A Critique of the Proposed South African Carbon Tax With Particular Analysis on Economic Consequences and Employment-Related Implications

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DECLARATION

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ABSTRACT

Following various commitments made by South Africa in terms of global climate change initiatives, the Department of the National Treasury released a discussion paper in December 2010 proposing the introduction of a carbon tax. The research sought to assess *whether a carbon tax is appropriate for South Africa* considering the international adoption of similar policies and what the implications of a carbon tax would be on South Africa's socio-economic development objectives.

This report presents findings showing that South Africa's greenhouse gas (GHG) emission commitments and proposals for a carbon tax are "out of step" with developing country peers, particularly leading countries such as China, India, Brazil and Russia. Further, the research demonstrates that the Treasury proposals will have a *significantly detrimental impact on the South African economy* and will result in employment reduction in the industrial sectors of the economy – mining, manufacturing, construction, trade and transport/communications.

While existing macro-economic studies identified in the literature review reveal that a carbon tax will have a negative effect on the economy, these studies tend to understate the degree of the problem. Furthermore, the Treasury discussion paper appears to omit certain important data from available studies, particularly regarding employment losses that, in terms of a relevant World Bank study, could be as high as 16% in lower skilled job categories.

The author's original research forecasts dire economic consequences based on a "bottom up" analysis of the "Top 47" industrial companies: lost GDP of 3% – 7% and job losses of 0.4m – 1.7m in the industrial sector. While the research had some limitations, it is sufficiently robust to *justify the call for a "pause" on the implementation on the carbon tax proposals* until policymakers and stakeholders better understand the "trade off" that must be made to achieve environmental objectives at the expense of socio-economic development objectives.

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1. INTRODUCTION

In December 2010, the South African Department of the National Treasury released a Discussion Paper with proposals to introduce a carbon tax to South Africa (Treasury, 2010). This report summarizes the research performed by the author to understand the Treasury proposals in the light of international developments, and particularly to assess the economic consequences of a carbon tax for South Africa.

The author's research in the literature review sought to understand South Africa's climate change policy commitments in relation to initiatives by the broader international community, and to understand the degree to which the *economic consequences* of these policies, notably the proposal carbon tax, have been analysed in the South African context.

From the literature review it is clear that existing work regarding economic implications for South Africa of a carbon tax are macro-economic modelling studies that look at the economy from a "top down" point of view. The author analysed three of the most important of these "macro" studies in more detail by applying the current Treasury proposals, and then performed new original research using a "bottom up" company-level analysis approach to understand the implications of a carbon tax at the level that its true impact would be felt – individual companies; the objective being to assess how accurate the current "macro" studies are and to determine whether policymakers have adequately and correctly understood the economic implications of the proposed carbon tax.

1.1 Structure of the Research Report

The literature review in Chapter 2 provides an understanding of climate change "response" initiatives globally, and South Africa's climate change commitments compared with developing country peers and more developed countries.

Following a review of the Treasury proposals and rationale for a carbon tax, the literature review identifies studies and modelling that have attempted to establish the economic implications for South Africa of carbon taxes, particularly including the implications on South African energy prices. Several key macro-economic or “top down” studies were identified and reviewed.

Chapter 4 “applies” three of the most important “top down” economic studies identified in the literature review to the current Treasury proposals – essentially applying the level of the carbon tax proposed by the Treasury to the base studies performed by these three sources.

Chapters 5, 6 and 7 provide the author’s own original research using a “bottom up” company level analysis of the implications of a carbon tax on South Africa’s “industrial” sector companies, using a sample of the top 47 industrial corporations in South Africa that report their CO_2e (carbon dioxide equivalent) emissions data, and then extrapolating these results to the entire “industrial” sector of the economy. The results of this work (economic implications of the proposal carbon tax) are then compared with those in Chapter 4 to assess whether South African policymakers have correctly understood the consequences of introducing a carbon tax.

2. LITERATURE REVIEW

The first part of the literature review surveys key reports and studies that provide the overall global understanding on climate change and the need for GHG emission reduction, and further literature that describes the adoption around by various countries of policy mechanisms to reduce GHG emissions around the world. Literature describing the position taken by South Africa is then reviewed, particularly the "Long Term Mitigation Scenarios" (LTMS) documents prepared by the South African DEAT were reviewed together with their respective reference papers.

The literature review proceeds to study the salient features of the South African Treasury Discussion Paper (Treasury, 2010), being the principle document that presents the South African proposals for a carbon tax, along with its various reference papers and reports, many of which were commissioned specifically by the Treasury as inputs to formulate the proposed policy.

The review next identifies available literature to understand the degree to which carbon taxes or similar mechanisms have been adopted internationally, as a context for evaluating the appropriateness of the South African proposals.

Finally the literature review focuses on literature related to the *core theme of this research work which is the economic implications of introducing a carbon tax*, covering studies and modelling that have attempted to establish the economic implications for South Africa of carbon taxes including the implications on South African energy prices.

2.1 The Global Understanding on Climate Change and the South African Situation

The United Nations Intergovernmental Panel on Climate Change (IPCC) completed one of the most extensive studies on climate change and its implications in 2007. According to the IPCC's Fourth Assessment Report in 2007, "most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations". The IPCC defined 'very likely' as "the assessed likelihood, using expert judgement, greater than 90%". This report demonstrated that climate change has begun to have negative impacts on people and ecosystems and that extreme negative effects can be anticipated in the future if global warming continues along its current path (IPCC, 2007).

The UK-Government commissioned Stern Review, another extensive and comprehensive study on climate change, showed that the costs to the world of "inaction" in reducing GHGs will be in the order of 5 to 20 times the cost of the mitigation actions required and therefore advocates mitigation rather than "inaction" (Stern, 2006). The Stern Review estimates that "the annual costs of stabilisation at 500-550ppm CO2e to be around 1% of GDP by 2050 - a level that is significant but manageable". It contrasted this with the costs of inaction, suggesting "BAU ("business as usual" scenario of no action) climate change will reduce welfare by an amount equivalent to a reduction in consumption per head of between 5 and 20%" (Stern, 2006).

It should be noted that the author does not necessarily accept the analysis of the IPCC and Stern work as correct, and notes that studies such as "The 'Stern Review' on the Economics of Climate Change" (Nordhaus, 2007) provide extensive criticism of this work. However, an analysis of the merits of the IPCC work and the Stern Review is not the ambit of this research as these studies are cited only for the purpose of setting the context for the policy positions adopted by the South African Government, of which the carbon tax elements are subject to critique in this research.

The IPCC set a global goal of having global emissions peak by 2015 to maintain temperature increases to a range between 2.0 and 2.4ºC, and thereafter for emissions to begin to decline (IPCC, 2007).

The United Nations Framework Convention on Climate Change (UNFCCC) and the associated Kyoto Protocol were established to achieve emission reduction targets by countries across the world. Initially, during its first phase 2008-2012, only developed countries were required to make firm commitments to limiting emissions, but developing countries such South Africa, China, India and Brazil, were expected to begin implementing emission reduction targets in the second phase after 2012 (LTMS, 2007).

In 2004 South Africa, at 440 mtpa CO2e, produced less that 1% of the world's total 49,000m tons CO2e emissions (LTMS, 2007) but relative to its population size and level of economic development, South Africa's GHG emissions are very high. South Africa's per capita emissions are 9.2 tons carbon per annum compared with the global average of 6.9 tons per annum (Soden, 2011). The primary cause of South Africa's "carbon intensity" is that its economy is energy intensive and coal accounts for 75% of the fossil fuel demand and 93 per cent of electricity generation (Treasury, 2010).

2.2 South African Government Policy and the Treasury Discussion Paper on Carbon Taxation

2.2.1 South African Climate Change Policy and Commitments

The South African Cabinet commissioned a DEAT-led process in 2006, called the Long-Term Mitigation Scenarios (LTMS), to develop a national policy on climate change and greenhouse gas emissions that would inform South African negotiators in the UNFCCC process.

The LTMS work identified a "Growth Without Constraints" scenario for South Africa where no effort is made to reduce energy intensity and carbon usage, and in this scenario demonstrated that GHG emissions would be 4 times the 2003 level by 2050 or 1,330 mtpa CO2e (LTMS, 2007). As such, LTMS proposed a "Required by Science" target scenario of emission *reductions of 30% to 40% below the 2003 levels by 2050* to around 300m mtpa CO2e (LTMS, 2007) and performed various technical studies and modelling work to identify the emission reduction benefits to 2050 of possible policy actions, and their cost.

It should be noted that the *LTMS was only able to identify and model actions to reduce CO2e emissions to 600 mtpa by 2050* (a 50% increase over the 2003 base year and 100% above the LTMS target) and relied on unknown and unquantifiable technology solutions for the shortfall in the 300m mtpa CO2e target to be achieved (refer to chapter 2.4.3 for further review of the LTMS policy actions).

At the 2009 Copenhagen climate change negotiations, South Africa voluntarily committed to reduce domestic GHG emissions by 34 per cent by 2020 and 42 per cent by 2025 (Treasury, 2010), *exceeding the LTMS target and significantly exceeding the possible reductions that the LTMS had identified* and quantified based on known technology to reduce emissions to 600mtpa by 2050.

While the Copenhagen targets do not quantitatively tally with the LTMS, the Treasury's Carbon Tax arises from the LTMS policy recommendations which proposed a carbon tax level beginning at R100 per ton CO2e rising to R750 per ton CO2e by 2040.

In October 2011, South Africa released the National Climate Change Response White Paper (DEAT, 2011) which presents the South African Government's proposed response to climate change and the overarching objective of achieving a low-carbon economy. This White Paper affirms the Treasury Discussion Document (Treasury, 2010) in advocating a carbon tax as the major "market based" policy instrument to achieve South African climate change response objectives and strategies.

2.2.2 Salient Features of the Treasury Carbon Taxation Proposals

The Treasury, in its December 2010 Discussion Paper, invited comment from stakeholders on its proposal to introduce carbon pricing to South Africa. The key features proposed by Treasury are summarized (Treasury, 2010):

- A carbon tax is proposed in preference to an emissions trading system because of its relative simplicity, administrative ease and lower susceptibility to "lobbying" effects;
- The tax is likely to be structured on a "proxy input" basis on energy inputs – basically an added sales tax on fuels such as coal, gas and petroleum based on their calculated CO2e emissions post-use;
- The tax will be phased in, starting at R75 per ton CO2e and increasing to R200 per ton CO2e (at 2005 prices);
- Mechanisms will be considered to offset the negative effects of the tax on lowest income groups, loss of labour and reduction of competitiveness to South African firms that compete internationally;
- For these purposes, a partial degree of "recycling" of revenues from the tax will occur but the full "earmarking" of tax receipts will not occur and a proportion of the tax (implied to be the majority) will be added to the general fiscal budget;
- In principle, the tax will eventually be set at a level equal to the full marginal abatement cost of GHG emissions (being the additional cost to reduce GHG emissions to target levels) but until there is full and harmonised international adoption of carbon taxes, the level of the tax will create a price for carbon that is *lower* than the marginal abatement cost of GHG emissions.

Subsequent to the original submission of this report, in his budget speech at the end of February 2012, the Finance Minister of South Africa established a tax rate and structure for the carbon tax at R120 per ton CO2e increasing by 10% per annum, but stated that the first 60% of emissions would be excluded (Gordhan, 2012). This effectively means that the starting carbon tax will be R48 per ton CO2e (40% of R120) in 2013/2014, lower than the level of R75 per ton CO2e (in 2005 prices) stated in the Treasury Discussion Paper. The modelling and analysis in this research is based on the original Discussion Paper levels of the carbon tax.

2.3 International Adoption of Carbon Pricing

This section of the literature review sought information on the extent to which carbon taxes, or alterative “market based” regulatory mechanisms such as “cap and trade” or emissions trading schemes (ETS) have been adopted internationally (collectively carbon taxes and ETS are referred to as “carbon pricing” in this report).

2.3.1 International Adoption of Carbon Pricing

At the present time only developed countries have adopted carbon pricing. Recently a study by UCT (Winckler et al, 2010, page 152) reviewed the international adoption of carbon pricing and concluded, “no such scheme has been implemented in developing countries as at 2009,” although announcements have been made by Mexico, China and India regarding introduction of carbon pricing. China is considering “piloting” a trial ETS scheme in certain provinces as part of its 12th Five Year Plan (Productivity Commission, 2011).

Amongst developed OECD countries, Finland, Sweden, Norway, and Denmark adopted carbon taxes in the early 1990s while Netherlands, Italy, Germany introduced some form of carbon tax later that decade. The UK implemented a tax in 2001 and recently, the City of Boulder, Colorado (2007), and the Canadian provinces of Quebec (2007) and British Columbia (2008) have implemented carbon pricing policies at a “sub-national” level (Lachapelle, 2009).

The Scandinavian countries (Finland, Sweden, Denmark and Norway) have retained carbon taxes as their primary policy tool whereas other European countries have moved towards the ETS approach, in some cases with supplementary taxes (Marquard et al, 2009). The European Union ETS (EUETS) system was introduced in 2005 and is targeted at electric utilities and industrial plant facilities. The EUETS therefore addresses less than 50% of CO2 emissions and less that 33% of all GHG emissions because other crucial emitting sectors are not covered by the ETS scheme (Metcalf et al, 2009).

New Zealand introduced an ETS scheme in 2008 while Japan and South Korea have announced (and subsequently delayed) the introduction of ETS schemes. Various sub-national ETS schemes exist in certain US and Canadian states, some including non-binding “caps” (Productivity Commission, 2011).

Australia is the most recent country to propose the introduction of Carbon Pricing. The current Australian proposals were also informed by work from the Productivity Commission which studied emission reduction policies in nine key economies – China, Germany, India, Japan, New Zealand, South Korea, the United Kingdom and the United States (Sherriff, 2011) and the Garnaut Review which also drew on the extensive current body of knowledge regarding climate change and the benefit of analysing two decades of experience gained by European countries in applying Carbon Pricing (Garnaut, 2011). The proposals are currently in passage through Australia’s parliament, having been approved by the lower chamber on 12^{th} October 2011 (Wall Street Journal, 12^{th} October, 2011).

The Australian proposals have been praised by analysts as being “practical and comprehensive” (Kaye, 2011), largely due to the benefit of “late mover” hindsight.

Perhaps South Africa should also adopt a similar “late mover” approach to Carbon Pricing. Primarily its developing country status may provide the moral basis to do so, but pragmatically the Australian model shows the evident benefit of learning that can be derived from following the pioneering efforts of developed countries.

2.3.2 UNFCCC Commitments

While developing countries have not applied carbon pricing as policy, at the December 2009 Copenhagen UNFCCC Summit notable developing countries Brazil, South Africa, India and China made commitments to reducing GHG emissions (Garnaut, 2011).

In fact, the South African pledge at the Copenhagen Summit of 34% GHG reductions by 2020 relative to 2000 emissions was *significantly above the pledges made even by many developed countries* (Japan – 33%, US – 16%, EU and Canada – 13%) and the weighted average of GHG reduction pledges calculated by Goldman Sachs of developing countries at 13% (Tadquell, 2011). It should be noted that the South African pledge of 34% was made conditional on financial and technological assistance from developed countries.

At Copenhagen, China and India structured their pledges as reductions in emissions intensity – i.e. a reduction in the ratio of emissions to GDP – and committed to reductions in this metric of 27%-31% (Tadquell, 2011). This appears to be a more sensible approach compared with absolute emission reductions because it caters for high economic growth, which is clearly of paramount importance to these countries. Interestingly, at Copenhagen Russia pledged an increase in GHG emissions of 15%-31% by 2020 (Tadquell, 2011).

2.3.3 Participation by Emerging Countries in the CDM

While emerging countries have not yet adopted carbon taxes or other carbon pricing policies, significant action has been taken by major emerging countries to reduce GHG emissions in terms of the Clean Development Mechanism (CDM) system. CDM is a component of the UNFCCC Kyoto Protocol that provide financial incentives for developing countries who ratified the Kyoto Protocol in 2002 to implement “CDM Projects” for which they receive Certified Emission Reduction credits (CERs) and are able to sell these CERs to developed countries who have set mandatory emission limits in terms of the Kyoto Protocol, such as EU countries (Winckler et al, 2010).

China is a leader in this regard: it has registered 626 CER projects and has a further 1,205 CER projects in the pipeline for 2012, representing a total of 6,017 million tons CO2e reduction and generating 54% of annual CERs worldwide. South Africa, by comparison, has only 16 CER projects (registered and pipeline) indicating a significant opportunity for emission reduction that would effectively be paid for by developed countries (Winckler et al, 2010).

CDM participation presents a clear financial incentive for South African companies to reduce GHG emissions.

2.3.4 Key Learnings from the International Experience

A key issue is the manner in which a government deploys carbon tax revenues. In Sweden for example, carbon tax revenues are "recycled" to reduce labour costs to firms whereas in Norway carbon taxes flow to the general fiscus (Deverajan et al, 2009). Modelling performed in South Africa (refer to chapters 2.4 and 4.3) demonstrates that the negative economic consequences of a carbon tax can be ameliorated if the tax receipts are re-cycled, but unfortunately the Treasury's proposals largely steer away from the "recycling" approach and seek to adopt the Norwegian approach (Treasury, 2010).

One key issue highlighted by the literature is the *harm caused to the international competitiveness of exporting companies* from countries who introduce carbon taxes relative to those who do not. Often, where carbon pricing exists, targeted subsidies are provided by countries to their local companies to "neutralize" this effect and maintain competitiveness. In this regard conflicts exist between the international policies of the World Trade Organization (that attempts to prevent subsidies that distort international trade) and the Kyoto Protocol that seeks the adoption of carbon pricing (Rich, 2004).

The issue of the competitiveness of South African industrial companies is one crucial issue that requires assessment, particularly export industries (including the mining sector) that are "price takers" in that they compete with commoditized products on international markets and are therefore not able to increase prices to compensate for increased costs as a result of a carbon tax. Where South African companies must compete with other companies from emerging markets that have not introduced carbon taxes, clear competitive disadvantages will apply, potentially threatening the existence of these South African companies.

2.4 Economic Implications of Carbon Pricing

The focus of this research is on the economic implications of introducing a carbon tax to South Africa. The earlier sections of the literature review provide a context to the issue of climate change and the commitments of countries to reduce GHG emissions. South Africa has made significant commitments to GHG reduction and appears to be out of step with its developing country peers in this regard, acting more in line with European countries who have already attained high levels of socio-economic development.

So the concern is whether the Treasury has correctly made the “trade off” between the environmental benefits of introducing a carbon tax against the costs to the South African economy and the socio-economic welfare of its people in introducing the tax.

This requires detailed focus on the economic implications of a carbon tax.

2.4.1 International Work on the Impact of Carbon Pricing

A huge volume of literature exists internationally regarding the economic implications of carbon pricing. A meta-analysis in this regard of literature and carbon pricing impact models was performed by Qureshi et al (2006) concluding that despite a great deal of variance in different models and differences in assumptions particularly around the impact of new technologies, generally carbon prices *materially impact economic growth* once these move above “low levels” of around \$15/ton CO2e for 550 ppm CO2 stabilization (Qureshi et al, 2006).

This project does not delve further into the internationally-focussed literature, seeking instead to understand the economic consequences for South Africa of carbon pricing.

2.4.2 The Eskom Elasticity Study

For a series of interactions with the Department of Public Enterprises (DPE) related to proposed electricity tariff increases, Eskom commissioned the “Electricity Elasticity Study” in 2009 (Maleka et al, 2009) to assess the economic implications of higher power prices in South Africa. The Eskom Elasticity Study involved a review of international experience of the economic effects of power price changes, and modelling of South Africa-specific impacts, utilizing Eskom’s historical power consumption data from 1970 to 2009 across customer segments. While the Eskom Elasticity Study is not in the public domain, the author was able to receive access permissions to the main output reports for the purposes of this research, and the work appears to be extremely thorough. The author’s view is that its results are authoritative due to Eskom’s capabilities and unique electricity usage-related data for South Africa.

Price elasticity of a product refers to the degree to which demand or usage of that product would increase or decrease as a result of increased or decreased prices. A product with high price elasticity of demand would suffer a large decrease of usage if prices increased.

Key findings of the Elasticity Study pertinent to this research are summarized below (Maleka et al, 2009):

- Internationally, demand for electricity is generally inelastic (meaning its consumption does not drop significantly if prices increase) since it is a necessity rather than a luxury good. However, industrial users of electricity are relatively “price elastic” in the long term in that their usage of electricity will drop if prices rise, particularly if electricity costs are a large portion of their total production costs. The elasticity of industrial users was found to be -0.45x on average internationally meaning that a 1% increase in power prices results in a 0.45% decrease in power usage by industrial users;

- During the industrialization phase of a country's economic development, increase in electricity usage is highly correlated to increase in income. The industrialization phase refers to the phase during which a developing country increases industrial activity, moving towards higher socio-economic development;

- Based on actual behaviour in South Africa from the analysis of Eskom's 1970-2009 data, the price elasticity of manufacturing and agriculture consumers was calculated to be the highest at -0.30x and -0.27x respectively on a long-term basis (i.e. referring to the long term decline of electricity usage observed arising from power increases). Price elasticity of specific sub-sectors "at risk" were found to be mining related services at -1.73x, electrical machinery at -0.93x, ferro-alloys at -0.84x, and chemical products at -0.57x;

- Macro-economic modelling of the economy-wide impact of power price increases determined that each 1% increase in electricity would result in a 0.04% decrease in real GDP, a 0.05% decrease in real household disposable income and a 0.01% reduction in formal employment.

2.4.3 South African LTMS Modelling

Although, as has been discussed earlier, South Africa's commitments at Copenhagen in terms of the UNFCCC significantly exceed the policy targets proposed by LTMS (and in that sense the LTMS work was overlooked to a degree by South African policymakers), the modelling work performed by LTMS is useful in assessing the implications of a South African carbon tax. This section of the review therefore extracts the pertinent cost and benefit information from the LTMS literature. The underlying LTMS economic models were not available to the author.

LTMS performed technical and economic studies to quantify the costs and emission reduction benefits of various policy actions that could be taken by the South African Government. These were grouped into three "strategies" which cumulatively anticipated an increase in SA emissions to over 600 mtpa CO_2e by 2050.

A fourth "strategy" was stated but not modelled or quantified, essentially relying on technology innovation to enable South Africa to achieve the LTMS goal of some 300 mtpa CO_2e by 2050 (LTMS, 2007).

Table 1 below summarizes the three "strategies" modelled in detail by the LTMS together with a snapshot of the modelled cost and benefits to the South African economy (Winckler, 2007 and ERC, 2007):

Table 1: Summary of Three LTMS "Strategies" – Benefits and Costs

LTMS Strategy	Description	Benefit	Cost
Start Now	All policy actions available to Government that have "negative cost" (positive economic impact)[1]	231mtpa CO_2e avoided[2]	None – "negative" cost of R2.971bn[3] pa or 0.48% of GDP positive impact 2.18% *reduction* in total energy costs[4]
Scale Up	Inclusion of additional policy actions that have true cost	287mtpa CO_2e avoided[2]	Cost of R11.209bn pa or 0.77% of GDP negative impact 3.63% increase in total energy costs
Use The Market	Introduction of carbon taxes and incentives such as subsidies on biofuels, renewable power and solar water heaters (SWHs)	363mtpa CO_2e avoided	Cost of R3.522bn pa or 0.11% of GDP negative impact 0.66% increase in total energy costs

The third "Use the Market" strategy is not in itself useful to isolate the costs and benefits of introducing a carbon tax because it is combined together with the effects of the incentives for biofuels, renewable power and solar water heaters.

Digging a little deeper into the underlying LTMS modelling work reveals the impact of the "base case" carbon tax starting at R100/tonne CO_2e and rising to R750/tonne by 2040 as costing R10.714bn per annum[3] or 0.92% of GDP[2] and increasing South African energy costs by 4.28% while reducing emissions by 256mtpa[2] (ERC, 2007).

The LTMS "Economy-Wide Modelling" (Pauw, 2007) provides more analysis of the implications of a carbon tax. By 2015, GDP is expected to be 2% below the

[1] Although LTMS ostensibly only included positive economic impacts in the "Start Now" strategy bundle, certain negative economic items (i.e. true costs) were included such as the introduction of renewable and nuclear power generation but these were offset such that the total of the bundle was economically positive.

[2] Calculated as the total emission reductions or economic impact over the 2003-2050 period divided by 48 years (mean used for GDP %). The quantum for emissions reflected is from energy sector savings only, and excludes other related emission savings.

[3] Net present value of costs or benefits at a 10% discount rate in 2003 terms.

situation without a carbon tax, and employment and wages are expected to drop after 2015. Pauw's anticipated increase in unskilled employment up to 2015 is unlikely to materialize as explained in chapter 2.3.2.

Pauw states, "welfare effects are generally negative, with rising prices and reduced wage income impacting negatively on spending power and hence welfare levels." (Pauw, 2007, page 24).

In relation to the Treasury's specific proposals, Pauw's work indicates that a R75/tonne CO2e carbon tax without revenue recycling results in a 1.4% and 3% reduction in semi-skilled and unskilled employment respectively.

A 2010 update of the 2007 LTMS economy-wide by Marna Kearney stated, (Winckler et al, 2010, page 98) "In conclusion: A CO2 tax may not be the most appropriate tool to achieve the desired results considering the economic development objectives of South Africa if it leads to higher prices for energy. However, as seen from the results, if the CO2 tax is combined within the LTMS framework its negative impact is negated through higher investment and GDP growth."

2.4.4 World Bank Study Analysing Treasury Proposals

A study by the World Bank in 2009, providing supporting economic analysis of the Treasury proposals, was performed to assess the economic and employment implications of various carbon tax alternatives in South Africa (Devarajan et al, 2009). This study identified significant potential negative employment implications of a carbon tax because of South Africa's labour market inflexibility where labour costs are "sticky" and cannot adjust downwards with the additional cost pressures from a carbon tax on companies. This study identified that a carbon tax in the range of R96 to R165 per tonne CO2e could have the effect of *reducing employment between 1% and 16% for low skilled and semi-skilled workers* depending on different assumption scenarios tested (Devarajan et al, 2009).

Clearly these are significant potential negative implications for employment, especially if the top-end of the Devarajan study of 16% employment losses applies.

The Treasury discussion paper cites the World Bank study and uses aspects of it to determine which design features of a carbon tax are most effective, but it does not present the key employment-related findings of this work which seems to be rather misleading and contrary to the purpose of a discussion document which should inform stakeholders and policy-makers about the implications of the carbon tax proposals. Instead, the Treasury paper downplays the World Bank study by stating “Generally, the static nature of such models make them unsuitable for modelling the impacts of long-term problems such as climate change with significant uncertainty, and are more useful for short-term assessments linked to specific shocks to the model.” (Treasury, 2010, paragraph 143)

2.4.5 Other Studies Pertinent to South Africa Regarding the Economic Impact of Carbon Pricing or Higher Energy Prices

The HSRC Study

The South African Human Science Research Council (HSRC) completed a study in July 2008 on the economic implications for South Africa of power price increases and power rationing based on economy-wide modelling and financial modelling. The key finding of the HSRC work is that power price increases are less damaging than power rationing (especially unpredictable power rationing) but that both have negative implications on economic growth and employment levels of lower skilled workers (Altman et al, 2008).

Specific key findings of the HSRC study pertinent to this project include the following (Altman et al, 2008):

- A 10% cut in electricity availability results in a 1.5% drop in employment of lower skilled workers while higher skilled employment levels remain unchanged, though at lower wage levels; and
- A 71.3% increase in electricity prices is necessary to achieve a short-term goal of 10% demand reduction, and would reduce GDP by 0.9%, employment by 1.4% and household income by 1.2%.

The HSRC study provides a useful calculation, using Statistics SA data, of the composition of the total cost structure of each South African industry sector (Altman et al, 2008 pages 29 to 31). This work isolates the total electricity and wage costs, and profitability of those sectors.

NERSA Modelling

The National Electricity Regulator of South Africa (NERSA) performed modelling to inform the “National Integrated Resources Plan” for the South African electricity sector. Amongst other things, this work calculated the level of a carbon tax necessary to make nuclear power comparable to coal power generation as the primary baseload technology and determined that a carbon tax level of R200 per tonne CO2e at 2006 prices was required for this purpose (Marquard et al, 2009).

Other Work

Papers from a 2010 conference hosted by the Energy Resource Council of the University of Cape Town (Winckler et al, 2010) reference a study by Roula Inglesi and James Blignaut using data for the period 1993-2004 that confirms negative elasticity of -1.692x arising from power price increases for the industrial sector while the transport and commercial sectors have positive price elasticities. For the agriculture and mining sectors, it was found that price does not play a significant role in the demand for electricity. Other than for the industrial sector, this work does not seem to align with the more comprehensive and informed Eskom elasticity study discussed earlier.

3. IS A CARBON TAX APPROPRIATE FOR SOUTH AFRICA?

3.1 Pigouvian Taxes to Achieve National Objectives

The early 20th century economist, Arthur Pigou, pioneered the concept of "externalities" being costs that arise from activities between producers and consumers that are not borne directly by the parties involved in those activities, but by third parties or society as a whole (Pigou, 1920). Pigou introduced the concept of taxes or other State interventions (subsequently called "Pigouvian taxes") to re-allocate the "externality" costs back to producers and consumers of a particular economic activity. The Treasury carbon tax proposals are a Pigouvian tax aimed at allocating the cost of environmental damage to South African producers and consumers.

Sir Nicolas Stern labelled climate change the single largest market failure or "externality" known to man based on the alarming results of the Stern Review on the consequence of climate change (Stern, 2006). State interventions towards carbon pricing – whether in the form of fixed carbon taxes or emissions trading schemes – are fundamentally aimed at allocating the "externality cost" of climate change back to the producers and consumers who generate climate change damage. This is the basic rationale for carbon taxes or other pricing schemes globally.

Clearly carbon taxes do not, in themselves, reduce carbon emissions. Instead, as is the intention of Pigouvian taxes, such taxes achieve twin objectives. On the one hand they allocate the costs of an "externality" back to the producers and consumers who cause such an externality to arise. On the other hand, they act as an incentive to reduce the economic activity giving rise to the externalities. In the case of a carbon tax, the intention is to create an incentive to reduce activities that result in GHG emissions or for emitters to find more "carbon efficient" ways of performing these activities.

Without denying the dire climate change challenges the world faces, the author submits that developing countries such as South Africa must address three crucial questions before implementing measures such as carbon pricing or other Government policy measures that enforce a reduction in GHG emissions:

1. *Whether developed and developing countries have different levels of responsibility to mitigate GHG increases that lead to global climate change*. The argument is made by large developing countries such as China that today's developed countries did not face the burden and costs of needing to limit GHG emissions during their crucial stages of economic development and that this assisted to speed their economic development. As such, developing countries that are currently decades behind in economic development should not have to bear such costs either at the development stage of their economic growth. This question translates into a debate around whether GHG emission reduction is in fact a valid *national objective* for a country like South Africa.

2. Even if it is taken as given that the need to reduce GHG emissions is a valid national objective of developing countries like South Africa, then *to what extent should policy measures be put into place when there is a trade off against other national objectives*? Specifically, should GHG emission reduction measures be put into place if these are detrimental to competing national objectives such as socio-economic development? It would seem that socio-economic objectives should be prioritized among national objectives for developing countries.

3. *Are government-led carbon pricing schemes such as a carbon tax necessary and most effective in reducing GHG emissions*, or can actions be taken that do not impose cost burdens on companies and consumers?

3.2 Trading Off National Objectives in Developing Countries

In relation to the first two questions above, the literature review shows that for *most developing countries it appears that national objectives* such as employment creation, increase in welfare through increased incomes and general socio-economic development are more important than climate change-related objectives.

The literature review has also shown that South Africa has made very significant GHG reduction commitments in UNFCCC global climate change negotiations and that these commitments are “out of step” with other developing country peers. Larger developing countries such as China, India, Brazil and Russia have recognized that their socio-economic development is the primary national objective and have not been willing to introduce measures that would hamper the achievement of these economic development goals. Unfortunately, with its high UNFCCC commitments and the proposed carbon tax, it appears that South Africa is seeking to act in step with European and other developed countries rather than its peers, and this potentially at a detriment to crucial national objectives related to socio-economic development.

In all, these questions highlight the need to understand the socio-economic cost of the Treasury’s proposed carbon tax for South Africa. *The objective, therefore, in the remaining sections of this report, is to assess the true economic implications of the proposed carbon tax*.

This is done in two ways in the research:

- Chapter 4 applies the studies identified in chapter 2.4 of the literature review to the current Treasury proposals – essentially relying on studies performed by others and that have informed current policy in South Africa, but applying the now-known level of the carbon tax proposed by the Treasury.

- Chapters 5, 6 and 7 provides the author’s own original research using a “bottom up” company level analysis of the implications of a carbon tax on

South Africa's "industrial" sector companies, using a sample of the top 47 industrial corporations in South Africa that report their CO2e emissions data, and then extrapolating these results to the entire "industrial" sector of the economy.

3.3 Can the Trade-Off be Avoided?

In relation to the third question posed in chapter 3.1, it would obviously be ideal for developing countries such as South Africa to take policy actions that reduce GHG emissions *without suffering a trade-off* against negative economic consequences.

Interestingly, the LTMS study (refer to Chapter 2.4) demonstrates that a significant number of policy actions can be taken that will reduce GHG emissions *without negative cost to the South African economy*. This is a crucial point in questioning the underlying rationale of the carbon tax because it may be more appropriate for South Africa, given its stage of economic development, to focus only on climate change objectives when these also support (rather than hamper) socio-economic development objectives.

LTMS identified various measures in its "Start Now" LTMS strategy option (refer to chapter 2.4.2 and Table 1) that would result both in GHG emission reductions and positive economic consequences – basically "no brainer" action items for South Africa.

Unfortunately the LTMS work also included certain actions that have negative economic consequences into its "Start Now" strategy, such as the introduction of renewables and nuclear power generation. Even if these negative items remain included in the "Start Now" actions, LTMS indicates that an annual stimulus of some R2.7bn (in 2003 present value terms) representing 0.48% of GDP could be enjoyed by the South African economy while reducing annual emissions by 231 mtpa CO2e, being 53% of the 2004 "starting levels".

Since the LTMS “Start Now” scenario makes it clear that South Africa can make a positive contribution towards global climate change initiatives and can achieve a level of GHG reductions without harming (in fact bolstering) its socio-economic development objectives, *this fundamentally questions the necessity for a carbon tax to be imposed*, at least until those initial actions have been taken.

3.4 The Benefits of Delaying a Carbon Tax

Other reasons exist for a country like South Africa to delay the implementation of carbon pricing while first seeking to make progress in its socio-economic development objectives, which should be of primary importance.

The literature review shows that “late adopters” of carbon pricing policy such as Australia benefit from the learning experience of the “early movers” (mostly European countries who have over the past decades also refined and adjusted their policies) and are then able to introduce robust and carefully designed schemes that are most effective in achieving GHG goals while minimizing negative consequences (Kaye, 2011).

Most importantly, this research report *presents results suggesting that the true negative economic consequences of a carbon tax in South Africa have not yet been analysed and understood correctly and that a carbon tax may be very negative for the economy and employment, conflicting with more important national development objectives*. Certainly, if this is true, more time and study should be taken before a carbon tax is introduced.

3.5 Is It Necessary to Pressurize the Private Sector?

A fundamental assumption is made by policymakers who seek to introduce carbon taxes or similar schemes: that the private sector will not take responsibility and positive initiative towards GHG emission reduction unless taxes exist to “pressurize” them towards action.

This may be well be an incorrect assumption for several reasons.

The voluntary international Carbon Disclosure Project (Gray, 2009 and CDP, 2010) is an example of a private sector-led initiative that reports current emission levels for participating companies together with their emission reduction targets and planned initiatives. The degree of voluntary participation by large corporations internationally and in South Africa in the CDP project is an example of private sector-led initiative to reduce GHG emissions without government pressure.

Companies worldwide understand that their stakeholders, particularly their public shareholders, have environmental concerns and the CDP is one way in which companies are reacting to these concerns.

In South Africa, a great deal of industrial activity is generated by large corporations that have multi-national presence. These companies typically align their global operations, including GHG reduction initiatives, to the expectations of the broader international community, and developed country governments in locations where they operate outside of South Africa. The large mining companies such as BHP Billiton and Anglo American, who are large contributors to the South African economy, are examples in this regard.

Aside from the above, it must be recognized that *a strong financial incentive already exists for South African companies to reduce GHG emissions* because of the CDM opportunities under the Kyoto Protocol. The CDM system means that significant “carrots” are already in place and that the Treasury’s proposed carbon tax “stick” may not be necessary.

Many of the international carbon pricing schemes (refer to chapters 2.3.1 and 2.3.3) such as the European Union Emissions Trading Scheme (EUETS) enable developing countries such as South Africa to participate in those schemes through the Kyoto Protocol’s CDM mechanism and thereby to obtain financial credits for GHG emission reduction schemes in their own countries. This is a powerful financial incentive for private sector companies in countries like South Africa to introduce GHG emission reduction projects and obtain compensation from EUETS participants who pay the respective South African company a rate “per tonne of CO2e” which offsets applicable European emissions.

If a South African company participates in the EUETS scheme, effectively European producers and consumers bear the cost of GHG emission reduction projects in South Africa.

As described in chapter 2.3.3, China has taken full advantage of the CDM opportunity, having registered 626 projects to date and having a further 1,205 projects in the pipeline for 2012, representing a total of 6,017 million tonnes CO2e reduction. South Africa, by comparison, has only 16 projects (registered and pipeline) indicating a significant opportunity for emission reduction that would effectively be paid for by developed countries (Winckler et al, 2010).

Recognizing the strong financial incentive of the CDM scheme, the South African government could consider introducing policy actions to co-ordinate, facilitate and catalyse South African industrial companies to obtain the benefit of international CDM schemes particularly the EUETS.

It should be noted, however, that the EU may modify its scheme to trade CDM credits only with “least developing” countries and that South Africa may therefore not qualify to participate in the EUETS at some stage in the future. Trading with other participants in the UNFCCC should however remain a possibility.

In the case of participating in CDM schemes, as with the LTMS “Start Now” actions, South Africa and its policymakers can avoid making a trade off between environmental objectives and negative economic consequences.

Retaining a carbon tax does unfortunately create a trade-off dilemma, as the following chapters will demonstrate.

4. THE ECONOMIC IMPACT OF CARBON TAXES ON SOUTH AFRICA

This section of the research revisits three of the most important studies identified in the literature review (chapter 2.4) that modelled the economic implications for South Africa. The Eskom Elasticity Study and the LTMS modelling work were applied to the tax levels proposed by the Treasury for the carbon tax, and the 2009 World Bank study was revisited.

From the paper by Qureshi et al that provides a meta-analysis of *international* literature and carbon pricing impact models, the conclusion was that carbon taxes or similar initiatives materially impact economic growth once these move above “low levels” of around $15/tonne CO2e for 550 ppm CO2 stabilization (Qureshi et al, 2006). The Treasury’s starting proposal of R75 per tonne of CO2e is just below this level in 2010 terms (since the R75 rate per tonne CO2e is in 2005 money and would equate to R107 or approximately $14 in 2010 terms if escalated by the PPI index for the 2005-2010 period). However, since the Treasury would scale up the rate to around R200 per tonne CO2e over time, the tax would soon fall into the band of what Qureshi et al conclude would *materially impact economic growth.*

To arrive at a more precise quantitative impact of the Treasury proposal on the South African economy, this chapter:

(1) calculates the increase in electricity prices in South Africa if the Treasury’s carbon tax proposals are applied,

(2) applies the modelling work of the Eskom elasticity study identified in the literature review to quantify the economic implications of an electricity price increase of this nature,

(3) assesses the relevance of the LTMS modelling work and the impact of the Treasury proposals on this work, and

(4) revisits the 2009 World Bank study that provided modelling support to formulate the Treasury proposals.

4.1 Quantifying the Increase in Electricity Costs for South Africa

The Treasury proposals involve a carbon tax rate of R75 per tonne of CO2e *in 2005 prices* and therefore it is necessary to increase this rate by inflation to be applicable to 2010 prices. Escalating the 2005 Treasury rate of R75 per tonne to 2010 prices using the economy wide producer price index (PPI) for the period 2005-2010 results in a *R107 per tonne CO2e carbon tax rate for 2010*.

Table 2 presents a simple calculation that the author performed to estimate the increase in electricity prices for South Africa if the Treasury's proposed rate of carbon tax was applied to Eskom. This calculation assumes that Eskom would pay the full carbon tax and pass it on to consumers of electricity through higher prices to maintain the same level of profits as it had in 2010 (necessary to retain its current debt rating to be able to finance future capital development). Financial, tariff and emissions information for Eskom was obtained from the Eskom 2010 annual report.

Table 2: Calculation of Eskom Tariff Increases Required to Offset Carbon Tax

	Actual Eskom Financial and Tariff Data 2010	**Adjustment For Carbon Tax of R107 per tonne CO2e[5]**	**Adjusted Eskom Financial and Tariff Data 2010**
Revenue (Rm)	R 69,942m	Incr. R 24,111m	R 94,053m
Total costs (Rm)	R 66,322m	Incr. R 24,111m	R 90,433m
Net Profit (Rm)	R 3,620m	stays constant	R 3,620m
Average tariff (cents/kWh)	31.9 cents/kWh	incr. 11.0 c/kWh	42.9 cents/kWh
% tariff increase	34% tariff increase to bear R24bn carbon taxation cost based on 2010 Eskom emissions of 224.7mt CO2		

Table 2 illustrates that a 34% one-off tariff increase is necessary for Eskom to maintain is currently level of profitability (assumed to be necessary for Eskom's bond rating to remain constant as its crucial source of funding for new expansion capacity) in the light of a R24bn carbon taxation cost arising from its 2010 CO2e emissions of 224.7mtpa.

4.2 Applying the Eskom Elasticity Study

The Eskom Elasticity Study (refer to chapter 2.4.2) performed macro-economic modelling of the economy-wide impact of power price increases for South Africa based *inter alia* on historical Eskom tariff and power consumption data, the degree to which different sectors of the economy reduce power usage and output as a result of power price increases (price elasticity) and other factors.

In summary, the Eskom work determined that *each 1% increase in electricity prices* will result in the following impacts on the South African economy:

[5] Eskom reported total CO2 emissions for 2010 of 224.7m tonnes. At the 2010 proposed Treasury rate of R107 per tonne, this equals a total of R24m carbon tax imposed by Eskom.

- 0.04% decrease in real GDP;
- 0.05% decrease in real household disposable income; and
- 0.01% reduction in formal employment.

If the Treasury's proposed carbon tax was introduced in 2010, the calculation in chapter 4.1 shows that this would result in a one-off 34% electricity price increase. The resultant shock to the South African economy based on the Eskom study is as follows:

- 1.38% decrease in real GDP representing a total reduction in output of R36.7 billion in 2010;
- 1.72% decrease in real household disposable income being R27 billion in 2010; and
- 0.34% reduction in formal employment, equating to a loss of 45,772 jobs in South Africa in 2010.

The above effects are clearly significant.

However, there are two reasons why applying the Eskom Elasticity Study does not provide a complete view of the economic impact of the Treasury Proposals.

Firstly, the Eskom model is only designed to calculate the *implications of electricity price increases on the economy*, and therefore does not analyse the impact of a carbon tax on scope 1 emissions by industrial companies, being the emissions arising from the primary industrial activity of those companies. "Scope 1" CO2e emissions are the direct emissions arising from a company's productive activities and from facilities that it owns and controls while "scope 2" CO2e emissions are indirect emissions arising from electricity, heat or steam that a company purchases. The Eskom elasticity study application would therefore only estimate the results of the carbon tax on the scope 2 emissions of South Africa's industrial companies.

Secondly, it is unlikely that the results of the Eskom Elasticity Study can be applied in a *linear fashion* meaning that for a single 1% increase in power prices, the resultant 0.01% decrease in formal employment may be correct but for large increases in power prices such as the 34% tariff increases calculated as a result of a carbon tax, it is likely that a hyperbolic impact will apply meaning that the effect will be more than 34 times the effect of a 1% tariff increase.

Of course, the author was not able to ascertain the precise impact of a 34% electricity price increase from the available Eskom information since the underlying economic model was not available.

4.3 **Analysing the LTMS Modelling Work**

The modelling work involved in the LTMS was extensive but the underlying model itself is not publicly available and therefore it is not possible to tailor the LTMS work to the Treasury's current proposals. As such, results must be used from LTMS-related reports and several data points were extracted as applicable to this research:

- LTMS (ERC, 2007) calculates the introduction of a carbon tax in South Africa to have negative economic consequences – causing a *shrinkage of 0.92% of GDP* based on a R100 per tonne CO2e tax (this is slightly below the Treasury's proposals of R107 per tonne CO2e in 2010 terms). While significant, the LTMS forecast is 33% more optimistic than the 1.38% decrease in GDP derived from the Eskom Elasticity Study which the author believes itself understates the economic impact (refer to chapter 4.2); and

- Elsewhere in the LTMS literature (Pauw, 2007), it is stated that the impact by 2015 of the introduction of a carbon tax will be a reduction in GDP of 2% below baseline conditions (without a carbon tax).

Note that both of these estimates suffer from certain problems described below.

The LTMS modelling is sensitive to many assumptions and since results are presented over a 48 year forecast period until 2050, the results that are derived are particularly hostage to uncertainty. The scope of this project does not entail a full review and critique of the LTMS but, comments are made here in respect of several important assumptions made by the LTMS with respect to economic implications of the carbon tax proposals.

4.3.1 Does the LTMS Modelling Understate the Energy Cost Increases Arising from Carbon Taxes?

The LTMS modelling assumes that the introduction of a carbon tax in South Africa will increase South African energy costs by 4.28%. The author has calculated that the likely electricity cost increases would be in the order of 34% when the carbon tax is imposed (see chapter 4.1) and this is a reasonably sound calculation in the short term based on Eskom's business economics for 2010.

While electricity is not the only source of South African energy, the other sources of energy are also mainly fossil fuel based and are GHG emission intensive. This therefore raises questions regarding the assumptions used by LTMS for energy cost increases and whether the LTMS modelling has understated the negative economic impact of a carbon tax increase.

4.3.2 LTMS Modelling Assumes "Tax Recycling" Unlike the Treasury Proposals

Various options were analysed in the LTMS modelling for the carbon tax to be "recycled" or re-invested back into the economy including tax breaks on labour and capital, a tax break to households, and subsidies on the price of food. The third option (a subsidy on food prices) was found to have the best economic and welfare benefits especially for the poorest South Africans (Van Heerden et al, 2006).

As discussed in chapter 2.2.2, the Treasury proposals indicate a bias against “recycling” carbon tax receipts, instead opting to include such tax receipts in the general fiscus.

The base case macro-economic modelling used by LTMS of the carbon tax (Pauw, 2007) assumes that the carbon tax revenue will be fully recycled through subsidies for the poor and results show that this improves the “welfare” measures for lower income groups calculated by the LTMS. However, in the Treasury Discussion Paper, although some re-allocation is envisaged for lower income households, the entire tax revenue is not intended to be recycled though mention is made by Treasury of a possible payroll tax credit. Pauw’s work assumes low-skilled labour increases in the food sector until 2015 because of these subsidies, but these employment gains are unlikely to be realized both because Treasury does not appear to intend to use the tax in this manner, and even if it did, the Government has not demonstrated a track record in its Welfare and Social Services departments to effectively introduce broad-based poverty alleviation schemes. Without this “revenue re-cycling”, Pauw illustrates that employment losses can be anticipated from the start of the scheme.

In short, the base case LTMS modelling used to produce “headline results” for South African policymakers assumed a beneficial “tax recycling” system will be introduced but this is not envisaged in the current Treasury carbon tax proposals.

Pauw’s calculations for a R75 per tonne CO2e carbon tax without “tax recycling” show an impact of reducing employment by between 1.4% and 3% (see chapter 2.4.3) which, *based on 2010 employment levels, would be between 185,000 and 400,000 lost jobs*.

4.4 The 2009 World Bank Study

As identified in the literature review, the Treasury's proposals were co-ordinated with a study by the World Bank in 2009 that provided economic modelling support to inform the Treasury's proposals (Devarajan et al, 2009).

This World Bank study identified that a carbon tax in the range of R96 to R165 could have the effect of *reducing employment between 1% and 16% for low skilled and semi-skilled workers* depending on different assumption scenarios tested (Devarajan et al, 2009).

As mentioned in chapter 2.4.4, the Treasury discussion paper appears to downplay the World Bank study and does not present its core findings on employment in a quantitative way (Treasury, 2010, paragraph 143). This is of significant concern because if stakeholders and policy makers were aware that the Treasury's tax proposals could result in up to 16% employment reduction for lower skilled workers, the appetite to adopt the carbon tax is likely to be *seen more clearly for what it is: a trade-off prioritizing environmental objectives above socio-economic development objectives, particularly employment creation objectives.*

4.5 Conclusion

A simple calculation shows that the introduction of the Treasury's proposed carbon tax at the expected R75 per tonne CO2e (2005 prices) will result in a one-off price increase for electricity of 34% based on Eskom's 2010 financial dynamics.

If this 34% electricity price increase is applied to the Eskom Elasticity Study results in a linear way, a significant "shock" reduction in South African GDP of 1.38% is calculated to occur. However, it is likely that the Eskom Elasticity Study cannot be applied in a linear way for large price increases such as the author's estimated 34% tariff increase, and that with hyperbolic effects, the actual reduction to GDP would be higher. Also the Eskom study only covers "scope 2" emissions of industrial sector companies and does not assess the impact of the carbon tax on their primary “scope 1” emissions.

The financial modelling from the LTMS exercise also illustrates negative economic consequences from introducing a carbon tax – a reduction of 0.92% of GDP. However, the LTMS modelling that produced this result is potentially subject to two major flaws in assumptions – an overly optimistic assumption about the degree to which energy costs would increase from a carbon tax, and an assumption of productive “tax recycling” which the Treasury’s proposals do not incorporate. If one “digs down” into the LTMS modelling and studies the scenario where “tax recycling” is not incorporated, job losses of 185,000 and 400,000 are forecast, but this statistic is not provided as a clear headline result in the main LTMS reports.

Of significant concern is that the most recent study most applicable to the Treasury’s carbon tax proposals, the World Bank Study (Devarajan, 2009) has been downplayed in the Treasury discussion document and its key employment related finding was not mentioned by the Treasury: that up to 16% employment reduction of lower skilled workers may occur as a result of the carbon tax.

Overall, the concern therefore exists that South African policymakers and the Treasury have not adequately assessed, or are under-estimating the economic impact of introducing a carbon tax. A clear trade-off exists between achieving environmental objectives at the expense of socio-economic development objectives, and the Treasury discussion paper does not appear to have adequately informed stakeholders and policymakers of this stark trade-off.

5. THE IMPACT ON SOUTH AFRICAN INDUSTRIAL COMPANIES

Imposing a carbon tax means making a trade-off in national objectives, emphasizing the objective of environmental preservation while placing the objective of socio-economic development at a degree of risk. The objective of this research project is to understand the true economic "costs" for South Africa of the imposition of the Treasury's proposed carbon tax so that these can be weighed up against the environmental benefits that such a tax would hope to produce.

Chapter 4 has applied and summarized the findings of the various macro-level studies and economy-wide modelling performed in recent years that have informed South African policymakers, and illustrates that the *impact on South African economic growth, welfare and employment is generally detrimental if a carbon tax is implemented*, but also that inadequate research has been performed to inform stakeholders and policymakers.

The problem with macro-level models that have informed environmental policy including the Treasury-related models that informed the carbon tax proposals (those identified in the literature review in chapter 2.4 and analysed in Chapter 4) is that they apply a large degree of generalization in that they adopt a macro-economic "top-down" approach of assumptions and cause-effect calculations to the economy as a whole and do not assess the exact implications of a policy such as carbon taxes at the level where it really has an impact – the level of individual companies.

The central *original research performed for this project* was to analyse the impact of the carbon tax at a "company level", and then to extrapolate this impact from the "bottom up" to broad economic sectors in contrast to the current "top down" economic analysis that exists. This is inherently a superior approach if accurate emissions data can be obtained for specific companies since the exact quantum of the carbon tax is calculated for a particular company and its impact can be analysed in the light of the actual financial conditions of that company.

This work focuses on the *financial sustainability* and *employment capacity* of selected South African companies most impacted by the carbon tax, and is presented in chapters 6 and 7.

As will be explained in the "methodology" discussion in chapter 6, the author's "bottom up" company-level research targeted the South African "industrial sector", defined as the sectors in Table 3 – i.e. *mining, manufacturing, construction, trade and transport/communications*. Note that the electricity generation sector was excluded from the "industrial sector" because its inclusion would cause "double counting" of emissions as the GHG emissions of Eskom (and other power generators) are counted by industrial companies as "scope 2" emissions being the emissions associated with their energy inputs.

Chapter 4.1 does however provide similar analysis for Eskom to that performed for the "industrial sector" companies based on its actual emissions and financial data for 2010. In this regard, Eskom as the highest single CO2e emitter in South Africa is covered by this research to an extent.

6. RESEARCH METHODOLOGY

The author's research methodology was designed to analyse the impact of the carbon tax on the *financial sustainability* and *employment capacity* of South African companies. These two concepts are related, the latter deriving from the former. *Financial sustainability* is the profitability and financial health of companies – for companies to have economic activities that enable them, at worst, to remain in business, and in normal times to generate adequate risk adjusted returns for the capital invested by shareholders. *Employment capacity* refers to the ability of companies to create and maintain a workforce of staff, and this is of course totally a function of the economic sustainability of the particular companies.

6.1 Research Design

6.1.1 Major Contributors to the South African Economy

The first goal in designing the research was to narrow down the analysis to focus on sectors that are the most significant contributors to the economy as a whole.

An economy such as ours in South Africa does not exist as a single unit, but rather comprises three broad components – private households, the government sector and private businesses, the latter being divided into a formal sector and an informal sector. The formal private company sector is by far the largest component of the economy, representing 72% or 9.5m of South Africa's 13.3m jobs in the fourth quarter of 2010. Government has a 20% share and private households represent the remaining 8% of employment (StatsSA, 2010). The informal private sector of course also contributes to the economy, but is by definition under-reported.

Since private companies contribute most to the South African economy, the impact of a carbon tax at the level of individual companies should be assessed since this is where the impact will occur. Once the impact on formal businesses is understood, this will also provide a future base for understanding informal businesses.

The research work therefore excluded private households and government and related fiscal-funded employment activities such as education and social services.

6.1.2 Sectors Where a Carbon Tax Will Have the Greatest Impact

The second goal in designing the research was to hone in on business sectors where the carbon tax is likely to have the greatest impact, which are of course the sectors that emit the greatest quantities of CO2e. Intuitively this excludes services sectors but the author reviewed the CO2e emissions data from the entire group of 2010 CDP disclosing companies and confirmed that carbon emissions from financial services and real estate companies was significantly lower than companies from other sectors. Further, no pure agricultural companies reported carbon emissions data so this sector was naturally excluded.

As a result of the above two factors, the author opted to exclude agriculture, financial services, real estate and other business services from the analysis and *focus the analysis on companies in mining, manufacturing, construction, trade, transport and communications* (refer to table 3). It would be consistent with terminology used in the investment community to term this remaining group of economic sectors as the "**industrial sector**", and the author uses this term throughout in broad reference to the various sectors listed in table 3 and on which the author focussed in his analysis.

As mentioned earlier, it was important to exclude the electricity generation sector from the "industrial sector" for the purposes of the analysis because emissions by power generation companies (mainly Eskom) are counted by industrial companies as "scope 2" emissions being the emissions associated with their energy inputs. Chapter 4.1 does however provide similar analysis to that which is to follow in this report for Eskom based on its actual emissions and financial data for 2010.

In terms of the Treasury proposals it is not yet certain how the emissions related to energy sources will be taxed. These may be taxed at the *fuel source* (i.e. coal mining companies may pay a tax on coal that will be used for power generation), at the *point of emission* (i.e. Eskom would pay the carbon tax cost) or at the *point of final use* (i.e. the respective industrial company would pay a tax on its “scope 2” emissions). The Treasury discussion paper does

Either way, these costs would be passed on (through higher coal prices and higher electricity prices) to the industrial company and the financial impact would be the same. Therefore, for the purposes of the financial modelling performed, the author calculated the carbon tax as payable by the ultimate industrial user company.

6.1.3 Availability of Data

A third issue in designing the research was the availability of data. In performing quantitative analysis, a “chicken and egg” effect always exists in balancing research objectives with determining what data is available for analysis, since the latter limits the former.

To perform the necessary analysis for the chosen business sectors, the author required financial information about companies (income statement and balance sheet information), employment information and carbon emission data.

The Treasury proposals seek to levy a carbon tax on the basis of a rate per tonne of CO2e so the most crucial information required was actual CO2e emissions data at a company level. While country-level estimates have been made by various groups and some very broad sector estimates also exist (and are subject to the potential flaws of “top down” modelling discussed earlier), actual measured company-level emissions data is scarce.

Fortunately, a number of South Africa’s top JSE-listed companies voluntarily disclose their CO2e emissions in terms of the global “Carbon Disclosure Project” (CDP) and divide these into scope 1 and scope 2 emissions. Scope 1 emissions result directly from a firm's activities while scope 2 emissions indirectly arise from a firm's energy use.

Since these are mostly listed companies, the necessary financial and employment related information is publicly available, some of it audited.

Further, Statistics SA provides financial and employment data for detailed industry segments, using "standard industry classification" (SIC) codes. While not as accurate as the audited listed company information, the SIC-level data is extremely useful because it provides an economy wide aggregation of all companies within an industrial subsector. So, for example, SIC code 2 aggregates all "mining and quarrying" financial and labour company data and has sub-SIC sectors codes such as SIC 2410 "mining of iron ore" covering those particular companies.

6.1.4 A Single Year Snapshot: 2010 Carbon Tax Impact

Quantitative modelling can quickly become extremely complex as one attempts to capture each of the cause-response dynamics of the business environment into the analysis. For example, if a carbon tax is levied it will result in an additional cost to companies, but these business are likely to react in a number of ways in the short and long term with actions such as price increases to customers, cost reduction and (as is the goal of the Treasury's carbon tax) greater energy and carbon efficiency. Clearly a great deal of assumptions and complexity arise if such elements are to be quantified. While the conceptual integrity of the model improves by adding such dynamics, the increased need to make assumptions and create "black box" effects also increase, often counter-acting the increase in sophistication.

As such, the author decided to adopt the approach of creating a "static snapshot" to limit the scope of the quantitative modelling with a few simplifying factors which are clearly stated (and the effect of which will be qualitatively discussed in assessing the quantitative results). These are:

- Analysing the impact of the carbon tax on companies for a single financial year, 2010 – this is the most recent year for which all of the financial, employment and carbon emission data was available;
- Assuming that the full carbon tax reduces the company's profits and that companies are not able to increase revenue nor gain efficiencies by reducing costs other than staff costs; and
- If companies drop below a threshold level of profitability and return on invested capital, they close down.

6.1.5 A Quantitative Financial Model

Considering the above parameters, the author designed a financial quantitative model with the following characteristics:

- A detailed analysis was performed using accurate company-level data for the 47 industrial sector companies that disclosed their CO2e emissions, using their published financial and employment related information. (A further 13 financial services and real estate companies that disclosed CO2e emissions were excluded as explained earlier);
- The detailed 47 company analysis modelled the implications on 2010 profitability assuming the base case being the R75[6] per tonne CO2e presented in the Treasury discussion paper. Threshold levels of profitability and return on

[6] Refer to chapter 5.1.3. The Treasury proposes introducing a carbon tax at R75 per tonne CO2e in 2005 prices. Escalating this to 2010 prices using the general PPI resulted in a R107 per tonne CO2e carbon tax for 2010. It was assumed that this carbon cost would be deductible for income tax purposes and therefore effectively be reduced by 28.5% to arrive at the implications on net

investments were used to assess whether the sustainability of certain companies was at risk;

- For the 47 industrial sector companies, a reduction in the company's labour force was calculated as the cost saving needed to fully offset the new carbon cost. In addition, a total reduction in the labour force was modelled where the impact of carbon costs caused a huge reduction in profitability or negligible returns, or inability to service debt;

- The 47 industrial sector company analysis was then extrapolated to the entire industry sectors that these companies represent (or are similar to) using StatsSA SIC data. As shown in Table 3, this extrapolation enabled the model to estimate the impact on sustainability and employment data in the following SIC sectors which in aggregate employed 6.8m workers in 2010 and generated R4.6 trillion in revenue.

Table 3: Summary of SIC Sectors Covered by Analysis

SIC Sector	**2010 Employment**	**2010 Revenue**
2 – Mining	0.3m	R0.3 trillion
3 – Manufacturing	1.6m	R1.6 trillion
5 – Construction	1.1m	R0.3 trillion
6 – Trade	3.0m	R1.9 trillion
7 – Transport and Communications	0.8m	R0.5 trillion
Total	**6.8m**	**R4.6 trillion**

As mentioned earlier, the author excluded the electricity generation sector from the "industrial sector" because it would amount to "double counting" GHG emissions since Eskom (and other power generators') emissions are counted by industrial companies as "scope 2" emissions being the emissions associated with their energy inputs.

6.1.6 Coverage of the Top 47 Companies

The sample of 47 of South Africa's largest industrial corporations selected for detailed analysis comprises a significant portion of South African carbon emissions and economic activity. In summary, the sample of industrial sector corporations:

- *Emitted a total of 233.5 million tonnes CO2e in 2010 which is approximately 35%-40%* of the South African total emissions – assuming the 2004 estimate of 440mt CO2e for the country (LTMS, 2007) is escalated by the cumulative PPI for 2004-2010 as a rough proxy to arrive at an estimate of 660mt CO2e in 20120 for South Africa;

- *Generated total revenues of R2.2 trillion which is 40%* of total private and public sector revenue (or output) of R5.5 trillion (StatsSA, 2012); and

- *Employed 1.1m fulltime employees,* which was 8.4% of the total employed workforce in the fourth quarter of 2010 and 11.7% of total private sector employees at that time.

Table 4 below lists the 47 industrial sector companies covered by the detailed analysis together with their 2010 CO2e emissions, total revenue and employment workforce.

Table 4: The 47 Industrial Sector Companies Covered by Detailed Analysis

Company	Main Sector	Sub-Sector	Scope 1 CO2e Emissions 2010	Scope 2 CO2e Emissions 2010	Total CO2e Emissions 2010	Total Revenue (Rm)	Total Staff Employed
Sasol	Energy	Energy	61 768 000	9 553 000	71 321 000	142 436	33 708
ArcelorMittal SA	Manufacturing	Steel	10 730 360	4 330 419	15 060 779	30 224	5 145
African Oxygen	Manufacturing	Chemcals	5 400 000	9 000 000	14 400 000	4 721	3 434
AECI	Manufacturing	Chemicals	299 114	176 980	476 094	11 569	6 821
PPC	Manufacturing	Cement	5 129 030	577 990	5 707 020	6 826	3 234
Sappi	Manufacturing	Pulp and Paper	4 778 698	2 118 889	6 897 587	50 711	14 900
Mondi Group	Manufacturing	Pulp and Paper	4 420 810	1 447 991	5 868 801	59 415	29 000
SABMiller	Manufacturing	Food and Beverages	1 449 442	1 182 614	2 632 056	105 409	69 212
Tongaat Hulett	Manufacturing	Food and Beverages	787 711	309 388	1 097 099	9 681	39 314
Tiger Brands	Manufacturing	Food and Beverages	470 522	274 972	745 494	20 430	11 348
Rainbow Chicken	Manufacturing	Food and Beverages	120 296	321 065	441 361	6 956	7 386
Oceana	Manufacturing	Food and Beverages	161 323	68 575	229 898	3 657	1 711
Altech	Manufacturing	Electronic Equipmen	11 562	42 688	54 250	22 810	12 037
The Bidvest Group	Manufacturing	General Industrial	277 009	387 943	664 952	118 483	105 057
Hulamin	Manufacturing	General Industrial	299 329	224 912	524 241	5 809	2 887
Barloworld	Manufacturing	Industrial Machinery	115 241	91 148	206 389	49 823	18 671
Nampak	Manufacturing	Paper	87 911	503 642	591 553	14 706	12 543
Adcock Ingram	Manufacturing	Pharaceuticals	12 616	27 130	39 746	4 454	2 760
Caxton CTP	Manufacturing	Publishing	14 993	95 758	110 751	4 340	5 850
BHP Billiton	Mining	Diversified Mining	21 355 000	27 688 000	49 043 000	502 173	40 757
Anglo American	Mining	Diversified Mining	8 850 000	10 252 000	19 102 000	195 720	100 000
ARM	Mining	Diversified Mining	647 720	1 735 289	2 383 009	14 893	9 643
Gold Fields	Mining	Gold	1 308 764	5 093 511	6 402 275	31 565	46 747
Anglo Platinum	Mining	Platinum	427 290	5 152 793	5 580 083	46 025	48 509
AngloGold Ashanti	Mining	Gold	1 183 000	3 489 000	4 672 000	38 833	62 046
Impala Platinum	Mining	Platinum	693 145	2 930 324	3 623 469	33 132	54 000
Harmony Gold	Mining	Gold	146 036	3 444 600	3 590 636	12 473	35 821
Lonmin	Mining	Platinum	81 277	1 488 755	1 570 032	13 864	25 097
Northam Platinum	Mining	Platinum	15 293	645 745	661 038	3 571	9 983
Exxaro Resources	Mining	Coal	542 000	2 238 794	2 780 794	17 155	10 544
Kumba Iron Ore	Mining	Iron Ore	246 909	454 104	701 013	38 704	5 500
Group Five	Construction	Construction & Engir	803 177	185 506	988 683	9 207	6 761
Murray and Roberts	Construction	Construction & Engir	513 739	286 767	800 506	30 535	42 422
WBH-Ovcon	Construction	Construction & Engir	58 024	32 737	90 761	14 767	7 311
Netcare Limited	Healthcare	Healthcare	27 906	366 360	394 266	23 221	28 700
Medi-Clinic	Healthcare	Healthcare	11 804	154 237	166 041	18 625	13 588
Dimension Data	IT and Telecom	IT	13 107	67 533	80 640	28 566	10 915
MTN Group	IT and Telecom	Telecommunications	280 246	281 201	561 447	114 684	17 820
Vodacom Group	IT and Telecom	Telecommunications	26 970	339 462	366 432	61 197	5 302
Imperial Holdings	Trade	Motor Vehicle Trade	758 011	156 468	914 479	64 667	40 898
Massmart	Trade	Retail Trade	19 775	271 534	291 309	52 950	8 445
New Clicks	Trade	Retail Trade	5 943	90 499	96 442	14 103	8 309
Pick n Pay	Trade	Retail Trade	155 098	586 268	741 366	51 946	49 200
Woolworths	Trade	Retail Trade	27 706	329 024	356 730	25 582	24 649
Truworths	Trade	Retail Trade	462	75 022	75 484	7 858	7 148
The Spar Group	Trade	Retail Trade	33 134	35 925	69 059	38 820	2 570
Grindrod	Trade	Shipping Trade	321 199	7 010	328 209	30 203	5 631
Total			**134 886 702**	**98 613 572**	**233 500 274**	**2 207 498**	**1 113 334**

The author would submit that weight can be placed on the results of this analysis because such a significant portion of total emissions and economic activity is covered by the sample of 47 industrial sector companies the author analysed, and the fact that the analysis can assess the economic implications of the carbon tax at a high level of accuracy since exact emissions and financial data is utilized for each of these companies in terms of the "bottom up" analysis.

Of interest is the low coverage by the sample of 47 industrial sector companies of the total private sector workforce relative to economic activity (only 8.4% of workforce compared with 40% of revenue/output). This illustrates the fact that employment is not evenly spread throughout the economy and that the conventional wisdom and general economic rule that smaller companies are more intensive employers than large corporations holds true. However, rather than weakening the analysis, this is likely to indicate that estimates of employment losses for large corporations derived from the detailed 47 company analysis is *likely to understate the total job losses for the economy* once results were extrapolated.

6.2 Data Collection

The input data for the quantitative analysis was collected from the following sources:

- The 47 industrial sector company scope 1 and scope 2 CO2e emissions data was obtained from Carbon Disclosure Project (CDP, 2010) while their financial and employment data was obtained from Bloomberg (Bloomberg, 2012). In selected instances where data items were missing in Bloomberg, the source annual reports for the respective companies were obtained from the company websites[7].

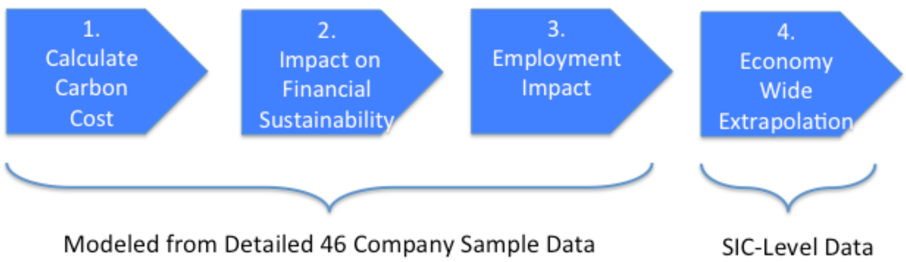
- Financial and employment data for SIC sectors 2,3,5,6 and 7 was obtained from the Stats SA website public access portal of its Annual Financial Statistics Survey 20101 (AFS) estimates and its Q4 2010 Labour Survey respectively.

- The South African producer price index (PPI), GDP per sector, total employment compensation and gross operating surplus per SIC sector were also obtained from Stats SA.

6.3 Data Analysis and Interpretation

Once the necessary data was collected, a simple four stage model was built to estimate the impact of the proposed carbon tax on the financial sustainability and the employment capacity of South African companies. This approach is depicted in Figure 1 and is described further below.

Figure 1: Framework of Carbon Tax Impact Model



[7] Bloomberg data for the most recent financial year was used - in some cases a financial year ending during 2011 and covering some of the 2010 fiscal year. For dual listed companies, data obtained in USD, EUR and GBP was converted at the average exchange rate for the applicable financial year obtained from Bloomberg. Staff cost and/or workforce data not available on Bloomberg were obtained for Sasol, Harmony Gold, Anglo Platinum, Goldfields, Kumba Iron Ore, Hulamin and Tongaat Hulett from the respective annual reports most recently available on the company websites.

6.3.1 Step 1 – Quantum of the Carbon Tax Burden

Using the actual total CO2e emissions for 2010 (scope 1 plus scope 2), the model calculated the total “carbon tax” cost for each of 47 company sample.

In this regard, the model utilized a “base case” level for the carbon tax using the Treasury’s proposal of R75 per tonne of CO2e, escalated to 2010 Rands. The Treasury proposes introducing a carbon tax at R75 per tonne CO2e *in 2005 prices* but it is necessary to increase this to be applicable to 2010 financial information. Escalating the 2005 Treasury rate of R75 per tonne to 2010 prices using the economy wide producer price index (PPI) for the period 2005-2010 resulted in a *R107 per tonne CO2e carbon tax for 2010 for the base case*.

Certain assumptions were made in this first stage calculation:

- It is not yet certain from the Treasury proposals which parties would be taxed for scope 2 emissions arising from energy consumption by industrial customers – i.e. whether it is the energy producer (Eskom or other energy source producers) or the consumer (an industrial company) that will pay the tax. Eskom has made it clear that any carbon tax it attracts would be passed on to customers. As such, it is assumed that the industrial companies themselves will pay the full carbon tax for both their scope 1 and scope 2 emissions.

- It was assumed that this carbon cost would be deductible for income tax purposes and therefore effectively be reduced by 28.5% to arrive at the implications on net profits after taxation.

- However, the income tax reduction of 28.5% was not utilized when calculating the impact of absolute cost increases for companies, which is relevant when considering the amount of offsetting costs that a company must cut from other sources to maintain profitability at current levels.

The results of the first stage analysis of carbon tax costs are presented in Table 5 for the base case carbon tax rate.

Table 5: Base Case Carbon Tax Cost to 47 Industrial Companies (Ranked by Total Carbon Tax Payable)

Company	Main Sector	Sub-Sector	Gross Carbon Tax 2010 (Rm)	Carbon Tax % of Total Costs 2010	Net Carbon Tax 2010 (Rm)	Carbon Tax % of Profits After Tax 2010
Sasol	Energy	Energy	7 653	7.3%	5 472	27.6%
BHP Billiton	Mining	Diversified Mining	5 262	2.2%	3 763	2.3%
Anglo American	Mining	Diversified Mining	2 050	1.7%	1 466	3.2%
ArcelorMittal SA	Manufacturing	Steel	1 616	6.1%	1 155	85.9%
African Oxygen	Manufacturing	Chemcals	1 545	37.6%	1 105	1175.3%
Sappi	Manufacturing	Pulp and Paper	740	1.6%	529	-32.8%
Gold Fields	Mining	Gold	687	3.4%	491	13.5%
Mondi Group	Manufacturing	Pulp and Paper	630	1.2%	450	21.1%
PPC	Manufacturing	Cement	612	13.1%	438	55.8%
Anglo Platinum	Mining	Platinum	599	1.8%	428	4.3%
AngloGold Ashanti	Mining	Gold	501	1.7%	358	56.3%
Impala Platinum	Mining	Platinum	389	1.8%	278	4.2%
Harmony Gold	Mining	Gold	385	3.8%	275	45.7%
Exxaro Resources	Mining	Coal	298	2.3%	213	4.1%
SABMiller	Manufacturing	Food and Beverages	282	0.4%	202	1.2%
ARM	Mining	Diversified Mining	256	2.4%	183	5.5%
Lonmin	Mining	Platinum	168	1.5%	120	6.3%
Tongaat Hulett	Manufacturing	Food and Beverages	118	1.5%	84	10.1%
Group Five	Construction	Construction & Engir	106	1.3%	76	-34.8%
Imperial Holdings	Trade	Motor Vehicle Trade	98	0.2%	70	2.7%
Murray and Roberts	Construction	Construction & Engir	86	0.3%	61	-3.5%
Tiger Brands	Manufacturing	Food and Beverages	80	0.5%	57	2.2%
Pick n Pay	Trade	Retail Trade	80	0.2%	57	7.2%
Kumba Iron Ore	Mining	Iron Ore	75	0.6%	54	0.4%
The Bidvest Group	Manufacturing	General Industrial	71	0.1%	51	1.4%
Northam Platinum	Mining	Platinum	71	2.3%	51	14.5%
Nampak	Manufacturing	Paper	63	0.5%	45	7.2%
MTN Group	IT and Telecom	Telecommunications	60	0.1%	43	0.3%
Hulamin	Manufacturing	General Industrial	56	1.0%	40	54.9%
AECI	Manufacturing	Chemicals	51	0.5%	37	6.1%
Rainbow Chicken	Manufacturing	Food and Beverages	47	0.8%	34	9.2%
Netcare Limited	Healthcare	Healthcare	42	0.2%	30	1.9%
Vodacom Group	IT and Telecom	Telecommunications	39	0.1%	28	0.3%
Woolworths	Trade	Retail Trade	38	0.2%	27	1.7%
Grindrod	Trade	Shipping Trade	35	0.1%	25	3.0%
Massmart	Trade	Retail Trade	31	0.1%	22	2.5%
Oceana	Manufacturing	Food and Beverages	25	0.8%	18	5.3%
Barloworld	Manufacturing	Industrial Machinery	22	0.0%	16	1.6%
Medi-Clinic	Healthcare	Healthcare	18	0.1%	13	1.1%
Caxton CTP	Manufacturing	Publishing	12	0.3%	8	1.8%
New Clicks	Trade	Retail Trade	10	0.1%	7	1.1%
WBH-Ovcon	Construction	Construction & Engir	10	0.1%	7	0.9%
Dimension Data	IT and Telecom	IT	9	0.0%	6	0.6%
Truworths	Trade	Retail Trade	8	0.1%	6	0.3%
The Spar Group	Trade	Retail Trade	7	0.0%	5	0.6%
Altech	Manufacturing	Electronic Equipmen	6	0.0%	4	0.8%
Adcock Ingram	Manufacturing	Pharaceuticals	4	0.1%	3	0.4%
Total			**25 055**	**1.6%**	**17 914**	**5.2%**

Table 5 presents the results of the "base case" carbon tax as currently proposed by the Treasury (R75 per tonne CO2e in 2005 prices) for the sample of 47 industrial companies. As the table shows, these companies would pay a total of R25bn in carbon tax (assuming their 2010 operating activities) and their total reduction in after tax profits would be R18bn.

The impact on companies varies significantly: led by Sasol with its significant GHG emissions from the coal and gas liquefaction process activities and other "heavy industry" companies in the mining, smelting and cement industries through to low emitting companies in the IT, trade and pharmaceutical sectors with a low anticipated carbon tax burden.

While the carbon tax, as a proportion of the companies' total taxes was on average low at 1.6%, the impact on profitability was far more significant at a 5.2% reduction on average.

As a result of this divergence, one would expect those companies with little carbon tax burden to take minimal action, or none at all, while those facing a bigger burden would have the incentive to take significant action in the short term to reduce other costs and in the medium to longer term to attempt to increase revenue and reduce carbon emissions.

More concerning is the very significant "dent" that the carbon tax would produce in the profits of selected companies such as Sasol (28% reduction) and Mondi (21% reduction). Others could see near half or more of their profits eroded: Arcellor Mittal (86% reduction), Anglogold (56% reduction), PPC (56% reduction), Hulamin (55% reduction) and Harmony (46% reduction). Afrox would have its entire profits wiped out while the negative % of profits shown in the table above relate to companies such as Group Five, Sappi and Murray and Roberts who are already loss-making and would face the additional burden of a carbon tax in these circumstances.

For such companies, the reaction to a carbon tax is expected to be more vigorous including strong cost-cutting measures, and closure of certain lines of business. It is interesting to note that many of the companies who face the largest carbon tax burden (such as Sasol and the mining companies) are “price takers” meaning that they produce commodities or similar products that are priced or traded on international markets and these companies cannot therefore offset higher costs by increasing prices to customers. Instead, the total amount of a carbon tax would result in a direct profit reduction with the only mitigation being to reduce other costs (in the short and long term), or to reduce carbon emissions (a long term response).

The analysis shows the companies most at risk to be Afrox, Group Five, Sappi and Murray and Roberts, Arcellor Mittal, Anglogold, PPC, Hulamin and Harmony. In total these nine companies employ 176,000 fulltime staff and generate R190bn of revenue for the South African economy. Should these companies face closure, the dire economic consequences are clear. These aspects are illustrated further in the subsequent steps of the analysis.

6.3.2 Step 2 – Impact on Financial Sustainability

The next stage of the analysis was to calculate the impact of the carbon tax on the profitability and financial sustainability of the 47 industrial companies in the sample. In this regard, three specific “tests” were then designed to identify companies for which financial sustainability would be “at risk” as a result of the carbon tax. These are described as follows:

- Firstly the extent of profit reduction was considered and companies were identified where a reduction of more than 20% occurred to profits – this was taken as a “shock” that would likely require drastic action by management. Such action would very likely include drastic cost cutting, but probably also closure of lines or segments of the business, the latter causing long-term economic impairment.

- Secondly, the amount of invested capital in the company was identified and a level of return on equity of 15%[8] was established as the minimum required return by shareholders on their invested capital. The return on equity for each company was then calculated subsequent to the imposition of the carbon tax (assuming an income tax deduction of the carbon tax cost as discussed earlier) and companies were identified that fall below this minimum 15% return level. Such companies would in principle fail the test of "financial sustainability" since they cannot pay shareholders the minimum required return on invested capital. In the longer term, such companies would cut segments of their business or would close down entirely, again resulting in permanent impairment to the economy of South Africa.

- Thirdly, the level of debt of each company was established and compared with the level of available profits (subsequent to the carbon tax) that can be applied to debt servicing. A level of 5%[9] of total debt was established as the minimum annual requirement of debt servicing failing which a corporate debt default would be expected. Companies were identified to be "at risk" in terms of financial sustainability if their annual debt servicing costs was more than 50% of their annual profits (after considering the carbon tax). Inability to service debt results in drastic short-term consequences for companies including the need for severe cost cutting and business segment closure actions by management, and sometimes bankruptcy.

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[8] The required return on invested capital by shareholders is traditionally calculated in terms of the "capital asset pricing model" being the risk free rate (the SA Government R186 long bond rate – yielding 8.6% at 21 February 2011) plus a market risk premium (approximately 6.3% according to a study by Fernandez et al access at http://www.iese.edu/research/pdfs/DI-0920-E.pdf) equalling 15% on a rounded basis. In practice the required return on capital differs per industry and company depending on its risk characteristics but the 15% was chosen as fairly reflective for the purposes of this study for the 47 company analysis.

[9] Usually debt servicing on interest bearing debt would be equal to the prime interest rate plus a portion of capital that must be repaid – i.e. a number far higher than 5%. However, most companies have a large component of interest free liabilities (such as short term creditors) and a large portion of balance sheet liabilities are never repaid because these are "rolled over" for as long as the business remains a going concern (particularly provisions and creditors). Hence on the assumption that one third of debt is repayable at a rate of 15% (interest and capital), the 5% was derived.

Table 6 presents the results produced by the model for the financial sustainability analysis. The highlighted red cells highlight instances where companies are “at risk” by failing one of the financial sustainability tests described above.

A glance at this table illustrates the dramatic effect of the carbon tax, at the currently proposed “base case” rate. Only 17 companies of the sample 47 companies *do not* fail one of the three tests of “financial sustainability” the author designed. Conversely 64% of the sampled companies are “at risk” from a financial sustainability point of view. The results are discussed further in chapter 7.

It should be highlighted that the “at risk” test in this stage of the model is different from the “likely bankruptcy” test that is performed in the next stage of the analysis to identify companies that are likely to fail and shed their entire workforce. The “likely bankruptcy” test places a higher hurdle rate on minimum required return (i.e. a lower ROE hurdle) on equity and profit cover of debt servicing costs than applied in these “at risk” tests.

Table 6: Impact on Financial Sustainability of Carbon Tax on 47 Industrial Companies (Ranked by Drop in Return on Equity, Base Case Carbon Tax Rate)

Company	Main Sector	Sub-Sector	Reduction in ROE	ROE Post Carbon Tax	Net Profits After Carbon Tax (Rm)	Debt Servicing Cash Needed (Rm)	Debt Service (Shortfall)/ Excess (Rm)	Debt Service % of Profits
African Oxygen	Manufacturing	Chemcals	1175%	-37%	(1 011)	128	(1 139)	-13%
ArcelorMittal SA	Manufacturing	Steel	86%	1%	190	458	(269)	242%
AngloGold Ashanti	Mining	Gold	56%	1%	279	1 780	(1 502)	639%
Hulamin	Manufacturing	General Industrial	55%	1%	33	137	(104)	416%
Harmony Gold	Mining	Gold	46%	1%	327	483	(157)	148%
Northam Platinum	Mining	Platinum	15%	3%	298	91	208	30%
Netcare Limited	Healthcare	Healthcare	2%	21%	1 587	2 149	(562)	135%
Medi-Clinic	Healthcare	Healthcare	1%	11%	1 164	1 649	(485)	142%
Murray and Roberts	Construction	Construction & Engineering	-4%	-34%	(1 797)	712	(2 508)	-40%
Sappi	Manufacturing	Pulp and Paper	-33%	-21%	(2 144)	1 681	(3 825)	-78%
Group Five	Construction	Construction & Engineering	-35%	-13%	(294)	275	(569)	-94%
PPC	Manufacturing	Cement	56%	36%	347	273	74	79%
Sasol	Energy	Energy	28%	13%	14 322	3 382	10 941	24%
Mondi Group	Manufacturing	Pulp and Paper	21%	5%	1 687	1 559	127	92%
Gold Fields	Mining	Gold	14%	7%	3 140	1 145	1 996	36%
Tongaat Hulett	Manufacturing	Food and Beverages	10%	13%	749	443	306	59%
Rainbow Chicken	Manufacturing	Food and Beverages	9%	12%	334	93	241	28%
Pick n Pay	Trade	Retail Trade	7%	34%	728	447	281	61%
Nampak	Manufacturing	Paper	7%	10%	583	361	222	62%
Lonmin	Mining	Platinum	6%	8%	1 780	529	1 250	30%
AECI	Manufacturing	Chemicals	6%	13%	565	292	273	52%
ARM	Mining	Diversified Mining	6%	14%	3 128	510	2 618	16%
Oceana	Manufacturing	Food and Beverages	5%	23%	316	31	284	10%
Anglo Platinum	Mining	Platinum	4%	17%	9 531	1 439	8 092	15%
Impala Platinum	Mining	Platinum	4%	13%	6 360	900	5 460	14%
Exxaro Resources	Mining	Coal	4%	29%	4 995	560	4 435	11%
Anglo American	Mining	Diversified Mining	3%	17%	44 342	10 040	34 303	23%
Grindrod	Trade	Shipping Trade	3%	14%	814	414	400	51%
Imperial Holdings	Trade	Motor Vehicle Trade	3%	19%	2 492	1 176	1 316	47%
Massmart	Trade	Retail Trade	3%	20%	855	655	200	77%
BHP Billiton	Mining	Diversified Mining	2%	40%	161 773	15 798	145 976	10%
Tiger Brands	Manufacturing	Food and Beverages	2%	25%	2 527	298	2 229	12%
Caxton CTP	Manufacturing	Publishing	2%	9%	455	54	401	12%
Woolworths	Trade	Retail Trade	2%	39%	1 604	249	1 355	16%
Barloworld	Manufacturing	Industrial Machinery	2%	8%	1 001	914	87	91%
The Bidvest Group	Manufacturing	General Industrial	1%	19%	3 488	1 469	2 019	42%
SABMiller	Manufacturing	Food and Beverages	1%	10%	16 558	5 689	10 868	34%
New Clicks	Trade	Retail Trade	1%	67%	644	164	479	26%
WBH-Ovcon	Construction	Construction & Engineering	1%	20%	727	293	433	40%
Altech	Manufacturing	Electronic Equipment	1%	9%	538	305	233	57%
Dimension Data	IT and Telecom	IT	1%	15%	966	595	370	62%
The Spar Group	Trade	Retail Trade	1%	38%	947	291	657	31%
Adcock Ingram	Manufacturing	Phraceuticals	0%	23%	751	101	651	13%
Kumba Iron Ore	Mining	Iron Ore	0%	78%	14 269	475	13 794	3%
Vodacom Group	IT and Telecom	Telecommunications	0%	51%	8 217	1 263	6 954	15%
MTN Group	IT and Telecom	Telecommunications	0%	19%	14 257	4 036	10 221	28%
Truworths	Trade	Retail Trade	0%	38%	1 937	59	1 878	3%
Total			**5.2%**	**21%**	**326 356**	**65 843**	**260 514**	**20%**

6.3.3 Step 3 – Employment Impact of the Carbon Tax

The third stage of the analysis was to calculate the impact of the carbon tax on the employment levels of the 47 industrial companies in the sample. This analysis estimates the likely job losses in the 47 company sample arising from two situations:

- Firstly, all companies are assumed to recover the amount of additional costs arising from the carbon tax through a direct reduction in workforce. As discussed in chapter 5, this is a major simplifying assumption made in the analysis and it could be argued that this provides an overly aggressive quantification of job losses as companies could react in other ways such as attempting to increase revenue, reduce other costs besides staff costs, reduce carbon emissions or simply accept lower levels of profitability. The impact of this assumption will be discussed later in chapters 6.4 (Limitations of the Study) and in the results discussion and recommendations in chapter 7; and
- Secondly, where companies are at a high risk of failing and going bankrupt, that company's entire workforce is counted towards the employment losses arising from the carbon tax.

For the second category of employment losses from bankruptcy, similar tests were performed as for the financial sustainability analysis (step 2 of the model) but a higher hurdle was applied to identify "likely bankruptcies" candidate companies rather than the lower hurdle indicated above for identifying companies "at risk". The assumptions used for "likely bankruptcy" companies were as follows:

- Where the reduction in the return on equity as a result of carbon tax resulted in an ROE of 5% or less. In the "at risk" calculations, a minimum ROE of 15% was used (based on a 9% risk free investment rate). For this test a return of 5% was used – a reasonable level for bankruptcy at almost half of the rate at which investors can invest risk free and therefore would not provide capital to an enterprise or allow capital to remain deployed in the business; and

- Where the profits after the carbon tax are below the amount required for debt servicing – i.e. profits are 100% of debt servicing as opposed to the “at risk” calculations which set the threshold of debt servicing being 50% more of profits.

Table 7 presents the results of this stage of the analysis for the base case rate of the carbon tax. It shows that 66,833 jobs are likely to be lost as companies cut costs to maintain profitability in the light of the carbon tax burden. More dramatic is the result shown in the table that 11 companies fall into the “likely bankruptcy” category (shaded in Table 7) and the additional job losses from this group would total 225,687 bringing the total expected losses from the introduction of the carbon tax to 276,007 or 25% of the total workforce employed by the 47 company sample.

Again, the results are discussed more fully in chapter 7.

Table 7: Employment Impact of Carbon Tax on 47 Industrial Companies (Ranked by Likelihood of Bankruptcy, Base Case Carbon Tax Rate)

Company	Main Sector	Sub-Sector	Total Staff Employed	Staff Costs % of Total Operating Cash Costs	Carbon Tax % of Staff Costs	Number of Staff Reduced to Offset Carbon Tax	Likely Bankruptcy Candidate	Number of Staff Lost From Bankruptcy	Total Staff Reduction (Cost Saving OR Bankruptcy)
African Oxygen	Manufacturing	Chemcals	3 434	22%	170%	3 434	TRUE	3 434	3 434
ArcelorMittal SA	Manufacturing	Steel	5 145	11%	55%	2 818	TRUE	5 145	5 145
AngloGold Ashanti	Mining	Gold	62 046	23%	7%	4 591	TRUE	62 046	62 046
Hulamin	Manufacturing	General Industrial	2 887	13%	8%	230	TRUE	2 887	2 887
Harmony Gold	Mining	Gold	35 821	54%	7%	2 490	TRUE	35 821	35 821
Northam Platinum	Mining	Platinum	9 983	30%	8%	777	TRUE	9 983	9 983
Netcare Limited	Healthcare	Healthcare	28 700	44%	1%	152	TRUE	28 700	28 700
Medi-Clinic	Healthcare	Healthcare	13 588	52%	0%	32	TRUE	13 588	13 588
Murray and Roberts	Construction	Construction & Engineering	42 422	32%	1%	372	TRUE	42 422	42 422
Sappi	Manufacturing	Pulp and Paper	14 900	18%	9%	1 336	TRUE	14 900	14 900
Group Five	Construction	Construction & Engineering	6 761	30%	4%	281	TRUE	6 761	6 761
PPC	Manufacturing	Cement	3 234	21%	63%	2 037	FALSE	-	2 037
Sasol	Energy	Energy	33 708	18%	41%	13 754	FALSE	-	13 754
Mondi Group	Manufacturing	Pulp and Paper	29 000	17%	7%	2 056	FALSE	-	2 056
Gold Fields	Mining	Gold	46 747	53%	6%	3 030	FALSE	-	3 030
Tongaat Hulett	Manufacturing	Food and Beverages	39 314	22%	7%	2 640	FALSE	-	2 640
Rainbow Chicken	Manufacturing	Food and Beverages	7 386	16%	5%	347	FALSE	-	347
Pick n Pay	Trade	Retail Trade	49 200	9%	2%	906	FALSE	-	906
Nampak	Manufacturing	Paper	12 543	26%	2%	257	FALSE	-	257
Lonmin	Mining	Platinum	25 097	51%	3%	747	FALSE	-	747
AECI	Manufacturing	Chemicals	6 821	22%	2%	157	FALSE	-	157
ARM	Mining	Diversified Mining	9 643	13%	19%	1 824	FALSE	-	1 824
Oceana	Manufacturing	Food and Beverages	1 711	15%	6%	94	FALSE	-	94
Anglo Platinum	Mining	Platinum	48 509	33%	5%	2 563	FALSE	-	2 563
Impala Platinum	Mining	Platinum	54 000	31%	6%	3 095	FALSE	-	3 095
Exxaro Resources	Mining	Coal	10 544	31%	7%	790	FALSE	-	790
Anglo American	Mining	Diversified Mining	100 000	27%	6%	6 126	FALSE	-	6 126
Grindrod	Trade	Shipping Trade	5 631	4%	3%	163	FALSE	-	163
Imperial Holdings	Trade	Motor Vehicle Trade	40 898	15%	1%	467	FALSE	-	467
Massmart	Trade	Retail Trade	8 445	7%	1%	70	FALSE	-	70
BHP Billiton	Mining	Diversified Mining	40 757	16%	14%	5 782	FALSE	-	5 782
Tiger Brands	Manufacturing	Food and Beverages	11 348	11%	4%	497	FALSE	-	497
Caxton CTP	Manufacturing	Publishing	5 850	25%	1%	77	FALSE	-	77
Woolworths	Trade	Retail Trade	24 649	13%	1%	317	FALSE	-	317
Barloworld	Manufacturing	Industrial Machinery	18 671	15%	0%	61	FALSE	-	61
The Bidvest Group	Manufacturing	General Industrial	105 057	12%	1%	568	FALSE	-	568
SABMiller	Manufacturing	Food and Beverages	69 212	22%	2%	1 244	FALSE	-	1 244
New Clicks	Trade	Retail Trade	8 309	12%	1%	57	FALSE	-	57
WBH-Ovcon	Construction	Construction & Engineering	7 311	18%	0%	30	FALSE	-	30
Altech	Manufacturing	Electronic Equipment	12 037	18%	0%	19	FALSE	-	19
Dimension Data	IT and Telecom	IT	10 915	21%	0%	17	FALSE	-	17
The Spar Group	Trade	Retail Trade	2 570	2%	1%	21	FALSE	-	21
Adcock Ingram	Manufacturing	Pharaceuticals	2 760	15%	1%	24	FALSE	-	24
Kumba Iron Ore	Mining	Iron Ore	5 500	17%	3%	182	FALSE	-	182
Vodacom Group	IT and Telecom	Telecommunications	5 302	10%	1%	52	FALSE	-	52
MTN Group	IT and Telecom	Telecommunications	17 820	9%	1%	180	FALSE	-	180
Truworths	Trade	Retail Trade	7 148	15%	1%	70	FALSE	-	70
Total			**1 113 334**	**18%**	**9%**	**66 833**		**225 687**	**276 007**

6.3.4 Step 4 – Economy-Wide Extrapolation

Steps 1-3 of the analysis provided a detailed examination of the impact of the carbon tax on 47 major industrial companies in South Africa, using accurate information on their carbon emissions and their actual financial results and position during 2010.

The final stage of the analysis extrapolated the results of the 47 company analysis to the entire "industrial" sectors of the South African economy that the 47 companies represent as shown in Table 3. The model calculated key variables of possible lost revenue and potential lost employment, both as a result of through business closure or downsizing.

Table 8 below provides a comparison of the selected key financial "income statement" and "balance sheet" information for the 47 companies compared with the entire SA economic wide "industrial" sector to which the extrapolation is applied.

Table 8: Comparison of Financial and Employment Statistics of Top 47 Companies and Total Industrial Sector Companies

	47 Sample Industrial Companies	Total SA "Industrial" Sector
Revenue (Rm)	2 207 498	4 626 809
Profit % of revenue	16%	6%
Return on equity %	22%	22%
Debt:equity ratio	0.85	1.78
Fulltime employees	1 113 334	6 773 629
Employees per R1m revenue	0.50	1.46
Profit per fulltime employee (R)	309 225	38 860
Staff costs (Rm)	288 352	546 866
Staff cost per employee pa (R)	258 999	80 735

Of particular interest from the data shown in Table 8 is the degree to which the broader South African "industrial" sector companies are, on average, less profitable than the 47 companies used in the detailed analysis which are the largest companies in the respective sectors (profit margin of 6% compared 16% for the larger 47 companies). The broader sector of smaller companies, on average, has more debt (debt equity ratio of 1.78 times compared with 0.85 for the larger 47 companies) and are more intense employers, having 1.46 employees per R1m of revenue compared with 0.50 employees per R1m of revenue for the 47 larger companies.

The implications of these comparative financial and employment statistics is important because it means that the *broader universe of SA industrial companies will be even more negatively affected* by the introduction of the carbon tax than the larger 47 companies analysed in the study because their lower level of profits and higher debt mean that their financial sustainability will be more severely affected by an increased cost burden, while their higher labour intensity will cause proportionately more jobs to be shed than with the 47 larger companies.

These “amplifying factors” for the smaller companies making up the remainder of the “industrial sector” are taken into account in the extrapolation but only using the total information for the entire universe rather than granular data for companies within sectors (since this is not available). In other words, the extrapolation allows for a higher level of downsizing, business closure and bankruptcy (and resulting job losses) for smaller companies than for the larger 47 companies, but because this is done at an aggregate rather than individual company level, the potential for distortions exists in the extrapolation results.

The results of the extrapolation exercise are shown together with the overall summary of the analysis in chapter 7. The basis of extrapolation for specific calculation is shown in the notes to table 9 in chapter 7.

6.4 **Limitations of the Study**

The analysis performed had several limitations due to the methodology adopted and the assumptions that were made. Three limitations are considered most important and are described below:

1. A single year, 2010, was taken as a "snapshot" year to understand the impact of the carbon tax, assuming the tax had been introduced in that year. Conceptually it would be more correct to view the impact of the carbon tax over multiple periods, since the reaction of companies will be over multiple periods. This will add a fair degree of complexity to the modelling work, but should be considered for future work.

2. It was assumed that companies would compensate for the entire cost increase arising from the carbon tax by reducing staff numbers in the 2010 snapshot year. A criticism may be made that this assumes that companies are not able to adopt alternative approaches to compensating for the carbon tax such as (i) raising prices to customers (largely a correct assumption since a large portion of the industrial companies such as the mining houses are price takers, selling their product on competitive international markets), (ii) reducing other costs, (iii) implementing measures to reduce CO_2e emissions or (iv) accepting lower levels of profitability. With the short term one year "snapshot" that was used for the analysis, this assumption is probably fair but additional complexity can be built into the model in future work to deal with multiple periods and other actions by companies to offset the carbon tax burden.

3. The simple manner in which the detailed "Top 47" company results were extrapolated to the entire universe of SA industrial companies will inevitably result in distortions from reality since the assumption is made that the characteristics of the "Top 47" are identical to the remaining companies in the sector.

While the point 1 above should not skew the argument either way (i.e. it would probably not cause the results of the analysis to overstate or understate the carbon tax implications), point 2 could be considered to present an overly aggressive (damaging) impact on job losses than may exist in reality. However, this is likely to be outweighed by the extrapolation issues mentioned in point 3 above which are overly generous to the non "Top 47" companies since these are more labour intensive and less profitable and therefore job losses are in reality likely to be higher in that group compared with the “Top 47”.

So to some extent, on a qualitative basis, it could be argued that the two most important limitations to the analysis that may skew the results away from reality, counter-balance each other.

Other more minor factors should be recognized that may create some distortions in the results:

- In the “Top 47” universe, there is a component of foreign income and emissions from several companies that operate outside of South Africa. Strictly speaking the GHG emissions and financial information from non-SA activities should be excluded, but reported data in this regard was not available.

- On the basis that Eskom was excluded form the “Top 47” company analysis to avoid double counting emissions (Eskom’s scope 1 emissions are effectively a large portion of industrial companies’ scope 2 emissions), it may be more correct also to exclude Sasol form the “Top 47” analysis as an energy provider.

- One key “test” used both to determine “at risk” companies and “likely bankruptcy” candidates related to debt serving and in this regard a broad assumption was made for all 47-sample companies that annual debt servicing of 5% of total balance sheet liabilities is required. This is explained in the footnote 9 of chapter 6.3.2. In reality, the composition of total liabilities will differ for each company and future work should analyse these liabilities per company more carefully and determine more accurate debt servicing requirements.

- In the “at risk” and “bankruptcy” minimum ROE tests, levels of 15% and 5% minimum ROE were applied to all companies. In reality the minimum cost of capital differs per company and per sector and ideally a tailored hurdle should be applied to each company.

- For the Top 47 companies, data was reported for their respective financial year-ends that were not all on 31 December 2010 and therefore only a portion of their emissions and financial data related to the 2010 calendar year whereas other data was for the 2010 calendar year. It is unlikely that this had a major impact on skewing the results.

Finally, it must be stressed that this research is focussed on a single issue of quantifying the direct economic and employment consequences of the carbon tax under certain simplifying assumptions. The Treasury and other South African policy bodies have cited compensating factors such as the job creation that will arise in “green industries” as a result of the carbon tax. While such “compensating factors” are noted, their quantification is not within the scope of this research and this highlights the fact that the work performed in this research is not a comprehensive modelling exercise of all economic and employment related implications of the carbon tax.

7. SOUTH AFRICAN INDUSTRIAL SECTOR COMPANY ANALYSIS

This section contains the summarized results of the author's modelling work from which conclusions are drawn. The key outputs of the author's analysis and modelling work are presented and discussed, while more detailed results at a "company level" are presented in tables 4-8 in chapter 6.3 to illustrate the "step by step" results produced from the analysis.

7.1 Presentation of Results

The most important output data from the analysis and modelling work is presented in Table 9 and are discussed in the following chapter 7.2.

Table 9: Summary of Analysis Results – 2010 Impact on Base Case Carbon Tax (References to notes below table)

	47 Company Detailed Analysis	SA Economy Wide Impact on Industrial Sectors
A. Summary information of universe		
Size of 47 company sample relative to economy-wide "industrial" sectors to which it was extrapolated	1.1 million employees R2.2 trillion revenues	6.8 million employees R4.6 trillion revenues
Total carbon emissions[1] Carbon taxation cost for 2010[1] Carbon taxation % of total company operating costs[2]	233.5m tonnes CO2e R25 billion carbon tax 1.6% of total costs	489.4m tonnes CO2e R53 billion carbon tax 1.3% of total costs
B. Financial sustainability analysis[2]		
1. Number of companies "at risk" of financial failure	30 of 47 companies	Company numbers unknown
2. Total revenue of "at risk" companies	R438 billion	R918 billion
3. Total employment of "at risk" companies	673,141 employees	4.1 million employees
4. Invested capital of "at risk" companies	R 919 billion	R708 billion
C. Employment impact analysis[3]		
1. Job losses to offset carbon taxation costs	66,833 lost jobs	406,620 lost jobs
2. Job losses as a result of bankruptcy caused by carbon taxation	225,687 lost jobs	1,373,101 lost jobs
3. Total job losses from cost reduction and possible bankruptcy[4]	276,007 lost jobs	1,679,252 lost jobs

Notes Relating to Table 9

1. Carbon emissions and taxation costs are extrapolated by total revenue since this is deemed the best indicator of the extent of a company's activities. Please refer to chapters 6.1.6 and 6.3.1 for the detailed methodology and assumptions used to analyse the Top 47 industrial companies and calculate their anticipated carbon tax.

2. Refer to chapter 6.3.2 for detailed methodology and assumptions related to step 2 of the model that identified "financially at risk" companies, particularly the three "at risk" tests. Extrapolation is based on the percentage of revenue, employment and equity respectively of the Top 47 companies relative to total revenue, employment and equity respectively of the "industrial sector" companies from the SIC data.

3. Refer to chapter 6.3.3 for detailed methodology and assumptions related to step 3 of the model that identified job losses arising from the carbon tax and the manner in which probable "bankruptcies" are determined as a result of the carbon tax. Extrapolation is based on the percentage of employment of the Top 47 companies relative to total employment of the "industrial sector" companies from the SIC data.

4. Note that line C3 (total job losses) does not equal lines C1 plus C2 because C1 includes also marginal job losses from companies that are expected to go bankrupt.

7.2 Discussion of Results

Table 9 provides all of the salient information summary information from the author's analysis and financial modelling. The results are discussed in this section to understand implications of the Treasury's carbon taxation proposals on South African industrial companies.

7.2.1 The "Bottom Up" Analysis Covers a Significant Portion of South African Industrial Companies

The results presented in Table 9 illustrate that the detailed "Top 47" industrial company analysis contains a significant "chunk" of the total South African "industrial" economic activity (1.1m employees, R2.2 trillion revenues) and a large portion of almost half of all South African "industrial" sector companies by revenue – R2.2 trillion revenues in the Top 47 is 48% of the R4.6 trillion of revenues of all SA industrial companies.

Since detailed and accurate company-level financial information was obtained for the 47 company sample and actual emissions information is known for each company, the precise carbon tax can be calculated and its financial implications can be assessed for each business in this sample group with a reasonably high degree of confidence (subject obviously to the simplifying assumptions made as described in the research design section in chapter 6.1).

This "bottom up" analysis approach is most effective in determining the implications of the carbon tax since the impact is assessed at the correct level of "granularity" (the level where the carbon tax actually hurts companies) compared with the top-down economic models that have been used to inform the decisions of South African policymakers in respect of the carbon tax proposals.

The extrapolation exercise in step 4 of the author's modelling (described in chapter 6.3.4) certainly suffers from the same "generalization" risk that characterizes the macro-economic studies identified in the literature review but since accurate information exists for the "Top 47" companies that represent such a large portion – 48% – of the total industrial sector, this risk is somewhat reduced.

7.2.2 *The Magnitude of Carbon Taxes Expected*

At the Treasury's proposed carbon tax levels, the Top 47 companies will pay some R25bn per annum in carbon tax (in 2010 terms), while *the South Africa industrial sector as a whole will pay a total of R53bn in carbon taxes*.

To put this in perspective, Table 10 below compares this expected R53bn carbon tax in 2010 terms based on the Treasury proposals to the overall "scale" of South Africa's industrial sector, comparing it to the GDP contribution, gross operating profit and employment costs of the "industrial sector" overall. For the purposes of this research it is important to recall that the South African "industrial sector" is defined as the sectors in Table 3 – i.e. mining, manufacturing, construction, trade and transport/communications.

Table 10: Proportion of Carbon Tax to Key Economic Statistics

	SA Economy Wide Industrial Sectors
Carbon tax burden in 2010 arising from Treasury Proposals	R53 billion
% of GDP for "industrial sector" companies in SA	4% of R1.2 trillion GDP industrial sector
% of gross operating profit for "industrial sector" companies in SA	8% of R690 billion total gross profit of industrial sector
% of employee compensation for "industrial sector" companies in SA	10% of R539 billion compensation paid to employees

The percentages of GDP, operating profit and employee compensation show what a significant "shock" the carbon tax will have on the South African industrial sector. In the short term it will significantly erode profits and likely reduce employment.

As Table 9 shows, the additional cost burden from the carbon tax will be 1.6% and 1.3% respectively for the Top 47 and entire universe of SA industrial companies. While at first blush these percentages may not seem high, they need to be evaluated in terms of the net profit margins of the respective groups that are 16% and 6% respectively for the Top 47 and entire universe of SA industrial companies[10]. In this light, it is clear that the additional cost burden of the carbon tax is a significant “shock” to company profits, particularly for those outside of the “Top 47” universe who suffer a low 6% profit margin.

As noted in chapter 6.1.2, the author’s methodology has assumed that the “scope 2” emissions portion of the carbon tax related to energy inputs will either be paid by the industrial companies themselves although the Treasury proposals are not clear in this regard. But whether the tax on energy sources is paid at the fuel source (e.g. coal mining company), or by the producers of energy such as Eskom who would pay R24bn in carbon tax in 2010 terms (refer to chapter 4.1 for this calculation) this cost would pass directly to industrial companies who consume energy. In other words, the total R53bn carbon tax that industrial companies are expected to pay would either be paid entirely by these companies, or in part by energy producers or source fuel providers. Either way, such companies will have higher input costs to the extent of R53bn per annum (in 2010 terms).

7.2.3 Threatening Financial Sustainability

Part B of Table 9 provides the key results of the three tests described in section “Step 2” which sought to identify companies that would, in financial terms, be “at risk” of financial failure as a result of the burden of the carbon tax.

Chapter 6.3.2 provides detailed information on the three tests and their rationale but in summary, a company was considered to be financially “at risk” if, as a result of the carbon tax, its profits in 2010 would drop by more than 20%, if its return on invested equity capital dropped below 15% or its profits dropped to the extent that more than 50% of profits are required to service debt. The analysis assumed that management would have to take reasonably drastic action if one or more of these

[10] Calculated as profit after tax divided by revenue.

conditions applied to a particular company including significant cost reduction actions and likely the closure of less profitable sections of the business.

This portion of the analysis was not intended to imply high probability that a particular company would become bankrupt if one of the three “at risk” tests were met but instead that it was “at risk” financially – either of bankruptcy or something short of bankruptcy. This analysis provides useful information on *the degree to which the carbon tax will cause stress to industrial companies*, and likely some reduction of overall economic activity through cost reduction and/or closure of business segments.

The results shown in Table 9 (part B) are staggering. Of the “Top 47” companies analysed in detail, *more than two thirds (30 companies or 68% of the 47 total) would be financially “at risk”.* These companies have R438bn in revenue, employ 673,141 staff and represent R919 billion in equity capital invested by shareholders.

On the basis of the simple extrapolation performed by the author’s research, if the remaining SA industrial companies were assumed to be alike in all respects to the “Top 47” analysed in detail, the total SA industrial sector would have companies with R918 billion in revenue and 4.1 million employees “financially at risk”. However, as has been discussed earlier in chapter 7.2.2, the smaller companies to which the extrapolation applies generally have lower levels of profitability than the “Top 47” (6% profit margin rather than 16% for the “Top 47”) and therefore it is reasonable to assume that an even greater proportion of companies that represent a significant portion of the nation’s overall industrial economic activity would be at risk.

7.2.4 Threatening Employment

While the financial sustainability analysis to identify “at risk” companies presented in the previous section is a very important indicator of the burden that the carbon tax will place on South African companies, it is, for several reasons, not as "tangible" or "impactful" as assessing the potential job losses as a result of carbon taxes. Firstly, the financial "at risk" classification simply indicates that drastic action must be taken by management but does not accurately predict what that action will be. Secondly, in the minds of certain South African policy-makers, objectives related to the profitability and financial returns of equity investors is not always seen as overly important, until the consequences of a loss of economic activity are felt.

On the other hand, employment creation is without doubt one of South Africa's top national objectives and if the trade off was clearly understood by policy makers of achieving environmental goals at the expense of employment, the author submits that the matter would be evaluated far more carefully.

Part C of Table 9 therefore provides probably the most important part of this research in estimating the likely job losses in the "Top 47" company sample and extrapolating this to the entire industrial sector. The methodology and assumptions for this "Step 3" of the analysis are presented in chapter 6.3.3. In brief, job losses are estimated from two sources – cost cutting through staff retrenchment to offset carbon tax costs, and staff retrenchment from businesses that are likely to be faced with bankruptcy as a result of the carbon tax burden. For this second category similar tests were performed as the "at risk" financial analysis, but far higher thresholds for minimum profitability and debt service cover were applied.

In summary, for the "Top 47" companies, *the carbon tax threatens to cause the retrenchment of 66,833 jobs (6% of the workforce of those companies)* if all of the "Top 47" companies can remain in business and shed only a limited number of employees to offset carbon tax costs. However, based on the author's "bankruptcy" tests, 11 companies in the "Top 47" sample would no longer remain financially viable and if these suffered bankruptcy (which was considered likely), a *total of 276,007 jobs would be lost in the "Top 47" sample, representing 25% of the workforce of those companies*.

The 11 likely bankruptcy candidates are shown highlighted in Table 7 and are mainly in construction, gold and platinum mining, healthcare and certain manufacturing sectors such as steel (Arcellor Mittal) and pulp and paper (Sappi).

On an extrapolated basis, the *entire SA industrial sector would face 406,620 job losses through cost cutting alone assuming no companies go bankrupt*. However, once likely bankruptcies are considered, a very significant 1.68m jobs would be lost. On this extrapolated basis, the number of *job losses from cost cutting is 3.1% of the total South African workforce as at Q4 2010, while the latter, incorporating bankruptcies, is 12.6%.*

As discussed in the financial "at risk" analysis, the smaller companies to which the extrapolation applies generally have lower levels of profitability than the "Top 47" companies (6% percent profit margin rather than 16% for the "Top 47") and therefore it is reasonable to assume that an even greater number of job losses could occur than is estimated by the simple extrapolation performed in this analysis.

7.2.5 Comparison with the Macro-Economic Models

It is useful to compare the salient results of the author's "bottom up" research to the three macro-economic studies that were evaluated in Chapter 4 with respect to employment losses arising from the carbon tax and GDP impact.

In this regard it must be noted that the author's analysis identified the *total company revenue* of the "Top 47" companies and the extrapolation universe in his work. It is important to recognize that company revenue and GDP are not identical, the latter being the aggregate of "value added" by companies or company revenues minus purchases (otherwise known as "gross profit"). The "Top 47" analysis work performed in this research did not extract "value added" information for the "Top 47" companies and therefore the precise GDP impact for these companies is not known. As a proxy, the average GDP:revenue ratio from the

StatsSA data for all South African industrial sector companies in 2010 of 39%[11] was used to convert the accurate revenue information from the "Top 47" analysis to a rough GDP equivalent.

Table 11 shows the GDP and employment impacts of the carbon tax from the Eskom Elasticity study, the LTMS modelling work and the World Bank study, compared with the author's research.

Table 11: Results of "Top 47" Bottom Up Analysis Compared to Three Macro Study Results

	GDP Impact	Employment Impact
Applied Eskom elasticity study (chapter 4.2) – electricity price increase only	1.38% decrease	45,772 lost jobs
LTMS study (chapter 4.3) – assumes the positive benefits of "tax recycling"	0.92% decrease 2% decrease by 2015	185,000 to 400,000 lost jobs
World Bank study (chapter 4.4)	1%-16% decrease in semi-skilled and unskilled employment	
Author's research impact of carbon tax - Top 47 industrial company impact only from cost cutting and bankruptcies	R90 billion or 3.4% decrease in GDP	66,833 to 276,007 lost jobs (0.5%-2.1% of total SA workforce)
Author's research – extrapolated impact to all SA industrial companies from cost cutting and bankruptcies	R188 billion or 7.1% decrease in GDP	0.41m to 1.68m lost jobs (3.1%-12.6% of total SA workforce)

Table 11 shows that the author's "bottom up" research forecasts far more dire consequences to the South African industrial sector than the economic analysis consulted by policymakers. The exception is the World Bank study that indicates job losses potentially in the same range as the author's research but, as discussed in chapter 4.4, the Treasury in its discussion paper omitted this World Bank data.

[11] Obtained from the StatsSA 2010 "Annual Financial Statistics Survey" by calculating GDP contribution (assumed as "revenue" minus "purchases") and dividing this calculated GDP contribution by revenue. The weighted average for SIC codes 2,3,5,6,7 being the "industrial" sector to which this analysis applies was 39%.

Some consideration is useful on the discrepancies between the author's results on the one hand and the Eskom Elasticity Study and the LTMS Modelling on the other hand:

It has already been discussed in chapter 4.2 that the Eskom Elasticity Study is only designed to calculate the implications of electricity price increases on the economy, and therefore *does not analyse the impact of a carbon tax on scope 1 emissions by industrial companies*. As such, it is not able to determine the full implications of the carbon tax proposals by the Treasury. Also importantly, the Eskom model is unlikely to apply in a linear manner to large electricity increases such as the 34% tariff increase expected to arise from the carbon tax proposals and therefore the GDP and employment impacts are likely to be understated in the manner the author has applied in the Eskom study in chapter 4.2.

The LTMS study suffers from the flaws described in chapter 4.3 in that it assumes positive "tax recycling" effects which the Treasury does not plan to fully apply in its proposals, and it seems to underestimate the impact of the carbon tax on electricity prices. However, the LTMS estimate of 185,000-400,000 job losses without "tax recycling" (refer to chapter 4.3) as shown in Table 11 is somewhat in line with the lower end range of the author's research.

7.2.6 Qualitatively Assessing the Employment Implication Results

Clearly the results regarding possible job losses from the carbon tax are substantial, and may even be considered inflammatory in relation to the public debate in relation to the proposed carbon tax. In the context of the South African Government's plan to create 5 million new jobs and reduce unemployment from its astronomical 25% rate, the risk of 1.7m jobs being lost as a result of the carbon tax would certainly focus the minds on the trade-off that is being made against socio-economic development objectives.

Different levels of confidence apply to each of the four “job loss” estimates calculated by the author’s analysis, arising from the methodologies and assumptions the author has used in this analysis. The following evaluation of each of the four different job loss estimates is provided together with some qualitative considerations that should be considered in interpreting the results.

1. *The “Top 47” companies experience 66,833 job losses assuming no bankruptcies.* This analysis is based on accurate CO2e emissions and financial information for the sampled companies, which provides confidence. The most contentious assumption made is that the entire quantum of the carbon tax will be recovered by staff retrenchments, which assumes that companies cannot stabilize their profits through cost cutting in other areas, cannot raise their revenues, and will not tolerate lower levels of profitability. In reality, some of these other mitigating actions may well be taken by companies to offset the carbon tax burden (and thereby reduce the need for job losses). On the other hand, other factors may increase the quantum of job losses and qualitatively this provides a counter-weight to the potential criticism mentioned above:

    a. Firstly, only fulltime jobs have been considered in the author’s “Top 47” analysis and most companies have part time workers and a significant number of personnel employed as contractors. The extent of job losses of these part time workers and contractors has not been calculated and would increase the total.

    b. Secondly, a typical pyramid exists in the employment structure of all companies where a large number of lower skilled employees earn lower salary and wages, but make up a large portion of overall staff costs due to their numbers, while fewer highly skilled employees earn substantially more. As the work described in chapter 2.4.4 of the literature review pointed out (Devarajan et al, 2009), lower skilled workers are likely to suffer job losses more than higher skilled workers as a result of the carbon tax. Again, the analysis has not quantified this factor, which would in reality see a higher numbers of employees being retrenched that has been calculated.

2. *The "Top 47" companies experience 276,007 job losses assuming bankruptcies do occur if the two "stress tests" in chapter 6.3.3 are failed – ROE falls below 5% and profits fall below debt servicing requirements.* In some ways, the total 225,687 job losses from the bankruptcies of 11 companies in the 47 company sample are more defendable to the criticisms that may levelled against the calculation in point 1 above, since there is no doubt that staff loose their jobs if a company goes bankrupt. Critics may argue that companies will not go bankrupt after a single "bad year", but this is not a strong argument as the carbon tax is expected to be a permanent feature of the South African environment and the Treasury is steadily expected to increase its level over time. The issue then will be whether companies can reduce GHG emissions cost effectively to offset ever-rising carbon taxes. The calculation of the carbon tax for the 47 companies their applicable financial information are accurate for 2010 and provide a great deal of confidence to the results.

3. *The full extrapolated universe of SA industrial companies experience 406,620 job losses assuming no bankruptcies.* The following qualitative factors should be noted in regard to these results:

    a. A criticism of these results may arise from the inherent assumptions that exist when an extrapolation is performed – the assumption that the sample of 47 companies has identical characteristics to the entire universe of industrial companies. For example, it may be questioned whether the rate of CO2e emissions (that is known precisely for the 47 company sample) is the same for the remainder of the industrial sector (which is unknown but assumed to be the same in the extrapolation exercise). The author concedes that this uncertainty exists and that the concern is valid, but this uncertainty does not mean the results would be higher or lower.

b. It has already been mentioned that the broader SA industrial sector has inferior profitability and higher relative staff levels than the "Top 47" companies. As such, the simple extrapolation performed has likely been generous as the smaller companies in the extrapolation universe have fewer profits to absorb the carbon tax burden, and when they do shed jobs, these are likely to be greater in magnitude since these companies employ more people per unit of revenue and production than the larger companies.

4. *The full extrapolated universe of SA industrial companies experience 1.68 million job losses assuming bankruptcies do occur.* Again, the same concern as discussed in point 3 regarding extrapolation exists with this data, but also, because of the weaker financial condition of the smaller companies in the extrapolation universe relative to the "Top 47" and the higher labour intensity of these companies, not only are job cuts expected to be more severe than the simple extrapolation in the research calculates, but more companies are likely to face bankruptcy due to this weaker financial position and poorer access to debt and equity resources compared with large listed companies. So, in reality, the job losses could be expected to be greater than has been calculated.

7.2.7 Headline Results Summary

In short, the author believes that a fair deal of confidence can be placed on the results of the "Top 47" industrial company analysis and that it provides a useful indication of the GDP and employment consequences of the Treasury's proposed carbon tax. Certainly it is acknowledged that certain limitations exist that weaken the analysis, but chapter 7.2.6 has identified a number of qualitative factors that could in fact indicate an even more negative impact from the carbon tax.

As such, the author summarises the following "headline results" of this analysis as reasonably robust and worthy of consideration in the national debate about a carbon tax for South Africa:

- For the “Top 47” industrial sector companies, the burden of an R25m carbon tax in 2010 terms would likely result in a range of 66,000 to 275,000 job losses, and likely cause 11 significant company bankruptcies.

- For the entire South African industrial company sector, the total projected carbon tax of R53bn could result in job losses in the order of 0.4 million to 1.7 million.

- The carbon tax would place the financial sustainability of many South African companies “at risk” due to its added cost burden for companies. In the “Top 47” sample, 30 companies would be placed “at risk” representing R919bn of invested equity capital and employing 0.67m staff. In the entire SA industrial sector, companies employing 4.1m staff could be financially at risk. In short, companies employing between 0.67m and 4.1m staff would be financially “at risk” as a result of the carbon tax proposals.

- The carbon tax would reduce GDP by between 3.4% and 7.1%.

8. CONCLUSIONS

This research report has examined South Africa's policy on climate change and its proposed carbon tax both from a conceptual point of view and from the perspective of the implications on socio-economic development. Available economic studies identified in the literature review were applied to the carbon tax proposals and original "bottom up" research was performed for industrial sector companies to understand the implications of a carbon tax on employment and financial sustainability.

8.1 Critique of the Treasury Carbon Tax Proposals

This first part of the conclusions summarises several salient issues identified in the author's research as a critique of South Africa's climate change policies and the proposed carbon tax.

South Africa is Surpassing Its Developing Country Peers

South Africa's UNFCCC commitments of 34% GHG emission reduction by 2020 and 42% by 2025 are "out of step" with similar developing countries and far more in line with the initiatives of European countries that have lesser socio-economic development challenges than South Africa does.

South Africa's UNFCCC commitments also significantly exceed the possible reductions that the government's primary research initiative on climate change, the LTMS, had identified and quantified based on known technology to reduce emissions to its suggested target of 600mtpa by 2050.

The LTMS proposals advocate introducing a carbon tax to achieve a significant reduction of GHG emissions in South Africa, but the LTMS modelling work shows that doing so would have negative implications on South Africa's economic growth

– a reduction of 0.92% of GDP would arise as a result of introducing a carbon tax at levels similar to the Treasury's proposals (refer to chapter 2.4.2).

For most developing countries it appears that national objectives such as employment creation, increase in welfare through increased incomes and general socio-economic development are more important than climate change-related objectives. Larger developing countries such as China, India, Brazil and Russia have not been willing to make significant climate change commitments or introduce major policy measures that would hamper economic development as "first priority" objectives.

The Carbon Tax is an Unnecessary Sacrifice of Economic Growth Objectives

By contrast, South Africa seems willing to "trade off" socio-economic development objectives to achieve climate change objectives.

The LTMS identifies a number of policy actions that can be taken to reduce GHG emissions without negative cost to the South African economy. In its "Start Now" LTMS strategy option, LTMS identifies a set of initiatives that will reduce GHG emissions by 231Mt with a positive increase in GDP of 0.48%. If South Africa can make a positive contribution towards global climate change initiatives and can achieve a level of GHG reductions without harming (in fact bolstering) its socio-economic development objectives, this fundamentally questions the necessity for a carbon tax to be imposed, at least until those initial actions have been taken.

The fundamental assumption made by policymakers who seek to introduce carbon taxes or similar schemes that the private sector will not take positive initiative towards GHG emission reduction unless taxes exist to "pressurize" them towards action is not correct. The participation by many South African companies in the voluntary international Carbon Disclosure Project is an example of private sector-led initiative to reduce GHG emissions.

Also, a strong financial incentive already exists for South African companies to reduce GHG emissions – since they are able participate in global schemes through the Kyoto Protocol's CDM mechanism to obtain financial credits for GHG emission reduction schemes in South Africa. If a local company participates in the EUETS scheme, for example, effectively European producers and consumers bear the cost of GHG emission reduction projects in South Africa. While Chinese companies are taking full advantage of the international CDM opportunity, South Africa has only a few projects active in this regard and more can be done.

To avoid making a choice between environmental objectives and negative economic consequences, the South African government could introduce policy actions to co-ordinate, facilitate and catalyse South African companies to participate in international CDM schemes, and pursue other actions identified in the LTMS "Start Now" strategy rather than introducing an economically punitive carbon tax.

Lack of Analysis on Negative Economic Consequences

The author's work seeks to demonstrate that the Treasury discussion document does not present stakeholders and policymakers with adequate information on the negative economic consequences of the proposed carbon tax.

Although the LTMS study shows that there will be negative economic consequences from introducing a carbon tax – a reduction of 0.92% of GDP – the LTMS modelling is subject to two major flaws in assumptions. Firstly the LTMS incorporates overly optimistic assumptions about the degree to which energy costs would increase from a carbon tax – it assumes only a 4.28% increase in energy costs from a carbon tax (refer to Table 1 in chapter 2.4.3) whereas the author estimates a 34% increase in electricity prices alone as a result of the carbon tax (refer to chapter 4.1). Secondly, the LTMS assumes productive "tax recycling" which the Treasury's proposals do not incorporate.

If one "digs down" into the LTMS modelling and studies, the scenario where "tax recycling" is not incorporated forecasts job losses of 185,000 and 400,000, but this statistic is not provided as a clear headline result in the main LTMS reports nor is it cited in the Treasury discussion document.

Another significant concern is that the recent study most applicable to the Treasury's carbon tax proposals, the World Bank Study (Devarajan, 2009) has been downplayed in the Treasury discussion document and one of its most pertinent findings was not mentioned by in the Treasury discussion paper – that up to 16% employment of lower skilled workers could result as a result of the carbon tax.

As Table 11 in chapter 7.2.5 shows, the author's "bottom up" company-level research shows more dramatic consequences from the carbon tax on GDP growth and employment than the existing economic modelling work that has been performed in South Africa to assess the implications of a carbon tax.

The concern therefore exists that South African policymakers and the Treasury have not adequately assessed, or are under-estimating, the economic impact of introducing a carbon tax.

Potentially Severe Consequences

The key findings of the author's work show potentially severe consequences for the South Africa companies. Reduction to GDP arising from the carbon tax could be between 3.4% and 7.1% and companies employing between 0.67m and 4.1m staff would be financially "at risk" as a result of the carbon tax proposals.

For the "Top 47" industrial sector companies, the burden of a R25bn carbon tax in 2010 terms would likely result in a range of 66,000 to 275,000 job losses, and potentially 11 significant company bankruptcies. For the entire South African industrial company sector, the total projected carbon tax of R53bn could result in job losses in the order of 0.4 million to 1.7 million.

While the author's work may be subject to criticism, it is submitted to be relatively robust taking into account the limitations that have been qualitatively addressed in chapter 7.2.6.

In any event, the author does not to claim to present a completely correct economic model. Instead his purpose was to indicate that in a matter of great national importance, much more analysis and attention is required before South African policymakers proceed with a carbon tax.

8.2 **Recommended South African Approach**

The author submits that only one reasonable course of action exists in response to the logic presented in this report and that is summarized in chapter 8.1. *South Africa should "pause" its plans to implement a carbon tax* until the economic consequences of such a tax – and particularly its implications on employment – have been more thoroughly analysed and communicated to policymakers and stakeholders.

If policymakers, stakeholders and the general public properly understand the economic realities of a carbon tax, it is very likely that its implementation will be deferred until South Africa achieves a higher level of economic development. Or if a carbon tax is nonetheless to be introduced, at least a properly informed trade off can be made, recognizing the cost to achieve environmental objectives at the detriment to our economy and social welfare.

The additional time taken to understand economic consequences can be used productively to improve the design of carbon pricing that may eventually be introduced in South Africa – as Australia has shown, there are great benefits to being a "last mover" in these matters and to adopting the experience of other countries.

This does not mean that South Africa needs to be passive in global climate change initiatives. Many positive actions can immediately be taken to reduce GHG emissions without sacrificing economic growth – the “Start Now” bundle of actions identified by the LTMS can be initiated as a strong positive step.

Also, if South Africa is completely “inactive”, there may be negative consequences in trade actions taken by countries that do adopt carbon taxes. In this regard, it will remain important that South Africa keeps “in step” with its peers, being other leading developing countries such as China, India and Brazil.

Private sector companies should be encouraged and supported in participating in schemes such as the EUETS and to obtain Kyoto CDM credits. This will further reduce South African GHG emissions without cost to our economy.

And a degree of faith can be put in the private sector to reduce GHG emissions without government intervention, a faith that is not totally misplaced as this research report shows.

“Signalling” actions by government that carbon pricing schemes will be introduced at some stage in the future (perhaps once certain socio-economic goals have been achieved) will place a suitable amount of “constructive pressure” on private sector companies to begin implementing more energy efficient and less CO2e-heavy processes.

9. RECOMMENDATIONS FOR FURTHER WORK

The most obvious recommendation that flows from this research is to perform further modelling work to improve the level of accuracy and detail of the current analysis presented in this report, particularly to address the limitations of the research outlined in chapter 6.4.

The goal of such work would not only be to provide a greater degree of confidence in estimating economic implications of a carbon tax but, equally or more importantly, it would help to understand the manner in which such a tax affects companies and how they are expected to respond to carbon pricing.

A more detailed and complex research initiative would, for example, include analysis to:

- Extend the model to assess the impact of the carbon tax over multiple periods rather than the single 2010 snapshot performed here, since the reaction of companies will be over multiple periods;
- Create a modelling tool that assesses the degree to which companies may adopt alternative approaches to compensating for the carbon tax such as:
    a. raising prices to customers – this will require an "elasticity" study for each industry in which companies operate,
    b. the extent to which costs other than staff costs can be reduced,
    c. the extent to which companies may implement measures to reduce CO_2e emissions and the cost and timing thereof, and
    d. the degree to which companies can bear lower levels of profitability;
- Improve the manner in which the model extrapolates detailed company results to the entire universe of SA industrial companies. Ideally this should include a broader data gathering exercise of more industrial sector companies together with data on their CO_2e emissions.

Another area recommended for further work (and which is of particular interest to the author) is to research the impact of carbon pricing on the utilization of primary energy fuels (such as coal) and secondary energy sources (such as electricity). It would be very useful to understand the level of carbon taxation at which least cost electric power generation alternatives (assumed to be coal-fired power generation) are supplanted by more expensive alternatives, and to assess the economic consequences of this “energy switching”.

One hypothesis that the author would seek to examine in future research work is that the introduction of carbon taxes at a sufficiently high level would cause coal-fired power generation to be less economic than nuclear power generation for baseload power stations, and that as a result, the rich endowment of South Africa’s “next generation” Waterberg coalfield could be sterilized by such taxes. The Waterberg coalfield, a significant national asset with huge untapped coal resources, contains a rich endowment of export grade metallurgical and thermal coals that depend on nearby power generation utilizing lower quality coals to justify and support the economics of new mines and the associated water and rail infrastructure.

10. GLOSSARY OF ABBREVIATIONS

bn	Billion
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CERs	Certified Emission Reduction Credits
CO2e	Carbon Dioxide Equivalent
DEAT	South African Department of Environmental Affairs and Tourism
DER	South African Department of Energy Resources
ETS	Emissions Trading Scheme
EUETS	European Union Emissions Trading Scheme
GHG	Greenhouse Gases
IPCC	United Nations Intergovernmental Panel on Climate Change
LTMS	Long Term Mitigation Scenarios prepared by DEAT, 2007
m	Million
Mt	Million tonnes
mtpa	Million Tonnes Per Annum
ROE	Return on Invested Equity Capital
Treasury	South African Department of the National Treasury
UNFCCC	United Nations Framework Convention on Climate Change

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