

Economics of climate change: Context and concepts related to mitigation

Emily Tyler
Zelda Dunn
Michelle du Toit



 Energy Research Centre
UNIVERSITY OF CAPE TOWN

G:ENESIS

 **EPRU**
Environmental Policy Research Unit

Economics of climate change: Context and concepts related to mitigation

HARALD WINKLER
ANDREW MARQUARD
EMILY TYLER
MARTINE VISSER
KERRI BRICK



February 2009
Energy Research Centre
University of Cape Town

Acknowledgements

These reports are the result of collaboration between the Energy Research Centre (ERC), Environmental Policy Research Unit (EPRU) and Genesis Analytics. ERC and EPRU are both research units at the University of Cape Town. The research by Genesis Analytics was commissioned by ERC, drawing on NRF funding which is gratefully acknowledged. The individual reports may also appear in other report series.

Contents

Acknowledgements	iii
1. Introduction	1
2. Sustainable development and climate change	1
3. Towards climate policy	1
4. Putting a price on carbon	2
5. Our history and the minerals-energy complex	2
6. Our low-carbon future and redefining competitive advantage	3
7. Carbon and carbon markets	3
8. Some key conceptual distinctions	4
9. A conceptual framework	5
10. Some broad questions	6
References	6

1. Introduction

Climate change is increasingly seen as not only an environmental issue, but a deeply economic one. ‘Climate change presents a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen’ (Stern Review 2006). Markets are failing to put a price on the emissions of greenhouse gases, passing the costs on to society as a whole.

2. Sustainable development and climate change

For a country like South Africa, where the priorities are focused on poverty alleviation and job creation, the challenge of reducing greenhouse gas (GHG) emissions has to be located very much in the context of development. Development in the sense of building the capacity to meet basic human needs. In this context, mitigation is very much a challenge of making development more sustainable (Sathaye *et al.* 2007; Munasinghe 2007; Winkler 2009a). Sustainable development has the potential to contribute to mitigation.

Conversely, climate change has the potential to undermine sustainable development. Climate change is already having predominantly negative impacts on people and ecosystems. The damages associated with the negative impacts of climate change are projected to be extensive (IPCC 2007). To highlight just two: natural systems are at threat, with several tens of percent of their endemic species threatened by extinction this century; and in terms of health, the spread of vector-borne diseases like malaria could put an estimated 124 million people in Africa at increased risk. The *costs* of the damages can – given our present state of knowledge – only be estimated in broad ranges. But what we do know is that the damage costs are likely to exceed those of reducing GHG emissions – maybe a factor of two, maybe ten, but larger. The costs of inaction outweigh those of climate action.

Putting a price on carbon aims to internalise those external costs. The African National Congress (ANC) recognised this in its resolution on climate change at the 2007 Polokwane conference. It called for South Africa to ‘set a target for the reduction of greenhouse gas emissions’ and identified as on the means to meet this target ‘putting a price on the emission of carbon dioxide and other green house gases’ (ANC 2007).

At the same time, there is a process underway internationally to reach agreement on a framework for GHG emissions reduction. In the process of negotiations around the future of the climate regime, it is important that South Africa has an understanding of the implications of domestic emissions trading, a carbon tax, and other economic instruments for pricing carbon and / or incentivising low- and zero-carbon technologies.

3. Towards climate policy

South Africa is in the process of formulating a long-term climate policy, which will establish a framework for climate action by the country for the next several decades. South Africa recently completed a scenario exercise, the Long Term Mitigation Scenarios (LTMS), a stakeholder-driven research process, which identified a suite of the most effective mitigation options available to the country based on the best available scientific information (see Winkler 2007). A carbon tax was the individual option with the largest mitigation potential of all the options modelled, resulting in reductions relative to baseline of 12,287 Mt CO₂-eq over the period 2003-2050 (ERC 2007: 8). The LTMS Scenario Building Team suggested that ‘approaches that yield a triple dividend (growing the economy, creating jobs and improving income distribution) need further work’ (SBT 2007: 19). In July 2008, Cabinet considered the outputs of the LTMS work and adopted a ‘peak, plateau and decline’ trajectory for the country’s future GHG emissions. Among the strategic options presented, the ‘Use the market’ strategy was considered, and specifically the potential of ‘increasing the price on carbon through an escalating CO₂ tax, or an alternative market mechanism’ (Van Schalkwyk 2008)

National Treasury has conducted analysis over several years on environmental fiscal reform, including analysis of taxes for energy-related environmental issues (National Treasury 2006, 2003). Minister Trevor Manuel announced in his 2008 budget speech that ‘options that will now come under scrutiny for implementation include the use of emission charges and tradable permits, tax incentives for cleaner production technologies and reform of the existing vehicle taxes to encourage fuel efficiency’ (Manuel 2008). Emission charges could certainly include a carbon tax or a tax on fossil fuel inputs; while tradeable permits could apply to GHGs, or to technology and measures that reduce emissions, such tradable renewable energy certificates or white certificates trading. In the same speech, Manuel announced a new levy of 2c/kWh on electricity generated from non-renewable sources. Given that over 90 percent of South Africa’s electricity comes from coal, many observers saw this as South Africa’s first carbon tax.

4. Putting a price on carbon

‘Putting a price on carbon’ is likely to have profound impacts across society. It would change relative prices across all economic sectors, it would make low-emission technologies more attractive than emissions-intensive ones and would affect individual behaviour through the price mechanism. Economic theory suggests that it should be a cost effective means of reaching an environmental objective – that of reducing GHG emissions.

Our hypothesis is that putting a price on carbon can contribute effectively to mitigation in South Africa, in terms of economic efficiency, social equity and environmental outcome.

- The key environmental outcome will be the reduction of GHG emissions. The extent of reductions will depend on the responsiveness of the economy to a price on carbon.
- The social implications will depend on the distribution of costs and benefits among households, as well as the recycling of revenue (tax or auctioning).
- Mitigation will have implications for economic output, but also be distributional – there will be winners and losers among economic actors.

More generally, effectiveness depends on the choice of policy instrument (cap and trade or tax or other options) and its detailed design. Each of the above points require significant research on its own.

5. Our history and the minerals-energy complex

In terms of mitigation,¹ South Africa’s history with the minerals-energy complex poses a particular challenge. This complex comprises mining, minerals processing, the energy sector, and associated industries linked to these sectors, based initially on mining, and then on beneficiation, underpinned by some of the cheapest electricity in the world (Fine & Rustumjee 1996). Not only do we depend on coal for three-quarters of our primary energy, but mining and energy-intensive sectors are still key to our economy. Yet our use of energy is inefficient in comparative analysis (DME 2003).

In short, climate change mitigation poses significant challenges for South Africa and its energy development, historically highly energy-intensive. At the same time, the country faces a host of daunting development challenges, exacerbated by the legacy of apartheid (Winkler & Marquard 2007). In the short term, improved energy efficiency is the obvious first solution – saving energy, putting money back in the pockets of consumers and companies and contributing to a better environment. The longer-term changes required notably include changing the fuel mix and making a transition to a low-carbon economy (Winkler 2009b).

Examining both challenges, the papers in this series consider how alternative conceptions of a development path can be achieved. In the short-term, energy efficiency provides large potential

¹ Mitigation here means reducing greenhouse gas emissions or increasing sinks, as distinct from adaptation to the impacts of climate change.

for mitigation – and energy savings at the same time. Changing South Africa’s fuel mix, dependent to three quarters on coal, is at least a medium-term challenge. The minerals-energy complex is so central to the economy that it is likely to take decades to change dramatically. The most transformative change is to a change in economic structure, likely to take long to achieve.

6. Our low-carbon future and redefining competitive advantage

South Africa will need to redefine its competitive advantage *from* attracting energy-intensive sectors on the basis of cheap but dirty electricity, *to* building a new advantage around climate-friendly technologies and systems. As we have argued elsewhere (Winkler & Marquard 2007), five possible strategies are: to adjust state incentives; to focus mitigation efforts on non-energy-intensive sections of the economy;² setting energy-intensity targets for intensive sectors; using economic instruments, such as a carbon tax or domestic emissions trading; and last but not least, re-focusing industrial policy and investment strategy on low- and zero-carbon sectors of the economy. The papers in this collection represent a very initial, collaborative research effort intended to begin filling the gaps in understanding of these issues in South Africa. Broader and deeper collaboration will be needed to take this analysis further.

7. Carbon and carbon markets³

Some theoretical background on economic instruments and carbon markets should inform the practical considerations. Markets are a means to an end, not an end in themselves. Of course there may be those who glorify the market and see it as something to be valued for itself, in particular, one that is efficient at allocating scarce resources. What markets are not good at is equity. Yet when one considers that a market can be perfectly competitive and glaringly unequal in the distribution of wealth at the same time, the critique becomes more fundamental. It does raise questions whether the market, left to its own devices, would be a useful tool to achieve environmental objectives – such as limiting GHG emissions.

Initial allocation of resources are crucial in determining who dominates markets and whether the resulting allocations are equitable. If one wants to use markets for the purpose of reducing GHG emissions, one should understand some basics about the ‘good’ – or more accurately, the ‘bad’ of pollution – that we are dealing with. That leads us to some basics about carbon.

Carbon moves through ecosystems in a global cycle which includes the atmosphere as a well-mixed system. One feature is that energy flows essentially follow the carbon. Another implication is that carbon emitted anywhere in the world has the same effect on the global system. Any means of governance, whether based on the market or state, needs to be global to be effective, ultimately. It also implies that off-setting emissions will not work in the long run – emissions will cycle back to bite us.

The critical limit that creates scarcity is that the atmosphere has a limited capacity to absorb carbon without consequences. Increased concentrations of carbon in the atmosphere force warming. Human-induced emissions from burning fossil fuel and deforestation have increased the carbon in the atmosphere. The evidence that we are causing global warming is now unequivocal. Globally, we need absolute reductions very soon.

Bringing together what we know about carbon and markets, what approach should we take to carbon markets? It depends on our purpose. In the context of climate policy, the purpose is to reduce GHG emissions – while still achieving sustainable development.

² Energy-intensive industries could be identified by the percentage of their costs spent on energy.

³ This section is adapted from Winkler (2008).

No-one owns the atmosphere, but we are over-using the absorptive capacity of this global resource. Ownership can be thought of as a bundle of rights, which in Western tradition become absolute and melded into one. There should be no right to emit, since that would constitute a right to pollute. What is needed, rather, is a system to limit the over-use of the atmosphere. It is more useful to talk about a common property management system for the use rights to the atmosphere than about outright ownership.

A common property management system for GHG is what the United Nations Framework Convention on Climate Change (UNFCCC) is set up to negotiate. Those attempts may be imperfect; they are certainly much too slow at present; but they do bring together the community of nations in the attempt to avoid dangerous climate change. Hopefully it is clear from the above that no system can succeed without reducing emissions of carbon.

A multi-lateral system needs to be implemented through action at the national and local levels. What tools do governments, and societies more broadly, have at their disposal? Policy, investment and technology are three core elements (Wellington *et al.* 2007). Within the policy domain, two broad categories of tools are regulatory and economic instruments.

National caps on GHG emissions are an obvious tool – put a cap on GHG emissions. Regulatory mechanisms are attractive from an environmental point of view, in that they directly set environmental targets. But to really see the effect in practice, regulation has to be enforced – and that requires institutional capacity and financial resources.

There may be more cost-effective means of achieving a similar end. Economic instruments promise to achieve outcomes with fewer resources. In the context of pressing development needs, this potential should not be ignored. They are the focus of this series of papers on the economics of climate change in South Africa.

Carbon taxes seek to effect change through the price mechanism, internalising the external costs of carbon. But would taxes achieve an equitable outcome, given that pure markets do not address distributional issues? These are just some of the questions to be addressed in the series.

Emissions trading combines a regulatory aspect (a cap) with economic means (trading). Hence cap-and-trade. The crucial issue for an equitable design is whether permits are auctioned or grandfathered. In the past, all theory has suggested they should be auctioned – but actual trading systems have grandfathered, i.e. given the largest allocations to big emitters. The European Emissions Trading System is about to change that, auctioning allowances. Domestic emissions trading are the subject of the work of Tyler, du Toit and Dunn (2008). Not only emissions may be traded. Tradable renewable energy certificates (TREC)s are designed to make changes towards a more sustainable fuel mix more cost-effective. TREC)s are examined in detail in Brick and Visser's paper (2009). They seek to trade the 'greenness' of the electricity being generated, and are commonly called 'green certificates'; white certificates are the equivalent for energy efficiency, considered by Tyler and du Toit (2008).

For South Africa, it is no longer a choice, we have to reduce emissions using all the tools at our disposal – direct regulation as well as economic tools. Economic instruments range from green and white certificates to carbon taxes and emissions trading. They are different ways of pricing carbon in energy markets, internalising external costs and, ultimately, reducing GHG emissions.

8. Some key conceptual distinctions

Based on this theoretical background, it is helpful to make some conceptual distinctions between terms used across these papers.

Direct and indirect instruments – direct instruments target GHG reduction as their main aim, whereas indirect instruments are measures which target GHG reductions only indirectly but which are certain to have an impact on GHG reduction. Indirect instruments may also have other policy goals as well, and moreover GHG reduction may not be the primary goal. For instance, energy efficiency programmes are indirect instruments in that these are aimed at reducing energy consumption, not GHG emissions, but certainly have a significant impact on

GHG emissions. These might also have other primary goals (for instance, avoiding load-shedding in the current electricity crisis).

Economic instruments here include any measures which aim to reduce GHG emissions (either in absolute terms, relative to a baseline, or in relation to a specified unit of input or output (for example, GHG/ton of output, or GHG/Rand of output) using the mechanism of price. These would thus include direct measures such as carbon taxes or cap-and-trade systems, as well as indirect measures such as TRECs, feed-in tariffs and energy efficiency taxes or other measures which do not target GHGs directly, but which have the impact of lowering GHG emissions as specified above. A carbon tax is a ‘pure’ economic instrument in the sense that it relies exclusively on price, whereas cap-and-trade uses a regulatory limit (the cap, set administratively), but allows emitters to trade in order to achieve the goal most cost-effectively. A price for carbon is set in the trading system, but depends significantly on the cap set, and how much or little scarcity it creates.

Regulatory instruments are usually indirect instruments and are implemented through regulation of an input or an output of a specific process (often via standards for efficiency or for output of pollutants), or an outright prohibition. For instance, utilities might be required to attain a specific percentage of supply from renewable sources, minimum fuel efficiency standards for classes of vehicle might be set, or specific inefficient technologies (for instance incandescent lightbulbs) might be restricted in their use or removed from the market altogether. Applied directly to GHG emissions, a regulatory instrument might, for example, be a cap on emissions from power stations, synthetic fuel plants, iron & steel plants and other large sources.

Supportive programmes would increase the effectiveness of economic instruments, given that, although a tax would provide an economic incentive to lower GHG intensity, other barriers frequently remain (economic and non-economic).

Incentives are usually in an economic form and thus technically economic instruments, in reality they are cross-cutting measures which encourage the adoption of lower-carbon measures and technology, and could involve a combination of subsidies, tax breaks and other non-economic measures.

9. A conceptual framework

Some of these distinctions can be summarised in diagrammatic form. Figure 1 shows selected examples of instruments that use economic and regulatory approaches, and that directly or indirectly address GHG emissions.

	Economic instruments		Regulatory instruments
Direct	Carbon tax	Cap and trade	GHG emission standards
Indirect	Fuel input tax	Green or white certificates	Building standards

Figure 1: Conceptual framework of different instruments for climate change mitigation

This framework provides some context for the details examination of particular instruments in the main papers in this series.

10. Some broad questions

A broad set of questions arises across the set of initial papers:

1. Which instrument will result in the most effective, equitable and efficient reductions of GHG emissions in South Africa?
2. What are the implications, including costs and benefits, of choosing to use different economic instruments for mitigation?
3. How responsive is the system (and its parts) to various economic instruments for mitigation?
4. What are the key design elements that need to be considered to design the best instrument for mitigation in South Africa?
5. How could different instruments be combined, and what supportive measures might be needed to implement a set of instruments?

We hope that these papers and discussion around them will further elaborate these questions and assist in defining future research agenda, as South Africa prepares for implementation of mitigation actions.

References

- ANC (African National Congress) 2007. Resolution on climate change: ANC 52nd National Conference, Polokwane, Limpopo. <http://www.anc.org.za/show.php?doc=ancdocs/history/jan8-08.html>.
- DME (Department of Minerals and Energy) 2003. Integrated energy plan for the Republic of South Africa. Pretoria. www.dme.gov.za.
- ERC (Energy Research Centre) 2007. Long Term Mitigation Scenarios: Technical summary. October 2007. Pretoria, Department of Environment Affairs and Tourism. <http://www.erc.uct.ac.za/Research/LTMS/LTMS-intro.htm> Accessed 30 October 2008.
- Fine, B & Rustomjee, Z 1996. *The political economy of South Africa : from minerals-energy complex to industrialization*. London, C. Hurst.
- IPCC 2007. Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva.
- Manuel, T 2008. Budget speech, 20 February. Cape Town, Parliament. <http://www.treasury.gov.za/documents/national%20budget/2008/speech/speech.pdf> Accessed 22 February 2008.
- Munasinghe, M 2007. *Making development more sustainable: Sustainomics framework and practical applications*. Colombo, MIND Press.
- National Treasury 2003. Market-based instruments to support environmental fiscal reform in South Africa: A discussion document. Pretoria, National Treasury.
- National Treasury 2006. A framework for considering market-based instruments to support environmental fiscal reform in South Africa. Draft policy paper. Pretoria, National Treasury Tax Policy Chief Directorate. <http://www.treasury.gov.za/tax/default.htm>.
- Sathaye, J, Najam, A, Cocklin, C, Heller, T, Lecocq, F, Llanes-Regueiro, J, Pan, J, Petschel-Held, G, Rayner, S, Robinson, J, Schaeffer, R, Sokona, Y, Swart, R & Winkler, H 2007. Sustainable development and mitigation. Chapter 12. in B Metz, O D Davidson, P Bosch, R Dave and L M Meyer (Eds). *Climate Change 2007: Mitigation, Contribution of Working Group III to the IPCC Fourth Assessment Report*, Cambridge University Press.

- SBT (Scenario Building Team) 2007. Long Term Mitigation Scenarios: Strategic Options for South Africa. Pretoria Department of Environment Affairs and Tourism. <http://www.environment.gov.za/HotIssues/2008/LTMS/A%20LTMS%20Scenarios%20for%20SA.pdf> Accessed 15 October 2008.
- Stern Review (Stern review team) 2006. The economics of climate change. London, Treasury. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm (accessed October 2006).
- Van Schalkwyk, M 2008. Government outlines vision, strategic direction and framework for climate policy. Statement by Marthinus van Schalkwyk, Minister of Environmental Affairs and Tourism, 28 July. Cape Town. www.environment.gov.za Accessed 29 July 2008.
- Winkler, H (Ed) 2007. *Long Term Mitigation Scenarios: Technical Report*. Prepared by the Energy Research Centre for Department of Environment Affairs and Tourism, Pretoria, October 2007. <http://www.erc.uct.ac.za/Research/LTMS/LTMS-intro.htm> Accessed 30 October 2008.
- Winkler, H 2009a. *Cleaner energy, cooler climate: Developing sustainable energy solutions for South Africa* Cape Town, HSRC Press.
- Winkler, H 2009b. Mitigation is an energy issue in South Africa. in R Ziplies (Ed). *Bending the curve: Your guide to tackling climate change in South Africa*. Cape Town, Africa Geographic 120-137.
- Winkler, H & Marquard, A 2007. Energy development and climate change in South Africa: Decarbonising growth in South Africa. Occasional paper 2007/40, for UNDP's Human Development Report 2007/8: Fighting climate change: Human solidarity in a divided world. New York, Human Development Report Office. http://hdr.undp.org/en/reports/global/hdr2007-2008/papers/winkler_harald%20and%20marquard_andrew.pdf accessed 29 January 2008.