

The potential impact of carbon emissions tax on the South African mining industry

L Huisman
20517076

Mini-dissertation submitted in partial fulfilment of the requirements for the degree *Magister Commercii* in South African and International tax at the Potchefstroom Campus of the North-West University

Supervisor: Prof P van der Zwan

May 2014



Preface

I would like to take the opportunity to thank all parties that assisted the progress of this study. Special recognition to my supervisor for untiring assistance and the persistence and long suffering endurance while reviewing and disputing complications for the umpteenth time. I would also like to thank my family for their support and understanding. To my loving and supporting wife, thank you for your compassion, love and boosting my morale during this exacting period. I would also like to express my gratitude to the Lord Almighty for granting me the necessary skills to write this dissertation.

Soli Deo Gloria!

Abstract

The objective of this research and aim of this dissertation was to determine the potential impact of the introduction of a carbon emissions tax (hereafter CET) on the South African mining industry and this has been achieved by addressing the following three areas of research:

Most urgently, a literature review was required in order to obtain an understanding of why a carbon tax or alternative system was required. A detailed understanding of the functioning of these systems was invaluable to the outcome of the study. The survey conducted, confirmed the fact that global warming and related climate change brought about by human interference, constitute both global and national complications. The study confirmed that market based instruments can assist in addressing this problem and that these are generally considered to be more effective than traditional command-and-control policies. Notwithstanding this finding, in order to ensure efficacy, careful consideration should be given to the economic climate in which they are to be implemented.

Secondly, a literature review was essential in order to fully comprehend the nature of the South African economy and specifically the South African mining industry's contribution to the aforementioned problem. The importance of the industry to the economy had to be acknowledged. It was then established that the South African economy, and in particular the South African mining industry, contribute to this predicament due to their considerable dependence on coal fired power stations for the supply of electricity. The study revealed that should this industry be adversely affected by the proposed taxation, the economy as a whole would suffer.

Finally, a literature review as well as quantitative examples were used to estimate the impact of CET on the South African mining industry. This outcome was achieved by evaluating the results of taxation as opposed to the objectives of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA).

The study found that the effect on most of the objectives of the MPRDA, and especially those related to job creation, economic growth and equal access for all applicants on entering the arena of the mining industry, may well be affected adversely by the implementation of the proposed CET, as the tax was found to impact negatively on the industry's profits. It has also been assessed that the iron ore sector will be the most affected sector and that smaller

companies will be affected to a larger degree than larger companies. The modus operandi and selection of allocated beneficiaries when allocating the revenue collected from the proposed CET by the National Treasury were also found to play a significant role in whether or not the objectives of the MPRDA were positively or negatively influenced by the implementation of the tax.

The outcome of the study performed on the research question confirmed that, if said effect of the proposed CET on the South African mining industry was to be compared to the objective of the MPRDA, both positive and negative implications could be identified.

Keywords

Carbon tax, carbon emissions, mining industry.

Uittreksel

Die navorsingsvraag in oorweging geneem in die studie, was om die impak van die bekendstelling van 'n koolstof- emissie belasting op die Suid-Afrikaanse mynboubedryf te bepaal. Hierdie doelwit is bereik in die volgende drie proefnemings.

Eerstens; 'n literatuurstudie is gedoen om die noodsaaklikheid al dan nie van die instelling van 'n koolstofemissie belasting of alternatiewe stelsel vas te stel en die administrasie van hierdie stelsels te bepaal. Die studie het bevestig dat aardverwarming en verwante klimaatsverandering veroorsaak word deur menslike aktiwiteite, wat dit beide 'n globale en nasionale probleem maak. Die studie het verder bevind dat markgebaseerde instrumente hierdie probleem in mindere of meerdere mate suksesvol kan aanspreek en hierdie instrumente is dus oorwegend as meer effektief as tradisionele bevel-en-beheer-beleide beskou. Die studie bevestig dat deeglik oorweeg en heroorweeg moet word oor die ekonomie waarin die instrumente geïmplementeer word, om sodoende 'n effektiewe uitkoms te verseker.

Tweedens was 'n literatuurstudie noodsaaklik om die aard en omvang van Suid-Afrika en veral die Suid-Afrikaanse mynboubedryf se bydrae tot die probleem te bepaal, asook om insig te verkry in die belangrikheid van die bedryf betreffende die ekonomie. Daar is vasgestel dat Suid-Afrika en meer spesifiek die Suid-Afrikaanse mynboubedryf bydra tot die genoemde probleem, omrede sy groot afhanklikheid van elektrisiteitsvoorsiening deur steenkool-aangedrewe kragstasies om aan sy bedrywighede te voldoen. Die studie het verder getoon dat, indien die mynboubedryf nadelig geraak sou word deur die voorgestelde

belasting, die ekonomie as 'n geheel kan skade ly as gevolg van die belangrikheid van mynbou betreffende die ekonomie.

Ten slotte, 'n literatuurstudie sowel as kwantitatiewe voorbeelde is gebruik om die moontlike impak van koolstofemissie belasting op die Suid-Afrikaanse mynboubedryf te bepaal. Hierdie doelwit is bereik deur die teenoorstellende evaluering van die belasting met die doelwitte van die Minerale en Petroleum Hulpbronne Ontwikkelings Wet 28 van 2002 (MPHOW). Die studie het bevind dat die uitwerking op die meeste van die doelwitte van die MPHOW, maar veral op die doelwitte wat verband hou met werkskepping, ekonomiese groei en eweredige toegangsmoontlikhede vir almal wat die mynboubedryf wil betree, negatief geraak mag word as gevolg van die potensiële negatiewe invloed op die bedryf se winsgewendheid deur die implimentering van die koolstofemissie belasting. Daar is ook vasgestel dat die ystererts sektor die meeste geraak sal word, terwyl kleiner maatskappye in meerdere mate as groter maatskappye geraak sal word. Die toepassing en keuse van verdeling van die inkomste gegenerer uit 'n koolstofemissie belasting deur die Nasionale Tesourie, sou ook 'n beduidende rol speel by bepaling daarvan of die doelwitte van die MPHOW positief of negatief geraak word deur die implementering van die belasting.

Die studie laat ons tot die gevolgtrekking kom dat, wanneer die effek van die voorgestelde koolstof emissie belasting op die Suid Afrikaanse mynbou bedryf vergelyk word met die doelwitte van die MPHOW, daar beide positiewe en negatiewe implikasies mag wees.

Sleutelwoorde

Koolstofbelasting, koolstofvrystellings, mynboubedryf.

Index

CHAPTER 1: INRODUCTION AND BACKGROUND TO RESEARCH	1
1.1 Introduction	1
1.1.1 The South African economy	1
1.1.2 Background to research	1
1.1.3 Motivation for research	2
1.2. Problem statement	4
1.3. Objective.....	4
1.4. Research methodology	4
1.5. Overview of the research.....	6
CHAPTER 2: THE THEORY BEHIND THE IMPLEMENTATION OF CARBON EMISSIONS TAX	8
2.1 Objective of this chapter:.....	8
2.2 Greenhouse gases, carbon dioxide and climate change.....	8
2.3 Methods of counteracting climatological change.....	11
2.3.1 Summary of why action is required	11
2.3.2 Different approaches to counteracting damage	12
2.3.3 Design of different market based instruments.....	16
2.3.4 Different carbon taxation options.....	17
2.3.5 Advantages and disadvantages of market-based instruments	20
2.3.6 Conclusion on market based instruments.....	25
2.4 Summary.....	26
CHAPTER 3: SOUTH AFRICAN ENERGY, SOUTH AFRICA’S MINING INDUSTRY AND CARBON EMISSIONS TAX.....	28
3.1 Objective of this chapter.....	28
3.2 South African electricity generation and impact on global warming.....	28
3.2.1 South Africa’s contribution to global warming.....	28
3.2.2 South Africa’s energy generation.....	30
3.2.3 South Africa’s indirect impact on global warming	33
3.2.4 South African dilemma relating to climate change.....	34
3.3 The South African mining industry	35
3.3.1 The South African Mining Industry’s energy needs and uses	35
3.3.2 The South African Mining Industry’s importance in the national economy.....	39
3.4 The proposed Carbon Emissions Tax (CET) for South Africa	41
3.4.1 The background to the development of the proposed CET for South Africa	41
3.4.2 The initial carbon tax proposal, comments thereon and adjustments made.....	43
3.4.3 The current tax proposal and comments made thereon.....	51

3.5 Conclusion.....	59
CHAPTER 4: POTENTIAL IMPACT OF CARBON EMISSIONS TAX ON THE SOUTH AFRICAN MINING INDUSTRY	60
4.1 Objective of this chapter.....	60
4.2 Introduction to the evaluation of the impact of CET on the South African mining industry	60
4.2.1 Objectives of the Mineral and Petroleum Resources Development Act (28 of 2002) that the CET will be evaluated against.....	61
4.2.2 Calculations that need to be performed in order to evaluate the objectives of the Mineral and Petroleum Resources Development Act (28 of 2002)	62
4.3 Specific aspects considered when performing the analysis.....	71
4.3.1 The method with which the carbon tax calculation will be made.....	71
4.3.2 The rate at which the tax will be calculated	71
4.3.3 The different mining sectors and the relevance of selecting these sectors.....	71
4.3.4 The different companies considered in the quantitative gross profit impact analysis	73
4.3.5 The amount of carbon dioxide emitted per company.....	75
4.3.6 Calculation of the basis against which CET should be measured.....	75
4.3.7 Assumptions required in the calculation	76
4.4 Results of the CET impact analysis.....	77
4.4.1 Tables and general results of the analysis	77
4.4.2 Interpretation of the results of the analysis	84
4.5 Conclusion.....	91
CHAPTER 5: SUMMARY AND CONCLUSION	93
5.1 Objective of this chapter.....	93
5.2 Research findings	93
5.2.1 Research objective 1: Understanding carbon tax	93
5.2.2 Research objective 2: Understanding the South African dynamic.....	94
5.2.3 Research objective 3: The impact of a carbon tax	94
5.3 Limiting factors as well as areas for further research.....	96
5.3.1 Limitations of the study.....	97
5.3.2 Areas for further research.....	97
5.4 Overall conclusion of the study	98
ANNEXURE 1.....	99
List of References	105

Index of Tables

Table 1-1: Research methodology	5
Table 3-1: Electricity per user utilized.....	37
Table 3-2: Proposed emission thresholds per sector.....	49
Table 3-3: Additional allowance for trade intensive industries	54
Table 4-1: Mining companies selected for the analysis.....	74
Table 4-2: Three year average impact on gross profit percentage at various reduction levels per sector.....	77
Table 4-3: Average impact on gross profit at various reduction levels per sector	78
Table 4-4: Average impact on gross profit percentage at various reduction levels per sector and company	79
Table 4-5: Average impact on gross profit at various reduction levels per sector and company	81
Table 4-6: Average impact on gross profit percentage at various reduction levels per company.....	83
Table 4-7: Summary of impact of carbon tax on objectives of Mineral and Petroleum Resources Development Act (28/2002)	88

Index of Figures

Figure 2-1: The greenhouse effect (University Corporation for Atmospheric Research, 2001).	9
Figure 2-2: Illustration of the broad responses to global warming and climate change (Herber & Raga, 1995:258).....	12
Figure 2-3: Marginal cost vs. Marginal benefit optimisation chart	15
Figure 2-4: The two main market based instruments (National Treasury, 2010:27).....	16
Figure 2-5: The two options when applying a carbon tax	17
Figure 2-6 : Full flow of the preceding discussions.....	25
Figure 3-1: Primary energy intensity evaluated with market exchange rates (2004) (Suehiro, 2007:5).....	29
Figure 3-2: South African per Capita emissions over a period (World Bank, 2013)	30
Figure 3-3: Domestic coal use in South Africa (IEA, 2011)	31
Figure 3-4: South African total primary energy supply in 2008 (IEA, 2011)	31
Figure 3-5: South Africa's Electricity Production by Fuel (IEA, 2011).....	33
Figure 3-6: South African Energy Consumption by Sector (World Resources Institute, 1999)	36
Figure 3-7: Eskom's Energy Consumption by Sector (Van Zyl, 2009:7)	36
Figure 3-8: Energy demand in the industrial and mining sector (Nortje, 2006:45).....	38

CHAPTER 1

INTRODUCTION AND BACKGROUND TO RESEARCH

1.1 Introduction

1.1.1 The South African economy

South Africa is a rapidly growing and developing country which relies considerably on energy generated from coal and other fossil fuels in order to facilitate its growth. This results in South Africa's economy being highly carbon- and energy intensive (National Treasury, 2010:3). In 2007 coal was utilized to generate approximately 72 per cent of South Africa's main energy supply, while coal accounted for an estimated 85 per cent of South Africa's electricity generation capacity (Energy Information Administration, 2010). As a result of South Africa's aforementioned reliance on coal as primary source of electricity, South Africa is the 12th largest emitter of carbon dioxide in the world and accountable for close on 1.6 per cent of total global emissions (UNEP, 2004:1-20). South Africa is also considered to be responsible for approximately half of Africa's carbon emissions (UNEP, 2004:1-20). As a result of South Africa's extensive carbon and energy consumption, South Africa's per capita emission rate more closely relates to that of developed countries like Austria, Spain and Iceland, than to other developing countries like Cuba, Mexico and Argentina (Department of Environmental Affairs and Tourism, 2003). The energy sector in South Africa is of significant importance to the national economy as it provides the electricity required in order for South Africa's industries to develop and operate and this, in turn, results in economic growth (Energy Information Administration, 2010).

1.1.2 Background to research

The most comprehensive energy intensive sector of the South African economy is the industrial/mining sector, which consumes 47 per cent of the total energy supply in the country and consists mainly of mining and mining related companies (Department of Minerals and Energy, 2004:8). According to reports by Wright (2005), the modern mining industry is extremely energy intensive. Wright (2005) propounds that the mining process has evolved significantly, since employing mainly picks and shovels as tools. This development in the procedure of extracting minerals from the earth, has become increasingly capital- and

energy intensive, with, on average 65 - 80 per cent of energy sources utilized in mining activities such as fragmenting rock and extracting minerals and metals (Tromas & Meech, 2002). The reason for this steady increase in the energy consumption, is the need to delve ever deeper to extract the minerals (Mbendi, s.a.), as well as the modern practice of reprocessing the minerals further after extraction (Wright, 2005). The mere fact, however, that this sector has high energy requirements, does not necessarily indicate inefficiency or waste (Department of Minerals and Energy, 2004:8).

1.1.3 Motivation for research

In recent times it has become increasingly important for companies to not only consider the financial implications of their functioning, but to also take into consideration the environmental impact. Internationally, this resulted in the Kyoto Protocol being accepted in 1997 and its taking effect in 2005. When the Kyoto Protocol was signed, 37 industrialized and developed countries had to adhere. South Africa, as a developing country, is not bound by this document, but has also been experiencing the effect of the trend towards becoming more environmentally conscious. This resulted in triple bottom line reporting becoming compulsory for all JSE listed companies as well as the concepts of corporate citizenship and sustainability being incorporated as core features in the third edition of the King Code of Corporate Governance (Mammatt, 2010). This resulted in South Africa adhering to the international trend resulting in South Africa's 2009 announcement that it would voluntarily reduce its carbon footprint (United Nations, 2010:12). In the same announcement South Africa set itself a reduction target of 34 per cent by 2020 and a reduction of 42 per cent in domestic greenhouse gas emissions by 2025.

A global development in this trend has been to tax the carbon emissions of entities in order to curtail polluting the atmosphere with greenhouse gases. In order to address this pollution, the National Treasury has published a documentary discussion addressing the Carbon Emissions Tax (hereafter CET, used interchangeably for carbon emission tax as well as carbon emissions tax) options available to South Africa (National Treasury, 2010 & National Treasury, 2013). The objective of this taxation is to effect behavioural change in the use of carbon intensive energy resources, while still remaining competitive. If a carbon tax is decided upon, the tax will be levied on the amount of carbon dioxide emissions produced by an entity at a rate determined by government. This will bring about an increase in the price of electricity produced from high carbon content fuels, which, in turn, will increase expenses of

manufactured products dependent on high carbon content electricity. Resulting from this, the selling price of these products will soar (Dowdey, 2007). This will also cause more expensive, but less carbon intensive energy resources, to grow more consumer friendly and affordable in comparison to fuels richer in carbon content. Carbon tax thus amounts to essentially no more than a pollution tax, acting as a restraint on those who pollute the environment (Dowdey, 2007).

Eskom, the largest carbon emitter, supplies the mining sector with a significant amount of its energy (47 percent). Take this into account, 13 of the top 15 combined greenhouse gas emitters on the JSE, are currently mining or are mining related companies (National Treasury, 2010:36). It should, however, be noted that South Africa is one of the world's foremost producers of minerals. South Africa is the most profuse Platinum producer in the world as well as one of the largest gold, coal and diamond suppliers. In 2009 the mining industry contributed 8.8 per cent directly, and another 10 per cent indirectly to the National gross domestic product. The mining sector also provides more than 1 million jobs in South Africa, it accounts for more than 20 per cent of private sector investment as well as 12.3 per cent of total investment in the South African economy (Chamber of mines, 2011:1-42). Based on these facts, and figures, it can be concluded that the South African mining sector is of significant importance in the South African economy.

The South African mining industry is a material contributor to greenhouse gas emissions in the South African context and will therefore be directly affected by any CET or alternative taxation imposed in South Africa. This means that the mining sector is an important sector when considering the implications of carbon tax on the South African economy.

The potential impact on the mining sector is compounded by the fact that the mining industry is a price taker, and as such it cannot pass this increase in production costs on to the consumer of its products (Cabral, 2000: 85 – 86). The impact of such taxation on the South African mining industry may potentially be detrimental. Seeing as the goal set out by the National Treasury (2010:59) is to reduce carbon emissions while protecting the competitiveness of key industries, the large potential impact of the CET on the mining industry seems to undermine these objectives. In order to fully understand the potential impact of CET and to suggest possible alternatives or amendments, research in this regard is essential.

1.2. Problem statement

The problem statement of the study concerns possible adverse consequences that the proposed CET may have for the South African mining industry.

Research will address the following question:

What are the possible implications of the implementation of the proposed carbon emissions tax on the South African mining industry?

1.3. Objective

In order to answer the question posed in par. 1.2 above, the following research objectives must be achieved:

- 1.3.1. To gain a detailed understanding of the necessity for implementing carbon tax globally by exploring the damage that greenhouse gases cause the environment and to explicate how carbon emissions reduction schemes can counteract this damaging effect, distinguishing between various alternative scenarios (Chapter 2).
- 1.3.2. To gain a profound understanding of South Africa's, and in particular the South African mining industry's contribution to global warming, the significance of this industry pertaining to the South African economy, as well as gaining an insight into of the proposed CET (Chapter 3).
- 1.3.3. To determine the possible impact of CET on the South African mining industry by evaluating the tax and reviewing it in comparison to the Mineral and Petroleum Resources Development Act (28 of 2002) (MPRDA). Where possible, this evaluation will be illustrated through the use of quantitative examples (Chapter 4).

1.4. Research methodology

The research objectives, as set out in chapter 1.3 above, have been achieved by employing the investigative methods discussed in Table 1.1.

Table 1-1: Research methodology

Research objective	Research methodology
Refer to 1.3.1.	<p>This objective was achieved through a literature review of the following aspects:</p> <ol style="list-style-type: none">1. The damage that greenhouse gases and in particular carbon dioxide, causes the environment2. Clarifying how CET can counteract this damage.
Refer to 1.3.2	<p>This objective was achieved through a literature review of the following aspects:</p> <ol style="list-style-type: none">1. South Africa's contribution to the problem.2. The nature of the mining industry's need for energy consumption.3. The mining industry exacerbating emission of carbon dioxide in South Africa.4. The valuable contribution this industry makes in the South African economy.5. A history of the CET Proposal and related comments on the efficacy of said proposal.
Refer to 1.3.3.	<p>This was achieved by analysing the proposed Carbon Emission Tax in light of the objectives of the Mineral and Petroleum Resources Development Act 28 of 2002, supported by both a literature review and where practicable, appropriate quantitative examples.</p>

1.5. Overview of the research

The research conducted has been presented in the following chapters.

CHAPTER 2

THE THEORY VALIDATING THE IMPLEMENTATION OF CARBON EMISSIONS TAX

(Addresses research objective 1.3.1.)

The objective of this chapter was to gain an understanding of the need to globally implement a CET or its alternative. This chapter aimed to assess the various methods used in combating carbon dioxide emission, as well as to identify positive and negatives aspects of these methods.

CHAPTER 3

SOUTH AFRICAN ENERGY CONSUMPTION, SOUTH AFRICA'S MINING INDUSTRY AND CARBON EMISSIONS TAX

(Addresses research objective 1.3.2.).

This chapter targets South Africa's contribution to global greenhouse gas pollution when seen in comparison with other developing countries. This chapter endeavoured to illustrate the problem that South Africa faces and indicated that there is a need to reduce carbon emissions in South Africa. The importance of the South African mining industry within the South African economy was considered, as well as the specific energy needs of South African mines. This chapter concluded with a review of the development of the current CET proposal and various opinions on this.

CHAPTER 4

POTENTIAL IMPACT OF CARBON EMISSIONS TAX ON THE SOUTH AFRICAN MINING INDUSTRY

(Addresses research objective 1.3.3.).

In this chapter it was attempted to determine the potential impact of the proposed CET on the South African mining industry. This was achieved by evaluating the impact in the context of the objectives of the Mineral and Petroleum Resources Development Act. This was, where possible and appropriate, supported by quantitative examples of the proposed Carbon Tax in the South African mining industry.

CHAPTER 5

SUMMARY AND CONCLUSION

This chapter provides a synopsis of the findings of Chapters 2, 3 and 4. The possible impact of the proposed Carbon Emission Tax Proposal specific to the South African mining industry was also summarized.

CHAPTER 2

THE THEORY UNDERLYING THE IMPLEMENTATION OF CARBON EMISSIONS TAX

2.1 Objective of this chapter:

In this chapter a detailed understanding for the need to implement carbon tax globally was attained by exploring the damage that greenhouse gases and in particular carbon dioxide causes the environment. Ways in which carbon emissions reduction schemes can counteract this damage, as well as the implementation of and dissimilarities among various alternatives, including critique on these alternatives, were also reviewed.

2.2 Greenhouse gases, carbon dioxide and climate change.

According to Dimmer (2011:40), global warming and climate change present a very real threat to humankind. Before different mechanisms that can be used to combat global warming and in order for climate change to be explored, a complete understanding of the need for these protective measures needs to be attained. In its proposal relating to carbon taxes, the National Treasury (2010:13) defines climate change as the additional or abnormal changes in climate above and beyond the natural fluctuations that takes place and these additional or abnormal changes are primarily caused by the release of greenhouse gases. This occurs as a result of human activities. Greenhouse gases can be defined as those gases that have the ability to trap or ensnare the sun's heat in the earth's atmosphere similar to the way in which the glass in a greenhouse contains the heat of the sun inside the greenhouse (Le Treut *et al.*, 2007). These gases achieve this effect by reflecting the earth's heat radiation (which is a reflection of the heat rays of the sun), back at the earth (Le Treut *et al.*, 2007; IPCC, 2007). This effect is known as the greenhouse effect and can best be illustrated by making use of a diagram as indicated below in figure 2.1 (University Corporation for Atmospheric Research, 2001). Figure 2.1 illustrates that some of the rays are trapped in the atmosphere and these rays cause the greenhouse effect.

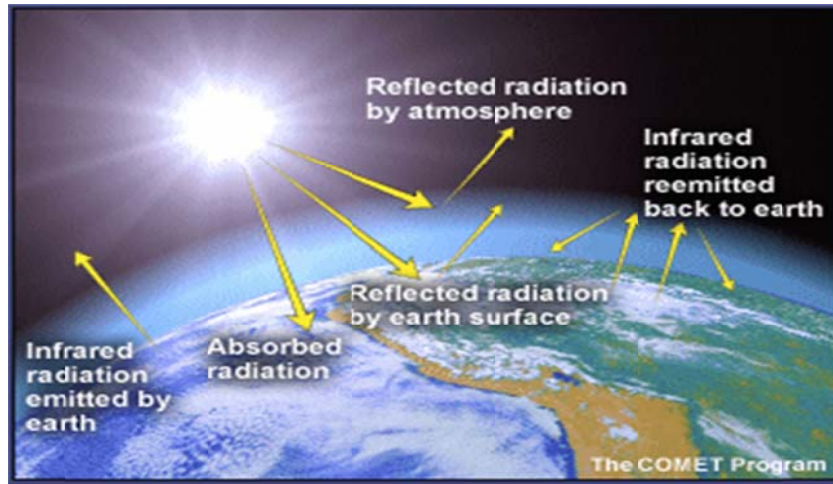


Figure 2-1: The greenhouse effect (University Corporation for Atmospheric Research, 2001).

When discussing the greenhouse effect it is important to bear in mind that the greenhouse effect effectively protects the earth from the extreme cold of outer space by acting like a blanket wrapped around the earth and trapping the sun's heat inside (*Kushnir, 2000*). The greenhouse effect is a natural phenomenon of the atmosphere and is responsible for changes in the natural climate and temperature (*Le Treut et al., 2007; Wuebbles & Jain, 2001*). This is called the natural greenhouse effect.

The problem that the earth now faces, is that the density of greenhouse gases in the Earth's atmosphere is increasing (*Science Daily, 2008; Wuebbles & Jain, 2001*), and the most apparent and significant contributor to this increase, is human activity (*The National Academies, 2001:1-5*). This increase in the volume of greenhouse gases in the atmosphere, causes the natural greenhouse effect to grow more pronounced and this enhanced greenhouse effect is the main cause of global warming (*Science Daily, 2008*). As a result of this, the temperature of the earth has been steadily on the increase since the measurement of the earth's temperature in 1850, with the highest recorded temperatures being recorded at the end of the 20th century and the beginning of the 21st century (*IPCC, 2007; Wuebbles & Jain, 2001*). The average temperature of the earth has also steadily been on the increase by 0.2°C annually over the last 50 years (*National Treasury, 2010:3*).

Ever since the start of the Industrial Revolution, the emission of greenhouse gases associated with human activity, has increased (*Wuebbles & Jain, 2001*). Carbon dioxide is one of these greenhouse gases and is considered to be one of the most significant contributors to the enhanced greenhouse effect (*IPCC, 2007*). According to *Pearce (1991:938)* the concentration of carbon dioxide, as well as that of other greenhouse gases, is increasing significantly as a

result of human activity. Deforestation and the use of carbon emitting fossil fuels such as coal, oil and natural gas, especially that required for generating power, has given rise to an increasing amount of carbon dioxide as well as other greenhouse gases being emitted and remaining in the atmosphere (Wuebbles & Jain, 2001; Herber & Raga, 1995:257). Measurements of ice cores indicate that carbon dioxide concentrations which have been stable for over a thousand years, have increased from 280ppm (parts per million) when measured before the Industrial Revolution (1750-1850) to 364ppm by 1997 (Wuebbles & Jain, 2001). This indicates a 30 per cent increase in the amount of carbon dioxide in the atmosphere over said period and because carbon dioxide is a greenhouse gas, it increases the greenhouse effect. The Intergovernmental Panel on Climate Change (IPCC, 2007) stated that, for the greater part, the observed increase in globally averaged temperatures since the mid-20th century could be assigned to the observed increase in anthropogenic greenhouse gas concentrations. This indicates that human activities are now affecting the composition of the atmosphere and the increased amount of carbon dioxide emitted, plays an important role in this change (Hansen, 2005).

The devastating consequence of this is that, were the rate of carbon dioxide emission to be maintained at its 2006 level, it is expected that the concentration of carbon dioxide would reach 550ppm by approximately 2035 (National Treasury, 2010:4). This would imply that by 2035, the earth's temperature will have increased by between 2°C and 5°C (National Treasury, 2010:4). This temperature increase can be hazardous as this change is directly correlated to the average change in temperature as experienced during the previous ice age. (Stern, 2006). Stern (2006), in his review on climate change, went on to state that, even at a more conservative increase of 2°C, all countries will be affected, especially the poorest who will suffer more and at an earlier stage. This, despite the fact that they have least contributed to climate change.

Following: the effects of this increase in global temperature according to Stern (2006), as well as researched by other sources, and how this will affect climate change.

- The glaciers are thawing and this will increase the risk of flooding during the rainy seasons as well as reduce the amount of water available in the dry seasons. Resulting from this, deserts will expand, sandstorms will occur more frequently and periods of harsh droughts, ever growing in severity, will follow in quick succession (Anon., 2006:15).

- A decline in crop yields will ensue, as global warming continues to escalate with Africa suffering the greatest consequences, temperatures will soar by between 3-4°C and African crop yields could decline by 15 per cent with sub-Saharan Africa being worst affected, as virtually no arable land in this region is under irrigation (National Treasury, 2010:4). Although crop yields will initially grow with moderate temperature increases, this will only continue until optimal temperatures are reached, followed by a decline in yields surpassing these (Sherwood & Idso, 2010:1).
- Resulting from the increase in the amount of carbon dioxide being emitted, ocean acidification will occur (Spotts, 2009). This oceanic acidification could potentially severely impact on and damage marine ecosystems, as these ecosystems could be destroyed along with the economies that rely on them (Spotts, 2009).
- As a result of the glaciers melting, the sea level will rise. This will result in flooding, as well as in outbreaks of cholera and other water-based as well as water-borne diseases, habitat loss and land-use loss. Populations in coastal cities or on islands will be forced to relocate to higher areas (Stern, 2006; Borroto, 1998).
- Global warming will fingerprint wild animals as well as plants and entire eco systems will be affected and may even be depleted. Plants and animals have the ability to adapt to climatic changes, but at this ever-increasing rate in global temperature warming, these are suffering measurably. Species of animals and plants might not be able to adapt or evolve fast enough and then become extinct (Root *et al*, 2003:57).

All of these facts indicate that global warming is a global threat which can have devastating consequences on both the environment and economy. Based on this investigation, it is clear that the increasing volumes of carbon dioxide speed global warming. Emissions of carbon dioxide should, if feasible, be monitored, managed and diluted. In summary, global warming should be counteracted (Dimmer, 2011:40).

2.3 Methods of counteracting climatological change

2.3.1 Summary of why action is required

Based on the preliminary information, it is clearly an indisputable fact that climatic changes caused by enhanced emissions of greenhouse gases pose a real and serious threat and that action needs to be taken in order to mitigate or curtail this threat. The damage that human populations have already wreaked, is virtually irreversible and costs too extreme to reverse

this damage (Pearce, 1991:938). Concerning future damage, Stern (2006) argues that the worst effects of climate change can still be avoided, but only if immediate and decisive action is taken. The exact measures that need to be taken in order to minimize the threat of global warming, remain a topic of considerable debate. The fact remains that procrastinating intervention is not an option (Waggoner, 2009:3; Mann, 2009:46).

2.3.2 Different approaches to counteracting damage

When considering the variety of measures that can be implemented in order to combat global warming through the reduction in carbon dioxide, we are presented with two divergent approaches (Refer to figure 2.2 below).

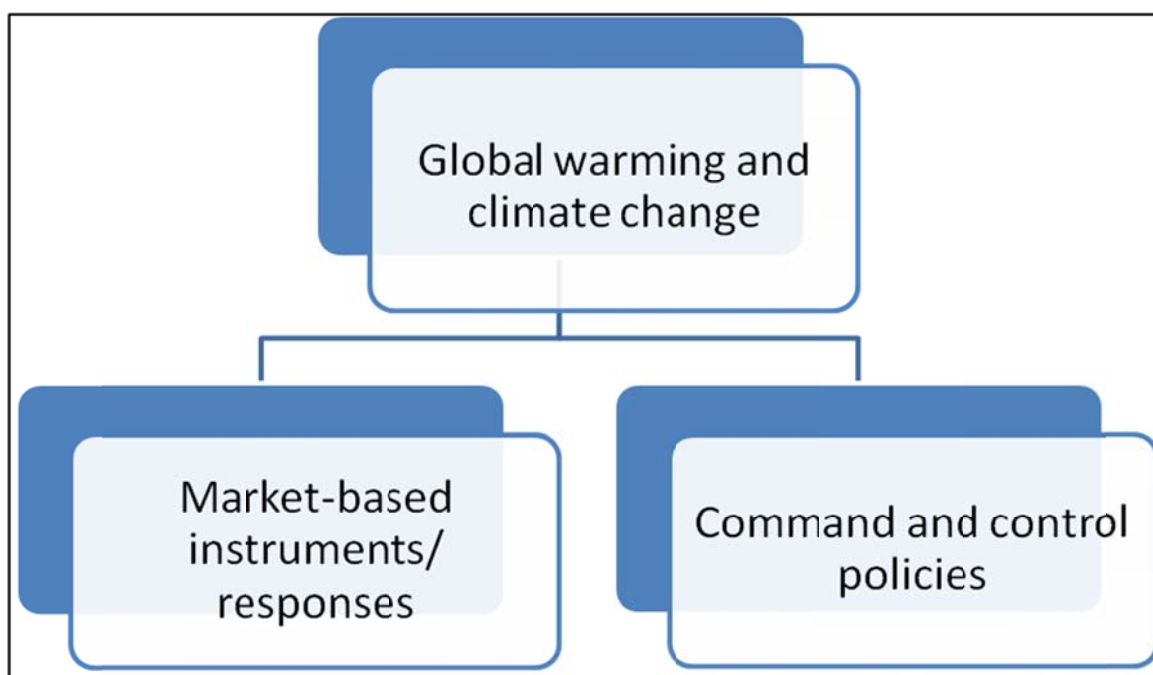


Figure 2-2: Illustration of the broad responses to global warming and climate change (Herber & Raga, 1995:258)

With a command and control policy the government imposes and enforces a regulation or standard on the amount of carbon dioxide that industrial plants are permitted to emit (National Treasury, 2010:25; Stavins, 1997:6). Market-based instruments use pricing mechanisms and enforce penalties in order to discourage pollution and achieve emission reductions. Market-based instruments curtail carbon dioxide emissions by imposing fines and exacting payment (Mann, 2009:44; National Treasury, 2010:25). There are a few incidental benefits common to both these approaches, other than curtailing global warming and reducing carbon dioxide levels: The potential to save depleted resources through improved management (command and control policies) and by inflating the prices of these resources (market-based instruments), will contribute to the substitution of low carbon for high carbon

fuels (Pearce, 1991:939). This is a significant benefit when bearing in mind that resources such as coal, natural gas and other fossil fuels are ultimately finite and while there are still no practicable large scale alternatives to energy generation other than the burning of these fossil fuels, this benefit should not be underestimated (Waggoner, 2009:8). Pearce (1991:939) states that another benefit of both these instruments is that both instruments encourage energy conservation either to gain a competitive advantage, or to avoid additional costs or penalties.

The main advantage that market-based instruments yields over traditional command and control policies, is the fact that market-based instruments provide the polluter with more flexibility when considering tools advantageous to reducing emissions, as the polluter can either incur costs by investing in modern technology in order to reduce carbon emissions, pay an allowance fee in order to emit more carbon dioxide, or combine these options (National Treasury, 2010:4). Market-based instruments will therefore promote innovation and development in technology and allow for the market to find the most cost-effective manner of reducing emission of greenhouse gases, as well as distribute the costs associated with reducing these emissions evenly across the entire economy (Avi-Yonah & Uhlmann, 2009:29-30). It is therefore submitted that in this regard command and control policies are prone to dissatisfy, as they do not allow the polluter any other options other than that of incurring costs and investing in technology in order to reduce carbon emission. Market based instruments provide for different options available to reduce emissions, depending on the tool decided on. This has the effect that a market-based system can achieve the necessary level of emission reductions at a lower cost than that enforced by means of traditional command and control policies (Ekins & Barker, 2001: 368). Finally; market-based instruments can also be implemented faster than command and control policies, especially if those are upstream carbon taxes where the tax is enforced at the stage that said fuels that are needed to generate emission are introduced into the economy, is selected. This results from the fact that the number of parties directly affected and therefore those that can give input on the proposed instrument will be reduced when compared to a command and control system where the number of affected parties may potentially be much larger (Avi-Yonah & Uhlmann, 2009:31).

A further argument favouring market based instruments is that the atmosphere, water, climate and the environment in general, can be considered global public goods as these “items” are there to the benefit of all with no private ownership (Herber & Raga, 1995:259). The combating of global warming is made difficult by the tools employed by man when fuelling

the energy needed to sustain life (Finnern, 2010:26). It is unlikely that mankind will radically change its way of life and inconvenience itself unless forced to do so by being punished for not complying or rewarded when in compliance (Finnern, 2010:26). As discussed earlier in this chapter (chapter 2.2), global warming is caused or enhanced by the release of greenhouse gases and in particular the emission of carbon dioxide. The fact that the emission of carbon dioxide has been allowed without serious repercussions and that the environment, a societal responsibility, has been endangered and depleted of natural resources, can be seen as the single biggest market failure of the twentieth century. This failure to conserve imposes a substantial cost on everyone, including those innocent of the abuse of fossil fuels (Zimmer, 2008:68-71; National Treasury, 2010:10). It can therefore be argued that, as the environment is a societal possession and it was the market that failed to protect and conserve it, the market should be held responsible for correcting the problem.

Market prices usually do not provide for the environmental cost associated with the supply of products or services in their pricing (National Treasury, 2010:20). For this reason market-based instruments are designed to incorporate into the price of goods the costs of damages suffered and in this way reduce the demand for these products. This will cause behavioural changes in consumers. This may not always be the case with command and control policies, as the effect that the environmental tax has on the price of the product may not be obvious to the consumer (Anon, 2010:24; Mann, 2009:44). In its discussion paper on the implementation of a CET, the National Treasury (2010:3) also acknowledges this fact and states that environmental related taxes have an important role to play in discouraging activities that impose high social costs and facilitate attaining sustainable economic growth and development. In order to accomplish this, market-based instruments aim to determine the environmental cost of production related to the use of fossil fuels and then include these costs in the pricing of these products (Herber & Raga, 1995:258). If these costs are internalized in the cost of products, the resulting price signals would aid in establishing behavioural change and development of alternative energy sources (Zimmer, 2008:67). Countries have only started to implement market-based instruments during the last couple of decades and as a result of this previously unassessed aspect, these tools tend to meet with political resistance. The consumer is familiar with command and control policies and the goal of these market-based tools may then be misinterpreted as that of additional tax revenue generation rather than conservation of the environment (Ekins & Barker, 2001: 368).

It should also be noted that market-based instruments may distort behaviour as these withdraw funds from the economy, slows down economic growth, and causes short-term reduction in GDP (Waggoner, 2009:7; Parry, 1994:64). Long term growth should, however, not be hampered by the implications of a market-based instrument, provided that said selected instrument is designed to accommodate the traits of the economy of that country and that this tool is implemented effectively (Kiuila & Markandya, 2009:705). In a perfectly functioning market-based system, the long term marginal social cost to the atmosphere and the marginal social benefit, should be identical. The marginal social benefit of pollution should correspond with the marginal social cost of pollution; being equal to the revenue generated by the system used in assisting to repair the damage caused to the environment (Herber & Raga, 1995:259). This principle is illustrated by figure 2.3. The figure indicates that, at a marginal cost and marginal benefit of approximately R6100 and pollution of 2.4x units, the system is in equilibrium and thus functioning at its optimal efficiency (Please note that the amounts used in the figure are created solely for illustrative purposes).

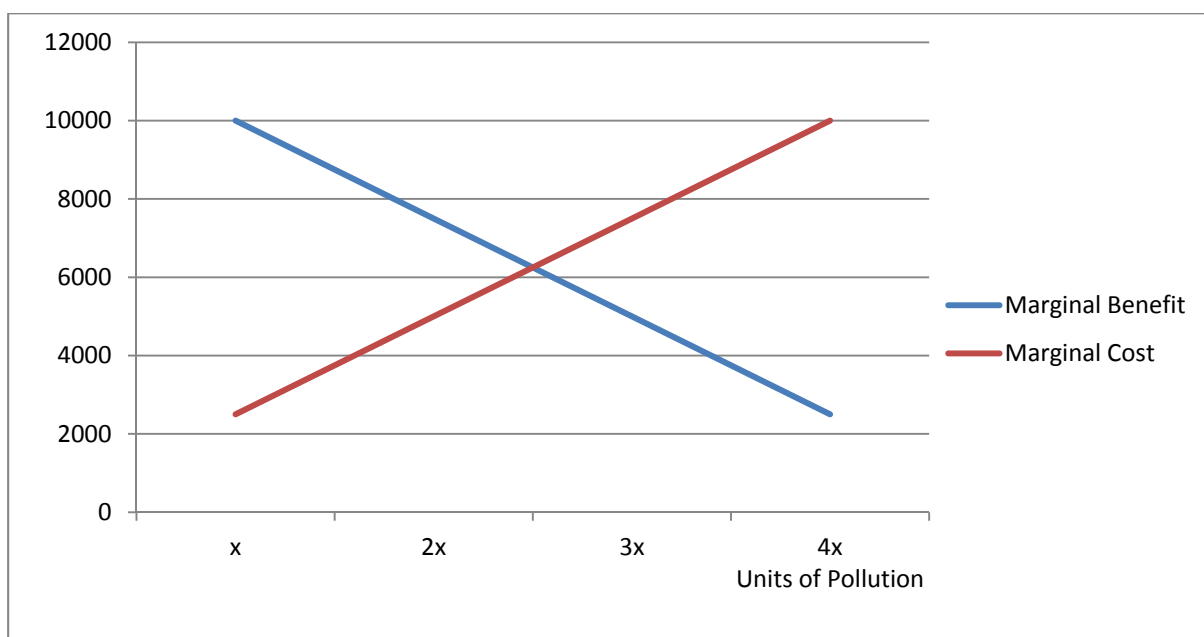


Figure 2-3: Marginal cost vs. Marginal benefit optimisation chart

The National Treasury discussion paper on carbon taxes, indicates that a market based instrument will be implemented to combat climate change and carbon emissions (National Treasury, 2010:30). Based on the preceding discussion, it is concluded that this decision to use market-based instruments in order to combat carbon emissions, is supported by the required theory and presents the more appropriate course of action.

2.3.3 Design of different market based instruments

Based on the literature related with the considerations on how market based instruments can be used to combat global warming, two distinct instruments can be identified. These instruments are emission trading schemes, (alternatively referred to as Cap-and-Trade Schemes), and carbon taxes as illustrated in Figure 2-4 below (National Treasury, 2010:27).

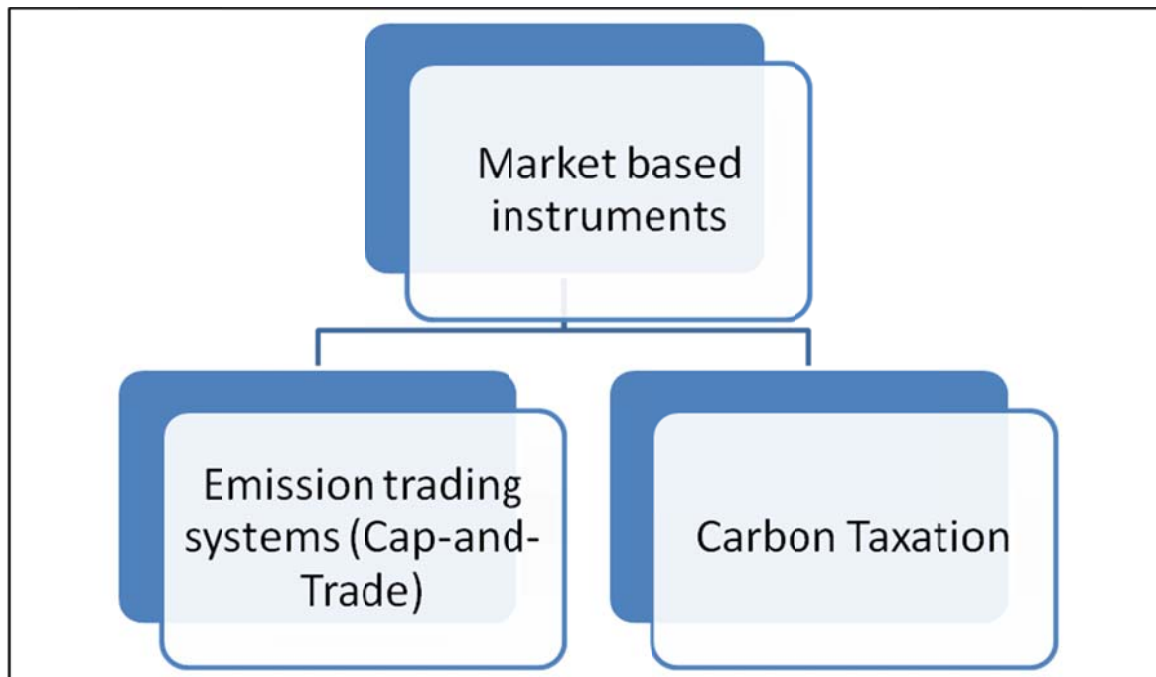


Figure 2-4: The two main market based instruments (National Treasury, 2010:27)

In an environment where a Cap-and-Trade Scheme has been applied, the government imposes a quantity restriction on the amount of emissions allowed, and allocates tradable permits for emitting at a lower rate, which, in turn, can be sold to over emitters (Mandy, 2010:28). This is where the Cap-and-Trade name originates from. The cap element in the name, refers to the limit imposed on emitters, whereas the trade element in the label refers to the buying and selling of these emission permits. This provides emitters with the following two options of complying; they can either reduce their carbon output by using lower carbon emitting fuels or by using fossil fuels more effectively. Alternatively, they can choose to buy allowances to emit more carbon dioxide, which will increase the production cost of the product involved. Simultaneously, by trading in emission rights, a new market for emission rights will be created (Mann, 2009:44; Anon, 2010:25).

In an environment where a carbon tax system is applied, the government determines the price per ton of carbon dioxide emitted and the market determines the amount of carbon dioxide it

is willing to emit at these prices (Mandy, 2010:28). Emitters again have two options available to them: They can either reduce the amount of carbon by using lower carbon emitting fuels, or by using fossil fuels more effectively and in so doing, pay less tax. They can continue as is customary, and pay the full tax levy, which, in turn, will increase the production cost of the product involved, and this increase will ultimately be passed on to the user of the product (Mann, 2009:44). A carbon tax can not solely be applied at the point where the actual carbon dioxide is emitted (this is referred to as downstream tax), but as mentioned earlier, it can also be applied at the point where the fuels that are needed to generate these emissions, are introduced into the economy (referred to as upstream tax).

2.3.4 Different carbon taxation options

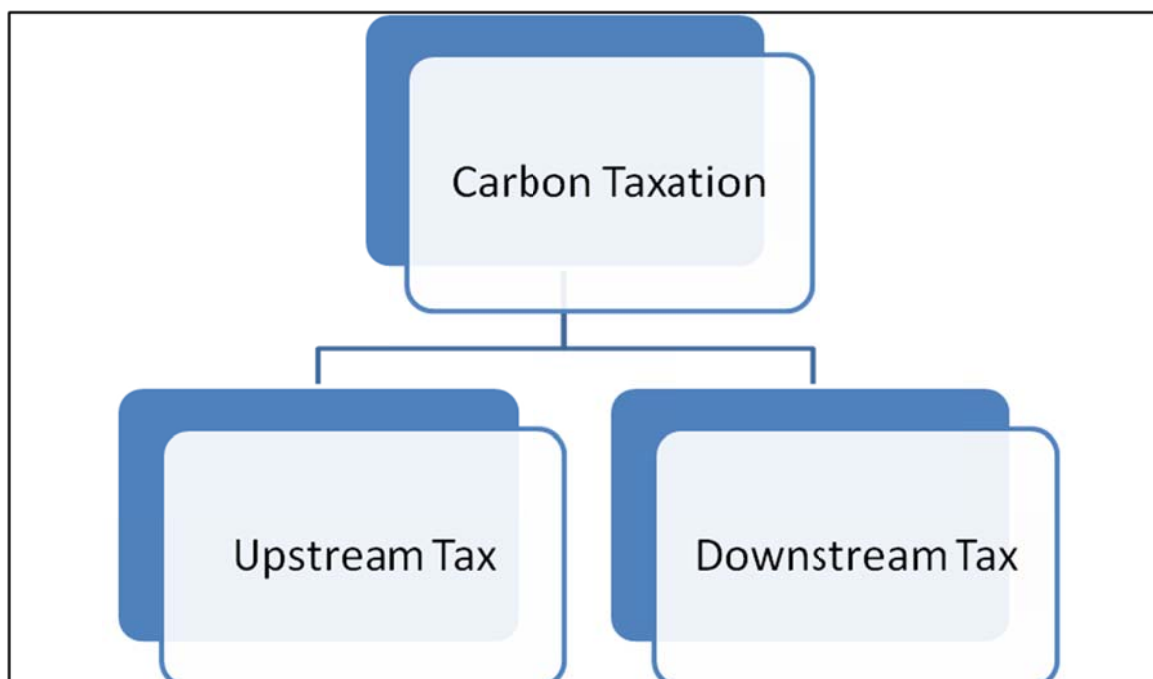


Figure 2-5: The two options when applying a carbon tax

In general, an upstream tax is easier to administer and implement when compared to a downstream tax, as there will generally be fewer participants in such a system (National Treasury, 2010:7). If the United States of America is considered as an example, there are only 30 coal producers that control eighty-six percent of the coal market, while the number of end users of the coal supplied by these producers, may be infinite (Waggoner, 2009:10). An upstream tax will thus ensure that the greatest amount of carbon is taxed, as carbon enters the system and diminish a large amount of the administrative burden on the system (Avi-Yonah & Uhlmann, 2009:31). This will arguably not give emitters of carbon and users of carbon intensive energy, the same incentive to change their ways or production methods, seeing as it

will be easy for the producer to shift the lion's share of tax payment on to the consumers of its products or services (National Treasury, 2010:7). It is submitted that this will especially be the case where there are only one or two prolific producers of specific types of products or services in a country (for example; Eskom as main supplier of electricity in South Africa). It follows that additional regulation in this regard will be required in order to meet both emission targets and to regulate prices. If, however, there are a multitude of producers in a specific field, then producers will not be able to simply shirk responsibility and shift the taxation onto the consumers without jeopardising their competitive advantage (Waggoner, 2009:5). When considering a downstream tax, Avi-Yonah & Uhlmann (2009:31) states that there are certain challenges facing this system. These challenges can include the fact that, with a downstream tax, the number and kinds of users of carbon based products are increased significantly, which increases the administrative burden of testing compliance and enforcing this tax. The administrative burden is increased, because of the increased number of facilities that will need to be tested and the strain this will cause the enforcer.

From this discussion it becomes clear that, when imposing a carbon tax, considerable thought should be given to the point at which the tax should be implemented. A carbon tax should preferably be directly applied to the emissions of carbon dioxide, as this will result in the greatest behavioural changes, but if this were not feasible from an administrative point of view, the tax may have to be levied on an upstream basis (National Treasury, 2010:9). A similar upstream cap-and-trade system can also be implemented and this may also lighten the administrative burden on the body of regulation.

2.3.4.1 Functioning of market based instruments

Both carbon tax and emission trading instruments, follow the principle of the polluter-paying, as those polluting the atmosphere are taxed on their pollution. According to Pearce (1991:940), could the amount of income tax possibly be reduced due to the implementation of either an emission trading scheme or a carbon tax, then the choice of instrument will enjoy even greater public support. This is also referred to as the double-dividend-effect, as benefits over and above the environmental benefits are reaped. A double-dividend results in two benefits: Firstly, society is assured of a cleaner and protected environment and, secondly, by protecting the environment money on other forms of tax is saved and, resulting from this, the tax system is less distorted (Bovenberg & de Mooij, 1994:1085). Public acceptance of a scheme is also of critical importance to the eventual success of the scheme, and this should

not be seen as inconsequential (Bristow *et al.*, 2010:1824). The eventual success of both these instruments in achieving their objectives, will depend on government's allocation of the revenue generated from these instruments (Mann, 2009:44). Ideally, in order to gain maximum political and public support, either of these choices should be revenue neutral (Waggoner, 2009:5).

A system is deemed revenue neutral when, for example, a taxpayer that was taxed at a net tax rate of twenty-five percent before implementation of the scheme, is still taxed at twenty-five percent after the system has been implemented. Recent research has indicated that, when the tax burden of the labour force is reduced and substituted for an environmental form of tax, the overall most favourable outcome for all concerned, will result (Kiuila & Markandya, 2009:705). Research has previously indicated that, with a properly designed market based scheme, the ensuing revenue generated by the scheme, will more than compensate for the revenue initially lost by relieving some of the workforce's tax burden (Parry, 1994:76).

Both these instruments share some advantages as both create incentives for using less fossil fuel or using fossil fuel that emit less carbon dioxide by making use of alternative energy sources, investing in both carbon lowering technologies and improvements in current technologies, in order to increase energy efficiencies (National Treasury, 2010:21). Regarding the above mentioned substitution results, Herber & Raga (1995:258) stated that if carbon tax levies were to be applied to carbon emitted from fossil fuels solely, the advantage would be greater than if carbon tax were to be applied to all energy sources. An added benefit to companies investing in the environment, will result if government were to allow for an offset of carbon dioxide captured against the amount of carbon dioxide emitted. In doing so, companies will aid in protecting the natural environment, as the net carbon emission produced per company will reduce, with the added benefit of a reduction in their overall tax burden (Mann, 2009:45). This will also present a company with additional options when deciding on methods to reduce its liability, resulting from the choice of either of the instruments.

In a perfect market, the efficiency of both market-based instruments would correlate, as the reduction in carbon emissions, would be apparent when a carbon tax is implemented and the price per tradable permit will be known when considering an emission trading scheme (Mann, 2009:44; Weitzman 1974:482). Under imperfect market conditions, however, the similarities between these two instruments are limited by the fact that the pollutant's

abatement cost, as well as other detail, are unpredictable (Wait, 2011). The advantages and disadvantages of both systems will now be discussed in greater detail.

2.3.5 Advantages and disadvantages of market-based instruments

Based on the arguments in 2.3.4, it can be concluded that, when a carbon tax is implemented, the price will be constant, while the amount of reductions will vary and thus result in price predictability. With an emission trading scheme, the amount of reductions will be constant while the price will vary, determined by supply and demand, ensuring reduction certainty. There are arguments that support price certainty as well as arguments in favour of reduction certainty. Those who favour reduction certainty, base their argument on the fact that, with reduction predictability, the focus be directed at the environment instead of at the economics necessary to make the system a viable option (Avi-Yonah & Uhlmann, 2009:36). Those in favour of fixed pricing, argue that benefits derived from these systems will only become apparent after a period of time, while the cost will be an immediate burden and that current market conditions reflect adversely upon fluctuating pricing (Avi-Yonah & Uhlmann, 2009:36). Montero (2002:452) concluded that if there is market uncertainty regarding the amount of damage caused by carbon dioxide, then an emission trading scheme will be more effective in combating carbon emissions, as the amount that emissions can be reduced by will be clear and maximum emission allowance can be changed according to requirements.

Related research by Pizer (2002:432) found that where a market reflects uncertainty related to the costs associated with a system or uncertainty regarding the costs of damage caused by carbon dioxide, then a CET will perform better in combating carbon emissions as prices could then be inflated or deflated, as is required.

When comparing a carbon taxation scheme to an emission trading scheme, advantages and disadvantages concerning those become apparent.

2.3.5.1 Advantages of carbon tax

A carbon tax is simple by design, as the tax is a set price per unit of carbon dioxide emitted (Avi-Yonah & Uhlmann, 2009:38). As the amount of carbon dioxide released per unit of fossil fuel burned is either known or easy to establish, this system is quick and easy to implement (Zimmer, 2008:68). It is this workability that is the main advantage, as this will

allow for a tax to be introduced quickly and effectively, while still sending a clear and concise warning to polluters that the emission of greenhouse gases will result in an additional expense (Avi-Yonah & Uhlmann, 2009:37-44). An added advantage of a carbon tax is the speed with which a tax can be implemented. The reason for this, is that early action is imperative to counter act the damage of global warming and while precious time is wasted on the design, testing and implementation of an emission trading scheme, polluters are free to continue transgressing as they please and in so doing, they aggravate the problem (Zimmer, 2008: 68). A carbon tax will be easier to comprehend and will thus be more acceptable than an emission trading scheme and will provide investors with valuable information on, for example, the energy efficiency of a company due to its simplicity and practicality (Mann, 2009:45). Another advantage that a carbon tax yields over an emission trading scheme, is that it will be easier for the consumer of a product or service to witness the cost to the environment and to change their ways. The administrative burden of a carbon tax is low, as it is possible for a carbon tax system to utilise existing tax systems for collection and enforcement (Zimmer, 2008:68; National Treasury, 2010:6). Should the need arise, a carbon tax system will be much simpler to modify and adjust in order to meet the specific needs at any given stage (Avi-Yonah & Uhlmann, 2009:7). When a carbon tax is levied, the tax will not add to the volatility of energy pricing, the way an emission trading scheme would, as the price of emissions will be fixed as well as be available to all concerned (Mandy, 2010:28; Mann, 2009:45). Finally, a carbon tax system will make provision for businesses to plan ahead in order to minimize the tax, make energy-critical decisions and take alternative actions where necessary (Zimmer, 2008:68; Avi-Yonah & Uhlmann, 2009:43).

2.3.5.2 Advantages of emission trading schemes

Emission trading schemes have recently been enjoying an increasing amount of political support (Mandy, 2010:28). In the United States of America, both of the electable candidates favoured an emission trading scheme in the run up to the 2008 nationwide election (Avi-Yonah & Uhlmann, 2009:5). The reason for this increase in political support is the potential advantage of becoming part of an internationally-linked trading scheme (Mandy, 2010:28). An internationally linked emissions trading scheme will assist in protecting a country's producers, especially those that supply goods internationally, as the price for emissions will be determined and enforced globally. The above could possibly be seen as a disadvantage, should said carbon tax system prevent international producers from passing the tax on to its consumers in other countries (National Treasury, 2010:7). Theoretically, an

emission trading scheme provides more flexibility, in that a trading scheme allows for the industry to decide on the most cost effective way of reducing carbon emissions, either by buying permits to continue as is, or by cutting down on emissions (Avi-Yonah & Uhlmann, 2009:6). An emission trading scheme can best be illustrated as the “carrot” in the “carrot and stick” adage, as these schemes reward traders for cutting down on their carbon emissions in the form of a tradable commodity, while a carbon tax will be considered a “stick” as it imposes a tax when companies or traders fail to adhere (Zimmer, 2008:67). An additional advantage of a properly designed emission trading scheme, is that there are a larger number of beneficiaries in such a scheme than there would have been if the tax had not been not recycled (Bristow *et al.*, 2010:1833).

2.3.5.3 Disadvantages of a carbon tax scheme

It is to the disadvantage of a carbon tax that it is referred to as a *tax* (Mann, 2009:45) as industry will always resist any new taxes implemented (Pearce, 1991:940). This reluctance to use the label *tax*, is also the reason why there is more political support for emission trading systems than for carbon taxation (Avi-Yonah & Uhlmann, 2009:45). Waggoner (2009:2) in a counter argument stated, that if a carbon tax is revenue neutral, it will be more politically acceptable. Another problem associated with carbon tax is, were the tax to be imposed without resulting in reduction in the greenhouse gas emissions, there will be renewed political opposition to the tax and especially to tax levy increases (Avi-Yonah & Uhlmann, 2009:46). As mentioned earlier, another significant disadvantage of a carbon tax levy, is the fact that the volume of carbon emissions reduction resulting from this, cannot be specified, unless in the unlikely circumstance of the market elasticity being stipulated beforehand (Mann, 2009:45; Pearce, 1991:942). While most of the carbon taxes that have been implemented around the world have been successful in reaching their emission targets, results are still not conclusive, as taxes have only recently been implemented and reductions resulting from these have yet to be ascertained (Ekins & Barker, 2001: 369). When implementing a carbon tax (especially a downstream tax), the implications of decisions on the exemption of some of the industries deserve careful consideration, as this might permanently impair the system in its entirety (Avi-Yonah & Uhlmann, 2009:48). Additional consideration should also be given to the effect that a carbon tax might exert on low-income households, as this sector is particularly vulnerable to price increases of basic resources (Ekins & Barker, 2001: 369).

2.3.5.4 Disadvantages of an emission trading scheme

Introducing emission trading schemes presents a number of disadvantages. One of these disadvantages is the fact that an emission trading system is, by nature, less transparent than a carbon tax system as there are various factors affecting the price and quantity of tradable allowances (Mandy, 2010:28). A further disadvantage that an emission trading scheme is presented with, is the fact that it places a larger administrative burden on the organisers of this system, owing to the complexity of the scheme when compared to the relative simplicity of the carbon tax system (Zimmer, 2008:68; Mann, 2009:45). According to Avi-Yonah & Uhlmann (2009:38) and Zimmer (2008:68), there are a number of causes for this complexity of an emission trading scheme.

Firstly, a baseline or cap for the scheme as an entity needs to be decided upon and this baseline might need to be adjusted for specific industries.

Also, it needs to be settled how the tradable allowances will be allocated and how the system will be set up and monitored to prevent foul play. The issue of how to allocate these allowances, complicates matters, and there is an increased risk of foul play when complicating the method of allocation. According to Waggoner (2009:34) there is a possibility that, if the allowances are allocated based on current use, companies that have in the past ignored their impact on the environment, will be rewarded by receiving more substantial allowances than companies who are currently working hard on reducing their carbon footprint. It is also submitted that, no-matter how these allowances are allocated, this will remain an extremely controversial issue with far reaching consequences. It is further submitted that the same problem can affect a carbon tax system if a fixed carbon emission limit is set for an industry and companies are only taxed on emission exceeding this limit.

Thirdly, a decision needs to be made on how international trade will be regulated, if regulated at all, and what the impact of trading with countries that do not adhere to greenhouse emission reduction protocols will entail. Further decisions concerning allowances for offsets which will reduce carbon emissions related taxes and penalties on investment in “green” projects as well as on the value of allowances allocated per project, need to be taken. This is also an additional risk when involving a carbon tax system. To ensure that prices do not fluctuate unnecessarily, safety values for allowances need to be implemented. When these safety values are either too high or too low, they effectively counteract the operations of the

market and in doing so, diminish the value of the scheme. Some companies will suffer due to these restrictions imposed when compared to an uninhibited scheme (Zimmer, 2008:69).

The last complication that faces a carbon emission trading scheme, is facing the decision on whether the system will allow the banking of unused allowances. This banking will effectively lower future carbon emission liability, especially where the maximum allowance is reduced in future. Borrowing allowances against future reductions, which will lower current carbon emission liabilities will also complicate the system if allowed (Revelle, 2009:3). It is submitted that, as a result of the possibility of borrowing allowances against future reductions, the risk exists that small, speculative and/or exploratory companies will be enticed to pollute at will, realising large windfall gains before closing shop and skipping payments due. It is further submitted that, as a consequence of all the previously mentioned decisions that need to be taken concerning carbon emission schemes, substantial industry involvement will be required in designing such a system. The aforementioned industry involvement will result in risking system manipulation by industries wishing to gain undue benefits from this scheme (Zimmer, 2008:69).

The complexity of a carbon emission trading scheme is not the only disadvantage. A further disadvantage is that, were standards not continuously adjusted and set slightly above the best technology currently at their disposal, a company will not be presented by incentive to go beyond these standards (Pearce, 1991:942; Avi-Yonah & Uhlmann, 2009:6). Based on the preceding statement, it is submitted that the only difference between a properly functioning emission trading scheme and a carbon tax on the investment in new technology, is the fact that the state or governing body will not be investing the funds in alternative energy directly as is the case with a carbon tax where the funds are collected from industry and invested by government in technology that government considers preferable, but industry itself will invest the funds directly in technology that industry considers most beneficial.

Declining industrial activity is another risk to emission trading schemes as some industry players will be more inclined to reduce production and in so doing, gain the tradable allowances (National Treasury, 2010:6). Emission trading schemes are relatively untested and as we are facing an international environmental crisis, with immediate action being required to address this crisis, serious consideration to the long lead time required to test, modify and implement such a scheme should be given (Avi-Yonah & Uhlmann, 2009:6).

The final disadvantage of an emission trading scheme, seen in the light of the recent economic recession, is the fact that these new tradable allowances will become the basis of speculation in financial derivatives. Possible dangers ensuing from this speculation is the foundation for some of the arguments against emission trading schemes (Mann, 2009:45).

In reaction to the above-mentioned advantages and disadvantages, it is important to keep in mind that a well-designed system of either of these market based instruments will be more effective than a poorly-designed system of the other (Revelle, 2009:1).

2.3.6 Conclusion on market based instruments

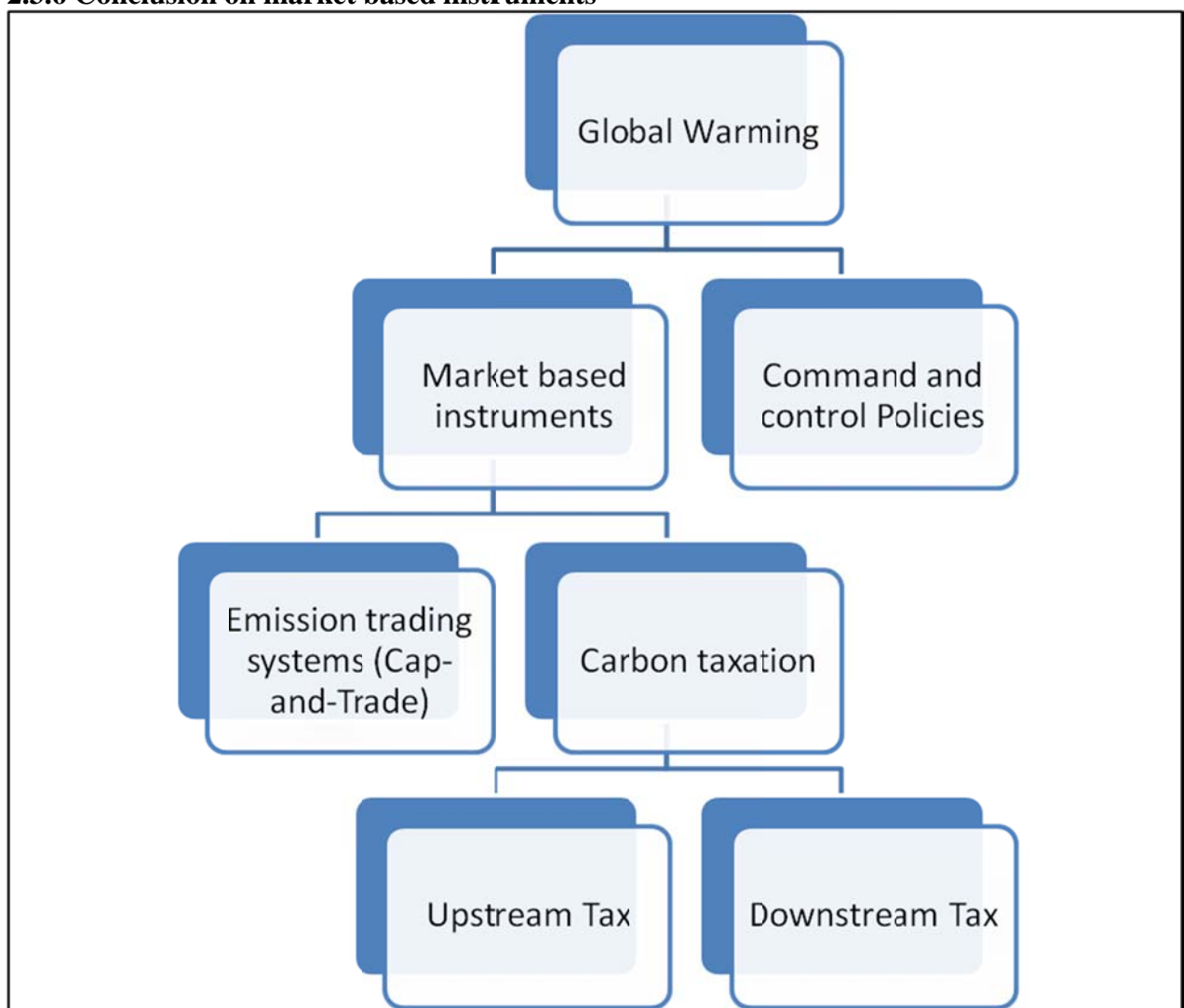


Figure 2-6 : Full flow of the preceding discussions

From the discussions expounded in chapter 2.3.5.1 to 2.3.5.4, it is clear that both systems are imperfect and that each system contains its own flaws. When considering which of these systems to implement, one should carefully keep in view the effect that these imperfections

may have on a nation's economy to try and minimise this effect. There is, however, no single scenario that will simultaneously benefit the environment, society and the economy and a decision will have to be taken on which aspect to see as the main focus of the system (Kiuila & Markandya, 2009:709). In recent times an increasing number of scholars have started to favour a carbon tax as opposed to an emission trading scheme (Mann, 2009:44). In the United Kingdom, where an emission trading scheme has been implemented for a number of years, sixty-six percent of companies have welcomed a switch to a carbon tax system (Zimmer, 2008:68). It is essential to note once more that the technique, as well as the intention with which either of these two systems are introduced, is of crucial importance to the outcome (Mandy, 2010:28). If a tax is introduced and these funds are then only used to supplement government's revenue streams, with no form of revenue recycling and lacking any clear plan with which to implement these funds in order to combat climate change, it is unlikely that the tax will gain any public support (Mandy, 2010:28; Anon, 2010:25). Moreover, it is important to note that even if a carbon tax were to enjoy a lot of global support, this would not necessarily guarantee that said carbon tax would be the ideal option for South Africa. Careful consideration should be given to South Africa's specific needs and economy, especially when taking into account South Africa's excessive reliance on the mining industry. This will be discussed in greater detail in chapter 3. Neither a carbon tax, nor an emission trading scheme in isolation, will slow down global warming. Transformation needs to take place concerning methods in which we generate energy, provide transportation and conserve rainforests, if the effects of global warming and climate change are to be stopped and reversed (Zimmer, 2008:67; Avi-Yonah & Uhlmann, 2009:50).

2.4 Summary

In summary, it was established in this chapter that global warming and climate change are existent global problems, and that immediate measures should be taken in order to ward these off. Viable solutions to these problems were discussed and it was established that market based instruments are generally considered to be a better response to this problem, than are traditional command-and-control policies. Both carbon tax- and emission trading schemes were discussed and the advantages and disadvantages of these were evaluated. This chapter issues a warning that neither of these two schemes would result in the desired carbon dioxide emission reductions without proper planning for the type of economy and significant behavioural changes in that economy, both globally as well as in South Africa. Contributions

by the South African and South African mining industry relating to the carbon emissions problem, as well as suggested CET proposals will be discussed in chapter 3.

CHAPTER 3

SOUTH AFRICAN ENERGY, SOUTH AFRICA'S MINING INDUSTRY AND CARBON EMISSIONS TAX

3.1 Objective of this chapter

In chapter 2 it was established that the effects of global warming will have negative consequences globally as well as in South Africa and that immediate action is required. The objective of this chapter is therefore to explore the nature of South Africa's energy needs by gaining an understanding of South Africa's contribution to global warming. This chapter further aims to provide an overview of the South African mining industry, its contribution to global warming through the emission of carbon dioxide, and the importance of this industry in the South African economy. Lastly, this chapter reviewed the proposed CET and its development in South Africa, in particular its application in the mining industry.

3.2 South African electricity generation and impact on global warming

3.2.1 South Africa's contribution to global warming

In chapter 2.2 it was established that conclusive evidence exists to indicate that greenhouse gases, specifically carbon dioxide, enhances the natural greenhouse effect which leads to global warming and the damage that is associated with global warming globally.

The effects of global warming will be felt in South Africa as well as by the rest of Africa. Not only is South Africa affected by global warming, but it is also a contributor to the problem. This is evidenced by the fact that in 2004 South Africa was the 12th largest emitter of carbon dioxide in the world and considering that South Africa is still a developing country, the scale of the South African problem becomes apparent (UNEP, 2004:1-20). In 2004 South Africa was responsible for 1.6 per cent of total global carbon dioxide emissions, as well as for almost half of Africa's carbon dioxide emissions (UNEP, 2004:1-20). Recent studies found that South Africa was consistently among the top 20 largest carbon dioxide emitting countries in the world (Eberhard, 2011:1; IEA, 2009:1). As illustrated in Figure 3.1, South Africa's energy intensity is higher than that of most other developing and developed countries. Suehiro (2007: 1) defines energy intensity as the amount of energy consumed to achieve a unit of work. This figure shows that, in 2004, South Africa was approximately twice as energy intensive as most other developing countries, (like Brazil and Chile, also with high dependence on the mining industry) and 4.8 times more intensive than the world leaders.

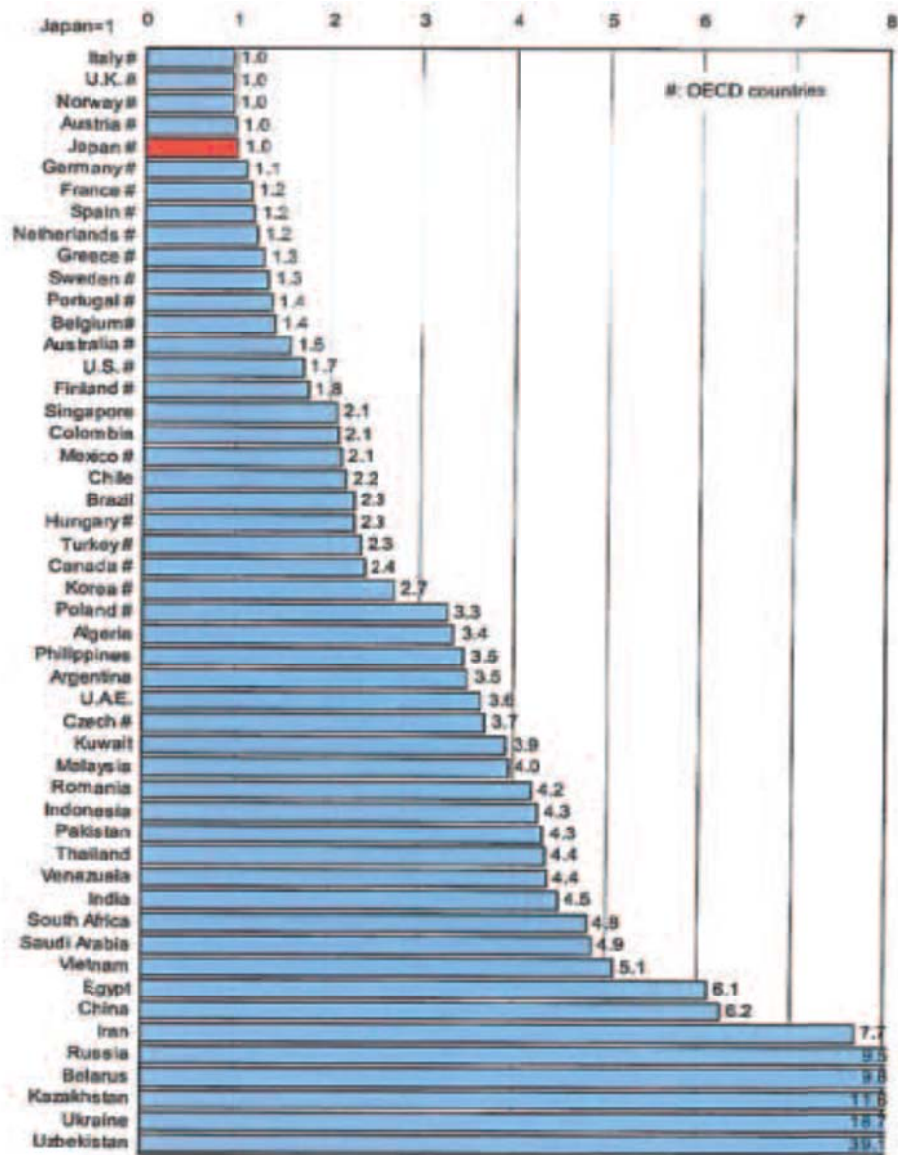


Figure 3-1: Primary energy intensity evaluated with market exchange rates (2004) (Suehiro, 2007:5)

Figure 3.2 illustrates that South Africa’s per capita emissions are substantially higher than the rest of Sub Saharan Africa and far exceed those of other developing countries like China, Brazil and India, which are the countries mentioned by the National Treasury (2010:13). The figure also indicates that South Africa’s per capita emissions are in line with developed countries with low primary energy intensity like Norway and France, with the difference being that the South African emissions are showing an increasing trend, while those of France and Norway are on the decrease.

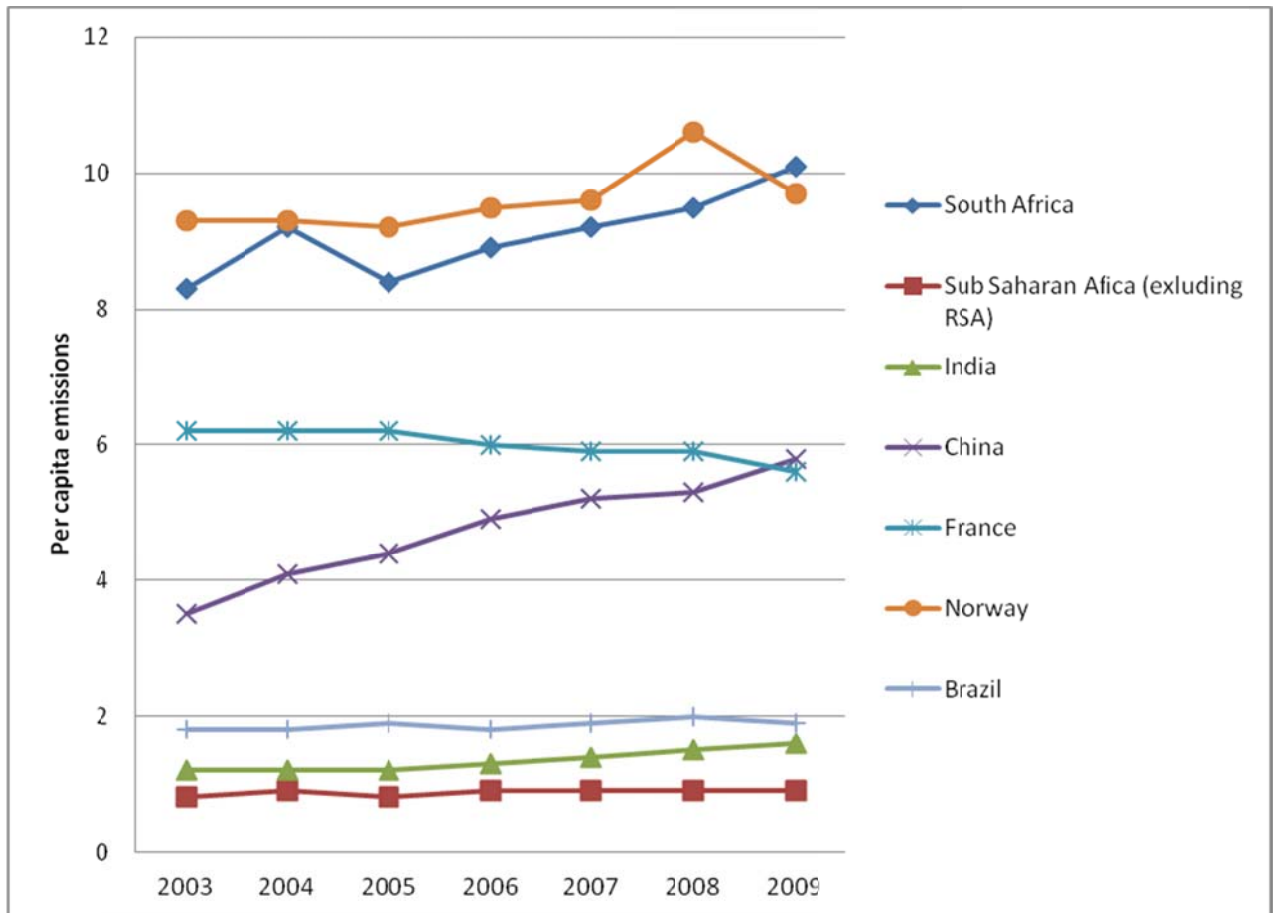


Figure 3-2: South African per Capita emissions over a period (World Bank, 2013)

Based on the discussion in this section of the chapter, it is submitted that South Africa is not only affected by global warming, but is also a contributor to the problem.

3.2.2 South Africa's energy generation

The reason behind South Africa's comparatively high contribution to global carbon dioxide emissions, lies in the fact that South Africa has a fast growing economy which is extremely dependent on energy in order to achieve its economic and social development goals (National Treasury, 2010:3; Winkler, 2005:27). This complication of South Africa being a highly energy intensive economy, is compounded by the fact that 94 per cent of all electricity generated is produced from coal, as opposed to energy produced from oil as is the case in other countries. In addition, approximately 33 per cent of South Africa's oil demand is met by the conversion of coal to oil and other liquids (IEA, 2009:1; Chamber of Mines, 2011, Van Zyl, 2009:6). In South Africa, 53 per cent of all coal utilised was consumed in the production of electricity and in 2008, 71 per cent of South Africa's total primary energy supply was generated from coal (Chamber of Mines, 2011; IEA, 2011).

Winkler (2005:27) stated that renewable energy contributes relatively little to the primary energy supply and even less to the commercial energy consumption in South Africa. Musondo (2010: 42-43) went on to say that, for the foreseeable future, other non-coal sources of electricity generation will lag behind that of coal energy generation and only in the distant future will South Africa be able to generate enough electricity through renewable energy sources to supply its energy demands. An additional concern related to renewable energy, is that renewable energy is still more expensive than is coal fired electricity. This situation is, however, changing with renewable energy becoming cheaper as countries learn from past experience (Winkler, 2005:36). Musondo (2010: 42-43) added that it took Brazil more than two decades to implement an economically feasible renewable energy alternative. He was of the view that, without coal as source of energy generation in South Africa, South Africa will certainly not be able to meet its current and growing energy demand. This assessment is supported by figures 3.3 and 3.4 below, which indicate the importance of coal in the South African economy.

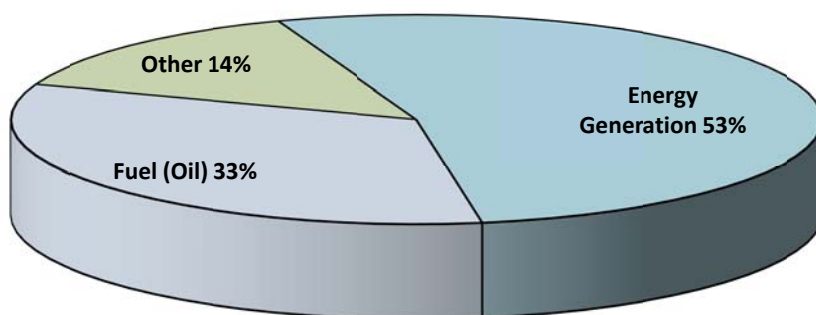


Figure 3-3: Domestic coal use in South Africa (IEA, 2011)

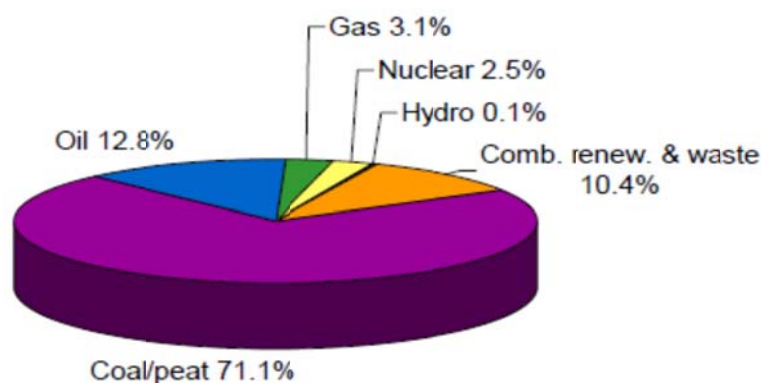


Figure 3-4: South African total primary energy supply in 2008 (IEA, 2011)

South Africa's heavy dependence on coal to generate electricity is not likely to reduce in the foreseeable future, as much of the expansion in South Africa's energy capacity will be generated with the construction of coal fired power stations such as Mdupi and Kusile power stations. Due to the calculated world population growth; world population being expected to increase with 25 per cent over the next 25 years, energy demand will increase, resulting in an already strained energy supply chain being constricted even further (Eberhard, 2011:18; Lok, 2009:22). This leads to the conclusion that the South African energy sector (primarily Eskom) is responsible for the most significant portion of carbon dioxide emissions in the South African economy as the largest portion of coal utilised in the economy is being utilised by this sector (Janse van Vuuren, 2008:61).

The reason for using coal so extensively in South Africa, is found in the fact that South Africa has substantial coal layers or coal beds which are relatively thick and close to the surface, and therefore allows for low-cost mining (Eberhard, 2011:2). All of these factors contribute to coal being a relatively cheap and abundant source for the generation of electricity, especially when compared to costs associated with nuclear power stations which are up to three times more expensive to establish than their equivalent coal fired power stations (Lok, 2009:22). The National Treasury (2010:3) supported this conclusion by stating that the abundance and low cost of coal are the main causes for South Africa's significant reliance on this mineral, especially in the production of electricity. Figure 3.5 below indicates the South African electricity production by fuel source, and that large quantities of coal are consumed to generate electricity. The availability and abundance of coal has therefore led to South Africa being one of the cheapest, yet more environmentally unfriendly, providers of electricity in the world (Van Zyl, 2009:8).

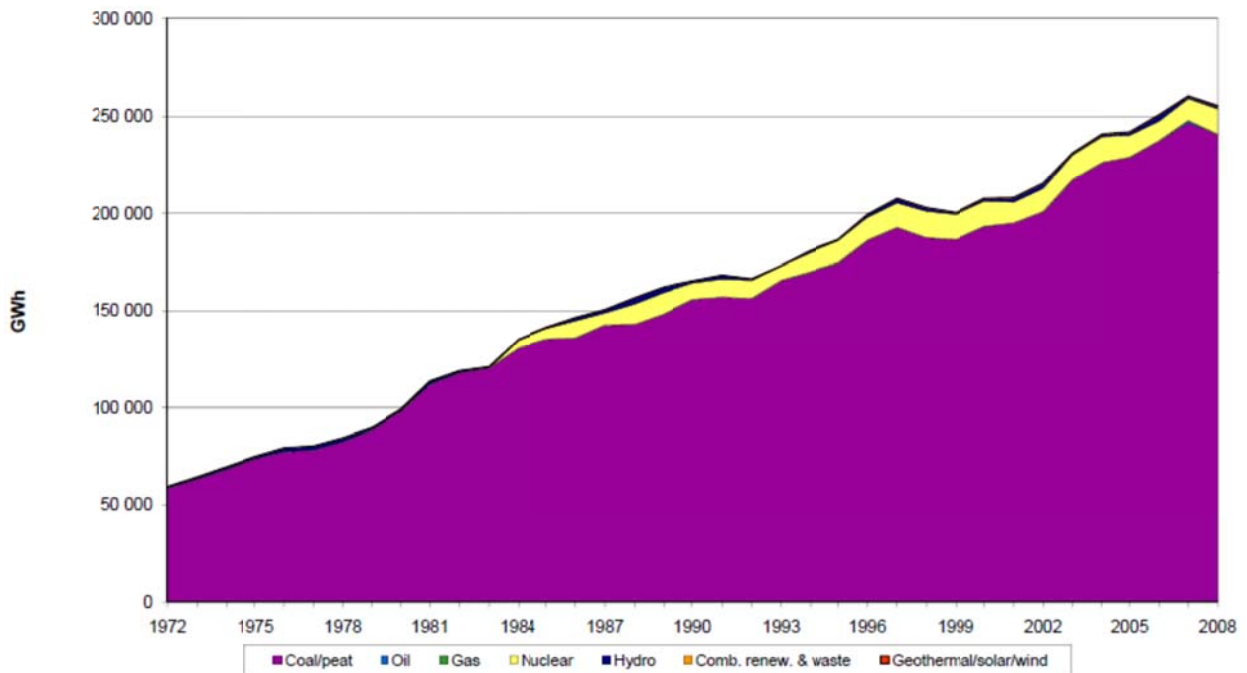


Figure 3-5: South Africa's Electricity Production by Fuel (IEA, 2011)

The importance and consumption of coal in the South African economy can be summarised as follows: coal accounts for 70 per cent of primary energy consumption, 93 per cent of electricity generation and 30 per cent of petroleum liquid fuels creation (Eberhard, 2011:4).

From the discussion in the preceding paragraphs it is evident that South Africa has a carbon intensive economy. This view is supported by the fact that South Africa's per capita carbon emission rate exceeds the world average and currently stands at approximately 10 tonnes emitted per capita gained (National Treasury, 2010:13). This results in the South African per capita emission rate being comparable to that of developed countries like Austria, Spain and Iceland rather than to other developing countries like Cuba, Mexico and Argentina (Department of Environmental Affairs and Tourism, 2003).

3.2.3 South Africa's indirect impact on global warming

When taking the discussion in chapter 3.2.1 and 3.2.2 into consideration, South Africa's direct contribution to global carbon dioxide emissions is evident. South Africa's contribution to global carbon dioxide emissions is not limited to only its direct contribution, as South Africa is a significant participant in the global coal market (Eberhard, 2011:1).

In 2009 South Africa was classified as the sixth largest coal producer and the fifth largest coal exporter in the world (Eberhard, 2011:2). In more recent studies, South Africa was

classified as the seventh largest coal producer with 3.3 per cent of world production, and sixth largest coal exporter with 70 million metric tonnes or 6.7 per cent of world coal exports (International Energy Agency, 2012:15). According to the Chamber of Mines (2010:17), South Africa exports roughly one fourth of all coal produced, but this quarter represents approximately half of the total revenue generated from coal. The South African coal export market is expanding and the upgrading of the coal export capacity is underway, which will inflate the export market to approximately 91 million tonnes of coal per year (Lok, 2009:22). The reason for the large amount of South African coal exports, is found in the fact that South Africa is advantageously positioned between the Atlantic and Pacific coal markets, which allows South Africa to meet any shortfalls that either of these markets might experience (Eberhard, 2011:1). The effect is that South Africa's total impact on global carbon dioxide emissions is vastly more far reaching than just its own direct contribution through the use of coal.

3.2.4 South African dilemma relating to climate change

It is evident from the discussion in chapter 3.2.1 to 3.2.3, that South Africa is a contributor to global warming and climate change, both directly and indirectly, and that action is required to reduce South Africa's carbon emissions. The use of all carbon based fuels should therefore be minimised when considering climate change mitigation (Van Zyl, 2009:6). Energy usage is indispensable to social prosperity, alleviating poverty and supporting economic development and as such South Africa, as a developing country with high dependence on carbon based fuels, faces the challenge of promoting economic and social development while simultaneously trying to reach its climate change targets (Anon, 2010:24; Yilmaz & Ulsu, 2007:1117; Cao, 2003:61-64). South Africa therefore needs to identify and analyse the cost and benefit derived from the trade-off between environmental protection and economic development when establishing its energy generation goals (Cao, 2003:64).

Eskom (2010:2) stated that the ability to supply a country's electricity needs affects economic growth directly. This was emphasised during the blackouts in the first quarter of 2008 when the economic growth of the country fell to 1.6 per cent from 5.5 per cent for the same period in 2007 (South African Reserve Bank, 2008:5). South Africa faces the additional pressure that, in 2005, only two thirds of all South Africans had access to affordable, reliable and adequate electricity and urgent action is called for to supply these members of the population with electricity, while simultaneously reducing carbon dioxide emissions (Winkler, 2005:27).

Given the combination of South Africa's exorbitant level of carbon dioxide emissions when compared to those of other developing countries; its excessive dependency on coal as primary source of energy and the population growth, both nationally and internationally, it is unlikely that the volumes of carbon dioxide emissions will decrease while the economy continues to grow and develop (National Treasury, 2010:3; Cao, 2003:61). The aforementioned statement attests to South Africa's dependency on sustainable energy for its economic growth. It is submitted that South Africa has the opportunity to establish an environmentally responsible development programme and an environmentally conscious economy by focusing on sustainable development. This can, however, only ever be achieved if the standards and incentives that are set are realistic and flexible enough to promote quick action when conditions change, as well as to interpret and modify said incentives in order to meet local conditions (Cao, 2003:65).

3.3 The South African mining industry

3.3.1 The South African Mining Industry's energy needs and uses

The discussion in chapter 3.2 indicated that South Africa relies heavily on coal, especially in the generation of electricity. During its 2012 financial year, South Africa's primary energy supplier, Eskom, sold electricity directly to approximately 3 000 industrial customers, 1 000 mining customers, 50 000 commercial customers and 84 000 agricultural customers. It also supplied electricity to more than 4.7 million residential customers during this, same period (Eskom, 2012). Eskom, as a state owned company, dominates South Africa's power industry by supplying 95 per cent of South Africa's electricity utilisation and approximately 45 per cent of electricity utilised in Africa (Eberhard, 2011:14; Eskom, 2011).

In 1999 the World Resources Institute (1999) indicated that almost half of the energy consumed in South Africa, was due to industrial activities. Mining operations are grouped under this industry in figure 3-6.

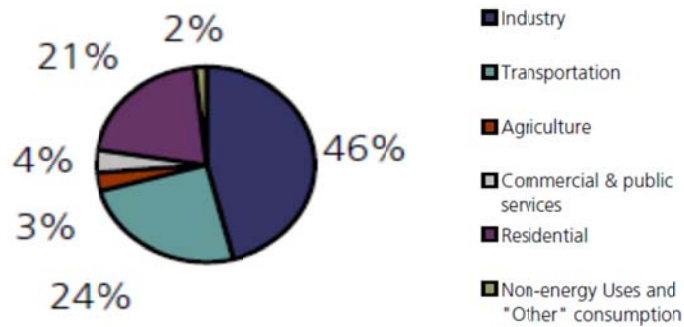


Figure 3-6: South African Energy Consumption by Sector (World Resources Institute, 1999)

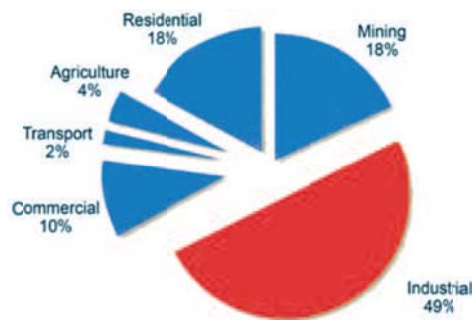


Figure 3-7: Eskom's Energy Consumption by Sector (Van Zyl, 2009:7)

In more studies conducted recently, it was found that approximately half of Eskom's electricity generated, is supplied to industrial consumers and eighteen per cent is supplied to the mining and residential sectors respectively (Van Zyl, 2009: 6).

In 2007 the Chief Executive of the Chamber of Mines in South Africa, indicated that the Mining Industry accounts for 16 per cent of the total energy demand in the country, and that 93 per cent of all electricity usage in mining, is generated from coal (Diliza, 2007:2). Based on the information in Table 3.1, it is submitted that the mining industry appears to be the most energy intensive sector in the South African economy on a usage per industry level.

Table 3-1: Electricity per user utilized

Sector	Percentage of Eskom Electricity used	Number of users	Percentage per user
Industrial	49%	3 000	0.0163%
Mining	18%	1 000	0.0180%
Commercial	10%	50 000	0.0002%

It is therefore concluded that the mining sector is a significant consumer of electricity when compared to the overall energy consumed in South Africa as well as a sector that is very energy dependent (Seekoei, 2009:48-49; Anon, 2009:36). This fact was emphasised during the blackouts of 2008 when some mines were forced to cease operations temporarily to try and recover from the energy deficiencies (Anon, 2009:36; Seekoei, 2009:49).

The reason behind South Africa's high energy intensity is found in the nature of the activities in the mining industry: hoisting of ore, smelting and drilling, and the fact that the mining industry is inherently energy intensive (SA, 2009:8). South African mines are mostly deep-level mines. Ore reserves that are deep below ground increase the amount of energy required for hoisting ore, cooling, pumping water and supplying air for underground drilling and ventilation (Van Zyl, 2009:7; SA, 2009:8). An additional factor contributing to the South African mining industry's high energy intensity is that the ore grades are declining (Department of Energy, 2010:72). Due to this decline, mines, especially gold mines, are now required to delve even deeper and need to mine greater amounts of ore for each tonne of gold produced. Eskom (2010:2) indicated that from the vast supply of electricity supplied to the mining industry, gold mines consume 47 per cent while platinum mines use 20 per cent of electricity supplied. Figure 3.8 illustrates the energy requirements in the South African industrial and mining sectors.

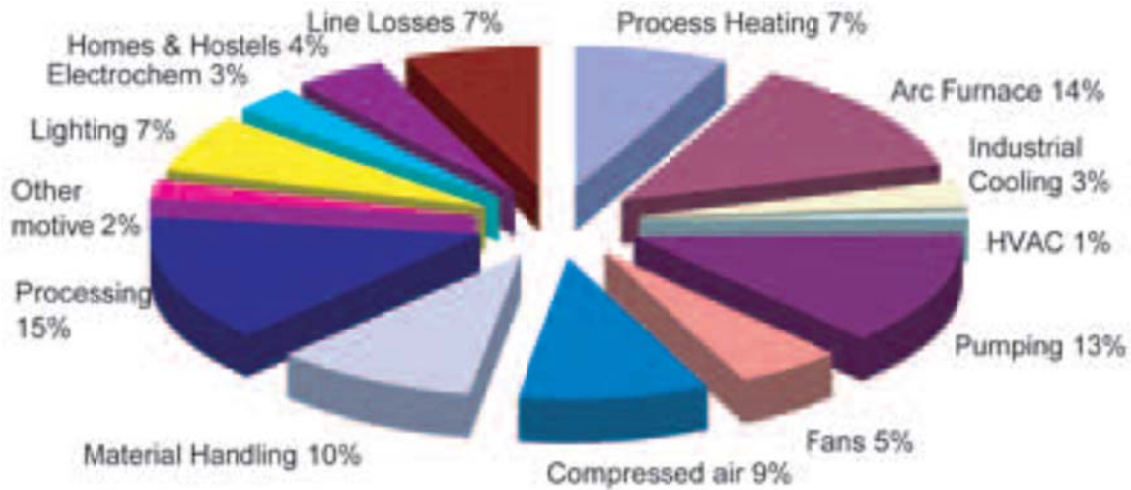


Figure 3-8: Energy demand in the industrial and mining sector (Nortje, 2006:45)

When taking into account the energy needs of the mining industry, it can be concluded that electric motors and motor systems form the major portion of the electricity used in the industry as they will be utilised in pumping, operating ventilation fans, supplying air and running conveyor belts (Eskom, 2010:3). Eskom (2010:3) indicated that 60 per cent of all electricity used in mining is used by electric motors and motor systems and that pumping is the activity that uses the most electricity. Based on Figure 3.8, the processing of minerals by the mining industry is another significant use of electricity in the mining industry.

Eskom (2010: 4-7) explained the energy needs of the above mentioned electricity utilisation equipment as follows:

- Compressed air systems are used extensively in the mining industry in order to operate a variety of equipment, including drills that form an integral part of operations. By their nature air systems are vulnerable to damage and leaks and this reduces the effectiveness of the equipment and wastes electricity. The problem results in more efficient systems losing 5 per cent of capacity while substandard systems lose upwards of 40 per cent.
- Pumping equipment is utilised in most South African mines, as without these pumps deep level mining will be virtually unfeasible. These pumps supply water for drinking, washing and other process applications at high pressure to various parts of the mines. Most underground mines in South Africa also experience an inflow of ground water which has to be pumped out in order to maintain mining operations (Chamber of Mines, 2013).

- Ventilation fans are required in mines in order to ventilate underground mining operations, supplying fresh air to miners and extracting dangerous gases. To this effect most fans are run 24 hours a day which results in substantial electricity usage. The average gold mine in South Africa requires approximately 6 cubic meters of air to be circulated per second for each 1000 tonnes of rock mined per month (Chamber of Mines, 2013).
- The Chamber of Mines (2013) indicates that a substantial amount of electricity is also required for cooling in mines. This is due to the fact that the deeper the mine operates, the higher the virgin rock temperature grows.

The preceding discussion indicates that the South African mining industry is a material contributor to carbon emissions in the South African context, due to the fact that the mining industry is a significant user of electricity generated in South Africa.

3.3.2 The South African Mining Industry's importance in the national economy

Before considering the implementation of a carbon tax, the significance of the South African mining industry in the national economy should be evaluated.

Based on gross domestic product contributed to the economy with approximately US\$ 21 billion contributed, (Baxter, 2011:5) the South African mining industry is the fifth largest mining sector in the world. As per the facts and figures as published by the Chamber of Mines (2011:1-42) for 2011, the mining industry contributes to the South African economy in the following ways:

- The mining industry contributed 8.8 per cent directly to the gross domestic product (hereafter GDP) but its combined contribution (direct and indirect) was much larger at approximately 19 per cent. This means that the mining industry contributed R99.4 billion to the GDP during 2011. Baxter (2011:26) supported the above by stating that most of the expenditure incurred by South African mines is incurred in South Africa and therefore stimulates economic growth and development.
- The mining industry, notwithstanding the recent economic recession, still contributes more than 20 per cent of private sector investment and approximately 12.3 per cent of total investment to the South African economy. Diliza (2007) further indicated that the mining industry is also responsible for 50 per cent of merchandise export, both

primary and through beneficiated mineral exports. This leads to the mining sector earning more than 50 per cent of foreign exchange earnings (Baxter, 2011:24).

- As for the Johannesburg Securities Exchange (hereafter JSE); the mining industry accounted for 29 per cent or R1.4 trillion of the JSE's total worth.
- The mining industry contributed 18.5 per cent of corporate tax receipts with approximately R11 billion paid in 2009 (Baxter, 2011:24).
- The mining industry further supplied 93 per cent of electricity through the supply of coal to coal fired power stations and in turn the mining industry used approximately 15 per cent of electricity generated (Baxter, 2011:24). This indicates that the mining industry, in particular the coal mining industry in South Africa, has a special interest in the wellbeing of the electricity supply industry (Chamber of Mines, 2013).
- Eskom (2010:2) indicated that the South African mining industry does not only consume a significant amount of electricity, but is also the country's largest producer of national wealth.
- Just under 500 000 people were also directly employed in the mining industry and this accounts directly for 8% of the total private non-agricultural employment. South Africa's mining industry further also creates another 500 000 indirect labour opportunities (Baxter, 2011:24).
- South Africa has the world's largest reserves of gold, platinum group metals, chrome, manganese and large reserves of other metals (Department of Energy, 2010:72). South Africa is the largest platinum producing country, and one of the leading producers of gold, diamonds, base metals and coal.

This synopsis indicates that, considering the mining industry and the amount of carbon emissions that it is responsible for, the importance of the industry to the South African economy should not be disregarded.

When contemplating the implementation of a carbon tax in South Africa, it is important to acknowledge that investment in the South African economy is dependent on South Africa having a competitive, stable and predictable mining environment as well as a transparent taxation system (Diliza, 2007). The political, environmental and financial challenges facing government on implementing a carbon tax that affects the mining industry, are extensive.

3.4 The proposed Carbon Emissions Tax (CET) for South Africa

3.4.1 The background to the development of the proposed CET for South Africa

As stated in chapter 1.3, at the 2009 Climate Change Conference held in Copenhagen South Africa announced that it will voluntarily reduce its carbon footprint by 34 per cent by 2020 and by 42 per cent by 2015. Shortly after, the National Treasury released its original discussion paper for public comment on reducing greenhouse gas emissions. In this discussion document the National Treasury (2010:15-19) pointed out that global warming, as a result of the burning of fossil fuels, is a real and significant threat to South Africa and to the rest of the world. The Treasury indicated that, not only is South Africa affected by global warming, but it is also a contributor to global warming through the emission of carbon dioxide in relatively large volumes, when compared to emission by other developing countries and to the rest of Africa. Similar conclusions have been reached in the earlier discussions in this document, specifically in chapter 2.2 and chapter 3.2.

In response to the above threat of global warming, the National Treasury (2010:27) indicated that it considered a market based instrument to be more effective than command and control policies imposed on the South African environment. The National Treasury argued that, command and control policies were likely to add an additional cost to the economy when compared to market based instruments. As different sectors will have different abatement costs to reduce emissions, command and control policies will force some polluters to accept higher abatement costs in order to reduce emissions costs than would have been paid if market based instruments were used. This is due to the fact that, with a market based instrument each polluter has the choice as to what form of abatement to choose, and the cheapest option available can therefore be adopted. The greater flexibility of market based instruments should therefore result in a reduction in the total cost that a carbon reduction programme will enforce on the economy. These arguments are consistent with the views discussed in chapter 2.3.2.

The discussion paper considered both carbon tax and emission trading schemes (National Treasury, 2010: 27-29). In conclusion, the National Treasury (2010: 58-59) found that a carbon tax will be more suited to the South African economic climate than an emission trading scheme would be.

The following key arguments have been raised by the National Treasury in favour of a carbon tax above an emission trading scheme:

1. A carbon tax design is easier to administer and to comprehend and can be administered by the existing tax authority. New financial regulations will therefore not be required.
2. The level of tax can be phased in over time and a carbon tax can easily be adjusted to reflect the cost of carbon emissions.
3. Carbon tax will provide price certainty, which is essential for investment decisions in a developing market, as the price per emission will be known from the start of the policy and will not be determined by a market that can fluctuate.
4. Uncertainty relating to tax implications (VAT and other) of trading credits will be avoided.
5. With a carbon tax the competitive market required for effective trading of emission credits is not a prerequisite, and therefore the uncertainty relating to participation and market pricing of emission credits is eliminated.

The decision of the National Treasury to implement a CET as opposed to a carbon emission trading scheme, was not accepted without criticism and some of the key arguments are discussed below.

The Chamber of Mines (2001:10) commented that, while many of the international competitors of the South African mining industry have not implemented a carbon tax or similar programme, the implementation of a carbon tax in South Africa, without an international agreement relating to carbon emissions, will result in the erosion of the competitiveness of the South African mining industry (Chamber of Mines, 2011: 10). Concerning this statement, Lloyd (2011:20) was of the view that, as carbon emissions and global warming are in essence global problems and not country specific problems, introducing a carbon tax in South Africa whilst the rest of the world does not do so, will cause South Africa to become uncompetitive. In his opinion, it would be premature to introduce a carbon tax in South Africa, while the biggest emitters are not implementing a carbon tax and this will only cause South African industries to be less competitive.

The Energy Research Centre (hereafter ERC) commented that in the original form the carbon tax proposal does not provide for timing commitments and does not indicate when the modest

rate of R75 will be increased to the high rate of R200 and therefore, if these timing increases are not specified, a weaker price signal will be communicated to the market. This will result in price uncertainty and will reduce the advantage that a carbon tax has over an emissions trading scheme. The ERC continued to assert that the National Treasury's argument stating that there are too few players in the South African market to render an emissions trading scheme effective, does not take in to consideration the fact that global emissions trading schemes can be linked (Energy Research Centre, 2011:1-5).

The advantages and disadvantages of carbon tax and emissions trading schemes were considered in chapter 2.3.5 as well as 2.4. Notwithstanding the fact that a detailed assessment in this regard is beyond the scope of this study, the discussion suggested that a carbon tax will be more effective where price certainty is required and this supports the National Treasury's assessment that a carbon tax will be the better option for South Africa. Based on the review of the energy requirements, as well as on the economic importance of the South African mining industry (chapter 3.3), it is submitted that special attention needs to be given to the potential impact on this industry when implementing a CET.

3.4.2 The initial carbon tax proposal, comments thereon and adjustments made

3.4.2.1 Initial carbon tax proposal

In its discussion paper for public comment on reducing greenhouse gas emissions, the National Treasury (2010:59) suggested that a carbon tax should be implemented at a fixed rate of between R75 and R200 per tonne of carbon dioxide emitted, based on 2005 values. In this paper the National Treasury also suggested that:

- The tax rate should, over time, equal the marginal costs to the environment.
- All sectors of the economy should be covered.
- The tax should preferably be based on verified emissions, but a proxy tax on the carbon content of the fossil fuel utilised, would also be considered.
- Any tax relief tax should be limited and be of a temporary nature.
- Revenue generated from this tax will not be earmarked specifically and in full for carbon reducing projects, but will be used as the Treasury deems appropriate, which may include budgeting for specific environmental projects.
- The tax needs to minimise the impact on the poor and not impede the competitiveness of key industries.

3.4.2.2 Comments on the initial carbon tax proposal

A number of comments regarding the proposal suggested above, were submitted to the National Treasury and some of these have been discussed below.

At the annual general meeting of the Chamber of mines on the proposed CET, the Chamber commented that the mining industry is strongly opposed to a carbon tax, as this it will only increase the revenue of the National Treasury, without achieving a lower carbon intensive economy (Chamber of Mines, 2011: 10). The Energy Research Centre (2011: 1-5) stated that, budget allocation or earmarking of the revenue collected from the carbon tax to carbon reduction projects, may be a better option than having no specific allocation. Further clarity on how National Treasury intends to reduce other tax burdens from the public with the additional revenue generated from the carbon tax, is required. Based on the discussion in chapter 2.3.4 and 2.3.6, if the above can be achieved, more public support for the tax will be achieved and will contribute to the ultimate success of the tax.

The Energy Research Centre (2011:1-5) commented that the reluctance of the National Treasury to allocate funds to specific projects, and the objective to assist the poor by allocating some of the revenue of the tax, are contradictory and stated that the earmarking of funds will increase transparency of the tax and will thereby generate more public support. The Energy Research Centre continued to state that more clarity is required concerning how the poor will be protected when the implementation of a carbon tax will likely only increase the cost of electricity. Based on the discussion in chapter 3.2, it is to be expected that, due to the high reliance of the electricity sector on coal in the production and generation processes, a carbon tax is likely to increase electricity prices. It is therefore submitted that, based on the importance of the mining industry and the National Treasury's objectives to protect key industries as well as the poor, special consideration should be given to marginal mines and the potential effect that the implementation of a carbon tax may have on these mines.

Excluding certain sectors from the tax should be considered, but this decision must be taken with due care, as it may ultimately lead to the implementation of an ineffective system (Energy Research Centre, 2011:1-5). Even though this is not specifically included in the scope of the study, chapter 2.3.5.3 stated that sector exclusions may permanently weaken a carbon tax system and is therefore consistent with the ERC's comment. The ERC continues to state that sector exclusions should only be considered if the industries are inflexible in the

short to medium term, and that revenue collected through this tax should be allocated to programmes created in order to assist these highly affected and energy intensive sectors in reducing their carbon emissions. It is submitted that constructed on information in chapter 3.3.1, the mining industry resembles one of these industries with high energy reliance and inflexible energy generation options and, for this reason, should be considered for initial exclusion from the proposed carbon tax, while more acceptable solutions are researched.

An adjustment mechanism should be incorporated into the carbon tax in order to ensure that the level of the tax levy can be adjusted, with the aim to achieve the long term emission reduction targets as set out above. This mechanism will ensure that emission reduction uncertainty will be mitigated (Energy Research Centre, 2011: 1-5). It is submitted that this adjustment can be applied both nationally and on an individual polluter level and thereby enforce the principle of the polluter being forced to pay (Chapter 2.3.4), whereas those that do not meet targets and pollute, are taxed more than those that meet reduction targets.

The discussion in chapter 3.3.2 of the South African mining industry already indicated that this is a key industry in the South African economy and therefore, based on the preceding discussion, the objective of protecting the international competitiveness of key industries may be endangered by the implementation of a carbon tax. The competitiveness of key industries should be protected by finding industry specific solutions rather than by starting at a low rate in order to accommodate, as this will counteract the ultimate goal of reducing greenhouse gases (Energy Research Centre, 2011:1-5). It is submitted that this approach is acceptable for the mining industry, but while research is being performed to find this appropriate solution, a phase-in approach is the most effective alternative in order to ensure the competitiveness of the mining industry.

In another comment by Lloyd, he stated that South Africa, as a developing country, needs to focus on growing its economy. The implementation of a carbon tax will result in a tax on development, as it will be a tax on energy, and energy and development are directly associated in South Africa (Lloyd, 2011:20). In chapter 3.2.2 it was stated that South Africa requires energy in order to achieve its developmental goals. In chapter 2.3.2 it was stated that, as long as the market based instrument decided on is implemented correctly and takes into account the country's economic situation, the long term effect of the instrument will not harm that country's economic growth, due to the fact that the long term marginal social cost and the social benefit will be identical.

The ERC stated that calculating the marginal cost of carbon emissions entails significant uncertainties and unpredictability and was of the view that, as carbon emissions and global warming are global problems, the global marginal cost per emission should be calculated and that this will prove difficult (Energy Research Centre, 2011:1-5). In a related point, Lloyd commented that the rates proposed by the Treasury are too high, specifically when compared to independently established external cost rates (Lloyd, 2011:20). The ERC suggested that it might be more appropriate to set the tax level at the minimum cost estimate for achieving a specific set of national economy-wide mitigation goals. Based on the comments from the Chamber of Mines, it is submitted that this option will be acceptable to the mining industry and connects with the theory that, as the long term social cost and social benefit associated with a market based instrument is equal, the instrument will not harm long term economic growth (Chapter 2.3.2).

The ERC commented that consideration should be given as to when a CET is implemented as the possibility exists that the industry will pass on this tax to the end users of its products and services (Energy Research Centre, 2011:1-5). This is considered specifically relevant in the mining industry as the mining industry is a price taker and therefore has to accept externally generated prices on products. Based on facts in chapter 3.2 and 3.3, Eskom is the major producer of electricity and is likely to pass on the tax to the users, with mining being a significant user of Eskom products (Cabral, 2000: 85 – 86). Deduced from this fact, it is submitted that careful consideration should be given to ensure that the carbon tax is implemented accurately and takes into account the economic conditions in the country, specifically bearing in mind its impact on the mining industry with its unique energy requirements, and its relevance to the economy (as discussed in chapter 3.3), in order to prevent hampering the competitiveness of the industry.

In summary the following key deductions have been made:

- Without specific allocation of the funds collected with a CET, to carbon reduction projects, it is unlikely that the goal of a decrease in carbon emissions in the economy will be achieved.
- It will be hard to determine how the poor will be protected from the effects of growing electricity costs, due to lack of on budget allocation of funds.
- The exclusion of some sector from the tax should be considered, especially where those sectors are highly affected by the tax.

- An adjustment mechanism should be considered to ensure that the level of tax levied can be adjusted to protect, among others, key industries.
- Specific long term solutions for protecting key industries should be found rather than a phasing-in of the tax with tax exemptions for key industries.
- The calculation of the taxation rate is difficult to determine, as the international costs of carbon emissions needs to be determined at the outset. If in general, the rate is considered too high the suggestion is that the rate should be equal to the minimum cost to achieve a set of national carbon reduction goals.
- Consideration should be given to the time at which the tax will be imposed, as well as to carrying the ultimate tax burden (industry or user) associated with the tax.

3.4.2.3 Adjustments to the initial carbon tax proposal

During 2012, and in response to the public comments received, the National Treasury (2012:56) proposed some adjustments to the design of the original proposal for a carbon tax. A carbon tax of R120 per tonne of carbon dioxide, as opposed to the R75 to R250 price range in the original proposal, will be levied from 2013/14 and will be increased by 10 per cent annually. This was to give transparency as to the timing and levels of CET and to enhance the price certitude.

In response to, and with the intention to address the comments relating to a potential exclusion from, as well as an adjustment mechanism to the tax, a percentage based threshold on total emissions below which the carbon tax would not be levied, rather than an absolute emission threshold, was implemented. The initial tax free threshold was set at 60 per cent of total carbon emissions for each year of assessment, with the option for the National Treasury to increase or decrease this percentage over time (refer to table 3.2 below for more detail on the proposed threshold). This was comparable with excluding or reducing the effect on certain sectors from CET and resulted in a phasing in of carbon tax. This would have assisted the National Treasury to better determine the cost to industry and related reduction in greenhouse gases over time. The percentage-based threshold was therefore an adjustment mechanism that intended to achieve optimal reduction in greenhouse gases while giving industry time to adjust to the different levels of the tax. The percentage threshold and reduced CET rate acknowledged the fact there was no global CET agreement and that implementing one locally, would restrict the competitiveness of the South African economy.

In response to the comments made that certain sectors should be excluded from the tax in order to protect the international competitiveness of these sectors, the tax-free threshold would be higher for sectors that process raw materials locally and include the iron and steel, cement, aluminium and glass sectors (Refer to table 3.2 below for more detail on the threshold proposed). The purpose of this amendment was to ensure that sectors that process locally, would be less affected by the implementation of a CET and the impact of the tax on economic growth would therefore be reduced.

For further protection of key international trading companies, and in response to the comments made that international trading companies would become uncompetitive, an additional adjustment would also have been allowed for trade exposed sectors. There was no such allowance in the original proposal.

Offsets against a company's carbon tax liability would be allowed for investments in carbon emission reduction incentives. This allowance would only be made for a maximum range of between 5 and 10 per cent until 2019/20. This would have allowed the industry to select the most cost effective approach to take in response to the carbon tax levy by providing industry more flexibility and was not allowed for deduction in the original proposal. Additional relief might also have been considered for companies that could reduce their carbon intensity during the initial phase (2013/14 to 2019/20) of the carbon tax. This would have resulted in companies having additional incentives to invest in green technology and reduced carbon emissions.

In response to the comments made that the cost per tonne of carbon dioxide would be difficult to determine, and that the original tax rate would be too high, the National Treasury decided that the carbon tax would be phased in from 2013/14 until 2019/20, instead of a once off implementation as was originally suggested. The percentage based tax free threshold would thereafter either be reduced, or could be completely replaced by an absolute emissions threshold.

Reductions in carbon intensity would have been measured against a base year or industry benchmark. The polluter-pays-principle would therefore have been applied and the goal or benchmark for each industry could have been specifically set, based on the characteristics of the industry involved. The original proposal did not make any distinction between industries, and therefore this suggested adjustment would have acknowledged the comments made that

different industries have different levels of emissions and have different abatement opportunities available to them.

The National Treasury once again reiterated that revenue generated from the tax collected, would not be earmarked for any specific goal, but consideration would be given to environmental concerns and to supporting low income households. Once again no specific mention of how this would be achieved was made.

Table 3-2: Proposed emission thresholds per sector

Sector	Basic tax free threshold below which no tax will be levied during the first phase (2013 to 2019)	Maxim additional allowance due to trade exposure	Additional allowance for “process” emissions	Total maximum tax free threshold	Maximum offset percentage
Electricity	60%	0%	0%	60%	10%
Petroleum (coal to liquid)	60%	10%	0%	70%	10%
Petroleum (oil refinery)	60%	10%	0%	70%	10%
Iron and steel	60%	10%	10%	80%	5%
Aluminium	60%	10%	10%	80%	5%
Cement	60%	10%	10%	80%	5%
Glass & ceramics	60%	10%	10%	80%	5%
Chemicals	60%	10%	10%	80%	5%
Pulp & paper	60%	10%	0%	70%	10%
Sugar	60%	10%	0%	70%	10%
Agriculture, forestry and land use	60%	0%	40%	100%	0%
Waste	60%	0%	40%	100%	0%
Fugitive emissions: coal	60%	10%	10%	80%	5%
Other	60%	10%	0%	70%	10%

National Treasury (2012:186)

The following additional design clarity on the total tax free threshold and adjustment to the basic tax free percentage was provided in the 2012 Budget Review (National Treasury, 2012:186-187):

- The total maximum tax free percentage for each entity would be limited to 90 per cent of actual verified emission over a given period. Each entity would therefore always have paid carbon tax on a minimum of 10 per cent of emissions.
- The basic tax free threshold would have been adjusted, based on a formula that takes into account efforts made by companies in order to reduce carbon intensity during the year. The formula would have calculated a factor (Z) for the company that took into account the agreed benchmark carbon intensity for the sector (Y) that the company operates in, as well as the average measured and verified carbon intensity of the output of the company (X) during the period under review. The formula proposed, was: $Z = Y / X$. Utilising this formula, companies that gave performances exceeding that of the industry standard, would have been rewarded with a higher basic tax free threshold while companies that were performing more poorly than did industry, would have been penalised with a lower basic tax free threshold. This would have enhanced the-polluter-pays-principle and would therefore have resulted in more public support for the tax. The example below illustrates the adjustment made.

Example

Companies A, B and C are in the same industry and sector. The agreed benchmark for the sector has been determined as 1 tonne of carbon dioxide per unit of output (Y). The three companies produce the following levels of carbon dioxide emissions per unit produced (X):

- A= 0.9
- B= 1
- C=1.1

Based on the formula, the basic tax free threshold for each company is reflected as follows: $(Y/X) * 60$ per cent:

- $A = 1/0.9 * 60$ per cent = 66.67 per cent
- $B = 1/1 * 60$ per cent = 60.00 per cent
- $C = 1/1.1 * 60$ per cent = 54.55 per cent

The example illustrates that the less carbon intensive the company is when compared to the benchmark, the higher the basic tax free threshold will be and the amount of carbon tax payable will therefore be reduced. The reverse is also illustrated.

During the 2013 Budget Review, the National Treasury (2013:57) confirmed that a carbon tax would be phased in over time and continued to state that a revised discussion document would follow during the year, while also making two further design alterations.

Carbon taxation would still be effective at a rate of R120 per tonne of carbon dioxide emitted but the effective date for payment of any amount of tax has now been extended and specified as 1 January 2015.

The National Treasury indicated that some of the revenue that would be generated from the carbon tax, would be utilised to fund energy-efficiency savings tax incentives, while the phasing out of electricity levies over time would also be considered. This was a move away from the previous stance that no specific allocation of funds would be allowed and this acknowledged the comments made in this regard.

3.4.3 The current tax proposal and comments made thereon

3.4.3.1 Latest CET proposal

During May 2013 the National Treasury (2013) released the updated policy paper on CET. The policy paper outlines that the carbon tax policy has been designed by taking into account the following key considerations (National Treasury, 2013:46):

- The tax should be technically and administratively feasible to implement.
- In the long term, the rate at which the tax is levied should be equal to the marginal cost of external damage caused per emission, but over the short term, while there is still no global emission reduction agreement available, the tax rate should be conservatively set so as to protect key industries.
- Tax free thresholds and offsets to a maximum of 90 per cent of total emissions will initially be allowed in order to allow for industry to adjust to the new tax, and simultaneously to protect key industries as well as low income households.

- Consideration will be given to on budget allocation of funds generated by the implementation of the tax. These funds will be made available for projects that reduce carbon emissions, as well as reduce the impact of the tax on low income households.
- The National Treasury once again stressed that relief measures resulting from implementing the tax, will be temporary in nature.

The following key design features have been identified from the updated carbon tax discussion document and discussed below (National Treasury, 2013:46-64).

The tax base that will be used in the calculation should ideally be based on the amount of direct greenhouse gas emitted per polluter. As this option is not feasible at this stage resulting from lack of measurement of emissions, a fuel input tax will be levied based on emissions factors linked to the fossil fuels and amount of fossil fuels used. A tax rate of R120 per tonne of carbon dioxide equivalent will be levied from 2015 and will increase by 10 per cent per annum. It is to be trusted that this will give strong price signals, which will influence the investment behaviour of affected companies.

A project implementation phased approach to the application of the proposed carbon tax will be implemented by increasing the level of tax in the manner stated above, and by using a percentage based threshold based on absolute emissions as indicated below. No tax below this threshold will be levied during the first phase of implementation (2015-2019) and the initial tax free threshold has been set at 60 per cent and will once again be adjusted for individual companies to ensure efficacy when compared to a benchmark for the sector (refer to chapter 3.4.2.3). The National Treasury has indicated that the high tax free threshold has been implemented in order to reduce the adverse effect that the implementation of a national carbon tax without an internationally binding agreement can have on the competitiveness of key industries.

Additional guidance with regard to the adjustment of the basic tax free threshold, has been provided. The guidance states that the same formula and approach as discussed in chapter 3.4.2.3 will be taken but clarifies by stating that both the agreed benchmark carbon intensity for the sector and the average measured and verified carbon intensity of the output of the company, will include both scope 1 (direct carbon emissions) and scope 2 (indirect carbon emissions through purchase of electricity etc.) emissions. The National Treasury has further commented that, relating to the electricity generation sector, during the initial period the

sector's benchmark for coal fired power stations will be set at the current most effective (least emissions per unit of electricity generated), coal fire power station level of emissions. This has been decided on, even though the National Treasury confirmed that it is very probable that the electricity sector will pass on the tax to end users.

The National Treasury has also provided further clarity on the maximum efficiency adjustment, declaring that the basic tax free rate threshold can be adjusted but stating that the rate can only be adjusted by a maximum of 5 per cent (either increasing or decreasing), and that a total maximum reduction (including offsets) of 90 per cent can be achieved. A company will therefore always pay tax on a minimum of 10 per cent of carbon emissions released.

Trade exposed sectors that are also energy intensive will gain additional relief in the form of a maximum increase of 10 per cent in the tax free threshold (refer to table 3.2 in chapter 3.4.2.3). Trade intensive industries have now been defined as industries where the international inputs and exports combined are responsible for in excess of 40 per cent of domestic output and the mining industry has been classified in this category. Companies that fall in this category will now have the choice of using one of two formulas in order to calculate the additional relief. This is still to be discussed in greater detail at a later stage in this chapter.

Initially, offsets against the tax payable will be allowed for investments in carbon reduction projects. A detailed list of the percentage based threshold, offsets and other allowances is provided in chapter 3.4.2.3 table 3.2. The only change made to this table in the revised discussion document, is that aluminium has been considered a separate sector.

The National Treasury has still not provided exact guidance as to what will qualify as offsets, but have committed to publishing a further discussion document in this regard during the second half of 2013.

The National Treasury has once again stated that the phasing out of the current electricity level in the long run will be considered, but has made no firm commitment in this regard. The Treasury has also mentioned that the much awaited section 12L of the Income Tax Act (58 of 1962) which allows for deductions for proven electricity efficiency savings, is in the process of being implemented.

As indicated above, there has been no significant new adjustment to the 2012 and 2013 budget speech information provided. The most significant change is that the National Treasury has moved away from a “no ring fencing” stance since the first draft was published to a stance in which allocation of revenue and tax-shifting will be considered.

Clarity in calculating maximum trade exposure deduction

Based on the above discussion, a formula based approach will be followed to calculate the maximum allowance for trade and energy intensive sectors. Firms have the choice of two formulas to calculate the additional percentage relief. Firms will have the option to either use exports only, or exports and imports combined, and express this as a percentage of total sales or output. Please see below for the formulas:

- Exports and imports
 - $Y1 = 0.2 * (E+I)$
- Exports only
 - $Y2 = 0.4 * (E)$

In the formulas above Y1 and Y2 are the percentage additional allowance that will be granted (up to the maximum of 10 per cent). E represents the exports as a percentage of output (minimum of 5 per cent allowed) and E+I represent exports and imports as a percentage of output (minimum of 5 per cent allowed). Table 3.3 below illustrates the impact that the formula can have on a range of values.

Table 3-3: Additional allowance for trade intensive industries

Exports and imports		Exports only	
(E+I)	Additional allowance received	(E)	Additional allowance received
Below 10	0	Below 5	0
10	2	5	2
20	4	10	4
30	6	15	6
40	8	20	8
50	10	25	10
60	10	30	10
70	10	35	10

3.4.3.2 Comments on the latest CET proposal

The latest draft of the proposed CET policy was open for public comment until 2 August 2013 and comments on the latest proposal as well as on the previous proposal that have not been resolved, have been made and discussed below.

A CET on the energy sector will be inappropriate as the South African energy sector is ultimately centrally governed, planned and operated by the government. There is limited scope for moving away from coal fired power stations in the short or medium term as, currently, the vast majority of power is generated from coal in South Africa and will therefore be subject to the proposed tax (Nersa, 2011:5-7; Cloete & Tyler, 2012:2).

A carbon tax will therefore ultimately increase the cost of the electricity price as the current electricity pricing policy allows for Eskom to pass on the full impact of the tax to consumers (Promethium Carbon, 2013:4; Deloitte, 2013:2). The potential impact of this allowance to pass on the CET will have a double negative impact on the economy. Firstly, the incentive for Eskom to invest in a less carbon intensive electricity generation option is reduced, as Eskom will only pass on the tax and secondly, the transparency of the tax is reduced (Promethium Carbon, 2013:4; Falco, 2013:20). This may lessen the impact the allowance for trade intensive industries and carbon offsets can exert, and will have negative behavioural consequences when the parties affected have very limited or no options in response (Nersa, 2011:7). A number of South African companies will therefore be disproportionately vulnerable to the implementation of a carbon tax (Cloete & Tyler, 2012:2). It is submitted that this is especially true for the mining industry as this industry will be affected by both the increase in electricity prices due to its heavy reliance on electricity generated by Eskom (chapter 3.2), as well as by its inability to pass these increases on to the users of its products, as it is a price taker.

National Treasury has not set a minimum level of emissions where no tax is payable as is international practice (refer to chapter 3.4.3.1 where it is discussed that 10% tax will always be payable). Due to this, all companies emitting greenhouse gases, however small the amount of emissions may be, will be required to pay CET. This may lead to a scenario where a company that is exempted from greenhouse gas reporting requirements, will still need to pay CET (Promethium Carbon, 2013:4).

The level or the way in which sector benchmarks will be set has not been clarified in the carbon tax policy. As these benchmarks are used in the calculation of the efficiency of the basic tax free threshold, the impact on individual companies can be substantial (Promethium Carbon, 2013:4). These benchmarks can further be difficult to determine, based on differentiation in the South African economy and the difficulty experienced by the United Kingdom (Regan & McNamara, 2012:3). The only guidance provided in this regard, is that the electricity sector will use the most efficient coal generated electricity plant as the benchmark for all coal fired power stations. As this will be the most effective plant, the effect will be a lower basic tax free threshold set for the industry in general and an increase in the overall tax burden on the economy.

As discussed above, this additional tax burden will not be paid by Eskom and others suppliers of electricity, but by the consumers of the products. This approach will also be difficult to implement and unreliable, as different players in the different industries have different business models and product specifications and will therefore utilise electricity in various ways (Promethium Carbon, 2013:5). It is submitted that, based on chapter 3.2 and 3.3, the mining industry is a prime example, as the different mines have different energy requirements and needs depending on the depth of the resources, the quality of the ore reefs and the type of metal or mineral mined.

The level of tax that will be paid will depend on the sector that a company is classified in. There is, however, uncertainty regarding which sector companies will be classified into (Promethium Carbon, 2013:6). It is submitted that this is especially difficult for the mining industry, as the same company can extract as well as process minerals and may therefore potentially fall within more than one sector classification.

The updated proposed CET regime does, however, have some advantages as well. The global environment is moving towards lower carbon emissions and by implementing a CET, South Africa is determining that it moves with the times and this reduces the likelihood of negative international trade implications (Cloete & Tyler, 2012:2; Promethium Carbon, 2013:2). This statement should, however, be qualified by noting that, while the rest of the world may be considering a carbon tax or its alternatives, it will be futile for South Africa to implement a carbon tax in isolation, without an international carbon agreement as China, the world's leading carbon emitter, has increased its carbon emissions during the year by the total amount of South African carbon emissions (Gafner, 2012:18).

The advantages of investing in carbon reduction projects are that these can be offset against the carbon tax and whereby tax responsibility is reduced and this allows for industry to choose the lowest cost mitigation solution (Promethium Carbon, 2013:2). A further advantage is the complete exemption given to the agriculture industry during the initial phase of implementation as this provides security of food and agricultural resources and protects the poor from some of the effects of the tax (Promethium Carbon, 2013:3). It should however, be noted that the increase in electricity prices will negatively affect the poor, who, in some cases, already have to choose between electricity and nutrition, as taxation gives rise to overall price inflation. (Misty, 2013:1; Falco, 2013: 20; Cloete & Tyler, 2012:2).

In summary, the following key comments have been made:

- Applying the proposed CET on the South African energy sector (mainly referring to Eskom) will be inappropriate, as this will ultimately result in the price of electricity being increased. Eskom will have the opportunity of recharging the tax to consumers and this will result in the incentive for Eskom to invest in less carbon intensive electricity generation options to be reduced.
- Any potentially positive impact on behavioural change that the proposed allowance for trade intensive industries and carbon offset options may have had, will be negatively affected as parties affected will have very limited or no options when responding to the tax. The mining industry may be affected more than most, due to its heavy reliance on electricity generated by Eskom as well as by its inability to pass these increases on to the users of its products as it is a price taker.
- A minimum level of emissions where no tax is levied has not been set and for this reason all companies emitting greenhouse gases, however small the amount of emissions may be, will be required to measure carbon emissions and pay CET.
- Limited guidance has been provided as to the method that will be used to determine the sector benchmarks and as these benchmarks will be used to determine the ratio of efficiency and basic tax free threshold, the impact on individual companies can be substantial if set too high.
- The level of tax free allowances a company is entitled to, will depend on the sector that the company is classified in. There is, however, uncertainty as to the sector companies will be assigned to, especially as some of those companies may potentially fall within more than one sector, due to the nature of their operations.

- The implementation of a CET in South Africa, indicates that South Africa is following the global trend of being more environmentally conscious and South Africa has thereby reduced the chances of negative international trade implications being imposed on itself.
- The allowance for investments to be made in carbon reduction projects, can be offset against the carbon tax and thereby reduce the tax responsibility and this is advantageous as it allows for the industry to choose the least cost solution.
- The exemption given to the agriculture industry during the initial phase of implementation will assist in protecting the poor from the knock-on effect of the tax on agricultural products. The poor will, however, not be exempted from the effects of the tax, as the increased electricity prices will negatively affect them by causing prices of various other products to inflate.

3.5 Conclusion

Based on the discussion in this chapter, it is evident that South Africa is a contributor to global warming through its comparably high carbon dioxide emissions. It is, additionally, evident that the South African mining industry is a material contributor to South African carbon dioxide emissions through its heavy reliance on coal fired electricity in its operations, while simultaneously acting as an important sector in the South African economy. The comments on the proposed CET, indicate that there is limited scope for the mining industry to move away from coal fired electricity to avoid the tax, as the South African electricity market is ultimately government owned and operated. Based on the classification of specific companies and the tax free threshold (reduction) being applied, the impact that a CET can have on specific companies and divisions in the mining industry will also vary. The proposed implementation of a CET could therefore significantly affect and potentially be detrimental to the South African economy as a whole, if the mining industry is adversely affected. The potential negative impact is compounded by the fact the mining industry is a price taker, and as such it cannot pass this increase in production costs on to the consumer of its products (Cabral, 2000: 85 – 86). As the goal set out by the National Treasury (2010:59) is to reduce carbon emissions while protecting the competitiveness of key industries, and Parker (2009:48) stated that a tax incentive that is properly structured can assist South Africa in moving toward a more sustainable energy future, the substantial potential impact of the CET on the mining industry will be investigated in greater detail in chapter 4.

CHAPTER 4

POTENTIAL IMPACT OF CARBON EMISSIONS TAX ON THE SOUTH AFRICAN MINING INDUSTRY

4.1 Objective of this chapter

In chapter 3, it was concluded that the mining industry may be negatively affected by the implementation of a carbon emission tax (CET). The objective of this chapter (4) is therefore to evaluate the possible impact on the South African mining industry in more detail. This evaluation was performed by evaluating whether the implementation of CET will be in line with the objectives of the Mineral and Petroleum Resources Development Act (28 of 2002) (MPRDA), the legislation that implements the governmental policy in respect to the South African mining industry. The discussion was reinforced by a series of quantitative examples.

4.2 Introduction to the evaluation of the impact of CET on the South African mining industry

Based on the discussions in Chapter 3, the South African mining industry is an important contributor to the South African economy, as well as a significant contributor to carbon dioxide emissions in this country. Recent electricity price increases, coupled with the wage cost increases due to strikes, skills shortages and other related factors have put the South African mining industry under additional pressure. Some observers suggest that any potential adverse impact of a carbon tax may prove to be detrimental to the South African mining industry (Vermaak, 2009:6). Based on these comments, and the conclusion reached in Chapter 3; that the proposed implementation of a CET could significantly affect and potentially put the South African economy as a whole at risk by adversely affecting the mining industry, the potential impact of a carbon tax on the mining industry needs to be investigated.

In order to illustrate the potential effect that CET can have on the South African mining industry, the proposed carbon tax needs to be evaluated against a measure relevant to the South African mining industry.

The election of South Africa's first democratic government in 1994 gave rise to considerable changes occurring in South Africa's mineral policy and the legislation supporting this policy.

The procedure of developing a stable and workable long term policy in the South African market was extremely intricate as the vast number of stakeholders affected by such a policy had to be taken into consideration and these findings culminated in the Mineral and Petroleum Resources Act (28 of 2002) (MPRDA). This legislation was the result of industry and government cooperating and reaching agreement on conflicting aspects. This resulting act differed from its previous legislation in that it incorporated social aspects into the act (Cawood, 2004:53 - 56). This new view, historical importance and industry input into the MPRDA were considered when selecting the MPRDA as basis for the evaluation of the impact that the proposed CET may exert on the mining industry.

In the MPRDA the South African government has set out a list of objectives that it aims to achieve in connection with the South African mineral resource base. The CET proposal will be measured against the objectives of the MPDRA in order to determine the consistency of the two pieces of legislation. At the time of writing, the CET proposal is still in draft format and changes can therefore still be made before implementation, in order to ensure that the two pieces of legislation are consistent.

4.2.1 Objectives of the Mineral and Petroleum Resources Development Act (28 of 2002) that the CET will be evaluated against

Due to its significant historical value, as well as to the level of industry input, MPRDA will, as mentioned in the introduction to this chapter, be used to evaluate the potential impact of the proposed carbon emissions act on the mining industry. Section 2 of the MPRDA lists the following key objectives that need to be achieved in the South African mining industry:

- (a) “Recognise the internationally accepted right of the State to exercise sovereignty over all the mineral and petroleum resources within the Republic;
- (b) Give effect to the principle of the State’s custodianship of the nation’s mineral and petroleum resources;
- (c) Promote equitable access to the nation’s mineral and petroleum resources to all the people of South Africa;
- (d) Substantially and meaningfully expand opportunities of historically disadvantaged persons, including women in order that those may enter the mineral and petroleum industries and benefit from the exploitation of the nation’s mineral and petroleum resources;

- (e) Promote economic growth and the development of mineral and petroleum resources in the Republic;
- (f) Promote employment and advance the social and economic welfare of all South Africans;
- (g) Provide for security of tenure in respect of prospecting, exploration, mining and production operations;
- (h) Give effect to Section 24 of the Constitution by ensuring that the nation's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development; and
- (i) Ensure that holders of mining and production rights contribute towards the socio-economic development of the areas in which they are operating”.

In order to determine any inconsistency between the proposed CET and the objectives of the Mineral and Petroleum Resources Development Act (28/2002), the basis for the calculation as well as the information that will be used has to be formulated. The key aspects that have been decided upon and form the basis for the calculations that follow in chapter 4.4 will now be discussed in greater detail.

4.2.2 Calculations that need to be performed in order to evaluate the objectives of the Mineral and Petroleum Resources Development Act (28 of 2002)

In order to determine which calculations need to be performed to achieve the objectives of the Mineral and Petroleum Resources Act, each objective will now be investigated.

Objectives (a) – (b)

These objectives relate to state ownership (sovereignty) and protection (custodianship) of all the mineral resources in South Africa. With the implementation of the MPRDA in 2004 the state, on behalf of or as trustee for all the people of South Africa, took ownership of all the mineral resources in South Africa (van der Vyver, 2012:125). As custodian, the state therefore has the obligation to protect and manage the nation's mineral resources serving the best interest of the nation. As a carbon tax is imposed by the state itself and is dependent on its own resources, it is submitted that a CET will not have any direct impact on the sovereignty or ownership of the state.

The MPRDA, in Section 16 to 27, lists the requirements that a company needs to comply with in order to be granted prospecting and or mining rights. These requirements include an approved environmental programme to be presented, irrespective of the size of the company. Based on this requirement, the implementation of a CET will be in line with the MPDRA, as both acts aim to ensure that mining companies operate in a more environmentally friendly manner to the benefit the nation as a whole.

As indicated above, the state needs to manage the nation's resources for the good of the nation (custodianship). When evaluating the impact of a proposed CET on this objective, consideration needs to be given to the way in which the funds generated by the tax, will be spent. As indicated by the National Treasury and discussed in chapter 3, no concrete indication has been provided as to how, to what degree and to what purpose the funds generated with the tax, will be allocated. It has, however, been determined, that consideration will be given to on budget allocation of funds generated. The aforementioned serves to aid in drawing the conclusion that careful consideration needs to be given as to how the funds are to be allocated in order to ensure that introducing the tax, will serve the best interests of the nation. If the tax revenue is, for example, used to reduce the income taxes levied on low income households, or used to develop rural areas, this objective should be achieved.

Another requirement of the MPRDA that large companies need to meet when applying for prospecting or mineral rights, is the submission of a technical, economic, labour and social plan. The implementation of a CET will directly affect the economic part of this plan and consideration therefore needs to be given to the impact of the tax levy on the profitability of mines. This has been discussed extensively in the objectives ensuing, as these have a more direct link to profitability. It is, however, submitted that the implementation of a CET cannot be so stringent as to render mining companies uneconomical, especially when taking into account the importance of these companies in the South African economy as a whole (chapter 3). It is important to note that the MPRDA does not have this same requirement for small companies. This indicates that the impact that the implementation of a CET will have on smaller companies, should be taken into account, as it is not the intention of the MPRDA to deny small companies and communities access to the resources of the nation (Cawood, 2004:60).

This discussion indicates that the implementation of a Carbon Emission Tax in the mining industry, may have a potential positive impact in that it could protect the resources of the

nation, as well as a potential negative impact, as smaller companies may suffer negative effects, due to the custodianship objectives in MPRDA, depending on, among other aspects, National Treasury's allocation of the revenue generated with the tax.

Objectives (c) – (d)

These objectives allow for equal opportunity for all, but specifically benefit previously disadvantaged groups by providing them with the opportunity to enter into and benefit from the mineral and resources sector. It is an undeniable fact that there is an unequal distribution of wealth in South Africa. The objectives of the MPRDA indicate that this act aims to correct the imbalance by providing previously disadvantaged groups with additional opportunities to enter, participate and benefit in the South African mining industry. The challenges concerning these objectives, are twofold (Cawood, 2004:58):

1. Access is required to the funds needed for investment in mining projects. Without the required capital, investing in mining projects will prove difficult, unless enforced ownership is implemented by government. On its website, the Chamber of Mines (2011) stated that the South African mining industry is extremely capital intensive and this will be a barrier to entry for all new investors. For previously disadvantaged groups, funding will therefore be required in order to invest in mining related projects.
2. Balance is required between increasing previously disadvantaged ownership in mining companies and social upliftment of previously disadvantaged communities in general. This challenge can therefore be summarised by stating that ownership structure cannot be changed without consideration being given to the economic impact of this change as the potential lost funds could have been used to assist with a growing need for social welfare involvement.

The MPRDA acknowledges these facts and therefore makes provision for the submission of technical and financial assistance for previously disadvantaged persons and, labour plans and social plans for the community as a whole when applying for prospecting or mineral rights (Cawood, 20004:58).

The introduction of a CET on the South African mining industry, will result in an additional cost being levied on this industry and may therefore result in the industry's profitability decreasing, which will add an additional barrier to entry in this sector. As previously disadvantaged groups will require funding to enter this industry, it is submitted that, when

profitability decrease, the investment opportunity will become less attractive and therefore potential investors will be less likely to receive funding. This is consistent with the comments made by Nersa (2011:5-7) and Cloete & Tyler (2012:2) as discussed in chapter 3.4.3.2. The effect that the implementation of a CET will have on the industry's profitability, therefore needs to be investigated to determine if the objective of equal access for all, can be achieved.

Cloete & Tyler (2012:2) continued to state that a number of companies may be inappropriately affected and was supported by Promethium Carbon (2013:5) in stating that different companies have different cost structures and will therefore be affected differently by the implementation of a CET. Based on these comments, as well as the MPRDA, excluding small companies from the requirements of submitting a technical, economic, labour and social plan when applying for prospecting and mineral rights, the impact that the implementation of a CET can have on the profitability of smaller companies, needs to be investigated to ensure that all parties have equal access to the mining industry.

When evaluating profitability the net operating income as disclosed in the annual financial statements of companies in the mining industry, cannot be used as a basis for calculating profitability. Net operating incomes includes many non mining related aspects (for example financial derivatives) and it is submitted that this figure can therefore vary significantly from year to year without any changes in operations. The effect on profitability will therefore be investigated by evaluating the impact on the gross profit and gross profit percentage of the industry, the individual sectors within the industry and different companies within these industry sectors.

As the objectives of MPRDA do not only state that all parties, including previously disadvantaged groups must be able to invest in the mining industry, but also that these groups should benefit from the industry, the impact that the introduction of a CET can have on these non-investment related benefits, need to be investigated. Cawood (2004:59) indicates that these related benefits are aspects such as the provision of fresh drinking water, first right to employment opportunities and the creation of community funds. As indicated in the discussions above, a CET will be an additional cost to the industry and the funds generated by the tax will be distributed by the National Treasury. It is therefore submitted that as the tax will be an additional cost to the mining industry and additional revenue for government, that mining companies will have less funds to invest in local communities, but that government will have more. The allocation of the funds by the National Treasury will therefore play a

significant role in whether this objective can be achieved by the implementation of a CET. Based on the lack of information made available by the National Treasury, no opinion is expressed in this regard and it is suggested that, when more information becomes available, this be the subject of further study.

Objective (e)

This objective relates to the economic growth and development in the mining sector. The only guidance that the MPRDA provides in relation to what is meant by economic growth is that economic growth needs to take place with increased beneficiation of mineral production. It is submitted that this indicates that the profits of the mining industry needs to increase and also that these profits need to be distributed to all stakeholders in the industry. Two aspects should therefore be considered. Firstly, the effect on profitability when implementing a CET on the mining industry and secondly, the distribution of these profits to all stakeholders. The second aspect has been discussed in the preceding objectives and the conclusion has been reached that this objective of the MPRDA can be achieved if the National Treasury allocates the revenue generated to social and environmental aspects that uplift the previously disadvantaged stakeholders and communities. The first aspect will now be evaluated further.

Effect on profitability

Cawood (2004:61) states that, with the implementation of the MPRDA, the intention was to encourage development of mineral and petroleum properties. As discussed in the objectives above, it can be seen that the MPRDA complies with the requirement for the submission of a technical, economic, labour and social plan when applying for mineral and prospecting rights. It is submitted that the definition of economic growth and development does not only imply profitability, but also social, environmental and labour related development. Social development pertaining to uplifting the communities as well as equitable access has been discussed in the previous objectives and labour and environmental development will be discussed in the objectives that follow. The focus of this discussion will therefore lie in the aspect of profitability of economic growth.

As mentioned in chapter 3.4.3.1, the National Treasury is only considering on budget allocation of the funds it will receive from a CET and have not made any clear commitment in this regard. In chapter 2.3.5.4 it was indicated that a carbon tax (as opposed to a Carbon Trading Emissions System) will result in the funds received by government from a carbon tax

paid by the industry, to be invested in projects which will lower the carbon emissions of the industry. Based on this statement, the mining industry will have a cost element added to its operations by the implementation of a carbon tax and may not receive a corresponding direct benefit of investment in the development of lower carbon emitting operations, depending on National Treasury's allocation of the funds. The comments made in chapter 3.4.3.2 based on Promethium Carbon (2013:4) and Falco (2013:20), support this assumption, as they state that the implementation of a CET in the energy sector (Eskom), will be passed on to consumers (the mining industry) and will therefore reduce the incentive for Eskom to invest in projects to reduce reliance on high carbon emitting sources such as coal in favour of more environmentally friendly options, as Eskom will ultimately not pay the tax. In the same chapter Nersa (2011:7) stated that, based on the same reasons, the allowances for trade intensive industries and other carbon offsets may be insufficient to protect these industries from the negative impact of an additional cost being added. Promethium Carbon (2013:4) as well as Regan & McNamara (2012:3) commented that there should be a minimum level of emission below which no tax will be payable in order to assist small and struggling companies grow and develop, but also warned that the establishment of this level as well as industry benchmarks, can be difficult. The aforementioned indicate that the implementation of a CET will add an additional cost to the industry and may therefore reduce profitability.

Based on the views expressed by the AAIL (American Association of Individual Investors) a company uses its gross income to fund research and development as well as to make investments to generate future sales (AAIL, 2011:20). The AAIL also stated that, if gross profit declines, it is an indication of negative pressure on profitability and will be a red flag for investors, as this will indicate that a company's growth rate is declining and that said company may therefore struggle to continue operations if the trend persists.

The preceding indicates that the impact on gross profit and gross profit percentage may be a key indicator of the potential impact of a CET on the growth and development of the South African mining industry. This would warrant further investigation in order to evaluate the effect that the implementation of a CET will have on achieving economic growth and development in the mining industry in general, on its various sectors and on smaller and larger companies in these sectors (chapter 4.4).

Objective (f)

This objective relates to job creation as well as related wealth generation in the South African mining industry and affected communities, as well as on the nation as a whole.

The first aspect that needs to be considered relates to the impact that the implementation of CET can have on the job creation. As is evident from the recent economic recession, employment figures decreased when commodity prices fell during this period (Goodman & Mance, 2011:5). The mining industry has historically relied on increasing commodity prices in order to justify increased investment in employment (Davidson, 2011:23). As discussed in objectives (c) - (e) above, CET will be an additional cost to the mining industry and it is submitted that the implementation of the tax might have an inverse effect on employment as profitability reduces (similar to profits decreasing in the economic recession). Based on this assessment the impact of CET on the gross profits and gross profit percentage will be indicators of the impact on reaching the objective of increased employment in the mining industry.

The second aspect that needs to be considered relates to the impact that the implementation of CET can have on the wealth creation in the South African mining industry and economy as a whole. The discussion above indicates that the implementation of a CET can have a negative impact on the employees of mining companies if profitability decreases, but consideration also needs to be given to the broader community. As discussed in objectives (a) and (b) above, if the National Treasury, as collector of the tax revenue, uses the funds generated by the tax in order to reduce for example income taxes on low income households, the tax may benefit the nation as a whole. Consideration has to be given to the allocation of these funds in order to ensure that this objective is met and communities and low income households are supported. As the National Treasury has not communicated the way in which the funds will be allocated, further research in this regard is suggested when the information becomes available.

Objective (g)

This objective relates to providing security of ownership over mineral rights. The MPRDA in Sections 16 to 27 lists the requirement that a company needs to comply with in order to be

granted prospecting and or mining rights. These requirements have been discussed in the objectives above and ensure that industry has clarity as to the information required to gain mining and prospecting rights and the periods for which these rights will be valid.

As discussed in objectives (a) and (b) above, the implementation of a CET will affect the economic portion of the plan, when applying for prospecting or mining rights. It is therefore submitted that, in the manner that CET affects different companies and different sectors differently, this objective may not be achieved as highly affected companies will be less profitable and therefore less likely to gain the prospecting and mining rights. The impact of CET on the mining industry's profitability should therefore be investigated.

Objective (h)

This objective relates to developing South Africa's mineral resources in an orderly and ecologically sustainable manner while promoting justifiable social and economic development.

As indicated by the National Treasury and discussed in chapter 3.4, the carbon tax collected will not be allocated to any specific project, but will rather form part of the tax fiscus. Based on this, CET will have no direct, measurable impact on social and economic development in communities by the companies producing the carbon emissions in these communities as it will be National Treasury's responsibility to allocate and govern the funds collected. No further study in this regard will be performed as once again sufficient information is lacking.

Chapter 3 indicates that South Africa, and specifically the South African mining industry, is a contributor to global warming through the emission of greenhouse gases and especially through emissions of carbon dioxide. The opportunity therefore exists for a CET to positively influence behaviour (Chapter 2.3.2) in the mining sector.

The comments on the proposed CET as discussed in chapter 3.4.3.2 state that South Africa has limited options other than using coal fired power stations to generate electricity which will be subject to tax. Companies will therefore have limited opportunity to gain relief from the tax through the use of low carbon options. The comments made (and discussed above) as well as National Treasury's stance on allocation of the CET collected to low carbon projects, indicates that it will be difficult for the CET to achieve this objective, as companies have

limited options. The degree to which behavioural change will be affected, falls outside the scope of this study as no measurable sources in this regard could be found. It is submitted that, if gross profit decreases, companies will search for a low carbon alternative in order to remain profitable. This indirect factor will be investigated further.

Objective (i)

This objective relates to mining companies contributing to the social and economic development of the areas in which they operate. This objective recognises that there are multiple stakeholders involved in mining operations and requires mining companies to take corporate responsibility by only allocating mining and prospecting rights to companies that have sound social and labour plans as required by Section 16 to 27 of the MPRDA (Cawood, 2004:58).

As mentioned in the objectives above, the implementation of a CET will create an additional cost to the mining industry. It is therefore submitted that mining companies will have less funds available for social and economic projects for the communities in which the companies operate, but that National Treasury will have more funds to allocate. As indicated in objective (h) above, the National Treasury will not be allocating the CET collected to any specific objective or project, but the tax will rather form part of the tax fiscus as a whole. The tax may therefore not be invested in the areas surrounding the mines. Based on this assessment, the objective of the act might not be met and will be dependent on how the National Treasury ultimately allocates the tax collected. No further study in this regard will be performed as the intention of allocation by the National Treasury is not clear.

Based on the discussions in this section of the chapter, it has been determined that all objectives, except for objective (i), will be directly affected by profitability. As discussed above, profitability will be evaluated based on gross profit and gross profit percentage as these are stable indicators of mining operations. Chapter 4.3.6 provides further detail as to how the gross profit was calculated when the profitability analysis was performed.

4.3 Specific aspects considered when performing the analysis

4.3.1 The method with which the carbon tax calculation will be made

In order to evaluate the potential impact that a CET can have on the profitability of the South African mining industry, a series of quantitative examples need to be performed. Established on the discussion in chapter 4.2.2, that indicated that many of the objectives are linked to profitability, calculations need to be performed to determine the impact of a CET on the gross profit figures of the companies selected. The quantitative examples are performed based on the operating and design information of a CET as provided by the National Treasury in the discussion paper for public comment on the implementation of a carbon tax released December 2010 as well as on the amendments made to it in the 2012 and 2013 budget and subsequent information provided in chapter 3.4.3.1.

4.3.2 The rate at which the tax will be calculated

As mentioned in chapter 3.4.3.1 the National Treasury states that a rate of R120 per tonne of carbon dioxide will be levied from 2015 onwards. This rate will be used in calculating the carbon tax liability for the companies selected, as described in chapter 4.3.3.

4.3.3 The different mining sectors and the relevance of selecting these sectors

As mentioned in the objective in chapter 4.3.1, all resource sectors need to be considered when evaluating the potential impact of a CET on the South African mining industry.

The following information has been obtained from the Chamber of Mines (2011) and based on this information, the following sectors have been selected to illustrate the potential impact of the CET on the mining industry:

Gold sector

As the mainstay of the South African economy for over a century, and as one of the world's largest gold producing countries, the importance of gold for South Africa becomes apparent. To this effect the gold mining industry contributes 4 per cent directly and 10 per cent indirectly to South African Gross Domestic Products and in 2010 gold contributed 32 per cent to the total revenue from mining activities. The deep-level mining of gold in South

Africa has resulted in South Africa becoming the world leader in deep-level mining technology. On the downside, deep-level mining, has become an increasingly costly process as well as capital intensive, with significant amounts being spent on ventilation, cooling and hoisting, especially when referring to hard rock mining.

The preceding facts indicate the importance of the gold sector in the South African economy. The sector also uses approximately half of the electricity utilised by the South African mining industry (chapter 3.3), making it a sector within the mining industry that could be severely affected by the introduction of a CET that is factored into the cost of electricity. For these reasons, this sector was included in the quantitative analysis performed.

Platinum sector

South Africa has the world's largest known deposits of platinum group metals and is the largest platinum producer. To this effect, platinum group metals contributed 37 per cent to total mining revenue during 2010. Most of these platinum group metals are found in the Bushveld Igneous Complex and this complex contains approximately 55.7 per cent of the global platinum reserves. The platinum sector is also responsible for consuming approximately 20 per cent of all electricity used by the mining industry.

These facts indicate that the platinum sector is a major sector in the South African economy and is therefore included in this study as a CET that has a significantly adverse impact on this industry and may have wider implications for the South African economy.

Iron ore (Steel) sector

South Africa has the sixth largest reserve of iron ore in the world, with approximately nine per cent of the world's total reserves. The markets, both nationally and internationally, for iron ore as well as other base metals are steadily growing and iron ore sales account for 4 per cent of the total revenue from mining activities. The Chamber of Mines specifically distinguished this sector from the other sectors, mentioning it as separate sector which indicates that this sector functions in a different manner to the other sectors that operate in the mining industry. The effect of a carbon tax on this sector will therefore also to be investigated.

Mining and minerals sector

South Africa is the third largest coal producer in the world and with approximately 11 per cent of the total recoverable high quality coal reserves in the world, South Africa is a major player on the global coal stage. As the primary source for electricity generation in South Africa and a major export product, the importance of coal cannot be underestimated. A lot of mines in South Africa do not only focus on mining one mineral. The possible effect on these mines that have a diversified focus, should also be investigated.

This last category selected for the study, is based on the Chamber of Mines (2011) as well as the Carbon Disclosure Project (2011:22-23), representing a large number of mining commodities. This indicates that there is a general mining category into which coal and other minerals are classified.

4.3.4 The different companies considered in the quantitative gross profit impact analysis

To illustrate the potential impact that a CET can have on the South African mining industry by using quantitative examples, a number of companies were selected from the industries above. When selecting companies for this study, the limiting factor was gaining information regarding different companies' carbon dioxide emissions. The reason for this is that it is not currently compulsory for companies to disclose information relating to their carbon dioxide emissions. To this effect, a voluntary carbon disclosure project was undertaken in 2011 and the JSE 100 companies were all called upon to participate in this survey (*It should be noted that at the time of this study, the 2012 results were released but were not used, as the 2012 financial statements for all the companies selected, were not available*). Of these 100 companies 28 are classified in the "Energy and Materials" sector and 17 of these companies are mining or mining related companies (Carbon Disclosure Project, 2011: 49). Based on the sectors identified above the following selection has been made:

1. All the participating gold producing companies were selected (three in total).
2. The three highest carbon dioxide emitting platinum companies have been selected from the 6 companies in this category. Three companies have been selected for the study in order to be consistent with the gold industry, since the objective of this study is not to calculate the impact of a CET on all companies in all sectors, but merely to illustrate the potential impact that a CET may have on the industry. Three companies are deemed an appropriate representation of the industry.

3. The three highest carbon dioxide emitting minerals mining companies have been selected from the 7 companies in the project for the same reasons as mentioned in 2 above.
4. Both steel producing companies have been selected.
5. The only other company that was selected was Sasol. Sasol is now classified as an energy company, but with its high emissions, importance in the South African economy and with all the coal used in Sasol's operations being mined and supplied by its subsidiaries, Sasol was also selected (Eberhard, 2011:19).

The other companies were not selected, as they form part of the paper and packaging, chemicals, industrial gases, chemical and construction materials sectors respectively.

Table 4.1 illustrates the companies selected, as well as the sector within which they are classified.

Table 4-1: Mining companies selected for the analysis

Company	Mining related sector
AngloGold Ashanti	Gold
Gold Fields	Gold
Harmony Gold Mining Company	Gold
Anglo American	Metals and Minerals
BHP Billiton	Metals and Minerals
Exxaro Resources	Metals and Minerals
Anglo Platinum	Platinum
Impala Platinum Holdings	Platinum
Northam Platinum	Platinum
ArcelorMittal SA	Iron Ore
Evraz Highveld Steel and Vanadium Corporation	Iron Ore
Sasol	Other

4.3.5 The amount of carbon dioxide emitted per company

In order to calculate the amount of tax payable per company selected, the amount of carbon emissions needs to be obtained. Since 2000, the carbon disclosure project has challenged the world, including South African companies, to measure and report on their carbon emissions (Carbon Disclosure Project, 2011:10). The 2011 survey found that South Africa had the second highest response rate internationally and 99 per cent of all responding companies disclosed their greenhouse gas emissions (Carbon Disclosure Project, 2011:10). For these reasons, the carbon disclosure project was selected as the basis for carbon emissions data.

The carbon disclosure document distinguishes between Scope 1 and Scope 2 emissions. The National Treasury (2010:36) as well as the Carbon Disclosure Project (2011:11) defines Scope 1 emissions as all those emissions that are produced from sources owned or controlled by a company. To describe Scope 1 emissions more simply, it can also be described as the direct emissions of a company. Scope 2 emissions, on the other hand, are all the indirect emissions that a company is responsible for by virtue of the use of electricity. The assumption made for purposes of this quantitative analysis, is that energy producers will, wherever possible, recoup the full amount of the CET payable from the buyer or consumer of its product (electricity). This assumption is supported by the fact that South Africa's power industry is dominated by Eskom, a state owned company, which supplies 95 per cent of the country's electricity consumption and approximately 45 per cent of electricity used in Africa (Eberhard, 2011:14; Eskom, 2011). With this assumption in place the CET calculation will be based on the combined Scope 1 and 2 emissions.

4.3.6 Calculation of the basis against which CET should be measured

Based on chapter 4.2.2, above mentioned gross profit was selected as basis for calculating the effect on profitability that a carbon tax can have on the mining industry, due to the fact that the gross profit does not include substantial non mining aspects or activities. Where the gross profit of a company was not disclosed in the financial statements, the profit from operations has been used or calculated, seeing as this figure should approximate gross profit and exclude all non-mining related income and expenses. Where possible and disclosed in the annual financial statements for the companies selected and operating profit calculated, special items and measurements, as well as non-hedge-derivates-and-contracts have been excluded from operating income. Where the financial statements have been denominated in a currency other

than South African Rand (ZAR), oanda.com was used as a source to convert the figures to ZAR. In this conversion the midpoint period average for the financial year under review was used. In the event of a financial year end change, the period over which the 2011 financial statements spanned, was used in the comparative years.

4.3.7 Assumptions required in the calculation

The following assumptions were made when calculating the impact that CET can have on different sectors in the mining industry.

As mentioned above, it was assumed that Eskom, a state owned company and the main energy producer in South Africa, will pass on 100 per cent of the tax imposed on it to its customers, as it will not make commercial sense for the state to tax itself. The further assumption was made that the energy producers will not impose a profit margin on the CET amount. It is therefore assumed that the level of reduction in scope 2 emissions will be more difficult to achieve, as this will relate to the electricity being purchased from Eskom.

Due to the lack of information relating to carbon dioxide emissions, the amount of carbon dioxide emitted by the chosen companies will be consistent with the amount of emissions, as is disclosed in the Carbon Disclosure Project (2011:49). The average per tonne carbon dioxide emissions for the sector will also not materially differ from the sample average selected. As no indication has been given at the time of the analysis of what the agreed industry benchmark rate will be, the average industry rate multiplied by 90 per cent will be used for both scope 1 and 2 emissions. The figure of 90 per cent is based on a conservative 10 per cent efficiency increase for the industry.

As the National Treasury has indicated that minimal, if any, relief from this tax will be allowed, the assumption is made that there will be no deductions in terms of the income tax or other relief from this tax, other than the deductions as described in chapter 3.4.3 and are related to the latest CET proposal. As only the electricity, petroleum and iron-and-steel sectors are shown in the table mentioned above, only the specific relief of these sectors will be used, while the “other” category will be used for the remaining companies in, for instance, the gold and platinum sectors.

4.4 Results of the CET impact analysis

4.4.1 Tables and general results of the analysis

When applying the above rates, thresholds and assumptions to the identified companies, the summarised results as indicated in Table 4.2 to 4.6 have been produced. The full results have been attached in Annexure 1. In Annexure 1, the calculated CET has been calculated at three different rates in order to illustrate the potential impact on a company if the maximum reduction rate cannot be achieved. This calculated CET has then been used to calculate the effect on gross profit and gross profit percentage for the companies selected and only these results have been indicated in the tables below.

Table 4-2: Three year average impact on gross profit percentage at various reduction levels per sector

Sector per year	Total revenue for the companies selected in specific industry	Total of Gross Profit/Operating profit for the companies selected in specific industry	Average of Gross Profit/Operating profit % for the companies selected	Reduction in Gross profit % @ 100% maximum allowance reduction	Reduction in Gross profit % @ 75% maximum allowance reduction	Reduction in Gross profit % @ 50% maximum allowance reduction
Gold	258,945,650,000	75,332,700,000	24.1%	1.0%	1.4%	1.9%
2009	72,567,100,000	16,890,450,000	21.8%	1.1%	1.5%	2.0%
2010	84,207,750,000	23,052,650,000	22.6%	0.9%	1.3%	1.7%
2011	102,170,800,000	35,389,600,000	27.8%	1.0%	1.4%	1.9%
Iron Ore	1,769,956,685,400	131,378,989,500	9.1%	0.6%	1.1%	1.7%
2009	513,143,895,300	18,550,915,800	3.6%	0.1%	0.1%	0.2%
2010	569,808,772,500	50,689,428,900	8.9%	0.1%	0.1%	0.2%
2011	687,004,017,600	62,138,644,800	12.0%	1.1%	2.1%	3.1%
Metals and Mining	1,918,315,622,900	645,497,898,300	27.0%	0.5%	0.8%	1.1%
2009	577,584,456,800	131,823,487,500	16.0%	0.5%	0.8%	1.0%
2010	593,038,133,500	210,738,605,200	31.5%	0.6%	1.0%	1.3%
2011	747,693,032,600	302,935,805,600	33.4%	0.5%	0.8%	1.0%
Other (Sasol)	402,528,000,000	144,370,000,000	35.8%	1.5%	2.8%	4.0%
2009	137,836,000,000	49,328,000,000	35.8%	1.4%	2.7%	3.9%
2010	122,256,000,000	43,073,000,000	35.2%	1.6%	2.9%	4.3%
2011	142,436,000,000	51,969,000,000	36.5%	1.4%	2.7%	3.9%
Platinum	229,230,173,000	50,105,182,000	22.3%	0.7%	1.0%	1.2%
2009	65,994,042,000	12,551,913,000	22.8%	0.8%	1.1%	1.4%
2010	75,416,083,000	16,970,975,000	23.1%	0.6%	0.9%	1.2%
2011	87,820,048,000	20,582,294,000	20.9%	0.6%	0.9%	1.1%

Table 4.2 indicates the effect that CET will have on the different sectors identified. This table shows the effect as the reduction in gross profit percentage and indicates that Sasol will be most affected.

Table 4-3: Average impact on gross profit at various reduction levels per sector

Sector per year	Total revenue for the companies selected in specific industry	Total of Gross Profit/Operating profit for the companies selected in specific industry	Average of Gross Profit/Operating profit % for the companies selected	Reduction in Gross profit @ 100% maximum allowance reduction	Reduction in Gross profit@ 75% maximum allowance reduction	Reduction in Gross profit@ 50% maximum allowance reduction
Gold	258,945,650,000	75,332,700,000	24.1%	8.1%	11.6%	15.2%
2009	72,567,100,000	16,890,450,000	21.8%	5.7%	8.0%	10.4%
2010	84,207,750,000	23,052,650,000	22.6%	8.5%	12.0%	15.4%
2011	102,170,800,000	35,389,600,000	27.8%	10.1%	14.9%	19.7%
Iron Ore	1,769,956,685,400	131,378,989,500	9.1%	4.4%	8.5%	12.6%
2009	513,143,895,300	18,550,915,800	3.6%	1.8%	3.9%	6.1%
2010	569,808,772,500	50,689,428,900	8.9%	0.7%	1.4%	2.1%
2011	687,004,017,600	62,138,644,800	12.0%	7.5%	14.3%	21.1%
Metals and Mining	1,918,315,622,900	645,497,898,300	27.0%	5.0%	7.7%	10.3%
2009	577,584,456,800	131,823,487,500	16.0%	11.0%	16.8%	22.6%
2010	593,038,133,500	210,738,605,200	31.5%	2.3%	3.5%	4.6%
2011	747,693,032,600	302,935,805,600	33.4%	1.8%	2.8%	3.7%
Other (Sasol)	402,528,000,000	144,370,000,000	35.8%	4.2%	7.7%	11.2%
2009	137,836,000,000	49,328,000,000	35.8%	4.0%	7.4%	10.8%
2010	122,256,000,000	43,073,000,000	35.2%	4.5%	8.3%	12.2%
2011	142,436,000,000	51,969,000,000	36.5%	4.0%	7.3%	10.6%
Platinum	229,230,173,000	50,105,182,000	22.3%	4.4%	6.2%	8.0%
2009	65,994,042,000	12,551,913,000	22.8%	6.1%	8.6%	11.1%
2010	75,416,083,000	16,970,975,000	23.1%	3.0%	4.2%	5.5%
2011	87,820,048,000	20,582,294,000	20.9%	4.1%	5.7%	7.4%

Table 4.3 indicates the effect that CET will have on the different sectors identified. This table shows the effect as the reduction in gross profit and indicates that the Gold sector will be the most affected.

Table 4-4: Average impact on gross profit percentage at various reduction levels per sector and company

Sector per year per company	Total revenue for the companies selected in specific industry	Total of Gross Profit/Operating profit for the companies selected in specific industry	Gross Profit/Operating profit % for the companies selected	Reduction in Gross profit % @ 100% maximum allowance reduction	Reduction in Gross profit % @ 75% maximum allowance reduction	Reduction in Gross profit % @ 50% maximum allowance reduction
Gold						
2009						
AngloGold Ashanti	30,745,000,000	7,525,000,000	24.5%	0.6%	1.0%	1.3%
Gold Fields	30,326,100,000	7,528,450,000	24.8%	0.9%	1.3%	1.6%
Harmony Gold Mining Company	11,496,000,000	1,837,000,000	16.0%	1.7%	2.4%	3.1%
2010						
AngloGold Ashanti	38,833,000,000	13,000,000,000	33.5%	0.5%	0.7%	1.0%
Gold Fields	34,090,750,000	9,252,650,000	27.1%	0.9%	1.2%	1.6%
Harmony Gold Mining Company	11,284,000,000	800,000,000	7.1%	1.5%	2.1%	2.7%
2011						
AngloGold Ashanti	47,849,000,000	19,104,000,000	39.9%	0.4%	0.6%	0.8%
Gold Fields	41,876,800,000	15,455,600,000	36.9%	0.7%	1.0%	1.3%
Harmony Gold Mining Company	12,445,000,000	830,000,000	6.7%	1.8%	2.7%	3.6%
Iron Ore						
2009						
ArcelorMittal SA	513,143,895,300	18,550,915,800	3.6%	0.1%	0.1%	0.2%
Evrz Highveld Steel and Vanadium Corporation	-	-	-	-	-	-
2010						
ArcelorMittal SA	569,808,772,500	50,689,428,900	8.9%	0.1%	0.1%	0.2%
Evrz Highveld Steel and Vanadium Corporation	-	-	-	-	-	-
2011						
ArcelorMittal SA	681,417,017,600	61,301,644,800	9.0%	0.1%	0.1%	0.2%
Evrz Highveld Steel and Vanadium Corporation	5,587,000,000	837,000,000	15.0%	2.2%	4.1%	6.0%
Metals and Mining						
2009						
Anglo American	178,075,336,800	39,481,663,500	22.2%	0.4%	0.6%	0.9%
BHP Billiton	384,500,120,000	92,037,824,000	23.9%	0.5%	0.8%	1.0%
Exxaro Resources	15,009,000,000	304,000,000	2.0%	0.6%	0.9%	1.2%
2010						
Anglo American	210,360,034,500	68,304,023,700	32.5%	0.3%	0.5%	0.7%
BHP Billiton	372,562,099,000	139,946,581,500	37.6%	0.5%	0.7%	1.0%
Exxaro Resources	10,116,000,000	2,488,000,000	24.6%	1.2%	1.7%	2.2%
2011						
Anglo American	228,833,369,600	77,196,275,200	33.7%	0.3%	0.5%	0.7%
BHP Billiton	506,388,663,000	222,931,530,400	44.0%	0.3%	0.5%	0.7%
Exxaro Resources	12,471,000,000	2,808,000,000	22.5%	0.9%	1.3%	1.7%
Other						
2009						
Sasol	137,836,000,000	49,328,000,000	35.8%	1.4%	2.7%	3.9%
2010						
Sasol	122,256,000,000	43,073,000,000	35.2%	1.6%	2.9%	4.3%
2011						
Sasol	142,436,000,000	51,969,000,000	36.5%	1.4%	2.7%	3.9%

Platinum						
2009						
Anglo American Platinum	36,687,000,000	1,972,000,000	5.4%	0.7%	1.0%	1.2%
Impala Platinum Holdings	26,121,000,000	9,762,000,000	37.4%	0.5%	0.7%	1.0%
Northam Platinum	3,186,042,000	817,913,000	25.7%	1.1%	1.6%	2.0%
2010						
Anglo American Platinum	46,025,000,000	8,034,000,000	17.5%	0.6%	0.8%	1.0%
Impala Platinum Holdings	25,446,000,000	8,152,000,000	32.0%	0.6%	0.9%	1.2%
Northam Platinum	3,945,083,000	784,975,000	19.9%	0.8%	1.1%	1.4%
2011						
Anglo American Platinum	51,117,000,000	8,555,000,000	16.7%	0.5%	0.7%	0.9%
Impala Platinum Holdings	33,132,000,000	11,642,000,000	35.1%	0.5%	0.7%	0.9%
Northam Platinum	3,571,048,000	385,294,000	10.8%	0.9%	1.2%	1.5%

Table 4.4 indicates the effect that CET will have on the different companies selected per sector identified. This table shows the effect as the reduction in gross profit percentage and indicates that all companies will be affected differently with the worst affected companies being the smaller companies in each sector.

Table 4-5: Average impact on gross profit at various reduction levels per sector and company

Sector per year per company	Total revenue for the companies selected in specific industry	Total of Gross Profit/Operating profit for the companies selected in specific industry	Gross Profit/Operating profit %	Reduction in Gross profit@ 100% maximum allowance reduction	Reduction in Gross profit @ 75% maximum allowance reduction	Reduction in Gross profit @ 50% maximum allowance reduction
Gold						
2009						
AngloGold Ashanti	30,745,000,000	7,525,000,000	24.5%	2.6%	3.9%	5.2%
Gold Fields	30,326,100,000	7,528,450,000	24.8%	3.5%	5.1%	6.6%
Harmony Gold Mining Company	11,496,000,000	1,837,000,000	16.0%	10.9%	15.1%	19.3%
2010						
AngloGold Ashanti	38,833,000,000	13,000,000,000	33.5%	1.5%	2.2%	2.9%
Gold Fields	34,090,750,000	9,252,650,000	27.1%	3.1%	4.5%	5.9%
Harmony Gold Mining Company	11,284,000,000	800,000,000	7.1%	21.0%	29.2%	37.4%
2011						
AngloGold Ashanti	47,849,000,000	19,104,000,000	39.9%	1.0%	1.5%	2.0%
Gold Fields	41,876,800,000	15,455,600,000	36.9%	1.9%	2.7%	3.6%
Harmony Gold Mining Company	12,445,000,000	830,000,000	6.7%	27.4%	40.5%	53.6%
Iron Ore						
2009						
ArcelorMittal SA	513,143,895,300	18,550,915,800	3.6%	1.8%	3.9%	6.1%
Evrz Highveld Steel and Vanadium Corporation	-	-	-	-	-	-
2010						
ArcelorMittal SA	569,808,772,500	50,689,428,900	8.9%	0.7%	1.4%	2.1%
Evrz Highveld Steel and Vanadium Corporation	-	-	-	-	-	-
2011						
ArcelorMittal SA	681,417,017,600	61,301,644,800	9.0%	0.6%	1.2%	1.9%
Evrz Highveld Steel and Vanadium Corporation	5,587,000,000	837,000,000	15.0%	14.4%	27.3%	40.3%
Metals and Mining						
2009						
Anglo American	178,075,336,800	39,481,663,500	22.2%	1.7%	2.8%	3.8%
BHP Billiton	384,500,120,000	92,037,824,000	23.9%	2.0%	3.2%	4.4%
Exxaro Resources	15,009,000,000	304,000,000	2.0%	29.3%	44.4%	59.6%
2010						
Anglo American	210,360,034,500	68,304,023,700	32.5%	1.0%	1.6%	2.2%
BHP Billiton	372,562,099,000	139,946,581,500	37.6%	1.2%	2.0%	2.7%
Exxaro Resources	10,116,000,000	2,488,000,000	24.6%	4.7%	6.9%	9.1%
2011						
Anglo American	228,833,369,600	77,196,275,200	33.7%	0.9%	1.4%	2.0%
BHP Billiton	506,388,663,000	222,931,530,400	44.0%	0.7%	1.2%	1.6%
Exxaro Resources	12,471,000,000	2,808,000,000	22.5%	3.9%	5.7%	7.5%
Other						
2009						
Sasol	137,836,000,000	49,328,000,000	35.8%	4.0%	7.4%	10.8%
2010						
Sasol	122,256,000,000	43,073,000,000	35.2%	4.5%	8.3%	12.2%
2011						
Sasol	142,436,000,000	51,969,000,000	36.5%	4.0%	7.3%	10.6%
Platinum						
2009						

Anglo American Platinum	36,687,000,000	1,972,000,000	5.4%	12.6%	17.8%	23.0%
Impala Platinum Holdings	26,121,000,000	9,762,000,000	37.4%	1.4%	2.0%	2.6%
Northam Platinum	3,186,042,000	817,913,000	25.7%	4.4%	6.1%	7.7%
2010						
Anglo American Platinum	46,025,000,000	8,034,000,000	17.5%	3.2%	4.5%	5.8%
Impala Platinum Holdings	25,446,000,000	8,152,000,000	32.0%	1.9%	2.7%	3.6%
Northam Platinum	3,945,083,000	784,975,000	19.9%	4.0%	5.5%	7.0%
2011						
Anglo American Platinum	51,117,000,000	8,555,000,000	16.7%	3.0%	4.2%	5.4%
Impala Platinum Holdings	33,132,000,000	11,642,000,000	35.1%	1.4%	2.0%	2.6%
Northam Platinum	3,571,048,000	385,294,000	10.8%	8.0%	11.0%	14.1%

Table 4.5 indicates the effect that CET will have on the different companies selected per sector identified. This table show the effect as the reduction in gross profit and indicates that all companies will be affected differently with the worst affected companies being the smaller companies in each sector.

Table 4-6: Average impact on gross profit percentage at various reduction levels per company

Year per company	Total revenue for the companies selected	Total of Gross Profit/Operating profit for the companies selected	Gross Profit/Operating profit %	Reduction in Gross profit % @ 100% maximum reduction	Reduction in Gross Profit % @ 75% maximum reduction	Reduction in Gross Profit % @ 50% maximum reduction
2009						
Sasol	137,836,000,000	49,328,000,000	35.8%	1.4%	2.7%	3.9%
Harmony Gold Mining Company	11,496,000,000	1,837,000,000	16.0%	1.7%	2.4%	3.1%
Northam Platinum	3,186,042,000	817,913,000	25.7%	1.1%	1.6%	2.0%
Gold Fields	30,326,100,000	7,528,450,000	24.8%	0.9%	1.3%	1.6%
AngloGold Ashanti	30,745,000,000	7,525,000,000	24.5%	0.6%	1.0%	1.3%
Anglo American Platinum	36,687,000,000	1,972,000,000	5.4%	0.7%	1.0%	1.2%
Exxaro Resources	15,009,000,000	304,000,000	2.0%	0.6%	0.9%	1.2%
BHP Billiton	384,500,120,000	92,037,824,000	23.9%	0.5%	0.8%	1.0%
Impala Platinum Holdings	26,121,000,000	9,762,000,000	37.4%	0.5%	0.7%	1.0%
Anglo American	178,075,336,800	39,481,663,500	22.2%	0.4%	0.6%	0.9%
ArcelorMittal SA	513,143,895,300	18,550,915,800	3.6%	0.1%	0.1%	0.2%
Evraz Highveld Steel and Vanadium Corporation	-	-	-	-	-	-
2010						
Sasol	122,256,000,000	43,073,000,000	35.2%	1.6%	2.9%	4.3%
Harmony Gold Mining Company	11,284,000,000	800,000,000	7.1%	1.5%	2.1%	2.7%
Exxaro Resources	10,116,000,000	2,488,000,000	24.6%	1.2%	1.7%	2.2%
Gold Fields	34,090,750,000	9,252,650,000	27.1%	0.9%	1.2%	1.6%
Northam Platinum	3,945,083,000	784,975,000	19.9%	0.8%	1.1%	1.4%
Impala Platinum Holdings	25,446,000,000	8,152,000,000	32.0%	0.6%	0.9%	1.2%
BHP Billiton	372,562,099,000	139,946,581,500	37.6%	0.5%	0.7%	1.0%
Anglo American Platinum	46,025,000,000	8,034,000,000	17.5%	0.6%	0.8%	1.0%
AngloGold Ashanti	38,833,000,000	13,000,000,000	33.5%	0.5%	0.7%	1.0%
Anglo American	210,360,034,500	68,304,023,700	32.5%	0.3%	0.5%	0.7%
ArcelorMittal SA	569,808,772,500	50,689,428,900	8.9%	0.1%	0.1%	0.2%
Evraz Highveld Steel and Vanadium Corporation	-	-	-	-	-	-
2011						
Evraz Highveld Steel and Vanadium Corporation	5,587,000,000	837,000,000	15.0%	2.2%	4.1%	6.0%
Sasol	142,436,000,000	51,969,000,000	36.5%	1.4%	2.7%	3.9%
Harmony Gold Mining Company	12,445,000,000	830,000,000	6.7%	1.8%	2.7%	3.6%
Exxaro Resources	12,471,000,000	2,808,000,000	22.5%	0.9%	1.3%	1.7%
Northam Platinum	3,571,048,000	385,294,000	10.8%	0.9%	1.2%	1.5%
Gold Fields	41,876,800,000	15,455,600,000	36.9%	0.7%	1.0%	1.3%
Impala Platinum Holdings	33,132,000,000	11,642,000,000	35.1%	0.5%	0.7%	0.9%
Anglo American Platinum	51,117,000,000	8,555,000,000	16.7%	0.5%	0.7%	0.9%
AngloGold Ashanti	47,849,000,000	19,104,000,000	39.9%	0.4%	0.6%	0.8%
BHP Billiton	506,388,663,000	222,931,530,400	44.0%	0.3%	0.5%	0.7%
Anglo American	228,833,369,600	77,196,275,200	33.7%	0.3%	0.5%	0.7%
ArcelorMittal SA	681,417,017,600	61,301,644,800	9.0%	0.1%	0.1%	0.2%

Table 4.6 summarises the effected that CET has on all companies selected per year of study. This table shows the effect as the reduction in gross profit percentage and indicates that all companies will be adversely affected.

4.4.2 Interpretation of the results of the analysis

The summary of the profitability analysis as indicated in chapter 4.4 and Annexure 1 can be interpreted as follows when compared to the objectives as per chapter 4.3.1 and 4.3.2.

General effect on mining industry

Based on the result as indicated in table 4.4, 4.5 and 4.6 it can be seen that, as expected, the gross profit percentage of all the companies in all sectors selected, will be reduced by the implementation of a CET on the mining industry. This indicates that the implementation of a CET will add an additional cost to the mining industry in general which resulted in profit margins declining. Based on these findings, the objectives of the MPRDA may be affected in the following manner:

- An additional barrier will be added for entering the mining industry in general, as an additional cost will have to be incurred by the industry and profitability will therefore reduce. This may cause previously disadvantaged groups and communities to be denied access to the industry, as the granting of funds for investment purposes will be more difficult to obtain and threatens objectives (c)-(d) of the MPRDA.
- As the industry becomes less profitable, the economic growth and development in the industry as well as the broader economy, may slow down or decline and this threatens objective (e) of the MPRDA.
- The reduction in profit margins will result in less funds being available for investment in new personnel and development of current personnel and may result in retrenchments. This will not be in line with objective (f) of the MPRDA.
- The potential positive impact of the reduction in companies' profit margins, is that companies will be more aware of the environmental impact of their operations and the cost (of not reducing the environmental impact) on their bottom line. This may cause behavioural changes in the companies affected. The positive impact may however be counteracted by National Treasury's stance of not allocating funds to specific projects to reduce reliance on high carbon emitting energy sources and the monopoly that Eskom has on the South African energy market as discussed in chapter 4.3.2. The reduction in profit margin may therefore have a positive impact on the objective (h) of the MPRDA.

Effect on different sectors

The results as documented in Table 4.2 and Table 4.3 indicate that different industries considered in this analysis will be affected differently by the implementation of a CET. These tables also indicate that the gold and platinum mining sectors will be affected more than most, when looking at absolute reductions. When calculating total reductions (in both gross profit and gross profit percentage) as a percentage of original gross profit percentage for all industries, it becomes clear that the iron ore sector will be affected more than any other sector and that this sector had the lowest gross profit percentage to start with. The results of these tables indicate that a general allowance in the mining industry is not sufficient and if the mining industry in general and the all sectors in the industry want to be equally protected, the allowances for high energy users should be reconsidered. The objectives of the MPRDA are affected as follows:

- Objectives (c) and (d) of the MPRDA relates to equal access for all to the nation's mineral resources, but specifically to those that have been disadvantaged in the past. As discussed in chapter 4.2.2, these previously disadvantaged persons require funding in order to obtain funds to invest in the mining sector and the granting and level of funding will depend on the profitability of the investment opportunity. Based on this, some sectors are affected more than others, for example gold and iron ore and funding for investment in these sectors will be more difficult to obtain and may be an obstacle to entry into these markets by previously disadvantaged persons.
- The reduction in profitability in all sectors as well as the importance of all the sectors to the South African economy as described in chapter 4.3.5, indicate that slowing the economic growth in any of the sectors could be detrimental to the South African economy as a whole. As discussed in chapter 4.2.2, a reduction in profitability may lead to a reduction in economic growth. Objective (e) of the MPRDA will therefore be threatened by the implementation of a CET on the mining industry in general, but specifically in sectors worst affected. Consideration should therefore be given to providing additional relief for the proposed CET on highly affected industries.
- As mentioned in the general comments above, the reduction in profitability will result in fewer employment opportunities and may even cause retrenchments. The effect will be compounded in highly affected sectors and will therefore not be in line with objective (f) of the MPRDA. Additional relief for these sectors is therefore required.

As indicated in the discussion above, specific sectors will require additional relief for the effects of a CET to ensure that the objectives of the MPRDA can be achieved. One way in which this may be achieved, is by excluding all scope 2 emissions, or, stated differently, by excluding Eskom from the tax. Annexure 1 indicates that all companies, excluding Sasol and ArcelorMittal, have significantly lower scope 1 than scope 2 emissions. When the 2011 results are used we can see that for all companies selected, 40 per cent of total emissions relate to scope 2 emission and when Sasol, as the largest scope 1 emitter, is excluded from this calculation, this percentage increases to 57 per cent. The exclusion of scope 2 emissions can therefore significantly reduce the tax burden on all companies, depending on their individual scope 1 and scope 2 emissions. This exclusion may, however, weaken the tax system as a whole by allowing some industries to emit freely and will therefore reduce the effectiveness of a CET as an environmental tax (Chapter 2.3.5.3).

Effect on different companies

Tables 4.4 and 4.5 indicate the effect that the implementation of a CET can have on an individual company level and illustrate that the gross profit and gross profit percentage of all companies selected are negatively influenced by a CET. Based on the results in the above mentioned tables, smaller companies (in terms of revenue, gross profit and gross profit percentage), will be affected to a larger extent than will larger companies when the same criteria is used. This is evident when, for example in the gold sector, Harmony, the smallest company chosen, and Goldfields, the largest, are inspected and compared. The same conclusion can be reached in all sectors and this indicates that economies of scale may assist larger companies in resisting the impact of a CET and this adds an additional barrier to entry into the sector for new, smaller companies. The following conclusions are reached when the objectives of the MPRDA are considered.

- As custodian of the nation's resources, government is required to manage these resources for the good of the nation. As a part of this responsibility, the MPRDA requires the submission of an economic plan as part of the application for prospecting and or mineral rights. This indicates that, as the profitability of smaller companies is affected to a greater extent than that of larger companies, these new and small companies may struggle to obtain mining rights as well as funding to invest in mining operations. This is inconsistent with objective (b), as this will not be in the best interest of the nation, as well as with objectives (c) and (d), as this will not promote equal access for all to the nations mineral resources.

- The reduction in profitability in smaller companies, indicate that fewer new companies are likely to enter the market and that smaller companies already in the industry, may not remain viable, especially those in highly affected sectors. The results in table 4.4 accentuate the fact that companies with low gross profit margins suffer more when compared to other, larger companies in the same sector. This indicates that marginal mines (mines with low profit margins) and marginal shafts (individual mine shafts in a company) will be increasingly pressurised as profitability reduces and therefore economic growth may be reduced. These findings are therefore inconsistent with objective (e) of the MPRDA and additional relief for these companies as well as the effect that this relief can have on the strength of the overall CET system must be considered.
- As mentioned in the general comments above, the reduction in profitability will result in fewer employment opportunities and may even cause retrenchments. The effect will be compounded in highly affected companies and will therefore not be in line with objective (f) of the MPRDA. Additional relief for these sectors is therefore required.
- As mentioned above, all applications for new mineral and prospecting rights need to be accompanied by, amongst other aspects, an economic plan. As smaller companies will be affected to a larger degree, it will be more difficult for them to obtain these rights. It is therefore submitted that objective (g) of the MPRDA might not be achieved, as these companies will have less security of tenure over the rights allocated.

In reaction to the above findings, linking the CET payable to the profitability or revenue figures of the companies affected, it is necessary to ensure that all companies and in particular smaller and marginal companies are not adversely affected. This solution may, however present its own challenges, as it may allow start-up companies to pollute freely and close down their operations before any tax liability becomes due. This may be addressed by structuring the tax in a manner where a minimum tax burden will always be payable as well as linking the tax to profitability where more tax is payable the larger the profit made.

Table 4-7: Summary of impact of carbon tax on objectives of Mineral and Petroleum Resources Development Act (28/2002)

Objective of MPRDA	Potential impact of CET introduction
(a)	No impact, as a carbon tax is imposed by the state on itself and based on its own resources and will not have any direct impact on the principle of sovereignty or ownership of the state.
(b)	<p>Both positive and negative impacts on the objective of custodianship depending on, among other aspects, aspects such as National Treasury’s allocation of the revenue generated with the tax.</p> <p>Positive as both the CET and the MPRDA aim to promote more environmentally friendly operations.</p> <p>Allocation of funds by National Treasury will also affect this objective positively if the funds are used to uplift previously disadvantaged persons and communities, depending on the negative tax impact on the industry being less than the positive impact on these communities.</p> <p>The profitability in smaller companies is affected to a greater extent than that of larger companies and therefore new and small companies may struggle to obtain mining rights as well as funding that would allow them to invest in mining operations. This will negatively impact on the country and is therefore inconsistent with this objective.</p>
(c)	Potential negative impact on this objective as entry into this industry will be less likely for smaller companies due to the profit margins of these companies being affected to a greater extent than are larger companies as well as already high fixed operating costs required to enter this market. As all sectors will not be equally affected, it is also less likely that entry in highly affected sectors will take place, especially for previously disadvantaged groups.
(d)	Potentially negative impact on this objective, as entering into this industry will be harder for smaller companies, due to the profit margins of these companies being more adversely affected than those of larger companies, with already high fixed operating costs required to enter this market being a contributing factor. As all sectors will not be equally adversely affected, it is also less likely that entry into highly affected sectors will take place, especially where previously disadvantaged groups are concerned.

	<p>As the tax will be an additional cost to the mining industry and additional revenue for government, mining companies will have smaller funds to invest in local communities, but government will be able to invest more. The allocation of the funds by the National Treasury will therefore play a significant role in whether this objective of social upliftment can be met.</p>
(e)	<p>The first section of this objective, concerns the allocation of funds received from the CET. This objective can be achieved if the National Treasury allocates the revenue generated to social and environmental aspects that uplift the previously disadvantaged stakeholders and communities.</p> <p>The second section of this objective relates to the effect that the CET can have on profitability in the mining industry. This section may potentially be negatively impacted, as profit margins will shrink and less funding will be available for research and development, with the resulting deceleration of economic growth. As smaller (potentially growing) companies bear the brunt, fewer new companies will enter the market and smaller companies may find functioning in highly affected sectors exacting. Due to shrinking profit margins, marginal mines will also be adversely affected, with the same consequences.</p>
(f)	<p>This objective is concerned with two aspects. The first relates to the influence that profitability has on employment and may be impacted negatively, as profit margins will decline and fewer funds will be available when employing new personnel. In smaller companies and seriously disadvantaged sectors, the effect may be compounded. Due to the decline in profit margins, marginal mines will also be adversely affected and the same conclusion is reached.</p> <p>The second aspect relates to the creation of wealth and specifically for previously disadvantaged sectors. This aspect may be positively impacted on if the National Treasury as collector of the tax revenue uses the funds generated by the tax in order to reduce income taxes on low income households. The allocation of the funds by National Treasury will therefore determine whether this goal is achieved.</p>
(g)	<p>All applications for new mineral and prospecting rights need to be accompanied by, amongst other aspects, an economic plan. As the profitability of smaller companies will be more seriously affected by the implementation of a CET, these will find it more difficult to be allocated and to renew these rights.</p>
(h)	<p>Potential positive impact, as companies will be more aware of the environmental</p>

	<p>impact that operations exert. The positive impact is, however, counter acted by National Treasury's stance of not allocating funds to specific projects to reduce reliance on high carbon emitting energy sources and on the monopoly that Eskom has on the South African energy market.</p>
(i)	<p>Potential positive impact, depending on the allocation of CET revenue collected by the National Treasury. Mining companies will, however, not directly affect the social and economic development of the environment in which they operate, as the funds will be paid to National Treasury and not in community outreach programmes.</p>

4.5 Conclusion

The conclusions drawn from this chapter indicate that the implementation of a CET on the mining industry may potentially be inconsistent and contrary to the objectives of the Mineral and Petroleum Resources Development Act (28 of 2002) in some respects. This chapter further found that the commentary on the implementation of a CET (chapter 3) is valid, based on the discussions held and calculations performed.

Key findings in this chapter:

- The results of the study indicate that the profitability of all companies and sectors will be adversely affected by the introduction of a CET on the mining industry. This indicates that an additional barrier to entry into the mining industry will be created for new companies and therefore prejudice the objectives (c) and (d) of the MPRDA. It further indicates that economic growth and development, as well as employment investment and new appointments may decrease, which will also be contrary to the objectives (e) and (f) of the MPRDA. The reduction in profitability will also ensure that companies are more aware of the effect that their operations have on the environment and in this regard will be in line with objective (h) of the MPRDA.
- The method in which the National Treasury ultimately allocates the funds generated by the tax, was found to affect the majority of the objectives of the MPRDA. The chapter found that, while behavioural change in line with the objective of the MPRDA may result from the implementation of a CET, the specific allocation of the funds by the National Treasury, as well as Eskom's monopoly of the South African energy sector, can hamper this positive impact. The National Treasury will have to decide whether to allocate the funds collected to carbon reduction projects in order to reduce the negative impact on the profitability of the industry, or to allocate the funds in projects to assist the poor. The reluctance of the National Treasury to give a firm commitment on the allocation of funds collected has been found to negatively affect objectives (b), (d), (e), (f), (g), (h) and (i) of the MPRDA.
- The profitability in some sectors in the mining industry has been found to be affected worse than other sectors in the industry. Depending on the measure chosen, either the iron ore or gold and platinum sectors are worst affected, but all sectors were found to be negatively affected. The MPRDA will therefore be affected in the same manner as discussed in the above discussion related to profitability.

- The study further indicated that all the sectors in the mining industry will be affected differently and therefore the suggested reductions proposed are not effective in protecting all sectors equally and are not specific enough for the diverse nature of the South African mining industry. It was however determined that if Scope 2 emissions are excluded from the tax that a significant reduction in the tax liability can be achieved on the industry in general as well as on an individual company level.
- As indicated in the above discussion, the profitability of all companies will be negatively affected and hamper the objectives of the MPRDA. The results of the study also indicated the smaller companies may potentially be affected more than larger companies and will therefore result in the aforementioned effects on the MPRDA being compounded. The same conclusion holds true for marginal mines and marginal mine shafts. The study also suggests that to counteract this negative impact on lower profit and smaller companies, the CET should be linked to profitability of individual companies. The reasons why smaller companies and marginal mines will be more affected than larger companies is suggested as a topic for future research.

The objective of affecting behavioural change while protecting key industries as set by the National Treasury with the implementation of a CET can therefore be concluded will be difficult to achieve with the current structure of the CET. It is therefore submitted that while realising the need for action to curb the effect of global warming and the contribution of South Africa and specifically the South African mining industry to the problem, the potential negative effect that CET could have on certain sectors, smaller companies and marginal mines as well as equal access for all to this industry should be reconsidered. The contribution of this study as well as research findings and areas for further study have been summarised in chapter 5.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 Objective of this chapter

Chapter 1.1.3 indicated that South Africa and the South African mining industry are not only affected by the effect of the enhanced greenhouse gas effect but are also contributors to the problem. Due to the mining industry's importance to the South African economy the problem statement and related research question (chapter 1.2) were set to investigate the possible negative impact that the implementation of a CET can have on the South African mining industry. The objective of this chapter is therefore to provide a summary of the key findings of the research reported in this document and how these findings address the research objectives and ultimately the research question set.

5.2 Research findings

5.2.1 Research objective 1: Understanding carbon tax

The first research objective that was set was to gain a detailed understanding of the need for implementing carbon tax globally by exploring the damage that greenhouse gases cause to the environment, explain the reasoning on how carbon emissions reduction schemes can counter act this damage as well as the working of and distinction between different reduction schemes (chapter 1.3.1). The objective has been addressed in Chapter 2.

In response to this objective the following results have been obtained (chapter 2.4):

Global warming and climate change as a result of human activities are real and global problems, and that immediate action is needed to curb the effects thereof. The two most common responses to the aforementioned problem have been investigated and it has been determined that market based instruments are generally considered to be a better response to this problem than traditional command-and-control policies.

The two most prominent market based instruments namely carbon taxes and emission trading schemes and advantages and disadvantages of both were investigated and it was concluded that neither of these two schemes on their own would result in the desired carbon dioxide emission reductions globally and in South Africa without proper planning for the type of economy in which they are implemented.

5.2.2 Research objective 2: Understanding the South African dynamic

The second research objective that was set was to gain an understanding of South Africa's and in particular the South African mining industry's contribution to global warming, the importance of this industry in the South African economy as well as to gain an understanding of the proposed CET proposal (chapter 1.3.2). This objective has been addressed in chapter 3.

In response to this objective the following results have been obtained (chapter 3.4 and 3.5): South Africa is not merely a bystander when it comes to global warming, but is affected by and contributes to global warming through its comparably high carbon dioxide emissions. It is furthermore evident that the South African mining industry is a material contributor to the South African carbon dioxide emissions through its heavy reliance on coal fired electricity in its operations while simultaneously being an important sector in the South African economy.

It was determined that the effect of the implementation of a CET could be detrimental to the South African economy as a whole if the South African mining industry is adversely affected by the tax especially seen in the light that the mining industry is a price taker, and as such it cannot pass this increase in production costs on to the consumer of its products. The development of the proposed CET as well as industry comments thereon have been investigated and found that while improvements to the original proposal have been made, that there are still multiple concerns with the current proposal. These concerns include but are not limited to the following. The proposed CET includes the South African energy sector within the scope of the tax which has been found to be inappropriate. The tax further has no minimum level under which no tax will be payable and therefore all companies, no matter the size of the company or quantity of emissions produced, will have to measure carbon emissions and pay the tax. Additionally it was found that there is a level of uncertainty regarding the determination of the sector benchmarks that will be set as well as the classification of companies in these sectors.

5.2.3 Research objective 3: The impact of a carbon tax

The third research objective that was set was to determine the possible impact that CET can have on the South African mining industry by evaluating the tax against the Mineral and Petroleum Resources Development Act (28 of 2002) (chapter 1.3.3). Where possible this was

illustrated through the use of quantitative examples. This objective has been addressed in Chapter 4.

In response to this objective the following results have been obtained (chapter 4.5):

The implementation of a CET on the mining industry may potentially be inconsistent and or contrary to the objectives of the Mineral and Petroleum Resources Development Act (28 of 2002) (MPRDA) in some respects while it may potentially enhance or increase other aspects. The commentary on the implementation of a CET, as discussed in chapter 3, have also been found to be valid based on the discussions held and profitability calculations performed.

Based on the above comparison between the MPRDA and the proposed CET, it was established that the profitability of all companies and sectors will be negatively impacted by the introduction of a CET on the mining industry. This indicates that an additional barrier to entry into the mining industry will be created for new companies and is therefore contrary to the objectives (c) and (d) of the MPRDA. It further indicates that economic growth and development as well as employment investment and new hires may decrease, which will also be contrary to the objectives (e) and (f) of the MPRDA. The reduction in profitability will also ensure that companies will be more aware of the effect that their operations have on the environment and in this regard will be in line with objective (h) of the MPRDA.

The method in which the National Treasury ultimately allocates the funds generated with the tax was found to affect the majority of the objectives of the MPRDA. The comparison found that while behavioural change in line with the objective of the MPRDA may be a result of the implementation of a CET that the specific allocation by the National Treasury of the funds as well as Eskom's monopoly over the South African energy sector can hamper this positive impact. The National Treasury will have to decide whether to allocate the funds collected to carbon reduction projects in order to reduce the negative impact on the profitability of the industry or to allocate the funds in projects to assist the poor. The reluctance of the National Treasury to give a firm commitment on the allocation of funds collected has been found to negatively affect objectives (b), (d), (e), (f), (g), (h) and (i) of the MPRDA.

Based on the comparison of the profitability in different sectors of the mining industry some sectors have been found to be affected worse than other sectors in the industry. Depending on the measure chosen either the iron ore or gold and platinum sectors are the worst affected, but

all sectors were found to be negatively affected. The MPRDA will therefore be affected in the same manner as discussed in the above discussion related to profitability.

The comparison further indicated that all the sectors in the mining industry will be affected differently and therefore the suggested reductions proposed are not effective in protecting all sectors equally and are not specific enough for the diverse nature of the South African mining industry. It was however determined, that if Scope 2 emissions are excluded from the tax, that a significant reduction in the tax liability can be achieved by the industry in general as well as on an individual company level.

As indicated in the above discussion, the profitability of all companies will be negatively affected and hamper the objectives of the MPRDA. The results of the comparison further indicated that smaller companies may potentially be affected more than larger companies and will therefore result in the aforementioned effects on the MPRDA being compounded. The same conclusion holds true for marginal mines and marginal mine shafts.

The objective of affecting behavioural change while protecting key industries as set by the National Treasury with the implementation of a CET, will be difficult to achieve with the current structure of the CET. While realising the need for action to curb the effect of global warming and the contribution of South Africa and specifically the South African mining industry to the problem, the potential negative effect that CET could have on certain sectors, smaller companies and marginal mines as well as equal access for all to this industry, should be reconsidered. The adjustments needed to be made to the CET in order to address these potential negative aspects are not straightforward or easy to achieve, but as indicated through the study, these changes are imperative (chapter 4.2.2 and 4.4.2).

5.3 Limiting factors as well as areas for further research

This section has been divided into two sections, the first of which deliberates about the limitations in the study. The second section suggests possible areas for future research with regard to the negative impact that CET can have on the mining industry.

5.3.1 Limitations of the study

While the research objectives have still been achieved, two unavoidable limitations to the study have been identified. Firstly, due to the lack in information regarding direct and indirect carbon emissions, the quantitative research performed in chapter 4.4 has only been performed on a limited number of companies in the mining industry. It is submitted that, if all information had been available, the results could have been improved on. Secondly, not all the companies referred to in the above-mentioned quantitative examples, presented their gross profit figure in the financial statements and a calculated operating profit therefore had to be used.

5.3.2 Areas for further research

During the course of this study, a number of opportunities for future research have been identified and these do not detract from the results of the current study. Firstly, the National Treasury has not committed to any specific allocation of the funds generated from the CET (chapter 3.4.3.1). It is suggested that the socio-economic impact of this on the mining companies as well as on all stakeholders in the mining industry be evaluated in further detail. Secondly, the level of behavioural change that the implementation of a CET can achieve, considered in the light of Eskom's significant influence over the South African energy sector as well as the nature of the mining industry's high energy needs, should be investigated (chapter 3.4.3.2 and chapter 4.5). Third, the reason for the proportionately higher impact that a CET can have on small companies, marginal mines and marginal mine shaft as well as possible means to protect them should be investigated further (chapter 4.4 and chapter 4.5). Lastly, methods to protect key highly affected industries should be considered as well as the potential impact that negatively affecting these sectors can have on the South African economy (chapter 4.4 and chapter 4.5).

5.4 Overall conclusion of the study

The research question set in chapter 1.2 was to determine the possible implications of the implementation of the proposed CET on the South African mining industry. The study conducted confirmed that when the effect of the proposed CET on the South African mining industry is compared to the objective of the Mineral and Petroleum Resources Development Act (28 of 2002), both positive and negative implications to these objectives were identified. The study found that most of the objectives of the MPRDA, but especially the objectives that relate to job creation, economic growth and equal access for all to enter the industry may be affected negatively by the implementation of a CET. The study further found that while the profitability of all companies will be affected negatively by the implementation of a CET, all sectors in the mining industry will not be affected to the same degree and as a result the difficulty of entry into these highly affect sectors will be increased. It was also established that the profitability of smaller and marginal companies will be more affected than larger companies by the implementation of a CET. The study further found that careful consideration by the National Treasury needs to be given to the allocation of the funds collected with the tax as the allocation can affect the objectives of the MPRDA either positively or negatively.

ANNEXURE 1

Sector	Year	Company Name	Scope 1 Emissions	Scope 2 Emissions	Combined Carbon dioxide emissions tons	Basic tax free threshold	Adjusted Basic tax free threshold	Maximum trade allowance for trade exposure	Additional allowance for process emissions	Maximum offset	Total maximum tax reduction	75% of Maximum tax reduction	50% of Maximum tax reduction	Revenue	Cost of Sales / Operating costs	Gross Profit/Operating profit	Gross Profit/ Operating profit %
Gold	2011	AngloGold Ashanti	1,215,000	3,482,000	4,697,000	60%	65%	10%	0%	10%	85%	63%	42%	47,849,000,000	28,745,000,000	19,104,000,000	39.9%
Gold	2011	Gold Fields	1,377,194	5,164,897	6,542,091	60%	55%	10%	0%	10%	75%	56%	38%	41,876,800,000	26,421,200,000	15,455,600,000	36.9%
Gold	2011	Harmony Gold Mining Company	2,103,211	3,422,823	5,526,034	60%	55%	10%	0%	10%	75%	56%	38%	12,445,000,000	11,615,000,000	830,000,000	6.7%
		Average	1,565,135	4,023,240	5,588,375	60%	58%	10%	0%	10%	78%	59%	39%	34,056,933,333	22,260,400,000	11,796,533,333	27.8%
Platinum	2011	Anglo American Platinum	457,336	5,154,402	5,611,738	60%	65%	10%	0%	10%	85%	64%	43%	51,117,000,000	42,562,000,000	8,555,000,000	16.7%
Platinum	2011	Impala Platinum Holdings	584,504	3,108,473	3,692,977	60%	65%	10%	0%	10%	85%	64%	43%	33,132,000,000	21,490,000,000	11,642,000,000	35.1%
Platinum	2011	Northam Platinum	14,258	634,165	648,423	60%	65%	10%	0%	10%	85%	64%	43%	3,571,048,000	3,185,754,000	385,294,000	10.8%
		Average	352,033	2,965,680	3,317,713	60%	65%	10%	0%	10%	85%	64%	43%	29,273,349,333	22,412,584,667	6,860,764,667	20.9%
Iron Ore	2011	ArcelorMittal SA	11,938,852	4,443,096	16,381,948	60%	65%	10%	10%	5%	90%	68%	45%	681,417,017,600	620,115,372,800	61,301,644,800	9.0%
Iron Ore	2011	Evraz Highveld Steel and Vanadium Corporation	2,799,579	1,811,503	4,611,082	60%	65%	10%	10%	5%	90%	68%	45%	5,587,000,000	4,750,000,000	837,000,000	15.0%
		Average	7,369,216	3,127,300	10,496,515	60%	65%	10%	10%	5%	90%	68%	45%	343,502,008,800	312,432,686,400	31,069,322,400	12.0%
Metals and Mining	2011	Anglo American	9,809,076	10,190,815	19,999,891	60%	65%	10%	0%	10%	85%	64%	43%	228,833,369,600	151,637,094,400	77,196,275,200	33.7%
Metals and Mining	2011	BHP Billiton	19,591,969	26,139,168	45,731,137	60%	65%	10%	0%	10%	85%	64%	43%	506,388,663,000	283,457,132,600	222,931,530,400	44.0%
Metals and Mining	2011	Exxaro Resources	502,594	2,107,933	2,610,527	60%	65%	10%	0%	10%	85%	64%	43%	12,471,000,000	9,663,000,000	2,808,000,000	22.5%
		Average	9,967,880	12,812,639	22,780,518	60%	65%	10%	0%	10%	85%	64%	43%	249,231,010,867	148,252,409,000	100,978,601,867	33%
Other	2011	Sasol	64,166,000	10,815,000	74,981,000	60%	60%	10%	0%	10%	80%	60%	40%	142,436,000,000	90,467,000,000	51,969,000,000	36.5%

Sector	Year	Company Name	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	% reduction in Gross profit @ maximum reduction	% reduction in Gross profit @ maximum reduction	% reduction in Gross Profit @ 75% maximum reduction	% reduction in Gross Profit @ 50% maximum reduction	% reduction in Gross Profit @ 50% maximum reduction	
Gold	2011	AngloGold Ashanti	22,574,989	53,381,242	84,187,495	167,136,000	229,812,000	292,488,000	189,710,989	283,193,242	376,675,495	1.0%	0.4%	1.5%	0.6%	2.0%	0.8%
Gold	2011	Gold Fields	46,954,050	82,169,588	117,385,125	247,915,056	340,883,202	433,851,348	294,869,106	423,052,790	551,236,473	1.9%	0.7%	2.7%	1.0%	3.6%	1.3%
Gold	2011	Harmony Gold Mining Company	63,096,330	110,418,578	157,740,825	164,295,504	225,906,318	287,517,132	227,391,834	336,324,896	445,257,957	27.4%	1.8%	40.5%	2.7%	53.6%	3.6%
		<i>Average</i>	<i>44,208,456</i>	<i>81,989,802</i>	<i>119,771,148</i>	<i>193,115,520</i>	<i>265,533,840</i>	<i>337,952,160</i>	<i>237,323,976</i>	<i>347,523,642</i>	<i>457,723,308</i>	<i>2.0%</i>	<i>1.0%</i>	<i>2.9%</i>	<i>1.4%</i>	<i>3.9%</i>	<i>1.9%</i>
Platinum	2011	Anglo American Platinum	8,232,048	19,894,116	31,556,184	247,411,296	340,190,532	432,969,768	255,643,344	360,084,648	464,525,952	3.0%	0.5%	4.2%	0.7%	5.4%	0.9%
Platinum	2011	Impala Platinum Holdings	10,521,072	25,425,924	40,330,776	149,206,704	205,159,218	261,111,732	159,727,776	230,585,142	301,442,508	1.4%	0.5%	2.0%	0.7%	2.6%	0.9%
Platinum	2011	Northam Platinum	256,644	620,223	983,802	30,439,920	41,854,890	53,269,860	30,696,564	42,475,113	54,253,662	8.0%	0.9%	11.0%	1.2%	14.1%	1.5%
		<i>Average</i>	<i>6,336,588</i>	<i>15,313,421</i>	<i>24,290,254</i>	<i>142,352,640</i>	<i>195,734,880</i>	<i>249,117,120</i>	<i>148,689,228</i>	<i>211,048,301</i>	<i>273,407,374</i>	<i>2.2%</i>	<i>0.6%</i>	<i>3.1%</i>	<i>0.9%</i>	<i>4.0%</i>	<i>1.1%</i>
Iron Ore	2011	ArcelorMittal SA	143,266,224	465,615,228	787,964,232	213,268,608	293,244,336	373,220,064	356,534,832	758,859,564	1,161,184,296	0.6%	0.1%	1.2%	0.1%	1.9%	0.2%
Iron Ore	2011	Evraz Highveld Steel and Vanadium Corporation	33,594,948	109,183,581	184,772,214	86,952,144	119,559,198	152,166,252	120,547,092	228,742,779	336,938,466	14.4%	2.2%	27.3%	4.1%	40.3%	6.0%
		<i>Average</i>	<i>88,430,586</i>	<i>287,399,405</i>	<i>486,368,223</i>	<i>150,110,376</i>	<i>206,401,767</i>	<i>262,693,158</i>	<i>238,540,962</i>	<i>493,801,172</i>	<i>749,061,381</i>	<i>0.8%</i>	<i>1.1%</i>	<i>1.6%</i>	<i>2.1%</i>	<i>2.4%</i>	<i>3.1%</i>
Metals and Mining	2011	Anglo American	176,563,368	426,694,806	676,826,244	489,159,120	672,593,790	856,028,460	665,722,488	1,099,288,596	1,532,854,704	0.9%	0.3%	1.4%	0.5%	2.0%	0.7%
Metals and Mining	2011	BHP Billiton	352,655,442	852,250,652	1,351,845,861	1,254,680,064	1,725,185,088	2,195,690,112	1,607,335,506	2,577,435,740	3,547,535,973	0.7%	0.3%	1.2%	0.5%	1.6%	0.7%
Metals and Mining	2011	Exxaro Resources	9,046,692	21,862,839	34,678,986	101,180,784	139,123,578	177,066,372	110,227,476	160,986,417	211,745,358	3.9%	0.9%	5.7%	1.3%	7.5%	1.7%
		<i>Average</i>	<i>179,421,834</i>	<i>433,602,766</i>	<i>687,783,697</i>	<i>615,006,656</i>	<i>845,634,152</i>	<i>1,076,261,648</i>	<i>794,428,490</i>	<i>1,279,236,918</i>	<i>1,764,045,345</i>	<i>0.8%</i>	<i>0.5%</i>	<i>1.3%</i>	<i>0.8%</i>	<i>1.7%</i>	<i>1.0%</i>
Other	2011	Sasol	1,539,984,000	3,079,968,000	4,619,952,000	519,120,000	713,790,000	908,460,000	2,059,104,000	3,793,758,000	5,528,412,000	4.0%	1.4%	7.3%	2.7%	10.6%	3.9%

Sector	Year	Company Name	Scope 1 Emissions	Scope 2 Emissions	Combined Carbon dioxide emissions tons	Basic tax free threshold	Adjusted Basic tax free threshold	Maximum trade allowance for trade exposure	Additional allowance for process emissions	Maximum offset	Total maximum tax reduction	75% of Maximum tax reduction	50% of Maximum tax reduction	Revenue	Cost of Sales / Operating costs	Gross Profit/Operating profit	Gross Profit/ Operating profit %
Gold	2010	AngloGold Ashanti	1,183,000	3,489,000	4,672,000	60%	65%	10%	0%	10%	85%	64%	42%	38,833,000,000	25,833,000,000	13,000,000,000	33.5%
Gold	2010	Gold Fields	1,308,764	5,093,511	6,402,275	60%	55%	10%	0%	10%	75%	56%	38%	34,090,750,000	24,838,100,000	9,252,650,000	27.1%
Gold	2010	Harmony Gold Mining Company	146,036	3,444,600	3,590,636	60%	65%	10%	0%	10%	85%	64%	43%	11,284,000,000	10,484,000,000	800,000,000	7.1%
		<i>Average</i>	<i>879,267</i>	<i>4,009,037</i>	<i>4,888,304</i>	<i>60%</i>	<i>62%</i>	<i>10%</i>	<i>0%</i>	<i>10%</i>	<i>82%</i>	<i>61%</i>	<i>41%</i>	<i>28,069,250,000</i>	<i>20,385,033,333</i>	<i>7,684,216,667</i>	<i>22.6%</i>
Platinum	2010	Anglo American Platinum	427,290	5,152,793	5,580,083	60%	65%	10%	0%	10%	85%	64%	43%	46,025,000,000	37,991,000,000	8,034,000,000	17.5%
Platinum	2010	Impala Platinum Holdings	693,145	2,930,324	3,623,469	60%	65%	10%	0%	10%	85%	64%	43%	25,446,000,000	17,294,000,000	8,152,000,000	32.0%
Platinum	2010	Northam Platinum	15,293	645,745	661,038	60%	65%	10%	0%	10%	85%	64%	43%	3,945,083,000	3,160,108,000	784,975,000	19.9%
		<i>Average</i>	<i>378,576</i>	<i>2,909,621</i>	<i>3,288,197</i>	<i>60%</i>	<i>65%</i>	<i>10%</i>	<i>0%</i>	<i>10%</i>	<i>85%</i>	<i>64%</i>	<i>43%</i>	<i>25,138,694,333</i>	<i>19,481,702,667</i>	<i>5,656,991,667</i>	<i>23.1%</i>
Iron Ore	2010	ArcelorMittal SA	10,730,360	4,330,419	15,060,779	60%	65%	10%	10%	5%	90%	68%	45%	569,808,772,500	519,119,343,600	50,689,428,900	8.9%
Iron Ore	2010	Evraz Highveld Steel and Vanadium Corporation	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results
		<i>Average</i>	<i>10,730,360</i>	<i>4,330,419</i>	<i>15,060,779</i>	<i>60%</i>	<i>65%</i>	<i>10%</i>	<i>10%</i>	<i>5%</i>	<i>90%</i>	<i>68%</i>	<i>45%</i>	<i>569,808,772,500</i>	<i>519,119,343,600</i>	<i>50,689,428,900</i>	<i>8.9%</i>
Metals and Mining	2010	Anglo American	8,850,000	10,252,000	19,102,000	60%	65%	10%	0%	10%	85%	64%	43%	210,360,034,500	142,056,010,800	68,304,023,700	32.5%
Metals and Mining	2010	BHP Billiton	21,355,000	27,688,000	49,043,000	60%	65%	10%	0%	10%	85%	64%	43%	372,562,099,000	232,615,517,500	139,946,581,500	37.6%
Metals and Mining	2010	Exxaro Resources	542,000	2,238,794	2,780,794	60%	65%	10%	0%	10%	85%	64%	43%	10,116,000,000	7,628,000,000	2,488,000,000	24.6%
		<i>Average</i>	<i>10,249,000</i>	<i>13,392,931</i>	<i>23,641,931</i>	<i>60%</i>	<i>65%</i>	<i>10%</i>	<i>0%</i>	<i>10%</i>	<i>85%</i>	<i>64%</i>	<i>43%</i>	<i>197,679,377,833</i>	<i>127,433,176,100</i>	<i>70,246,201,733</i>	<i>31.5%</i>
Other	2010	Sasol	61,768,000	9,553,000	71,321,000	60%	60%	10%	0%	10%	80%	60%	40%	122,256,000,000	79,183,000,000	43,073,000,000	35.2%

Sector	Year	Company Name	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	% reduction in Gross profit @ maximum reduction	% reduction in Gross profit @ maximum reduction	% reduction in Gross Profit @ 75% maximum reduction	% reduction in Gross Profit @ maximum reduction	% reduction in Gross Profit @ 50% maximum reduction	% reduction in Gross Profit @ maximum reduction
Gold	2010	AngloGold Ashanti	21,490,334	51,607,750	81,725,167	167,472,000	230,274,000	293,076,000	188,962,334	281,881,750	374,801,167	1.5%	0.5%	2.2%	0.7%	2.9%	1.0%
Gold	2010	Gold Fields	46,954,050	82,169,588	117,385,125	244,488,528	336,171,726	427,854,924	291,442,578	418,341,314	545,240,049	3.1%	0.9%	4.5%	1.2%	5.9%	1.6%
Gold	2010	Harmony Gold Mining Company	2,628,648	6,352,566	10,076,484	165,340,800	227,343,600	289,346,400	167,969,448	233,696,166	299,422,884	21.0%	1.5%	29.2%	2.1%	37.4%	2.7%
		<i>Average</i>	<i>23,691,011</i>	<i>46,709,968</i>	<i>69,728,925</i>	<i>192,433,776</i>	<i>264,596,442</i>	<i>336,759,108</i>	<i>216,124,787</i>	<i>311,306,410</i>	<i>406,488,033</i>	<i>2.8%</i>	<i>0.9%</i>	<i>4.1%</i>	<i>1.3%</i>	<i>5.3%</i>	<i>1.7%</i>
Platinum	2010	Anglo American Platinum	7,691,220	18,587,115	29,483,010	247,334,064	340,084,338	432,834,612	255,025,284	358,671,453	462,317,622	3.2%	0.6%	4.5%	0.8%	5.8%	1.0%
Platinum	2010	Impala Platinum Holdings	12,476,610	30,151,808	47,827,005	140,655,552	193,401,384	246,147,216	153,132,162	223,553,192	293,974,221	1.9%	0.6%	2.7%	0.9%	3.6%	1.2%
Platinum	2010	Northam Platinum	275,274	665,246	1,055,217	30,995,760	42,619,170	54,242,580	31,271,034	43,284,416	55,297,797	4.0%	0.8%	5.5%	1.1%	7.0%	1.4%
		<i>Average</i>	<i>6,814,368</i>	<i>16,468,056</i>	<i>26,121,744</i>	<i>139,661,792</i>	<i>192,034,964</i>	<i>244,408,136</i>	<i>146,476,160</i>	<i>208,503,020</i>	<i>270,529,880</i>	<i>2.6%</i>	<i>0.6%</i>	<i>3.7%</i>	<i>0.9%</i>	<i>4.8%</i>	<i>1.2%</i>
Iron Ore	2010	ArcelorMittal SA	128,764,320	418,484,040	708,203,760	207,860,112	285,807,654	363,755,196	336,624,432	704,291,694	1,071,958,956	0.7%	0.1%	1.4%	0.1%	2.1%	0.2%
Iron Ore	2010	Evraz Highveld Steel and Vanadium Corporation	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results
		<i>Average</i>	<i>128,764,320</i>	<i>418,484,040</i>	<i>708,203,760</i>	<i>207,860,112</i>	<i>285,807,654</i>	<i>363,755,196</i>	<i>336,624,432</i>	<i>704,291,694</i>	<i>1,071,958,956</i>	<i>0.7%</i>	<i>0.1%</i>	<i>1.4%</i>	<i>0.1%</i>	<i>2.1%</i>	<i>0.2%</i>
Metals and Mining	2010	Anglo American	159,300,000	384,975,000	610,650,000	492,096,000	676,632,000	861,168,000	651,396,000	1,061,607,000	1,471,818,000	1.0%	0.3%	1.6%	0.5%	2.2%	0.7%
Metals and Mining	2010	BHP Billiton	384,390,000	928,942,500	1,473,495,000	1,329,024,000	1,827,408,000	2,325,792,000	1,713,414,000	2,756,350,500	3,799,287,000	1.2%	0.5%	2.0%	0.7%	2.7%	1.0%
Metals and Mining	2010	Exaro Resources	9,756,000	23,577,000	37,398,000	107,462,112	147,760,404	188,058,696	117,218,112	171,337,404	225,456,696	4.7%	1.2%	6.9%	1.7%	9.1%	2.2%
		<i>Average</i>	<i>184,482,000</i>	<i>445,831,500</i>	<i>707,181,000</i>	<i>642,860,704</i>	<i>883,933,468</i>	<i>1,125,006,232</i>	<i>827,342,704</i>	<i>1,329,764,968</i>	<i>1,832,187,232</i>	<i>1.2%</i>	<i>0.6%</i>	<i>1.9%</i>	<i>1.0%</i>	<i>2.6%</i>	<i>1.3%</i>
Other	2010	Sasol	1,482,432,000	2,964,864,000	4,447,296,000	458,544,000	630,498,000	802,452,000	1,940,976,000	3,595,362,000	5,249,748,000	4.5%	1.6%	8.3%	2.9%	12.2%	4.3%

Sector	Year	Company Name	Scope 1 Emissions	Scope 2 Emissions	Combined Carbon dioxide emissions tons	Basic tax free threshold	Adjusted Basic tax free threshold	Maximum trade allowance for trade exposure	Additional allowance for process emissions	Maximum offset	Total maximum tax reduction	75% of Maximum tax reduction	50% of Maximum tax reduction	Revenue	Cost of Sales / Operating costs	Gross Profit/Operating profit	Gross Profit/ Operating profit %
Gold	2009	AngloGold Ashanti	1,414,817	3,464,083	4,878,900	60%	62%	10%	0%	10%	82%	62%	41%	30,745,000,000	23,220,000,000	7,525,000,000	24.5%
Gold	2009	Gold Fields	1,143,188	4,527,119	5,670,307	60%	55%	10%	0%	10%	75%	56%	38%	30,326,100,000	22,797,650,000	7,528,450,000	24.8%
Gold	2009	Harmony Gold Mining Company	83,584	4,143,503	4,227,087	60%	65%	10%	0%	10%	85%	64%	43%	11,496,000,000	9,659,000,000	1,837,000,000	16.0%
		<i>Average</i>	<i>880,530</i>	<i>4,044,902</i>	<i>4,925,431</i>	<i>60%</i>	<i>61%</i>	<i>10%</i>	<i>0%</i>	<i>10%</i>	<i>81%</i>	<i>61%</i>	<i>40%</i>	<i>24,189,033,333</i>	<i>18,558,883,333</i>	<i>5,630,150,000</i>	<i>21.8%</i>
Platinum	2009	Anglo American Platinum	493,312	4,993,136	5,486,448	60%	65%	10%	0%	10%	85%	64%	43%	36,687,000,000	34,715,000,000	1,972,000,000	5.4%
Platinum	2009	Impala Platinum Holdings	405,354	2,699,297	3,104,651	60%	65%	10%	0%	10%	85%	64%	43%	26,121,000,000	16,359,000,000	9,762,000,000	37.4%
Platinum	2009	Northam Platinum	17,364	739,365	756,729	60%	65%	10%	0%	10%	85%	64%	43%	3,186,042,000	2,368,129,000	817,913,000	25.7%
		<i>Average</i>	<i>305,343</i>	<i>2,810,599</i>	<i>3,115,943</i>	<i>60%</i>	<i>65%</i>	<i>10%</i>	<i>0%</i>	<i>10%</i>	<i>85%</i>	<i>64%</i>	<i>43%</i>	<i>21,998,014,000</i>	<i>17,814,043,000</i>	<i>4,183,971,000</i>	<i>22.8%</i>
Iron Ore	2009	ArcelorMittal SA	12,420,730	3,756,528	16,177,258	60%	65%	10%	10%	5%	90%	68%	45%	513,143,895,300	494,592,979,500	18,550,915,800	3.6%
Iron Ore	2009	Evraz Highveld Steel and Vanadium Corporation	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results
		<i>Average</i>	<i>12,420,730</i>	<i>3,756,528</i>	<i>16,177,258</i>	<i>60%</i>	<i>65%</i>	<i>10%</i>	<i>10%</i>	<i>5%</i>	<i>90%</i>	<i>68%</i>	<i>45%</i>	<i>513,143,895,300</i>	<i>494,592,979,500</i>	<i>18,550,915,800</i>	<i>3.6%</i>
Metals and Mining	2009	Anglo American	9,620,000	10,177,000	19,797,000	60%	65%	10%	0%	10%	85%	64%	43%	178,075,336,800	138,593,673,300	39,481,663,500	22.2%
Metals and Mining	2009	BHP Billiton	23,093,870	28,798,955	51,892,825	60%	65%	10%	0%	10%	85%	64%	43%	384,500,120,000	292,462,296,000	92,037,824,000	23.9%
Metals and Mining	2009	Exxaro Resources	674,403	1,601,994	2,276,397	60%	65%	10%	0%	10%	85%	64%	43%	15,009,000,000	14,705,000,000	304,000,000	2.0%
		<i>Average</i>	<i>11,129,424</i>	<i>13,525,983</i>	<i>24,655,407</i>	<i>60%</i>	<i>65%</i>	<i>10%</i>	<i>0%</i>	<i>10%</i>	<i>85%</i>	<i>64%</i>	<i>43%</i>	<i>192,528,152,267</i>	<i>148,586,989,767</i>	<i>43,941,162,500</i>	<i>16.0%</i>
Other	2009	Sasol	62,966,000	9,714,000	72,680,000	60%	60%	10%	0%	10%	80%	60%	40%	137,836,000,000	88,508,000,000	49,328,000,000	35.8%

Sector	Year	Company Name	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	Carbon emission tax @ R120 @ maximum reduction	Carbon emission tax @ R120 @ 75% maximum reduction	Carbon emission tax @ R120 @ 50% maximum reduction	% reduction in Gross profit @ maximum reduction	% reduction in Gross profit @ maximum reduction	% reduction in Gross Profit @ 75% maximum reduction	% reduction in Gross Profit @ 75% maximum reduction	% reduction in Gross Profit @ 50% maximum reduction	% reduction in Gross Profit @ 50% maximum reduction
Gold	2009	AngloGold Ashanti	30,371,422	65,223,076	100,074,731	166,275,984	228,629,478	290,982,972	196,647,406	293,852,554	391,057,703	2.6%	0.6%	3.9%	1.0%	5.2%	1.3%
Gold	2009	Gold Fields	46,954,050	82,169,588	117,385,125	217,301,712	298,789,854	380,277,996	264,255,762	380,959,442	497,663,121	3.5%	0.9%	5.1%	1.3%	6.6%	1.6%
Gold	2009	Harmony Gold Mining Company	1,504,512	3,635,904	5,767,296	198,888,144	273,471,198	348,054,252	200,392,656	277,107,102	353,821,548	10.9%	1.7%	15.1%	2.4%	19.3%	3.1%
		Average	26,276,661	50,342,856	74,409,051	194,155,280	266,963,510	339,771,740	220,431,941	317,306,366	414,180,791	3.9%	1.1%	5.6%	1.5%	7.4%	2.0%
Platinum	2009	Anglo American Platinum	8,879,616	21,459,072	34,038,528	239,670,528	329,546,976	419,423,424	248,550,144	351,006,048	453,461,952	12.6%	0.7%	17.8%	1.0%	23.0%	1.2%
Platinum	2009	Impala Platinum Holdings	7,296,372	17,632,899	27,969,426	129,566,256	178,153,602	226,740,948	136,862,628	195,786,501	254,710,374	1.4%	0.5%	2.0%	0.7%	2.6%	1.0%
Platinum	2009	Northam Platinum	312,552	755,334	1,198,116	35,489,520	48,798,090	62,106,660	35,802,072	49,553,424	63,304,776	4.4%	1.1%	6.1%	1.6%	7.7%	2.0%
		Average	5,496,180	13,282,435	21,068,690	134,908,768	185,499,556	236,090,344	140,404,948	198,781,991	257,159,034	3.4%	0.8%	4.8%	1.1%	6.1%	1.4%
Iron Ore	2009	ArcelorMittal SA	149,048,760	484,408,470	819,768,180	180,313,344	247,930,848	315,548,352	329,362,104	732,339,318	1,135,316,532	1.8%	0.06%	3.9%	0.14%	6.1%	0.22%
Iron Ore	2009	Evraz Highveld Steel and Vanadium Corporation	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results	no results
		Average	149,048,760	484,408,470	819,768,180	180,313,344	247,930,848	315,548,352	329,362,104	732,339,318	1,135,316,532	1.8%	0.1%	3.9%	0.1%	6.1%	0.2%
Metals and Mining	2009	Anglo American	173,160,000	418,470,000	663,780,000	488,496,000	671,682,000	854,868,000	661,656,000	1,090,152,000	1,518,648,000	1.7%	0.4%	2.8%	0.6%	3.8%	0.9%
Metals and Mining	2009	BHP Billiton	415,689,660	1,004,583,345	1,593,477,030	1,382,349,840	1,900,731,030	2,419,112,220	1,798,039,500	2,905,314,375	4,012,589,250	2.0%	0.5%	3.2%	0.8%	4.4%	1.0%
Metals and Mining	2009	Exxaro Resources	12,139,254	29,336,531	46,533,807	76,895,712	105,731,604	134,567,496	89,034,966	135,068,135	181,101,303	29.3%	0.6%	44.4%	0.9%	59.6%	1.2%
		Average	200,329,638	484,129,959	767,930,279	649,247,184	892,714,878	1,136,182,572	849,576,822	1,376,844,837	1,904,112,851	1.9%	0.5%	3.1%	0.8%	4.3%	1.0%
Other	2009	Sasol	1,511,184,000	3,022,368,000	4,533,552,000	466,272,000	641,124,000	815,976,000	1,977,456,000	3,663,492,000	5,349,528,000	4.0%	1.4%	7.4%	2.7%	10.8%	3.9%

List of References

- AII. 2011. Profit Margin Analysis.
<http://www.aaii.com/computerizedinvesting/article/profit-margin-analysis.pdf> Date of Access: 27 August 2013.
- ANGLOGOLD ASHANTI. 2011. Annual Financial statements 2011. 332p.
- ANGLOGOLD ASHANTI. 2010. Annual Financial statements 2010. 393p.
- ANGLO AMERICAN. 2011. Annual Report 2011. 226p.
- ANGLO AMERICAN. 2010. Annual Report 2010. 214p.
- ANGLO AMERICAN PLATINUM. 2011. Integrated Annual Report 2011. 324p.
- ANON. 2006. China says global warming is melting glaciers. *Business & the environment*, 17(7):15-16, July.
- ANON.2009. Eskom seminar Energy efficiency in mining: corporate. *Inside Mining*, 2(9):36, September.
- ANON. 2010. Carbon tax or cap-and-trade – a new dawn for SA business. *Enterprise Risk*, 3(11):24-25.
- ARCELOR MITTAL. 2011. Annual Report 2011. 220p.
- AVI-YONAH, R.S. & UHLMANN, D.M. 2009. Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming than Cap and Trade. *Stanford Environmental Law Journal*, 28(3):3-50.
- BAXTER, R. 2011. Opportunities and Challenges facing the South African Mining Industry. (Paper delivered to SACEA AGM on 17 February 2011.) 32p.
- BHP BILLITON. 2011. Annual Report 2011. 268p.

BORROTO, R.J. 1998. **Global warming, rising sea level**, and growing risk of cholera incidence: a review of the literature and evidence. *GeoJournal*, 44(2):111-120, February.

BOVENBERG, A.L. & DE MOOIJ, R.A. 1994. Environmental Levies and Distortionary Taxation. *The American Economic Review*, 84(4): 1085-1089, September.

BRISTOW, A.L., WARDMAN, M., ZANNI, A.M. & CHINTAKAYALA, P.K. 2010. Public acceptability of personal carbon trading and carbon tax. *Ecological Economics*, 69(1): 1824-1837.

CABRAL, L.M.B. 2000. Introduction to Industrial Organisation. London, England: The MIT Press.

CAO, X. 2003. Climate change and energy development: implications for developing countries. *Resources Policy*, 29: 61-67.

CARBON DISCLOSURE PROJECT. 2011. CDP South Africa JSE 100 Report 2011: Partnering for a low carbon future. <https://www.cdproject.net/CDPResults/CDP-2011-South-Africa-JSE-100-Report.pdf> Date of Access: 29 March 2013.

CARBON DISCLOSURE PROJECT. 2010. CDP South Africa JSE 100 Report 2010. <https://www.cdproject.net/CDPResults/CDP-2010-South-Africa-JSE100.pdf> Date of Access: 04 April 2013.

CARBON DISCLOSURE PROJECT. 2010. CDP South Africa JSE 100 Report 2010. http://us-cdn.creamermedia.co.za/assets/articles/attachments/24152_sa_cdp_2009.pdf Date of Access: 04 April 2013.

CAWOOD, F.T. 2004. The Mineral and Petroleum Resources Development Act of 2002: A paradigm shift in mineral policy in South Africa. *The Journal of The South African Institute of Mining and Metallurgy*, 53-64, January/February. <http://www.saimm.co.za/Journal/v104n01p053.pdf> Date of Access: 04 April 2013.

CHAMBER OF MINES. 2011. Education: Coal. <http://www.bullion.org.za/content/?pid=82&pagename=Coal> Date of access: 24 November 2011.

CHAMBER OF MINES. 2011.

<http://www.bullion.org.za/content/?pid=84&pagename=Gold> Date of Access: 12 November 2011.

CHAMBER OF MINES. 2011. *Annual Presidential Review for use by dr Xolani Mkhwanazi at the 121st annual general meeting of the chamber of mines of South Africa on Tuesday 1 November 2011 at country club Johannesburg, 1-18p.*

<http://www.bullion.org.za/documents/2011-11-02-Final%20Presidential%20Review%20Nov%202011.pdf> Date of access: 10 June 2013.

CHAMBER OF MINES. 2012. *Facts and Figures 2012.*

<http://www.bullion.org.za/content/?pid=71&pagename=Facts+and+Figures> Date of Access: 29 March 2013.

CHAMBER OF MINES. 2013. *Electricity in mining.*

<http://www.bullion.org.za/Departments/Economics/Economics.htm> Date of Access: 29 March 2013.

CLOETE, B. & TYLER, E. 2012. *Carbon Tax Design Options – A Discussion Document.* 34p.

http://awsassets.wwf.org.za/downloads/carbon_tax_design_options_a_discussion_document_final_launch_product_1.pdf Date of Access: 12 June 2013.

DAVISON, B. 2011. *Mining employment trends of 2007-09: A question of prices.* Monthly labour review, 19 – 23, April.

DELOITTE. 2013. *Policy Paper for Public Comment Carbon Tax Policy Paper May 2013.* 2p. <https://www.deloitte.com/assets/Dcom-SouthAfrica/Local%20Assets/Documents/Carbon%20Tax%20Policy%20Paper%20for%20Public%20Comment.pdf> Date of Access: 12/06/2013.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. 2003. *Greenhouse gas emissions.*

DEPARTMENT OF MINERALS AND ENERGY: 2004. *Draft Energy Efficiency Strategy of the Republic of South Africa.*

DILIZA, M.G. 2007. *Investing in South Africa: The Current state of play and what the future holds.*

<http://www.bullion.org.za/MediaReleases/Media%20archives/Investment%20in%20SA%20Mining%20London%202007.pdf> Date of Access: 29 November 2011.

DIMMER, K. 2011. CO2 Tax: The Dirty Tax. *Tax Professional*, 40-41.

DOWDEY, S. 2007. How Carbon Tax Works.

<http://science.howstuffworks.com/environmental/green-science/carbon-tax.htm> Date of Access: 20 Apr. 2011.

EBERHARD, A. 2011. The Future of South African Coal: Market, Investment and Policy Challenges. Program on Energy and Sustainable Development, January.

EKINS, P. & BARKER, T. 2001. Carbon Taxes and Carbon Emissions Trading. *Journal of economic surveys*, 15(3):321-376, July.

ENERGY INFORMATION ADMINISTRATION. 2010. South Africa Energy Data Statistics and Analysis - Oil, Gas, Electricity.

http://www.eia.doe.gov/cabs/South_Africa/pdf.pdf. Date of access: 21 April 2011.

ENERGY RESEARCH CENTRE. 2011. Comments on discussion paper “Reducing Greenhouse Gas Emissions: The Carbon Tax

Option”. http://www.erc.uct.ac.za/ERC_Comments_Treasury_carbon_tax%20.PDF Date of access: 11/06/2013.

ESKOM. 2010. The Energy Efficiency series: Towards an energy efficient mining sector.

http://www.eskomidm.co.za/wp-content/themes/eskom/pdfs/Industrial/Mining/121040ESKD%20Mining%20Brochure_paths.pdf Date of access: 28 March 2013.

ESKOM. 2011. Company information. <http://www.eskom.co.za/c/40/company-information/> Date of Access: 29 November 2011.

ESKOM. 2012. Integrated report 2012.

http://financialresults.co.za/2012/eskom_ar2012/integrated-report/index.php. Date of Access: 28 March 2013.

EVRAZ HIGHVELD STEEL AND VANADIUM. 2011. Integrated Annual Report 2011. 321p.

- EXXARO. 2011. Integrated Annual Report 2011. 220p.
- EXXARO. 2010. Integrated Annual Report for the period ended 31 December 2010. 320p.
- FALCO, D. 2013. Acelor Mittal SA questions carbon tax. *Star Business Report*: 20, 05 June 2013.
- FINNERN, A. 2010. Carbon Tax What's it all about?. *Accountancy SA*, 26-27, December/January.
http://findarticles.com/p/articles/mi_qa5377/is_201012/ai_n56625064. Date of Access: 25 October 2011.
- GAFNER, K. 2012. World Carbon Emissions and Carbon Tax. *Energise*, August 2012.
http://www.sde.co.za/World_Emissions_and_%20the_Carbon_Tax_Energise_August_2012.pdf Date of Access: 12/06/2013.
- GOLDFIELDS. 2011. Annual Financial Report for the 12 month period ended 31 December 2011. 144p.
- GOLDFIELDS. 2010. Annual Report for the year ended 30 June 2010. 286p.
- GOODMAN, C.J. & MANCE, S.M. 2011. Employment loss and the 2007-09 recession: A Overview. *Monthly labour review*, 3 – 12, April.
- HANSEN, J.E. 2005. A slippery slope: How much global warming constitutes “dangerous anthropogenic interference”? An Editorial Essay. *Climate Change*, 68(3): 269-279, February.
- HARMONY GOLD MINING COMPANY. 2011. Integrated Annual Report 2011. 346p.
- HARMONY GOLD MINING COMPANY. 2010. Annual Report 2010. 368p.
- HERBER, B.P. & RAGA, J.T. 1995. An international carbon tax to combat global warming: An economic and political analysis of the European Union proposal. *The American journal of economics and sociology*, 54(3):257-267, July.
- IMPALA PLATINUM HOLDINGS. 2011. Integrated Annual Report 2011. 220p.

INGLESI, R. & POURIS, A. 2010. Forecasting Electricity Demand in South Africa: A Critique of ESKOM's Projections. *South African Journal of Science*, 106(1/2): 50-53, January/February.

INTERNATIONAL ENERGY AGENCY. 2009. South African CCS Roundtable Summary.

http://www.iea.org/country/n_country.asp?COUNTRY_CODE=ZA&Submit=Submit

Date of Access: 24 November 2011.

INTERNATIONAL ENERGY AGENCY. 2011. South African Energy Statistics.

http://www.iea.org/country/n_country.asp?COUNTRY_CODE=ZA&Submit=Submit

Date of Access: 24 November 2011.

INTERNATIONAL ENERGY AGENCY. 2012. Key World Energy Statistics.

<http://www.iea.org> Date of Access: 28 March 2013.

IPCC. 2007. Climate change report: Synopsis report: Summary for Policymakers. 22p.

JANSE VAN VUUREN, R. 2008. Carbon capture and storage: towards sustainable energy management. *CSIR Sciencescope*, 3(1):60-61, June.

KIUILA, O. & MARKANDYA, A. 2009. Can transition economies implement a carbon tax and hope for a double dividend? The case of Estonia. *Applied Economic Letters*, 16:705-705.

LE TREUT, H., SOMERVILLE, R., CUBASCH, U., DING, Y., MAURITZEN, C., MOKSSIT, A., PETERSON, T. AND PRATHER, M. 2007. Historical Overview of Climate Change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

LOK, G. 2009. South Africa's energy: Demand vs. Energy supply. *Inside mining*, 2(11): 22, November/December.

LLOYD, P. 2011. The case against a carbon tax for South Africa. *Energize*, 16-20, October.

MAMMATT, J. 2010. Sustainability reporting and assurance: the way of the future: SA business perspective: sustainability 2009: special reports. *Accountancy SA*, January.

MANDY, K. 2010. Carbon Taxes Versus Cap-and-trade. *Tax Professional*, 28.

MANN, R. 2009. To tax or not to tax carbon- is that the question. *Nat. Resources & Env't*, 24: 44-46.

MBENDI. s.a. <http://www.mbendi.com/indy/ming/gold/af/sa/p0005.htm> Date of Access: 20 Apr. 2011.

MISTY. R. 2013. 'YOU CAN'T EAT ELECTRICITY' Why tackling inequality and hunger should be at the heart of low carbon development in South Africa. *Oxfam Discussion Papers*, 1-34, May 2013.

<http://www.oxfam.org/sites/www.oxfam.org/files/dp-south-africa-low-carbon-development-inequality-hunger-280513-en.pdf> Date of Access: 12 June 2013.

MONTERO, J.P. 2002. Prices versus quantities with incomplete enforcement. *Journal of Public Economics*, 85:435-454.

MUSONDO, H. 2010. Renewable energy technology is nice to have but Eskom has to keep the lights on. *Without Prejudice*, 10(4):42-43, May.

NATIONAL TREASURY. 2010. DISCUSSION PAPER FOR PUBLIC COMMENT Reducing Greenhouse Gas Emissions: The Carbon Tax Option.

http://www.treasury.gov.za/comm_media/news_archive_2010.aspx

Date of access: 11/06/2013.

NATIONAL TREASURY. 2012. Budget review 2012.

<http://www.treasury.gov.za/documents/national%20budget/2012/review/default.aspx>

Date of access: 11/06/2013.

NATIONAL TREASURY. 2013. Budget review 2013.

<http://www.treasury.gov.za/documents/national%20budget/2013/review/default.aspx>

Date of access: 11/06/2013.

NATIONAL TREASURY. 2013. Carbon Tax Policy Paper: Reducing greenhouse gas emissions and facilitating the transition to a green economy.

<http://www.treasury.gov.za/public%20comments/default.aspx>

Date of access: 11/06/2013.

NERSA. 2011. NERSA Comments on Carbon Tax Discussion paper. 8p.

<http://www.treasury.gov.za/divisions/epifr/tax/CarbonTaxWorkshop/NERSA.pdf> Date of access: 12/06/2013.

NORTHAM PLATINUM LIMITED. 2011. Annual Integrated report 2011. 138p.

NORTJE, T. 2006. South Africa's demand side management programme. *Vector*: 42-46, January.

OANDA. 2013. Historical Rates. <http://www.oanda.com/currency/historical-rates/> Date of access: 03 April 2013.

PARRY, I.W.H. 1994. Pollution Taxes and Revenue Recycling. *Journal of Environmental Economics and Management*, 29:64-77, July.

PEARCE, D. 1991. The role of carbon taxes in adjusting to global warming. *The Economic Journal*, 101(407):938-948, July.

PIZER, W.A. 2002. Combining price and quantity controls to mitigate global climate change. *Journal of Public Economics*, 85: 409-434.

REGAN, K. & MCNAMARA, A. 2012. Carbon and energy efficiency policy in South Africa Summary Report. 15p.

http://www.climateriskandopportunity.co.za/%5Cdownloads%5CCarbon_and_EE_Policy_in_SA_Final_2012_Summary.pdf Date of Access: 12 June 2013.

REVELLE, E. 2009. Cap-And-Trade Versus Carbon Tax Two Approaches To Curbing Greenhouse Gas Emissions. *League of Woman Voters*, 1-11.

<http://www.lwv.org/AM/Template.cfm?Section=Home&CONTENTID=17539&TEMPLATE=/CM/ContentDisplay.cfm> Date of Access: 27 October 2011.

ROOT, T.L., PRICE, J.F., HALL, K.R., SCHNEIDER, S.H., ROSENZWEIG, C., POUNDS, J.A. 2003. Fingerprints of global warming on wild animals and plants. *Nature*, 421(6918):57-61, February.

PROMETHIUM CARBON. 2013. Promethium Carbon comments on the carbon tax policy paper of 2 May 2013. 6p. <http://www.promethium.co.za/news/amended-promethium-carbon-comments-on-the-carbon-tax-policy-paper-of-2-may-2013/> Date of Access: 12/06/2013.

SASOL. 2011. Integrated Annual Report 2011. 153p.

SASOL. 2010. Annual review and summarised financial information 2010. 95p.

SCIENCEDAILY. 2008. Greenhouse Gases, Carbon Dioxide and Methane, Rise Sharply In 2007. 24 April 2011.

<http://www.sciencedaily.com/releases/2008/04/080423181652.htm> Date of Access 25 August 2011.

SEEKOEI, K. 2009. Controlling the flow of slurry: Reducing energy and water wastage in mines. *CSIR Science Scope*, 3(3):48-49, January.

SHERWOOD, K. & IDSO, C. 2010. Will global warming reduce crop yields. *CO2 Science*, 13(16):1.

SOUTH AFRICA. 2009. National Energy Efficiency Strategy of the Republic of South Africa. (Proclamation No. 908, 2009.) *Government gazette*, 32342:56, 26 Jun.

SOUTH AFRICA. 2002. Mineral And Petroleum Resources Development Act 28 of 2002. Pretoria: Government Printer.

SOUTH AFRICAN RESERVE BANK. 2008. Quarterly Bulletin December 2008.

SPOTTS, P.N. 2009. At Copenhagen global warming conference, alarms on ocean acidification. *Christian Science Monitor*, 15 December.

STATISTICS SOUTH AFRICA. 2009.

http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf Date of access 18 June 2011.

STATISTICS SOUTH AFRICA. 2011.

<http://www.statssa.gov.za/keyindicators/CPI/CPIHistory.pdf> Date of access 18 June 2011.

STAVINS, R.N. 1997. Policy Instruments for Climate Change: How Can National Governments Address a Global Problem?, *Resources for the future* , 1-36, January.

<http://ageconsearch.umn.edu/bitstream/10757/1/dp970011.pdf> Date of access 9 August 2013.

STERN, N. 2006. Stern review: The Economics of Climate change, 1-576, October.
http://webarchive.nationalarchives.gov.uk/20130129110402/http://www.hm-treasury.gov.uk/stern_review_report.htm Date of Access: 23 September 2013.

SUEHIRO, S. 2007. Energy Intensity of GDP as an Index of Energy Conservation. *IEEJ*, 1-5, August.

TROMANS, D. & MEECH, J.A. 2002. Impacting Energy Efficiency: Improving Energy Use in Grinding. <http://www.mining.ubc.ca/cerm3/energy%20efficiency.html> Date of Access: 20 Apr. 2011.

THE NATIONAL ACADEMICS. 2001. Climate Change Science: An Analysis of Some Key Questions. 42p.

UFCCC, 1997. Kyoto Protocol.

UNEP: 2004. Climate Policy Frameworks Beyond 2012: Development and Climate Change in South African Context. Energy Research Centre. University of Cape Town. November 2004: pp 1-20.

UNITED NATIONS. 2010. An African chorus on climate change. *Africa Renewal*: 12, January. <http://www.un.org/ecosocdev/geninfo/afrec/vol23no4/african-chorus-on-climate-change.html> Date of access: 17 June 2011.

UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH. 2001. The Greenhouse effect. http://www.ucar.edu/learn/1_3_1.htm. Date of Access 25 August 2011.

VAN DER VYVER, J.D. 2012. Nationalisation of Mineral Rights In South Africa. *De Jure*, 125-142.

VAN ZYL, E, ed. 2009. Energy Efficiency Made Simple Vol 2. South Africa: Crown House. 252p.

- VERMAAK, P. 2009. Prevent, Mitigate, Insure: Mining risk demands a holistic approach. *Enterprise Risk*, 3(8):6-7, September.
- WAGGONER, M. 2009. Why and How to Tax Carbon. *Colorado Journal of International Environmental Law and Policy*, 20(1): 1-34.
- WAIT, M. 2011. R26bn carbon tax poised to stunt junior miners- Deloitte. *Mining Weekly*, June. <http://www.miningweekly.com/article/r26b-tax-on-the-cards-for-south-african-mining-industry-2011-06-10>. Date of Access: 25 October 2011.
- WEITZMAN, M.L. 1974. Prize vs. Quantities. *The Review of Economic Studies*, 41(4):477-491, October.
- WORLD RESOURCES INSTITUTE. 1999. Energy and Resource- South Africa. http://earthtrends.wri.org/pdf_library/country_profiles/ene_cou_710.pdf Date of Access: 29 November 2011.
- WRIGHT, S. 2005. Gold-Mining Profits Healthy. ZEAL Speculation and Investment. <http://www.zealllc.com/2005/gmprof.htm> Date of access: 20 Apr. 2011.
- WINKLER, H. 2005. Renewable energy policy in South Africa: policy options for renewable electricity. *Energy Policy*, 33:27-38.
- WORLD BANK. <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries/ZA-ZF-IN-CN-FR-NO-BR?display=graph>, Date of access 28/03/2013.
- WUEBBLES, D.J. & JAIN, A.K. 2001. Concerns about climate change and the role of fossil fuel use. *Fuel Processing Technology*, 71: 99-119.
- YOCHANAN KUSHNIR. 2000. Solar Radiation and the Earth's Energy Balance. <http://eesc.columbia.edu/courses/ees/climate/lectures/radiation/> Date of access: 25 August 2011.
- YILMAZ, A.L. & ULSU, T. 2007. The role of coal in energy production-Consumption and sustainable development of Turkey. *Energy Policy*, 35:1117-1128.
- ZIMMER, M.T. 2008. Carbon Tax: Ready for prime time?. *Sustainable Development Law & Policy*, 8(2): 67-72.