COMBATING CLIMATE CHANGE:
How might "green" growth facilitate or hinder SA's developmental objectives?

One of a series of three expert papers on aspects of climate change and economic development commissioned by the Centre for Development and Enterprise

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Climate Change Mitigation: An emerging market perspective

CDE Series Introduction

The South African government has voiced a clear commitment to mitigating the impact of climate change by reducing green house gas emissions and facilitating the development of low-carbon growth. In 2009, President Zuma outlined an ambitious trajectory for emissions reductions, subject to international financial assistance. Ahead of last year's COP17 in Durban, cabinet approved the National Climate Change Response White Paper, which includes a proposal for a carbon tax that could come into effect as early as the next financial year. Government has already begun to invest heavily in renewable energy, and the recently-released National Development Plan envisions the 'transition to an environmentally sustainable, climate-change resilient, low-carbon economy' to be well underway by 2030.

By international standards, these are relatively ambitious commitments to fighting climate change. But, as a developing country with high levels of poverty and perhaps the world's most serious crisis of unemployment, South Africa needs its economy to grow as rapidly as possible. In light of this, it is necessary to consider whether our economic development goals are compatible with our climate change commitments. Is it possible for South Africa to meet the potentially contradictory goals of promoting industrial development and employing millions of people while at the same time committing to the reduction of carbon emissions? Do we have the necessary policies in place to facilitate this and are they aligned with each other? What other countries can we look to as models for aligning these two agendas? What potential is there for low-carbon growth in South Africa?

With support from the Friedrich Naumann Foundation, CDE has commissioned four papers from international and local experts to address some of these questions. These papers are intended to promote a more informed debate regarding the interaction of our climate change mitigation strategies and our developmental challenges. The views presented in these papers are those of the authors and do not necessarily agree with those of CDE or the Friedrich Naumann Foundation.

- Paper one: *Future Trajectories of Climate Change Negotiations* by Oxford University's Smith School of Enterprise and the Environment.

  This paper describes United Nations Convention on Climate Change (UNFCCC) negotiations to date and presents possible scenarios for future global or bilateral agreements. Although South Africa's emissions are high relative to our GDP, we contribute less than 2 per cent of global emissions. It is necessary, therefore, to consider our position within global negotiations and how decisions taken by other countries and in global forums might impact our development goals. This paper situates South Africa within the complex terrain of global mitigation agreements and considers which possible scenarios would be in our best interest.

- Paper two: *The Response of China, India and Brazil to Climate Change*, also written by the Smith School.

  This paper addresses the approaches of other emerging economies toward climate change mitigation and adaptation. With South Africa, these countries make up the BASIC negotiating group in the UNFCCC and share similar concerns regarding poverty alleviation and economic growth. The authors describe actions being taken in each of these countries, analyse the strengths and weaknesses of each approach, and suggest lessons South Africa can learn from their experiences.

- Paper three: *Growing a Green Economy* authors Dr Nick Segal and Brent Cloete

  This paper examines the rationale and potential consequences of 'greening' the South African economy in line with the government's climate change mitigation goals. This think piece reviews the alignment of the country's economic development and climate change objectives, and consider to what extent green growth is feasible in South Africa. The authors assess the trade-offs and economic costs of mitigation, as well as the coherence of policies governing the transition to a green economy.

- Paper four: provisionally titled *South Africa's Energy Needs* by Dr Emily Tyler.

  This paper assesses policies that impact on energy planning and carbon emissions in South Africa. Dr Tyler highlights the convergences and inconsistencies in these policies, as well as their costs and consequences. The paper profiles the country's energy supply and consider the feasibility of lowering its carbon intensity. It examines how the government's energy plans might affect energy-intensive sectors of the economy, such as mining and minerals, and, in turn, economic growth.

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Executive Summary

This report considers the relevance of the 'green economy' to South Africa, a country with huge challenges of slow growth, along with high unemployment, poverty and inequality. Its purpose is to illuminate the complexities of seeking to keep in balance, on the one hand, the social and economic aspirations of an emerging nation in political transition with, on the other, the need for sustained health of the natural environment, all within the context of a turbulent global political economy.

What is a green economy?

In the broadest sense the concept of the green economy is simple. It speaks to the notion of an economy that is in tune with its natural environment so that, subject to inevitable long- and short-term influences, it remains ecologically healthy. In practice, however, the concept has become complicated. This is partly because it is used liberally and interchangeably with the related but strictly different terms of sustainable development, climate change, global warming and low-carbon economy. One of the consequences of this confusion is a shift in focus from the holistic parameters of "greenness" to the contemporary emphasis on greenhouse gas (GHG) emissions: ecological health is now invariably equated with a low-carbon economy. While acknowledging the desirability of a broader focus , this paper focuses on the "low-carbon economy" element of a "green economy", and eschews consideration of all the other factors that determine overall ecological health.

The green economy and sustainable development

Climate change has long been regarded as a sustainable development issue. It impacts on all three pillars of sustainable development: environmental, economic and social. The health of socio-economic systems depends on a balance between these three pillars. The environmental impact of climate change could potentially lead to the health of any one of the other two pillars falling below a sustainable level, which causes the whole system to break down. But if one of the other two pillars becomes unsustainable, the system also breaks down – rendering futile the environmental benefits of reduced climate change.

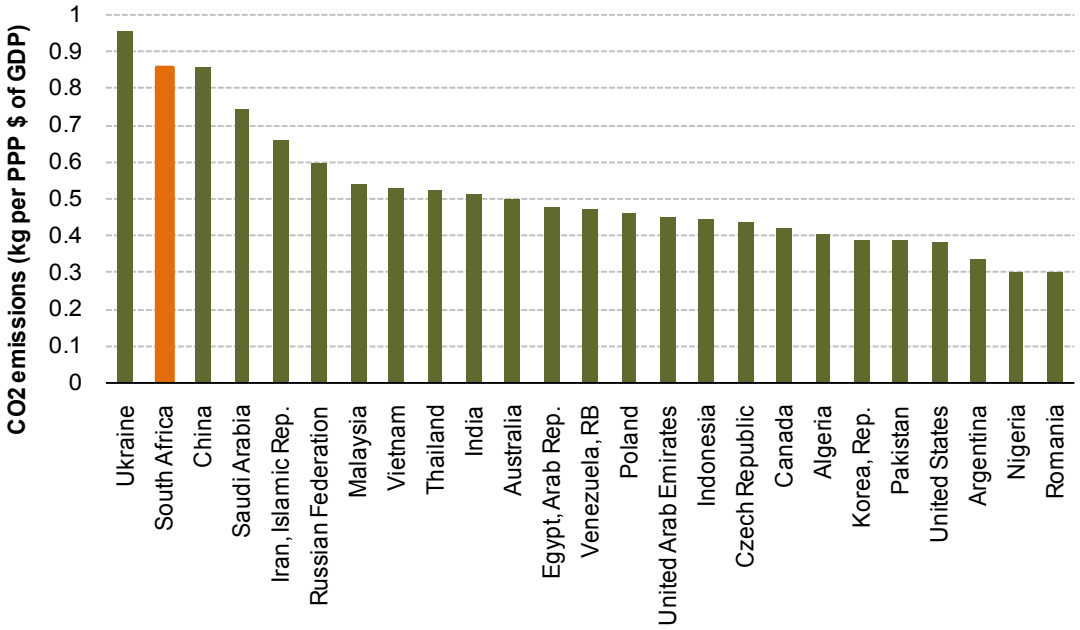
The interconnectedness between the transition to a green economy and South Africa's economic and social policy objectives is well understood by policymakers, if not always clearly reflected in their terminology. What needs to be more clearly communicated is that the 'green' economy in South Africa is framed as an economy that meets sustainable development criteria. Its greenness is not derived from the potential environmental benefits of mitigation actions, but rather from the desire to prevent climate change from reducing the flow of ecosystem services to a level that jeopardises sustainable development. This definition implies a direct focus on the economic and social pillars of sustainable development.

Rationale for moving to a green economy

The economics of policies to deal with global warming are inevitably complex. There is the profound difficulty associated with the judgment as to how much to spend in the short term on mitigating actions in order, with some uncertainty, to benefit future generations. Views on this issue vary significantly. There are those who advocate high expenditures immediately to cut emissions. At the other extreme, there are those who assert that more information is needed before mitigating actions are warranted and hence that the only expenditures that can be justified are on R&D relating to both the science and development of mitigation technology and more detailed evaluations of policy options. The current mainstream view, however, is that immediate mitigation action is warranted; but disagreements persist about the scale or intensity of this action.

South Africa has a highly carbon-intensive economy because of its dependence on coal as a primary fuel. South Africa's GHG emissions increased by around 26% between 1990 and 2005. Indeed, the country is proportionately one of the highest emitters of GHGs in the world, especially when only CO_2 is considered (see diagram below). However, in 2005 it accounted for just over 1% of global GHG emissions (but 40% of Sub-Saharan Africa's emissions).

Figure 1: Carbon-intensity of major economies (GDP at PPP >$200bn in 2008)



Source: WDI (2012)

There are four principal reasons for South Africa's stated intention to move to a green economy:

- reducing GHG emissions to reduce the expected, adverse impacts of climate change nationally, which are many, diverse and sometimes localised. A transition to a green economy, which will require a number of mitigation actions, will signal to the international community that South Africa takes climate change seriously. Hopefully this will encourage other countries to do the same

- international diplomacy. South Africa has been punching above its weight in climate change negotiations, and all the signs are that the country wishes to continue to play a prominent role in driving international efforts to negotiate a cooperative approach to reduce future climate change

- ensuring the economy remains competitive in a future carbon-constrained world, through reducing carbon-intensity and implementing policy actions to reduce South Africa's vulnerability to international trade and other regulations that seek to reduce emissions

- promoting industrial development and employment creation through investment in new, green industries. Despite the intuitive appeal of these proposals, the local studies on which they are based are seriously flawed: they do not take into account the impact of growth in the green sectors (or the impact of policies to support growth in these sectors) on the rest of the economy, and scant attention is paid to the conditions that need to be put in place for the green sectors to thrive, especially bearing in mind that South Africa is by no means the only country to harbour green growth ambitions.

The carbon-intensive nature of the South African economy, while increasing the need to transition to low-carbon economic activities as a risk reduction measure, also means that such a transition will be a mammoth task. The transition may include a number of opportunities in areas like facilitating a structural change towards higher value and knowledge-based economic activities and non-traditional tradable goods and services that can diversify exports, and could even possibly support labour-intensive and broad-based industrialisation . In addition, carbon pricing may lead to increased competitiveness as firms are forced to audit their production processes for unexploited efficiencies to offset carbon costs . However, these effects may be insufficient to compensate for a potential loss of competitiveness in the short to medium term by emissions-intensive South African sectors relative to competitors in countries with less strict carbon policies or more carbon-efficient production processes.

Impact of "greening" the South African economy

The expected impact of climate change mitigation actions on an economy depends on numerous factors: the estimation of baseline GHG emissions, the objectives of mitigation policy (targets and time-frames), the degree of flexibility allowed, the substitution possibilities open to producers and consumers to reduce emissions, the expected rate of technological change, whether the value of co-benefits from mitigation action is included (eg reductions in air pollution), and the discount rate used.

However, taking all of these factors into account, there has been a degree of consistency in the results of studies on the possible impacts of mitigation measures on the South African economy. In general, the aggregate impacts (whether positive or negative) have been found to be small, with a high dependency on the way the mitigation actions are implemented (and in particular how revenues from carbon taxes are used, or whether other supporting measures are in place to reduce the impact of mitigation actions).

There is a dearth of information locally on current emissions, and the cost, risks and commercial viability of mitigation options, at a sector (and particularly sub-sector) level. This inevitably casts doubts on the robustness of local modeling results. Nonetheless, the local findings are consistent with the results of international studies. The latter typically find that while there is an economic cost to reducing GHG emissions, this cost can be reduced by using efficient policy instruments (like broad-based carbon taxes rather than highly specific energy taxes), and by recycling revenue to reduce the impact of existing taxes.

All the modeling work done to date suggests that the cost of climate change mitigation will be modest and therefore manageable. Intuitively, this is surprising. After all, the immediate effect of mitigation measures is to impose additional costs on enterprises which, in the absence of compensating actions, will reduce their competitiveness. Clearly what will matter is precisely what the mitigation measures are and also how they are applied. For instance, the imposition of a carbon tax, accompanied by a reduction in other taxes so that the tax burden on firms is not increased, should have no impact on firms' competitiveness and is likely to increase the effectiveness of the economy as a whole.

A caveat to these modeling exercises is the lack of detailed information on the availability and attractiveness of mitigation options at a sectoral level. Further, all the exercises are based on circumstances that predate the sharp rise in electricity prices experienced since 2008. There is thus a possibility that many of the low-cost energy mitigation options available in the economy already have been implemented, thereby raising the average cost (and by extension the impact) of mitigation activities.

The compatibility of the 'green economy' with other policy objectives

From a theoretical perspective, climate change mitigation is not incompatible with South Africa's existing socio-economic goals. Indeed, government believes that mitigation actions can directly benefit the other two pillars.

Firstly, the poor is the population group most at risk to climate change, so mitigation actions support socio-economic goals in the long term.

Secondly, mitigation measures will increase the competitiveness of the South African economy in a carbon-constrained future, and in the medium term present a way of avoiding trade measures linked to GHG emissions that may disadvantage local exports. At present the risk of this seems low, since only the EU amongst South Africa's trading partners has broad-based carbon prices in place. This may change before the end of the decade since the parties to the UNFCCC have agreed to a global agreement to mitigate climate change by 2015 and to be in force by 2020. Further, given the emissions-intensity of South Arica's economy, in the absence of a local carbon price, it will probably take decades to reduce the emissions-intensity of exports to a level where GHG-linked trade measures are no longer a threat.

Thirdly, government is placing emphasis on the potential for co-benefits (in particular 'green' jobs) linked to mitigation actions. Whether this emphasis is justified, however, is doubtful.

Additionally, many of the actions required for an efficient transition to a green economy, notably increasing the flexibility of the South African labour market, or increasing the local skill base, will also have a directly positive impact on other local policy objectives.

In practice, however, the impact of climate change mitigation implemented as part of a transition to a green economy is less clear.

South Africa faces formidable socio-economic challenges, and its record in addressing them is far from satisfactory. The addition of a "green" objective, with all its attendant complexities, materially increases the difficulties of socio-economic and other policy formulation. It also, because of the many different government departments and other interests involved, makes policy implementation far more difficult.

The lack of a framework for explicitly identifying and addressing policy trade-offs could lead to an increase in misalignment between environmental, economic and energy policies. Indeed, the pointers are that energy, industrial and mitigation policies will not be well aligned, with the likelihood that only some (or even none) of the respective policy objectives are achieved. And if achieved, the cost may be much higher than would have been the case had policies been designed to work with rather than against one other.

As an additional national policy objective, the transition to a green economy will undoubtedly add to the complexity of policy-making in South Africa. The structures and processes are not yet in place to deal with this enhanced complexity, and the government runs the risk that some existing objectives will be jeopardised by a short-term focus on the transition to a green economy. The National Climate Change Response White Paper, however, calls for the economy-wide impacts of mitigation actions to be considered when policy is developed, reducing this risk.

The real risk inherent in managing the transition to a green economy in the absence of a transparent mechanism for trading-off policy objectives is thus that policymakers are not willing to countenance any trade-offs whatsoever that harm the attainment of existing policy objectives in the short term– even if it becomes apparent that the world is moving to a carbon-constrained economic system. If this is the case, South Africa's economic prospects may be harmed by being stuck with a highly carbon-intensive economic structure.

Conclusion

Given that South Africa's contribution to global emissions is minuscule, the only way South Africa can achieve a material impact globally is for its mitigation actions to serve as an exemplar for encouraging other

countries to do the same. Viewing the cost of local policies as an insurance policy against (or even a lobbying payment to try and incentivise actions that prevent) catastrophic climate change may be useful. As such, it is important to have a clear idea of how much South Africa is prepared to 'spend' in terms of its other policy objectives.

There is no a priori reason why a gradual and well-planned transition to a green economy should have a negative impact on South Africa meeting its other policy objectives. However, in order to make sure this is the case, a better understanding is required of the potential costs and benefits of local mitigation actions at the sector level.

Thinking that the transition will be costless, particularly in the short term, however, seems optimistic. And to ensure that costs, should they materialise, do not have a negative impact on South Africa's development objectives, it is important to put in place a framework for dealing with them. At the very least, there should be a discussion about what costs would be palatable in order to reduce the risk of catastrophic climate change. Or looking at it from a different perspective, what level of cost will be seen as having a detrimental impact on the country's meeting its overall developmental objectives?

1. INTRODUCTION

This report is a think-piece about the concept of the "green economy" and its relevance to a country such as South Africa with its huge challenges of slow growth, unemployment, poverty and inequality. Its purpose is to illuminate the complexities of seeking to keep in balance, on the one hand, the social and economic aspirations of an emerging nation in political transition with, on the other, the need for sustained health of the natural environment, all within the context of a turbulent political economy globally. One particular aspect of the green economy, namely the need to avoid catastrophic climate change, has received particular emphasis and is the focus of this paper.

Given the many demands on its resources and on its generally weak institutions, can South Africa afford to embrace the concepts of the green economy? Equally, can it afford not to?

In order to answer these and related questions, the report sets out briefly the country's socio-economic performance since the transition to democracy nearly 20 years ago, before reviewing the international literature on the (confusingly) interrelated notions of sustainable development, global warming, climate change and the green economy. It then goes on to examine these notions in the South African context, as a platform for addressing directly the fundamental questions raised above.

2. SOUTH AFRICA'S SOCIO-ECONOMIC PERFORMANCE POST-1994

The South African story of the past two decades contains many achievements[?]. Effecting an essentially peaceful political transition to democracy, after centuries of racially based discrimination; maintaining its position as a world technological leader in minerals, power generation, water management and other fields; having first-class capabilities in such critical sectors as financial services, health-care and agriculture; being regarded as one of only a few economic gateways to a fast-growing Africa; being invited to join the developing world's elite club (now) known as BRICS; punching above its weight in global political circles and in some sporting and cultural arenas; having three of its citizens being awarded the Nobel Peace Prize; these are but some of the areas in which the country stands distinctive over the past two decades or so.

Over the same period, however, its record – even if considerably improved relative to the previous 20 years - is marred by economic under-achievement. By international standards the growth rate has been sluggish with effective average per capita income growth only 1.6% per annum over the 20 years between 1990 and 2010 compared with a growth rate of 4.5% and 9.2% in India and China respectively (PWT, 2011). The country has slipped progressively down the competitiveness rankings in the reports of the World Economic Forum: from 32 in 2000 (World Economic Forum, 2001:2) to 54 in 2011 (World Economic Forum 2012:1). It has one of the of the world's highest Gini coefficients (0.63 in 2009) (World Bank, 2012), which may well be worsening; an exceptionally and persistently high rate of unemployment (between 26% and 38%, depending on the metric used) (Statistics South Africa 2011:6), with some 51% of youth between the ages of 15 and 24 (Jones, 2011) being unemployed; a schooling performance that in some respects is shocking (in the latest WEF report, South Africa came 138th out of 142 countries in mathematics and science achievement at secondary level) (World Economic Forum 2012:445); and so on.

The ANC-led government has embarked on a number of strategies to improve the growth rate and to accelerate the pace of socio-economic development. The first was the Reconstruction & Development Programme (RDP) of 1994 which, within an orthodox macroeconomic framework, was essentially a wish-list for improvements in employment creation, housing, health, education, electricity and water distribution and other key social sectors. The RDP was supplemented in 1996 by GEAR (Growth, Employment and Redistribution), which confirmed RDP-style policies at the micro level and critically introduced a programme

of macroeconomic stabilisation in order to increase the country's attractiveness to foreign investors as a means of boosting the growth rate and employment generation. While the RDP was never formally abandoned, it was also never really implemented as an integrated package. By contrast, at the macro level, GEAR was well implemented (although it never achieved its growth and job targets).

In 2006, in a renewed attempt to stimulate the economy the government launched AsgiSA (Accelerated and Shared Growth Initiative South Africa). In addition to a special effort to address the chronic skills shortage, this programme focused on a number of economic sectors because of their evident potential for inter alia growth, exports and jobs.

The change of administration in 2009 ushered in yet another approach to economic and social policy. The Department of Trade & Industry formulated an Industrial Programme and Action Plan (IPAP, now in its third version, dated 2012), which to some extent builds on AsgiSA's selected sectors. The new Economic Development Department published in 2011 an economic strategy entitled The New Growth Path, with ambitious targets for employment-intensive growth. The National Development Plan, published in 2011 by the new National Planning Commission (a strategic advisory body housed in the Presidency), is based on a refreshingly frank diagnosis of the country's problems and contains by far the most comprehensive, rigorous and (in most respects) realistic vision and plans for the future.

The foregoing paragraphs lead to two important observations. First, despite the various major attempts to put in place strategies and policies significantly to advance socio-economic development, the achievements so far are modest. Second, the current planning and policy scene is complex and confusing, given the co-existence of three substantive documents emanating from three separate departments and each separately endorsed by the Cabinet.

The scene is further complicated by the plethora of policies, regulations and new institutions that govern the political economy. A distinctively South African theme runs through these: the desire to hasten the pace of racial transformation across the whole society but especially in the economic domain. Measures to promote affirmative action in employment and notably Black ownership of businesses, to stimulate procurement from Black-owned businesses as well as formation of new such enterprises – these are but some of the many thrusts aimed at transforming the economy. In key sectors these obligations on established businesses are captured in a Charter, which sets agreed targets that have been negotiated between government, labour and organised business (and sometimes also "the community").

A further complexity lies in the generally inefficient functioning of not only the transformation-specific institutions but also, with only a few notable exceptions, the principal state departments involved at all three levels of government. This inefficiency comprises administrative malfunctioning and sometimes endemic corruption. It also arises out of severe skills shortages and diminished institutional memory as well as an inadequate appreciation of the notion of trade-offs between policy objectives so that, for instance, environmental or other regulations are imposed without regard to their invariably adverse impacts on other goals.

It is within this somewhat unsatisfactory policy framework that the country's stated intentions of being a leader in the reduction of greenhouse gas (GHG) emissions must be assessed. Admittedly, the country is an unusually heavy emitter, essentially because of its almost total reliance to date on (poor quality) coal for electricity generation. Admittedly, too, the commitments – which are unusually ambitious in that they call for absolute reductions in emissions – are not expressed unconditionally.

But the fact is that South Africa has explicitly admitted into its policy agenda the notion of becoming a green(er) economy. Does it really understand what this entails? Does it understand the limitations of what one middle-sized country can achieve in the absence of concerted action by all other countries? Does it have

the skills and the institutions to accommodate yet more complexity, both intellectual and practical, in policy formation and execution?

These and related questions are at the heart of this report. In order to answer them, we must first review the relevant international literature, which is the subject of the next chapter.

3. WHAT IS A GREEN ECONOMY?

In the broadest sense the concept of the green economy is intuitively simple. It speaks to the notion of an economy that is in tune with its natural environment so that, subject to inevitable long- and short-term influences, it remains ecologically healthy. There are many dimensions to this ecology, revolving around man's ability to manage his use of the "natural capital" of air, land, water and biodiversity in a manner that does not compromise the well-being and the development potential of future generations.

In practice, however, the concept has become complicated. This is partly because in both scholarly and popular literature it is used liberally and interchangeably with the related but strictly different terms of sustainable development, climate change, global warming and low-carbon economy. One of the consequences of this confusion is a shift in focus from the holistic parameters of "green-ness" to the contemporary emphasis on greenhouse gas (GHG) emissions: ecological health is now invariably equated with a low-carbon economy.

Invariably, but also not inappropriately. The scientific evidence is that the excessive presence of CO_2, which indisputably is a cause of ecologically harmful global warming, is cumulative over very long periods and also largely irreversible. By contrast, damage to other ecosystems – river basins, forests, fish stocks and the like – can usually be arrested and turned around. Further, global warming provides a stimulus to climate change and hence potentially to continuing degradation of the physical environment.

The concept has become further complicated by the introduction of the social and even the political dimensions of sustainability. These are entirely legitimate parameters but they are also subjective, fuzzy and not easily measured.

Despite these caveats, this paper focuses exclusively on the need to reduce/mitigate GHG missions, in other words to move to a low-carbon economy. It thus implicitly focuses on the "low-carbon economy" element of a "green economy", and it eschews consideration of all the other factors that determine overall ecological health.

This section commences by defining sustainable development. It then proceeds to consider the role of climate change mitigation within the sustainable development debate. The section concludes by considering what exactly a green economy is, and whether it is justifiable to use the term interchangeably with that of a low-carbon economy.

3.1 Evolution of thinking about sustainable development

Ever since Malthus, economists have believed that environmental factors place a constraint on growth and development. The publication of *Silent Spring*, by Rachel Carson in 1962, however, introduced the concept of sustainable development as we know it today (IISD, 2009). By considering the increasing impact of agricultural pesticide use on animal species and human health, Carson emphasised the interconnectedness between the environment, social well-being and the economy.

There is no single definition of sustainable development.. Nevertheless, the foundation of contemporary thinking is undoubtedly the 1987 Brundtland Report, *Our Common Future*[1], which defined sustainable development as "Development that meets the needs of the present, without compromising the ability of future generations to meet their own needs".

The Report observed that this definition is based on two principles: that of 'needs', particularly those of the world's poor, and that of 'limitations' imposed by technology and social organisation on the environment's ability to meet present and future needs. One consequence of the vague and somewhat idealistic nature of the Brundtland definition is that it has allowed "institutions of government, civil society, business, and industry each to project their interests, hopes and aspirations onto the banner of sustainable development" (Kates et al, 2005: 10)

A distinction has developed over time between 'strong' and 'weak' sustainability. Strong sustainability rests on the assumption that a fixed stock of natural resources (so-called natural capital) is essential to sustain the productive capacity of economies, and cannot be substituted with man-made capital (Perman et al, 1996). The stock of natural capital thus needs to remain constant for development to be sustainable.[2]

The premise of weak sustainability, in contrast, is that man-made capital is largely substitutable for natural capital, such that, as long as future generations 'inherit' a total stock of capital (both natural and man-made), there is no reason they will necessarily be any less well-off than the current generation.

The World Summit on Sustainable Development in Johannesburg in 2002 extended the Brundtland definition to include what are now widely regarded as the three pillars of sustainable development by identifying a "collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development – economic development, social development and environmental protection (UN WSSD, 2002:1). The 2003 World Development Report (World Bank, 2003:37) reinforced these ideas by arguing that societies need to "manage a broad portfolio of assets", embracing not only physical and human capital but also environmental and social assets.

The concept of sustainable development has thus evolved from a focus on maximising development while minimising environmental impact, to a focus on the three pillars of sustainability (or portfolio of supporting assets), each seen as important as the others. From an economic perspective, the three pillars are akin to the classic factors of production: capital, labour and natural resources (including ecosystem services)[3]. If these inputs into the production process are not perfectly substitutable and if any one of them falls below a minimum level, the production opportunities of the economy will be negatively impacted.[4]

Introduction of socio-political and environmental factors into the notion of sustainability points to its being context-specific. It points also to key differences between rich and poor countries. Since developed countries have typically made progress in addressing the most pressing of their economic and social challenges, they tend to place a higher premium on the environmental or ecosystem services pillar of sustainable development. By contrast, the priority in developing countries is still the social and economic pillars.

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[1]Named after the former Norwegian Prime Minister Gro Harlem Brundtland, who chaired the UN World Commission on the Environment and Development.

[2] According to Perman et al (1996), man-made capital includes If physical, human and intellectual capital. World Bank (2003:18) adds social capital to the list of man-made capital. Social capital is defined as "interpersonal net-works and the trust and shared values they generate".

[3] Le Maitre et al (2007:368) define ecosystem services as the "goods and services that ecosystems provide to society". According to the Millennium Ecosystem Assessment (2005:v), ecosystem services include the following four categories of services: pr*ovisioning services* (eg food, water, timber, and fibre); *regulating services* (eg regulating climate, floods, disease, wastes, and water quality) ; cultural services (eg the provision of recreational, aesthetic, and spiritual benefits); and *supporting services* (eg soil formation, photosynthesis, and nutrient cycling).

[4] A decline in the stock of social capital (trust and interpersonal relationships) can have an equally (or even more severe) negative impact on an economy than a reduction in the ecosystem services available to an economy.

The Commission on Growth and Development (2008:65) states that focusing on growth first and ignoring the environment until later is a "costly mistake". The reasons are twofold: not only do pollution and environmental degradation disproportionately affect the poor, but the cumulative pressure placed on the earth's ecology as a result of faster economic growth over the past two centuries may come to threaten continued economic growth. If that were to happen, ecological stress would itself impose equivalent stress on the social and political systems. Further, by focusing on economic growth to the detriment of natural capital/environment, the pursuit of growth has made developing countries more vulnerable to natural disasters (World Bank, 2010).

It can thus be argued that early attention to environmental standards supports equity and growth goals in the long term. This is not to say that in developing countries the environmental pillar necessarily has to be on an equal footing with the other pillars. For, if the greatest short-term risks to non-sustainability lie in dire socio-economic conditions, a greater emphasis of growth and equity would be justified. However, as graphically illustrated by Jared Diamond in his 2005 book *Collapse*, completely ignoring the environmental pillar is likely to lead eventually to a collapse of the socio-economic system.

3.2 The rising significance of climate change

The scientific study of global warming, originally stimulated by the International Geophysical Year (1957-58), predates the concept of sustainable development but is now inextricably intertwined with it. International cooperation around climate change was initiated in 1988 through establishment of the Intergovernmental Panel on Climate Change (IPCC), and in 1992, at the "Earth Summit" conference held in Rio de Janeiro, the UN Framework Convention on Climate Change (UNFCCC) was set up as the main international coordinating vehicle. This conference is widely held as having brought sustainability firmly into mainstream development thinking.

Climate change is the critical environmental issue that lends credence to the need for strong sustainability (see previous section) because of evidence that the upper limit of the ability of the earth's atmosphere to absorb greenhouse gases without calamitous consequences is being reached (UNDP, 2011)[5].

Climate change has emerged as the "dominant environmental issue" of the early 21st century (Adams, 2009:104). Among the reasons for this are:

- natural disasters (such as Hurricane Katrina in 2005 and the heat waves that killed 70 000 people in Europe in 2003 and 70 000 people in Russia in 2010)
- a strong economic argument, advanced in the *Stern Review* of 2007,[6] that early action will be more cost-effective than a delayed response (and that the cost of this early response may be more manageable than previously thought)
- a strong scientific basis for immediate action to prevent climate change, provided by the Fourth Assessment Report from the IPCC in 2007
- effective campaigning and advocacy (eg the film and book[7] *An Inconvenient Truth* featuring Al Gore and the book *Revenge of Gaia* by the influential environmentalist James Havelock).[8]

[5] Section 4 provides an overview of the likely general impacts of climate change and over what time frames these impacts are expected to materialise. In Section 5 some of the specific impacts of climate change on South Africa are highlighted.
[6] Some of the assumptions used in the Stern Review, mainly the use of a very low discount rate, have since been challenged. See for instance Nordhaus (2008). For more holistic economic arguments for immediate actions that are less dependent on discount rate assumptions, see World Bank (2010).

The importance of climate change has also increased in the field of development economics, with UNDP (2007:24) calling it "one of the defining forces shaping prospects for human development during the 21st Century". Furthermore, the belief has also developed that unmitigated climate change threatens the hard-won development gains achieved internationally since the middle of the twentieth century (Commission for Africa, 2010; World Bank, 2010).

The focus on climate change as THE critical environmental issue coincided with the onset in 2008 of the current global financial crisis. The crisis has led to a questioning of prevailing growth models, as well as to providing the opportunity for some stakeholders to argue for short-term expansionary policies that would simultaneously address lingering concerns about the environmental sustainability of growth over the long term (UNEP, 2011).[9] Thus, for instance, the OECD's 2009 *Declaration on Green Growth* called for "green investment to contribute simultaneously to economic recovery in the short term, and to help establish the environmentally friendly infrastructure required for a green economy in the long term" (OECD, 2009:1).[10]

However, because the *Declaration* mentioned 'sustainable growth' rather than 'sustainable development', concerns were raised that green growth or the green economy could be used as an alternative to sustainable development that might emphasise environmental protection and economic growth to the detriment of social justice (Lin and Iyer, 2010). This possibility was worrying from a poor country perspective, where the risk of systemic un-sustainability due to collapse of the social pillar of sustainable development is invariably more immediate than in rich countries.

The UN Conference on Sustainable Development in 2012 (Rio+20) embedded the concept of a green economy within the existing sustainable development framework by adding the social dimension.[11] The Rio+20 Outcome Document emphasises that the green economy should "contribute to eradicating poverty as well as sustained economic growth, enhancing social inclusion, improving human welfare and creating opportunities for employment and decent work for all, while maintaining the healthy functioning of the Earth's ecosystems" (UNCSD, 2012:9).

It is thus evident that the emphasis on climate change and on transition to a green economy supports the move towards sustainability in developing countries by leading to a balanced approach towards all three pillars of sustainable development. In Africa, for instance, national poverty reduction strategies "have paid little attention to environmental issues in general or to climate change in particular, but the situation is slowly improving as concern about climate change grows" (Commission for Africa, 2010:45).

[77] The IPCC and Al Gore were jointly awarded the Nobel Peace Prize in 2007 for their efforts in encouraging action on climate change (Archer and Moskwa, 2007).

[8] Havelock has since acknowledged that he may have overstated the risks of climate change in his 2006 publication (see Harrabin, 2012).

[9] Although the strong public support for action to mitigate climate change was a major driver of the new focus on green growth, Barbier (2010) mentions that the realisation of the role environmental degradation plays in causing and deepening poverty, and recent evidence of exactly how unsustainable most current economic activity was, were also supporting factors. The Millennium Ecosystem Assessment completed in 2005, for instance, had shown that ecosystems had been modified more rapidly and extensively during the previous five decades than any comparable period in human history – leading to a significant and mostly irreversible loss in biodiversity and levels of ecosystem services (Barbier, 2010).

[10] Interestingly, however, the concept of 'green growth' was initially introduced in an multilateral setting at the 5th Ministerial Conference on Environment and Development in Asia and the Pacific, held by the Economic and Social Commission for Asia and the Pacific (part of the United Nations Economic and Social Council) in 2005 (Vavouras, 2010). The Conference recognized that the high economic growth rates experienced by the region were creating serious concerns about environmental sustainability in member countries. The emphasis was not on climate change per se, but on finding a growth model that was environmentally sustainable.

[11] As shown in Section **Error! Reference source not found.**, the United Nations Environment Programme had incorporated 'social equity' into its definition of a green economy already in 2010.

3.3 What is a green economy?

It was stated in the introductory chapter of this report, as well as in the opening paragraphs of the present chapter, that our focus is on the cumulatively adverse socio-economic and ecological impacts of global warming and, accordingly, on the need to mitigate GHG emissions as the principal cause of warming. We observed too that the concept of a green economy embraces, but goes way beyond, reduction of GHG emissions. The present section briefly amplifies these issues.

There is no single or universally agreed definition of what constitutes a green economy (UNDESA, 2011; UNCSD, 2011). ADF (2010:3) sees a green economy as delivering low-carbon growth and employment creation through the "pursuit of an informed, sustainable development trajectory that simultaneously improves growth and leads to sustainable social and economic development". AUC and UNECA (2011:2) define a green economy as: "an outcome-oriented concept that aims at improving human well-being without undermining the resource base that current and future generations depend on for their livelihoods. It serves to link economic performance with efficient resource utilisation and a just distribution of the benefits within and across generations." UNCSD (2011) notes the broad agreement that green policies can "save energy, reduce emissions, utilise resources more efficiently and open new areas of economic development".

UNCSD (2012:16) believes that "a green economy in the context of sustainable development and poverty eradication should protect and enhance the natural resource base, increase resource efficiency, promote sustainable consumption and production patterns, and move the world toward low-carbon development. ...[a] green economy is not intended as a rigid set of rules but rather as a *decision-making framework* to foster integrated consideration of the three pillars of sustainable development in all relevant domains of public and private decision-making [emphasis added]"

UNEP (2010:5) defines a green economy, in its most basic form, as an economy that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". This expands on the basic definition by stating that "a green economy is characterised by substantially increased investments in economic sectors that build on and enhance the earth's natural capital or reduce ecological scarcities and environmental risks. These sectors include renewable energy, low-carbon transport, energy-efficient buildings, clean technologies, improved waste management, improved freshwater provision, sustainable agriculture, forestry, and fisheries. These investments are driven by, or supported by, national policy reforms and the development of international policy and market infrastructure".

There are indeed further definitions, each with its particular emphases and carefully chosen words. However, without seeking to be comprehensive, it is abundantly clear that it is an all-embracing and utopian concept. It is also clear that no national economy anywhere could claim to be wholly green. But the fact of its complex and multi-faceted character, along with its idealism, does not deny its significance or the necessity for all societies to strive to be greener than they currently are. That this will require profound structural and behavioural changes also does not diminish the importance of aspirational objectives.

UNEP (2011:20) highlights the fact that the paths countries follow to transition to a green economy will vary significantly, and will be based on each country's natural and human capital and its level of development. This view was echoed by UNCSD (2011:19) which stated that "there are as many green economies as there are development paths, with no one-size-fits-all solution".

The Green Growth Knowledge Platform (2012:1)[12] provides the following definition of green growth, highlighting the relationship between green growth and sustainable development: "green growth means fostering economic growth and development, while ensuring that natural assets continue to provide the

[12] The Green Growth Knowledge Platform is a partnership between the Global Green Growth Institute, the Organisation for Economic Co-operation, the United Nations Environment Programme, and the World Bank.

resources and environmental services on which our well-being relies. It focuses on the synergies and trade-offs between the environmental and economic pillars of sustainable development. Importantly, green growth does not neglect the social pillar; on the contrary, without good governance, transparency, and equity, no transformative growth strategy can succeed".

In sum, therefore, despite the many formulations, the concept of the green economy is intuitively simple. As stated in the first section of this chapter, a green economy is in harmony with its physical environment so that, subject to inevitable long- and short-term influences, it remains ecologically healthy. There are many dimensions to this ecology, revolving around man's ability to manage "natural capital" in a way that ensures that the development potential of future generations is not compromised.[13] The needs of the current generation, however, are not ignored since the purpose of sustainable development is to ensure that the socio-economic system remain sustainable over time. If the economic or social pillars of sustainable development deteriorate to a level where the system breaks down, this aim would not have been achieved – and it would be irrelevant whether or not the environment pillar remained intact.

4. THE SCIENTIFIC CASE FOR ACTION ON CLIMATE CHANGE

The greenhouse effect refers to a process whereby much of the energy that reaches Earth from the sun is trapped by the atmosphere rather than radiating back into space. The greenhouse effect is critical to life on Earth, since without it the Earth's average surface temperature would be below the freezing point of water. The greenhouse effect is caused by the presence of so-called greenhouse gases (GHGs) in the atmosphere.

The most important GHGs are water vapour and carbon dioxide (CO_2). Methane, nitrous oxide, ozone and a number of others which occur in small quantities also contribute to the greenhouse effect. Increasing the concentration of GHGs in the atmosphere raises the Earth's temperature.[14] Further, as average atmospheric temperatures increase, the probabilities of certain types of weather events are affected. Some weather events have already become more frequent and intense, like heat waves and heavy downpours, while others have become less so, like extreme cold spells (IPCC, 2007).

While the increase in average global temperatures can be referred to as "global warming" (IPCC, 2007:98), the real concern is that high average temperatures may lead to "profound impacts on biological and human activities that are sensitive to the climate" as higher average temperatures lead to changes in temperature extremes, rainfall patterns, storm location and frequency, floods, sea-level rises, water availability issues, droughts, and desertification (Nordhaus, 2008:2; Stern, 2011). Phrasing the issue slightly differently, Stern (2011:3) states that "global warming causes climate change which in turn directly affects peoples' lives and livelihoods, including where they can live".[15]

Several components of the climate system affect atmospheric concentrations of GHGs. These components include oceans, natural phenomena like volcanic eruptions, and the metabolic processes of plants and animals (including humans). Since the start of the industrial era, however, human activity, and in particular

[13] Or phrased differently, that sufficient ecosystem services are available so that the development of future generations are not impaired. See footnote 3.

[14] Climate, often defined as "average weather", is characterised as the atmospheric component of the broader climate system, which in turn is defined as a "complex, interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things". Climate is typically described by referring to the "mean and variability of temperature, precipitation and wind" during a given time period. 30 years is the typical time period used, but it can vary from a number of months to millennia (IPCC, 2007:94).

[15] As highlighted in the previous footnote, this analogy is not strictly correct. Since average temperature is one of the defining features of climate, and increase in average temperatures is technically climate change irrespective of whether other climate components change. The distinction between global warming and climate change is however useful to illustrate the uncertainty in the wider climate change debate. This issue is addressed in the remainder of this chapter.

the combustion of fossil fuels and clearing of forests, has "greatly exceeded" the impact of natural processes in altering the amount of GHGs in the atmosphere (IPCC, 2007b:100; Royal Society, 2010).[16] The concentration of CO_2, for instance, in 2005 had increased by roughly 35% since the industrial revolution primarily as a result of human activity (IPCC, 2007b). The average 2011 global CO_2 concentration is estimated to be 39% higher than pre-industrial levels (Blasing, 2012; Conway and Trans, 2012).

Given the potentially adverse impacts of climate change, and the fact that most scientists believe human activity is a significant contributor to this process, there is a compelling argument for actions to reduce GHG emissions (commonly referred to as climate change mitigation or GHG abatement activities). In practice, however, the issue is not straightforward.

As Nordhaus (2008:204) points out, "climate change is a complex phenomenon, subject to great uncertainty, and changes in our knowledge occur virtually daily". Almost all scientists agree that the Earth is indeed warming (IPCC, 2007a; Lomborg, 2010; Nordhaus, 2012; Pielke, 2010). The UK Government Chief Scientific Adviser John Beddington (quoted in Webster and Franklin, 2010:1) states that it is "unchallengeable that CO_2 traps heat and warms the Earth and that burning fossil fuels shoves billions of tonnes of CO_2 into the atmosphere". Further, as Nordhaus (2012:1) states, the "finding that global temperatures are rising over the last century-plus is one of the most robust findings of climate science and statistics". While individual scientists and commentators still challenge this finding, the consensus has been recently strengthened by the findings of the Berkeley Earth Surface Temperature study (Berkeley Earth) which confirmed the increase in average global temperatures previously identified (Berkeley Earth, 2011; Muller, 2011).[17]

The Berkeley Earth results are important for a number of reasons. Some team members had been sceptical about the way previous studies had been conducted, and had voiced these concerns publicly. Only one of the team of 10 scientists was a climatologist. They were thus not climate-change research 'insiders'. Berkeley Earth also used a new, robust and statistically intensive methodology that addressed many of the concerns that had been expressed about the methodology of earlier studies; it also used a much larger set of temperature readings. Importantly, the research was transparent - both the data and the model used in the analysis were and remain freely available on the Berkeley Earth website[18] (Black, 2011; Roosevelt, 2011; Zelman; 2011).

The link between, on the one hand, an increase in average temperatures and, on the other, changes in other climate variables and extreme weather events, however, is more contentious. Most scientists believe that there is such a link, but the nature of that link and its likely consequences has been subjected to more debate. In contrast to his claim relating to global warming above, Beddington (quoted in Webster and Franklin, 2010:1) states that:

> "When you get into large-scale climate modelling, there are quite substantial uncertainties. On the rate of change and the local effects, there are uncertainties both in terms of empirical evidence and the climate models themselves".

This view is echoed by the Royal Society (2010:1)[19], which states that while there is strong evidence that the Earth has warmed over the last half-century, and that this warming has been caused by human activity, the "size of future temperature increases and [of] other aspects of climate change, especially at the regional

[16] NAS (2011a:1) is slightly more circumspect in its framing of the issue, stating that climate change is "very likely caused primarily by human activities".

[17] See for instance Lawson (2009) and Allegre et al (2012). For a broader perspective on the debate around the scientific basis for global warming and climate change, also see Nordhaus (2012) and LETTERS (2012).

[18] http://berkeleyearth.org/

[19] The statement originated after 43 of its members raised concerns that the previous statement issued by the Royal Society did not adequately distinguish between areas where wide agreement existed amongst scientists and areas that were still subject to significant uncertainty (Harrabin, 2010).

scale, are still subject to uncertainty." Hansen et al (2012) posit that the probability distribution for global seasonal mean temperatures has shifted towards higher temperatures. They also believe that he tails of the distribution have become longer and skewed towards higher anomalous temperatures. If this is indeed the case, it not only makes extreme temperatures more likely, but changing probability distributions complicate forecasting.

In fact, given the complexity of the climate system and the many social, economic, technological and other factors that interact with it, NAS (2011b:1) cautions that it is unlikely that certainty regarding future risks will ever be achieved.

Both NAS (2011b) and The Royal Society (2010), however, believe that the current uncertainty regarding the evolution of climate change should not be viewed as sufficient to prevent action to mitigate and adapt to climate change. The Royal Society (2010:13) holds the position that "the potential impacts of climate change are sufficiently serious" to warrant action. NAS (2011a:1) states that, amongst other reasons for states' actions to limit substantially the future degree of climate change and to prepare to adapt to its impacts;

> "The risks of continuing "business as usual" are greater than the risks associated with strong efforts to limit and adapt to climate change. Policy changes can potentially be reversed or scaled back if needed, whereas many adverse changes in the climate system would be difficult or impossible to 'undo'".

Thus, while uncertainty persists, the general message to emerge from the scientific community is that action to reduce future climate change linked to raising GHG concentrations is wholly justified.

5. THE ECONOMIC CASE FOR A RESPONSE TO CLIMATE CHANGE

Economic studies dealing with climate change are, similarly to the scientific literature, subject to large uncertainties. Differences exist with respect not only the future costs and benefits of policy actions, but also to the methodologies used to evaluate the impact of climate change.[20]

Apart from the inherent uncertainties arising out of the scientific debate, there are factors that complicate the economic analysis:

1. The impact of climate change is expected to intensify in future, meaning that future generations will bear the brunt of any costs that do materialise. Issues of inter-generational equity are thus important.[21]

2. GHG gases are long-lived, ie they remain in the atmosphere far into the future.[22] In the absence of cost-effective technologies to remove CO_2 from the atmosphere, CO_2 emissions are thus effectively irreversible under within the planning time frames of policymakers.

3. The possibility of positive feedback loops in the climate system also creates the possibility that the climate change impacts of a given level of GHG emissions are non-linear.[23] In particular, there may be thresholds beyond which the impact of additional GHG emissions on the climate system increases swiftly and significantly.

4. Given these factors, some economists has questioned whether the standard economic tool for evaluating policy interventions, cost-benefit analysis, is useful in assessing climate change (see for instance Weitzman (2009a) and Kruik (2009)).

Generally there are three main schools of thought regarding the economic justification for action to mitigate climate change.

The first school believes that, based on standard cost-benefit analysis, there is a case for immediate stringent emissions cuts.

The second school argues that it is more cost-effective to start off with modest reductions in emissions, and to ramp up mitigation efforts as the uncertainty around the impacts is reduced and new technologies are developed that reduce the cost of mitigation.

The third school maintains that there is a case for immediate deep cuts in emissions. This view is not based on cost-benefit analysis, but on the judgment that there is a cut-off point beyond which climate change will

[20] See, for instance, Arrow (2007), Goulder and Pizer (2006), Helm (2008), Nordhaus (2008), Quiggin (2007), Weitzman (2009a) and Tol (2009).

[21] Nordhaus (2008:204) summarises the situation as “climate change is unlikely to be catastrophic in the near term, but it has the potential for serious damages in the long run”.

[22] Weitzman (2009a) mentions that of CO_2 emitted today, roughly 70% will still be present in atmosphere after 10 years and 35% after 100 years. After 100 000 years, roughly 5% will still be present.

[23] As temperatures increase, a number of possible feedback mechanisms can reduce the ability of land and systems to remove GHG from the atmosphere, thereby creating a “positive carbon cycle feedback” that leads to higher atmospheric concentrations of GHGs (IPCC, 2007a:38). As an example, Weitzman (200b) mentions that at higher temperatures large amounts of GHGs that are currently naturally sequestered in arctic permafrost and other boggy soils may be released into the atmosphere. A positive feedback loop could thus be created where a given level of GHG emissions leads to a specific increase in temperature, which in turn leads to an additional release of GHGs (which is now only indirectly related to human activity) which in turn leads to higher increases in temperature. The impact of GHG emissions on climate change could thus be non-linear in that there is not a continuous fixed relationship between the two variables. If these feedback effects are activated, an exponential increase in warming could materialise for even small increase in GHG emissions.

have infinitely large negative impacts. Since it is unclear where this point is, the contention is that early and significant reductions in GHG emissions will reduce the probability of such a catastrophic outcome.

In addition to the above "mainstream" views, two other perspectives are worth noting.

The first is that, while climate change is important, it should not be seen as the defining issue of the day. Supporters of this view do not favour reductions in GHG emissions, but rather argue for investment in research and development both to reduce the cost of future reductions in emissions and to make dealing with climate change less costly.

The second view is that climate change demands immediate and drastic action. In contrast to the three mainstream views given above, the argument here is that climate change cannot be avoided simply by incorporating mitigation action into current economic growth models. Instead, climate change (and all other environmental issues) can be prevented only if economic growth is curbed drastically.

These various viewpoints are amplified below.

The Stern Review (Stern, 2007:1, 27) considered the potential costs and benefits of climate change policy interventions (including adaptation) in detail. Using standard cost-benefit analysis, Stern found that the benefits of "strong, early action on climate change outweigh the costs". He went further to state that the "economic risks of inaction in the face of climate change are very severe", and that delaying climate change mitigation actions would be "costly and dangerous".

According to Quiggin (2007:1), the Stern Review "changed the terms of the debate by presenting the issues in economic rather than scientific terms". It also led to a lively debate amongst economists regarding the validity of assumptions used in the Review (see, for instance, Yale (2007) and Quiggin (2007)). The main issue is the use of a very low discount rate.[24] While some economists feel that Stern's results hold even when discount rates are used that are closer to those observed in reality (see Arrow (2007), others feel that the low discount rate results in disproportionately large estimates of the costs of climate change, and thus inflate the urgency of early and onerous mitigation action. This typifies the second mainstream school of thought.

The latter view is most often associated with Nordhaus (2007, 2008). He does not question Stern's judgment that climate change is a serious problem requiring immediate action. In fact, Nordhaus (2007:668) believes that there is a broad consensus amongst economists regarding this point, and states that "[a]ll [past] economic studies find a case for imposing immediate restraints on greenhouse gas emissions". Nordhaus (2007, 2008), however, does not believe that Stern's call for deep and prompt cuts in emissions is justified.

Rather, he judges that cutting emissions sharply in the near future is inefficient, and that the same level of future environmental benefit (ie reduction in expected level of climate change) can be achieved by smaller initial emissions reductions that are ramped up over time. The reason for there being net benefits to large short-term reductions, as argued by Stern is, according to Nordhaus (2007:701, 2008), the use of an unjustifiably low discount rate that is not compatible with current "marketplace real interest rates and savings rates". Nordhaus (2007:687, 2008) instead favours a "climate-policy ramp" that consists of "modest rates of emissions reductions in the near term, followed by sharp reductions in the medium and long term". The rationale for such a ramp is (Nordhaus, 2007:687):

[24] The low discount rate reflects a utilitarian viewpoint that it is morally wrong to discount the utility of future generations since "all people count equally and that there is no justification for treating people more favourably simply because they were born earlier" (Delong, 2006; Quiggin, 2007:12). This issue is complicated by the fact man-made capital cannot always fully substitute for natural capital (see the discussion on the 'weak' versus 'strong' definitions of sustainable development in Section **Error! Reference source not found.**)[This link didn't work when printed]. Neumayer (2007), for instance, feels that this is a stronger justification for the near zero discount rate used in Stern (2007) than utilitarianism.

> "In a world where capital is productive, the highest-return investments today are primarily in tangible, technological, and human capital, including research and development on low-carbon technologies. In the coming decades, damages [to economic prospects from the effects of climate change] are predicted to rise relative to output. As that occurs, it becomes efficient to shift investments toward more intensive emissions reduction."

Nordhaus also believes that the exact timing and composition of emissions reductions depend upon estimates of the cost of mitigation, the cost of climate change damage, and the extent to which climate change (and its impacts) are non-linear and non-reversible. It is not unreasonable to expect that these estimates will become more accurate over time. Policymakers should thus be in a better position to design the packages of 'more intensive emissions reductions' in future than they are today, which provides an additional reason for sticking to modest, low-cost interventions in the next two or three decades.

As the main proponent of third school of thought, Weitzman (2009a, 2009b) believes that the usefulness of standard cost-benefit analysis (CBA) tools to investigate the economics of climate change is over-stated. Weitzman (2009a:17) asserts that the "sheer magnitude of the deep structural uncertainties [in climate science and the way it is included in economic models] ... will likely dominate plausible applications of CBA to the economics of climate change".

Because off the non-zero probability that climate change will lead to potentially unlimited negative impacts (ie catastrophic climate change may lead to a "disastrous collapse of planetary welfare"), Weitzman (2009b:1) suggest s that mitigation actions should be seen as insurance against catastrophic climate change. Also, because of possible feedback effects or non-linearities in the relationship between GHG concentrations and average temperature increases, Weitzman (2009a, 2009b) believes that the probability of catastrophic climate change is higher than standard models or scientific theory predict.[25] Given the possibility of feedback effects accelerating climate change, as well as the long-lived and irreversible nature of CO_2 emissions, Weitzman (2009a:15) believes the "wait and see" approach of Nordhaus (2007, 2008) is not tenable. By the time scientists have sufficient information that climate change is heading for catastrophic proportions, it may be too late to do anything about it.

Rather than comparing the potential benefits and costs of policy interventions, Weitzman (2009b:18) contends the "key economic question" in climate change economics is the overall cost of programmes to reduce the probability of catastrophic climate change, and by how much the programmes reduce the probability of massively negative outcomes. Instead of worrying about whether or not early mitigation actions bring net present benefits (ie the cost of mitigation is outweighed by the cost of damage as a result of climate change averted), Weitzman (2009a, 2009b) thus advocates asking how much society is prepared to pay for reducing the risk of catastrophic climate change. This line of thinking is closely related to that of the National Academy of Science (2011:1), which states that given the uncertainty in climate predictions "(d)ecisions about the exact magnitude and speed of response efforts will depend on how much risk society deems acceptable".

The two main alternative perspectives are as follows:

Much like the first approaches advocated by Stern and Nordhaus, research by the Copenhagen Consensus on Climate used CBA as a "transparent and practical" method to evaluate the desirability of different ways to address climate change (Lomborg, 2010). A panel of five leading economists was asked by the Centre to rank alternative responses to climate change based on cost and benefits obtained from its own knowledge and from specially commissioned research (Stokey et al, 2010). The panel preferred a package of options

[25] The outcome distribution has "fat tails", which mean that extreme negative outcomes are more likely than expected.

focused on R&D (in the areas of climate engineering[26], energy and CCS) and planning for adaptation (dealing with the effects of climate change). The package of interventions, estimated to cost about $110 billion per year from 2010 to 2020, is seen as sufficient largely to resolve the climate change problem within a decade (Lomborg, 2010a). The panel observed that, while a well-designed policy of gradual carbon cuts could reduce emissions significantly at low cost, overly ambitious or poorly designed policies could be much more expensive (Stokey et al, 2010). In summarising the conclusions of the project, Lomborg (2010a) suggested that while mitigation activities are not currently desirable for their own sake, carbon pricing could play an important supporting role in the approach put forward by raising funds for R&D and incentivising development and deployment of affordable and effective technology options.

This focus on R&D and adaptation was confirmed by a similar exercise organised by the Copenhagen Consensus Centre in 2012. The latter exercise asked a panel of five distinguished economists to prioritise action on ten of the world's pressing challenges (Copenhagen Consensus, 2012). The climate-related activities singled out for funding were: R&D into agricultural yield enhancement, geo-engineering and green energy, along with investment in early warning systems for natural disasters.[27] The expert panel felt that funding for mitigation action at present was premature, since in its view material CO_2 reductions were unlikely in the absence of large-scale technological breakthroughs.

In stark contrast to the preceding justifications for action on climate change, proponents of ecological economics[28] adhere to the low-growth, no-growth or de-growth school of thought (the last term sometimes being referred to as steady-state economics). This view holds that pressing environmental and resource constraints cannot simply be solved by increasing efficiency while continuing to strive for economic growth. Instead, economic activity needs to be reduced to a level where economies meet the strong sustainability criteria (ie the stock of natural capital remains constant – see Section 0 (O'Neil, 2011; Schneider et al, 2010; Victor, 2011). The basic premise is that by changing the way humans live, individually and socially, it may be possible to achieve greater social cohesion, higher levels of well-being and more fulfilled lives without economic growth and the consequently inevitable environmental degradation (Jackson, 2009; Lorek and Fuchs, 2011).The move away from economic growth is expected to happen initially in the developed world, where the means and levels of consumption make this feasible. As environmental issues and resource constraints intensify, however, developing countries may have to follow suit (Victor, 2011).

Proponents of this final approach to combating climate change believe that a lack of growth may well be a result of orthodox policies to reduce emissions, and therefore that it is worth investigating de-growth and steady-state economic models. Jackson (2009) notes that the current range of estimates of the cost of mitigation actions is typically of the same order of magnitude as growth rates in developed countries. Mitigation could thus easily bring an end to GDP growth in developed countries. This becomes a greater possibility when one takes into account that the economic cost of mitigation is unlikely to be equally distributed between countries. Developed countries are expected to bear a higher proportion of mitigation

[26] Climate- or geo-engineering refers to intentionally modifying climate to reduce the harmful effects of global warming (Bickel and Lane, 2010). The term thus encompass a range of technical measures to combat the effects of climate change, including, for example, marine cloud whitening (creating artificial unnaturally white clouds over the ocean to reflect solar energy back into space), stratospheric aerosol insertion (inserting particles into the atmosphere to reflect solar energy into space) or air capture (removing CO_2 from the atmosphere using large-scale industrial processes and storing it) (Bickel and Lane, 2010).

[27] The world's most pressing concerns were highlighted as hunger and malnutrition and infectious disease.

[28] Ecological economics is the study of the co-evolution and interactions between human economic activity and natural ecosystems in which economies are embedded (Xepapadeas, 2008). Ecological economists believe that the larger local and global natural ecosystems (of which they believe the economy is merely a subsystem) places limits on the physical growth of economies (Van den Berg, 2001). Their overriding goal is sustainable development, and they adhere to the strong definition of sustainability (ie natural and man-made capital cannot be substituted, see Section 0). For an introduction to ecological economics, and a discussion of how it differs from mainstream environmental economics, see Van den Berg (2001).

costs due to their higher per capital emissions, historical responsibility for emissions already in the atmosphere and higher *per capita* levels of income and consumption (Jackson, 2009; Victor, 2011).

Further, proponents of ecological economics believe that current estimates of both mitigation[29] and adaptation[30] costs may be unrealistically low. This combination of higher than expected mitigation and adaptation costs leads ecological economists to conclude that the politically appealing message that climate change can be addressed while sustaining current levels of consumption and economic growth in developed countries is simply wrong. Rather than pretending that they can prevent the inevitable, ecological economists feel that policymakers should start preparing for de-growth now and that, with proper planning and preparation, economies may stabilise in the long term at a higher sustainable steady-state level than would have been the case had they continued to muddle through with current policies.

In summary, there is a general agreement amongst economists that climate change is a serious concern that warrants attention. Within this broad consensus, however, there are different views on how the problem should be addressed. In general, with numerous caveats applying in individual cases, most high-profile economists seem to accept that the likely future risks and costs associated with climate change are sufficient to justify mitigation policy actions. There are however differences of opinion concerning the optimal timing and extent of mitigation. There are also more extreme views on the issue. Bjorn Lomborg and the Copenhagen Consensus Centre, for instance, believe that a focus on mitigation is misguided at present and the emphasis should be on R&D to reduce the cost of mitigation and adaptation in future. [31] At the other end of the spectrum, proponents of the ecological economics school of advocate a drastic reduction, or even cessation, of economic growth as a way to fight climate change.

Thus, In addition to the scientific uncertainties, there is uncertainty about the optimal economic strategy for dealing with climate change. What does seem to be uncontroversial, however, is that climate change poses significant risks for the global economy, and that these risks need to be addressed.[32] How this is to be done is still open to debate. The complexity of this situation is eloquently conveyed by Weitzman (2009a:13): "At the end of the day, policymakers must decide what to do on the basis of an admittedly sketchy economic analysis of a gray area that just cannot render clear robust answers".

6. SOUTH AFRICA'S GREENHOUSE GAS EMISSIONS PROFILE

According to the latest official National GHG inventory South Africa's GHG emissions[33] increased from 347 million tonnes of CO_2 equivalent in 1990 to 436 million tonnes in 2000 (an increase of 25.6%) (DEAT, 2009).[34] CAIT GPDE (2012), using a slightly different definition of GHG emissions[35], believes that South Africa's GHG emissions were only 15% higher in 2000 than in 1990, and 2005 emissions 26.3% higher.

[29] Current estimates typically exclude a number of factors that could include overall costs. Examples include: switching costs (i.e. strengthening transmission and distribution networks to accommodate intermittent electricity supply from renewables); policy costs (ie the risk that government failure may lead to suboptimal mitigation policies and/or rent-seeking); potential price impacts as demand for green technologies intensify and the fact that investments in certain mitigation activities may produce lower returns than other investment opportunities (or even zero in the case of technologies like CCS that serve only to reduce emissions and may adversely affect the efficiency of industrial processes) (Helm, 2008; Jackson, 2009; Victor, 2011).

[30] Helm (2008) believes that the impact of the physical effects of climate change on economic growth tend to be underestimated by economic models assuming perfect substitutability between natural and man-made capital.

[31] Other supporters of this view are Henderson (2009) and Lawson (2009).

[32] The actual impact will vary by location, but all studies show that global GDP is expected to be reduced as a result of climate change, and may fall dramatically as a result of catastrophic climate change.

[33] Excluding land use, land use change and forestry.

[34] The latest official National GHG Inventory, released in 2009, is for the year 2000. The Department of Environmental Affairs is currently finalising a national GHG inventory for the years 2000 to 2009.

The South African economy is very carbon intensive given its stage of development (DEA, 2011). This state of affairs is due to three primary reasons. Firstly, South Africa's energy supply is highly dependent on coal, the most carbon-intensive fossil fuel. About 90% of South Africa's electricity and 25% of its liquid fuel supply is based on coal. Secondly, because of South Africa's natural resource endowments, the relatively energy-intensive mining and minerals processing sectors play a large role in the local economy. Lastly, a history of very low electricity costs, and active industrial policy to use low electricity costs to attract energy intensive projects to South Africa, has led economic activity being skewed towards capital-and energy-intensive activities (DEA, 2011; DEAT, 2009; Nkomo, 2009; Winkler, 2008).

Given the energy-intensive nature of the South African economy, it is unsurprising that energy emissions form the bulk of local GHG emissions. In 2000 energy emissions accounted for 79% of total emissions, up from 75% in 1990 (DEAT, 2009). This percentage is unusually high compared to other developing countries. In 2000 average energy emissions in developing countries accounted for 49% of total emissions (DEA, 2011). Half of South Africa's energy emissions, so almost 40% of total emissions, originate from electricity generation. The remainder of South Africa's emissions originate from industrial processes and product use (14%, up from 9% in 1990), agriculture, forestry and land use (5%, down from 12% in 1990) and waste (2%, down from 4 % in 1990).[36] DEA (2011) asserts that emissions from land use change (mostly deforestation) and agriculture are a much smaller share of South Africa's total emissions than in a typical developing country where these emissions account for 44% of total emissions.

South Africa is one of the highest emitters of GHGs in the world, ranked 19th in 2005 if emissions from land-use change, forestry and international bunker fuel are excluded.[37] South Africa contributed 1.12% of global GHG emissions and 40.48% of Sub-Saharan Africa's emissions. In terms of GHG emissions per capita, South Africa was ranked 54th in 2005 and emitted 9 tonnes of CO_{2e} per person compared to a global average of 5.8 tonnes per person (CAIT, 2012).

In terms of CO_2 only, which as highlighted in Section 4 is a particularly problematic greenhouse gas due to its longevity, South Africa is an even more important emitter. Based on both Carbon Dioxide Information Analysis Center (CDIAC)(for 2008) and United States Energy Information Administration (US EIA) (for 2010) data South Africa ranks as the 13th largest emitter of CO_2 from energy use (Boden et al 2011; US EIA, 2012). The US EIA (2012) estimates that South Africa's CO_2 emissions from energy use increased by 56% from 1990 to 2010 (from 298 million tonnes to 465 million tonnes). CDIAC data shows a lower estimated increase in CO_2 emissions related to energy use between 1990 and the most recently available year (2008) of 31% (from 334 million tonnes of CO_2 to 436 million tonnes) (Boden et al, 2011).

Because of the energy-intensive nature of the South African economy and the carbon intensive nature of local energy, the carbon intensity of the economy is high compared to other major economies as illustrated in the figure below. The figure shows the most carbon intensive[38] economies with a gross domestic product of $200bn or more at purchasing power parity in 2008. Of the major economies, South Africa is the second most carbon intensive economy. South Africa would thus be vulnerable to competitiveness issues should the world move towards a carbon constrained economy accompanied by carbon pricing and border adjustment measures (see Section 0).

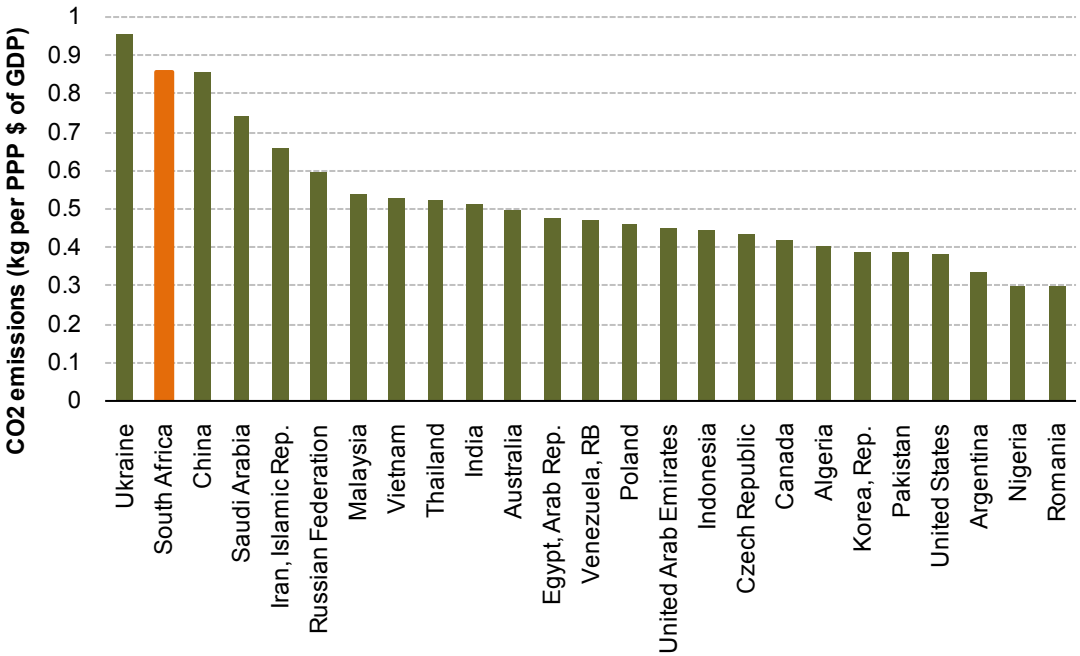
[35] Excluding land use change and forestry.

[36] DEA (2009) cautions that the 1990 and 2000 inventories are not directly comparable as a result of changes to the methodologies used to calculate emissions.

[37] No data on emissions from these sources are available for South Africa.

[38] Kilogramme of CO_2 per of purchasing power parity adjusted US dollar of local GDP. CO_2 stemming from energy use and cement manufacturing was used for the calculation (WDI, 2012).

Figure 2: Carbon intensity of major economies (GDP at PPP >$200bn in 2008)



Source: WDI (2012)

7. A green economy in South Africa

7.1 Definition

Give some of the data we have presented, it is unsurprising that there is confusion in South Africa as to what a green economy means. For instance, IMBEWU (2012:63) notes that the concepts of "sustainable development, sustainability, sustainable economic development, low-carbon economy and green economy are used interchangeably" in official policy and strategic documents, which leads to general confusion in policy objectives and approaches.

The *National Development Plan* released by the National Planning Commission (NPC)[39] in 2011 seems to support the idea that a low-carbon economy is a component of a green economy by stating that (NPC, 2011:128) "Shifting to a green economy, *including to a low-carbon economy*, is about shifting to a more sustainable economic growth and development path in the long term [emphasis added]". In the *Plan*, the green economy is dealt with as a "new and growing sector" within the broader "'economy and empowerment" section.[40] The "transition to a low-carbon economy" is afforded a separate chapter (NPC, 2011:128-129, 179).

In practice the two concepts are treated as one. While discussing the structural transformation that the NPC (2011:183) believes is necessary to remain on the Peak, Plateau and Decline (PPD) Trajectory after 2035[41], it is stated that the "key challenge is de-linking economic activity from environmental degradation and carbon-intensive energy, while remaining competitive and reducing unemployment, poverty and inequality". The focus on a low-carbon economy thus seems simply to highlight the NPC's (2011:69) belief that climate

[39] The National Planning Commission is an advisory body rather than a government department. It advises the President of the Republic of South Africa on issues related to long-term development (NPC, 2011).

[40] Within this sector conceptualisation, the green economy agenda is expected to "promote deeper industrialisation, energy efficiency and employment" (NPC, 2011:129).

[41] See ANNEXURE 1.

change is currently the "chief ecological challenge" in implementing a sustainable development strategy.[42] Also, the milestones provided for the "phasing" of the transition to a low-carbon economy are mostly process- rather than outcomes-based (see NPC,2011:192-193). This seems to indicate that the transition to a low-carbon economy can be seen as a "decision-making framework to foster integrated consideration of the three pillars of sustainable development in ... decision-making" – which conforms to UNCSD's (2012:16) conceptualisation of a green economy quoted in Section 0.

The *New Growth Path*, while placing a higher emphasis on employment creation, also essentially advocates a sustainable development strategy (EDD, 2010:6). The main indicators of success for the *New Growth Path* are listed as: "jobs (the number and quality of jobs created), growth (the rate, labour-intensity and composition of economic growth), equity (lower income inequality and poverty) and environmental outcomes". In both the New Growth Path (2010) and the latest Industrial Policy Action Plan (DTI, 2012), however, the green economy is addressed only as a specific sector within the overall economy.[43]

The green economy and its related concepts in South Africa are evidently used as a decision-making framework rather than a concrete end-state to aim for. The only concrete 'plan' that exists in this context, is the Peak, Plateau and Decline (PPD) greenhouse gas emissions trajectory referred to in the National Climate Change Response White Paper. What the trajectory actually means in terms of changes to the underlying economic structure is still unclear as it is currently positioned as a 'baseline' against which progress will be measured rather as a plan with explicit targets. [44] Also, as pointed out in NPC (2011), it is not yet clear how the "decline" phase of the PPD trajectory after 2035 will be accomplished. As the only quantitative conceptualisation of a transition to a green economy, however, it is likely that it will take centre stage in the minds of policymakers. Since it deals only with GHG emissions, however, it is likely to lead to an over-emphasis on the environment leg (and in this case only one component of the ecology) at the expense of the other legs of sustainable development unless complementary planning tools are developed to plan and track the move to a green economy. [45]

7.2 Rationale for move to a green economy

Climate change is a complex and broad issue, cutting across all three legs of sustainable development. By its very nature, it influences stakeholders in different ways. Producers in carbon-intensive sectors have seen their products vilified, for example, while suppliers of environmental goods and services to mitigate and adapt to climate change see great opportunity in rapidly expanding local and international markets. In addition numerous economic actors like farmers, owners and operators of infrastructure and owners of private property are vulnerable to the physical impacts of climate change.

The innumerable interests affected by climate change, coupled with the inherent uncertainties in what climate change comprises and what its impacts will be, make this a profoundly complex issue for societies and their governments to grapple with. The complexity is both illustrated and compounded by the difficulties governments experience in organising a coherent approach. In South Africa, for instance, the bulk of government-sponsored policy work has been done under the auspices of the Department of Environmental

[42] The NPC (2011:69) also highlights the importance of other "closely linked" ecological issues that need to be addressed like "water scarcity, pollution, food production and safety, and depleted fishing stocks".

[43] The 2011 Industrial Policy Action Plan (IPAP), for instance, includes 'green industries' as one of its focus areas. Green industries include: solar water heaters, wind energy, photovoltaic power, concentrated solar thermal power, industrial energy efficiency, water efficiency, waste management, biomass, energy-efficient vehicles, organic agriculture, biofuels and electric vehicles (Dti, 2011). The impact of climate change, policy measures to support climate change mitigation or the possible cost-increasing effect of greater roll-out of green industries (like renewable energy) on the rest of the economy (or the rest of the focus sectors in the IPAP) is not addressed. This conclusion remains valid for the 2012 IPAP (Dti, 2012).

[44] See ANNEXURE 2.

[45] The National Climate Change Response White paper does call for a more holistic approach that incorporates social and economic assessment by analysing the economy-wide impact of mitigation actions (see Section 0). Without the planning processes and tools to do this in a consistent manner, however, the practical impact of this may be limited.

Affairs, with only limited input from Departments like Treasury, Economic Development and Trade & Industry.[46]

This section sets out the most commonly cited reasons for a move to a green economy in South Africa.[47]. The first three are directly related to the direct or indirect impacts of climate change and associated policy, while the fourth comprises the co-benefits that may be realised by a move to a green economy.

The first reason centres on reducing GHG emissions to reduce the expected impacts of climate change on South Africa. The National Climate Change Response White Paper paints an alarming picture of the potential impact of climate change in South Africa (DEA, 2011:8). It mentions that South Africa is "extremely vulnerable and exposed" to climate change due to its socio-economic and environmental context (DEA, 2011:8). It also highlights the fact that South Africa is already water-stressed, and climate change raises the spectre of "future drying trends and weather variability with cycles of droughts and sudden excessive rains". The White Paper also states that, in addition to reduced water availability and the impact this will have not only on ecosystem stability, human health and agriculture, water-intensive economic activities like electricity generation will be affected. Extreme weather events like floods and droughts, combined with increased veld and forest fires and sea level rises are expected to impact on both the lives and livelihoods of people. Furthermore, the White Paper believes that the extinction of endemic plant and animal species that is expected to coincide with unmitigated climate change will also harm South Africa's biodiversity and consequently impact on the provision of eco-system services.[48]

Given the uncertainty regarding the impacts of climate change at the regional and local level mentioned in Section 4, the White Paper's description of the expected impacts of climate lacks nuance. Considering rainfall, for instance, Colvin et al (2009) mention that the impacts of climate change on South Africa are uncertain and expected to vary significantly by region. Schulze et al (referenced in Calvin et al (2009)) predict that rainfall will increase in Lesotho and parts of North West and the Eastern Cape Drakensberg, but will decrease in most of the rest of the country.

Using six different models, Lumsden et al (2009) find results that the east of their study area (which includes South Africa, Lesotho and Swaziland) will become wetter, while the west coast and adjacent interior will become drier. Since the eastern areas are expected to experience both more rainy days and more days with higher rainfall, more runoff is expected. While this would be beneficial in terms of dam filling, it would have negative implications for water quality (which in turn affects dam siltation, aquatic ecosystems and water treatment). The availability of potable water, counter-intuitively, may thus actual be reduced. The basic fact that South Africa's climate is expected to change, and that this will have local impacts, is thus not in question.

The poor are particularly vulnerable to climate change. They typically rely on environmental resources to a greater extent than the better-off (because for instance they do not have ready access to modern energy sources or secure water supply), and they lack the resources to respond effectively to the impacts of climate change (DEA, 2011; Pearce and Turner, 1990; Swart, 2008).

For all these reasons, the White Paper states that (DEA, 2011:8):

> "climate change [is] one of the greatest threats to sustainable development and... if unmitigated, has the potential to undo or undermine many of the positive advances made in meeting South Africa's own development goals and the Millennium Development Goals".

[46] A notable exception is the work being undertaken by the National Treasury on the likely impact of a carbon tax (see footnote 68). Important contributions in terms of discreet inputs have, however, been made by departments like Science and Technology, which funded the South African Risk and Vulnerability Atlas.

[47] A number of potential theoretical issues (like intergenerational equity, or being responsible international citizens) are not addressed. Rather, the analysis focuses on the most commonly reasons provided in policy debates and general literature.

[48] See footnote 3.

South Africa produced only about 1% of global GHG emissions in 2005. Consequently, any reduction in local emissions will have a very limited impact globally (CAIT, 2012).[49] Clearly climate change can effectively be addressed only by the "concerted and cooperative efforts of all countries "(DEA, 2011:9).

Unilateral climate change mitigation policy and action can thus be seen as signalling to the international community that South Africa takes climate change seriously. A transition to a green economy, which will include a number of mitigation actions, could thus encourage other countries to do the same.

The second reason for switching to a green economy is based on international diplomacy. Since the 15th Conference of the Parties (COP15) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Copenhagen in 2009, South Africa has been punching above its economic weight in climate change negotiations. South Africa is part of the influential BASIC group (Brazil, South Africa, India and China) which played a key role in negotiating the Copenhagen Accord (Lamont, 2010)[50]. Also, as the host of COP17 in Durban in 2011, South Africa has been prominent in driving international efforts to negotiate a cooperative approach to reduce future climate change.[51] Given the visibility and status that these actions afforded South Africa on the international stage, it is likely that the government will seek to maintain this leadership role internationally.

If a global agreement to limit GHG emissions is put in place [52], it is likely to include some form of economic incentive. This could comprise an internationally applicable instrument or, more likely, the greater use of domestic instruments. The reason for this is that economic instruments are more effective at incentivising emissions reductions, and lead to a lower overall cost of mitigation, than using regulatory instruments only (Cloete et al, 2010). Economic instruments to mitigate climate change, whether carbon taxes or cap-and-trade schemes, place a price on carbon.[53] This affects the relative costs of sectors within an economy, and between economies internationally, by effectively making carbon 'a factor of production' (Smale et al., 2006:33; Wooders et al., 2009). In a world with high carbon prices, countries that have not transitioned to low-carbon economies will find their international competitiveness adversely affected (Cloete and Robb, 2010).

In South Africa's case, in addition to a general lack of competiveness, exports may be disadvantaged if countries with tougher climate change mitigation measures (like high carbon prices) erect defensive barriers to guard against 'carbon leakage'. Carbon leakage refers to the relocation of production activities to jurisdictions with less stringent climate change policies as a result, for instance, of a shift in consumption of

[49] South Africa emitted 1.12% of global GHG emissions in 2005 if all major GHG gases are included, excluding emissions from land-use change and forestry and international bunker fuel.

[50] The Copenhagen Accord was a significant step forward in the international climate change negotiations since this was the first instance of developed and developing countries addressing the issue of climate change (and in particular mitigation targets) within the same document (later formalised under the UNFCCC process in the form of the Cuncun Agreements.

[51] COP15 in Copenhagen failed to deliver a legally binding international agreement to address climate change. Many commentators then looked to COP17 in Durban to achieve this. While this did not happen, the Durban Platform for Enhanced Action, accepted at COP17, launched a process aimed at formulating "a protocol, another legal instrument or an agreed outcome with legal force" that would be binding on all members of the UNFCCC, with effect from 2020 (UNFCCC, 2011:2).

[52] This will depend on the successful implementation of the Durban Platform for Enhanced Action (see footnote 51).

[53] Economic instruments to reduce GHG emissions force firms to internalise the full social cost of their activities by using market forces (Cloete et al, 2010). Internationally there is a move towards market based mechanisms to provide the central instrument climate change mitigation policy framework since they provide greater flexibility (and thus reduce the cost of mitigation) relative to firms when making mitigation decisions relative to direct regulation (which includes instruments like production and technology standards). Cloete et al (2010:xii), however, point out that while economic instruments are more efficient in s, "ultimately the particular country and sector context" will determine the most appropriate instrument to use. The main economic instruments to generate a broad-based carbon price are carbon taxes and emissions trading schemes (see Cloete et al (2010) for an overview of these instruments). Both instruments have benefits and disadvantages, and the choice of instrument will depend on local conditions (see, for instance, Goldblatt (2010) and Robb et al (2010)). The distinction between these two instruments, however, has become less important recently as innovative design has moved their impact closer together (see ANNEXURE 2).

carbon-intensive goods from local production to cheaper imported products that do not reflect carbon costs (van Asselt et al, 2009).

Carbon leakage can be addressed in a number of ways[54]. Border adjustment measures, however, are particularly worrying from a South African perspective. Border adjustment measures (also referred to as border tax adjustments) levy a tariff on imported goods equal to the difference in carbon price between the importing and exporting country to remove the artificial cost advantage of imports that do not include carbon costs. Such measures allowing a lot of discretion in their implementation, and can thus easily be used as protectionist tools (Bordoff, 2009; Frankel, 2009). South Africa's exports are carbon-intensive compared to most other countries. They are thus particularly vulnerable to becoming less competitive as a result of border adjustment measures (Arndt et al, 2011; Atkinson, 2010; Cosbey and Wooders, 2011).[55]

To summarise, the third reason for South Africa's moving to a green economy is to ensure the economy remains competitive in a future carbon-constrained world.

The fourth reason for transitioning South Africa to a green economy, and one on which the South African government places much emphasis, is the potential for local industrial development and employment creation. As the discussion below will show, however, there may be a trade-off between the prospect of uncertain future jobs in "green" industries and the stability of current jobs in other industries.

The importance attached to co-benefits by government is clear from the following official statements:[56] In 2008, the Minister of Environmental Affairs and Tourism described the transition to a "climate-friendly [growth] path as part of a *pro-growth, pro-development and pro-jobs strategy* [emphasis added]" (Van Schalkwyk, 2008:28). More recently, President Zuma (2011:1) reiterated that addressing climate change provides opportunities an opportunity for an economic transformation that will generate "green, inclusive, sustainable and shared growth ... which improves infrastructure, health, education and all basic services that our communities need to have an improved quality of life". He went on to emphasise that "decent work is at the centre of our efforts to build a more inclusive green economy".

This thinking is also reflected in the Economic Development Department's (EDD, 2010) New Growth Path strategy, which calls for the creation for 300 000 jobs in the green economy by 2020.[57] A number of local studies have also attempted to quantify the potential of 'green jobs'[58] in South Africa. Rutovitz (2010) believes that some 72 000 jobs could be created in the renewable energy sector in South Africa by 2030. The study also found that an additional roughly 36 000 jobs could be created if South African implemented policies to boost its local renewables manufacturing capabilities.

Casting the net beyond energy generation to include sectors involved in energy and resource efficiency, emissions and pollution control and natural resource management, Maia et al (2011) estimated that the

[54] Importers can be forced to internalise the cost of carbon in their imports by requiring them to surrender emissions or emissions reduction certificates (purchased from authorised local or international trading schemes) to local authorities that cover the carbon content of imports (Frankel, 2009; van Asselt et al., 2009). Labelling requirements, product specifications and a host of other measures can at best be used to allow local consumers to differentiate between more and less carbon-intensive goods), and at worst serve as non-tariff barriers masquerading as environmental policy initiatives (Van Asselt et al, 2009).

[55] One of the reasons for a focus on renewable energy in the 2012 IPAP (Dti, 2012:66) is to "safeguard [South African] exports from possible punitive carbon tariffs or taxes in increasingly sensitive export destinations."

[56] What is less clear, however, is whether the belief that these co-benefits will materialise is justified. This issue is returned to later in this section.

[57] EDD (2010), however, does not provide a definition of what it sees as the 'green economy'. The conditions necessary for these jobs to materialise, or the factors that may prevent them materialising, are also not addressed. This uncritical view of the potential positive spin-offs to a move to a green economy is common in local policy circles.

[58] UNEP (2008:3) defines green jobs as "work that contributes substantially to preserving or restoring environmental quality".

green economy in South Africa could create approximately 98 000 new direct employment opportunities in the short term (2011 – 12), 255 000 the medium term (2013 – 17); and 462 000 in the long term (2018 – 25).

The findings of these studies, however, are open to serious question. They look only at the employment potential in green sectors without taking into account the impact of growth in these sectors (or the impact of policies to support growth in these sectors) on the rest of the economy. Also, at best scant attention is paid to the conditions that need to be put in place for these employment outcomes to materialise.

If employment creation is to be used as an argument for a move to a green economy, the emphasis should be on the net employment impact (World Bank, 2011). And here the evidence becomes weaker. Considering the possible impact of renewable energy on growth and employment in the European Union, EmployRES (2009) finds that net employment creation of these technologies is significantly smaller than gross employment creation. This is a result of investments in renewable energy displacing investment in other energy sectors, and also of the negative effect that the higher cost of renewable energy (relative to conventional energy sources) has on demand in the rest of the economy. Taking these and other factors into consideration, Gülen (2011) questions whether green energy investments will lead to net employment creation.

Huntington (2009) considers a number of widely quoted estimates of the employment creation potential of renewable energy in the US, and concludes that it is significantly overstated and will materialise only if the cost of these technologies is dramatically reduced. Huntington (2009:12) believes the best guess is at current costs the employment impact of renewable energy will “be relatively small and the direction unknown”. This does not mean that support for renewable energy may not be justified on environmental or other grounds (like security of supply), but does imply that a greater emphasis on economic costs than employment creation potential is warranted when deciding whether to support renewable energy (Huntington, 2009).

The expectation of significant growth in green jobs in South Africa, as apparently everywhere, is also based on policy interventions driving the development of a domestic renewable energy manufacturing industry (DTI, 2011; Maia et al, 2011; SARi, 2010). Hughes (2011:6), however, is sceptical of this reasoning. With respect to the UK, he points out that the economic assumptions underpinning the widely held belief that green energy policies will promote innovation and the development of new industries does not hold since “Almost every country in the world wants to claim the same benefit”. Gülen (2011) mentions that there already is competition in the international renewables manufacturing industry, with new companies from countries like China, India and South Korea competing effectively with established suppliers in Europe and the US.

The protectionist measures (tariff protection, local content requirements, etc) that are often proposed to develop local industries will thus lead to higher production costs and amplify the potentially negative impact of more expensive renewable energy on the rest of the economy. By increasing costs, they may also retard the development of the market for products like renewable energy, and with it the local downstream activities like installation and tailored financing that often provide the bulk of employment opportunities associated with green sectors.[59] These measures also strain trade relationships, and may lead to retaliatory measures by countries negatively affected by these measures. Should the trade relationships deteriorate into ‘trade wars’, the impact on the rest of the economy may be severe as the prices of imports rise and access to export markets is constrained.[60]

[59] Of the 100 237 people employed in the solar industry in the US in 2011, more than half were involved in installation activities (52 503). A further 17 722 individuals were employed in sales and distribution, while only 24 064 were employed in manufacturing (The Solar Foundation, 2011).

[60] The trade relationship between the US and China is currently at risk of such a deterioration. China has recently lodged a case at the World Trade Organisation against the imposition of U.S. import tariffs on 22 Chinese products that the United States believes are subsidised or unfairly priced (ie dumped on the US market). These products include solar panels and steel towers for wind turbines (Bradsher and Cardwell, 2012; Miles, 2012). In retaliation, Chinese producers of polysilicon,

The impact on the rest of the economy of measures to develop local industry warrants particular attention in South Africa, since the average import tariff applied to imports of environmental goods and services in South Africa is less than half of the tariff applicable to merchandise imports overall (3.6 percent versus 7.8 percent) (World Bank, 2011). South African firms are thus able to procure environmental inputs and technologies from the most competitive international suppliers with low tariff costs.

Of the four reasons to transition to a green economy, incentivising global action to reduce future climate change (and its impact of South Africa) seems to be the strongest. If global coordinated action is forthcoming, it is expected that economic instruments and potentially border adjustment measures will become more widespread. A transition to a green economy thus also seems justified as a way of safeguarding the competitiveness of South Africa's exports in a carbon-constrained world. As is maintaining South Africa's prominent role in the international climate change negotiations it is seen as another way of pushing for global action. The potential for co-benefits like employment creation through a move to a green economy is more contentious. More work in this area is needed if the government wants to continue to make it one of the cornerstones of a transition to a green economy.

In summary, there are compelling reasons for South Africa to move to a green economy. The carbon-intensive nature of the South African economy, while increasing the need to transition to low-carbon economic activities as a risk reduction measure, also means that such a transition will be a mammoth task. The transition may include a number of opportunities in areas like facilitating a structural change towards higher value and knowledge-based economic activities and non-traditional tradable goods and services that can diversify exports, and could even possibly support labour-intensive and broad-based industrialization (Cloete and Robb, 2010). In addition, carbon pricing may lead to increased competitiveness as firms are forced to audit their production process for unexploited efficiencies to offset carbon costs (MEDS, 2007; Demailly, 2008). However, these effects may be insufficient to compensate for a potential loss of competitiveness by emissions-intensive South African sectors relative to competitors in countries with less strict carbon policies or more carbon-efficient production processes in the short to medium turn.

Potential competitiveness concerns are concentrated in upstream sectors, particularly in sub-sectors that utilise energy- and emissions-intensive processes to produce low-value-added products (Neuhoff and Matthes, 2008). These sectors are important to South Africa's international competitiveness. Energy-intensive upstream resource-based manufacturing currently constitutes a large part of the economy, until recently attracted significant local and foreign investment, and contributes disproportionately to exports (Winkler and Marquard, 2007). Reducing the competitiveness of these sectors would be problematic from a broader policy perspective, since the socio-economic challenges facing South Africa as a developing country (high levels of poverty, insufficient service delivery, high unemployment, etc.) mean that climate change mitigation must be balanced with the need for sustained economic growth and employment creation (DEAT, 2009). A structured approach for understanding the implications of a move to green economy (including the economy-wide impacts of favouring some kinds of jobs and investments over others, investing in certain types of infrastructure, etc) managing trade-offs with existing polices, and also trade-offs between short- and long-term costs and benefits, is required to ensure that balance is achieved.[61] What the impact of mitigation action in South Africa may be, and whether the issue of trade-offs is receiving sufficient attention by local policymakers will be addressed in the next section.

a key input into the production of solar cells, are lobbying the Chinese Ministry of Commerce to impose duties on imports of polysilicon from American (Bloomberg News, 2012).

[61] See Fakir et al (2011) for one conceptualisation of what such an approach may look like.

8. A GREEN ECONOMY AND SOUTH AFRICA'S EXISTING POLICY OBJECTIVES

8.1 Economic impact of mitigation actions

The expected economic impact of climate change mitigation actions on an economy depends on numerous factors. These include the estimation of baseline GHG emissions, the objectives of mitigation policy (targets and timeframes), the degree of flexibility allowed in the mitigation policy regime, the substitution possibilities open to producers and consumers to reduce emissions, the expected rate of technological change, whether the value of co-benefits from mitigation action is included (eg reductions in air pollution), and the discount rate used (Barker et al, 2007, Weyant, 2002).

Some of these factors, like the discount rate, are pure assumptions. Others, like the extent or nature of climate change policy, can change over time and are largely exogenous. Additional factors like substitution opportunities are largely fixed in the short and even medium term and can thus be considered structural economic characteristics.[62] Understanding the potential for substitution towards lower GHG inputs or products is thus an important factor in assessing the likely costs of mitigation actions. In order to do this, sufficient information is necessary with respect to the availability and cost of appropriate technologies and the replacement rate of infrastructure and capital equipment (Weyant, 2002).

Historically mitigation costs and potential have been assessed using two distinct approaches. 'Top-down' approaches take an economy-wide perspective and generally employ macroeconomic models using historical and current aggregate data. 'Bottom-up' approaches, in contrast, typically deal with mitigation options in individual sectors and focus on factors like current practices and available technologies, costs and characteristics like technology maturity and risk (Barker et al, 2007a; Hoogwijk et al, 2008; UNFCCC, 2008).

Both approaches have strengths and weaknesses. The top-down method typically includes more generic mitigation options, but also includes changes in market prices that drive behavioural change and also highlights substitution effects in input and output markets. Bottom-up models add richer information on individual technologies, and also highlight supply constraints to a greater degree than top-down models (Tol, 2000). The distinction between 'top-down' and 'bottom-up' approaches has become less clear as modellers have integrated bottom-up features (like increased technology detail) into top-down models while macro-economic feedback effects, changes to relative prices and other barriers to adoption have increasingly been built into the structure of bottom-up models. There has also been greater use of hybrid approaches where top-down and bottom-up models are explicitly integrated (Halsnæs et al, 2007; Hoogwijk et al, 2008).

It is currently uncertain what level of mitigation effort the government is aiming to achieve. While the PPD trajectory does provide some indication, it will not be the final word on the issue (see ANNEXURE 1). While this complicates the analysis of the expected impact of mitigation actions, it also means that there is at present not a fixed trade-off between climate change policy and other policy objectives. The timing and extent of mitigation goals have not been finalised, and nor has the likely aggregate impact of mitigation actions. The best indication of mitigation effort currently is still the National GHG Emissions Trajectory Range (based on the PPD trajectory) as defined in the National Climate Change Response White Paper and accompanying documents, but this trajectory may change soon as sectors undertake activities to generate the information required for the process of carbon budgeting.[63]

[62] Substitution opportunities are obviously influenced by factors like technological change, but this typically takes time.

[63] The White Paper calls for sectoral carbon budgets to be in place by 2013 and processes of mechanisms to translate sectoral carbon budgets into individual company level "desired emissions reduction outcomes" for firms above an as yet unspecified emissions threshold by 2014 (DEA, 2011:25). It is unlikely that these timeframes will be met, but they do indicate a measure of urgency on the part of government. Also – it is not clear what mechanisms have been put in place to incentivise sectors to generate the detailed information required to construct budgets.

In South Africa there is a dearth of information on current emissions, and the cost, riskiness and commercial viability of mitigation options, at a sector (and particularly sub-sector) level (Cloete et al, 2010; NPC, 2011). As a result, economic modelling of the likely economic impact of mitigation in South Africa has been based mostly on top-down methods with limited (if any) bottom-up elements included.[64] The lack of lack of bottom-up information could have significant effects on the robustness of modelling results. Given the emissions-intensity of the South African economy and the prominent role of emissions-intensive sectors, having underestimated the impact of mitigation actions could have serious knock-on effects that will not be picked up in economic modelling.[65]

South Africa's most significant medium- to long-term mitigation options, however, are concentrated in upstream sectors, particularly those of electricity generation, transport and liquid fuels (SBT, 2007). Hoogwijk et al (2008) compared the results from six top-down models with bottom-up estimates of mitigation potential[66] for four broad sectors (energy supply, transport, residential and services, and industry) in three regions (OECD, Economies in Transition[67] and the rest of the world). They found that energy and transport were the sectors for which the results from the two approaches were the most comparable. However, the results for both approaches showed most variability when applied to non-OECD countries.

Taking all of the above factors into account, there has been a reasonable degree of consistency in the results of studies that have looked at the possible impact of mitigation activities on the South African economy. Most of the studies used a carbon price as either a way to incentivise, or to serve as a proxy for, mitigation actions; the LTMS was again an exception, since the impact of direct mitigation actions was modelled for some scenarios. The results of some of the most cited local modelling exercises are provided below.[68]

Van Heerden et al (2006) found that a carbon tax would lead to a relatively small reduction in GDP, and that if the revenue raised by the tax is used to stimulate demand in the economy, the net impact on the GDP could even be positive.

The authors considered four possible ways of taxing GHG emissions at a price of R35/tCO_2: a direct tax on emissions, a fuel input tax, a tax on electricity use, and a tax on all energy. Without revenue recycling[69], all

[64] A notable exception is the LTMS, where a hybrid approach was followed that combined a top-down economic model with a bottom-up model of the energy supply sector in South Africa. Beyond the energy sector, however, limited bottom-up information was included, as the focus was placed on a number of specific mitigation interventions (referred to as 'wedges') due to data limitations (SBT, 2007)

[65] The LTMS identified a number of mitigation options as no- or low-cost, particularly relating to energy efficiency (SBT, 2007). Recent research, however, suggests that the situation may be more complex. An analysis of the mitigation options in a number of focus sectors, found few negative cost options (Cloete et al, 2010). Since 2008, the local price of electricity has increased significantly, which has led to the implementation of a number of energy efficiency options and other mitigation measures that have enabled firms to adjust to higher energy prices (Cloete et al, 2011). All sectors have, however, not implemented energy-related mitigation actions to the same extent, and firms are also at different stages of implementation (Cloete et al, 2011). While this may be the result of normal difference in cost structures between firms (which influences the way firms respond to all price shocks, not just from energy), this may also suggest that there are non-price barriers to energy efficiency interventions, particularly among smaller firms. If this is the case, these non-price barriers need to be better understood if carbon-pricing is to be used to incentivise the uptake of energy-related mitigation actions.

[66] Developed in Hoogwijk (2008a).

[67] Defined as Central and Eastern Europe and the Former Soviet Union.

[68] The National Treasury is currently undertaking a modelling exercise to evaluate the likely impact of a carbon tax on the South African economy. The final results of the exercise have not been released. Preliminary results, however, are broadly consistent with that of the studies mentioned here. The overall impact of a carbon tax largely depends on how the resulting revenues are used and on the availability of mitigation technologies. If revenues were recycled through a reduction in direct or indirect taxes, GDP would be reduced by only 0.18% in 2035. Inequality is marginally reduced, and a positive employment impact is expected (National Treasury, 2011).

[69] How carbon tax revenues are applied, known as revenue recycling, is a critical element of tax design, and will have a significant influence on the overall impact of the tax on the economy (Devarajan et al, 2009).Theoretically, a carbon tax should aspire to revenue neutrality (revenues are fully offset by reductions in other taxes) in that its objective is to change behaviour, not to raise revenue (Sumner et al, 2009), The revenue neutrality goal can be achieved through tax relief from

forms of taxation lead to a small reduction in GDP ranging from 0.093 percent (for a fuel tax) to 0.213 percent (for an energy tax). If the revenue raised by the tax instruments, however, were recycled through lower taxes on food, the GDP impact becomes marginally positive. Moreover, when combined with the food tax reduction all the different tax instruments modelled led to a decrease in GHG emissions, an increase in unskilled employment, and an increase in the consumption share of the poor. Van Heerden et al (2006) thus state that climate change mitigation policy could thus potentially lead to a "triple dividend" effect where an environmental benefit is coupled with an increase in income and a reduction in poverty.[70]

The LTMS modelled the economic impact of three mitigation scenarios. "Start Now" included interventions that were expected to have no net cost in the long term, while "Scale Up" included additional mitigation actions that had a positive cost.[71] The third scenario, "Use the Market", focused on tax and incentive packages. The results of this modelling showed that mitigation is likely to have only a small aggregate impact on growth and welfare. Ranging from a decreased in GDP in 2015 by 2% for the 'Use the Market" scenario to an increase an increase of 1.26% for "Scale Up". Interestingly, the impact on growth and GDP were not always in the same direction.

The initial modelling done in the LTMS (Pauw, 2007) was updated with a model that allowed for capital stock to increase over time (capital-intensive mitigation interventions in one period increased the capital stock in the economy in the next period) (Kearney, 2010).[72] Overall, therefore, the updated model shows a smaller negative or bigger positive impact for all scenarios as increased investment leads to a higher capital stock and increased production capacity in the economy.[73]

"Start Now" led to a small (0.1%) reduction in GDP in 2015 in the original model (SBT, 2007). Employment decreased by 0.3%, but average household welfare increased by 3% (although most of the benefits accrued to wealthy households). The results of the updated model were broadly similar (DEAT, 2008; Kearney, 2010).

'Scale Up', in contrast, led to an increase in GDP of 1% in 2015 in the original model. Employment also increased, but average household welfare fell by 1% (although that of low-income households increased slightly). The results of the updated model were again broadly similar, but GDP increased by 1.26% and the impact on average household welfare was ambiguous (poor households gained more and rich households lose less).

For the 'Use the Market' scenario, the results of the original and updated models differed significantly. In the original model, GDP was reduced by 2% in 2015, employment impacts were flat and welfare impacts generally negative. In the updated model employment impacts, GDP growth and welfare impacts all turned positive as a result of increased investment. GDP increased by 0.73% over the entire period to 2050.

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other taxes, or a weaker form of neutrality can be achieved on the expenditure side of the budget by spending on areas directly related to the tax such as mitigation technologies or transfers to the poor. The provision of relief from other taxes could enhance the overall efficiency of the tax system, providing a 'double dividend' of increasing growth prospects and reducing negative environmental impacts (Clarke, 2010). See Cloete and Tyler (2012) for a more detailed discussion of revenue recycling in the South African context.

[70] See Van Heerden et al (2006) for a discussion of 'double dividends' in environmental policy, which investigates the possibility that environmental tax could, in addition to environmental benefits, lead to economic or social co-benefits through the removal of existing distortions within the tax system.

[71] The overall cost of all mitigation actions was calculated to be R39/tCO_2.

[72] The static CGE model fails to solve for periods after 2030 due to a lack of substitution opportunities in the economy (and in particular a lack of natural gas supplies) for the "Use the Market" scenario. Due to concerns about the stability of results, results are only reported for the period 2005-2015 for all three scenarios (Pauw, 2007). The dynamic model provides results up to 2050 (Kearney, 2010). So the results are not directly comparable.

[73] The assumption of constant returns to capital is, however, questionable in some sectors. Investment in technologies like carbon capture and storage, for instance, may not only not lead to additional output, but may actually reduce the efficiency of some plants. Additional bottom-up analysis is required to assess the extent of this risk, which in turn will allow top-down models to be specified more accurately.

Devarajan et al (2009, 2011) considered the impact of carbon taxes on the South African economy in the presence of structural rigidities, mainly limited labour market flexibility and limited substitutability between capital and energy inputs. They confirm the standard result in the economic literature that a carbon tax with a broader base (ie a tax on all CO_2 emissions) is less detrimental to economic growth than one that is levied on a narrower set of goods (like energy-intensive commodities). In addition, they find that the economic cost of a carbon tax is increased if there is limited labour market flexibility (ie workers can't easily move between sectors to equalise wage rates). As the difficulty to substitute energy inputs for capital in the production process increases, so too does the welfare cost of a carbon tax, with the owners of capital being negatively impacted by a decrease in the return on capital.

Devarajan et al (2011) found that reducing South Africa's GHG emissions by 15% using a tax instrument led to a 0.33% (in the case of a flexible labour market) or 0.35% (with labour market rigidities) reduction in welfare.[74][75] In addition to increasing the welfare cost of a carbon tax, labour market rigidities also worsened the employment outcomes of low and medium skilled workers, where a reduction in employment of 0.9% (flexible labour market) fell further to 1.01% (rigid labour market). Devarajan et al (2009) showed that if the revenues generated by the carbon tax were used to reduce other taxes,[76] the welfare impact was reduced to 0.27% (with a flexible labour market) or 0.26% (assuming labour market rigidities).

In general, the studies above (and other local studies) found small aggregate impacts (whether positive or negative), and to a large extent the impact depends on the way the mitigation actions are implemented (and in particularly how revenues from carbon taxes are used, or whether other supporting measures are in place to reduce the impact of mitigation policy actions).

The World Bank (2011) confirms that the results of South African studies on the economic impact of GHG mitigation activities are consistent with the results of international studies. These studies typically find that while there is an economic cost to reducing GHG emissions, this cost can be reduced by using efficient policy instruments (like broad-based carbon taxes rather than highly specific energy taxes), and by recycling revenue to reduce the impact of existing distortionary taxes in the economy.[77]

Given that the bulk of South Africa's GHG emissions are energy related (see Section 6), one of the likely impacts of mitigation policy in South Africa will be to increase electricity prices (whether through direct interventions like increasing the proportion of electricity produced from renewables or the use of indirect instruments like carbon pricing). Given the sharp real increase in electricity prices in South Africa since

[74] The labour market rigidities modelled by Devarajan et al (2011) include rigid wages, reduced labour mobility and differential wages between sectors for workers with the same skills stemming from labour market regulations and union agreements. In the flexible labour market scenario these rigidities did not exist. OECD (2010) found that a rigid labour market was an important factor constraining growth and employment creation in South Africa.

[75] Welfare was measured as the base expenditure of all household. In an earlier study, Devarajan et al (2009) found that a 15% reduction in GHG emissions reduced GDP by 0.2%.

[76] An equal reduction percentage reduction in all indirect taxes (production taxes, sales taxes, value-added taxes, and import tariffs) in the economy is assumed.

[77] When setting mitigation policy there is a trade-off between environmental efficiency (the expected reduction in emissions) and economic efficiency (the cost of the policy to the wider economy). From a purely environmental efficiency perspective a carbon tax with no revenue recycling may be desirable since the competiveness of firms in carbon intensive activities are reduced (which should facilitate a structural transition in the economy was investment is targeted at lower carbon activities and sectors) and the disposable incomes of consumers are reduced (reducing expenditure and emissions in the wider economy). Revenue recycling is a way of reducing the economic cost of a policy like carbon taxation to both increase the political acceptability of the policy and to make any structural adjustments in the economy more orderly and less costly (see Cloete et al, 2010).

2008[78], it is tempting to consider the impact of increasing electricity prices on the economy to date as indicative of the expected economic impact of future mitigation policy measures.[79]

There are a number of problems with this approach. Firstly, this period coincided with the economic slowdown in the wake of the recent global financial crisis. This makes it difficult to disentangle the impact of electricity price increases with that of a decline in export demand and economic activity more generally. Secondly, it is likely that there will be threshold effects as firms respond to increasing electricity prices. The past impact of electricity price increases may thus not be a good predictor of the impact of future price increases. Local firms initially focused on implementing energy efficiency options that are easiest, least cost and quickest to implement (Cloete et al, 2011). There are indications that many firms may have implemented the majority of these "easy" adjustments, and there may thus be uncertain structural adjustments in the future as firms and investors invest in new, more energy-efficiency plants, processes or technologies in the same sectors, or divest from certain sectors as competitiveness starts to decline.

Where firms are part of multinational groups of companies, however, the decision to close down old, inefficient installations and invest in new installations are typically taken separately. Production facilities that are closed down in South Africa as a result of rising electricity costs may thus not be replaced with new facilities in South Africa (Cloete et al, 2011). In fact, some commentators believe that this is already happening and that mining and energy-intensive manufacturing firms are closing South African operations and relocating to foreign locations with lower energy costs, though of course there may be other factors involved too (Lazenby, 2012). With this in mind, it is worth noting that monthly nominal manufacturing sales in South Africa regained its July 2008 peak only in January 2012. On a seasonally adjusted basis, physical manufacturing production in South Africa in April 2012 was only 4% higher than 2005 levels (and still 13% below its April 2008 peak) (StatsSA, 2012). So while this does not necessarily indicate causality, the manufacturing sector in South Africa has been under strain in recent years (and there has been negligible growth in production volumes since 2005). Any claims that the South Africa economy has coped relatively well with increasing electricity prices, and should thus easily be able to accommodate the cost-raising effect of mitigation policy, would thus seem suspect (the caveat about the impact of external factors like the global economic slowdown notwithstanding).

8.2 Impact on policy environment

The models described in the previous section suggest that the cost of climate change mitigation is modest and therefore manageable. Intuitively, this is surprising. After all, the immediate effect of mitigation measures is to impose additional costs on enterprises which, in the absence of compensating actions, will reduce the firms' competitiveness. Clearly what will matter is precisely what the mitigation measures are and also how they are applied. For instance, imposition of a carbon tax, accompanied by a reduction in other taxes so that the tax burden on firms is not increased, should have no impact on firm competitiveness and is likely to increase the effectiveness of the economy as a whole.

But one can easily imagine other scenarios where the outcome will not be benign. Should a significant carbon tax with no recycling be levied on carbon-intensive local export sectors, it is possible that these sectors may shrink relatively fast. Given the structural rigidities in the South African economy (particularly a lack of labour market flexibility, see Devarajan et al, 2011), it may take a long time for resources to migrate from these sectors to more carbon-efficient local sectors. The adjustment cost from moving to a green economy in this fashion is expected to be large, and may not be politically or socially feasible.

[78] From 2008 to 2011 average Eskom tariffs increased by a factor of 2.6. Including the most recent increase in April 2012, average Eskom electricity prices have more than tripled since 2008 (see Eskom, 2012).

[79] The impact of mitigation policy would go further than simply increasing the cost of electricity. It would also increase the cost of other energy – and emissions-intensive products – thereby impacting relative prices throughout the economy.

Moreover, apart from potential issues affecting the models in questions (see footnotes 65 and 73 in addition to the discussion on the lack of bottom-up information earlier in this section), there are other factors not captured by economic models that may influence the impact of climate change mitigation actions on socio-economic outcomes.

Among the most important of these is the possibility that a focus on climate change mitigation could distract government from its other goals. Admittedly, as Section 0 has shown, government emphasises that the economic and social pillars of sustainable development will not be neglected during a transition to a green economy. But, as we have also seen in Section 2, South Africa faces formidable socio-economic challenges, and its record in addressing them is far from satisfactory. The addition of a "green" objective, with all its attendant complexities, materially increases the difficulties of socio-economic and other policy formulation. It also, because of the many different departments and other interests involved, makes policy implementation far more difficult.

This notion is supported by Anex (2009:7) who emphasises that since cognitive and analytical resources are limited, and that policy-making inevitably involves "conflicting objectives representing the values of different participants with no optimal solution", the fewer the number of policy objectives, the greater the likelihood of success.

Furthermore, the "Tinbergen rule" states that at least as many instruments as targets are required in order to achieve a given policy objective (Tinbergen, 1952). Traditionally policymakers thus had no choice but to proceed with consecutive comparisons based on a limited number of evaluation criteria when deciding on practical actions to achieve their policy goals (Anex, 2009; Lindblom, 1959). Modern analytical techniques like multi-criteria decision analysis (MCDA), however, can assist policymakers to consider the trade-offs and interactions between competing policy objectives. But these techniques are only useful when policy objectives are "well-defined and salient to decision-makers" (Anex, 2009:13; Bazilian et al, 2011).

At present it seems unlikely that the impact of facilitating a transition to a green economy on policy complexity has received sufficient attention.[80] The way the green economy has been described by policymakers in South Africa indicates a belief that policymakers can 'have their cake and eat it too' by simultaneously addressing all three legs of sustainable development (see, for instance, EDD,2010; DTI,2012; NPC,2011; Zuma ,2011). While this might be true in the long term, it is certainly not the case in the short term (NPC, 2011).[81]

The lack of a framework for identifying and addressing possible trade-offs explicitly is expected to lead to an increase in misalignment between environmental, economic and energy policies in South Africa. Trollip and Tyler (2011) point out that neither the second Industrial Policy Action Plan nor the New Growth Path addresses the likely implications of having to reduce South Africa's GHG emissions post-2035 (as indicated by the PPD trajectory) for the sectors and strategies the two documents single out to stimulate economic development. Furthermore, the Integrated Resource Plan 2010 effectively reserves 50% of expected future

[80] Bazilian et al (2011), for instance, believes that the competing criteria used to evaluate the decision to build the Medupi power station in South Africa (and also those used by the World Bank to fund it) was not clearly articulated. It is thus not clear now the different competing policy objectives affected by the decision were reconciled.

[81] Surprisingly little attention is paid to short-term trade-offs in the National Climate Change Response White Paper (DEA, 2011). The White Paper does mention that certain sectors may be vulnerable to mitigation policy measures due to being emissions-intensive and trade exposed, and that this may entail 'economic risks'. Two solutions are suggested (DEA, 2011:30). The first is to negotiate international commitments that allow South Africa "sufficient time and development [carbon] space for the required economic transition to [a] lower-carbon econom[y]". The second is to "manage and reduce the economic risks" at a national level. No indication of how this is to be done is provided. The White Paper does call for National Employment Vulnerability Assessment (NEVA) to assess the likely impact of mitigation actions on sectors. The Department of Economic Development is tasked with implementing the NEVA largely, it would seem, without the Department's knowledge or buy-in. Work on the NEVA has not started yet and it is unclear when (and whether) this work will be undertaken.

allowable GHG emissions (again based on the PPD trajectory) for the electricity sector without considering the impacts of this on the rest of the economy. Finally, Trollip and Tyler (2011) assert that the initial discussion paper on carbon taxes issued by the National Treasury[82] does not reflect a full understanding of the dynamics of the South African energy sector.[83] This is problematic since this is the sector where most of the trade-offs between mitigation and South Africa's development priorities are expected to occur as carbon pricing will increase the cost of energy; which will have knock-on effects throughout the economy. If energy, industrial and mitigation policies are not aligned, it could mean that only some (or even none) of the policy objectives in these areas are achieved. Or even achieved, the cost may be much higher than would have been the case had policies been designed to work with rather than against one other.

In summary, as an additional national policy objective, the transition to a green economy will undoubtedly add to the complexity of policy-making in South Africa. In theory, this new objective is compatible with existing policy objectives that focus on the economic and social dimensions of sustainable development. In practice, however, if structures and processes are not put in place to deal with this enhanced complexity, the government runs the risk that some existing objectives will be jeopardised by a short-term focus on the transition to a green economy. The fact that the National Climate Change Response White Paper (DEA, 2011), however, calls for the economy-wide impacts of mitigation actions to be explicitly considered when carbon budgets are developed (which in turn will inform overall mitigation ambition), reducing the risk from what Mendelsohn (2009:14) calls the "biggest threat climate change poses to economic growth" – namely overly aggressive short-term mitigation actions.[84]

It is thus unlikely that South Africa's existing policy objectives will be unexpectedly hamstrung by a move to a green economy. The real risk inherent in managing the transition to a green economy in the absence of a transparent mechanism for trading-off policy objectives may therefore be that policymakers are not willing to countenance any trade-offs whatsoever that harm the attainment of existing policy objectives in the short term– even if it becomes apparent that the world is moving to a carbon-constrained economic system. If this is the case, mitigation action might not be sufficiently stringent to incentivise a move to a more carbon-efficient economy, and South Africa's economic prospects may be harmed by being stuck with an outdated, overly carbon-intensive economic structure.

[82] An updated policy paper laying out the design of a carbon tax in South Africa is expected to be released by the National Treasury in the second half of 2012.

[83] Neither the liquid fuels nor the electricity markets in South Africa have competitive market structures. This complicates the transmission of carbon prices throughout the economy, and if not address in the design of a carbon tax, may impact on the efficacy of such an instrument in reducing GHG emissions (Trollip and Tyler, 2011; Cloete and Tyler, 2012).

[84] This is contingent on economy-wide impact assessments being transparent and credible. This will necessitate the models and other tools used taking into account not only sufficient bottom-up technical detail to model sectors accurately (ie ensuring accurate assumptions about technical substitutions opportunities), but also consider the specific characteristics of mitigation actions (ie investments in some mitigation technologies may have negative returns by not generating a return and/or reducing the efficiency of existing processes).

9. CONCLUSIONS

The South African economy has under-performed most emerging economies over the last two decades. Furthermore, despite a wave of early optimism, it has not realised its socio-economic development aspirations. While some (even if patchy) progress has been made in provision of services, along with substantial progress in establishing a social safety net, the same cannot be said about economic growth, eradicating poverty, increasing employment and reducing income inequality. To the government's list of priorities has recently been added the desire to reduce the extent of future climate change through the reduction of national GHG emissions.

The scientific basis for action is clear. The earth has already warmed, and further warming is expected. Despite uncertainties about the timing, extent and spatial distribution, there is a consensus that the impact of this warming will generally be adverse. On some assumptions, it could even be catastrophic.

Uncertainty also exists regarding the economic case for action. Most economists agree that action is warranted (itself no small feat), but there is not a consensus about what actions should be taken. This disagreement is linked to different perspectives on how the future costs of unconstrained climate change, and thus also the benefits from actions to limit the extent of climate change, should be assessed. The underlying issue is society's attitude towards risk, and particularly how comfortable we are to leave future generations to confront the possibility of catastrophic climate change.

There are additional uncertainties about the cost of future mitigation actions (and the knock-on effect on other socio-economic policy objectives). These include, on the up side, the possibility of commercialising CCS at affordable rates, drastically reducing the cost of renewables through technological advances or economies of scale, and the cheap (and environmentally responsible) extraction of non-conventional gas supplies to serve as an interim lower-carbon fuel while the transition to low- or no-carbon fuel sources is underway. On the down side, a distrust of nuclear energy following the Fukushima Daiichi disaster, the cheap extraction of unconventional oil or the expansion of particularly carbon-intensive fuel sources like oil from tar sands in Canada may require much deeper emissions cuts (at much greater cost) to be made elsewhere to avoid catastrophic climate change.

Climate change is a complex issue that spans many spheres. Even in benign scenarios, the health of individual ecosystems will be jeopardised and there will be social and economic consequences of various kinds. There will be winners and losers, patterns of activity will change and adjustment costs will be variably distributed.

Crucially, the impact of even low-level climate change will be borne disproportionately by the poor. Not only do they typically depend more directly on nature for services like energy, shelter and sustenance, but they also lack the resources to adapt to changing climate patterns.

In the worst-case scenario, climate change threatens not only individual ecosystems but that of the world as a whole. This would result in economic and social impacts that are impossible to fathom.

Climate change has long been regarded as a sustainable development issue. It impacts on all three pillars of sustainable development: environmental, economic and social. The health of socio-economic systems depends on a balance between these three pillars. The environmental impact of climate change could potentially lead to the health of any one of the other two pillars falling below a sustainable level, which causes the whole system to break down. But if one of the other two pillars becomes unsustainable, the system also breaks down. And since the goal of sustainable development is to keep the overall system in balance, this renders the environmental benefits of reduced climate change futile.

This interconnectedness between the transition to a green economy and South Africa's economic and social policy objectives is well understood by policymakers, if not always clearly reflected in their terminology. What needs to be more clearly communicated is that the 'green' economy in South Africa is framed as an economy that meets sustainable development criteria. Its greenness is not derived from the potential environmental benefits of mitigation actions, but rather from the desire to prevent climate change from reducing the flow of ecosystem services to a level that jeopardises sustainable development. This definition implies a direct focus on the economic and social pillars of sustainable development.

From a theoretical perspective, then, climate change mitigation is not incompatible with South Africa's existing socio-economic goals. Indeed, government believes that mitigation actions can directly benefit the other two pillars in three ways.

Firstly, the poor is most at risk to climate change, so mitigation actions support socio-economic goals in the long term.

Secondly, mitigation measures will increase the competitiveness of the South African economy in a carbon-constrained future, and in the medium term present a way of avoiding trade measures linked to GHG emissions that may disadvantage local exports. At present the risk of this seems low, since only the EU amongst South Africa's trading partners has broad-based carbon prices in place. This may change before the end of the decade since the parties to the UNFCCC have agreed to having a global agreement to mitigate climate change by 2015 and in force by 2020. Further, given the emissions-intensity of South Arica's economy, in the absence of a local carbon price, it will probably take decades to reduce the emissions-intensity of exports to a level where GHG-linked trade measures are no longer a threat.

Thirdly, government is placing emphasis on the potential for co-benefits (in particular 'green' jobs) linked to mitigation actions. Whether this emphasis is justified, as suggested earlier, is somewhat doubtful.

Additionally, many of the actions required for an efficient transition to a green economy, notably increasing the flexibility of the South African labour market, or increasing the local skill base, will also have a directly positive impact on other local policy objectives.

In practice, however, the impact of climate change mitigation implemented as part of a transition to a green economy is less clear for two principal reasons.

The first is that the impact of mitigation on the economy is not well understood. The modelling exercises that have been undertaken indicated that they are expected to have small aggregate impacts (whether positive or negative), provided that mitigation policies are designed carefully.

A caveat to these modelling exercises is the lack of detailed information on the availability and attractiveness of mitigation options at a sectoral level. Further, all the exercises are based on circumstances that predate the sharp rise in electricity prices experienced since 2008. There is thus a possibility that many of the low-cost energy mitigation options available in the economy already have been implemented, thereby raising the average cost (and by extension the impact) of mitigation activities.

Secondly, the cognitive and analytical resources dedicated to policymaking are limited. By adding climate change mitigation to the mix, the ambitious objectives government is seeking simultaneously to meet may become too big and too complex to be intellectually manageable as well as practically implementable.

This problem is under-scored by the way in which the green economy is conceptualised in South Africa, *viz* a belief that all three legs of sustainable development can be addressed simultaneously without any trade-offs. While this might be true in the long term, it is certainly not so in the short term. Some indication of the rules

that will be used to manage possible trade-offs is thus required to create policy certainty. It these rules are clearly defined and priorities outlined, the increased policy complexity could be more easily managed.

Given that South Africa's contribution to global emissions is minuscule, the only way South Africa can achieve a material impact globally is for its mitigation actions to serve as an exemplar for encouraging other countries to do the same. Rather than trying to measure the direct costs and benefits of mitigation actions, viewing the cost of local policies as an insurance policy against (or even a lobbying payment to try and incentivise actions that prevent) catastrophic climate change may be useful. As such, it is important to have a clear idea of how much South Africa is prepared to 'spend' in terms of its other policy objectives.

In summary, there is no a priori reason why a gradual and well-planned transition to a green economy should have a negative impact on South Africa meeting its other policy objectives. In order to make sure this is the case, a better understanding is required of the potential costs and benefits of local mitigation actions at the sector level.

Thinking that the transition will be costless, particularly in the short term, however, seems overly optimistic. And to ensure that costs, should they materialise, do not have a negative impact on South Africa's development objectives, it is important to put in place a framework for dealing with them. At the very least, there should be a discussion about what costs would be palatable in order to reduce the risk of catastrophic climate change. Or looking at it from a different perspective, what level of cost will be seen as having a detrimental impact on the country meeting its overall developmental objectives?

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ANNEXURE 1: SOUTH AFRICA'S CLIMATE MITIGATION CHANGE GOALS

It is clear from the economic literature addressed in Section 5 that the cost of climate mitigation actions is closely related to the level of effort required (the size of the desired reduction in emissions) and the timeframe within which these reductions are to be achieved.[85] In South Africa, mitigation targets are still being formulated.

Ever since 2008, Cabinet has supported a 'Peak, Plateau and Decline' (PPD) emissions trajectory that aims to reduce South Africa's GHG emissions by 30-40% below its 2003 levels by 2050 (Van Schalkwyk, 2008, SBT, 2007). The PPD trajectory was based on the Long Term Mitigation Scenarios[86] completed in 2007, and in particular the "Required by Science" (RBS) scenario – which assumed that South Africa joined a global multilateral agreement to reduce climate change and negotiated a local emissions reduction target that reflected a "fair contribution" towards this aim (SBT, 2007:9). The PPD trajectory essentially provides South Africa with more time in order to reach the RBS scenario trajectory than assumed in the LTMS, and calls for national emissions to "peak in the period from 2020 to 2025, remain stable for around a decade, and decline thereafter in absolute terms" (DEA, 2011:27). The PPD trajectory was also the basis for the conditional commitment targets made by the South African government at COP17, and subsequently included in the Cancun Agreements at COP18 in Cancun, of 34% emissions reduction relative to "Business as Usual" by 2020 and 42% by 2025.[87]

The National Climate Change Response White Paper released in 2011 used the PPD trajectory as the basis of a "National GHG Emissions Trajectory Range" defined to 2050, to serve as a "benchmark against which the efficacy of mitigation action will be measured" (DEA, 2011:27). It was emphasised, that this was only an initial National GHG Emissions Trajectory Range which was open to review on the basis of "monitoring and evaluation results, technological advances or new science, evidence and information" (DEA, 2011:28).[88] It is thus clear that the PPD trajectory should not be seen as a series of absolute emissions targets up to 2050. Because a number of different conceptualisations of the PPD trajectory have been used since 2008, the DEA subsequently released an explanatory note to provide a "clear and unambiguous" definition of the PPD trajectory (DEA, 2011a:1).

The White Paper called for the use of a "Carbon Budget approach" that would specify desired "emission reduction outcomes" for emissions-intensive sectors that are "consistent with the benchmark national GHG emissions range trajectory" (DEA, 2011:28). [89]

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[85] The relevant level of effort and time frames determines how fast firms need to move from relatively low cost and 'easy-to-do' interventions to reducing their GHG emissions to more costly and complicated mitigation actions that may impact on their competitiveness and profitability.

[86] The LTMS was commissioned by the South African Cabinet in 2006 to examine the local potential for GHG emissions mitigation. The LTMS was informed by the best available information, and aimed to provide a "sound scientific analysis from which Cabinet could draw up a long-term climate [change mitigation] policy" (SBT, 2007:1).

[87] NPC (2011a) mentions that since the he conditions set for meeting these targets (which included the provision of finance, technology and capacity building support to South Africa) have not been met by developed countries, there is no legal obligation on South Africa to meet these targets.

[88] At a general level, private sector stakeholders have questioned the use of the PPD as the basis for defining South Africa's emissions reduction ambitions. This was because it was felt that the LTMS (on which the PPD trajectory is based) was essentially a scenario exercise. While it did enhance the information base on which to inform policy-making, and moved the climate change mitigation debate forward, it was felt that it did not include detailed enough information and nor were its assumptions sufficiently interrogated to form the sole basis of mitigation policy decisions (see Section 0**Error! Reference source not found.**) The use of the PPD trajectory as the basis for the National GHG Emissions Reduction Range has also been questioned on technical grounds by some stakeholders (see, for instance, BUSA (2011)).

[89] A national carbon budget is the overall quantity of carbon emissions that a country can emit over a specified period of time. By definition a carbon budget is cumulative; it is the total carbon space available over a period, expressed as a single volume of carbon dioxide equivalent emissions (Fakir et al, 2011). What exactly a 'carbon budget approach' as presented

The White Paper stated further that the carbon budget process would identify “optimal combinations” of mitigation options that (DEA, 2011:28):

- minimise cost from sectoral and national perspectives;
- maximise sustainable development benefits from the same perspectives
- support emissions reductions consistent with the benchmark National GHG Emissions Reduction Trajectory Range.

Despite the central role of the National Climate Change GHG Emissions Reduction Trajectory Range, the White Paper clearly stated that carbon budgets are to be developed in a bottom-up fashion based on the latest available information rather than having the sectoral carbon budgets would be developed based on a top-down assessment of what the budgets for individual sectors would need to look like in order to remain on the National Climate Change Emissions Reduction Trajectory Range. While consideration of the National Climate Change Emissions Reduction Trajectory is likely to be given when the notational and individual sectoral carbon budgets are developed, the emphasis will be on the current and expected future emissions trends by sector, the timing, potential, feasibility and cost of available mitigation options, and the expected economy-wide implications of meeting the derived carbon budgets (DEA, 2011:28).

As mentioned earlier, the conditions attached to South Africa’s Copenhagen pledges have not been fulfilled. Until the detailed information necessary to set individual carbon sectoral carbon budgets are completed, and these carbon budgets are proposed and debated, it is unclear what South Africa’s short-to medium-term mitigation ambition will be. In the long term, presumably, the government is still committed to achieving the RBS level of emissions. But this level is also subject to change based on new information and the outcome of international negotiations.

in the White Paper entails is not clear, since carbon budgets are typically specified at a national level and the budget is then allocated to individual sectors based through a political process. The White Paper, however, seems to indicate carbon budgets will only be allocated to some sectors. While carbon budgets are fixed in terms of the quantity of overall emissions, the distribution of emissions over time (or the underlying emissions trajectory) for a given budget can vary (Fakir et al, 2011). It is thus possible that the mechanism envisaged in the White Paper will allow certain carbon-intensive sectors to emit more in early years than a strict adherence to the PPD trajectory would imply, in return for greater emissions reductions in later years. In this way the total amount of GHGs emitted by a sector between now and 2050 would remain the same, but the sector would have more time before it had to start implementing costly and complicated mitigation options (or had to start scaling down its operations in the absence of cost-effective mitigation options).

ANNEXURE 2: TAX VERSUS TRADING - THE DEBATE HAS MOVED ON[90]

Historically, there has been a vigorous debate concerning the relative merits of taxes and emissions trading schemes (ETS). From a theoretical perspective, however, the two instruments are actually very similar. In a perfect world, a tax (which sets a price for carbon directly and then lets the market decide on the amount of GHG to emit) and an ETS (which sets the amount of GHG to emit directly and then lets the markets set the carbon price) – are flipsides of the same coin. Both instruments can be used to set the socially-optimal level of emissions.

In practice, both instruments have advantages and disadvantages, but these are very narrowly linked to the local context and it is difficult to make broad generalisations. It is a fallacy, for instance, to think that a trading scheme is equivalent to a carrot while a carbon tax is a stick.

Full auctioning of permits under a trading scheme essentially imposes a cost on producers akin to a carbon tax. And a low and escalating tax, as proposed for South Africa (NT, 2010), is almost identical in effect to a "grandfathered" trading scheme[91] that moves to full auctioning over time and in which the carbon price increases slowly over time. Furthermore, the revenues from auctioning permits and imposing a carbon tax both accrue to the national fiscus, and the revenue profile of a grandfathered trading scheme moving towards full auctioning over time closely matches that of a low and escalating carbon tax. Opting for a trading scheme over a carbon tax is thus no guarantee that, as many commentators fear, a carbon pricing framework will not turn out to be a revenue-raising tool disguised as an environmental policy instrument.[92]

Carbon taxes and ETS are no longer viewed as „either/or" options. A number of countries in Europe (like the UK and Denmark) have local carbon taxes that operate in conjunction with the EU-ETS. The carbon pricing framework in Australia has also highlighted the narrow distinction between carbon taxes and trading schemes. Given that the certificates in the initial three years of the scheme's existence will not be tradable, the scheme essentially functions like a carbon tax that transitions to an ETS over time.

As a result of the growing realisation of the blurred lines between carbon taxes and ETS, the local carbon pricing debate has shifted from weighing the pros and cons of carbon taxes and ETS, to ensuring that a carbon pricing framework is designed in a way that supports a carbon-efficient and competitive local economy.

In SA, the concentration of emissions in a few companies (notably Eskom and Sasol which account for just under 60% of South Africa's emissions)[93] currently precludes the effective functioning of a market-based emissions trading scheme since the level of market liquidity required for an emissions trading scheme to function effectively is unlikely to be achieved. Thus, by default, it is likely that the mainstay of SA"s mitigation policy suite will look more like a tax than a trading scheme in the near future.[94] This does not, however, mean that there is no scope for integrating ETS elements within a broader carbon tax framework.

[90] This Annexure is taken in its entirety from Cloete and Tyler (2012).

[91] An emissions trading scheme in which a set number of emissions permits is allocated free to participants based on their historical emissions.

[92] See, for instance, Deloitte (2009) and Rycroft (2011).

[93] Authors' calculation based on Carbon Disclosure Project 2009 data

[94] This may change if the structure of energy markets evolve (the government is aiming for 30% of electricity to be supplied by Independent Power Producers (Eskom, 2009), and as international emissions trading becomes more of a reality.