In Reaching for the Goal, technologies are seen as systems. Stand-alone technologies are integrated into larger system, and taking a system view can increase savings. Technology interacts with human behaviour: For example, a decentralised grid, in which citizens can freely generate their own electricity and pass surpluses back to the grid. Integrating distributed generation into the grid requires further research and development (R&D). Such efforts should build on the Department of Science and Technology's climate change R&D strategy.

These technologies require aggressive R&D effort, which should begin at the same time as the Start Now Strategy. Bringing these technologies *to the market*, *at scale*, *backed up by investment*, and driven by *appropriate policy*, is critical to Reaching for the Goal.

2: Resource identification

The second set of actions refers again to technology, but with the stress on resource availability. Here two technologies stand out: imported hydro energy from the Congo or East Africa and natural gas (Kalahari and elsewhere). Significant gas found in the region would play a significant role in switching from coal. Security problems would have to be solved with imported hydro-electricity from our African neighbours. These two resource issues need further investigation, including the related political issues.

3: People-oriented measures: Incentivised behaviour change

One of the most compelling results of LTMS is that although most of the significant emissions reductions need to be within the energy sector, all the technology based actions simply do not "close the gap". Hence one must turn to the least studied of the possible options, being social behaviour.

Changes in social behaviour, whether driven by policy, education, or awareness, may yet prove to have large scale and low cost mitigation effects. This may be so across a number of sectors.

- Human habitation, urban planning and the built environment are also areas where social change and new patterns, approaches and expectations will likely have significant mitigation effects.
- The distance between work, home and other life functions is also a factor.
- In human movement, for example, modal shifts to public transport, a move away from individual car ownership towards the operation of shared vehicles, and other shifts deserve study. Business, commerce and consumption is currently heavily linked to human movement, much of which may be replaced by, for example, internet based interfaces.
- Food production and consumption, as well as localisation of these activities, are also examples worthy of study.

- Population growth, but more importantly the growth of an urbanised population with high commodity expectations could also be studied to see which changes may result in emissions reductions and how these might be driven.

- Tree planting and greening of towns is important.

4: Transition to a low-carbon economy

Another compelling result from LTMS was that the composition of our economy played a major role in our high emissions, and that a change in this, in our competitiveness, was worthy of further assessment. Perhaps the most difficult, but also most fundamental approach to mitigation would be to shift South Africa's economy away from its energy-intensive path. The results of the technical analysis suggest that energy efficiency and a cleaner fuel mix are significant mitigation actions, but in the long-run, the challenge is to consider the energy-intensity of our economy, structurally.

Instead of investing in energy-intensive sectors, which were at the heart of our economy over the twentieth century, South Africa would move towards a low-carbon economy. Industrial policy would favour those sectors that use less energy per unit of economic output. Such a change would have to be integrated into the dti's ***National Industrial Policy Framework and Action Plan***.

Over time, most economies shift from primary and secondary sectors to tertiary ones. South Africa's GDP has already shifted significantly from mining through manufacturing to services. Associated with this shift is a decrease in energy intensity. Yet policy still tends to define competitive advantage around energy-intensive sectors. Climate change may require that we re-define what we mean by competitive advantage. This could have several dimensions.

One dimension would be to focus on parts of the economy which are not as sensitive to energy price rises. A transition to a low-carbon economy in South Africa might involve shifting incentives – removing incentives for attracting energy-intensive investments and using the resources freed up to promote lower carbon industries.

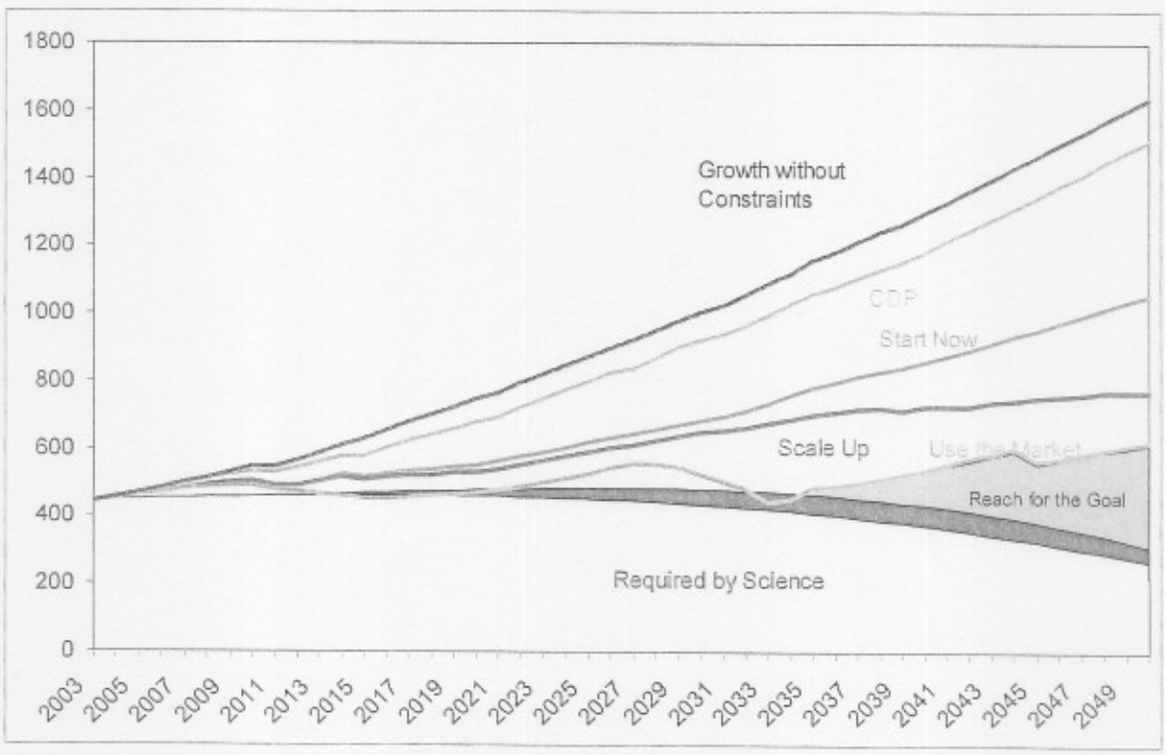
A low-carbon economy will not emerge overnight. That means that energy–intensive industries will continue to exist, and a comprehensive strategy will have to include transition for these sectors and its labour force. Policies that could assist energy-intensive industry would include promoting higher value-added sectors, as well as ambitious energy efficiency targets (since the potential for energy savings are greater).

More proactively, the transition would be to define new areas of advantage in climate-friendly technology. Much as Brazil has become a world leader in biofuels, South Africa could deliberately seek to build new competitive advantage in climate-friendly technologies, such as solar thermal electricity or the pebble bed modular nuclear reactor (PBMR). The aim would be to become a market leader, with government providing supporting measures.

The Challenge of reaching "Required by Science"

The results of the cumulative sets of actions under the **Reaching for the Goal** strategy may or may not fully close the gap between the two Scenarios by closing the final "emissions triangle". Without the ability to model the technologies, incentives, programmes and structural changes the result cannot be guaranteed. They are, however, guided by a long-term goal represented by the **Required by Science** scenario.

The graph below shows how **Start Now** would achieve around 43% of the goal; how **Scale Up** gets us about two-thirds (64%) of the way from GWC to RBS; and how **Use the Market** closes the gap by three-quarters (76%). The remaining "triangle" of emissions challenges the exploration of new territory.



LTMS concluded that the trajectory illustrated in the graph above for **Required by Science** is not realisable with currently known technologies. The question is how to get South Africa's emissions, after a period of unavoidable increase, to plateau, and then drop. Here two areas of "flexibility" appear. The first is: what is the "negotiating region" for the final goal set in the **Required by Science** trajectory. This could be anything between say -10% of current emissions and the full, undiscounted goal of -50%. The latter is not only what the latest science says is required, but is also discussed in political circles, e.g. the G8+5 process. This "discount" means that other richer developed nations will have to reduce emissions more, hence allowing South Africa to do less. The second are of flexibility is when and how high do South Africa's emissions peak? It is clear that if the peak is too high, the decline is harder to achieve; too late and the same applies. Arresting the emissions trajectory at the correct point at some time around the middle of the period becomes the subject of further planning. By implementing the **Start Now** and

Scale Up or Use the Market options South Africa will create the time to develop the strategies that will achieve the peak and decline of emissions.

Reaching the target in the Required by Science scenario requires in the first instance strong commitment and leadership. In the second it requires international alignment. It will only flourish with international technology and financial support, and with strong carbon markets. Finally it requires a committed investigation of future options.

Under this scenario South Africa responds enthusiastically to the moral imperative of climate change. It has acted in the interests of future generations.

Key findings

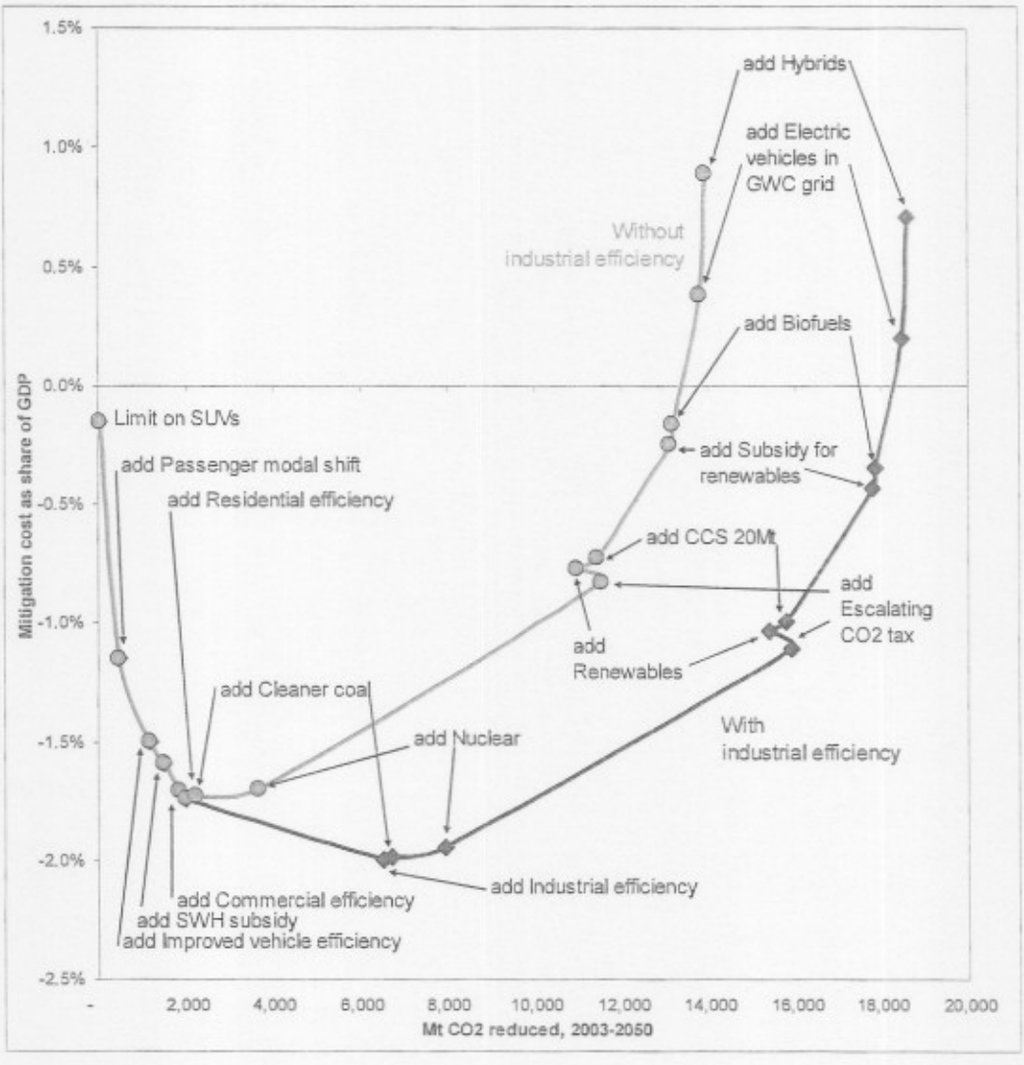
The key findings of the LTMS process are:

1. Growing without carbon constraints may be good for South Africa's economic growth, but will result in rapidly increasing emissions. A four-fold increase in emission by 2050 is likely to be unacceptable to the international community and is a high-risk approach on other grounds, such as rising oil prices, carbon constraints in trade and advancing impacts.
2. If all countries, including high emitters in the developing word, adopted this approach, climate change impacts in South Africa would be extensive.
3. A massive effort by South Africa to achieve emissions reduction sufficient to meet the RBS target. The gap between where South Africa's emissions are going and where they need to go is large (1300 Mt CO_2-eq, more than three times annual emissions of 446 Mt in 2003).
4. Certain quantifiable strategic mitigation options are immediately implementable, even if they require significant effort. These include energy efficiency, especially in industry; electricity supply options; CCS; transport efficiency and shifts; people-oriented strategies; supported by awareness (see Next Steps and Annexure for details). These potential strategies show good emissions reduction results: with costs to the economy range from affordable to significant. Significant mitigation action can have net public benefits, such as savings in energy bills and increased employment.
5. Within the quantifiable mitigation strategies, South Africa can choose both regulatory and economic instruments. Neither of these, however, completely closes the gap. With an escalating tax, economic instruments go the furthest in closing the gap – by almost three-quarters. But they are not intrinsically more effective than regulation.
6. Hence much preparation of a range of further, more uncertain and for now less understood actions need immediate exploration. These range from future technology to changes in social behaviour.
7. Key to success will be strong, committed and engaged South African leadership in government, business and civil society, coupled with international alignment and active support.

An overview of the cost implications of combined mitigation actions is outlined in the Technical Summary (section 7.3). In essence, this compares the total mitigation costs over a 48-year period with the size of the economy. Note that the "% of GDP" in this analysis does *not* refer to the impact on the economy, but simply puts mitigation costs in the context of the whole economy.

Assuming the Stern threshold of 1% of GDP level were acceptable overall costs to the South African economy, it is of interest to see where this level is crossed. This is calculated by adding different wedges incrementally, starting from the least-cost wedge. The 'share of GDP' is shown against the cumulative emission reductions on the x-axis of the diagram below.

Mitigation costs as share of GDP, for cumulatively combined wedges



As is seen in the results, combining a set of negative cost options – mostly energy efficiency in various sectors - would make the share of GDP more negative, so that the curve initial slopes downward. The diagram shows that a range of positive cost wedges, such as those in electricity generation or CCS, can be added and still remain below 0% of GDP.

The full implications for negotiators on the international front need to be further explored by the delegation. The LTMS process has analysed a range of quantifiable mitigation objectives, which provide information for South Africa to negotiate. For domestic policy makers, business leaders and leaders in South African society, LTMS has revealed that action will be required across the board, and extensive further work is required. These next steps are described in the next, final section.

Next steps

Scenarios can help inform long-term policy choices and negotiating positions – particularly when scenarios are underpinned by the rigorous analysis as presented in the LTMS Technical Report. Regardless of the pathway chosen by South Africa, some "across-the-board realities" emerge, suggesting list of next steps.

LTMS has presented two starkly different scenarios. The first step will be for a high level group of leaders to add their inputs to the LTMS study. The Scenarios and Strategic Options may be revised and will be presented to the South African Cabinet. It is suggested that the first step will be to make an move towards for a development path consistent with one of the two Scenarios presented. If the second Scenario is to be followed, as suggested in this study, a number of steps must follow.

Energy efficiency, esp in industry

Electricity supply options

Carbon capture and storage

Transport efficiency and shifts

1. Energy Efficiency is a component of all the strategic options in **Required by Science** scenario. Indeed, all the suggested strategies can be thought of as "Energy Efficiency plus". Energy Efficiency can deliver large and smart mitigation. Although economically obvious, voluntary agreements only work to a degree. Hence tough motivators will have to be introduced. Hence tough motivators will have to be introduced, some of which have already been suggested in the Energy Efficiency Strategy (DME 2005). Detailed design of such motivators requires urgent work and rapid implementation.
2. In electricity generation, the technology choice is fairly clear: there are two key domestic alternatives to coal. (Energy imports are another option but these come with key uncertainties – eg political stability for hydro from the DRC, and questions as to whether the Kalahari gas reserves are real.)
    - The challenges for nuclear power outlined in draft policy[19] include radioactive waste disposal, maintaining non-proliferation and economic viability. If these can be resolved, the expansion of nuclear power is an obvious choice. The nuclear build programme will be financed like other capital investment projects, through raising debt. For the PBMR, government has committed to finance 51% of the capital requirements over the next three years.
    - An equivalent scale of investment is needed in various renewable energy technologies. The challenge here is to scale up in the next years, so that implementation at larger scale is feasible and more affordable in future. The central problem is cost – and much depends on what technology learning happens in other countries (see the Technical Report). Renewable energy technologies face challenges due to intermittency of the source and dispatchability, which at larger shares may require additional investment in the system, e.g. storage. The Solar Power Tower shows most promise and may even have base-load potential.
    - Cleaner coal appears to reduce emissions by relatively small amounts, unless accompanied by Carbon Capture and

[19] DME published a nuclear energy policy and strategy for public comment, July 2007.

Storage (CCS).

3. Transport is the fastest growing emitting sector and poses the most complex challenges, because it encompasses fuels, vehicle technology, infrastructure, as well as behavioural changes. Biofuels cannot solve the problem at any scale. An overall package needs to be designed, addressing a range of interventions in the sector. This will look at the two large mitigation wedges as principal motivators: modal shift in the way human and freight movement is achieved, and technology transfer away from petrol and diesel. Electric vehicles and hybrids provide efficiency gains over conventional engines and hydrogen cars emit no GHGs at the point of use. The extent of mitigation will depend on the energy source from which the electricity, biofuel or hydrogen that power them is derived. Central and decentralised options need to be covered.
4. CCS is important and requires some attention and support. It is clear that this is a large part of the solution for both CTL and coal-based electricity, and hence is included as a major component of our energy security strategy. CCS needs to address challenges and uncertainties, including technical, geological, economic, environmental impacts and the regulatory framework – but above all, it needs to prove whether it can scale up by a factor of 10 or 100.
5. These are the big hits. But there are also many smaller activities that deliver cost-effective mitigation, such a manure management in agriculture (see the Annexure for an overview). Others are important to their sectors in their own right, e.g. fire control. A balanced portfolio should include wedges that have socio-economic/sustainable development benefits, notably in the residential sector. A number of government departments will have to address those activities showing most promise in their sectors.
6. Several strategic options require immediate support and further research:
    - Social behaviour change
    - Emerging technologies
    - Resource identification
    - Inducing a transition to a low-carbon economy

    Achieving changes in social policy and behavioural change would require focused public awareness raising.
7. The damage costs of climate change impacts under different concentration scenarios requires further research as the state of knowledge matures.

Other sectors

People-oriented strategies

Costs of inaction

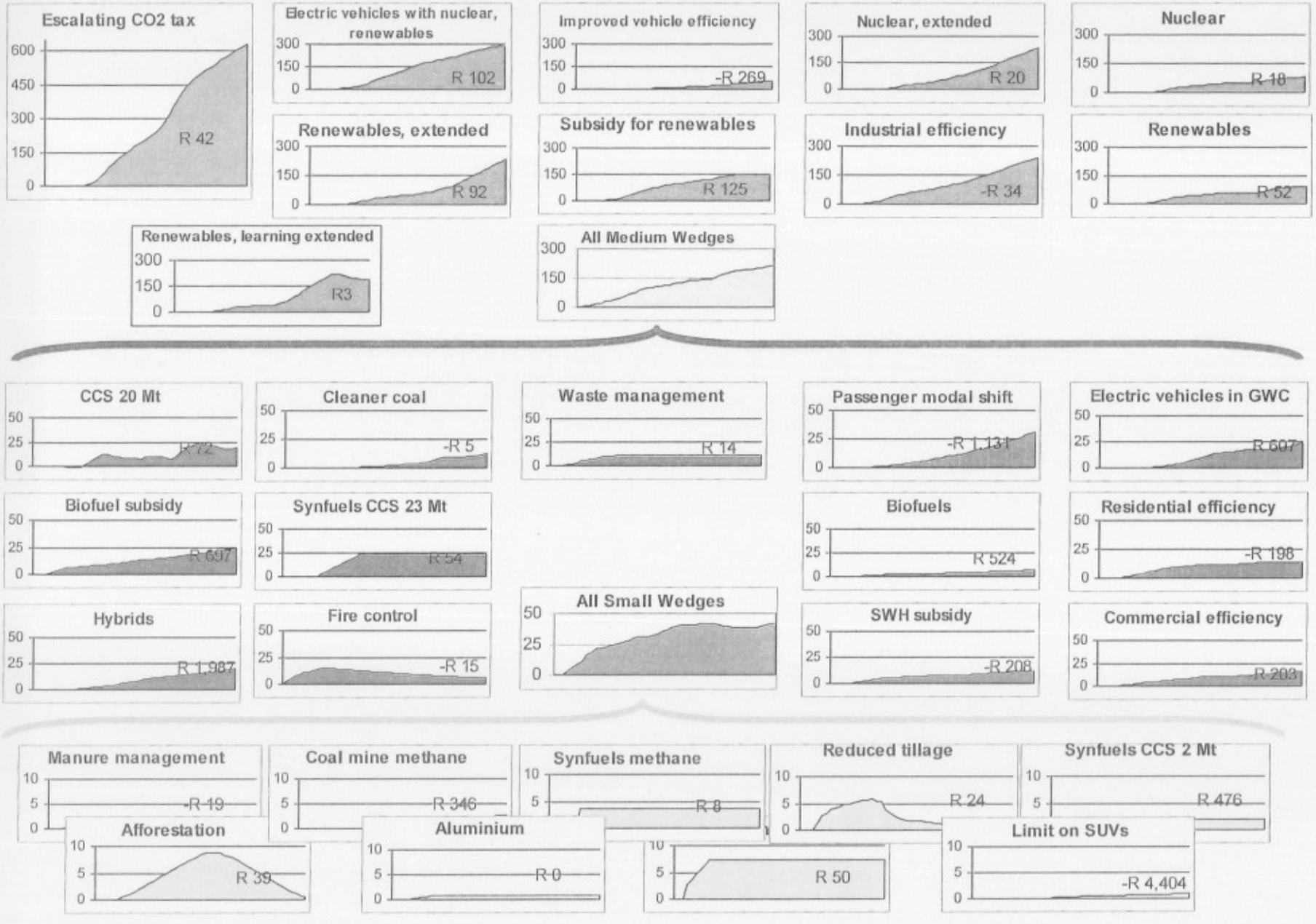
Awareness

None of the technologies, policies and measures highlighted above is a 'silver bullet'. Investment will be needed in a portfolio of mitigation actions. These strategic choices about investment and technology need to be guided by a long-term policy framework. Cost-effective solutions can best be found when policy guidance is 'loud, long and legal' and comprises a smart mixture of regulatory and economic instruments.

A further next logical step will be to finalise, on the basis of the parameters presented in the LTMS, a long-term climate policy for the country. This would require a more formal policy process, on the basis of which government would choose a strategy. This strategy may not be any of the ones presented here, but a combination or variant of these

wedges. A strategy could form the basis for a legislative and policy package, which will give effect to such policy at a mandatory level. This domestic process of policy making will closely interact with the international negotiations over the next two years. Between 2007 and 2009 a strengthened climate regime for the period after 2012 will be negotiated under the UNFCCC and its Kyoto Protocol.

The Climate Challenge can be easily presented in desperately pessimistic terms, or its existence can simply be denied. We have done neither: we were determined to accept fully the current science and proactively engage in climate action. The scenarios and strategies therefore present a positive, ambitious but realistic pathway that we can marry with the expected demands of the multinational negotiations.



Istanbul Convention (VI)

The annexes requesting approval are described below:

Annex B.4: this Annex deals with temporary importation of goods to be used in a manufacturing operation:

For the purposes of this Annex, the term "goods imported in connection with a manufacturing operation" means :

-matrices, blocks, plates, moulds, drawings, plans, models and other similar articles

- measuring, controlling and checking instruments and other similar articles, special tools and instruments, imported for use during a manufacturing process; and

"Replacement means of production" :

- instruments, apparatus and machines made available to a customer by a supplier or repairer, pending the delivery or repair of similar goods

Applies to :

goods imported in connection with a manufacturing operation must be owned by a person established outside the territory of temporary admission and intended for a person established in that territory

SARS South African Revenue Service

Istanbul Convention (VII)

The annexes requesting approval are described below:

Annex B.5: this Annex deals with temporary admission of goods imported for educational, scientific or cultural purposes:

Term "goods imported for educational, scientific or cultural purposes" means :

- the term "scientific equipment and pedagogic material" means any models, instruments, apparatus, machines or accessories therefore used for purposes of scientific research or educational or vocational training

- the term "welfare material for seafarers" means material for the pursuit of cultural, educational, recreational, religious or sporting activities by persons charged with duties in connection with the working or service at sea of a foreign ship engaged in international maritime traffic.

For the facilities granted by this Annex to apply :

- goods imported for educational, scientific or cultural purposes must be owned by a person established outside the territory of temporary admission - imported by approved institutions in reasonable quantities - not be used for commercial purposes

- welfare material for seafarers must be used on board foreign ships engaged in international maritime traffic, or must be unloaded from the ship to be temporarily used ashore by the crew, or must be imported for use in - places of worship where services for seafarers are regularly held.

SARS South African Revenue Service

Istanbul Convention (VIII)

The annexes requesting approval are described below:

Annex B.6: this Annex deals with temporary admission facilities for two categories of goods, namely travellers' personal effects and goods imported for sports purposes:

Goods imported for sports purposes" means - sports requisites and other articles for use by travellers in sports contests or demonstrations or for training in the territory of temporary admission.

Personal effects and goods imported for sports purposes shall be granted temporary admission in accordance with Article 2 of this Convention.

For the facilities granted by this Annex to apply :

- personal effects must be imported on the person or in the baggage (whether or not accompanied) of the traveller

- goods imported for sports purposes must be owned by a person established or resident outside the territory of temporary admission, and must be imported in reasonable quantities in the light of their intended use.

SARS South African Revenue Service

Istanbul Convention (IX)

The annexes requesting approval are described below:

Annex B.7: this Annex deals with temporary admission, subject to re-exportation, of tourist publicity material:

For the purposes of this Annex the term "tourist publicity material" means :

Goods imported for the purpose of encouraging the public to visit another foreign country, in particular in order to attend cultural, religious, tourist, sporting or professional meetings or demonstrations held there

For the facilities granted by this Annex to apply, tourist publicity material must be owned by a person established outside the territory of temporary admission, and must be imported in reasonable quantities in the light of its intended use.

SARS South African Revenue Service

Istanbul Convention (X)

Annex B.8: this Annex deals with temporary admission of goods imported as frontier traffic, for example goods carried by frontier zone inhabitants in the performance of their profession or trade:

Term "goods imported as frontier traffic" means :

- those carried by frontier zone inhabitants in the performance of their profession or trade (doctors, craftsmen, etc.)

- personal or household effects of frontier zone inhabitants imported by them for repair, manufacture or processing

- equipment intended for working on land located within the frontier zone of the territory of temporary admission

- equipment owned by an official body, imported in connection with a relief operation (fire,floods, etc.)

For the facilities granted by this Annex to apply :

- goods imported as frontier traffic must be owned by a frontier zone inhabitant of the frontier zone adjacent to that of temporary admission

- equipment for working on land must be used by frontier zone inhabitants of the frontier zone adjacent to that of temporary admission who work on land located in the latter frontier zone

- frontier traffic for repair, manufacture or processing must be of a strictly non-commercial nature.

SARS South African Revenue Service

Istanbul Convention (XI)

Annex B.9: this Annex deals with goods such as medical, surgical and laboratory equipment that are imported on a temporary basis for humanitarian purposes:

Term "goods imported for humanitarian purposes" means :

medical, surgical and laboratory equipment and relief consignments (all goods, such as vehicles and other means of transport, blankets, tents, prefabricated houses or other goods of prime necessity, forwarded as aid to those affected by natural disaster and similar catastrophes)

For the facilities granted by this Annex to apply :

- goods imported for humanitarian purposes must be owned by a person established outside the territory of temporary admission and must be loaned free of charge

- medical, surgical and laboratory equipment must be intended for use by hospitals and other medical institutions which, finding themselves in exceptional circumstances, have urgent need of it, provided this equipment is not available in sufficient quantity in the territory of temporary admission

- relief consignments must be dispatched to persons approved by the competent authorities in the territory of temporary admission