simply put, a Pigouvian tax places an additional cost on the externality generating activity, with the intention of reducing the marginal damage (MD) (damage incurred per unit of output generated), thereby increasing marginal benefit (MB) (benefit incurred per unit of output generated). The intention of a carbon tax is to alter consumer behaviour, through encouraging consumers to reduce their emissions. This is promoted through the elevation of a carbon tax. The higher a carbon tax is raised, the more pressure is placed on consumers and producers to alter their carbon emission behaviours (Chameides and Oppenheimer 2007:1670). Baumol and Oates (1971: 42) share a similar statement, that a Pigouvian tax should be implemented at a level where the tax on an activity is equal to the marginal social damages that the activity generates. The implication here is that the tax would be at a level high enough to not only cover the external damages created by the "polluting activity", but to also discourage future damages. Perman et *al* (2003: 218) and Oates (1990: 290) explained that the use of carbon taxes is effective in reducing emissions to an efficient level and reduces externalities produced by the emissions. Perman et *al* (2003: 217) illustrated the concept of MB and MC and how efficiency may be achieved through the implementation of a Pigouvian tax in figure 2.3 below.

At a position below the equilibrium (blue dot), MB>MC, which implies that society is benefitting positively and is being compensated over and above the damages that the emission polluting activities are causing; whereas a position above the equilibrium results in MC>MB, implying that society is experiencing a harmful negative externality and is not being compensated enough for it.

Perman et *al* (2003: 217) go on to introduce a carbon "emissions" tax into this scenario and explained its effectiveness through a typical example. Consider a polluting firm that faces an increasing marginal abatement cost curve. Left unregulated, it will choose to abate zero units of emissions and avoid the abatement costs represented by the area underneath the marginal abatement cost curve: C + D + F + G. Suppose a benefit-cost analysis has determined that optimal abatement occurs at the blue dot where the marginal benefit and marginal cost curves intersect. The resulting level of emissions is e*. To achieve this level of abatement, an emissions tax must be set where marginal benefit equals marginal cost, represented by the horizontal "tax" line. The polluting firm will find that it is cheaper to abate carbon emissions as long as the marginal abatement cost is lower than the tax. Since the tax (B + C) is greater than the marginal abatement cost (C) to the left of e* the firm will choose to abate. To the right of e* the marginal abatement cost (D + F + G) is greater than the tax (D + F) so the firm will choose to pay the tax and generate emissions = e' - e*.

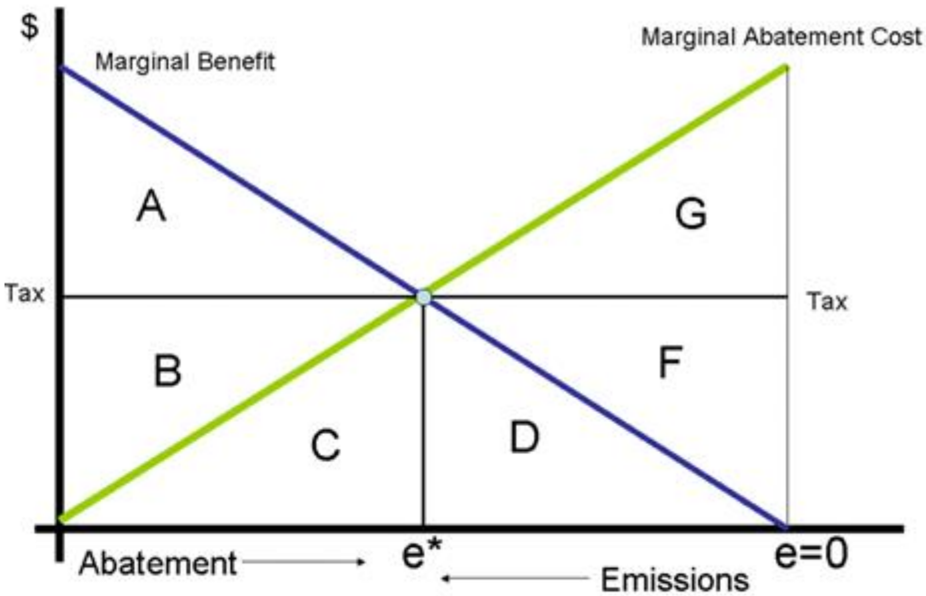


Figure 2.3: An Emissions Tax to Mitigate Carbon Pollution
(Perman et *al* 2003: 217)

Even though a carbon tax would be able to internalize the externality produced by a polluting industry, there are a number of externalities that may subsequently arise once a carbon tax is implemented. For instance, a tax on carbon dioxide emissions would result in the coal industry increasing the price of coal and passing on the burden of the tax to its end consumer. This in turn would increase energy prices, which would impact negatively upon poor households. Alton, Hartley and Thurlow (2012: 1) explain that there are a number of economic and social implications that a carbon tax creates. Alton *et al* (2012: 1) identify the effects on import/export competitiveness, the impact of increasing energy prices on poorer households and the impact on jobs and wages. However, Alton *et al* (2012: 2-10) continue to state that a carbon tax also provides direct revenues to government, which in turn may be recycled and used to reduce or eliminate these negative effects. There even exists the possibility of incurring a double dividend (a possible dual benefit incurred to an economy), by not only mitigating emissions but improving GDP through revenue recycling. This is addressed in more detail in chapter 4.

Besides the negative implications and issues of revenue recycling of a carbon tax, there is also a debate as to whether a carbon tax is effective as a possible market based instrument for reducing GHG emissions. This is discussed below.

2.2.2 The Merits and Demerits of Carbon Taxation

When emissions from one country adversely affect the environment of other countries, it would be first best from a cosmopolitan point of view for the polluting country to impose an internationally optimal Pigouvian tax on its emissions, a tax equal to marginal damage in all countries together (Kohn 1991: 337). Essentially it allows for countries to be accountable for their emissions. Countries that are knowingly polluting their own and other countries climates may be willing to implement a carbon tax, aimed at reducing their own emissions and providing revenues to offset the externalities they have imposed on other countries (Kohn 1991: 338). Hence, developed countries have the opportunity to collectively be accountable for the injustices they have imposed towards global warming through implementing carbon taxes upon themselves (Kohn 1991: 338).

Pielke (2009) explained how using a carbon tax is effective in putting a price on carbon. Initially the tax level may not be one hundred percent accurate and, in turn, under or over price the cost of carbon emissions. However, Pielke (2009) stated that putting a price on carbon at any level is a good starting point in reducing emissions. However, McKibbin and Wilcoxe (2002:117) warn against the use of carbon taxation in certain scenarios. Where Pielke (2009) is eager to set a tax at any level, McKibbin and Wilcoxe (2002: 117) caution that a tax set where the marginal benefits and marginal costs associated with the tax are uncertain may result in an adverse outcome. McKibbin and Wilcoxe (2002: 117) used a typical example of where a certain pollutant is only dangerous at very high levels of emission. At low levels of emissions, the pollutant is harmless and reducing the emissions can be done with constant returns to scale. McKibbin and Wilcoxe (2002: 117) explained this scenario as having a steep marginal benefit curve and a flat marginal cost curve. Given the scenario, a tax set below the cost of abatement would result in firms paying the tax and not reducing emissions. On the other hand, a tax set above the cost of abatement, would result in all firms completely cleaning up the pollutant and emissions completely stopping, which is not helpful as low emissions were considered harmless.

Sachs (2009) stated that a carbon tax has a significant advantage in being able to be levied upstream. This implies that a carbon tax could be imposed directly to the source of a polluting agent. Taxation on coal mines, oil refineries, natural gas deposits and other large emission industries can be far more effective and economically efficient than taxing an entire economy. However, being able to tax the entire economy on emissions is also another advantage of taxation. Sachs (2009) identified that a carbon tax can uniquely cover over an entire economy, from automobiles to household usage, and can be put in place to adapt the behaviour of these product usages.

Sachs (2009) built on this argument through that a carbon tax has the ability to raise transparent and calculable revenues, which can then be used for the acquisition of cleaner, more sustainable technology and the research and development of similar future technologies. Krupp, (2009) disagreed with the idea of a carbon tax as a means of abatement by stating that the disadvantage of a carbon tax is its inability to place a legal limit on the amount of emissions that industries can produce. As mentioned earlier by McKibbin and Wilcoxe (2002: 117), if a tax is set at a level where abatement costs are higher than taxes, industries will continue to increase their emissions and pay the tax, rather than actually try reduce their amount of carbon emissions. Stavins (2009) and Andrew, Kaidonis and Andrew (2010: 617) agreed with Krupp's, (2009) statement that a tax does not provide a definite attainment of a reduction in emissions; however Stavins (2009) and Andrew, Kaidonis and Andrew (2010: 617) additionally mentioned that a carbon tax provides superior assurance regarding implementation costs. Simply explained, a carbon tax can easily be applied to an already existing tax system in. All that is required is an amendment to current tax policy within the country. Andrew, Kaidonis and Andrew (2010: 617) continued to state that revenues from a carbon tax could also be used to remove or reduce existing taxes or to compensate low and middle income households which may be more severely affected by the tax.

Stavins (2009) also raised the issue of political pressures surrounding the introductions of a carbon tax. Governments may choose to provide certain tax exemptions to firms for their own personal gain, or due to political pressures in a voting campaign. These exemptions of sectors and firms would reduce the environmental effectiveness of a tax. Any government official that introduces a carbon tax would be subject to severe political pressures from interest groups that are most affected by the tax. From a political stand point a carbon tax is therefore very intimidating and impractical for politicians.

Komanoff (2009) provided a different opinion, that a carbon tax is an extremely effective tool in the abatement of carbon emissions. Komanoff (2009) explained how it is important that the world acquires new technologies that will help in the elimination of carbon production technologies and the production of clean sustainable technology in place. Essentially, Komanof (2009) raised four important reasons why a carbon tax is an ideal tool for reducing carbon emissions, namely: carbon taxes create price certainty; there is simplicity and immediacy in implementing a carbon tax; the possibility of international harmonization through the use of mechanisms such as border taxes and lastly, there is pure transparency in a carbon tax through legislation and in implementation.

Andrew, Kaidonis and Andrew (2010: 616) expressed a similar view that a carbon tax is transparent, which makes it difficult to avoid or evade. Furthermore, transparency ensures that all revenues generated by the carbon tax would have to be accounted for by government and made visible to the public. Fischhoff (2009) shares the same view of a carbon tax mainly that the transparency of a carbon tax allows the setting of clear defined goals which are made achievable through the accountability strained upon government.

An alternative market based instrument, which is widely supported as effective and also encourages international involvement in climate change mitigation, is through the establishment of a carbon market, known as an emission trading system or a cap and trade system.

2.2.3 A Cap and Trade System

"The first environmental permit markets were implemented during the 90s in the US to combat acid rain from SO_2 emissions" (Delbosc and de Perthuis 2009:12). Since then similar permit markets have been applied to carbon trading, in particular, the Kyoto Protocols framework. Delbosc and de Perthuis (2009:12) stated that the most developed emissions trading system to date is the European Union Emissions Trading Scheme (EU ETS). Flachsland, Edenhofer, Jakob and Steckel (2008:5) clarified this by identifying that EU ETS is indeed the largest existing cap-and-trade system in the world and initiated operations in 2005. Flachsland *et al* (2005: 5) continued that the EU ETS covers about 2Giga tonnes of CO_2 emissions at more than 10,000 installations across the 27 EU member states that make up the EU ETS.

A number of emissions trading systems have subsequently started after the EU ETS, including New Zealand, Australia, the Regional Greenhouse Gas Initiative (RGGI) of ten US-States in north-eastern USA, California, the Western Climate Initiative (eight US-State and two Canadian Provinces), and the Midwestern Regional Greenhouse Gas Reduction Accord (nine US-States and one Canadian Province) (Delbosc and de Perthuis 2009:13) .

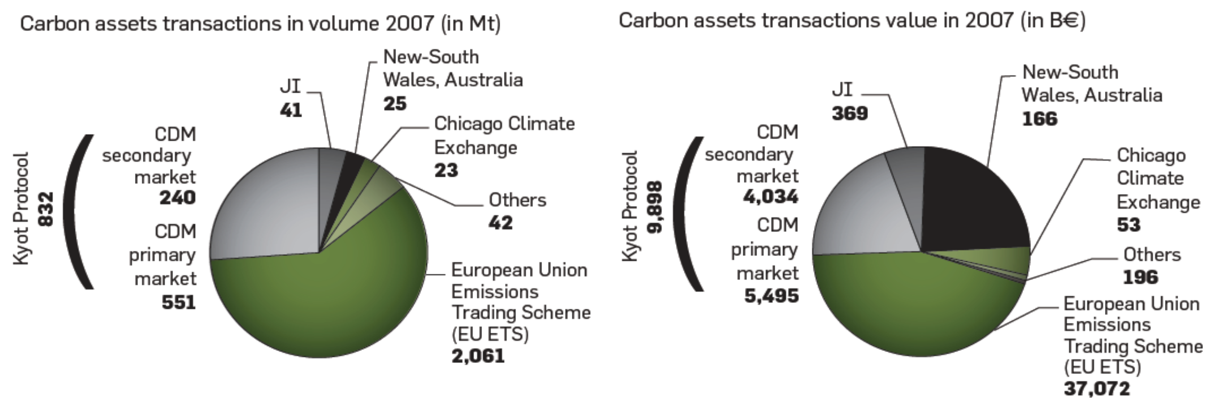


Figure 2.4: Volumes of Carbon Asset Transactions Since 2007
(Delbosc and de Perthuis 2009:12)

Figure 2.4 above provides a comprehensive illustration of the immense volume in ETS's transactions that have taken place since 2007. It is clear to see that the largest portion of carbon asset transactions have taken place in the EU ETS.

2.2.4 The Kyoto Protocol in Brief

"The Kyoto Protocol was adopted by the third conference of parties (COP 3) – held in December 1997 in Kyoto, Japan – and came into force on 16 February 2005 when the requisite number of countries acceded to it"(Scholtz and De Villiers 2011:22). The protocol simply sets fixed limits on the emissions of six greenhouse gases. These limits were initially imposed upon industrialized countries only. The reduction target level for industrialized countries was set at 5% of each individual country's 1990 emissions level (Scholtz and De Villiers 2011:22). Gilbertson and Reyes (2009:8) continued to clarify in depth that the Kyoto Protocol included 38 countries that committed to reducing their gas emissions levels by 2012 (2008-2012 is the first commitment period of the Kyoto Protocol).

At the end of the first commitment period, COP 17 was held in Durban (South Africa) to assess the results of the first commitment period and "the way forward" into the second commitment period. The result of COP 17 was the release of the Durban Platform document, which creates an *ad hoc* working group whose work will have to be completed by 2015, in order for the legal framework (Kyoto Protocol framework) to take effect as of 2020. The aim of this will be to strengthen greenhouse gas emissions reduction targets (United Nations, 2012: 2-10). The second commitment period will be a 5 year period beginning in 2013. In addition to this result, a Green Climate Fund is also to be launched, which is intended to help developing countries in their mitigation against climate change (United Nations, 2012: 55-57).

The Kyoto Protocol supports the use of carbon trading and carbon taxes as appropriate market based instruments in the mitigation of GHG emissions. During the first commitment period, the majority of the responsibility of climate change mitigation was placed on developed countries. Although this is slowly changing, there are “flexibility mechanisms” which help developed countries reach their emissions targets and allow developing countries to engage in climate change mitigation. Some of these mechanisms are addressed below.

2.2.5 Kyoto Protocol Flexibility Mechanisms

“The Protocol provides three "flexibility mechanisms" that an annex B country (a developed country that has ratified the Kyoto protocol) can use emissions trading, Joint Implementation (JI) and the Clean Development Mechanism (CDM), (McKibbin and Wilcoxe 2002:124).

Gilbertson and Reyes (2009:8) and Delbosc and de Perthuis (2009:13) explained emissions trading as a market based mechanism of emissions reduction, whereby government provide industries and other polluting agents with a license to pollute known as a carbon permit. These industries are assigned a specific cap regarding their pollution level (called assigned amount units (AAUs)). If these AAU’s are exceeded, it would result in a heavy fine. The permit therefore allows a polluting agent to trade their permit with another polluting agent, who may be able to make alternative energy changes more quickly or cheaply. Hence there is a certain level or leeway provided to polluting agents. This leeway provides essential time for polluting agents in which to adapt to the new carbon limiting policy. The emission trading system serves to develop a price on carbon emissions through the supply and demand for carbon permits (Delbosc and de Perthuis 2009:13). If an annex B country has excess emissions above its cap, it will be forced to trade with another annex B county with who has a deficit in emissions and surplus permits.

McKibbin and Wilcoxe (2002:124) explained a JI as one annex B country granting permission to another annex B country, to carry out an emissions reduction project in that annex B’s country for a percentage of the second country’s emissions permits. Delbosc and de Perthuis (2009:13) clarified this further by explaining that JI’s simply transfer credits from one annex B county to another. This means that JI’s do not create credits, every credit that is transferred from one country, is equally reduced in the country that transferred it. Essentially JI projects only take place in industrialized countries, and produce Emissions Reduction Units (ERU's), which are as mentioned above, transferred between two annex B countries to reduce the emission allowance in the giving country and increase the allowance in the receiving country. Spash (2009:23) mentioned that JI's are specifically designed for annex B countries to have more flexibility in reaching their emission target caps and more importantly, to encourage a more sustainable development in industrialized countries. Delbosc and de Perthuis (2009:13) identified that the main countries that have taken advantage of JI projects are Russia, Ukraine and Eastern European countries, however, Germany and France have recently begun JI projects as well.

A CDM differs from a JI and ETS in that it is designed to extend participation in the Protocol to non-annex B countries. Under this mechanism, an annex B country can receive emissions credits for undertaking a suitable emissions reducing project in a non-annex B host country (McKibbin and Wilcoxe 2002:124). These emissions saving projects range from building hydro-electric dams to capturing methane from industrial livestock facilities (Gilbertson and Reyes 2009:8). Spash (2009:23) explained that CDM's are designed to produce credits called certified emissions reductions (CER's), more commonly known as carbon credits. Again, this is another form of flexibility for annex B countries to be able to engage with non-annex B countries and attempt to increase their emissions allowances by producing carbon reducing projects in non-annex B countries. Delbosc and de Perthuis (2009:14) explained that the aim of CDM projects is to promote investments in developing countries by industrialized nations and to encourage the transfer of low emission technologies. Hence CDM's can be seen as to allow flexibility in helping annex B countries reach emission reduction targets, and a means to encourage non annex B countries (particularly African countries) to become more involved in the Kyoto Protocol, while simultaneously providing low emission technology to these countries.

Although the Kyoto Protocol supports a cap and trade system as an ideal market based instrument for the mitigation of GHG's and encouraging cleaner emissions technology, there are a number of debates concerning the advantages and disadvantages and effectiveness of a cap and trade system as opposed to other market based alternatives.

2.2.6 Merits and Demerits of a Cap and Trade System

Chameides and Oppenheimer, (2007: 1670) stated that a cap-and-trade system, which is well monitored and enforced, can ensure that environmental goals are achieved by a certain date. Given the sense of urgency in the world's need to reduce carbon emissions immediately; achieving targets that have been set is of great importance. Claussen (2009) made this clear through an explanation that an economy wide cap and trade system sets specific limits on greenhouse gas emissions, these limits are set at realistically obtainable levels, which make a cap and trade system ideal for reducing CO_2 emissions. Claussen (2009) also stated that a cap and trade system would encourage environmental integrity and cost effectiveness through an economy wide approach.

However, Pielke (2009) highlighted a possible negative implication of using a cap and trade system. Pielke (2009) claimed that a rigid cap on emissions would lead to increases in the costs of energy, increasing costs throughout an economy. If these costs are felt by consumers, consumers will in turn apply political pressures on elected officials. Consequently this will lead to the practice of a very flexible cap which will allow the cap to be evaded in order to reduce the effect on costs, ultimately defeating the purpose of the policy. Sachs (2009) is of the same opinion by stating that an ETS can be easily influenced to promote additional flexibility. Regulators of an ETS could simply distribute more permits to prevent prices from rising. This essentially defeats the purpose of a cap and trade system by allowing more emissions instead of less. Closely related to this is Spash's (2009: 13) interpretation of the modern industrial economy as consisting of two sectors: one in which producers are small, lack power and are subject to competition, and the other in which producers are large, have considerable power and run by professional managers. Spash (2009: 13) stated that professional managers share close relationships with politicians and regulators. This is particularly relevant to climate change because the energy and transportation sectors are dominated by large national and international corporations able to access considerable resources and lobby politicians to their own profits.

Krupp (2009), however, had a different view on the "private" industrial sectors impact on cap and trade systems. Krupp (2009) explained that the creation of a market allows the private sector to become heavily involved in improving the efficiency of the market. The profit motive of a capitalist system would encourage the private sector, through their investments, technical ability and vast amount of resources, to combat climate change. This may be through research into new technologies that promote cleaner energy sources or the more efficient use of current energy sources. Claussen (2009) agreed with this by stating that unlike traditional regulation, a cap and trade program constrains emissions but let's market forces set a price on emissions. Rather than mandating a specific technology, the flexibility afforded by emissions trading markets helps identify where emission reductions can be achieved most cost effectively. Cap and trade stimulates the development of new technological solutions that can enable deeper emissions cuts at lower cost in the future.

2.3 Synopsis

This chapter began by discussing climate change; how global warming and anthropogenic greenhouse gases have led to, and accelerated, climate change. This discussion then included the physical and economic impacts of climate change; the negative welfare and GDP implications that climate change will have on different areas of the world.

The abatement of climate change was then discussed through the alternative means of adaptation and the use of market based mechanisms. Adaptation discussed various means of climate change mitigation through human behavioural changes. In contrast to this, the market based mechanisms approach discussed how government could use a carbon tax or cap and trade system to help mitigate greenhouse gas emissions. The merits and demerits of each of these market based mechanism approaches were also examined.

To better understand how these markets based approaches of climate change mitigation could be used in South Africa, a brief overview of South Africa's current carbon and economic profiles need to be conducted. This would provide an opportunity to gauge the current environmental laws and review there applicability to climate change in terms of mitigation appropriateness.

Chapter 3
Background to South Africa's Position in Terms of Carbon Mitigation

Although the Kyoto Protocol, as previously stated, was put into effect in 1997, South Africa has only put forward an effective mitigation strategy in 2011. This is primarily due to the fact that South Africa is considered to be a developing country and thus has no legal obligations to reduce its carbon emissions levels. This delay to include South Africa in the Kyoto Protocol is to provide South Africa time to develop and to do so unhindered by emission standards. However, if South Africa's current levels of GHG emissions and its position as the economic power of Africa were considered, there exists a moral obligation for South Africa to reduce its GHG emissions levels, regardless of the Kyoto Protocols interpretation of obligations.

This chapter initially focuses on South Africa as a developing country and its current GHG emissions levels in a global comparison. It then continues to identify South Africa's previous environmental policies that contribute to the mitigation of GHG emissions and includes the most recent National Climate Change Response White Paper. Lastly, it identifies the two market based approaches to reducing GHG emissions that South Africa will be using in the immediate and medium to long term.

3.1 South Africa's Socioeconomic Profile in Brief

Although South Africa could be considered to be the "super power" of Africa in terms of economic development, it still has serious problems. South Africa had a GDP growth of 3, 2% (quarter on quarter, in December 2012), which has picked up from the recent recession experienced since 2008 (Statistics South Africa 2012:1). The South African government uses conservative fiscal policy, which focuses on controlling the inflation rate and encouraging a budget surplus. Currently inflation in South Africa is at 5% (SARB 2012: 1). However, these positive economic indicators do not mask the economic hardships that South Africa faces. The population level in South Africa is close to 50 million, with an unemployment rate of 24,9%, primarily focussed around the ages 15 – 30; in the unskilled work force (Statistics South Africa 2012:1). South Africa also has one of the highest levels of inequality in the world, with a GINI coefficient of 63.1 in 2009 (World Bank 2012:1).

3.2 South Africa's Emissions Profile in Brief

Given the fact that South Africa has the largest and most developed economy in Africa, it is expected that it will also have the highest level of carbon emissions as well. South Africa is considered widely as a global leader in mining and minerals and has an abundant supply in mineral resources. Gold mining is the greatest contributor to South Africa's GDP, with the coal industry being the second largest contributor. South Africa is an energy based economy, "with coal reserves estimated at roughly 30 billion tonnes, accounting for 95% of African coal reserves and 4% of world reserves. Coal provided an estimated 72% share of the country's total primary energy supply in 2007 and accounts for approximately 85% of electricity generation capacity" (DEA 2011: 14). However, being one of the largest mining countries in the world and having some of the largest coal deposits, the result is that South Africa is also one of the largest carbon emitters in the world. "In 2004, South Africa emitted about 387 million metric tons of CO_2, just under half of CO_2 emissions for all of Africa, and about 1.6 per cent of global emissions" (National Treasury, 2010: 16).

Table 3.1 provides a list of CO_2 emissions factors, in terms of which sectors within South Africa consume fuel to emit large amounts of CO_2. This is expressed as CO_2 tonnes per gigajoule. With regards to coal mining and coal usage, electricity is shown to be the largest emission factor of CO_2 in South Africa. However, in both coal mining and coal usage, Sasol (an energy and chemical company in South Africa) and discard coal (waste product from the operations of export collieries) follow close behind electricity as high CO_2emission factors in South Africa.

Table 3.1: Carbon Dioxide Emission Factors

Fuel	Sectors to which the emission factor is applied	CO_2 Ton/GJ
Coal mining	Electricity	96.25
	Other uses	94.6
	Sasol	94.6
	Discard Coal	94.6
Local crude oil extraction		73.33
COAL	Electricity	96.25
	Commerce and Industry	94.6
	Sasol	94.6
	Discard Coal	94.6
	Residential	87.001
Diesel	All users	74.07
HFO	All users	77.37
LPG	Commerce, Industry and Agriculture	63.07
	Residential	65.0
Paraffin	Commerce, Industry and Agriculture	71.87
	Residential	69.94
Petrol	All users	69.3
Gas	All users	56.1

(Adapted from: Haw and Hughes, 2007:31)

Table 3.2 illustrates South Africa's position in the world as a leading carbon emitter and provides insight into South Africa's trajectory to continue doing so. Blodget and Parker, (2010:5) found that an upward pressure is placed on carbon emissions, the more a countries population increases. With a population of close to 50 million, South Africa is ranked the 20th highest CO_2emitting country in the world (Blodget and Parker, 2010:5).

Table 3.2: Drivers of Greenhouse Gas Emissions: Top 20 Emitting Countries, 2005

Country	Population (in 1000'2)	Per Capita GDP (2005 int'l $PPP/Person)	Intensity(Tons Cequiv/million 2005 Int'l $PPP)	Total GHG Emissions (MMTCE)
China	1,304,500	4,088	369.4	1,970.3
United States	296,507	41,813	153.3	1,900.6
EU-27	490,032	26,592	105.7	1,377.7
Russian Fed	143,150	11,861	315.1	534.9
India	1,094,583	2,230	207.2	505.7
Japan	127,773	30.290	94.7	366.5
Brazil	186,831	8,474	174.8	276.8
Germany	82,469	30,445	106.2	266.8
Canada	32,312	34,972	176.7	199.7
U.K.	60,226	31,371	92.4	174.6
Mexico	103,089	11,387	146.4	171.9
Indonesia	220,558	3,209	229.2	162.2
Iran	69,087	9,314	240.2	154.6
Italy	58,607	27,750	94.9	154.4
France	60,873	30,591	80.7	150.2
S. Korea	48,294	21,273	145.8	149.8
Australia	20,400	31,656	231.9	149.7
Ukraine	47,105	5,583	503.0	132.3
Spain	43,398	27,180	101.5	119.7
S. Africa	**46,892**	**8,478**	**290.3**	**115.4**
Turkey	72,065	10,370	146.6	107.3
WORLD	6,461,584	8,708	188.1	10,569.3

(Adapted from Blodget and Parker, 2010:5)

3.3 South Africa's Current Environmental Policies to Help Mitigate Carbon Emissions in Brief

Given all the above, South Africa provides a significant contribution to global carbon emissions and hence global warming and ultimately climate change. Hence, South Africa has the very challenging task of trying to reduce and mitigate its GHG emissions levels. South Africa has previously developed a series of environmental policies through the Department of Environmental Affairs and Tourism (DEAT), which are more targeted towards environmental protection than specifically climate change. However, since the Kyoto protocol and the importance of climate change has been made aware, the DEAT has issued more policies that are focussed towards climate change, most importantly, the recent National Climate

Change Response, White Paper (2011). Shown below is a series of the most significant environmental policies issued by government which help reduce GHG and hence mitigate climate change.

Please note that there have been a number of environmental acts, policies and white papers that have been implemented besides those explained below. The intention here is to cover a few considerably important acts/white paper policies that bare significance to the establishment of the National Climate Change Response, White Paper (2011).

1) National Atmospheric Pollution Prevention Act (1965).

The Atmospheric Pollution Prevention Act is responsible for the control of noxious gases, smoke, dust, vehicle emissions etc. Noxious or offensive gases are controlled by the granting of registration certificates to seventy-two listed processes, which include power generation processes and gas, charcoal and coke processes (Department of Health and Welfare 1965: 1-38).

2) White Paper on an Environmental Management Policy for South Africa (1998).

"The policy defines the essential nature of sustainable development as the combination of social, economic and environmental factors. The policy furthermore sets ownership of sustainable development as the accepted approach to resource management and utilisation in South Africa, thus entrenching environmental sustainability in policy and practice" (DME 1998: 1-88). The crux of this policy is the integration of environmental and economic factors into development policy. Hence, resources in South Africa would no longer be managed in isolation through economic considerations, but as a combination through the inclusion of environmental factors.

3) National Ambient Air Quality Standard – Sulphur Dioxide Standards (2000).

"The purpose of ambient air quality guidelines or standards is to provide a basis for protecting public health from the adverse effects of, air pollution and for eliminating, or reducing to a minimum, those air contaminants that are known to be, or are likely to be, hazardous to human health and wellbeing" (DME 2001: 13). This simply means that commerce and industry need to consider the adverse effects that production processes and services have on air quality in South Africa. Hence, commerce and industry will be held accountable for any externalities produced that tarnishes air quality.

4) White Paper on Integrated Pollution and Waste Management (2000).

"This White Paper on Integrated Pollution and Waste Management for South Africa represents a paradigm shift from dealing with waste only after it is generated (i.e. "end of pipe") towards:

- pollution prevention
- waste minimisation
- cross-media integration
- institutional integration, both horizontal and vertical, of departments and spheres of government, and
- involvement of all sectors of society in pollution and waste management" (DME 2000: 10-11).

Since this act there have been a number of similar waste management acts, such as the National Environmental Management Waste Act of 2008 (DEAT 2009). Such acts were a breakthrough for South Africa's environmental policy, in that the acts seek to not only help control pollution and waste, but actively prevent pollution and waste from the source and only dispose of waste as a last resort. For example, since the National Environmental Management Waste Act of 2008 a hierarchy in disposing of waste understanding has been developed, i.e. where waste cannot be avoided, it should be recovered, reused, recycled and treated. Waste should only be disposed of as a last resort.

5) The Renewable Energy White Paper (2003)

Committed the country to 10 000 GWh contribution of renewable energy to final energy demand by 2013 (DME, 2003). The National Energy Regulator of South Africa (NERSA) developed a renewable energy feed in tariffs (REFIT's) to help with the power, particularly electricity problems that South Africa faced at the time (Winkler, Marquard and Jooste 2010: 7). This initiative was then changed to REBID's (renewable energy bids), run by the national treasury, in place of NERSA and, due to the low attention received by the REFIT initiative.

6) National Environmental Management of Air Quality Bill (2004).

It focuses on the adverse impacts of air pollution on the ambient environment and sets standards to control ambient air quality levels. At the same time it sets emission standards to minimise the amount of pollution that enters the environment.

The objectives of the Act are to protect the environment by providing reasonable measures for:

- The protection and enhancement of the quality of air in the Republic.
- The prevention of air pollution and ecological degradation.
- Securing ecologically sustainable development while promoting justifiable economic and social development (DEAT 2005: 1-29).

An example of the effectiveness of this is act is through the establishment of an Atmospheric Emissions License (AEL), which requires that an industry report on all its air pollution sources. An AEL is only granted to an industry once it is proven that it can comply with the requirements set out by the ACT (DEAT 2005: 1-29).

The above five acts and white papers are the most significant policies that have been implemented by government in the past with regards to reducing carbon emissions in South Africa. Of these five, the two white papers are of most importance as they provide the DEAT with the knowledge, authority and ability to effectively manage and enforce environmental policies. However, none of the above actually focuses specifically on climate change or specifically reducing carbon emissions. The, above policies focus on setting standards for pollution and ensuring the environment remains clean in general, however they do not provide financial incentive or consequences to reduce industrial, commercial or residential carbon emissions. In short, the above policies are not set for a GHG mitigation strategy.

In 2011, the government released a white paper within the DEAT that does set a strategy for facing climate change.

7) National Climate Change Response, White Paper (2011)

In 2010, the National Treasury published a discussion paper, with the proposal for a market based instrument for targeting greenhouse gas emissions, namely a new carbon tax (National Treasury 2010: 1-75). The discussion paper's purpose was to gauge the public's view of the proposal and to get comments, before the carbon tax effectively becomes new environmental tax legislation. Within the discussion paper, National Treasury provided their objective view as to why government decided to select carbon taxation as their preferred market based instrument.

Initially, national treasury recognized that in terms of setting a tax level or issuing of allowances for an ETS; both may lead to a less than optimal outcome and create inefficiencies. In the case of a carbon tax, this would be regarding the excess burden it places on low income households. However, regarding an ETS, the issue would be a low carbon price that no longer provides incentive to reduce emissions. In the eyes of the National Treasury, the problem experienced by the EU ETS during its first phase when the carbon price fell drastically low, is seen as a severe problem in implementing an ETS (National Treasury 2010: 27). National Treasury also highlighted a number of significant advantages in implementing a carbon tax would have over an ETS, namely:

• Participation and oversight of the tax by the existing revenue administration authority
• Involves fewer players and therefore incurs lower costs
• Minimises the opportunity for abuse and risk within the system as it follows a much simpler structure
• Creates less of an administrative burden associated with creating an entirely new accounting scheme for carbon allowances
• Minimises lobbying efforts.

(National Treasury 2010: 58).

In addition to this, National Treasury also stated that implementing an ETS would require extremely complex conditions to be met; some of these challenges would be as follows:

• The credibility of emissions caps
• The allocation of permits freely and/or auctioning of permits
• A competitive market to facilitate trading
• Price uncertainty (can fluctuate significantly)
• New set of financial regulations will be necessary
• Tax implications (income tax and VAT) of income derived from emissions trading
• Distributional implications and incidence are neither obvious nor transparent.

(National Treasury 2010: 59).

A comments paper on the discussion paper was then released by the National Treasury in the December 2010. The comments paper highlighted the main issues and concerns that the public found regarding National Treasury's Carbon Tax option, these were: 1) the level of the tax to be set, including an adjustment mechanism to help attain this level; 2) The use of tax revenues, particularly in a way to protect the poor; 3) Competitive implications for industry; 4) Border tax adjustments and, lastly; 5) The consideration of a hybrid carbon tax and ETS approach (National Treasury 2011: 1-9).

These comments rose through public concern and ultimately lead to government reconsidering the viability of an ETS approach. Hence in 2011, government released the National Climate Change

Response White Paper, which stated that carbon tax will be used in the immediate short term and ETS would be considered in the medium to long term as methods of carbon mitigation (DEAT 2011: 24).

"The National Climate Change Response White Paper has two objectives:

- To effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- To 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"(DEAT 2011: 5).

The policy covers 12 different sections that respond to climate change and how South Africa can face its challenges. Amongst these are government's plans for mitigation in the medium term addressed in section 6, of which the key approaches are:

- "Shifting to lower-carbon electricity generation options;
- Significant up scaling of energy efficiency applications, especially industrial energy efficiency and energy efficiency in public, commercial and residential buildings and in transport; and
- Promoting transport-related interventions including transport modal shifts (road to rail, private to public transport) and switches to alternative vehicles (e.g. electric and hybrid vehicles) and lower-carbon fuels.

In the short and medium term, several other options are available with a smaller mitigation potential, including:

- Carbon capture and storage in the synthetic fuels industry;
- Options for mitigating non-energy emissions in agriculture and land-use; and
- Transitioning the society and economy to more sustainable consumption and production patterns" (DEAT 2011: 25).

Most of the mitigation strategies mentioned above will help society adapt towards a more conscious way of living (where people are more aware of how their activities contributes to GHG emissions in South Africa) and hence attempt to reduce their GHG emissions. However, a very important method of mitigation mentioned, in the white paper is the use of market-based instruments such as carbon taxes and emissions trading schemes. South Africa already has a number of environmental tax levies in place, such as aviation taxes, electricity taxes, product taxes, transport fuel taxes, waste and water taxes.

TABLE 3.3: Current Environmentally-Related Taxes and Charges

SECTOR	LEVY (charge)	TAX RATE
Transport Fuels	General Fuel Levy	150 cent per litre (petrol). 135 cent per litre (diesel). Cent per litre (biodiesel).
	Road Accident Fund Levy	64 cent per litre.
	Equalisation Fund Levy	Currently zero.
	Customs and Excise Levy	4 cents per litre.
Vehicle Taxation	*Ad Valorem* Customs and Excise Duty (X), CO_2 component (Y)	(X) Graduated rate based on the vehicle price with an upper ceiling of 20% Plus (Y) graduated rate based on CO_2 emissions.
	Vehicle Licensing Fees	Fees vary between different provinces – usually based on weight.
Aviation Taxes	Aviation Fuel Levy	1,5 cents per litre on all fuel sales excluding foreign operators
	Airport charges	Charges imposed to fund the operation of the South Africa Civil Aviation Authority (SACAA).
	Air Passenger Departure Tax	R150 per passenger - international; R80 per passenger to BLNS countries.
Product Taxes	Plastic shopping bags levy	4 cents per bag
	Incandescent light bulbs	1 to 3 cents per watt (R3 per light bulb)
Electricity Taxes	NER Electricity Levy	A levy per kWh is implemented on all electricity generated to fund the National Electricity Regulator.
	Tax on electricity production – non-renewable resources	2 cents per kWh as from 1 July 2009
Water Supply	Water Resource Management Charge	Charge rates vary according to different users. The aim is to recover costs associated with water supply and abstraction.
	Water resource development and use of water works charge	Charge rates vary according to different users. The charges aim to recover the costs associated with the construction, operation and maintenance of water schemes.
	Water Research Fund Levy	This levy earmarked to fund the operations of the Water Research Commission.
Waste Water	Waste Water Discharge Charge System (proposed)	The WDCS is in the process of being developed. 3 components are proposed for the system. 2 are cost recovery based charge and the third a levy/ tax on waste effluent.

(Adapted from Department of National Treasury, 2009: 22).

Table 3.3 displays a number of current environmentally based policies in South Africa which help to mitigate carbon emissions and general pollution. These policies help prevent the excess emissions of GHG by implementing a tax levy (charge) on GHG emissions, similar to a carbon tax which the DEAT are going to introduce, but on a much smaller scale. These are policies which are capable of making a difference in combating climate change in South Africa if managed and coordinated and followed up on efficiently by government.

The above environmental related taxes and policies in table 3.3 only cover a limited number of sectors and do not provide enough of an incentive for large industries that produce a high amount of CO_2 emissions, to effectively reduce their emissions. Hence, the possible introduction of a carbon tax in 2013 (that solely focuses on mitigating carbon emissions) by government, will go a long way in further helping reduce GHG emissions and hence South Africa, to combat climate change. The possibility of also implementing an ETS as a market based instrument to help reduce carbon emissions over the medium to long term, would help South Africa tremendously in achieving carbon reduction goals. Being able to place a cap on carbon emissions is important in achieving reduction targets and an ETS would do exactly that. Hence, the National Climate Change Response White Paper has moved South Africa into a position in which South Africa can become actively involved in combating climate change.

3.4 Synopsis

South Africa is a developing country that suffers from typical third world economic problems, such as high levels of unemployment, HIV and AIDS epidemics and a large unskilled work force. South Africa is unique however, in that although it is a third world country, it is amongst the top 20 drivers of GHG carbon emissions in the world. This places a moral obligation on SA to make an attempt in reducing its carbon emissions. South Africa until recently had very little strategy in place to engage in carbon mitigation. It had a number of environmental policies such as the National Atmospheric Pollution Prevention Act (1965), the White Paper on an Environmental Management Policy for South Africa (1998), the National Ambient Air Quality Standard – Sulphur Dioxide Standards (2000) and a number of others which helped in maintaining a clean environment, but not specifically incentivising the reduction of GHG emissions. Recently however, government issued The National Climate Change Response White Paper which specifically outlines government’s strategy for combating climate change. The White Paper states that a carbon tax will be implemented as a short term mitigation strategy and an ETS as a medium to long term mitigation strategy. Both strategies are common market based instruments in reducing carbon emissions and considered effective amongst most economists and environmentalists. However, there are concerns on how government intends to recycle the revenues produced by a carbon tax and similarly those of an ETS.

Chapter 4
Collective Case Studies on Carbon Taxation and Emissions Trading Systems

Government will be implementing a carbon tax in 2013 as part of its mitigation strategy to reduce carbon emission levels in SA. As previously mentioned, a primary concern raised by the public was on the issue of the use of tax revenues, specifically how these revenues would be recycled to reduce negative implications that arise from implementing a carbon tax. How revenue is recycled is of particular importance to protecting the poor and those made worse off by a carbon tax. A good start at deciding how carbon tax revenues should be recycled is by looking at the challenges that countries who have already implemented a carbon tax have faced and how such countries overcame these challenges.

Government has also stated that they would be considering implementing an ETS in the medium to long term as an additional market based instrument for carbon mitigation. However, in the National Treasury's 2010 discussion paper on considering a carbon tax option, National Treasury highlighted "Windfall Profits" and "Over Allocation" amongst other concerns that it had in implementing an ETS. Hence, one approach to overcoming these concerns is to look at how the EU ETS dealt with them and particularly how SA could avoid these problems in implementing an ETS.

This chapter will be structured as follows: in considering the negative macroeconomic and microeconomic impacts of a carbon tax and how these effects may be reduced; case studies on New Zealand, Mexico, Norway and Ireland will be viewed. Each case study will address the following topics:

- New Zealand and Mexico – concerns of distributional and welfare implications of a carbon tax and revenue recycling through a food subsidy and a manufacturing tax subsidy.
- Ireland – Revenue recycling through tailored welfare packages.
- Norway – improving the economic efficiency and distribution of a carbon tax

In considering the concerns raised by the National Treasury in implementing an ETS, a case study on the EU ETS will be viewed. The case study will address the issues faced by the EU ETS through each of its phases, including the problems of "over allocation" and "windfall profits". Furthermore, issues of fraud will be identified.

4.1 The Case of Carbon Taxation in New Zealand

Creedy and Sleeman (2006) provided an analysis on carbon tax prices and welfare implications in New Zealand, in which the effects of imposing a carbon tax on consumer prices were analyzed. The primary concerns raised were: 1) The possibility of excess burdens arising due to price changes made by the tax and 2) the possibility of adverse impacts on welfare distribution due to the tax increasing the price of certain goods that cost a large proportion of low income earning households budget. Scrimgeoura, Oxleyb and Fatai (2005: 1440), in a similar paper, raised concerns of additional carbon tax implications, mainly, "the likely impact on economic growth, employment, investment and other macroeconomic variables". The concerns raised by the two papers of a carbon tax in New Zealand can be summarised into two broad negative implications, welfare affects and implications on economic performance. Where Creedy and Sleeman (2006) raised concern with regards to the social implications that carbon tax could have in New Zealand, while Scrimgeoura *et al* (2005) considered the possible reductions in economic performance.

The New Zealand government decided to attempt to reduce its emissions to 365 million tonnes of CO_2 equivalent prior to its first commitment period of 2008–2012, through the implementation of a carbon tax in May 2002. (Scrimgeoura *et al* 2005: 1443). The revenues generated by the tax were not going to be used as a supplement for government coffers, but to rather be recycled in a way to further help reduce carbon emissions in New Zealand and alleviate any social implications that may have arisen (McKibbin and Pearce 1997:60). Essentially, the decision to implement a carbon tax was based on the intention to reduce carbon emissions levels to New Zealand's 1990 levels as agreed upon by the Kyoto Protocol.

Carbon taxation, as the favoured market based approach by government, was widely opposed and ETS proposed as a viable alternative. Beard (2007: 1) stated that "a carbon tax would collect around $500 million per annum, impact on all New Zealanders, and do little to reduce emissions. Fifty per cent of New Zealand greenhouse gas emissions come from agriculture and 20% comes from transport, a carbon tax will not have much impact on reducing our increasing greenhouse gas emissions". Beard (2007: 1) continued that 70% of New Zealand energy is renewable, including hydro power, wind, geothermal and biofuels; furthermore, only 7% of greenhouse gas emissions are generated by thermal electricity and 14% produced by industry and manufacturing. The implication here is that a carbon tax would therefore only have a small positive impact on actual greenhouse gas emissions and a large negative impact on the business economy. Consequently, carbon taxation was abandoned in 2005, due to the reason that the costs of the tax, particularly towards business competitiveness outweighed the limited impact that it would have on reducing GHG emissions (Myer 2005: 1).

In addition to the above mentioned economic costs, Creedy and Sleeman (2006: 344) found that households with relatively low total expenditure levels would spend a proportionately greater amount of their income on carbon intensive commodities such as petrol and domestic fuel and power. However, Creedy and Sleeman (2006: 344) also stated that the carbon tax would not have had any significant impacts on inequality or welfare redistribution. Scrimgeoura *et al* (2005: 1447) made an important consideration that “policy instruments such as a carbon tax would adversely affect capital stocks”. The reduction in the economy’s capital stock would lead to reductions in GDP *ceteris paribus*, household consumption (an indicator of welfare change), exports and investment. This highlights the existence of some important tradeoffs which require consideration by policy makers.

This New Zealand experience of making a decision on implementing a carbon tax as a primary method of reducing GHG levels raises a number of important considerations, such as the welfare implications that a carbon tax would have on low-income households. Also, the amount of GHG that could actually be reduced by the carbon tax, including the amount of renewable energy the country produces in comparison to thermal; and the competitive implications and lastly the effects on the countries capital stock.

4.2 The Case of Recycling Carbon Tax Revenues in Mexico to alleviate distributional and welfare concerns

Höhne, Blum, Fuglestvedt, Skeie, Kurosawa, Hu, Lowe, Gohar, Matthews, de Salles and Ellermann (2011: 372-387) identified Mexico as the 11th largest GHG emitter in the world. Mexico like SA is a developing country and suffers from the same economic and social challenges as most third world countries. However, like South Africa, Mexico is considered one of the fastest developing emerging economies, primarily due to it being the sixth largest oil exporter (Black 2012b: 1). Despite the fact that Mexico is a developing country and, by Kyoto protocol standards, is not required to reduce its GHG emissions, Mexico recently committed to implement long-term climate change targets into its national legislation. Currently, the United Kingdom and Mexico are the only two countries in the world to have done this, the United Kingdom implemented a similar Bill in 2008 (Black 2012b: 1). The national legislation bill towards which Mexico has committed, states the following climate change targets will help Mexico to reduce the levels of its GHG emissions:

- 30% reduction in emission growth measured against a "business as usual" pathway by 2020, and 50% by 2050,
- 35% of energy to come from renewable sources by 2024,
- obligation for government agencies to use renewable energy resources, and
- the establishment of a national mechanism for reporting on emissions in various sectors (Black 2012a: 1).

To help achieve these targets, the Bill provides for the establishment of an ETS as Mexico's primary market based approach (Black 2012a: 1). However, research into the opportunity for a carbon tax as an alternative has also been carried out. As mentioned earlier Mexico is a developing country that faces economic adversities such as poverty, high levels of unemployment and a large unskilled labour force, which may make Mexico more susceptible to the negative effects of a carbon tax option.

Carbon taxation is generally considered to have adverse welfare implications on low income households (McKibbin and Pearce 1997:63). It is regressive in that it negatively affects low income households more than high income households due to the excess burden it places on these households (low income households have to spend a greater proportion of their income on food, when a carbon tax is implemented and food prices are generally increased, which places an excess burden on the poor) (Scrimgeoura *et al* 2005: 1430). Consequently, the dilemma would be implementing a carbon tax in such a way as to avoid these regressive tendencies. A common method promoted is to recycle the revenues generated by the carbon tax back to the low-income households in the forms of a subsidy, grants or other general welfare transfers (Scrimgeoura *et al* 2005: 1431).

In Gonzalez (2012), an analysis of two specific methods of revenue recycling to alleviate the excess burdens placed on low income households by a carbon tax in Mexico was carried out. The first was in the form of a food subsidy, and the second, a manufacturing tax cut. Gonzalez (2012: 1) explained how recycling carbon tax revenue in the form of a food subsidy would be both politically and economically feasible and tractable for a developing country. Recycling carbon tax revenue through the form of a food subsidy would make a carbon tax less regressive by reducing basic food prices for a poverty stricken country. This essentially makes recycling carbon tax revenues through a food subsidy a progressive option.

Gonzalez (2012: 2) explained the other option of recycling carbon tax revenues through the form of a manufacturing tax cut as a less progressive alternative. Although developing countries need to focus on their manufacturing (secondary) sectors in order to further develop, a manufacturing tax cut would not immediately alleviate the regressive effects of a carbon tax. Over time, through increased GDP levels and development, food prices may be encouraged to fall, so reducing excess burdens on low-income households. However, this is purely speculative and has no immediate guarantee to help alleviate the excess burdens. Ultimately, Gonzalez's (2012: 12) conclusion is that recycling carbon tax revenue in the form of a food subsidy would be the most progressive method; it would have a positive effect on low-income households and result in a higher greater reduction in carbon emissions, and achieving its environmental goal. This implies that although a carbon tax in Mexico may have negative implications on low income households, these implications may be avoided and actually improve the standard of living for low income households through the implementation of a food subsidy. As such, carbon taxation as a method of GHG mitigation in Mexico may be considered as an alternative market based instrument.

4.3 The Case of a Carbon Tax in Ireland

Callan, Lyons, Scott, Tol and Verde (2008: 407-412) analyzed the negative distributional effects of a carbon tax in Ireland and how these effects may be improved, through recycling the revenue generated by the carbon tax. They highlighted the fact that generally "green policies" such as Pigouvian taxes were regressive and have distributional implications for poorer households; hence they require policy reform to offset these negative effects. Callan *et al* (2008:408) explained that it was important that greenhouse gas emission policies rectify these negative effects for political feasibility. They used the example of a previous carbon tax policy that was implemented in Ireland in 2004, which was then thrown out by government due to its distributional implications on the poor. Therefore, the challenge faced in Ireland was at what level to set the carbon tax, and how to prevent negative social and economic implications of the tax.

Tol, Callan, Conefrey, Gerald, Lyons, Valeri and Scott (2008:2) explained that the decision of what level to set a carbon tax in Ireland were of no importance, the reason simply being that "a carbon tax in

Ireland will not stop climate change, it was unlikely to have a measurable direct impact on global warming since Ireland's emissions are a tiny fraction of global emissions. A carbon tax was only important to Ireland because it signals Ireland's commitment to international climate policy". Tol *et al* (2008: 5) stated that a carbon tax in Ireland "would be able to yield a double dividend for Ireland, by both reducing emissions and accelerating growth, if the revenue were properly recycled to reduce existing taxes". Tol *et al* (2008: 11) Identified three possible scenarios in which revenue may be effectively recycled to provide a double dividend: 1) the revenue is used to repay government debt (acquire financial assets); 2) the revenue is used to reduce income taxes and 3) the revenue is used to make a lump sum tax rebate to all residents.

Tol *et al* (2008: 13) explained that manufacturers in Ireland are price takers, consequently, if a carbon tax were implemented in Ireland alone, the manufacturing sector would still face the same prices as the increased production costs would not be able to be shifted to the end consumer. Hence, this would reduce the manufacturing sectors profitability and its competitiveness. However, local firms in the Irish markets are price setters and so would be able to pass on the tax burden to final consumers, which would have negative effects on consumption and reduce market output. However, Tol *et al* (2008: 14) explained that the loss due to the decreased competitiveness in international markets for manufacturers (exports) would be partially offset by the reduction in imports (inputs for manufacturers) due to the increased price on these inputs (the carbon tax) and the small increased price of the exports. Thus, the economic impact of a carbon tax in Ireland (excluding revenue recycling) would not be very significant.

If the Irish government were to decide to recycle carbon tax revenues through investing in financial assets, Tol *et al* (2008: 15) found that gross national product would have risen due to the increased revenues created by the investment of the carbon tax revenue. Furthermore, because of the majority of the manufacturing sector having foreign ownership, a large percentage of the carbon tax burden would fall on foreign capital. In addition to this, a double dividend would occur in which emissions reductions are also reduced due to the decrease in manufacturing output and the incentive to use cheaper alternative sources of energy. However, the alternative scenario in which the Irish government recycles all carbon revenues into debt repayment has a different result, where no double dividend is experienced.

Tol *et al* (2008: 15) then provided an alternative scenario for revenue recycling through decreasing income taxes which would create distortions within the labour market due to supply implications. They explained the logic of this as follows: a decrease in income taxes would increase the supply of labour and, through labour negotiations, lead to a decrease in the nominal wage rate to equate labour supply to labour demand. This, in turn, would lead to a small decrease in consumer prices as production costs are reduced and hence an overall increase in disposable income and consumption. Due to the highly elastic nature of Ireland's labour supply, the majority of the carbon tax incidence would fall on employers. This implies that if employers try to reduce nominal wage rates, employees may quit. As a result of this, the manufacturing sector would be encouraged to substitute factor inputs for increased labour due to the increased input costs created by the carbon tax. The increase in labour would result in an increase in output and therefore a rise in the volume of exports and gross national product (Tol *et al,* 2008: 15).

Tol *et al's*(2008: 17) last alternative channel of effectively recycling carbon tax revenue is through a lump sum tax refund to households. This method of revenue recycling has no labour market implications due to the nature of the refund. A tax refund would lead to an increase in disposable income and consumption. However, this increase in consumption would mainly be in imports for mid to high income households and food for low income households and, for this reason, will not affect the manufacturing sector. There would also be a modest increase in output in market based services due to the increased consumption. The net result would be an increase in gross national product.

Tol *et al* (2008: 19) provided a summary of how the three channels for revenue recycling differ and which would be the most effective for Ireland. With regards to investing revenues or repaying of government debt, there is no possibility of a double dividend. If the revenue were to be recycled through a lump sum tax refund, there would be no labour market distortions and consequently a lower increase in GNP. This lowers the possibility of double dividends and that's why is seen as a less viable option. The most successful option would be to recycle revenues through a decrease in income taxes. The reason for this is due to the labour market distortions that arise. The positive effects of the labour market distortions on the manufacturing sector gives rise to increased output volumes and exports. This essentially improves GNP and creates a strong double dividend. Interestingly, Wissema and Dellink (2007: 671 - 683), in a paper similar to that of Tol *et al* (2008), found that the possibility of a double dividend to be highly unlikely. Although Wissema and Dellink (2007: 680) strongly agreed that recycling carbon tax revenue by reducing income taxes were certainly more effective than providing lump sum tax refunds, the possibility of a double dividend was found to be optimistic. Furthermore, they stated that given the Irish governments history in implementing environmental policies, there was insufficient trust that the government would keep its promise to recycle the revenue from the tax by lowering other taxes

Callan *et al* (2008: 407 - 412), provided similar results to Tol *et al* (2008: 1-44) and Wissema and Dellink (2007: 671 - 683) with regards to how carbon tax revenues should be recycled in Ireland. Callan *et al* (2008:408) used data from the 2007 household survey in Ireland and found that a carbon tax in Ireland would indeed be regressive. The following findings were presented by Callan *et al* (2008:408):

1) In Ireland, the richer households had on average, 8 times higher disposable income than poorer households and emitted only 37 percent more carbon dioxide.
2) The top decile uses only 26% more electricity than do the bottom deciles.
3) The big difference between income deciles is in motor fuels: the top deciles use 132% more than the bottom one.

The implications here are split between rural and urban households. Due to the fact that rural households tend to be larger and further away from work, they require more electricity to run and more fuel to get to work, meaning, they would be more heavily impacted upon by a carbon tax.

To rectify these carbon tax implications, Callan *et al* (2008:410), suggested implementing a social welfare package through revenue recycling of carbon tax revenues collected. They explained how the social package would only benefit those who qualify, such as pensioners, the unemployed, people with short-term illness and long-term disability and one parent families. In addition, Callan *et al* (2008:410) also suggested an income tax adjustment that would help the poorer household's income distribution. Their first suggestion considered increasing the tax credit rate in Ireland to prevent the lower income households from being included in the low income tax brackets. This would specifically only help the bottom income deciles of Ireland and, hence, only those most adversely impacted. Their second suggestion regards providing a tax cut within the lower deciles income tax bracket by 0,5%. This again would only help lower income households and those most adversely affected (Callan *et al* 2008:410).

The results provided by Callan *et al* (2008:411-412) simply show that although a carbon tax is regressive, a well-structured social welfare package and tax adjustments can offset these negative impacts. Such a package in Ireland would only consume 80% of the revenues collected from the carbon tax (Callan *et al* 2008: 412). However, the social welfare package and tax adjustments only offset these negative effects for the lower half of the income distribution in Ireland, consequently more than half the population will not benefit from either tax adjustments or social welfare packages.

4.4 The Case of a Carbon Tax in Norway

Bruvoll and Larsen (2004: 501) stated that Norway has been one of the most devoted advocates for ambitious climate policies. Norway, a pioneer in carbon taxes, implemented the highest carbon tax rate at US$51 per tonne CO_2 in 1999, when the current global average carbon tax was US$21 per tonne CO_2. This means that Norway has implemented some of the highest carbon tax rates in the world, in an attempt to combat climate change (Bruvoll and Larsen 2004: 501). However, they explained that even though Norway has an aggressive carbon tax policy, the carbon taxes have surprisingly not been that successful. With emissions of CO_2 increased by 19 percent from 1990 to 1999, Bruvoll and Larsen (2004: 501) identified the most important emission reducing factors in Norway as the efficient use of energy and the substitution towards less carbon intensive energy, rather than its aggressive carbon tax policies. However, they continued to argue that it was the aggressive carbon tax policy that actually encouraged these important emission reducing factors.

A recent example of Norway's commitment to climate change policy and its Kyoto protocol target is the recent increase in Norway's domestic oil production taxes. Norway has doubled the carbon dioxide tax rate for its offshore oil and gas production in 2013, from 210 Norwegian Krone to 410 Krone (or €28 to more than €55) per ton of CO_2 (Shuetze 2012: 1). Considering that oil is a major energy resource in Norway and a large export, doubling taxes on off shore oil may affect these exports. Furthermore, Norway has set ambitious targets for it to achieve the Kyoto Protocol targets and to encourage other nations to follow suit. In its White Paper on climate change policy released in 2011, it states that:

- Norway will fulfil and exceed the Kyoto commitment within the first Kyoto Protocol commitment period by 10 percentage points.
- In the period up to 2020, Norway will commit to cutting global emissions of greenhouse gases equivalent to 30 per cent of Norway's emissions in 1990.
- Norway will be carbon-neutral in 2050 (Norwegian Ministry of the Environment 2011: 5).

Given these ambitious targets, Norway has the difficult challenge of achieving these goals. Increasing carbon taxes on carbon dioxide rates may help reach this challenge but may also have social and economic implications as well.

Godal and Holtsmark (2001: 622-653) looked at carbon taxation in Norway along a sectoral dimension rather than an income dimension. They acknowledged that carbon taxes in general have a proportionately greater impact on the low-income households due to a larger share of their available income spent on energy in comparison to high-income households. However, their main concern was on the proposition of changing the current tax regime to make it more economically efficient and more evenly distributed. The reasoning for this was that carbon taxation tends to be influenced by various organizations that represent specific economic sectors (Godal and Holtsmark 2001: 654). This means that various sectors tend to be taxed more heavily than others due to the influence that government has over those sectors and the revenue transfers made to government associated with those sectors whereas other sectors were completely exempt from Norwegian carbon taxes.

Godal and Holtsmark (2001: 653) provided an understanding of how carbon taxation could be made more efficient in Norway. Generally, sectors that face a higher carbon tax tend to have a greater incentive and make more of an effort to abate their emissions, whereas sectors that face a lower carbon tax have a lower incentive and therefore, make less of an effort to reduce their emissions. Where economic efficiency is improved, a sector has the ability to abate the emissions that have a lower marginal abatement cost than the tax imposed on that sector (Godal and Holtsmark 2001: 654). Economic efficiency is improved, in this sense, when the total costs of reaching an emissions target are reduced.

Godal and Holtsmark (2001: 654) highlighted several significant factors that the Norwegian government took into consideration in developing their current carbon tax scheme, which makes the tax unevenly distributed and, hence, less economically efficient:

1) Internationally competitive process industries seem to be more protected against taxation in general because politicians fear that at least parts of the industry would move abroad if taxed;
2) Rural areas in Norway are home to most processing industries and tend to be exempt from carbon taxes to protect the population levels in these areas. It was explained that these areas votes have more weight in parliamentary elections and thus a large influence over Norwegian politicians; and
3) The influence particular interest groups are able to exercise on policy formation.

Considering the above, the government in Norway made heavy exemptions and tax reductions for certain sectors in Norway. Godal and Holtsmark (2001: 656) proposed the removal of these exemptions and reductions, suggesting three possible alternative carbon tax schemes, which would be more economically efficient and evenly distributed over all sectors. The first simply taxed all sectors on CO_2 emissions only, the second on all Kyoto Protocol gases and the third on all Kyoto Protocol gases excluding methane emissions from agriculture and waste, nitrous oxide emissions from agriculture, and evaporation emissions from crude oil and solvents. The idea in each scheme was to provide a uniform tax over all sectors, so eliminating all government influenced exemptions. How this would be more economically efficient was in the extra estimated revenues that would be collected and recycled to reduce these costs. Under the current tax scheme, revenue that remained uncollected just for the exemptions on coal and coke was estimated at US$ 285 million (Godal and Holtsmark 2001: 656).

However, even with a more economically efficient carbon tax scheme which was evenly distributed, Godal and Holtsmark (2001: 660) and Bruvoll and Larsen (2004: 501) found that implementing these new schemes also had some adverse impacts on the economy. They both stated that a broad uniform tax would place a heavy burden on the industrial sectors international competitiveness, resulting on some industry having to leave Norway, reducing jobs and employment. Godal and Holtsmark (2001: 661) and Bruvoll and Larsen (2004: 501) provided similar recommendations for countries that may be deciding to implement a carbon tax:

1) For international industry, co-ordination in an international carbon tax standard should be implemented, which would prevent their competitiveness from being affected by a carbon tax being implemented domestically in one country and not others; and
2) If a carbon tax is to be implemented in a country, it should be implemented on a uniform broad scale, starting with a low tax that rises gradually, as opposed to a high tax implemented on a specific industry only. The reason for this is that in Norway to achieve cost effectiveness, it was found that increasing the initial existing tax across the entire sector is easier than including new sources which were previously exempt.

Godal and Holtsmark (2001: 661) share a closing remark with regards to the use of a Pigouvian tax as a tool for carbon abatement, “even though green taxes are commonly known to be an efficient instrument to achieve environmental goals in a cost-effective manner, evidence from Norway and other countries shows how political barriers often function as obstacles in the process of adopting such policies. This phenomenon is sometimes explained by the change in distribution of income that green-tax reforms can give rise to”.

4.5 Case Study on an Emissions Trading Scheme

As mentioned earlier, the EU ETS is the world's largest and most important emissions trading scheme to date, its value of allowances has grown from $8 billion in 2005, to over $120 billion in 2010 (UN, 2010: 24). The EU ETS was initiated in 2005, as the most cost effective way for EU states to meet their Kyoto protocol obligations, in reducing greenhouse gas emissions (Wen-Cen 2011: 114). Essentially, the scheme should allow the EU states to reach their obligations at a cost of between €2.9 and €3.7 billion annually (METI 2010: 1). The EU ETS is based on six fundamental principles:

- It is a 'cap-and-trade' system
- Its initial focus is on CO_2 from big industrial emitters
- Implementation is taking place in phases, with periodic reviews and opportunities for expansion to other gases and sectors
- Allocation plans for emission allowances are decided periodically
- It includes a strong compliance framework
- The market is EU-wide but taps emission reduction opportunities in the rest of the world through the use of CDM and JI, and provides for links with compatible schemes in third countries. (METI 2010: 1)

The EU ETS has been developed through a "learning by doing" approach, over a period of three phases Ellerman and Joskow (2008: 10). The phases correspond to the following years respectively: phase 1; 2005-2007, phase 2; 2008-2012 and phase 3; 2013-2020. Wen-Cen (2011: 114) explained that each phase has three policy instruments, namely: regulatory/voluntary, market-based instrument, and penalty/subsidy, to reinforce and integrate its ETS systems. Wen-Cen (2011: 114), described regulatory/voluntary policy as "providing important information in constructing the ETS and supporting regulations for market based instruments". Essentially, this is simply the provision of raw data on which to build a carbon trading platform. The actual carbon trading within a market, including setting of allowances, banking, borrowing and offsetting carbon credits, falls under the market based instrument policy (Wen-Cen 2011: 114). The third policy, penalty/subsidy, provides the ideal incentives to commit to emissions allowances. If allowances are exceeded, a penalty is enforced and subsidies are used to encourage participants not to do so. Therefore, the third policy is the most crucial in helping participants to achieve emissions targets.

Table 4.1 illustrates the EU ETS three phase plan, and specifically the policies mentioned earlier. Regarding allowances, the EU ETS made use of a grandfathering approach in phase 1; this is a method for the setting of a total target allowance based on previous emission results. In phase 2, the benchmark approach was used, which is a method that involves the setting of a total target allowance by establishing a benchmark intensity level for each industry or product, and multiplying that by the production allowance for each company. The EU ETS also carried out an auctioning method during all 3 phases, which allowed the EU ETS to sell emissions allowances from respective businesses mentioned above, to the government at a charge.

4.6 Allocation, Registries and Enforcement of the EU ETS

Petersen and Klepper (2008: 4) explained that each member state that made up the EU ETS are in control of their own distribution of allowances, operation of the registries for tracking allowances and emissions, and the monitoring, reporting, and verification procedures that underline enforcement. However, Ellerman and Joskow (2008:4) highlighted that each state was also provided with certain criteria and coordinated by procedures established by the European Commission. This means that the 27 independent members comprising the EU ETS have agreed to make the system work by conforming to a system of criteria and procedures and trading their allowances.

With the national allocation process (NAP), each member state proposes and justifies its allowances for the trading period (Clò 2008: 6), which implies that each state allocates its allowance amongst its installations as it sees fit. “Each member state also maintains its own registry to record the creation, transfer, and surrender of allowances; however, a high degree of uniformity is maintained through the Registries Regulation” (Ellerman and Joskow 2008:5). With regards to monitoring and reporting, as mentioned above, it is the responsibility of each member state to do so. Ellerman and Joskow (2008:6) explained that reporting, capturing and monitoring of trade transfers, sales and purchases are done very similarly to how a company’s finances are recorded. The transactions are recorded and audited by an external party. This would then be passed on to the national registry to ensure enforcement.

Table 4.1: The Regulatory and Voluntary Rules, Market Based Instruments Used and the Penalty and Subsidy that Each Phase Incurred (as discussed earlier)

	PHASE 1	PHASE 2	PHASE 3
REGULATORY OR VOLUNTARY			
Scope	27 EU member countries	Operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway)	EU Member States and participants in EU ETS
Coverage	CO_2	Covers only CO_2, but member states can "opt in" other gases. For example, Netherlands and Australia have opted to include nitrous oxide (N_2O) emissions from some specific installations	As Phase II, additional gases such as N_2O, per fluorocarbons (PFCs) will be added
Sources	Power stations, combustion plants, oil refineries, coke ovens, Iron and Steel, cement, glass, lime, brick, ceramics, pulp and paper	As Phase I: Power stations, combustion plants, oil refineries and iron and steel works, cement, glass, lime, bricks, ceramics, pulp, paper	As Phase II, perhaps expanded to petrochemicals, ammonia and aluminium industries
Mandatory/ Voluntary	Mandatory	Mandatory	Mandatory
Participants	Emitters	Emitters	Emitters
Target	Cap-and-Trade	Cap-and-Trade	Cap-and-Trade
Timescale	2005-2007	2008-2012	2013-2020
Reporting and Monitoring	YES	YES	YES
New entrant reserve	YES	YES	Yes: Up to 300 million allowances for the new entrant reserve; will be used to support the demonstration of carbon capture and storage (CCS) and innovative renewable technologies.
Unit	1 metric ton CO_2-eq	1 metric ton CO_2-eq	1 metric ton CO_2-eq

MARKET-BASED INSTRUMENTS			
Allowances	Free of charge: 95% Most commonly used grandfathering; rarely adopted benchmarking. Auction: 5% can be auctioned; only Denmark chose to auction full 5%.	Free of charge: 90% Most of the participants used of benchmarking, but this using almost entirely in the power sectors. Auction: Can auction up to 10%; only 11 Member States have decided to use auction.	Free of charge in industry: Benchmark: 1. set on the basis of the average of the top 10% of most GHG efficient installations 2. Sectors which have 100% of allowances are deemed to be the group that have high possibility to relocate outside the EU due to the carbon price Auction: At least 50% of allowances will be auctioned from 2013, but the auction of allowances in power sectors will be up to 100%
Banking	In principle, No. (Allowed in some countries)	YES	YES
Borrowing	NO	NO	NO
Offsets	Yes: CDM(excluding forestry)	Yes: CDM(excluding forestry) JI	Yes: CDM and JI may be continued, but the requirement of reducing emissions should be accomplished by renewable energy or resources after 2020,on condition of having international agreement
PENALTY AND SUBSIDY			
Financialincentives	N/A	N/A	N/A
Penalty	Yes: €40 Shortfall to be made up in the following year	Yes: €100 Shortfall would be made up	The excess emissions penalty of allowances issued from 2003 onwards shall increase in accordance with the European index of consumer prices

(Adapted from Wen-Cen 2011: 115-116)

4.7 Results of the EU ETS Phases

During the first phase (2005-2007), the EU ETS allocation policy was too relaxed due to the grandfathering methods used (Meti 2010:11). The end result for the first phase was a reduction in emissions by 8, 3% in 2007compared to 2005 levels. Ellerman and Joskow (2008:6) noted that during the first phase, banking was not allowed, so all the excess emissions generated in high energy consumption sectors such as energy conversion, iron and steel, cement, and paper/pulp, resulted in the carbon price falling sharply.

However, in the second phase, Meti (2010:12) depicted a different outcome, showing that the EU ETS reduced carbon emissions by 11, 6% compared to 2008 levels. The main explanation for the decrease in emissions, provided by Ellerman and Joskow (2008:7), is that from 2008, the financial crisis that occurred created a substantial decrease in demand, especially for products from high energy consumptions sectors. This was primarily because of deteriorating economic conditions, creating a liquidity shortage.

Displayed below, is a table showing high energy consumption sectors and their performances in emissions reductions for phase 2.

Table 4.2: Phase 2 Consumption Sectors Allocations and Corresponding Emissions Results (MT-CO_2)

	Allocation	Emissions results	Excess/shortfall
Power sector	**1181.1**	**1414.7**	**-233.6**
Total for sectors other than power	**645.4**	**559.2**	**86.2**
- Cement	204.5	181.3	23.2
-Oil refining industries	147.5	149.5	-2
-Iron and steel	179.2	128.4	50.8
-Paper pulp	36.5	30.7	5.8
-Other	77.7	69.3	8.4

(Adapted from METI 2010:12)

As can be seen above, phase 2 resulted in most industries achieving their targets, excluding the power sector and oil refineries. However, although the results for the second and third phases may appear positive and display effectively operating EU ETS, there are important controversies and issues that have risen.

4.8 Controversies and Fraudulent Issues Regarding the EU ETS

Two main controversies regarding the EU ETS that are highlighted by Ellerman (2008:28) were the issues of: "windfall profits" and "overallocation".

Windfall profits is a concern raised by the member states of the EU ETS, that the free allocation of allowances to the power sector has resulted in higher electricity prices, which ultimately has lead to the power sector making higher profits (this is explained below) (Ellerman and Joskow 2008 and Benz, Löschel and Sturm 2008: 6).

An important reason for the use of free allocation through grandfathering allowances was to protect the power sector through its transition in becoming liberalized and to encourage ETS sectors and non ETS sectors to take part within the EU ETS market.

Convery, Ellerman and De Perthuis (2008: 12) explained that with the free allocation of allowances, there was indeed a problem with windfall profits during phase one of the EU ETS. Ellerman and Joskow (2008:24), however, defended the EU ETS through their explanation that EU member states, at the time of implementing the EU ETS, during phase 1, were adopting various policies to "liberalize" wholesale and retail electricity markets. Essentially, member states were going through the process of making their power sectors more competitive in providing power to residential, commercial and industrial sectors, while at the same time launching the EU ETS to reduce carbon emissions by 2020 to honour their Kyoto Protocols. Deregulation of the power sectors implies that from 2020 generators of electricity would have to cover their own marginal costs of production through the market value received for electricity. Thus, this market value would have to cover the cost of CO_2 emissions allowances in its price, which would be passed onto consumers through electricity rates. Therefore, although the price of power did indeed rise, it was not due to the fact that electricity providers received free allocation allowances, but rather due to the deregulation of the power sectors.

Over-allocation, as mentioned above, means that the member states who have independence in assigning these caps, issued too many allowances, which essentially leads to the emissions cap in the EU ETS being non-binding. Essentially, the ETS emissions cap would have exceeded the theoretical ETS cap that was imposed on the ETS sectors (Clò 2008: 4). At the same time, an inconsistency arises with the issue of over-allocation. Over-allocation means that the caps set on each sector were to lax, which implies that it should have been set at a tighter level. If this had actually been done, the result would have been a higher electricity price due to the limit on CO_2 emissions in the power sector.

Regarding this issue, there were a number of studies carried out to determine whether this was the case for phase one of the EU ETS, (Gilbert et al 2005; Betz et al 2006 and Schleich et al 2007). An important contribution was provided by Ellerman and Buchner (2006), who compared the ETS verified emissions to the ‘Business as Usual’ emissions level of 2005 and found that both the ETS cap and the amount of emissions produced by the ETS sectors had been lower than the chosen benchmark, concluding that permits had not been over-allocated during the first phase. However, there does exist a certain level of controversy regarding Ellerman and Buchner’s (2006) findings. Grubb and Ferrario, (2006) contested their findings, stating that certain data used could never actually be observed, i.e. certain business as usual and benchmark data. Consequently, the amount of emissions that ETS sectors were producing before the first ETS phase is unknown and thus makes benchmarking emissions biased. The result of this is simply that, it is difficult to disprove or prove over-allocation.

The over allocation of allowances could lead to the carbon credit price taking a downward spiral as credits are over supplied. Convery *et al* (2008: 12), however, explained that during the first phase of the EU ETS, the emissions reductions goals set were very low, 1-2% and that under the first phase, each member state had to submit national allocation plans under a very short time frame. Essentially, the first phase was more of a trial phase with regards to achieving reductions goals (Ellerman and Joskow 2008:31). However, the second phase took on a more aggressive reductions goal and achieved better results.

Although, windfall profits and over allocation seem unfair and counterproductive to the abatement of carbon emissions, free allocation is a necessity and important part in initiating an ETS. Free allocation through grandfathering encourages non-ETS sectors to join and for this reason, cannot be avoided. The only alternative is through auctioning initial allowances, which would discourage participants from engaging in the market. Free allocation usually results in both over allocation and windfall profits from being experienced due to regulators (through the national allocation plan), over-compensating on allowances for their ETS sectors. This over-allocation also provided additional encouragement for participation in the first phase.

Although over-allocation was important to achieving the goals of the EU ETS, it can be resolved by ensuring that aggressive goals are set, which in turn limits the amount of allowances which could be auctioned in the future. Limiting these allowances would also prevent the carbon price from falling and makes the price more stable and keeps carbon credits in demand. Furthermore, auctioning allowances as opposed to grandfathering, as done in the first "trial phase", provided government with important revenues, which could then be used to ensure the process is effective and efficient.

In addition to windfall profits and over-allocation, a range of other fraudulent activities took place within the second phase of the EU ETS, which were a result of poor monitoring and regulation of information. Table 4.3 provides a detailed description of a few of these incidents.

Table 4.3: Carbon Market Fraud in the EU ETS

Date	Description of Fraud
January 2011	Discovery of an EU ETS-wide theft of €45 million worth of EU allowances leads to the closure of national carbon registries, the suspension of spot trade, and the implementation of an EU-wide upgrade of registry security.
November 2010	Incident of unauthorized access to EU ETS registry accounts in Romania results in the theft of 1.6 million EUAs.
November 2010	German Registry closes due to Trojan virus Nimkey.
March 2010	Hungary sells CERs that had already been surrendered to it under the EU's emissions trading scheme. In response, the EU amends the registry regulations to prevent CER recycling.
September 2009	European Commission proposes measures for a consistent response to deal with VAT or carousel fraud detected in the market in 2009–10.
January 2009	The widespread phishing attack on users of EU ETS registries prompts the EU to revise Internet security guidelines.

(Adapted from - World Bank 2011:40).

The root of all these fraudulent activities lies in the structure of the EU ETS through its independent registries. These registries within each member state were being preyed off of by highly skilled "cyber hackers" and thieves. The problem with having decentralized registries is the control and monitoring of information and transactions, being widespread and easily accessible. The response by the EU ETS was to create a single registry, regulated by the EU ETS Commission that would centralise each member state's registry, and henceforth carry out all registry operations in their stead. This way the EU ETS "would be protected from insider trading and also have control over the exchange of information, and supervision of markets in greenhouse gas emission allowances, electricity, natural gas, and their derivatives" (World Bank 2011:40).

4.9 Synopsis

The first section of this chapter uses a multiple case study analysis of the regressive economic and social implications of a carbon tax in various countries. Case study analyses were conducted on New Zealand, Mexico, Ireland and Norway. Regarding these regressive social and economic implications, methods of carbon tax revenue recycling as possible remedies were discussed. The second section covered the implementation of the EU ETS. Specifically how the EU ETS was implemented in three phases and the results of each phase. Controversies that were experienced in each phase of the EU ETS and their possible solutions were then discussed.

These findings will then be used as a comparison to what other economists have found regarding the economic and social externalities that may arise through the implementation of a carbon tax in South Africa and the available means of remedying these externalities through revenue recycling. Furthermore, in considering long term mitigation, the controversies experienced by the EU ETS and these may be avoided will be discussed within a South African context.

Chapter 5
Considerations for South Africa Regarding Carbon Abatement Policies and Carbon Revenue Recycling

5.1 Introduction

South Africa's immediate to short term policy in reducing carbon emissions is to implement a carbon tax, effective as of 2013, its medium to long term policy (under research) is the use of a carbon market (DEAT 2011: 41). The IMF (2011: 3) identifies both methods of mitigation as suitable for the pricing of carbon. A carbon tax or ETS in South Africa would reduce carbon emissions through two effects. The first would be through a demand effect, reducing energy demand through higher prices. The second a substitution effect, substituting from more to less energy intensive fossil fuels (Winkler and Marquard 2011: 55). Such policies would help South Africa contribute to the global effort in mitigating climate change. However, implementing these policies would also cause adverse economic impacts such as falling GDP, employment and welfare effects (Pauw 2007: 34). Such negative effects may be worse than the very externality being rectified by the tax. In South Africa's situation as a developing country, that already faces many economic challenges, these negative implications would make South Africa worse off and discourage the need to reduce carbon emissions. Hence, the importance of revenue recycling to reduce these negative effects and ensure that these policies do not only achieve the target of reduced carbon emissions, but also produce positive economic impacts, otherwise known as a double dividend.

In the case of implementing a carbon market, DEAT (2011: 41) announced in its national Climate Change Response White Paper, the DEAT's intention of investigating the feasibility of an emissions trading scheme. This means that an ETS is under consideration but not to be expected for implementation any time soon. The DEAT first needs to implement a carbon tax system and ensure its effectiveness before an ETS could be implemented. In implementing a carbon tax or an ETS, the possible adverse implications on GDP, employment and welfare are generally the same. A carbon tax or ETS will both result in higher energy prices, hence inflation, which reduces the welfare of low-income households. For this reason, the rest of this chapter refers to revenue recycling of both carbon taxes and ETS credits interchangeably. When a tax level of any denomination or amount is mentioned, it may be considered the equivalent to an allowance charged at the same amount. This is because of carbon being priced the same for both a carbon tax and a carbon credit.

The basis of the data used and explanation thereof, in this chapter will be derived from the works of Winkler, Marquard and Jooste (2010), Van Heerden, Gerlagh, Blignaut, Horridge, Hess, Mabuguf and Mabugu (2006), Devarajan, Delfin, Sherman and Karen (2009), with the primary use of Pauw (2007), due to their extensive work and data collection on LTMS and revenue recycling estimates for South Africa. Pauw (2007) used the MARKAL model to forecast the welfare and economic impacts of a carbon tax option on coal, crude oil and gas; the carbon tax level ranged from R250 per ton of emissions in 2008 and increased to R750 by 2050. The alternative methods of revenue recycling considered in the study and to be discussed are a bio-fuels subsidy, a food subsidy, household transfers, an income tax subsidy, a renewable and nuclear subsidy and a value added tax (VAT) subsidy. The results of these studies are compared with the case studies of New Zealand, Norway, Ireland and Mexico, and then discussed below to provide considerations for revenue recycling in South Africa. These considerations are for the implementation and revenue recycling of both a carbon tax and carbon market in South Africa.

The remainder of the chapter suggests considerations for additional implications that may arise in implementing a carbon market as a market based instrument for mitigating climate change in South Africa.

5.2 Externalities That May Arise in Implementing a Carbon Tax or Carbon Market in South Africa

An externality in this case is negative in its nature. Implementing a carbon tax or ETS could have a number of possible negative effects on South Africa's economy and households. The externalities discussed below are the negative implications on GDP and welfare, and the competitive and political concerns of implementing a carbon tax. These externalities and methods of reducing or possibly preventing their effects are discussed below.

5.2.1 The negative implications on GDP and Welfare

When implementing a market-based instrument, two important considerations are raised. The first is with regards to the impact on GDP. A market-based instrument has a negative effect on both fixed and working capital. An increase in energy prices is associated with a decline in energy intensive industry output. Carbon intensive industries, particularly manufacturing industries, constitute a large part of the economy, attract significant local and foreign investment, and contribute excessively to exports (Winkler and Marquard 2007: 12 and Devarajan *et al* 2009: 19).Each of these effects tends to have a negative impact on a county's GDP. The second consideration regards the welfare implications of implementing market-based instruments. A hike in energy prices increases the prices of all goods produced through carbon intensive energy processes. Many low-income households depend upon these goods for survival, hence influencing low-income households' disposable incomes. In chapter 4, Creedy and Sleeman (2006) and Scrimgeoura *et al* (2005) raised similar concerns regarding the implementation of a carbon tax in experienced by New Zealand.

Pauw (2007:38) found similar implications regarding the effects a carbon tax would have on GDP and household incomes in South Africa. A carbon tax in South Africa would essentially affect energy prices and therefore all energy users. Of significant importance are the effects a carbon tax will have on the coal industry. The DEA (2011: 14) stated that the coal industry is the largest emitter of carbon dioxide in South Africa and, consequently, will experience a large negative shock because of the implementation of the carbon tax. Pauw (2007: 35) reports that the coal sectors, particularly the ignite and coal to liquid petroleum sectors will experience massive reductions in output, beginning at a 11.7% and 36.9% reduction respectively at a R25 per tonne level, to a possible 53.2% and 99,6% if a R750 tax per tonne level was implemented. Such reductions in the coal industries impact negatively upon GDP.

Pauw (2007: 65-67) explained that a carbon tax in South Africa would place a significant excess burden upon low-income households. This would be due to the rise in price levels, decreasing real income and therefore reducing low-income households' standard of living. Furthermore, a carbon tax would also affect the unskilled employment sector in South Africa, which would exacerbate this excess burden. This would be largely due to the negative implications upon carbon dioxide intensive industries. However, low income households would not be affected the worst by a carbon tax. High income households are actually affected the most initially, due to their reductions in savings required to make the investments needed to adapt to the changing economy, particularly low emission energy investments.

5.2.2 Competitive and Political concerns

Two important lessons and considerations that Godal and Holtsmark (2001) and Bruvoll and Larsen (2004) raised regarding the implementation of a carbon tax in Norway, were the importance of a broad based tax, beginning at a low level and gradually rising over time to cover the marginal external cost created by carbon emissions and the competitive effects that a carbon tax has on an economy. The

Norwegian government learnt the hard way that there are political implications in attempting to increase the base of a carbon tax. Sectors that are provided with tax exemptions prefer to maintain their exemptions. Hence, the advice provided by Godal and Holtsmark (2001) and Bruvoll and Larsen (2004) is to include all sectors in the implementation of a carbon tax to avoid future political conflict. Furthermore, a carbon tax increases energy prices and, therefore, the cost of production for the manufacturing industry (Garnaut 2008: 3). This has a negative impact on competition for these industries, particularly exporters whose competitors do not incur the same carbon tax (Asselt and Brewer 2010:45).

The competitive implications here are directly related to South Africa's scenario in adopting a carbon tax. Increased production costs due to rising energy prices would have a negative impact on competition in South Africa, particularly regarding the export sector, particularly in upstream sectors (Neuhoff and Mathes 2007: 14). However, National Treasury (2010: 41) addresses this concern for South Africa businesses in its published Discussion Paper for Public Comment on Carbon Taxes. Amongst other proposed solutions, border taxes, possible exemptions and lower rates for certain sectors were suggested by National Treasury.

A border tax would raise the price of all imports to that equal of the same product produced in South Africa, through levying a tariff on imported goods equal to the differential between the local price of carbon and the price on carbon in the country where the imports originated (Winkler and Marquard 2011:20). This would eliminate the competitive advantage of foreign exporters who do not incur a carbon tax, essentially protecting South African local manufacturers. Furthermore, a border tax may provide possible refunds for exports that incurred a carbon tax; however, this was inappropriate as it undermines the intention of taxing all carbon emissions produced.

Border taxes, although a good solution to international competition, faces controversy in terms of the World Trade Organisations guidelines and rules on exercise taxes, "an excise tax on imports can only be imposed if there is an equivalent excise tax on like products in the home country" (DEAT 2010: 41). Although there are counter arguments to this rule, such as the precedent of allowing trade measures to combat global externalities (under the Montreal Protocol), discussed by Frankel (2009) and Bordoff (2009), the implication is that a border tax may create tensions in terms of international trade, and for this reason, made a non-viable alternative.

Making exemptions for industries that are most affected by a carbon tax in terms of international competition, would place South Africa in a similar scenario to Norway's experiences raised by Godal and Holtsmark (2001) and Bruvoll and Larsen (2004) in terms of tax exemptions. Not only would the industries who produce the most emissions receive exemptions, but a window for the possibility of political conflict and distortions in the future would be opened. Industries would protest their inclusion into a carbon tax and exempt sectors would be incorporated in the political voting process. Hence, the idea of a carbon tax exemption for certain industries was disregarded.

A possible, yet highly improbable, solution would be an internationally uniform carbon tax, effectively placing all countries under the same policy and, consequently, eliminating competitive advantages. However, this is an impractical solution as it would be difficult to encourage other countries to adopt a carbon tax policy that would deliberately affect the competitiveness their export sector.

The DEAT (2011: 41) declared the most effective solution for competitive concerns in its National Climate Change Response White Paper, essentially, the implementation of a broad based low carbon tax that gradually increases to cover the marginal external damages of GHG's. Such a carbon tax allows businesses time to adapt to the carbon tax and promotes the gradual switch to less carbon intensive sources of energy to reduce production costs and thus reduce the competitive challenges of the tax.

5.3 Considerations for Revenue Recycling

As mentioned in the previous chapter, the Irish case study provides a number of options for revenue recycling. Ireland's experiences in revenue recycling show that the key to obtaining a double dividend is through the distortion effects on the labour market that the recycled revenues create. The first three options mentioned are recycling revenues by repaying government debt (or making investments), reducing income taxes and making lump sum tax rebates. With regards to all three methods, it was found that in Ireland, reducing income taxes would provide Ireland with a double dividend in implementing a carbon tax. This was primarily due to the labour distortions that arose when income taxes were reduced. The net results of decreasing income tax, besides reducing carbon emissions were increases in employment, output and exports, hence improving GDP.

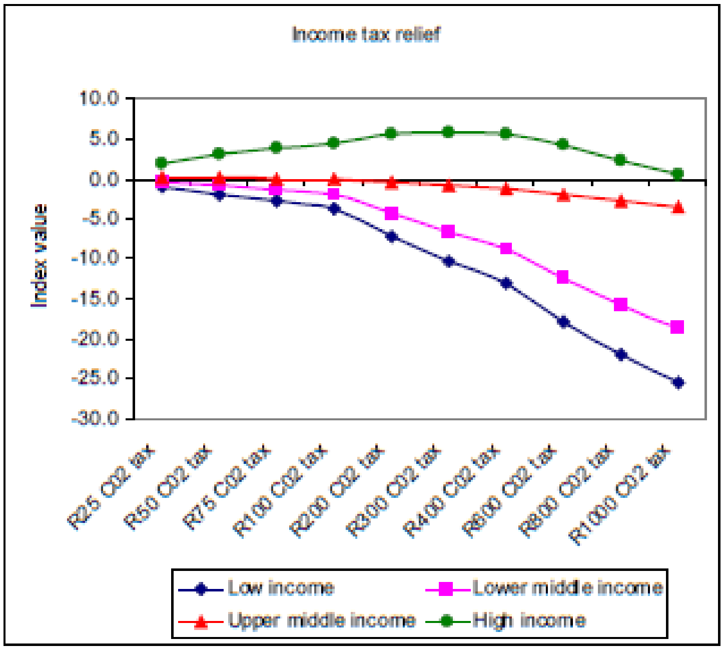
Another two alternatives suggested were an income tax decrease and the provision of welfare packages, both intended for the bottom deciles of Ireland's population. Both alternatives were found to be effective in improving the welfare effects of a carbon tax. Regarding the income tax decrease, two possibilities arose, the first involved increasing the income tax brackets so that the lower deciles did not face income taxes and the second suggestion was a simple tax cut for the lower deciles. The welfare packages included pensions, unemployment compensation, short-term illness and long-term disability and grants for one-parent families.

Two methods of revenue recycling, more in tune to a developing country that faces poverty and high unemployment, is the option of a food subsidy and a manufacturing tax cut. In Mexico, it was found that a food subsidy lowers food prices and thus increases the disposable income of low-income households. Consequently, a food subsidy could be progressively distributed among low-income households, which would reduce the welfare effects of a carbon tax. A manufacturing tax cut, on the other hand, was found primarily to benefit high-income households. This is essentially due to high-income households owning a larger share in manufacturing sectors. However, over time a manufacturing tax cut could improve production and output, leading to trickle down effects of increased GDP, benefiting low-income households through improved employment and development.

As mentioned above, in the Pauw's (2007) report on Long Term Mitigation Scenarios, the options of an income tax subsidy, VAT subsidy, household transfers, food subsidy and nuclear and renewable subsidy were analysed for revenue recycling. Graphical representations of the findings of each option are displayed below in terms of welfare implications. In addition, the potential impacts of each option on South Africa's - GDP is illustrated in figure 5.6 and employment and wage changes, displayed in table 5.1. The options of revenue recycling analysed by Pauw (2007) are analysed in a similar way, to those considered in Ireland and Mexico, regarding their impacts upon employment, GDP and welfare.

5.3.1 Welfare Implications of Revenue Recycling

Regarding welfare implications, it is important to select a channel through which revenue recycling would provide the least harm or most positive benefits to household welfare. Van Heerden *et al* (2006) identified the opportunity to improve household welfare through revenue recycling. Regarding South African environmental policy, it is important to ensure that climate change policies do not impact negatively on the poor, but rather protect the poor. Each channel of revenue recycling mentioned above is analysed in terms of their impacts of the welfare on households below



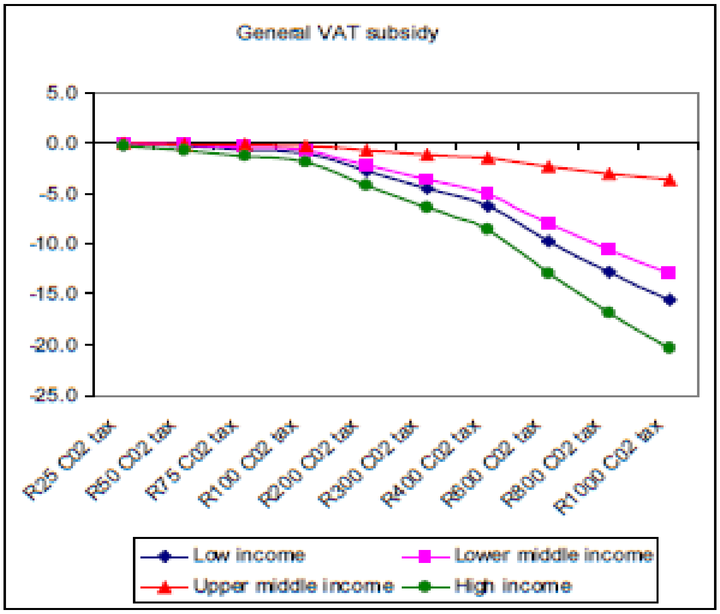
(Pauw 2007: 41)

Figure 5.1 Impact of Revenue Recycling Through an Income Tax Subsidy

In figure 5.1, the results of the welfare effects of an income tax subsidy are shown. An income tax subsidy tends to benefit the upper and middle-income levels of South Africa, with the upper income levels actually benefitting positively and experiencing an increase in welfare. (Pauw 2007: 36) explained that the upper income levels contribute the bulk of income taxes in South Africa; hence an income tax subsidy would benefit them directly. Winkler and Marquard (2007: 87) agree with this by stating that high-income households contribute 67% to total taxes, whereas low-income households only contribute 8.5% to total taxes, thus a tax relief would only benefit high-income households.

Although the middle-income levels do not contribute the bulk of income taxes in South Africa, they stand to gain more from an income tax subsidy than the lower middle and low-income levels respectively. DEAT's (2011: 41) National Climate Change Response White Paper, highlights that considerations for protecting poor income households and avoiding distributional impacts will be made in implementing a carbon tax. Consequently, an income tax subsidy achieves the opposite effect, decreasing the welfare of low income households. An income tax subsidy distributes income towards high-income households and is regressive by reducing the income of low-income households.

Furthermore, the very nature of South Africa's income tax system would prevent low-income households benefiting much from an income tax subsidy. Low-income households that are earning minimum wages are exempted from income taxes. For this reason, low-income households that would have suffered most from increased food prices, due to the implementation of a carbon tax, would have received limited to no benefits from an income tax subsidy.

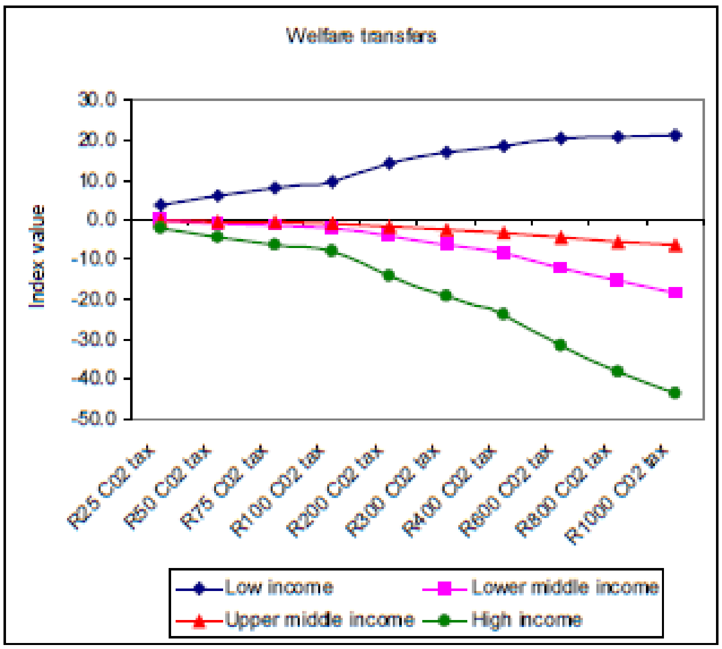


(Pauw 2007: 41)

Figure 5.2 - Revenue Recycling Through a VAT Subsidy

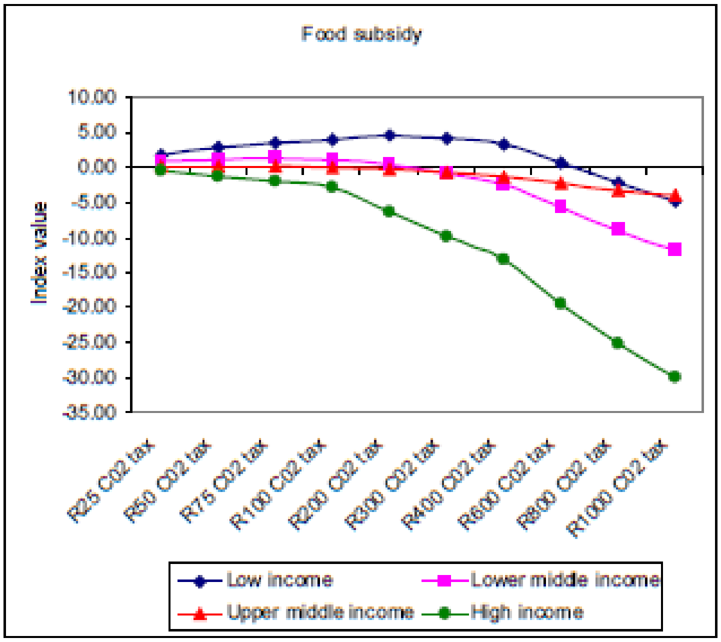
A VAT subsidy (Figure 5.2) does not increase the welfare of any income levels in South Africa. However, it does prevent all income levels from experiencing severe reductions in welfare at the low levels of a carbon tax. This is due to the slight increase in prices of goods from rising energy prices due to a carbon tax being countered by the decreased VAT levels of the same goods. This effect is made redundant once the carbon tax rate passes the threshold of the VAT subsidy. Hence, a VAT subsidy will not protect the low-income and middle-income from the welfare implications of a carbon tax effectively. A similar study conducted by Devarajan *et al* (2009: 22) regarding the reduction of indirect taxes (through processes identified as tax shifting, i.e. reducing other taxes faced by households and providing dividends, essentially returning taxed income), found the same result. Reducing indirect taxes can have a small positive effect on welfare and reduce the negative effects of a carbon tax.

Once the carbon tax level is raised high enough to cross the VAT subsidy threshold, it would begin to benefit the upper middle-income households' more than low, lower middle and high-income households'. High-income households would experience a decline in welfare due to the expensive switching costs they would incur to reduce the increased price of energy they would face. As the carbon tax rises, the running costs of high-income households' business operations would increase, lowering profits and income and, therefore, high-income households levels of welfare. Upper middle-income households, on the other hand, are generally not business owners, but rather highly skilled employees and hence, do not face the same burdens of business owners. From Pauw's (2007) above figure, it can be derived that, the upper middle-income households stand to directly benefit from a VAT subsidy and would only experience a minor decline in welfare as carbon taxes were raised. In contrast, the Low and lower middle-income households would suffer a decline in welfare simply due to the increased energy and goods prices. These households would not be able to afford the level of inflation a rising carbon tax would cause.



(Pauw 2007: 41)

Figure 5.3 - **Revenue Recycling Through Household - Welfare Transfers**

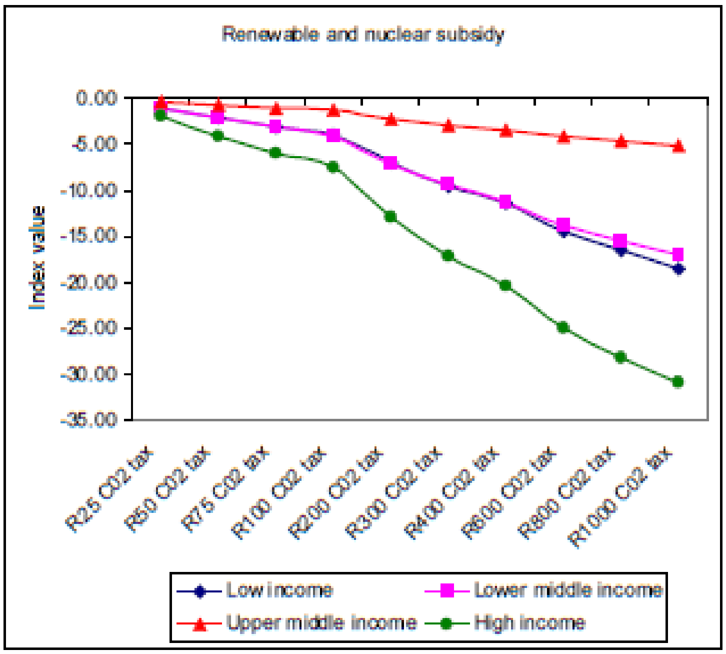


(Pauw 2007: 41)

Figure 5.4 - **Revenue Recycling Through a Food Subsidy**

Figures 5.3 and 5.4 provide two options for revenue recycling that are the best possible alternatives for protecting the poor from a carbon tax in South Africa. These options are a food subsidy, and welfare transfers. In figures 5.3 and 5.4, the welfare effects for low-income households are positive as they experience an increase in welfare from these two options. A food subsidy would reduce the price of food, on which low-income households spend a considerable proportion of their income. Therefore, reducing the price of food would raise their real income and, thus, purchasing power and standard of living. It would allow low-income households to spend additional income on more luxuries or personal development (education, etc), than what they were previously capable. A welfare transfer would have the same outcome. A transfer of income to low income households would again provide additional revenue for additional spending or personal investment, either way low-income households' standard of living will improve.

Interestingly, middle-income and high-income households would both experience a decline in welfare through both a food subsidy and welfare transfers. The reason for this would be due to the natures of a food subsidy and welfare transfers being tailored and intended to improve the welfare of low-income households specifically. Middle-income and high-income households would not benefit a great deal from a food subsidy, because these households are already capable of purchasing the amount of food they need. Furthermore, these households were never directly in jeopardy of not being capable of purchasing their required food if food price levels were to increase due to the implementation of a carbon tax. Hence, any benefits experienced by the reduction in food prices from a food subsidy, would be outweighed by the additional price increases of “other goods”, such as fuel, manufactured goods and imported goods that middle-income and high-income households usually purchase. Regarding a welfare transfer, high-income and middle-income households would not be entitled to such transfers and so derive no direct benefit from welfare transfers.



(Pauw 2007: 41)

Figure 5.5 - **Revenue Recycling Through a Renewable and Nuclear Subsidy**

Figure 5.5 shows that the welfare implications of recycling carbon tax revenues through a renewable and nuclear subsidy would be detrimental for all households in South Africa, regardless of their income levels. A renewable and nuclear subsidy is an alternative which would only provide benefits in the long run once energy prices are reduced through improved renewable technologies. In the immediate future, however, the welfare implications are similar to those of a VAT subsidy without the cushioning that a VAT subsidy would provide at the low carbon tax levels. Furthermore, the negative effects of a carbon tax would be much more severe for all households, which imply that a renewable and nuclear subsidy would offer no protection to the poor whatsoever.

5.3.2 Employment and Wage Considerations of Revenue Recycling

A study conducted by Devarajan *et al*, (2009: 25) found that a carbon tax on carbon-intensive industries, such as coal, crude oil and gas industries mentioned earlier, could have a negative effect on employment of up to 16%. An important point is raised by Van Heerden et al (2006:114) regarding unemployment is the distribution of unemployment. Unemployment in South Africa can be said to be solely made up of unskilled labour in abstract terms (a case of structural unemployment). However there are methods of reducing such effects, which is critical to prevent the growth of poverty in South Africa. Van Heerden *et al* (2006) identified the benefits of an employment dividend (the increase in employment, or decrease in unemployment), through the use of revenue recycling. These potential benefits and in certain cases costs, are discussed below with regards to each method of revenue recycling previously mentioned. Table 5.1, provided by Pauw (2007: 40), is used to illustrate and help explain the effects that each method of revenue recycling would have on employment and wages in South Africa.

In Table 5.1, the employment effects and wage changes of an income tax subsidy and welfare transfers are similar. Semi and unskilled labour incur a decrease, averaging -1% to -4% at the lower levels of a carbon tax. At the higher levels of a carbon tax, employment begins to decline at a much more significant rate for both an income tax subsidy and welfare transfer. Furthermore, the wage changes of highly skilled and skilled labour are negative throughout all possible levels of a carbon tax, from -1% at a R25 carbon tax level to greater than -20% at a R1000 carbon tax level for both an income tax subsidy and welfare transfers.

Table 5.1 – Employment and Wage Changes of Each Option

CO_2 tax		R25	R75	R100	R200	R300	R600	R1000
Renewable and Nuclear Subsidies								
Employment changes	Semi-skilled	-0.4%	-1.6%	-2.2%	-4.1%	-5.5%	-7.7%	-8.5%
	Unskilled	-1.0%	-2.8%	-3.6%	-6.2%	-8.2%	-12.4%	-16.1%
Wage changes	High-skilled	-1.0%	-3.2%	-4.1%	-7.2%	-9.6%	-14.4%	-18.6%
	Skilled	-1.3%	-3.7%	-4.7%	-8.1%	-10.7%	-16.0%	-20.7%
Subsidise Biofuels								
Employment changes	Semi-skilled	0.0%	-0.7%	-1.2%	-3.2%	-5.2%	-10.1%	-14.7%
	Unskilled	0.4%	0.5%	0.4%	-0.1%	-0.9%	-4.0%	-7.8%
Wage changes	High-skilled	-1.2%	-3.6%	-4.7%	-8.8%	-12.3%	-20.7%	-28.7%
	Skilled	-1.0%	-3.1%	-4.1%	-7.8%	-11.2%	-19.3%	-27.2%
Food Subsidy								
Employment changes	Semi-skilled	0.5%	0.6%	0.4%	-0.9%	-2.5%	-7.4%	-12.5%
	Unskilled	0.5%	0.8%	0.8%	0.4%	-0.5%	-4.1%	-8.7%
Wage changes	High-skilled	0.3%	0.2%	-0.1%	-1.5%	-3.3%	-9.1%	-15.9%
	Skilled	0.4%	0.4%	0.3%	-0.8%	-2.4%	-7.9%	-14.3%
General VAT Subsidy								
Employment changes	Semi-skilled	0.1%	-0.3%	-0.6%	-2.0%	-3.5%	-7.5%	-11.4%
	Unskilled	0.1%	-0.2%	-0.4%	-1.2%	-2.2%	-5.4%	-9.2%
Wage changes	High-skilled	0.0%	-0.5%	-0.8%	-2.2%	-3.6%	-7.9%	-12.7%
	Skilled	0.0%	-0.4%	-0.6%	-1.8%	-3.1%	-7.3%	-12.2%
Income Tax Relief								
Employment changes	Semi-skilled	-1.2%	-3.5%	-4.5%	-8.4%	-11.6%	-18.8%	-25.1%
	Unskilled	-1.0%	-2.6%	-3.4%	-6.2%	-8.6%	-14.5%	-20.3%
Wage changes	High-skilled	-1.3%	-3.7%	-4.7%	-8.4%	-11.5%	-19.0%	-26.1%
	Skilled	-1.4%	-3.6%	-4.7%	-8.3%	-11.4%	-18.9%	-26.1%
Welfare Transfers								
Employment changes	Semi-skilled	-1.1%	-3.2%	-4.2%	-7.8%	-10.9%	-17.9%	-24.0%
	Unskilled	-1.0%	-2.6%	-3.4%	-6.2%	-8.6%	-14.5%	-20.3%
Wage changes	High-skilled	-1.4%	-3.9%	-5.0%	-8.8%	-12.1%	-19.8%	-27.0%
	Skilled	-1.4%	-3.7%	-4.7%	-8.3%	-11.5%	-19.0%	-26.3%

(Adapted from Pauw 2007: 40)

The use of welfare transfers as an option for revenue recycling in South Africa, would result in a similar fashion to the example Ireland provided. A dilemma in using revenue transfers is its failure to promote distortions in the labour market, in that transfers neither encourage nor discourage employment. Certain transfers may promote educational development over the long term, however, transfers such as pensions, unemployment compensation, short-term illness and long-term disability and one-parent family incomes, do not promote job creation or provide employment. In South Africa, the skills development levy is a progressive transfer that helps provide skills for the less privileged. Improving the skills of the unemployed would provide them with a chance of employment and therefore, improve the welfare of low-income households. However, the program does not create jobs, but rather provide an opportunity for a person to find one. Alton *et al* (2012: 18) explained that social transfers improve the welfare of low-income households but leads to larger declines in national income. Hence, revenue recycling through transfers may encourage significant welfare effects; nevertheless, the employment effects are pessimistic.

Table 5.1 also displays the interesting effects on the employment of a VAT subsidy. Decreasing the rate of VAT reduces the prices of goods and services. Through the law of demand, a reduction in price implies an increase in quantity demanded, which requires an increase in the quantity supplied to clear the market. This theory implies that by reducing the rate of VAT, there should be an increase in employment. Table 5.1 shows that at the R25 level of carbon tax, employment due to a VAT subsidy does not change by a significant amount (0.1%). The reason for this is simply due to the carbon tax eliminating any impact on price that the VAT subsidy provides. In addition, the market elasticity for demand may not be sensitive to a small reduction in price that a VAT subsidy may provide.

An additional important consideration to be made in choosing a VAT subsidy as an option to recycle carbon tax revenues is the long-term effects on employment. The European Commission (2007: 12) explained that a low VAT rate does not lead to long term increases in employment. Without permanent effects on the labour market, the slight increases in growth tend to recede as higher employment triggers inflation, pressures on profits and higher interest rates. This implies that if a VAT option were to be chosen, any benefits it may provide through revenue recycling would be temporary. Hence, over time poor households would experience the effects of a regressive carbon tax.

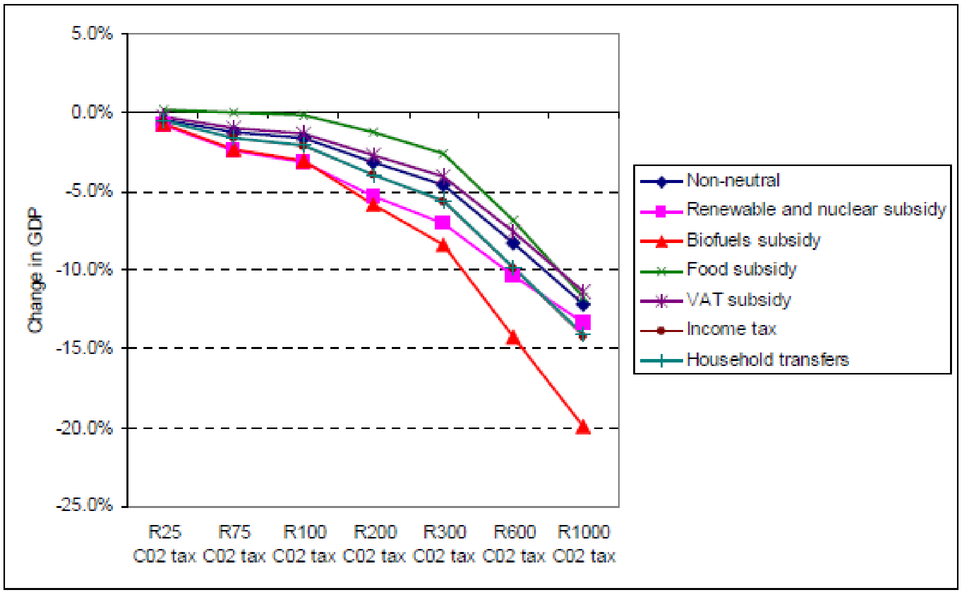
A production subsidy, such as a renewable and nuclear subsidy, intends to increase employment through the increased demand created by the subsidized price of the good. Consequently, there would be employment benefits provided in implementing production subsidies. However, the DEAT (2011: 79) explained that the additional incentive to switch from fossil fuel energy to renewable and nuclear energy, causes a decrease in employment in the coal industry. This fall in employment would outweigh the growth effects provided by the production subsidy as illustrated in table 5.1. However, the DEAT (2011: 79) explained that there is an important consideration to be made in choosing a renewable and nuclear subsidy, which is the benefit of reduced energy prices. Without such a subsidy, energy prices will continue to increase over time as the carbon tax level rises, which would place additional welfare implications on low-income households.

A food subsidy, similar to the food subsidy considered in Mexico, benefits a developing country significantly through providing employment for the unskilled. Agriculture, as the primary sector of developing countries, is a large contributor to employment. If food prices were to be subsidized, the quantity demanded for food would rise. For this reason, a food subsidy would create jobs for a considerable number of the unemployed in South Africa. This is illustrated by the positive effects on employment of the unskilled and semi-skilled in table 5.1. Employment in the unskilled sector is estimated to rise by an average of 0.6% up to a carbon tax of R200. On a similar level, a bio-fuel subsidy creates an analogous impression in employment in the agricultural industry. However, a bio-fuel subsidy would discourage growth in the coal industry, and, therefore, result in a fall in employment in the coal industry, which is also labour intensive. Thus, a bio-fuel subsidy does not create a positive change in employment, as is shown in table 5.1.

A further important consideration is the long-term economic effects of a food subsidy. A market-based instrument, such as a carbon tax, designed to reduce carbon emissions, is intended to rise over time to mitigate the negative marginal damages of GHG emissions. For this reason, as the tax level rises, the price of energy and therefore food will also rise and remove the positive impacts of the food subsidy through the reduction in the quantity demanded for food. Subsequently, employment in the agricultural sector will fall, reducing agricultural output and consequently GDP as well (as shown in table 5.1). This in turn would again reduce the welfare of low-income households.

5.3.3 The Effects of Revenue Recycling on GDP

Figure 5.6, provided by Pauw (2007:38), shows that none of the revenue recycling options provides any positive responses to GDP. A food subsidy seems to the closest positive option. A similar result was discovered by Van Heerden *et al* (2006: 134), where a direct tax break on both capital and labour and an indirect tax break to all households resulted in a poor response for GDP, whereas a reduction in the food price (a food subsidy) had a positive impact on GDP. These issues are discussed further through the various revenue recycling options previously stated in sections 5.3.1 and 5.3.2.



(Pauw 2007: 38)

Figure 5.6 – the Effects on GDP of Carbon Tax Revenue Recycling

Even at a low carbon tax level, an income tax subsidy would have provided no positive increase in GDP (figure 5.6).These results are in stark contrast to those experienced in Ireland. In Ireland, an income tax subsidy had a positive effect on employment and GDP through the labour distortions that occurred. In South Africa, as explained before, the majority of income tax payers are high-income households. This implies there would be a limited distortion in the labour market due to an income tax subsidy. The reason for this is that high-income households would spend their increased disposable income on imports and to a lesser extent locally produced goods. However, the possibility of experiencing a fall in the nominal wage rate is limited due to South Africa's powerful labour unions and their influence on the wage rate, particularly in the primary and secondary sectors Thus, there would be a limited positive impact on GDP. An income tax subsidy would only have a positive impact on GDP if the majority of the population received an income tax rebate. This would encourage increased consumption in the local market and hence increased demand and quantity supplied to clear the market.

Figure 5.6 illustrates the effect a VAT subsidy would have on GDP in South Africa. At a carbon tax level of R600, GDP is expected to decrease significantly by 7.5%. As explained earlier, a VAT subsidy would provide a cushioning for all households up until a certain threshold where the carbon tax level would exceed the VAT subsidy's benefits. However, these effects are very limited and a VAT subsidy has limited to no positive effects on GDP as the carbon tax level rises.

Regarding a renewable and nuclear energy, and a biofuels subsidy, there is a large expected decline in output of fossil fuel energy, specifically coal output and, consequently, a negative impact on GDP. The reason for this is the incentive to switch from fossil fuel energy to alternative energy, which causes a decrease in employment in the coal industry. A fall in employment causes a fall in disposable income and consumption, which, in turn, reduces GDP. Bio-fuels are expected to experience the largest fall in GDP of the two, at a maximum decrease of 20% with a carbon tax of R1000. This is a rate 5% higher than any possible alternative method of revenue recycling. This is because of the poor biofuel technology and the large increase in energy prices that would be experienced if a biofuel subsidy were to be implemented.

Where a food subsidy and welfare transfer was very similar with regards to welfare effects for low-income households, the two options differ very much in the impact on GDP. This largely is due to the employment effects of the two mentioned earlier. A food subsidy, similar to the food subsidy considered in Mexico, benefits a developing country significantly through providing employment for the unskilled. Agriculture, in the primary sector of developing countries, is a large contributor to employment. The boost in agricultural output in turn would encourage a positive impact on GDP. This is illustrated by the small positive increase in GDP at carbon tax levels up to R300. However, as mentioned earlier, the long term positive effects of a food subsidy are diminished by the rising carbon tax levels. The increased carbon tax would continue to increase energy costs and the cost of food production. This would decrease the quantity demanded of food and so the supply of food, reducing employment and thus GDP.

Welfare transfers share the same result as an income tax subsidy in terms of their expected impact on GDP. Because a welfare transfer has no positive impact on employment and, hence, supply, there is no opportunity for a welfare transfer to improve South Africa's GDP. Therefore at a carbon tax rate of R300, GDP is expected to fall a little over 5%.

Regarding all the above options for revenue recycling in South Africa, the results are generally fragile. Devarajan *et al* (2009: 3) found that a carbon tax that would reduce emissions by 15% in South Africa and would also reduce household welfare by an amount of 3%, if implemented on energy intensive industries. The most positive result that is presented is a food subsidy. The same method was promoted for a carbon tax in Mexico. A food subsidy provides ample protection for the poor regarding welfare effects, through the reduction in food prices. It moreover provides job creation and employment opportunity for the low skilled and semi-skilled, as well as support an increase in output and thus GDP, which in the least is equivalent to a double dividend. Winkler and Marquard (2011:56), Alton *et al,* (2012:14), Pauw (2007: 21) and Van Heerden *et al* (2006) all agreed that a food subsidy is a promising method of revenue recycling for a market based instrument in South Africa. Van Heerden *et al* (2006; 116) continued that a food subsidy may go as far as providing the opportunity of a triple dividend, the third being through a reduction in poverty. This places a high preference for a food subsidy as an optimum option of revenue recycling.

However, these authors also agreed that the effects of a food subsidy and benefits it may provide are temporary and over time will be made redundant through rising energy prices due to a rising carbon price. The DEAT (2011: 84) strongly supports these considerations by stating that at high levels of taxation, economic activity (specifically production) and employment will decline. DEAT (2011: 84) goes as far as to say that GDP will decline by 2-7% at a R250 tax and 9-12% at a R750 tax per ton of carbon dioxide. This leaves an opportunity for alternative means of revenue recycling to be explored. A possibility exists in implementing a hybrid approach, potentially combining multiple channels through which revenues may be recycled. An example of this would be through the implementation of a food subsidy, coupled with welfare transfers. Where a food subsidy would benefit South Africa in such a way as to provide a triple dividend, the effects as mentioned are limited. Thus, a combination with welfare transfers may help provide a more stable welfare effect and strengthen at least the possibility of a double dividend through the improvement of welfare and reduction in carbon emissions. However, more research needs to be done on the possibility of using multiple channels to strengthen the chance of a double or triple dividend.

5.4 Considerations in implementing a Carbon Market

As stated at the beginning of this chapter, establishing a carbon market in South Africa is a long way off. Considerable research needs to be done before such a market-based instrument may be adopted. However, a number of considerations have been brought to surface by the EU ETS experiences in implementing a carbon market. Two of these are the initial issuing of allowances and the importance of a centralised registry.

The initial issuing of allowances: As stated in the previous chapter, the EU ETS issued its allowances using two specific methods, grandfathering and auctioning. Grandfathering is often considered a good approach for the first initial allocation of allowances. The reasons are that it makes it easier to include industry into the market and prevents any transfers of capital from the private sector to the public sector, hence avoiding revenue recycling impacts. By giving industry allowances free in the first initial allocation, it improves the social political acceptability of the emissions trading scheme. Industry would be more willing to engage in a carbon market scheme if given the initial allocation allowances free than be forced to purchase their own allowances. However, an important issue that arises through grandfathering allowances is the possibility of over allocation. This would lead to certain industries receiving more allowances than other industries, causing competitive issues and potential "windfall profits". It also distorts the price signal in the carbon market, due to industries having excessive allowances and not being pressured to reduce emissions.

The alternative would be to auction these allowances. Auctions are efficient in that they create an environment in which the true cost of a good is expressed in the price paid for it, hence, providing accurate early price signals in the market. An auction by its very nature would prevent the possibility of over allocation, creating allocation efficiency, and eliminating windfall profits from occurring. By preventing over allocation, it becomes easier for an ETS to achieve its emissions targets and ensures that industries face a certain level of rigidity regarding their personal emission goals. This level of rigidity in producing emissions would further help provide an accurate price signal in the market.

However, an auction would also create a disincentive for industry to participate in the carbon market. Although this is an important consideration, especially in the current economic climate where credit is restrictive, it is possible to overcome this through inserting compulsory compliance. Again, the importance of using a broad based market instrument is raised. If compliance were to be made compulsory, it would need to include the majority of carbon intensive industries, to prevent future political implications.

The importance of a centralised registry, identified in the implementation stages of the EU ETS, is that a centralised registry provided a more efficient approach to monitoring and enforcing carbon market transactions and allowances. A decentralised registry lead to a number of fraudulent activities occurring (outlined in chapter 4) and weak control over the exchange of information and supervision over carbon markets. With regards to implementing a carbon market in South Africa, this issue may not be as large as it was in the EU ETS, simply because government would be limited to monitoring the South African carbon market only and thus be more manageable, as opposed to the monitoring of 27 independent member states. However, the fraudulent activities that occurred in the EU ETS were on a large scale and involved large quantities of finance, hence the importance of protecting and monitoring carbon market transactions efficiently.

With the establishment of a centralized agency, the South African government would be able to monitor and control all transactions and information that passes through the South African carbon market. This would limit the opportunity for information to be tampered with and possibly omitted. Furthermore a centralized registry also provides a convenient opportunity for the South African Revenue Services to process all transfers and other relevant information for the calculations of VAT and similar tax implications.

A centralized registry also has the added benefit of increased security. Having a single registry would allow the South African government to pool all its available resources into the monitoring and controlling of information passing though the single registry. Multiple registries would require increased resources to monitor. Thus a centralized registry would also save on resources and expenses, improving efficiency and the effectiveness of the carbon market.

5.5 Synopsis

This chapter covers the potential externalities that may arise in implementing a carbon tax or carbon market in South Africa. The possible negative implications on GDP and welfare were made aware of, followed by the possible political and competitive concerns that may arise. These implications were then followed by the potential means of preventing them through the method of revenue recycling. The possible methods discussed were as follows: an income tax subsidy, VAT subsidy, renewable and nuclear subsidy, a biofuel subsidy, welfare transfers and a food subsidy. Each method was discussed in terms of the possible welfare effect implications on household income levels, the implications on employment and, lastly, the implications on South Africa's GDP. The second section of this chapter discussed considerations for implementing a carbon market in South Africa. These were the initial issuing of allowances and the importance of a centralised registry.

Chapter 6
Summary and Conclusions

Climate change is a global threat that has the capability of impacting upon every country both negatively and positively. Although it is observed as a natural occurring phenomenon, it is indeed being exasperated daily by human activities that increase global temperatures (Delbosc and De Perthuis, 2009: 9). There are already known observable physical and economic impacts that have been recorded and make this an undisputable fact (Rosenzweig *et al*, 2007: 83). In order to attempt to mitigate these impacts, the abatement of climate change has become of increasing importance. A number of countries committed to this abatement through their compliance with the Kyoto Protocol in 1997.However, the protocol only enforced Annex 1 countries to reduce their greenhouse gas emissions and not developing countries. In reducing these emissions, two common market based mechanisms are used, *viz.* carbon taxes and emissions trading schemes. The National White Paper Response to Climate Change (2011) encouraged the use of a carbon tax in South Africa as an immediate to short term response. An ETS is under consideration as a medium to long term response.

Both mechanisms are known to have a number of merits and demerits; however, both a carbon tax and an ETS have the potential problem of under or over pricing the cost of carbon, making it ineffective in encouraging emissions reductions (McKibbin and Wilcoxe, 2002).In addition, both mechanisms can lead to a number of externalities arising due to their regressive natures. These externalities coupled with the current economic hardships that South Africa faces (an unemployment rate of 24.9% and low GDP growth rate) will make it difficult for the South African government to combat climate change while protecting the poor simultaneously.

6.1 Immediate to Short Term Policy Response

In considering the immediate to short term responses to climate change through the implementation of a carbon tax, New Zealand found that a carbon tax would be a regressive policy and have negative social implications for low income households and economic implications. These implications were identified as a rise in the price levels of carbon intensive products, including products such as food and fuel which are basic necessities for survival.

In Mexico, the possibility of establishing a carbon tax in a way as to avoid the social welfare implications of the carbon tax was explored. Carbon tax revenues could be recycled through a food subsidy and provide relief to low income households that otherwise would have carried a heavy excess burden due to increased food prices. In Ireland, recycling carbon tax revenues through the decrease in income taxes could result in a double dividend. This essentially implied that the carbon tax will not only decrease GHG emissions, but also result in a positive increase to the country's GDP. Decreasing income taxes would have distortional effects on Ireland's labour market and essentially encourage increased output in the manufacturing sector and a rise in GDP.

Carbon tax exemptions are seen to be granted by the government in Norway to secure political votes to certain sectors in urban areas. The removal of these exemptions would promote a broad uniform carbon tax. Two important considerations in implementing a carbon tax are the implementation of an international uniform carbon tax to alleviate potential competitiveness issues that arise when a carbon tax is implemented in a single country only and the implementation of a broad uniform carbon tax that starts at a low level and rises gradually to avoid difficulties of inclusion of exempted sectors at a later stage.

From these case studies it is possible to determine the potential externalities that may arise in implementing a carbon tax or carbon market in South Africa. The possible negative implications on GDP and welfare were first made aware of, followed by the possible political and competitive concerns that may arise. These implications were then followed by the potential means of preventing them through the method of revenue recycling. The possible methods discussed were as follows: an Income tax subsidy, VAT subsidy, renewable and nuclear subsidy, a bio fuel subsidy, welfare transfers and a food subsidy. Each method was discussed in terms of the possible welfare effect implications on household income levels, the implications on employment and lastly the implications on South Africa's GDP.

With regards to an income tax subsidy, it was found that only the high-income households would directly benefit from an income tax subsidy. Furthermore, an income tax subsidy would decrease employment for all sectors of labour at a high carbon tax rate. Lastly an income tax subsidy would also result in a decrease in GDP due to the negative implications it would have on employment.

A VAT subsidy was found to benefit all household income groups at a very low carbon tax rate, up to R100. Beyond this threshold, a carbon tax would begin to reduce the welfare of all income groups. Furthermore, a VAT subsidy would have provide a small insignificant affect on employment in South

Africa of 0.1% at a very low carbon tax level of R25, after which employment would decrease for all sectors. Lastly a VAT subsidy would incur a negative effect on South Africa's GDP.

The renewable and nuclear subsidy and a bio fuel subsidy were then discussed. Both a renewable and nuclear subsidy and a bio fuel subsidy were found to not be viable options. This is due to the negative impact that these options would have on the coal industry and hence employment and GDP. Both options would also have similar negative effects on low-income households which are required to be protected from a carbon tax.

A food subsidy and welfare transfer had the most positive effects on low-income household's levels of welfare. This was primarily due to the direct tailored affects that are intended for low-income households. However, a welfare transfer had no impact on employment or GDP, both employment and GDP were expected to decline if a welfare transfer were to be implemented as a method of revenue recycling in South Africa. A food subsidy however, had a positive effect on employment and GDP. Employment in the unskilled sector was expected to rise at an average of 0.4% until a carbon tax of R200. This in turn would provide a positive yet limited impact on South Africa's GDP for a short period until carbon tax levels rise high enough to offset this impact

A food subsidy was hence decided upon to have the most promising output criteria on which to recycle carbon tax revenues. Although a food subsidy is know where near to a perfect option, it may be a good option in which to start from and possibly create a hybrid method in which welfare, employment and GDP are all impacted upon positively. In addition, there exists the possibility of implementing a method of revenue recycling through a dual channel, i.e. a food subsidy coupled with a welfare transfer. Such a method would promote a welfare dividend for a longer duration and hence be more effective.

6.2 Medium to Long Term Policy Response

In considering the medium to long term approach to mitigating climate change, the EU ETS made use of a three phased approach, with three core policies, namely regulatory/voluntary, market-based instrument, and penalty/subsidy, to reinforce and integrate its ETS systems. The regulatory/voluntary policy ensures the participation of certain large GHG emission industry in each phase. The market based instrument policy being essential to the success of the EU ETS in each phase was primarily a cap and trade system. Lastly the penalty/subsidy policy is crucial in incentivising the achievements of emissions targets.

The EU ETS was implemented through a "learning by doing" approach, which allows others to learn from the EU ETS mistakes. Some examples of which are the importance of auctioning allowances throughout each phase rather than grandfathering. Auctioning of allowances prevents two important controversies which have been experienced in various phases of the EU ETS, "over allocation" and "windfall profits" (Ellerman and Joskow 2008). Through auctioning of allowances, the market will is more likely to only purchase as much as is needed and minimize the chances over allocation. This would in turn "tighten industry emissions" and prevent a situation where over allocation creates disincentives to reduce emissions. Auctioning would also prevent industry from gaining free allowances and hence prevent industry from gaining large unearned profits.

Another important learning point for consideration is the importance of a centralised registry. The EU ETS initially implemented various independent registries in various member states. Unfortunately, this resulted in various fraudulent activities occurring in independent member state registries. Furthermore, decentralised registries also makes enforcement and monitoring uneven and less strict, the result of which creates inefficiency in achieving the goal of emissions reduction. The implementation of a single centralised registry allows the EU ETS "to be protected from insider trading and also have control over the exchange of information, and supervision of markets in greenhouse gas emission allowances, electricity, natural gas, and their derivatives" (World Bank, 2011:40). This essentially strengthens the ability of a registry to perform its role in monitoring and enforcing ETS trade and transaction

Lastly two considerations for implementing a carbon market in South Africa were briefly discussed. These were the initial issuing of allowances and the importance of a centralised registry. The initial issuing of allowances would be made possible through either a grandfathering approach or an auction. Both approaches have positive and negative connotations and would require further carful considerations before implementation. A centralized registry was found to be the most effective method of controlling and monitoring transactions in the EU ETS. Such a method of controlling and monitoring transactions would also be highly efficient and effective in South Africa as well. A centralized registry would offer good protection and security of information and transactions, as well as effective VAT and tax monitoring

6.3 Conclusion

Anthropogenic GHG emissions are widely accepted to accelerate the process of climate change, hence the need to reduce these emissions. The Kyoto Protocol, although accepted to not be the ideal method of combating climate change, is definitely a step in the right direction in helping reduce global GHG emissions. Given South Africa's current environmental policies, the implementation of a carbon tax in the immediate to short term and a cap and trade system in the long term would help South Africa in combating climate change. However, such policies need to be implemented in such a way as to promote development rather than discourage it. Targeting GHG emissions through a tax or cap on carbon emissions must not be allowed to impact upon the economy negatively, nor disadvantage low income households, thus the importance of carbon revenue recycling. Most research into carbon revenue recycling in South Africa encourages the use of a food subsidy, which provides a double dividend through the reduction in food prices and the labour benefits it provides at lower tax levels. However, this is only a temporary solution. Additional measures need to be taken at higher tax levels. The possibility of combining a welfare transfer with a food subsidy would need to be considered to provide further protection for low income households.

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