A critical appraisal of the LTMS

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Preface

In July 2008, the South African cabinet endorsed the outcomes of the Long Term Mitigation Scenarios (LTMS) process, which explored South Africa's options for climate change mitigation in a multistakeholder process. The mere fact that the process took place in a political economy dominated by centralised, energy intensive and dirty industries, is an achievement. But will decision makers on industrial and energy policy accept its implications? And does the LTMS represent an adequate response to the challenges of climate change?

The following report observes that the LTMS process was not representative of South Africans, but skewed to current dominant economic players in terms of representation, sources of information and modelling assumptions. Some of its assumptions are highly questionable, such as the belief that carbon capture and storage is a viable technology, the real effects of energy efficiency measures in an economy striving for growth, and the view that nuclear energy is an appropriate response to climate change.

Earthlife Africa Johannesburg acknowledges the work that went into the LTMS, but wants to encourage an open, well-informed public debate that campaigns for people directed solutions to climate change.

The real South African response to climate change will be an open-ended process of transition to a society in which people are actively and consciously making the decisions that shape their collective future. It will not be a smooth process nor is the outcome certain. How things take shape will depend on what emerges from struggles, how people learn from struggle and from doing, and where they decide to take things from there.

This paper puts forward a set of arguments and takes some strong positions but it is not intended as the last word. Rather, the SECCP hopes that it contributes to people's debates in their organisations, through their networks and in the places where they live and work. It hopes to share in a continuing dialogue but believes that it is the conclusions and decisions for action that people come to that are important.

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Contents

Acronyms

Asgisa	Accelerated and Shared Growth Initiative
CCS	Carbon capture and storage
CDM	Clean Development Mechanism
GHG	Greenhouse gasses
GWC	Growth Without Constraints
HLG	High level group
IMC	Inter-Ministerial Committee on climate change
IPCC	International Panel on Climate Change
LFG	Landfill gas
LTMS	Long Term Mitigation Scenarios
MEC	Minerals and energy complex
PWR	Pressurised Water Reactors
PBMR	Pebble Bed Modular Reactors
RBS	Required By Science
SBT	Scenario building team
SRES	Special Report on Emissions Scenarios (by IPCC)
UNFCCC	United Nations Framework Convention on Climate Change
WTO	World Trade Organisation

The process

The Long Term Mitigation Scenarios (LTMS) should be welcomed in so far as it is the first indication that the South African government is getting serious about climate change. It is primarily concerned with how South Africa can reduce emissions of greenhouse gasses (GHGs) and so mitigate climate change.

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Box 1: Greenhouse gasses.

Greenhouse gasses (GHGs) are so called because they trap heat in the atmosphere in the same way that a glass greenhouse traps heat. Carbon dioxide (CO_2) is by far the most significant GHG because it is the most abundant and lasts longest in the atmosphere. It is followed by methane (CH_4). One tonne of CH_4 has 20 times the impact of one tonne of CO_2 but there is less of it and it decomposes to CO_2 over time. Nitrous oxide (N_2O) is the third most important and it is followed by nine other compounds.[1]

Carbon dioxide equivalents (CO_2e) are used as a measure of total GHG emissions and of the concentration of GHGs in the atmosphere. However, carbon dioxide emissions and concentrations are frequently used on their own, excluding other GHGs. Thus, the atmospheric concentration of CO_2e is now around 430 parts per million (ppm), according to the Sterne Report, while the concentration of CO_2 is over 385 ppm and rising by over 2 ppm each year. This compares with the pre-industrial CO_2 concentration of 280 ppm.

Global CO_2 emissions from fossil fuel use are running at about 26.4 billion tonnes a year (Gt/y). This is up from 23.5 Gt/y in the 1990s. About 5.9 Gt/y of additional CO_2 was released by 'land use change' – the expansion of industrial agriculture and deforestation – during the 1990s and this too is likely accelerating.

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The LTMS is represented as a research process that has produced a set of ideas for mitigation distinct from a policy process. This is both true and untrue. It is true in so far as an official policy process was promised following its presentation to Cabinet sometime in the second half of the year. Other than the reports being marked confidential, the LTMS had no public policy status until the minister announced it in the June 2008 Environmental Affairs and Tourism budget speech. Be that as it may, the LTMS most certainly is a pre-policy process and sets the terms of debate in what is officially designated as the policy process. As the environment minister put it, "The LTMS lays a firm basis for a progressive National Policy on Climate Change."[2] This was confirmed

[1] They are: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), hydrochlorofluorocarbons (HCFCs), chlorofluorocarbons (CFCs), the aerosol precursor and the chemically active gases sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NOx), and non-methane volatile organic compounds (NMVOCs).

[2] Budget Vote Speech, May 20, 2008.

when the Cabinet formally adopted a 'policy framework' based on the LTMS to "set the strategic direction for climate change" at its Lekgotla in July 2008.[3]

The LTMS was mandated by Cabinet, commissioned by the DEAT and overseen by an inter-ministerial group represented on the Project Management team by DEAT and DME officials. It has the following objectives:

1. South African stakeholders understand and are focused on a range of ambitious but realistic scenarios of future climate action both for themselves and for the country, based on best available information, notably long-term emissions scenarios and their cost implications;
2. The South African delegation to climate negotiations is well-prepared with clear positions on the post-2012 international climate regime[4]; and
3. Cabinet can approve (a) a long-term climate policy and (b) positions for the negotiations under the United Nations Framework Convention on Climate Change (UNFCCC).

The confidential status of the documents has been justified on the grounds that the process should not be politicised ahead of Cabinet's review of it. Rather, Cabinet should be able to make an 'objective' assessment based on the science and free from political pressures before the documents are opened up to public debate. As a corollary, the LTMS process itself was similarly free of political pressures and semi-secret. Participants agreed to maintain confidentiality as the condition of their participation.

As described in LTMS documentation, the process was defined in two stages. First, the scenario building phase centred on research relating to carbon emissions, the potential for reductions and the economic implications defined in terms of the impact on GDP growth, employment and equity. Participation in the 'scenario building team' (SBT) was by invitation. Participants were selected "to cover" different stakeholder groups and economic sectors and for their "known technical expertise" on climate change. While they were drawn from stakeholder groups, they were invited as individuals rather than as representatives of organisations. Hence, they were commonly referred to as 'sherpas'. A rough breakdown of participants by stakeholder groups shows: government 35; industry 19; civil society 9, including 2 from labour; and a sprinkling of academics and consultants. This phase was concluded in October 2007.

Second, the 'high level group' (HLG) process was to involve a 'dialogue' of the Inter-Ministerial Committee on climate change (IMC) and 'leaders' from business, labour and civil society. It was to start with presentations to the following stakeholder groups:

- the Directors General of Departments represented by the IMC
- the senior leadership within the Union movement
- the senior leadership within the NGO movement
- the leaders and captains in Industry and other relevant sectors.

[3] Media statement by Marthinus Van Schalkwyk, Minister of Environmental Affairs and Tourism, Cape Town, July 28, 2008.
[4] The present climate regime is defined by the Kyoto Protocol to the UNFCCC which expires in 2012.

Representatives chosen at these meetings were then to attend the HLG meeting where government would listen to the responses of the stakeholders. This was to be the first meeting between the stakeholders as well as with the ministers in the IMC.

The LTMS was presented to stakeholders at sectoral round tables in late 2007. There was, however, little coherence between this and the stakeholder feed-back process which was constantly revised, apparently to fit with a changing Cabinet time-table. In the event, separate meetings were called with business, labour and NGOs. Apart from the business meeting, they were poorly organised by DEAT. The labour and NGO meetings were hastily called in July 2008 ahead of the Cabinet Lekgotla. No-one arrived at the labour meeting while the NGO meeting was poorly attended. The HLG meeting between stakeholders has not happened.

Meanwhile, in April, the LTMS was presented to a meeting of Cabinet's economics cluster chaired by the Minister of Environmental Affairs and Tourism. DEAT was then to draw up a Cabinet memo, following input from the HLG meetings, for the economics cluster to consider ahead of its presentation to the full Cabinet. The process appears to have been fast-tracked and the Cabinet adopted the LTMS as part of the 'framework policy' on climate change at the July Lekgotla. The framework policy covers adaptation as well as mitigation.

With this, the LTMS process is over – or it will merge into a policy process. According to the environment minister's June budget speech,

> It will culminate in a National Climate Summit and Science Conference early in 2009. During this Summit we will formally launch the policy process that will translate the LTMS into fiscal, regulatory and legislative packages as well as sectoral implementation plans. The National Summit will involve the key government departments, industry, labour, NGO's and others.

Following the Cabinet Lekgotla, the minister announced:

> Cabinet has mandated a clear path for the future. Milestones will include a national summit in February next year, the conclusion of international negotiations at the end of 2009 and a final domestic policy to be adopted by the end of 2010 after international negotiations have been completed.

The substance of the LTMS

The LTMS produced three main documents:

- Long Term Mitigation Scenarios for South Africa otherwise known as the Scenario Document [SD]. This is the final outcome of the process, equivalent to the conclusions of the study;
- Technical Report [TR] and technical appendix. This is the detailed report, the guts of the study, on which the conclusions of the Scenario Document were made. It includes discussions of method as well as detailed findings.
- Process Report [PR]. This describes the process, more or less as outlined above.

It starts with a rationale:

Climate change is already harming people and ecosystems in Africa and South Africa and the poor are most vulnerable. Adaptation to climate change is therefore already necessary but, unless greenhouse gas emissions are reduced (through 'mitigation'), the environmental costs will escalate over time and threaten the world's economic viability. The economic costs of mitigation will be substantial, but doing nothing will ultimately cost much more. Acting sooner will cost much less than acting later.

Following the Fourth Assessment Report of the International Panel on Climate Change [IPCC 2007], the LTMS argues that the average temperature rise should be kept within the range of 2^{o} to 2.4^{o}C. This requires that global emissions should peak by 2015 and decline sharply thereafter. South Africa is a major emitter because of its energy intensive and coal dependent economy but, as a 'developing country', it is not required to commit to reductions under Kyoto. Kyoto expires in 2012 and a new post-2012 climate regime is now under negotiation. South Africa will face increasing pressure to reduce emissions. The LTMS therefore sets out to explore how SA can do that and at what economic cost.

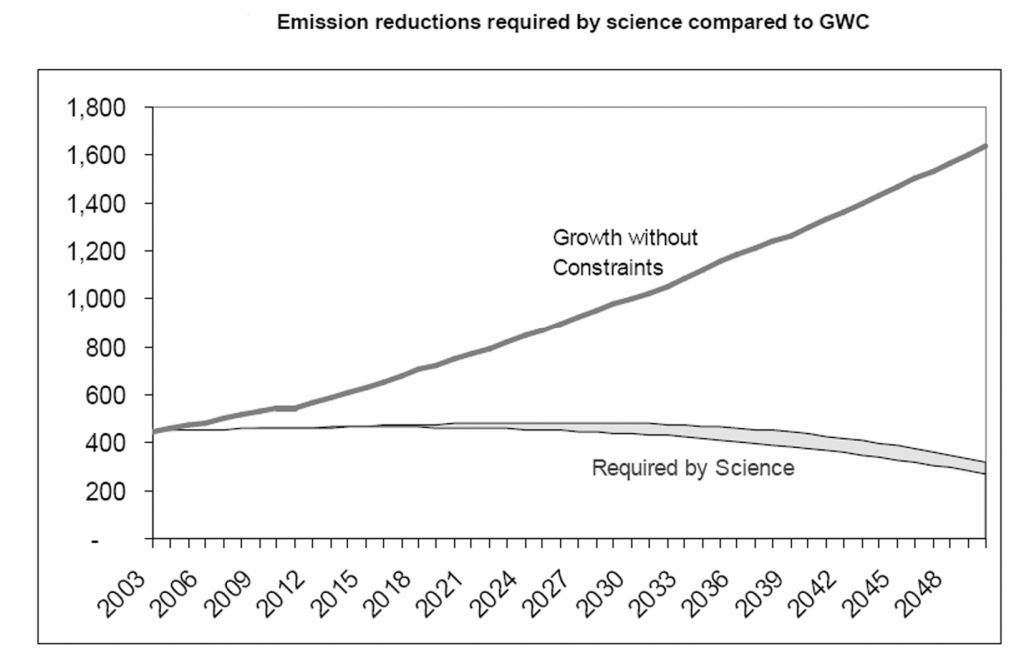
The remit of the LTMS is confined to climate change. It must be recognised, however, that climate is one dimension of a more general environmental crisis threatening economies and people's livelihoods and health. Environmental 'services' are now in jeopardy in many areas of the country and engineered responses will become increasingly expensive and infeasible.

Scenarios

The LTMS Scenarios report proposes two scenarios and a number of 'strategic options'. The two scenarios create top and bottom lines for emissions through to 2050 with 2003 as the starting year. They are labelled:

- Growth Without Constraints, and
- Required By Science

Figure 1: GWC and RBS emissions projections



Growth Without Constraints

Growth Without Constraints (GWC) is the 'no action' scenario and it results in emissions being four times higher by 2050 than they were in 2003. This is effectively where South Africa is going – or was going until the national electricity crisis interrupted things[5] – and is consequently used as the reference scenario against which the strategic options are assessed.

The scenario assumes that South Africa achieves the Asgisa growth targets, that climate change does no damage, and that oil, water and other resources are available to meet demand. The economy is, consequently, "still performing well" [SD: 8]. It is, in short, a highly unrealistic scenario. As the minister puts it in the statement following the July Cabinet Lekgotla, "If we continue with business-as-usual, we will go out of business." GWC nevertheless reflects the assumptions that have shaped present policy. Industrial policy therefore remains focused on energy intensive industries and, in addition to coal and nuclear electricity generation, coal-to-liquids fuel production is also expanded dramatically.

[5] The LTMS documents were produced ahead of the power crisis. It is, however, unlikely that the crisis has reduced emissions even temporarily because: diesel fired peaking plant has been used for base load; industry and commerce have bought in their own diesel generators; and coal trucking traffic has increased considerably to restore coal stocks at power stations. The additional demand for diesel has exceeded supplies from local refineries and resulted in costly imports of diesel with the result that the price of diesel has risen faster than the price of petrol.

A final note takes account of government's stated policies on energy efficiency and renewable energy under the heading Current Development Plans (CDP). These policies, if actually implemented, make little difference to the overall rise in GWC emissions.

It may be observed that the1998 White Paper on Energy already committed government to both efficiency and renewables. Neither commitment proved urgent. A renewables policy was produced five years later, in 2003, and an efficiency strategy was produced only in 2005. Both are timid – hence the small impact on emissions – and both gathered dust until the national electricity crisis provoked panic in 2008. As of now, rolling mass blackouts have contributed more to emissions reductions than policy has done – although this is more than compensated for by the over-use of diesel fired peaking plant and private diesel generators as well as increased coal transport by road. Eskom's new build programme, if it is fully realised, will certainly keep South Africa on the high emissions path described by GWC well past 2020.

Required By Science

Required By Science (RBS) shows South Africa's emissions peaking and then declining. SD puts the peaking date at 2020 and, by 2050, the country emits between 30 and 40% less than in 2003. TR shows that whether 30% or 40% is achieved depends largely on the date of peak emissions. If emissions peak in 2016, then the 40% reduction is achieved; if in 2020, 35% is achieved; if in 2026, 30% is achieved. While RBS allows for rising emissions before the peak dates, the rate of increase, starting from 2003, is considerably slower than in the GWC scenario. It is now 2008 and emissions have been rising in line with GWC. Any real starting point is therefore already much higher than assumed by LTMS.

The target band is calculated on the assumption that the world must reduce emissions by 50% by 2050 and that Northern countries make reductions of 80%, so allowing more modest reductions in Southern countries. This reflects that Northern have greater resources, produced most GHGs historically, continue to emit the most, and should therefore make the biggest reductions. However, the 50% global reduction is at the bottom end of the range of 85 to 50% reductions which the IPCC says is necessary to keep temperature rise within the 2^{o} to 2.4^{o}C range.

RBS is thus defined by the goal or target. It is not derived from the economy but from the logic of climate change as set out by the IPCC. Having set the target of a 30 to 40% reduction, it then works backwards to identify what needs to be done to reach it.

It should be noted, however, that the IPCC report is itself a conservative assessment of the pace of climate change. This is because it is produced under the scrutiny of governments who have cavilled over findings that might imply some qualification to their economic interests. It is also prevented from taking account of the latest studies. These studies show, amongst other things, that actual emissions are running higher than the most pessimistic of earlier IPCC projections, that the expected impacts of climate change are happening earlier than expected, and that a 1^{o}C rise is already dangerous. The

implications are: first, a 2^{o}C rise may soon be inevitable but will not prove 'tolerable'; second, ecological feed-backs are already kicking in and picking up pace; and third, reductions must be considerably more ambitious than the IPCC says. [See Box 2].

EcoEquity and Christian Aid [2006] argue that the temperature rise must be kept below 2^{o} and achieving this requires global emissions peaking in 2010, rather than the LTMS's 2015, leading to reductions from 2000 levels of around 80% by 2050, rather than 50%. Further, even if the North's emissions "magically drop to zero" in 2020, but Southern emissions continue to rise on a business as usual trajectory, the South's emissions will then exceed the entire world's carbon budget.

This suggests that the LTMS's early target for South Africa's emissions to peak in 2016 is cutting it fine and, even if 2^{o}C is accepted, the RBS bottom line of a 40% reduction by 2050 is still too high.

That said, SD argues that RBS "imagines a post-carbon world very different from ours, one that is therefore difficult to describe in detail." Part of the reason why it is difficult to imagine is that the energy planning model could not find a way to meet projected future energy demands while at the same time meeting the RBS target. TR concludes,

> The RBS climate target cannot be met within this framework. This suggest[s] that either one need[s] to redefine what is realistic (e.g., re-considering the extent to which mitigation options can be achieved 'realistically'); or the analysis needs to be conducted outside of the confines of a constrained modelling approach. [116]

SD softens the conclusion. RBS

> … depends on technologies and measures whose parameters are largely unknown, and therefore it cannot be assessed within a modelling framework based on known technologies with well-understood parameters, including cost.

It was also impossible to assess the costs of 'behavioural change'. Consequently, the energy supply and the economic costs of RBS are not modelled.

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Box 2: What is really required by science?

'Climate sensitivity' is about how much the earth will warm up in response to a particular concentration of carbon in the air. Earth's climate has never been stable. Over the last 650,000 years, it has fluctuated between cold ice-ages and warmer temperate periods. The difference in average global temperatures between an ice age and a temperate age has been around 5°C. These fluctuations in temperature have been accompanied by the fluctuation of CO_2 concentrations in the atmosphere ranging from 180 parts per million (ppm) during the cold periods to about 300 ppm in the warmest periods. The last ice age was about 20,000 years ago and human history has taken place in the warm period (the Holocene) that succeeded it. Pre-industrial CO_2 concentrations, in 1750, were at 280 ppm.

Temperature rise lags behind the rise in CO_2 concentrations by some decades. The earth is now 0.76°C warmer than in 1900 and the pace of warming is accelerating. It now averages about 0.2°C every decade. Because of the time lag, this probably reflects CO_2 concentrations in the 1980s or earlier and a further 0.6°C rise is still to come in response to present industrial carbon emissions.

The European Union now defines 2°C above pre-industrial temperatures as 'dangerous'. The IPCC report on mitigation indicates that avoiding temperature increases beyond the 2 – 2.4°C range requires that overall emissions peak between 2000 and 2015 and are then sharply reduced by between 50% and 85% by 2050. Thus, the window period for reversing emission trends is half over. However, the pace of carbon dioxide emissions has accelerated since 2000, growing faster than predicted in "the most fossil-fuel intensive of the Intergovernmental Panel on Climate Change emissions scenarios developed in the late 1990s" [Raupach et al 2007: 1].

The IPCC's findings exclude consideration of natural feed-back loops induced by global warming. Such feed-backs include: the melting of snow and ice with the result that less heat is reflected away from the earth by the white surface and more heat absorbed by the darker surface; the melting of permafrost peat bogs in northern Russia and Canada could release 70 billion tonnes of methane into the atmosphere – equivalent to 1.6 trillion tonnes of carbon dioxide; warming oceans could release even greater quantities of methane from methane-hydrates[6]; and the reversal of carbon absorption by soils which will turn a very significant carbon 'sink' into an equally significant carbon source. These feed-backs have long been predicted in the literature. They are now being observed. Once a 'tipping point' is reached, they will become irreversible and lead to runaway climate change. In consequence, temperature rises of "5 or 6°C or higher are plausible" [Stern 2006: 59].

Recent research, not taken into account by the IPCC, indicates that warming of 1°C already constitutes a "'dangerous' level of warming" [Levin and Pershing 2007: 3].

[6] Hydrates are a bit like ice but form under pressure at some depth. These formations are regarded as unstable and it is somewhat alarming that the US Department of Energy is experimenting with drilling them as a source of 'unconventional gas'.

Indeed, millions of people around the world, and particularly in Africa, are already faced with dangerous consequences of climate change. In testimony to the US Congress in June 2008, climate scientist James Hansen warned that "the oft-stated goal to keep global warming less than 2°C is a recipe for global disaster, not salvation".

This conclusion was based on a paper by Hansen et al [2008] which argues that a safe target for stabilising CO_2 concentration is "no more than 350 ppm" and may be less than that. In other words, the world has already overshot the mark. Nevertheless, disaster can be averted if the CO_2 concentration peaks at around 400 ppm and is then rapidly reduced. Taking account of peak oil, they argue that this is possible "if difficult to extract oil and gas is left in the ground", coal is not used to substitute for declining oil and all coal use is phased out by 2030 unless the carbon emissions can be safely sequestered, and forest and soil sinks are restored through reforestation and changed agricultural practices. This should return "CO_2 below 350 ppm late this century, after about 100 years above that level" [13, 14].
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RBS and the story of development

Although the economic costs of RBS cannot be modelled, LTMS finds this scenario 'more robust' than GWC. It shows the conditions in which each scenario can survive in the following table:

GWC is only robust if:	RBS is only robust if:
• International climate consensus collapse/fragment • Technologies not developed or don't flow freely • Oil cheap and abundant, no carbon premium on coal • Fragmented trade systems, bilaterals and free for all	• International climate consensus reached and effective • International flows of appropriate technology/ finance • Peak oil arrives, oil scarce and expensive, coal premiums • High degree of trade integration and globalisation

That GWC is entirely unrealistic has been noted above. In addition, SD observes that both scenarios will fail if climate impacts become unmanageable but adds that GWC actively contributes to that outcome. This point is well made but the other assumptions shown in the table are less convincing. With the exception of peak oil, they refer primarily to two international negotiation processes: the UNFCCC and (implicitly) World Trade Organisation (WTO) processes.

Taking the assumptions relating to RBS:

- International climate consensus reached and effective.

The possibility that a global consensus is reached but is not effective is not considered but ineffectiveness appears to be the condition of consensus. Wolfgang Sachs [2005]

observes that climate negotiators "were charged with protecting economic growth and not the climate" to which end the Kyoto Protocol embodies three strategies: Northern obligations to reduce emissions are transferred to the South and East; obligations are discharged through sinks; and negotiations are framed to focus on the economic tailpipe and exclude discussion of driving interests in the engine room. To achieve this, carbon trading is at the heart of Kyoto. Trading, or the transfer of obligations, between North and South is done through the 'clean development mechanism' (CDM).

The political classes now appear genuinely alarmed at the prospects of climate change but nothing indicates that there is a different agenda for negotiating the 'second commitment period'. Rather, they are entrenching a trading system that has no purchase on the level of actual emissions whatever, but which is already creating a flow of real money for finance capital [see Box 3 on the UK's intentions]. Meanwhile, Northern countries are not meeting their obligations for emissions reduction in the 'first commitment period' to 2012 – and will not do so except by trading.

At the climate negotiations, the US is justifiably seen as the spoiler in chief but, commenting on the 2008 G8 meeting, Walden Bello remarks that all northern governments "hang on to the position that economic growth can be 'decoupled' from energy use" and energy decarbonised with a magical technofix or two. This is a symptom of 'growthmania', a concept he takes from environmental economist Herman Daly.

> Growthmania … is a cultivated ideological predisposition that serves as a protective shield for global capitalism. Capitalism is an expansive mode of production, and it can only reproduce itself by continually transforming living nature into dead commodities. This is essentially what growth is all about. This is why ever-increasing consumption is so central to the engine of profitability that drives capitalism.
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> The G8 – the directorate of global capitalism – is trying hard to avoid just such radical controls on growth, consumption, profits, and the market that a viable strategy to stave off the looming climate catastrophe will necessitate. Voluntary cuts, technofixes, and carbon trading are desperate efforts to prevent the inevitable.[7]

But growthmania is not the preserve of the North. In the name of 'development', Southern governments are equally determined to defend economic growth and, as Bello observes in another article, have shown a determination to 'catch up' with the North at whatever cost to the environment and to people. He disputes that this elite view represents the South's perspective on the environment and documents the emergence of growing environmental and other movements resisting "a model of growth that has failed both the environment and society".[8]

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[7] Walden Bello, *The Anti-Climate Summit*, posted at truthout, July 15, 2008.
[8] Walden Bello, *The Environmental Movement in the Global South: The Pivotal Agent in the Fight against Global Warming*, Focus on the Global South, October 12, 2007.

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Box 3: Carbon trading

Environmental journalist George Monbiot reports that the UK's climate change bill will become law later this year. It requires that the UK's CO2 emissions are cut by 60% by 2050 with legally binding interim targets every five years. This, however, is at odds with its energy policy. Monbiot observes that an obscure government briefing note shows how the contradiction will be resolved:

> It explains that, during the latest stage of the bill, the government "remov[ed] the quantified limit on the use of internationally traded credits in meeting the UK's targets". In other words we could buy the entire cut from other countries. … But there are three problems. The first is that we are exporting emissions that are difficult to address and importing, through carbon trading, the easiest and cheapest cuts.
>
> The second is that while the emissions we export are certain and verifiable, the cuts we buy through carbon credits are often fraudulent. For example, as the writer Oliver Tickell documents, 96% of the carbon credits from hydroelectric dam construction were issued after construction had begun: the dams would have been built without the carbon market, so no additional cuts have been achieved. Around 30% of all carbon credits comes from the sale of trifluoromethane cuts by Chinese and Indian companies making refrigeration gases. Many of them are still producing this pollutant only because they make so much money from cleaning it up: the carbon market pays them 47 times more for these cuts than the gas costs to remove.
>
> Behind these problems lurks a much greater one, which is mathematically impossible to resolve. You can trade your way out of trouble when the cut you are trying to achieve is a small one. But when the global cut required to prevent two degrees of warming is 60 or 80 or 90%, then every rich nation must reduce its emissions by roughly the same amount. Otherwise half the world would have to buy credits equivalent to 180% of the emissions produced by the other half.
>
> The government will have to impose some kind of cap on carbon trading. But I bet it will be set high enough to cover any failures in domestic policy, as measured by the rigged accounting methods civil servants use. This means that successive governments will have no legal incentive to change their energy policies. The carbon trading provision torpedoes the useful content of the entire [climate change] bill.

Source: George Monbiot, *Traded Away*, The Guardian (London), July 24, 2008.

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The disputes between Northern and Southern governments at the climate negotiations are the product of a long history of unequal power relations but they conceal a common interest in a dysfunctional climate regime. As Bello puts it:

> When the Bush administration says it will not respect the Kyoto Protocol because it does not bind China and India, and the Chinese and Indian governments say they will not tolerate curbs on their greenhouse gas emissions because the US has not ratified Kyoto, they are in fact playing out an unholy alliance to allow their economic elites to continue to evade their environmental responsibilities and free-ride on the rest of the world.

- International flows of appropriate technology / finance.

The UNFCCC 'consensus' already promises technology transfers from North to South. The promise is contradicted in the WTO process and has been dishonoured. Intellectual property rights, leveraged on and designed to sustain unequal power relations, remain at the core of the global technology regime.

- Peak oil arrives, oil scarce and expensive, coal premiums.

Peak oil may drive greater energy efficiency and technology innovation. Already, however, it is driving greater energy and carbon intensity and dirtier production. Sasol's coal-to-liquid technology, for example, is increasingly in demand globally while South Africa is already exploiting the 'coal premiums' as hard as it can. There is no reason to think that governments or corporations will focus innovation driven by peak oil only on low carbon options rather than getting the last dregs of liquid fossil fuel out by whatever means possible. Indeed, arctic circle states are now slavering over the prospects of melting sea ice opening up the arctic sea bed for oil prospecting.

- High degree of trade integration and globalisation.

Globalisation and expanded trade have hardly contributed to reduced carbon emissions. Intellectual property rights are central to the WTO agenda which is itself largely determined by those with power and in their own interests. Indeed, the challenge to those interests by the more powerful Southern states is the primary reason for the failure of the Doha Round. The Southern challenge itself, however, is trapped within the same calculus of power that dictates the position of Northern countries: it is about competition for the rewards, in political and economic clout, of growthmania.

The LTMS does not in fact make an argument as to why it finds these four conditions significant. It appears rather to take its cue from the IPCC Special Report on Emissions Scenarios (SRES). IPCC has proved critical in terms of understanding the biophysical processes driving CC. It is a good deal less convincing when it comes to the social and

economic systems because it cannot address power relations or talk about capitalism. It sees patterns of inequality but cannot take account of the interests that create, and are sustained by, inequality.

Eternal growth

SRES develops four 'scenario families' through to 2100. These are not predictive but designed to 'explore' the relationship between the main drivers of emissions which SRES identifies as economic growth, population and technology development.[11] All scenarios portray a wealthier world with reduced inequality, though some less than others. Those scenarios with high levels of 'global convergence' produce the best results for equity and, depending on technology choices, the best long term results for emissions reductions. Scenarios describing a heterogeneous world in which societies are regionally or locally oriented end up, in 2100, with larger populations, greater inequality and higher emissions than the equivalent globalised scenarios. The growing inequality actually produced by globalisation thus far does not appear to inform the underlying assumptions.

IPCC naturalises 'five stages of economic development' which LTMS assumes will shape future GDP growth in South Africa LTMS [TR: 25, 26]:

- First, the pre-industrial economy, in which most resources must be devoted to agriculture because of the low level of productivity.
- Second, the phase of capacity-building that leads to an economic acceleration.
- Third, the acceleration itself (about two decades).
- Fourth, industrialisation and catch-up to the 'productivity frontiers' prevailing in the industrialised countries (about six decades).
- Fifth, the period of mass-consumerism and the welfare state.

This harks back to the development theory constructed in the US in the 50s and 60s to provide economic mechanisms for extracting resources from the Third World as a substitute for the direct colonial control of European imperialism. In the context of the Cold War, that theory provided a justification for US global hegemony in conflict with the Soviet Union and held up capitalism as the model for all to copy. With the collapse of the Soviet Union, capitalism was portrayed as triumphant. At the 2001 International Conference on Funding for Development (FfD), the US delegate "commended the capitalist model … as the only model that works. The goal of the FfD process, he claimed, should not be to negotiate changes in the system but to integrate countries into it …"[12] This is what defines the politics of 'catch up'.

If one applies the five stages to South Africa, the whole of the 20th Century seems to disappear from the history of economic development. The LTMS makes one brief reference to this history:

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[11] The effect of climate policy is specifically excluded from the scenarios although policies addressing other environmental concerns, primarily pollution, are included.

[12] Earth Negotiations Bulletin: International Conference on Funding for Development, International Institute for Sustainable Development, 17 Oct 2001.

> South Africa is unique in that its apartheid history created a huge disparity between different ethnic groups and the areas in which they live so that today parts of the country represent developed nations while large parts of the country fall into what would be classified as 'developing'. [TR: 26]

This seems intended to endorse the dual economy metaphor valorised in government's Accelerated and Shared Growth Initiative (Asgisa) rather than to address the history of development. Asgisa attributes poverty in the 'second economy' to a lack of development and aims to build a bridge enabling would-be entrepreneurs in the second economy to cross to the wealthy 'first economy'. That is, it aims to integrate them into the capitalist model. The problem, however, is that the poor are poor because they are integrated into capitalism, not because they are left out of it. The wealth of the 'first economy' remains very much dependent on paying workers less than a living wage, dispossessing people and externalising environmental costs. The metaphor works to conceal this and justifies a dual development strategy: core development is concerned to promote capital accumulation and economic growth while development-as-delivery ameliorates the real damage to people and serves to legitimate the political and economic elite.

LTMS then concludes, "South African could be described as being an accelerating economy (stage 3)". This fits with Asgisa's growth objectives which LTMS explicitly takes into account. However, whereas "governments would like to project a continuously high GDP growth", an examination of "other developed regions of the world" shows that "GDP growth increases, reaches a peak and then declines" [TR: 25]. GDP growth is therefore projected to increase over the next 10 years or so to peak in about 2020 and then decline over time, "flattening out around 3%" by 2050 [27]. Following the peak, South Africa presumably enters the 'industrialisation and catch up' stage and is on the way to the more equal society implied by the fifth stage of 'mass consumerism and the welfare state'.

There are several problems with this story of GDP growth. It is constructed with reference to developed and industrialising states: post-war Europe and Japan, South Korea between 1965 and 1990 and China since 1980. Except for China, all these countries were on the frontiers of the Cold War and received massive US support in the age of global Keynesianism. The neo-liberal 'Washington consensus' since 1980 has been considerably less expansive. Countries where growth and industrialisation failed, or which were de-industrialised, are not mentioned. Indeed, economic growth in South Africa itself was running at 6% in the 1960s – just a little below Korea's 7% and certainly good enough to qualify as an accelerating economy. Black workers and their families saw little benefit then and the working classes will see little benefit now.

China's industrialisation, on the back of massive peasant dispossession and pitifully low wages for workers, signals a major shift in global power relations. It does not, however, leave much space for industrialisation (stage 4) elsewhere. Rather, industry in Africa and Latin America has wilted in the face of Chinese competition. What has emerged is a triangular ordering of the global economy. Raw materials from Africa

and Latin America are taken to the Asian factory to produce goods consumed in the North. This flow of resources is largely managed by Northern transnational corporations who also determine the technologies of production and control product development.

Far from promising stages 4 and 5, this reinforces the centrality of South Africa's increasingly capital intensive 'minerals and energy complex'. It suggests that, in the absence of a crisis that leads to a transformation in the relations of power, the economic interests that shaped development in the 20th Century are set to shape it in the 21st Century.

Crisis, however, is very much on the cards. The big central banks may or may not manage to stave off global recession in the next year. The present desperation of global capital is, however, the latest symptom of a crisis that has its origins in the US defeat in Vietnam. Hitherto, the crisis has been managed by passing it off onto the global South – through structural adjustment programmes and the succession of regional crises – and by inflating one bubble after another to absorb surplus capital and pump up Northern (and Southern elite) consumption. As one wag put it, the US Fed needs to find another bubble fast.

Peak oil feeds into this crisis. High prices are already devastating poor importing countries and cramping consumption in the North. The prospects of global recession led to a decline of oil and other commodity prices in late July. Any signs of real recovery will likely provoke an escalation in prices and so nip growth in the bud. Having opened its capital markets to global hot money in the mid 90s, South Africa is peculiarly vulnerable to global economic volatility. Oil imports have outweighed mineral exports and the stress on foreign exchange reserves has led the central bank to hike interest rates – passing the economic costs to consumers – in an attempt to retain speculative capital and so prevent the collapse of the currency.

While the LTMS sees peak oil as one of the conditions for RBS to hold up, its implications are not apparent in its calculations of GDP growth. LTMS is undoubtedly right to challenge government's assumption of constantly high growth. But the smooth graph of its own projection is embedded in a narrative of development which equates development to GDP growth. This narrative is now exhausted and will be shredded in the coming crisis.

If anything, this adds urgency to finding a path to, and beyond, RBS for reasons other than climate change. It indicates the need for a wholesale transformation of power relations within which a different logic of development can be articulated. This cannot be led by the interests of corporate capital centred on the minerals and energy complex that have shaped development to date. If such a transformation is to be achieved, then people must organise for it and create the social movements that can bring it into being.

Strategic options

LTMS presents four strategic options which, "when implemented together, would allow South Africa to achieve the Required by Science Scenario" [SD: 13]. These options are titled: Start Now, Scale Up, Use the Market, and Reach for the [RBS] Goal.

The first three options are composed of mitigation actions which are modelled for costs, emission reductions and economy wide impacts. These mitigation actions are also called 'wedges' because each action shows a rising wedge of carbon savings over time. It is important to recall that these savings are made relative to GWC and do not represent an absolute reduction in emissions from any individual wedge or from the combination of wedges that makes up each of these three strategic options. The wedges fall into three categories: energy supply, energy use and non-energy sectors (industrial process emissions, waste and agriculture).

Below, we look at the first three strategic options, then at a selection of the wedges and how they are constructed, and finally at the fourth strategic option which (at least potentially) has a different logic from the first three.

Option 1 – Start Now

Start Now began life as 'can do'. It includes a set of wedges which reduce the rate of GHG emissions as compared with GWC and which save money (or at least cost very little) over time. The major wedges relating to energy use are industrial energy efficiency, more people using public transport in preference to private cars, and vehicle energy efficiency in cars, starting with a limit on the market for SUVs. Energy supply in this option is 27% renewables, 27% nuclear and 27% 'cleaner coal'. The remaining 19% is traditional dirty coal. Renewables and nuclear (assumed to emit no carbon) provide the big wedges.

GHG emissions in 2050 are a bit short of three times 2003 emissions instead of being four times higher as in GWC. In combination, these wedges save the economy about half a percent of GDP. However, different sectors of society or of industry are affected differently with some winners and some losers. In this option, there is a small loss of jobs compared with GWC but the job losses fall heaviest on unskilled workers. There is also an overall saving for households, but the biggest savings are made by the richest households.

Option 2 – Scale Up

Scale Up began life as 'could do' – assuming international assistance – and starts costing money. It adopts all the wedges from Start Now, extends some and adds some. The extended wedges are for renewables and nuclear energy which each provide 50% of electricity in 2050 – although 'cleaner coal' is not quite phased out. This requires much larger generation capacity to compensate for the variability of renewable production. Capacity is 180 GigaWatts in 2050 compared with 120 GW in GWC or around 140 GW

in Start Now. Present capacity (2008) is about 40 GW. New wedges include carbon capture and storage (CCS)[13] from synfuel production and the introduction of hybrid and electric vehicles.

Scale Up increases carbon savings when compared with GWC but, in 2050, GHG emissions are still rising and have more or less doubled compared to 2003 emissions. The cost to the economy is put at just less than 1% of GDP. Again, the benefits are unequal and this time the poor do better. There are more unskilled or semi-skilled jobs created than under GWC. Households overall lose around 1% of wealth, but the poor actually benefit slightly while the rich lose over 5% because they contribute more to the scaled up investments needed.

Option 3 – Use the Market

Economic measures might be a more accurate title. In Use the Market, state taxes on carbon emissions and subsidies for renewables influence prices. A rising carbon tax – from R100 / t CO_2e in 2008 (current CDM prices), to R250 in 2020, and then to R750 after 2040 – produces the largest single wedge modelled by LTMS, saving 12,287 Mt CO_2e against GWC over the full period from 2003 to 2050.

Subsidies for renewables and solar water heating also produce substantial carbon savings. Coal's share of electricity generation declines rapidly after 2025 when existing stations start reaching the end of their life. New build is biased to renewables because of the subsidy, with 118 GW installed by 2050 while nuclear adds 25 GW. Total installed capacity is 150 GW. In liquid fuels, CTL is phased out unless accompanied by CCS – which is only possible at a higher oil price than assumed by LTMS[14] – but 5 more crude refineries are built. The carbon tax has a smaller effect on demand "than one would expect in reality" and industry and transport emissions continue to rise. In transport, this is because "other options are limited" [SD: 19].

Carbon emissions initially track within range of the RBS scenario but start rising around 2035 to end up at 620 Gt/y in 2050 – about 1.4 times 2003 emissions. Costs to the economy are substantial at 2% of GDP. There are more jobs for lower skilled workers but fewer jobs for skilled and highly skilled workers. The impact on welfare in poor households is neutral but negative in rich households. The cost to the economy may be off-set by government spending of the additional revenue and SD flags the need for further research on how this may "yield a triple dividend (growing the economy, creating jobs and improving income distribution) …" [19].

[13] CCS involves separating carbon from plant emissions and piping it into underground geological strata. However, only some geological strata are thought likely to hold the carbon. None have been identified in South Africa and the most likely spot is off the west coast – a long way from the coal fields.
[14] The LTMS assumes US$97 a barrel for oil in 2030. This has, of course, already been overtaken.

Constructing wedges

These strategic options, and the wedges that compose them, were modelled 'bottom up' according to TR: "Stakeholders defined mitigation actions [wedges], which were then modelled by the research teams. Based on these results, actions were combined into action packages" [10]. The wedges are thus defined by economic sectors as they exist now and by comparison with the way they are expected to grow in GWC. In general, they also rely on data provided mostly by participants from government and industry and on their assumptions about what is or is not feasible.

This no doubt provided a practical way of proceeding. Where else would we begin but where we are now? And who else would have the data or the capacity to generate it? Nevertheless, it also binds each wedge to the dominant interests in the relevant sector and, for the most part, the savings are made without jeopardising those interests. Thus, for example, industrial energy efficiency uses less energy to do the same work as would be done in GWC. Overall, South Africa's growth path continues in the same direction and development is shaped by the corporate and state interests that have shaped it in the past.

In the first two strategic options, each wedge is more or less discrete and confined to the relevant sector. Thus, the possibility that carbon savings in one sector will require more emissions elsewhere is not considered. In the third option, the carbon tax has a system-wide effect, transcending the sectoral wedges, and goes some way to 'internalising' environmental costs. Clearly, this raises the question of who pays. Reductions are achieved primarily through technology change, directly driven by state regulation in the first two strategic options and indirectly driven by prices through the use of economic instruments in the third. LTMS pays particular attention to what participants regarded as realistic rates of technology development and replacement.

These comments do not imply that all wedges should be dismissed but rather that they should be approached critically. Technology change is essential to reducing emissions. Technologies also embed power relations. Big centralised power stations, for example, require the centralisation of institutional power in large corporate utilities. Technology change can thus open the possibility of changes in societal power relations but this depends on how they are articulated within people's struggles. Key questions concern the validity of the claims made in relation to any particular wedge and whether the effect is to entrench vested interests.

Energy wedges

LTMS uses Markal (Market Allocation), a modelling tool widely used in energy planning, to model possible energy futures. "The model is demand-driven, in that it starts from projections of useful energy demand" [TR: 12]. It is designed to match supply to demand at the least cost. It assumes first, that supply *can* match projected demand – Markal does not admit shortage – and second, that investors and consumers make 'rational choice' decisions based on costs. For the reference case (GWC), it assumes that development is a continuation of present trends: "For instance, energy efficiency is only

increased in line with historical trends" [TR: 13]. To construct the wedges, the model is 'constrained' by external criteria, such as a limit on carbon emissions or a target for energy efficiency or renewable energy, imposed by the modellers. It then finds the least cost options within these parameters.

Demand

GWC increases energy consumption by five times from 2003 to 2050. Energy for industry (including mining) and transport accounts for most of the growth in demand. Commercial, agricultural and residential demand growth is relatively small although not insignificant. For the wedges, reduced energy demand depends entirely on efficiency and the LTMS calculates that all efficiency wedges save the economy money.

Industry dominates energy demand, has neglected efficiency and is responsible for a high proportion of emissions. Industrial energy efficiency therefore makes for the biggest wedge on the demand side as boilers, fans and pumps etc. are made more efficient. Transport savings are calculated in terms of the energy required to move one passenger one kilometre. Transport of goods and commodities receives somewhat slight attention. Carbon savings are lower than for industry, partly because individual consumers are held to make choices that are not rational in terms of cost. More efficient vehicles make the largest saving. More comes from limiting the market for SUVs (i.e. forcing a shift to smaller cars) and this produces the highest economic savings proportionate to carbon savings. The LTMS does not draw the conclusion that the conspicuous consumption of the rich – which adds to GDP – is at the expense of the economy. A 'modal shift' from private to public transport produces significant savings both of carbon and to the economy. The biggest commercial and residential savings come from water heating followed by lighting and cooling and heating. Residential energy efficiency includes solar water heating.

Table 1 summarises LTMS calculations of CO_2e savings and economic costs (economic savings are represented by negative figures) for the full 47 years from 2003 to 2050. Carbon savings are relative to GWC in million tonnes of CO2e – absolute emissions continue to rise in all cases. Costs are in billions of Rands. Figures are indicative rather than 'true' but they give some sense of the scale of mitigations and costs.

Table 1: Energy efficiency wedges 2003 - 2050

	Industry	Transport			Commercial	Residential
		Light vehicles	SUV limit	Modal shift		
CO_2e saving (Mt)	4,572	758	18	469	381	430
Cost (R Bn)	- 3.2	- 4.2	- 1.6	- 11	- 1.6	- 1.8

Energy efficiency is a necessary but not sufficient condition for reducing energy demand and so limiting carbon emissions. The LTMS does not to take account of the 'Jevons paradox' that energy efficiency leads to an overall increase in energy use. For capitalism, increased energy efficiency is another form of increased productivity. It increases the work done by energy but the benefit is taken in profit and economic growth ahead of

overall energy saving. Put differently, the priority is the efficiency of capital, not energy, and the additional returns to capital must then be reinvested in further economic activity which requires more energy.

Thus, unless there is a limit to the supply of energy (contra Markal), energy efficiency is ultimately counter productive. Such a limit, however, is not compatible with economic expansion. If the quantity of energy is fixed then growing use for some can only be had at a loss to others. Assuming peak oil and a diminishing supply of energy, the equation becomes even more acute. A limit on energy supply may push efficiency as the present Eskom crisis demonstrates. Ultimately, however, Paul Mobbs observes that "energy efficiency is meaningless in the face of actual shortages" – efficient or not, the car will not go without fuel [2005: 143]. In a context of declining energy supplies, the choice is what – or whose – energy use to cut.

LTMS includes wedges for hybrid and electric cars. Both wedges are economically costly (but do not take account of costs coming down over time) but electric vehicles give better carbon returns at lower costs, particularly if a zero-carbon grid is assumed. LTMS assumes 60% of cars are electric by 2050. This substitutes for 25% of petrol use as minibus taxis, vans and the remaining cars use 75%. (Diesel demand is evidently assumed to be largely for heavy vehicles and is not affected.) The expansion of the grid to meet this additional demand does not appear to have been modelled but would be very considerable.

Supply - electricity

As noted above, the electricity supply mix is different in each of the strategic options above. 'Cleaner coal' essentially means more efficient generators. Integrated Gasification Combined Cycle (IGCC) is the most efficient (assumed to convert over 50% of the energy in coal to electric energy, as opposed to 35% for a conventional power station). It involves gasifying coal and using the gas as for a combined cycle gas generator. This technology is yet to be proved internationally but LTMS modelling shows it saving money on the assumption of higher efficiency. LTMS also models CCS for coal fired plants. It points out, however, that "South African geological conditions are not favourable for CCS" and the technology is not proven. It therefore sees limited potential for sequestration.

A variety of renewables are included in the modelling, but the main ones are wind, solar trough and solar tower. The costs of renewables vary according to whether 'technology learning' – implying the reduction of costs over time – is assumed or not.

Nuclear power is produced from Pressurised Water Reactors (PWR) and Pebble Bed Modular Reactors (PBMR). No additional learning is assumed for PWR which is an established technology. PBMR is yet to be proved but LTMS assumes it will work and builds learning into the cost assumptions – it does not model a case where the costs are not reduced over time. All data for PBMR relies exclusively on the PBMR Corporation and is not independently verified.

Table 2: Electricity supply wedges 2003 - 2050

	IGCC	Renewables			Nuclear	
Proportion of capacity in 2050	60%	27% + learning	50%	50% + learning	27%	50%
CO_2e saving (Mt)	167	2,757	3,285	3,990	1,660	3,467
Cost (R Bn)	- 0.02	- 8.2	6.3	0.3	0.6	1.4

According to LTMS, the Scale Up option of 50% renewables and 50% nuclear creates a 'zero carbon' grid. However, nuclear energy is only carbon free at the point of generation. Uranium mining, nuclear fuel fabrication and waste disposal are energy intensive processes incurring high carbon costs. The zero carbon claim rests on the assumption that nuclear fuel continues to be imported – so carbon costs are exported – and does not appear to take account of disposal. In 2007, however, government announced its intention to build a nuclear supply chain while escalating uranium prices have driven a new mining rush in South Africa as well as a number of other African countries. Final decommissioning of heavily contaminated plant – LTMS assumes 40 years operating life – consumes yet more energy. Taking the full life cycle into account, the Eco-Institute in Darmstadt, Germany, calculates that a 1,250 MW nuclear power station in Germany emits 33 grams of CO_2e per kWh, amounting to 250,000 tonnes per year. Carbon emissions are higher for lower grades of uranium ore: for grades between 0.1% and 1%, CO_2e emissions are 120 grams/kWh.[15] This implies between 16 and 58 Mt/y CO_2e from around 80 GW nuclear power in 2050. The higher figure is more likely because higher grade ore is mined first, leaving lower grades for the future.

The massive scaling up of nuclear is also likely to be accompanied by escalating radio-active contamination all along the production chain. South Africa already has serious legacy issues from mining and from the old apartheid uranium processing and fuel fabrication plants. Little of this has been cleaned up. In 2007 the National Nuclear Regulator (NNR) confirmed local suspicions that uranium and other radioactive elements had accumulated in river sediments and groundwater systems in the Wonderfontein Catchment Area. Hartebeestpoort Dam sediments are also contaminated. Uranium is a by-product of gold mining in this area and much of the contamination may be attributable to gold, but this points to a history of neglect with very serious consequences. The DME's 2007 Nuclear Energy Policy and Strategy, meanwhile, exhibits extraordinary complaisance in regard to nuclear waste disposal.

Nuclear power also comes at a cost to democracy. It requires high level security both for safety and because uranium is used to make bombs. Secrecy is intrinsic to the industry and allows it to decide what the public should or should not know. It is a powerful weapon for public relations used in the interests of the industry and not in the public interest.

The LTMS models costs to the economy but appears to accept industry's representation of costs. Nuclear critics argue that economic costs are high and potentially ruinous.

[15] http://www.precaution.org/lib/nuke_ghg_emissions.060224.pdf

Eskom has given an estimate of R100 billion for the first new PWR of about 4,000 MW.[16] When it produces a budget, it is most likely that this figure will rise substantially. Nuclear, however, has a track record of coming in at over three times budget and much behind time. We should not be surprised if the final bill is in the order of half a trillion. Since nearly all the equipment will be imported, the stress on an already vulnerable exchange rate will be intense. This will in turn drive economic and monetary policies to manage that stress. Citizens will pay: in price rises or taxes, in inflation and interest rate hikes to manage inflation, and in the loss of 'people oriented' investments [see Reach for the Goal below].

This is just for one plant. The Minister of Minerals and Energy is talking of up to 12 plants by 2030. This implies that more than one is under construction at any one time. The LTMS 50% nuclear option implies 20 or more PWRs by 2050. Beyond 2050, decommissioning of the first plants will start. In the UK, decommissioning costs are escalating and, of course, these plants are no longer generating revenues.

Further, the fuel supply chain is already stretched. Assuming that other countries pursue the nuclear option, there is a high risk that it will snap. Like oil, uranium prices are volatile now and a recent sharp fall in prices is putting investments, and hence future supplies, in jeopardy. LTMS fuel price calculations are based on GWC which assumes abundant oil supplies. Peak oil, however, will drag up all fuel prices including nuclear. This will be compounded by the depletion of cheaper uranium deposits and rising mining costs. At present, fuel is a minor part of the cost of nuclear energy, but this may well change.

In contrast, fuel for renewables is free and that does not change. Capital costs are therefore off-set over the full life cycle and the benefits will be compounded in the context of peak oil. South Africa has very good renewable resources, particularly for solar energy, which have hitherto been ignored. Moreover, the development of a renewables industry is within the scope of South Africa's capacities. There would now be a functioning industry if, in the last decade, renewables had been supported on the scale of the PBMR. LTMS notes that renewables create more jobs, particularly for lower skilled workers, than conventional fossil energy. In contrast, nuclear leads to an overall loss of jobs and most are high skilled [TR 141]. Holm et al [2008] identify several other advantages for renewables, including:

- Many technologies are composed of many small scale units which can be built relatively quickly in response to actual demand. Large scale conventional and nuclear plants, in contrast, have very long lead times and are built in response to long term demand projections. This was the case when Eskom over-invested in the 1980s. It was then left with 'stranded assets' and had to moth-ball several power stations.
- They are widely distributed, rather than centralised, and so reduce transmission costs as well as the risk of grid failures. The risk of plant failure is also minimised. In contrast, the failure of one large plant can throw the whole system

[16] This is the same technology as Koeberg – but more than twice the size.

into crisis as was shown when the bolt hit the fan at Koeberg and again during the national crisis.
- Most are simply not in the same league as coal or nuclear plants when it comes to local or global pollution.

There is, however, a wide variety of renewable technologies and not all share these advantages. Large-scale hydro (big dams), for example, has the same characteristics as conventional plant and imposes heavy environmental and social costs as well as high investment risks. Under centralised corporate management – state or private – other technologies, which are now small scale, may acquire similar characteristics as investment scales up.

Supply – liquid fuels

Liquid fuels consumption rises dramatically in all three options. LTMS modelling for the carbon tax wedge shows Sasol's CTL production being terminated in the mid 2030s [TR 111]. This suggests that CTL is not compatible with mitigation. Sasol's Secunda plant is presently the biggest single point CO_2 emitter in the world at around 52 Mt/y. LTMS modelled wedges for methane (CH_4) destruction and CCS for this plant with modest carbon savings.

Biofuels are modelled on the assumption that South Africa can produce up to 20% ethanol in petrol and 5% biodiesel in diesel without jeopardising on food security. This assumption should be treated with great caution. LTMS itself warns, "It should be noted however that if we also produce biofuels for sale to other foreign countries, this may no longer be true" [TR 44]. It does not, however, set any limits in relation to expanding fuel demand in South Africa. LTMS assumes biofuels are carbon neutral but acknowledges that this is contested in the international literature. The biofuels wedge yields a modest carbon saving at a significant cost. The alternative of a subsidy to biofuels yields greater carbon savings at much higher cost.

No mitigation wedges for crude oil refineries are modelled.

Table 3: Fuel supply wedges 2003 - 2050

	Sasol CH_4	Sasol CCS	Biofuel	Biofuel subsidy
CO_2e saving (Mt)	146	78	154	573
Cost (R Bn)	0.03	0.8	1.6	8.3

Non-energy wedges

LTMS models a range of emissions that are not produced by energy production or use. These include emissions from industrial processes, agriculture and waste. Most industrial process wedges are relatively small but may be significant in terms of reducing local pollution. For example, apart from their very substantial energy consumption, aluminium smelters emit perfluorocarbons (PFCs), a minor GHG but a major local pollutant. A

number of other common pollutants from industries such as cement, chemicals and metals are also minor GHGs.

Landfill gas (LFG) from waste contains up to 60% methane and 30% CO_2, so waste accounts for a significant 2% of South Africa's total GHG emissions. Rich people produce the bulk of domestic waste and LTMS assumes that the population as a whole will get richer between now and 2050. It therefore assumes growing mountains of waste going to landfill. Possible mitigation options start with waste minimisation, but this is not modelled because, LTMS suggests, waste management is given a low priority by government [TR 98]. Other mitigation options are composting and burning LFG in flares or for energy production. Composting organic wastes avoids future LFG production at a cost comparable to dumping it in landfills. Burning LFG essentially converts methane to CO_2 and so reduces GHG emissions overall. It should be observed that LFG is heavily contaminated with toxic compounds. Unless the gas is cleaned, combustion does not address local pollution issues. Thus far, energy projects have been funded through the CDM as well as electricity sales. CDM is a form of carbon trading and so transfers emissions elsewhere while alienating South Africa's future carbon entitlements.

The agricultural wedges provide the starkest evidence of the influence of vested interests (government as well as corporate) in defining mitigation actions.

Cattle, sheep and goats are ruminants, which means that they produce rather a lot of methane from 'enteric fermentation' – a polite scientific term for farting. Focusing on cattle, LTMS estimates that, excluding dairy, 15% are in feedlots with the remainder free-range. It proposes that the national herd be reduced by 30% by 2011 as this would benefit the quality of the herd as well as of rangelands and would not affect the overall value. So far, so good – assuming that there is a genuinely participative process particularly with African stock-keepers.

It then proposes that "5% of the free-range herd is moved to feedlot each year till 45% of the cattle will be in feedlots" [TR 87]. The rationale is that feedlot cattle will fart less provided that the quality of feed is improved. This, however, leaves a second problem. Manure from free-range animals does not produce methane but manure from feedlots does (for chickens and pigs as well as cattle). This is because it is pooled in large waste 'lagoons' which exclude oxygen and so results in anaerobic decomposition. LTMS proposes that most of this is dried and spread on the land. However, transport costs mean it cannot be taken too far and over-concentrated manuring pollutes land and water with nitrogen and phosphorus. Some must therefore be treated in anaerobic biogas digesters from which methane can be captured.

This is frankly bizarre. First, feedlots are energy intensive and rely on energy intensive farming and processing elsewhere for feed inputs as well as energy intensive downstream processing. Feed, whether improved or not, displaces emissions elsewhere. In the US, where feedlot production has expanded dramatically, beef production consumes 40 calories for every calorie of meat produced. LTMS does not discuss the relative energy use of free range and feedlot production. Second, feedlots are both land and water

intensive, largely because of the feed imports. US livestock consume seven times as much grain as US people do. This has implications for food security. Third, the pollution from concentrated manure is laced with other contaminants, notably antibiotics and often growth hormones as well, with direct effects on human health. Air pollution from feedlots goes beyond methane and includes particulates, hydrogen sulphide and ammonia.[17] Finally, feedlots have a history of spills and leaks. The LTMS proposals imply a vigilant regulatory authority which is not at all in evidence at present and which will not keep pace with a rapidly expanding feedlot industry.

In arable agriculture, cultivation releases carbon from the soil while the use of chemicals generally depletes the soil's capacity for carbon absorption. LTMS recommends no-till, reduced-till and conservation tillage to reduce carbon loss from soils. Again, however, it ignores the implications of heavy herbicide use in commercial variations of these techniques. Herbicides are produced from petrochemicals and both embody energy and are produced from energy and carbon intensive processes.

For both livestock and arable agriculture, LTMS takes no account of literature showing that organic agriculture contributes to "reduced consumption of fossil fuel energy …, reduced carbon dioxide emissions (48 to 60 percent less, except for very intensive crops), reduced nitrous dioxide, reduced soil erosion and increased carbon stocks" as well as much higher carbon absorption in comparison with conventional agriculture [Scialabba 2007].

LTMS also recommends an expansion of industrial plantation forestry despite acknowledging the serious impacts on water and biodiversity of grasslands. It argues that the time-averaged carbon density of plantations is higher than for grasslands, that wood wastes can be used to substitute for fossil fuels and that "long-lived forest products forms a carbon store itself" [TR 106]. Timberwatch argues to the contrary that industrial plantations destroy the carbon absorbing soils. It may also be noted that much of the forest product is for pulp for paper which is not long-lived. This aside, LTMS restricts its discussion to the plantations themselves and ignores the larger cycle of production through energy intensive mills and paper plants. Discussing emissions from wild-fires, LTMS argues that plantations make a relatively small contribution to fire emissions – apparently as a result of intensive fire management. In 2007, however, fires swept through large parts of the forestry areas in KwaZulu-Natal and Mpumalanga. These fires burn with far greater intensity than grassland fires and emit considerably more carbon. There is considerable potential for increased fire risk with climate change.

Economic measures

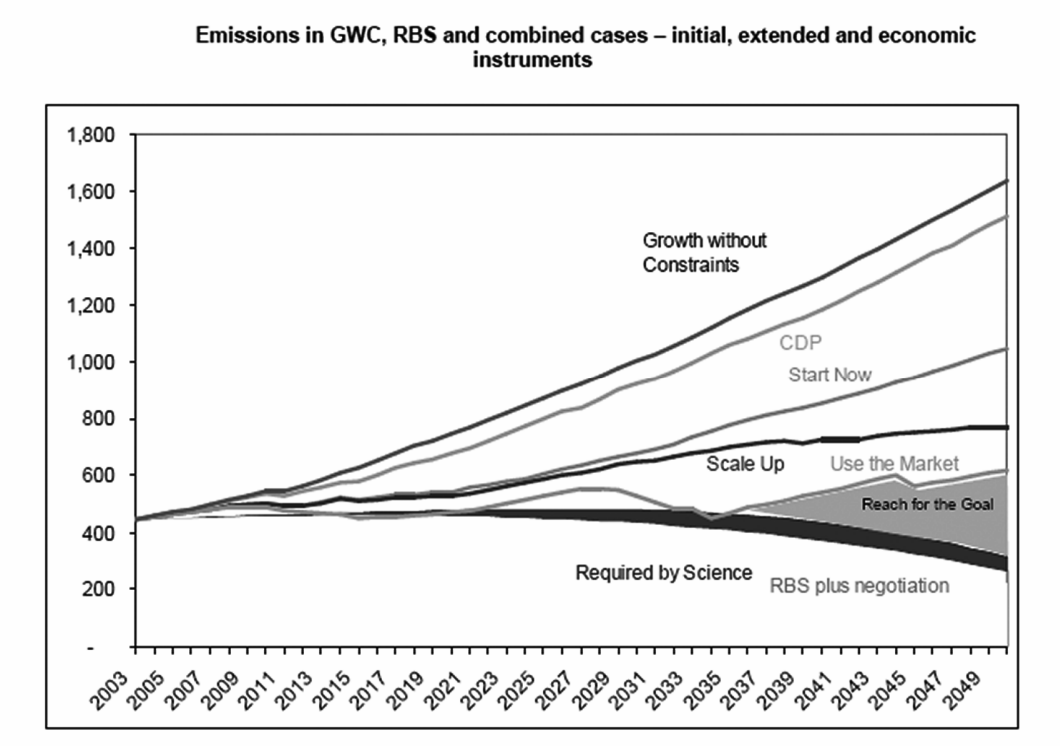
Economic measures are discussed under Use the Market above. As noted, the costs of a carbon tax may be off-set by government recycling the revenues through the economy. The tax has a potentially heavy impact on poor people. Environmental organisations and social movements have promoted an expanded free basic supply of energy to all people,

[17] See Factoryfarm.org. This is a programme of GRACE, referenced but apparently disregarded by LTMS.

followed by rising charges that penalise extravagant use. If this is accompanied by solar water heating and houses that are properly built to a decent standard of thermal efficiency, as recommended by LTMS, then people should be able to live comfortably within the expanded free basic supply.

Environmental organisations have also called for the recycling of carbon taxes into social and food security. There are two things to note here. First, social insecurity is produced through the present operation of the economy. Social protection – including grants, affordable services, decent housing and labour and environmental standards – is consequently of critical importance irrespective of climate change or a carbon tax. The carbon tax should certainly be recycled to produce a net benefit for the poor but should not be used to displace government's responsibility to use its resources as a whole to secure people's well-being. In the next section, this paper draws on the LTMS proposals for 'people oriented' measures to argue for a radical re-orientation of the economy. Second, a carbon tax has negative implications for the food price only in the context of energy and capital intensive agriculture. This agricultural regime should not be rescued by subsidies. Organic and labour intensive agriculture produces a net carbon sink. Transforming agriculture and securing fair exchange between the producers and consumers of food is a critical part of re-orienting the economy.

Figure 2: Emissions projections for Start Now, Scale Up and Use the Market



Option 4 – Reach for the Goal

The first three strategic options "only get South Africa two thirds of the way" to RBS [SD: 20]. Reach for the Goal must close the remaining gap. As with RBS itself, the economic costs of Reach for the Goal cannot be calculated because it relies on "unknown technologies and behavioural change" [SD: 21]. LTMS proposes four sets of actions for this option:

1. New Technology: investing in technologies for the future.
LTMS calls for "aggressive" R&D. Technologies should be identified for their potential to reduce emissions, particularly in the carbon intensive energy system, and on the level of risk and the potential for international transfers. These last criteria relate to the international negotiating position on technology transfer and to the assumption that successful new technologies are those that are developed and adopted globally rather than in isolation. Technologies are also seen as integrated into systems and interacting with 'human behaviour': "An example would be a decentralised grid, in which citizens can generate their own electricity and pass surpluses back to the grid" [SD: 21].

2. Resource identification: searching for lower-carbon resources.
LTMS proposes further investigation on importing hydro power from the Congo and importing gas from the Southern African region to substitute for coal. South Africa has already been involved in both. Eskom's continental ambitions – at least until 2004 when government mandated the new build programme – include the development of Grand Inga on the Congo River together with the West African Power Corridor transmission lines. For gas (and oil), South African corporations, notably Sasol and state-owned PetroSA, are scouring the region and Sasol is already importing gas from Mozambique.

3. People-oriented measures: incentivised behaviour change.
"Changes in social behaviour, whether driven by policy, education, or awareness, may yet prove to have large scale and low cost mitigation effects" [SD: 22]. In fact, most of the changes proposed are systemic: changing the pattern of urban development, including reducing distances between home, work and amenities; shifting to public transport; localising food production and consumption – implying a major effort around urban agriculture as well as enabling rural markets; responding to urban population (including urbanisation) growth "and high commodity expectations"; and 'greening' towns. People's behaviour is located within systems: however 'aware', they can't get on a bus that isn't there.

4. Transition to a low-carbon economy: redefining our competitive advantage
"Perhaps the most difficult but most fundamental approach to mitigation would be to shift South Africa's economy away from its energy-intensive path" [SD: 23]. Policy still defines South Africa's competitive advantage around energy intensive sectors. This must change and moving to a low carbon economy must be integrated into industrial policy. This implies redirecting investment, removing incentives designed to attract energy intensive investments and using the money to promote low carbon sectors. Strategies to support energy intensive industries and workers to make the transition would also be needed. LTMS suggests that such measures would support what is a natural process:

"Over time, most economies shift from primary and secondary sectors to tertiary sectors. South Africa's GDP has already shifted significantly from mining through manufacturing to services."

With the exception of point 2, this seems to represent a radical departure from present development policies. Whether it is or not, however, depends on how it is read. The assumptions behind the LTMS's larger story of development – the five stages leading to a service based economy – have been discussed above. These assumptions seem present in Cabinet's adoption of the strategy which commits to redefining competitive advantage and shifting to "a climate-friendly path as part of a pro-growth, pro-development and pro-jobs strategy" and an industrial policy promoting "sectors using less energy per unit of economic output".

Yet the shift to services is not necessarily what it seems. First, services cover a very wide range of activities, many of which are dependent on energy intensive industries. Hence, Sasol offers chemical engineering design services, founded on synfuel production, through a variety of strategic partnerships around the world. Second, the development assumed by the LTMS is not universal but reflects geo-political power and ranking. The major Northern economies have in effect outsourced production, along with the carbon emissions, and it is through services that they retain control of production. Monbiot observes, "A fair account of [the UK's] carbon emissions would include those we import minus those we export: a balance that can only worsen in a post-industrial economy."[18] As of now, South Africa participates in globalisation, with anxious enthusiasm, as a resource provider – well down the global rankings.

Finally, Ben Fine [2008] notes that financial services are now held to account for 20% of South African GDP. He argues that this is a symptom of financialisation and does not represent the banks' contribution to the economy but the economy's contribution to the banks. The banks themselves are closely tied to the major corporations at the heart of the minerals and energy complex (MEC) and, together with government, facilitated their listing off-shore in the global financial capitals. This off-shoring represented a huge disinvestment – appropriating resources produced in South Africa to finance the corporations' global ambitions. One might add that carbon trading falls under financial services and is similarly symptomatic of the parasitic financialisation of the global economy.

The LTMS doggedly abstracts its analysis from social power relations, but the first real test of government commitment to RBS must lie in its readiness to confront the power of the MEC to shape development and appropriate the proceeds. To date, it has acted to entrench the state's own interest in the MEC.

The 'people oriented measures' imply major social and economic investment. This will not be made within the terms allowed by the MEC or, indeed, by capital more broadly. For example, Cape Town's City authorities have stated their commitment to the dual priorities of economic growth driven by global competitiveness and pro-poor

[18] George Monbiot, *Traded Away*, The Guardian (London), July 24, 2008.

development. The first priority, however, has the effect of concentrating both public and private investment in wealthy areas. The pro-poor strategy is meanwhile failing. Urbanist Charlotte Lemanski comments that "the two goals appear mutually incompatible."[19] This dual development strategy is replicated at national level in Asgisa, which aims for 6% growth in the energy intensive 'first economy' and claims that it will support 'second economy' entrepreneurs by bridging the gap between the two economies.[20]

If the people oriented measures are to mean anything, they must define the shift to a low carbon economy. These two sets of actions cannot be treated independently of each other. Resources currently devoted to capital and energy intensive growth in the service of capital must be redirected to create an economy in the service of people. This will not be accomplished unless the process starts with people and is about people taking control of their economies through the process. Similarly, it should be recognised that technologies are not neutral but that they embody social power relations. Investments in new technologies must therefore be conceived as integral to this process. A decentralised grid based on many small generators, for example, embodies a very different set of social relations to a centralised grid based on a few giant plants while nuclear power entrenches the political power of the MEC and the security establishment.

Conclusion

RBS is uncosted because it cannot be achieved within the confines of current planning models. The assumption that informs these models is that economic growth constitutes the central organising principle of development. This is not because growth is needed to alleviate poverty but because it is needed to reproduce capital. This is what determines the bounds of realism in planning and it is this realism that has produced the crisis of climate change, the crisis of peak oil and the political and economic crisis gripping global capital.

The wedges were developed within the bounds of planning realism. Some wedges indicate pathways leading out of these bounds but others appear to be based on interests vested in the present realism. In particular, LTMS energy modelling assumes ever increasing demand. It is this that could not be reconciled with the carbon reductions required by science and it is this that will not be reconciled with declining global oil production following peak oil.

While the LTMS sees that RBS takes the country into uncharted realms, it retains growth as the central organising principle of development. It then takes the definition of national competitiveness as the fundamental issue. National competitiveness, however, becomes necessary because it is a function of growth. Rather than redefining national competitiveness, what is needed is a radical redefinition of what is meant by development and who defines it.

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[19] *Towards 2010: Going global leaves poor further behind*, Cape Argus, May 23, 2007.
[20] See The groundWork Report 2006 for a critique of Asgisa.

First, the central organising principle should be sustainable development founded on economic, social and environmental justice. This means a commitment to growing human solidarity and equality as well as a relationship to the environment which enhances rather than degrades the functioning of eco-systems both for their intrinsic value and for the eco 'services' they provide. The Constitutional justification of such a redefinition is found in the Environment Right. This does not imply that economy and production are unimportant, but that the economy must serve people, as may be inferred from the 'people oriented measures', rather than people serving the economy.

Second, peak oil implies a compelled shift to economic localisation. Climate change does not in itself compel such a shift but it is essential to any serious programme of mitigation. This means that national resources should be focused on supporting people's capacities to direct local development.

Third, if we are to address climate change, the energy system must be reviewed as a matter of urgency. Such a review should start with the new build programme and the focus on energy intensive industries and development. Overall, energy systems including power generation should be localised and placed under people's common control. Maintaining a level of national and regional grid capacity will remain important and this capacity should be provided by renewables. An aggressive programme of renewable energy, including solar water heaters, should therefore be prioritised. Supporting the capacity for local production of renewable energy components should be made central to industrial development policy.

Fourth, the transition to a different energy and development order will require energy inputs from the declining fossil fuel system. If these investments go into the declining system, they will represent a permanent loss. In the period between now and the target peak emission date of 2015, fossil fuel resources should therefore be used to build the new system.

Fifth, food is the most basic form of energy for people and the food system must be thoroughly transformed to enable people to define and take control of production and consumption and hence of their own futures. In the words of the Nyeleni Declaration on food sovereignty, this transformation should be based on people's right "to healthy and culturally appropriate food produced through ecologically sound and sustainable methods …" This implies a determined shift to organic production and sustained programmes for agrarian reform and urban agriculture.

Elements of a transition

In summary, a transition to policies based on the Environment Right is urgently needed and would have the following elements, a number of which are included in the LTMS:

- The rejection of the current rules of international relations, finance and trade, including the repudiation of the monetary debt that the North claims from the South and a demand that the ecological debt owed by the North to the South be honoured;
- Taming finance capital and markets through the use of a Tobin tax,[21] exchange controls or other means to moderate exposure to global economic volatility;
- Dismantling the power of corporations which is presently guaranteed by the state – or, more accurately, the international system of states – and expanding the space of people's common control of resources and production through institutions that they create.
- Fair trade and exchange at all levels (local, regional and global), including increased protection for vulnerable industries, such as textiles and clothing, that will be difficult to re-establish following a contraction of global trade;
- The use of green taxes, including carbon taxes, to reflect externalised costs of production;
- A transition to sustainable energy systems under people's common control, based on decentralised renewables and energy conservation, with the subsidy to fossil fuels transferred to renewable energies. Energy would need to be shared equally between all to ensure that everyone has enough. Similarly, local, national and global carbon allowances must be based on equal shares for all within the limits necessary to keep global warming well below $2^{o}C$ and to return atmospheric CO_2e concentrations to safe levels;
- Zero waste, including the return of organic wastes and sewerage to local energy systems and to soil fertility and the design of production and products such that all wastes are reconceived as resources;
- A major expansion of public transport systems and dramatically reduced use of petroleum to prevent the economy being drained by rising oil prices;
- The reconfiguration of urban space to shift away from consumption neighbourhoods defined by class and to reintegrate the poor into central areas while also putting amenities and jobs within walking distance for most people;
- Sustainable building with housing and workplaces that do not impose high costs for people to be comfortably warm or cool, built with low energy building materials such as earth rather than cement;[22]

[21] A Tobin tax is imposed on international financial transactions. So foreign investors in the stock exchange would pay a small percentage of the amount that they invest in tax, both when they put the money in and when they take it out. The effect is to discourage purely speculative investments.

[22] Cement making is one of the most energy intensive industries. In South Africa, the industry is angling to switch to waste incineration to reduce energy costs. This would make it even more pollution intensive.

- Support to local economic development – which may in any case be stimulated by escalating transport costs – with expanding local demand through increased employment and grants;
- Local organic food production linked to people's markets as part of a broader turn to organic and permaculture production technologies coupled with accelerated land reform;
- Sustainable water management with neighbourhood sewage systems providing energy, manure for urban agriculture and recycled water;
- Securing people's health and well-being, requiring both a radical reduction in pollution and provision of housing and services designed to meet people's needs rather than being designed for cost recovery;
- Conservation of local ecologies and biodiversity to ensure both the sustainability of 'ecological services' and as accessible local amenities;
- Ensuring inclusiveness and people's participation while interrogating the exclusive implications within the consumption economy.

Finally, two things must be emphasised: First, this is an open-ended process of transition to a society in which people are actively and consciously making the decisions that shape their collective future. It will not be a smooth process nor is the outcome certain. How things take shape will depend on what emerges from struggles, how people learn from struggle and from doing, and where they decide to take things from there. Second, this paper puts forward a set of arguments and takes some strong positions but it is not intended as the last word. Rather, the SECCP hopes that it contributes to people's debates in their organisations, through their networks and in the places where they live and work. It hopes to share in a continuing dialogue but believes that it is the conclusions and decisions for action that people come to that are important.

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