A NATIONAL CLIMATE CHANGE RESPONSE STRATEGY

FOR SOUTH AFRICA

September 2004

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM

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EXECUTIVE SUMMARY

Global climate change is possibly the greatest environmental challenge facing the world this century. Although often referred to as 'global warming', global climate change is more about serious disruptions of the entire world's weather and climate patterns, including impacts on rainfall, extreme weather events and sea level rise, rather than just moderate temperature increases. The developing world faces greater challenges than the developed world, both in terms of the impacts of climate change and the capacity to respond to it.

Concerned with the implications of global climate change, several governments came together in 1988 and formed the Intergovernmental Panel on Climate Change (IPCC). This led to the United Nations Framework Convention on Climate Change (UNFCCC), which was tabled in 1992 at the United Nations Conference on Environment and Development. The stated objective of the UNFCCC is to achieve stabilisation of the concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The South African Government ratified the UNFCCC in August 1997.

It was soon recognised that the commitments set out in the UNFCCC were inadequate for achieving its ultimate objective and this led to the adoption of the Kyoto Protocol in 1997, after much international negotiation. The South African Government acceded to the Kyoto Protocol in July 2002. In order to fulfil the requirements of the UNFCCC, South Africa has prepared an Initial National Communication to the UNFCCC, in accordance with Article 12 of the Convention. In addition, detailed South African Country Studies reports have been compiled on a sectoral basis. Using the results of this work, together with information from the IPCC Third Assessment Report, the Department of Environmental Affairs and Tourism has developed a national climate change response strategy.

The objective of this strategy is to support the policies and principles laid out in the Government White Paper on Integrated Pollution and Waste Management, as well as other national policies including those relating to energy, agriculture and water.

The strategies outlined in this document are designed to address issues that have been identified as priorities for dealing with climate change in South Africa. Whereas the national strategy must recognise international realities, including the growing pressure for quantified commitments of some kind by developing countries, including South Africa, it must be seen within the context of the present economic realties of the country and the inequitable distribution of global wealth. Thus the point of departure reflected in this strategy is achievement of national and sustainable development objectives, whilst simultaneously responding to climate change.

To this end, the strategy highlights the following as key issues and problems:

Supporting national and sustainable development

Sustainable development can be defined as development which meets present needs without compromising the ability of future generations to meet their needs. It encompasses the social, environmental and economic dimensions of development. Thus South Africa's position is to view climate change response as offering just one specific avenue of opportunity for achieving the sustainable development objectives of the national policies and legislation that are concerned with both development and environment issues. At the same time, international action on climate change can be viewed as a significant vehicle to redress the historic, inequitable and unsustainable north/south divide of the world's economy and prosperity. In support of this objective, South Africa's national climate

change response programme strongly supports the New Partnership for African Development initiative. There are many benefits to be derived in integrating climate change response programmes across national and regional boundaries, to serve common areas of interest and to maximise the utility of available resources.

Adapting to Climate Change

According to the IPCC Third Assessment Report, climate change is already happening, and will continue to happen even if global greenhouse gas emissions are curtailed significantly in the short to medium term. There is now more confidence that global climate change is a threat to sustainable development, especially in developing countries, and could undermine global poverty alleviation efforts and have severe implications for food security, clean water, energy supply, environmental health and human settlements. Acknowledging the overall vulnerability of South Africa to climate change impacts, it will thus be necessary to carry out adaptation measures in this country. The South African Country Studies Programme identified the health sector, maize production, plant and animal biodiversity, water resources, and rangelands as areas of highest vulnerability to climate change and these are the areas that need to be targeted for adaptation measures. With regard to vital industries, the mining and energy sectors are particularly vulnerable to climate change mitigation measures. Further, the South African economy is vulnerable to the possible response measures implemented by developed (annex 1) countries, since the economy is highly dependent on income generated from the production, processing, export and consumption of coal. This vulnerability extends across virtually all facets of the mining and energy sectors.

Developing a sustainable energy programme

South Africa, as a non-annex I country, is not required to reduce its emissions of greenhouse gases. However, the South African economy is highly dependent on fossil fuels and the country can be judged to be a significant emitter due to the relatively high values that can be derived for emissions intensity and emissions per capita. Such calculations put South Africa as one the world's top 15 most energy intensive economies, with a significant contribution to greenhouse emissions at a continental level. There could be benefits to be derived from adopting a future strategy that is designed to move the economy towards a cleaner development path. This will require continued attention to the process that is currently being developed to access investment through the Clean Development Mechanism of the Kyoto Protocol, technology transfer and donor funding opportunities. However, even given this scenario, emissions can still be expected to increase with economic development, albeit at a smaller pace than would have happened without intervention. The Department of Minerals and Energy has developed a white paper on renewable energy and clean energy development, together with an energy efficiency programme, to support diversification towards a less carbon intensive energy economy.

Meeting international obligations

South Africa, as a signatory to the UNFCCC, has to fulfil certain obligations including:

- Prepare and periodically update a national inventory of greenhouse gas emissions and sinks.
- Formulate and implement national and, where appropriate, regional programmes to mitigate climate change and facilitate adequate adaptation to climate change.
- Promote and cooperate in the development, application and diffusion of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases.
- Promote sustainable management, and promote and cooperate in the conservation and enhancement of sinks and reservoirs of all greenhouse gases.
- Cooperate in preparing for adaptation to the impacts of climate change.

- Take climate change considerations into account in the relevant social, economic and environmental policies and actions with a view to minimising adverse effects on the economy, on public health and on the quality of the environment.
- Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate uncertainties.
- Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change.
- Promote and cooperate in education, training and public awareness related to climate change.

The integration of climate change response in government

Although the Department of Environmental Affairs and Tourism has been designated as the lead agency for climate change response in South Africa, it is recognized that this is a cross cutting issue that has ramifications for diverse activities in other government departments. A national climate change strategy will thus require that many government departments work together in a coordinated manner, to ensure that response measures are properly directed, acceptable to all and carried out with a national focus. General awareness within government on the likely impacts of climate change is somewhat limited in those departments not directly involved with the issue. In order to adapt to climate change, and to prepare adequately for the likely impacts, capacity has to be built. This will ensure that the policies formulated will adequately address climate change adaptation. Further, it is important that the available skills and competencies within government are efficiently harnessed. Officials in other departments, within all spheres of government, often do not see climate change as a priority and some even see it as working against national development priorities. They are concerned that South Africa has a huge backlog of service delivery where the performance of each department is measured by how effective and efficient it is on service delivery. Therefore climate change needs to be addressed in such a way as to assist these departments to achieve their service delivery objectives i.e. through so-called "win-win" or "no regrets" measures.

Domestic legal obligations

South Africa currently has a number of laws relating to the protection and management of the environment. The overarching legislation is contained within the provisions of the National Environmental Management Act of 1998. Climate change is referred to explicitly in the White Paper on Integrated Pollution and Waste Management of 2000, and referenced in the White Paper on a National Water Policy for South Africa, 1997. It is also specifically addressed in the Government's imminent National Water Resource Strategy. Climate change is not addressed in current air quality legislation. The impending National Environmental Management: Air Quality Act will, however, specifically contain provisions for greenhouse gas emissions.

Climate change related education and training

Climate change is a relatively new issue in South Africa due to the prior isolation of this country from international events. Education, training and public awareness thus lag behind the requisite standards. The raising of public awareness on climate-related issues is promoted by the government through the Department of Environmental Affairs and Tourism (DEAT) and the South African Weather Services. Presentations and exhibitions are used as a mechanism to promote awareness of climate change, for example through the National Atmospheric Week, World Environment Day and World Meteorological Day promotions. Publications, such as the Environmental Education fact sheets, are produced by DEAT, and highlight important environmental issues.

Research development and demonstration

Technological change holds the key to meeting long-term climate change challenges. Climate change research needs to be properly coordinated and the benefits optimised to meet the needs of policy makers in South and Southern Africa. Attention needs to be focussed on projects that will assist with mitigation of, and adaptation to, climate change and address specific areas of vulnerability. Further, development and demonstration projects are required to show the advantages and acceptability of a variety of technologies related to climate change. Where appropriate, relevant local research should be structured to support the work of IGBP and the IPCC.

Inventories of greenhouse gases and air pollutants

Several organizations, including local governments and major energy, chemical and metallurgical undertakings, have undertaken long term air quality monitoring projects using modern continuously monitoring ambient air quality instrumentation. However there is a need to put in place a national ambient air quality monitoring network and information handling system in order to obtain an integrated database of air pollution data for purposes of air quality management and greenhouse gas inventories. It is envisaged that this information management system will already contain emissions data for various sources of air pollutants. Greenhouse gas inventories could be handled using the same system, to great advantage.

Accessing and managing financial resources for climate change

An effective programme for climate change response will require that South Africa has access to public sector funding and funding from government related institutions, such as the Development Bank of South Africa. Further, as a developing country, South Africa can access assistance from developed country partners to meet its obligations under the convention and, further, participate in the global mitigation of climate change. This requires a framework to access and manage the climate change financial resources on offer as donor funding.

The various elements of the response strategy described thus far have been translated into tangible strategies and actions to be implemented by government. It is thought that these actions will help South Africa achieve sustainable development objectives, while also fulfilling the need to respond to climate change.

A number of principles and factors guided the conception of this strategy and should be included in its implementation, including:

- Ensuring that the strategy is consistent with national priorities, including poverty alleviation, access to basic amenities including infrastructure development, job creation, rural development, foreign investment, human resource development and improved health, leading to sustainable economic growth;
- Ensuring alignment with the need to consistently use locally available resources;
- Ensuring compliance with international obligations;
- Recognizing that climate change is a cross cutting issue that demands integration across the work programmes of several government departments and stakeholders, and across many sectors of industry, business and the community;
- Focussing on those areas that promote sustainable development;
- Promoting programmes that will build capacity, raise awareness and improve education in climate change issues;

- Encouraging programmes that will harness existing national technological competencies;
- Reviewing the strategy constantly in the light of national priorities and international trends;
- Recognizing that South Africa's emissions will continue to increase as development is realised.

A number of key interventions have been proposed in this document that cut across the entire spectrum of possibilities for climate change response actions. Through the implementation of this national climate change response programme, South Africa will avail itself of the potential advantages that could stem from international action on climate change, whilst at the same time minimising its vulnerability to such events. To achieve this end, priority will be given to the following key interventions, although others appear in the key actions list in this document:

a) Rapidly develop the DNA function within the Department of Minerals and Energy to facilitate the forwarding of CDM project proposals to the Executive Board for approval without undue delay.
b) Perform a technology needs analysis for South Africa that builds on and integrates existing knowledge, through the Department of Science and Technology.
c) Access appropriate funds, as feasible, for implementation of the climate change programme, in particular for adaptation purposes.
d) Use the public sector and financing institutions linked to government, such as the Industrial Development Corporation and the Development Bank of South Africa to fund climate change projects.
e) Accelerate the process of education, training and awareness of climate change and its impacts to speed up the implementation of response actions.
f) Ensure the cooperation and buy-in of all stakeholders to climate change response through the NCCC and GCCC, to facilitate a coordinated national programme.
g) Harness the efforts of all stakeholders to achieve the objectives of the Government's White Paper on Renewable Energy (2003) and the Energy Efficiency Strategy, promoting a sustainable development path through coordinated government policy.
h) Implement sustainable industrial development through coordinated policies, strategies and incentives through the Department of Trade and Industry and the various industry sectors.
i) Accelerate water resource management and contingency planning through the Department of Water Affairs and Forestry.
j) Adapt agricultural, rangeland and forestry practices appropriately through the Departments of Agriculture and Water Affairs and Forestry.
k) Maintain an appropriate attendance at UNFCCC and related meetings.
l) Set a time frame for action, with specific milestones and responsibilities, to formulate appropriate national policies and measures for climate change action and develop a practicable plan of implementation.

The strategy contained in this document describes a broad framework for action and, as such, represents a starting point for such action. Detailed action plans with defined time-scales will be formulated meaningfully on a case by case basis, in the context of the ever changing political backdrop to climate change, technological progress and the robustness of the assumptions about what can be expected to transpire from the international negotiation process, together with the relevant commitments that are likely to flow from them. While it is extremely important to understand the reality and constraints of the South African economy, no door is closed to any action based on sound economic principles, which can bring tangible benefits to the country and its people. Both physical and economic vulnerability are duly acknowledged. There is no doubt that the next few decades will see major changes, not the least of which will be technological progress. History teaches us that what is far-fetched today will be common practice tomorrow. Thus the developed nations of the world, with their immense capital reserves, need to be encouraged to develop appropriate technologies to mitigate

global climate change. South Africa, as an integral part of the developing world, is always willing to accept new developments as they become appropriate to achieving its national goals and objectives.

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1. INTRODUCTION

1.1 The nature and factual basis of climate change

Global climate change is possibly the greatest environmental challenge facing the world this century. Concerned with the implications of global climate change, several governments came together in 1988 and formed the International Panel on Climate Change (IPCC). This led to the United Nations Framework Convention on Climate Change (UNFCCC), which was tabled in 1992 at the United Nations Conference on Environment and Development. The South African Government ratified the UNFCCC in August 1997. The stated objective of the UNFCCC is to achieve stabilisation of the concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To provide a sound scientific base for climate change, the International Geosphere-Biosphere Programme (IGBP) was set up to undertake and review research information for the IPCC. The IGBP secretariat is housed within the Swedish Royal Academy of Sciences and, although contributions to the IGBP are voluntary and are often made on a country by country basis, the programme provides much of the science that appears in the periodic IPCC assessment reports.

Although often referred to as 'global warming', global climate change is more about serious disruptions of the entire world's weather and climate patterns, including impacts on rainfall, extreme weather events and sea level rise, rather than just moderate temperature increases. The developing world faces greater challenges than the developed world, both in terms of the impact of climate change and the capacity to respond to it. On the other hand, by far the biggest contributions to global climate change come from the wealthy developed countries of the Northern Hemisphere.

There is an ever-increasing consensus amongst the scientific community that global climate change is a physical reality. There are still, however, wide ranges of uncertainty. Despite the uncertainties, it is generally believed that the observable human induced climate change signature is starting to emerge as a recognizable trend. There is a whole range of diverse scientific data to support this view. Similarly, there is little argument about whether there will be global climate change impacts. It is rather the size of the impacts and their implications that remain uncertain. However, the political community is of a somewhat more diverse opinion as world opinion is still very much divided. The natural resources are in the poorer, developing countries, which are exploited by the richer developed countries. These latter have already depleted their own natural resources but have the majority of the financial means. There is thus an inevitable conflict of interest.

The three most important greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The atmospheric concentration of CO_2 has increased by over 30% since the start of the industrial era, predominately due to fossil-fuel combustion and deforestation, with the atmospheric concentrations of CH_4 increasing by about 150% in the same period. The concentration of N_2O has increased by 16%. This has been accompanied by an increase in global surface temperature of 0.6±0.2°C. There has also been an observed decrease in snow cover and land-ice extent. Precipitation is increasing over the landmasses in the middle and high latitudes of the Northern Hemisphere. Over the sub-tropics, land-surface rainfall has decreased on average. Global mean sea level rise during the 20th century has been 1.5 mm/yr and this is continuing. Further there are indications of an increase in the number of extreme weather events being experienced. These observed changes are largely in line with the predictions from a variety of models, many of which have seen very rapid development in recent years with the advent of cheap and available computing power. Further, current evidence suggests that most of the observed warming over the last 50 years is likely to have been due to human activities.

Under a business as usual scenario, models indicate that likely surface temperature rises by 2100 will be in the range 1.4^0 to 5.8^0C, dependent on latitude and longitude. Precipitation extremes are projected to increase, together with the frequency of extreme inter-annual variability. Mean and peak precipitation intensities from tropical cyclones are likely to increase appreciably. More hot days and heat waves are very likely over nearly all land areas. Increases in daily minimum temperature can also be expected. There is projected to be a general drying of the mid-continental areas during summer. Glaciers and ice caps are expected to continue their widespread retreat during the 21st century and Northern Hemisphere snow cover and sea ice are projected to decrease further. Projections of global average sea level rise from 1990 to 2100 lie in the range 0.11 to 0.77 m.

For Southern Africa, sub-continental warming is predicted to be greatest in the northern regions. Temperature increases in the range of between 1^0C and 3^0C can be expected by the mid 21st century, with the highest rises in the most arid parts of the country. Of greater consequence for South Africa, as a semi-arid country, is the prediction that a broad reduction of rainfall in the range 5% to 10% can be expected in the summer rainfall region. This will be accompanied by an increasing incidence of both droughts and floods, with prolonged dry spells being followed by intense storms. A marginal increase in early winter rainfall is predicted for the winter rainfall region of the country.

1.2 The need for a national climate change response strategy

The need for a national climate change policy for South Africa was identified as an urgent requirement during the preparations for the ratification of the UNFCCC in 1997. A process to develop such a policy was thus instituted under the auspices of the National Committee for Climate Change (NCCC), a non-statutory stakeholder body set up in 1994 to advise the Minister on climate change issues and chaired by the Department of Environmental Affairs and Tourism (DEAT). A discussion document was subsequently produced and a workshop was held to which all stakeholders were invited to obtain the requisite input to the policy formulation process. The need to produce an action-oriented response strategy document was clearly identified at this workshop, rather than a specific policy white paper on climate change, as had originally been envisaged. The strategy was to broadly support the Policies and Principles laid out in the Government White Paper on Integrated Pollution and Waste Management as well as other national policies including those relating to energy, agriculture and water.

Climate change is a truly cross cutting issue that can affect the entire economy as well as many specific sectors including energy, transport, agriculture, forestry, water resources management and provision of water services, and health. A national climate change response strategy will promote integration between the programmes of the various government departments involved to maximise the benefits to the country as a whole, while minimising negative impacts. Further, as climate change response actions can potentially act as a significant factor in boosting sustainable economic and social development, a national strategy specifically designed to bring this about is clearly in the national interest, supporting the major objectives of the government including poverty alleviation and the creation of jobs.

1.3 Structure of the strategy document

The document is divided into five main sections, reflecting its primary objective. That is, it is a strategic document that clearly indicates the steps or actions to be taken by the government and other players to respond at a national level to the challenges posed by climate change.

In Chapter 1, the nature of climate change is introduced and the changes that can be expected to happen in a physical sense, both globally and locally, are explored. This leads on to the justification for regarding climate change as a serious challenge for South Africa and setting the scene for a national approach, so that the country may maximise any pursuant benefits and minimise negative impacts.

In Chapter 2, the international perspectives of climate change are reviewed and the obligations of the various parties under the UNFCCC and the associated Kyoto Protocol are examined, emphasising South Africa's status as a developing country and the reduced level of commitments for such parties compared to those for the developed country parties. South Africa's specific vulnerabilities are examined together with the possible economic consequences of climate change, both those directly incurred and those resulting from actions and impacts in other countries.

The key issues and problems related to climate change response in South Africa are examined in Chapter 3. The various adaptation and possible mitigation options for South Africa are explored, with emphasis on those actions that are likely to derive benefits in the area of sustainable development for the country. These issues are addressed in Chapter 4, by proposing a number of strategic objectives, actions and interventions. The main conclusions of the report and a list of key actions, which highlight the priority areas of the strategy and the role of other stakeholders, are given in Chapters 5 and 6.

2. INTERNATIONAL COMMITMENTS, VULNERABILITY AND SOCIO-ECONOMIC IMPLICATIONS OF CLIMATE CHANGE IN SOUTH AFRICA

2.1 Commitments under the UNFCCC

In terms of the UNFCCC, there are general commitments applicable to all parties. However, the developed countries, designated as annex I countries in terms of the convention, have specific extra commitments applicable only to them. In terms of the principles embodied in the convention, in developing countries, such as South Africa, the specific development needs and vulnerabilities should be taken into account, recognizing that economic development in such countries is essential.

As a developing country, South Africa is mandated to provide the prescribed data in the emission inventory and submit periodic national communications to the UNFCCC secretariat, although there are several other contributions that can be made which are essentially of a voluntary nature. Climate change response measures must be consistent with the national development needs and government priorities. Sustainable environmental management principles must be an integral part of such measures. Coastal zone management, water resources, agriculture, and measures for the protection and rehabilitation of areas affected by drought and desertification, as well as floods, need to be incorporated. Plans and measures need to minimise adverse effects on the economy, public health and the quality of the environment. South Africa needs to promote and cooperate in scientific, technological, technical, socio-economic and other research. Further, systematic observation to establish climate baselines, both nationally and throughout the region, needs to be undertaken. Training and public awareness at all levels related to climate change needs to be encouraged and prioritised.

Finally, South Africa needs to vigorously pursue the opportunities latent in the requirements that developed countries assist developing countries in their climate change response actions. This should be used as a vehicle to maximise the development benefits for South Africa, and the Southern African region as a whole, and to put in place suitable adaptation measures, ensuring a minimum of disruption while maximising the return on any internal resources that are used.

2.2 South African vulnerability

Measurable changes in climate can be expected to have significant effects on various sectors of South African society and the economy. These potential impacts have been explored in the South African Country Studies for a time horizon of 50 years, using a series of general circulation model (GCM) simulations. The potential effects of a changed climate within 50 years and possible adaptation strategies were identified for the following sectors: human health; maize production; plant biodiversity; water resources; rangelands; and animal taxa. Further, urban air pollution from low-level sources, such as domestic emissions, will become a greater problem, due to the enhanced occurrence of temperature inversions resulting from climate change. These inversions serve to trap the smoke from such sources near ground level giving rise to excessive ambient concentrations.

Health impacts can be expected from increases in temperature and changes in rainfall patterns. These include an increase in the occurrence of strokes, skin rashes, dehydration and the incidence of non-melanoma skin cancers. As a result of ecosystem changes, climate change may also bring about indirect health impacts such as an increase in the incidence of water-borne diseases. The occurrence of vector-borne diseases such as malaria could also increase if there is a significant extension of the malaria prone areas, as has been predicted in the projected climate change scenarios for South Africa as presented in the first national communication.

With regard to water resources, South Africa's rainfall is already highly variable in spatial distribution and unpredictable, both within and between years. Much of the country is arid or semi-arid and the whole country is subject to droughts and floods. Bulk water supplies are largely provided via a system of large storage dams and interbasin water transfer schemes and such infrastructure takes years to develop. Thus a reduction in the amount or reliability of rainfall, or an increase in evaporation would exacerbate the already serious lack of surface and ground water resources. Water availability in the arid and semi-arid regions, which cover nearly half of South Africa, ~~i~~s particularly sensitive to changes in precipitation. Desertification, which is already a problem in South Africa, could be exacerbated by climate change. Furthermore, climate change may alter the magnitude, timing and distribution of storms that produce flood events.

Seventy percent of the land surface of South Africa consists of natural and semi-natural ecosystems which provide rangelands for large herbivore species. Modelling suggests a general aridification of this type of land, especially where such rangelands are already marginal. Fodder production can be expected to be impacted, affecting marginal costs of ranching. Further, tree encroachment into the grassland areas is likely to increase due to the elevated CO_2 concentrations and the increase in temperature. The frequency of fire outbreaks is predicted to increase significantly.

About 70% of total grain production in South Africa consists of maize. Crop yield modelling predicts that, under a hotter drier climate, maize production will decrease by up to 20%, mostly in the drier western regions. Further, speciality crops grown in specific environmentally favourable areas may also be at risk, since both rainfall and temperature effects may cause significant changes in areas uniquely suitable for such specialised production. In addition, an increase in pests and diseases would also have a detrimental effect on the agricultural sector and invasive plants could become a greater problem.

The South African forestry sector is sensitive to climate change as it is based on plantations of non-indigenous species, located in relatively marginal areas, which comprise about 1.5% of the land area of the country. In addition to the effects of climate change, factors such as land availability, water demand, as well as environmental and socio-economic conditions will also affect this sector. Modelling predicts that climate change will affect the optimal areas for the country's major tree crop species, and impact on the marginal costs associated with planting in sub-optimal areas.

Biodiversity is important for South Africa because of its key role in maintaining ecosystem functioning, its proven economic value for tourism and its role in supporting subsistence lifestyles. Climate change modelling suggests a reduction of the area covered by the current biomes by up to 55% in the next 50 years. The largest losses are predicted to occur in the western, central and northern parts of the country. Species composition is expected to change, which may also lead to significant changes in the vegetation structure in some biomes, and, in some extreme cases, even leading to total species loss. With regard to animal taxa, climate modelling predicts that most animal species will become increasingly concentrated in the proximity of the higher altitude eastern escarpment regions, with significant losses in the arid regions of the country. Some species are predicted to become extinct.

Marine biodiversity is not expected to be impacted by the predicted ranges for rise in sea level. However, the predicted rise in sea surface temperature would result in the migration of species residing along the coast. Further, the changes in sea temperature may increase the intensity and frequency of upwelling events. This would cause alterations of near-shore currents, which can be expected to have the most significant impact on rocky shore ecosystems in South Africa. The nutrient and larval supply to the coast would be affected, thus influencing the community structures. In addition, studies have

indicated that there would be an increase in the occurrences of the harmful 'red tide' events on the west coast which cause mass mortalities of fish, shellfish, marine mammals, seabirds and other animals, and can result in illness and death in persons who eat contaminated seafood.

2.3 Economic implications

National economic matters fall within the competence of the National Treasury and thus all measures or actions that may ultimately impact on such issues will, as a matter of course, be referred in detail to this department.

According to information received from various Government Departments, the direct costs of employing officials for implementing climate change response ranges from no direct incremental costs, as the work is essentially seen as part of the ongoing work of the department concerned, to R1.6 million, which would involve the direct employment of three mid-level officials. For instance the Department of Trade and Industry (DTI) estimates that, to implement the strategy, it will require a minimum of R600 000 per annum, which includes remuneration to a champion to coordinate climate change matters within the department. It is assumed that this person will be available to attend the international and national meetings on behalf of the department and liaise with industries with regard to energy efficiency and other mitigation measures. A realistic estimate for all involved departments would be in the region of R5 million total.

On a holistic basis, there are three important dimensions to the economic implications of climate change in developing countries.

- The direct costs/benefits related to taking mitigation actions for climate change.
- The costs incurred in adapting to the physical changes that result from climate change.
- The indirect costs incurred in the loss of markets in the rest of the world as a result of their mitigative actions.

It is generally held that non-annex I countries are much more vulnerable to economic disruption through the imposition of climate change mitigation measures than are the developed countries. It must also be borne in mind that non-annex I countries are not required, in terms of the Kyoto Protocol, to adopt emission reduction or limitation targets, either of a voluntary or binding nature. However, climate change mitigation policies may promote sustainable development if they are designed to be consistent with broader societal objectives and, at the same time, they may offer substantial opportunities. This is a particularly important concept for South and Southern Africa. Some mitigation actions may yield extensive benefits in areas outside of climate change such as health, employment opportunities and reducing negative environmental impacts. However, the costs incurred by such actions may be excessive and render the actions unattractive. Differences in the distribution of technological, natural and financial resources among and within nations and regions, as well as differences in mitigation costs, are important considerations in the analysis of climate change mitigation options. Further, the challenge of addressing climate change raises an important issue of equity, namely the extent to which the impacts of climate change or mitigation policies create or exacerbate inequities, both within and across nations and regions. Global greenhouse gas stabilization will require that future global capital stock is less carbon-intensive. This has immediate implications for near-term investment decisions, especially in developing countries like South Africa for which an argument can be made that there is a need to become less carbon intensive. An immediate and sustained commitment to research and development is required if low-emission, low-cost substitutes are to be available when they become attractive investment opportunities. Research and development programmes to establish alternative, more efficient and sustainable applications for fossil fuels are needed. This includes research into, *inter alia*, clean coal technologies and the non-energy uses for fossil fuels. Some mitigation policies could

lead to net overall economic benefits, implying that the gains from many sectors could outweigh the losses for coal and other fossil fuels, and energy-intensive industries. These possibilities, including energy efficiency programmes and low emission and efficient supply side technologies, would tend to look attractive for non-annex I countries who need to develop and diversify their economies. This will require an enhanced transfer of technology to fossil fuel dependent non-annex 1 countries such as South Africa.

Although there may be costs incurred in adapting to the physical changes that result from climate change, such actions could also lead to sustainable development benefits that could be achieved, even if climate change were not a factor. Water saving schemes offers just one example. Such benefits need to be identified and actions that promote them should be facilitated through whatever means are available as though they were specifically aimed at adapting to climate change. This will assist in maximising benefits and minimising any economic impacts that could be potentially incurred in climate change adaptation actions.

Emission constraints in annex I countries can be expected to have significant impacts on non-annex I countries like South Africa, as a major coal exporting country. There will also be significant direct impacts. Other items specific to non-annex I countries are a potential slow down in global trade in carbon intensive products that are reliant on coal as the primary energy source. The coal reliant countries, such as South Africa, are particularly vulnerable. This vulnerability extends to almost the whole of the mining and energy sectors. However, this could be offset to some extent through opportunities to establish relatively high energy intensity industries in non-annex I countries and it can be argued that the relocation of energy intensive industries from annex 1 to non-annex 1 countries should be promoted, but that such relocations should be accompanied by the transfer of best available technologies. However, it can also be argued that this is undesirable as it could lead to increased exploitation of limited natural resources and may give rise to negative environmental impacts in terms of additional stresses to existing biomes and an increase in the generation of pollution and waste. Further, such actions may do little to alleviate the problem of unemployment through labour-intensive development. However, the development of new fossil fuel export markets amongst non-annex 1 countries could be encouraged. Annex I parties should commit themselves to reduce emissions from fossil fuels in terms of the convention and the protocol and should initially concentrate on domestic actions that will not negatively impact on the market for fossil fuels from developing countries. Further these commitments should focus primarily on the reduction of fossil fuel utilisation in and among annex 1 countries. Regional centres of excellence should be promoted that can provide focal points for data collection, the analysis of impacts, economic modelling, the secondment of both annex 1 and non-annex 1 persons, the pooling of information and capacity building.

3. KEY ISSUES AND PROBLEMS

In this chapter, the key issues and problems which the proposed climate change response strategy needs to address are identified.

3.1 Supporting national objectives and sustainable development

The South African Government's national priorities include, *inter alia*, the creation of employment, the alleviation of poverty and the provision of housing, which implies a commitment to the process of sustainable development and advancement. Thus South Africa's position is to view climate change response as an opportunity for achieving these aims. At the same time, international action on climate change can be viewed as a significant vehicle to redress the historic, inequitable and unsustainable north/south divide of the world's economy and prosperity. In support of this objective, South Africa's national climate change response programme must also strongly support the New Partnership for Africa's Development initiative. There are many benefits to be derived in integrating climate change response programmes across national and regional boundaries, to serve common areas of interest and to maximise the utility of available resources.

3.2 Adapting to climate change

According to the IPCC Third Assessment Report, climate change is already happening, and will continue to happen, even if global greenhouse gas emissions are curtailed significantly. There is now more confidence that global climate change is a threat to sustainable development, especially in developing countries, and could undermine global poverty alleviation efforts and have severe implication for food security, clean water, energy supply, environmental health and human settlements.

Acknowledging the overall vulnerability of South Africa to climate change impacts, it will thus be necessary to carry out adaptation measures in this country. The South African Country Studies Programme identified the health sector, maize production, plant and animal biodiversity, water resources, and rangelands as areas of highest vulnerability to climate change and these are the areas that need to be targeted for adaptation measures. Further, in addition to the physical concerns, over an appropriate period of time adaptation measures may require the development and implementation of low greenhouse gas emitting technologies and waste strategies, localisation of production, creation of sustainable and adaptable livelihoods, benchmarks and targets for progress to a less carbon and energy intensive economy.

With regard to South Africa's vital industries, the mining and energy sectors are particularly vulnerable with respect to climate change. In addition, the economy is vulnerable to the possible response measures implemented by annex 1 countries, since it is highly dependent on income generated from the production, processing, export and consumption of coal.

3.3 Developing a sustainable energy programme

South Africa, as a non-annex I country, is not required to reduce its emissions of greenhouse gases. However, the South African economy is highly dependent on fossil fuels and the country can be judged to be a significant emitter due to the relatively high values that can be derived for emissions intensity and emissions per capita. Such calculations put South Africa as one the world's top 15 most energy intensive economies, with a significant contribution to greenhouse emissions at a continental level. There could be benefits to be derived from adopting a future strategy that is designed to move the economy towards a cleaner development path. This will further require development of a strategy to

access investment through the Clean Development Mechanism (CDM) of the Kyoto Protocol, technology transfer and donor funding opportunities. However, even given this scenario, emissions can still be expected to increase with economic development, albeit at a smaller pace than would have happened without intervention.

To date the Department of Minerals and Energy (DME) is involved in a number of programmes to reduce emissions intensity. An energy-efficiency awareness campaign was initiated by the DME in 1996 to raise public awareness of the need to implement energy efficient measures in the home. This campaign was in response to a survey, conducted at the time that found that 60 percent of consumers were not aware of the need and reasons for conserving energy. Training and capacity building on energy efficiency is also being conducted by the Household Energy Action Training (HEAT) programme. The aim of the programme is to develop a household-energy capacity building and communication strategy. A joint project with the International Institute for Energy Conservation-Africa (IIEC-Africa), the Minerals and Energy Education and Training Institute (MEETI) and PEER-Africa, an environmental and engineering firm, will address delivery organizations on energy and environmental issues in the housing sector. PEER-Africa is presently involved in appropriate technology transfer and capacity building in low-income communities. A white paper on renewable energy and clean energy development was developed by DME and was approved by Cabinet in 2003. This sets a target of 10 000 GWh renewable energy contribution to final energy consumption by 2012, in addition to the existing renewable energy contribution of 67 829 GWh/annum, which represents about 9% of the national total consumption and includes present contributions from various sources of biomass.

3.4 Meeting international obligations

As previously mentioned, South Africa, as a party to the UNFCCC, has to fulfil certain obligations which include the following:

- Prepare and periodically update a national inventory of greenhouse gas emissions and sinks.
- Formulate and implement national and, where appropriate, regional programmes to mitigate climate change and facilitate adequate adaptation to climate change.
- Promote and cooperate in the development, application and diffusion of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases.
- Promote sustainable management, and promote and cooperate in the conservation and enhancement of sinks and reservoirs of all greenhouse gases.
- Cooperate in preparing for adaptation to the impacts of climate change.
- Take climate change considerations into account in the relevant social, economic and environmental policies and actions with a view to minimising adverse effects on the economy, on public health and on the quality of the environment.
- Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate uncertainties.
- Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change.
- Promote and cooperate in education, training and public awareness related to climate change.

There are no formal commitments to the IPCC but, where, appropriate, South Africans are encouraged to make meaningful contributions within this structure. Similarly, where possible, relevant local research should be structured to support the work of IGBP.

3.5 The integration of climate change response in government

Although DEAT has been designated as the lead agency for climate change response in South Africa, it is recognized that this is a cross cutting issue that has ramifications for diverse activities in other government departments. This will require the effective coordination amongst the various government departments that are involved in, or may be impacted by, climate change to ensure that response measures are properly directed, acceptable to all and carried out with a national focus. General awareness within government on the likely impacts of climate change is somewhat limited to those departments directly involved with the issues. In order to adapt to climate change, and to prepare adequately for the likely impacts, capacity has to be built. This will ensure that the policies formulated will adequately address climate change adaptation. Further, it is important that the available skills and competencies within government are efficiently harnessed. Officials in other departments, within all spheres of government, often do not see climate change as a priority and some even see it as working against national development priorities. They are concerned that South Africa has a huge backlog of service delivery where the performance of each department is measured by how effective and efficient it is on service delivery. Therefore climate change needs to be addressed in such a way as to assist these departments to achieve their service delivery objectives i.e. through so-called "win-win" or "no regrets" measures.

3.6 Government/Industry partnerships

Awareness and capacity within government on many aspects of climate change is limited, particularly in those departments not directly involved with the issues concerned. There is, however, capacity within various sectors of business and industry that could be harnessed in developing and implementing a practical and effective national climate change programme. Many industries, such as the energy and chemical sectors, are currently involved in the development of growth strategies. Further, it has been widely recognized that environmental performance and, in particular, cleaner production technology can represent a significant competitiveness factor for industry. Thus industry/business involvement should not be limited in nature or only have a role though capacity building in government. Appropriate government/industry partnerships should be encouraged and developed.

3.7 Domestic legal provisions

South Africa currently has a number of laws relating to the protection and management of the environment. The overarching legislation is contained within the provisions of the National Environmental Management Act of 1998. Climate change is referred to explicitly in the White Paper on Integrated Pollution and Waste Management of 2000, and referenced in the White Paper on a National Water Policy for South Africa, 1997. It is also specifically addressed in the Government's imminent National Water Resource Strategy. Climate change is not addressed in current air quality legislation. The impending National Environmental Management: Air Quality Act will, however, specifically contain provisions for greenhouse gas emissions.

3.8 Climate change related education, training, awareness and capacity building

Climate change is a relatively new issue in South Africa due to the prior isolation of this country from international events. Education, training and public awareness thus lag behind the requisite standards. Similarly, government has not got the necessary capacity to deal with climate change on an effective basis. Industry is better placed regarding technical skills. However, these skills are not usually specifically available for climate change related activities.

3.9 Climate change related research, development and demonstration

Climate change research needs to be properly coordinated and the benefits optimised to meet the needs of policy makers in South and Southern Africa. Attention needs to be focussed on projects that will assist with mitigation of and adaptation to climate change and address specific areas of vulnerability. Further, development and demonstration projects are required to show the advantages and acceptability of a variety of technologies related to climate change. There are some solid foundations in this area on which to build including, *inter alia*, renewable energy demonstration projects and the South African Environmental Observation Network (SAEON) programme, which is administered through ring-fenced grant funding by the National Research Foundation (NRF) and is well under way with the first site in the Lowveld area, with the Kruger Park as the core and adjacent sites offering some 6000 hectares under observation.

3.10 Inventories of greenhouse gases and air pollutants

Several organizations, including local governments and major energy, chemical and metallurgical undertakings, have undertaken long term air quality monitoring projects using modern continuously monitoring ambient air quality instrumentation. However there is a need to put in place a national ambient air quality information handling system in order to obtain an integrated database of air pollution data for purposes of air quality management and greenhouse gas inventory. It is envisaged that this information management system will already contain emissions data for various sources of air pollutants. Greenhouse gas inventories could be handled using the same system, to great advantage.

3.11 Accessing and managing financial resources for climate change

Currently, South Africa is experiencing financial constraints. This makes it difficult for the country to implement policies that are appropriate in its pursuance of its own national objectives and service delivery. South Africa, as a developing country, would be able to meet its obligations under the convention and contribute to the global mitigation of climate change through assistance from developed country parties**.** This requires a framework to access and manage the climate change financial resources on offer as donor funding.

4. STRATEGIC OBJECTIVES, PRINCIPLES AND PROPOSALS

A number of important issues and priorities in respect of global climate change and South Africa have been discussed in Chapter 3. In this Chapter we have sought to translate those priority factors into tangible strategies and actions to be implemented by government. It is thought that these actions will, in no uncertain terms, help South Africa achieve sustainable development objectives, while also fulfilling the need to respond to climate change.

4.1 Principles for the national climate change response strategy

A number of principles and factors guided the conception of this strategy and should be included in its implementation, including those contained in the National Environmental Management Act of 1998 and the importance of equity on the national and international scale. These are:

- Ensuring that the strategy is consistent with national priorities, including poverty alleviation, access to basic amenities including infrastructure development, job creation, rural development, foreign investment, human resource development and improved health, leading to sustainable economic growth;
- Ensuring alignment with the need to consistently use locally available resources;
- Ensuring compliance with international obligations;
- Recognizing that climate change is a cross cutting issue that demands integration across the work programmes of other departments and stakeholders, and across many sectors of industry, business and the community;
- Focussing on those areas that promote sustainable development;
- Promoting programmes that will build capacity, raise awareness and improve education in climate change issues;
- Encouraging programmes that will harness existing national technological competencies;
- Reviewing the strategy constantly in the light of national priorities and international trends;
- Recognizing that South Africa's emissions will continue to increase as development is realised.

In devising this strategy, an integrated approach was followed. The framework of interventions thus takes into account the policies and programmes of other government departments, and the fact that South Africa is a developing country. This should ensure that the principles of sustainable development are adequately served and do not conflict with existing development policies.

4.2 National objectives and sustainable development

In the non-annex I countries, such as South Africa, economic and social development remain critical issues. Thus the national climate change response strategy must, as far as possible, seek to promote the primary government objectives, which include job creation, the provision of basic services and infrastructure development, the alleviation of poverty, and the provision of housing. These priorities are also generally compatible with the principles of sustainable development as defined in the Rio Declaration of 1992.

Objective: Create a synergy between national government objectives, sustainable development and climate change.

There is a considerable degree of compatibility between national government objectives, sustainable development and climate change. The linkages need to be established to maximise the overall benefits to the country that can be obtained from climate change response. It is clearly stated in the IPCC Third

Assessment Report that sustainable development objectives are achievable that also benefit climate change mitigation, even if climate change was not the primary reason for taking such actions.

Intervention: Include climate change issues in sustainable development policies, indicators and criteria for South Africa which are consistent with any such indicators and criteria that are required by the DNA for CDM projects.

Indicators and criteria are needed which denote whether particularly development pathways lead to sustainability. Such criteria can be unique to South Africa and their development will require careful thought and stakeholder participation. Project proposals should be evaluated on sustainability criteria that have been formulated or adapted specifically for South Africa. In general, projects and proposals need to be evaluated holistically and any cross cutting issues must be identified and taken into account. Projects and proposals should be specifically screened to ensure that they promote national development objectives, even though they may also serve foreign and international interests as well.

The objectives of other environmental conventions and protocols, including the United Nations Convention on Biodiversity (UNCBD), the United Nations Convention to Combat Desertification (UNCCD), the Vienna Convention for the Protection of the Ozone Layer and the Ramsar Convention also need to be considered. Further, provision should be made for reporting of significant greenhouse gas emissions by public and private sources in terms of the agreed sustainable development indicators.

4.3 Institutional arrangements

Objective: To enable the relevant national government departments to address climate change issues in South Africa.

South Africa is no longer isolated internationally and is expected to take a leading role in the development of the Southern Africa region, and in the continent as a whole. This will require a strong and vigorous domestic climate change programme with the appropriate institutional capacity and arrangements. Due to the historic lack of participation in world affairs, including climate change issues, South Africa, to some extent, has not developed the capacity to achieve this. As a net result, there has been a lack of integration in climate change response between the various departments and non-government stakeholders, who all have their own specific objectives. The functional operational components for government response to climate change issues are illustrated in Figure 4.3.1. However, these various functions could continue to be carried out in several different departments, as appropriate, provided that there is proper communication and coordination. The important role of coordination between departments cannot be over-emphasised. One of the prime reasons for establishing the Government Committee for Climate Change (GCCC) was to facilitate this process.

Intervention: Ensure that the relevant national government directorates and sub-directorates have the capacity to carry out their assigned functions regarding climate change response, including the CDM.

Government needs to establish a procedure for the registration, coordination and reporting on climate change related projects to be undertaken using donor funding. To assist with this, a list of donor agencies needs to be maintained on a project information management system, with specific donor country interests and potential funds available. Project endorsement should be given on the grounds of non-duplication, economic benefits, social benefits and overall feasibility. If necessary, projects could be given priority ratings according to the severity of the required adaptation to avoid climate change impacts. Technical feasibility should also be adjudicated. Technology transfer and demonstration projects need to be encouraged.

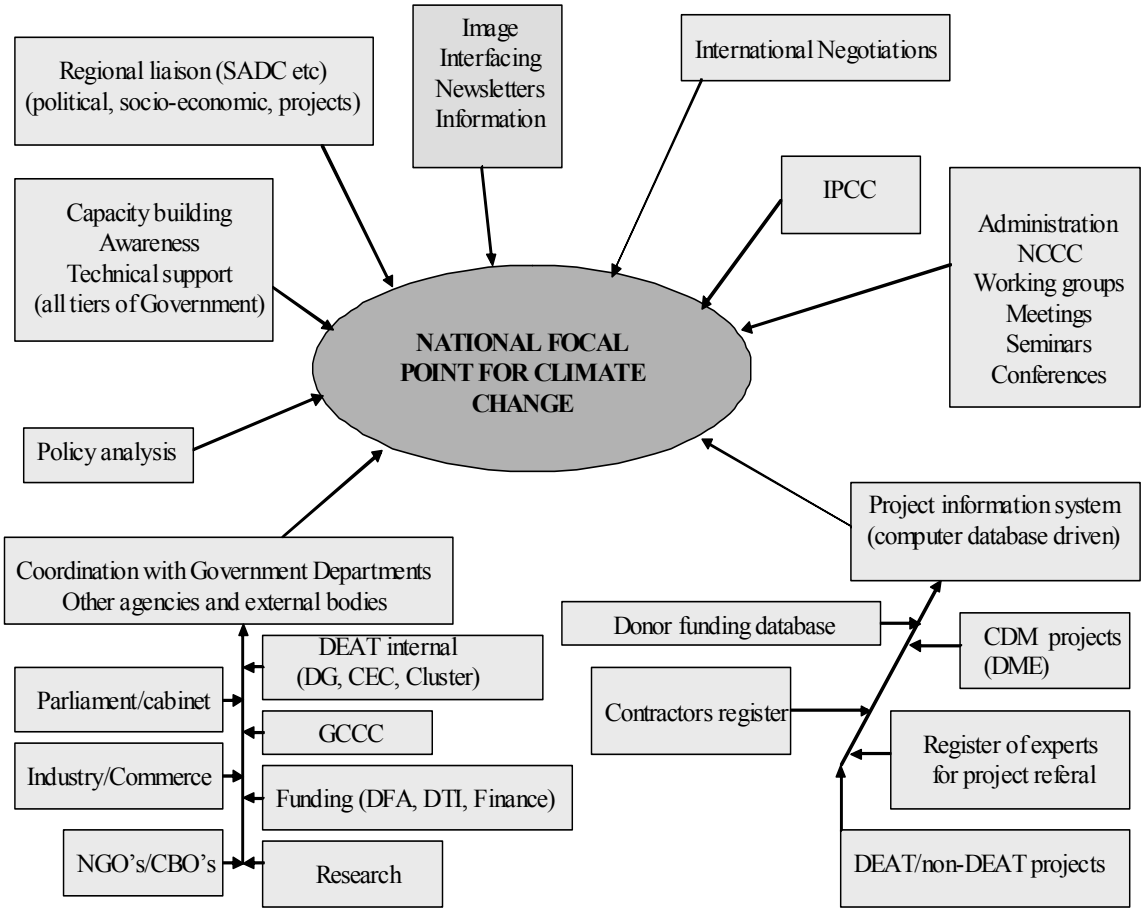

FIGURE 4.3.1: FUNCTIONAL OPERATIONAL COMPONENTS FOR GOVERNMENT RESPONSE TO CLIMATE CHANGE ISSUES

A technology needs assessment for climate change related projects in all sectors should be undertaken through the Department of Science and Technology (DST) and this must make extensive reference to the National Advanced Manufacturing and Technology Strategy (AMTS) for South Africa, produced by the CSIR for the National Advisory Council on Innovation (NACI), a body which advises the Minister of Science and Technology.

This process could be broad enough to cover related areas such as capacity building and could be assisted through United Nations Development Programme projects. DEAT will ensure that all South Africa's obligations in terms of the UNFCCC and Kyoto Protocol are adequately carried out, including the submission of the greenhouse gas inventory, assessed in the prescribed manner and presented in the correct format, and the National Communications.

Intervention: Establish procedures for CDM projects.

Government urgently needs to establish procedures for the registration, coordination and reporting on projects to be undertaken through the CDM. Detailed discussions have been held between high-level delegations from DEAT, DTI and DME. The following mechanisms are proposed, are being developed or have already been instituted.

a) A CDM secretariat is being set up within DME and it is envisaged that the Director General of DME will act, for legal purposes, as the Designated National Authority (DNA) in terms of the Kyoto Protocol, in which capacity he will have full signing authority and the associated accountability.
b) The DNA will be advised by a steering committee, chaired jointly by DME, DEAT and the DTI. It is, however, essential that other departments (for example the Department of Foreign Affairs) be permanently represented on the committee, as should other stakeholders, including civil society.
c) The CDM secretariat will introduce proposals to the steering committee who will make recommendations to the DNA. The DNA will issue letters of approval.
d) DTI would provide guidance on possible trade and investment implications of projects and will assist in the marketing of potential CDM projects in South Africa.
e) DTI will be instrumental in ensuring that, where possible, the CDM is used to support national trade and investment measures.
f) The CDM secretariat would provide a single point of entry for all information pertaining to the CDM, and would be able to advise on all aspects of the necessary South African and international processes and requirements.
g) The secretariat would be responsible for the registration of all projects, but not for actual project management, which would be the responsibility of the project developers.
h) The secretariat would serve as a focal point to the CDM Executive Board, as set up under the Kyoto Protocol, and deal with correspondence from this Board.
i) The secretariat would also provide input into the negotiating process on the CDM, through the NCCC.
j) The arrangements could be considered as interim with the possibility of them being reviewed in light of performance achieved, status of the Kyoto Protocol negotiations and the future scale of the CDM market.

It should be understood up-front that CDM primarily presents a range of commercial opportunities, both big and small. This could be a very important source of foreign direct investment, thus it is essential that the DTI participate fully in the process. Contracting organizations from the recipient country can

range from large private corporations, parastatals and the smaller commercial operations of academic institutes and consultancies aligned with NGOs. The actual range of potential projects is very large and can not be covered in detail here. However, as just a few examples, they could encompass fuel switching from coal to gas, clean coal technologies, energy efficient housing, the use of renewable energy resources or the production of electricity from landfill gas, as well as numerous other applications. The identification of suitable projects could be assisted by the results of the technology needs analysis referred to elsewhere in this document.

The overall governance and coordination of CDM is through the CDM Executive Board established under the Kyoto Protocol. The responsibility for constituting and appointing the Executive Board lies with the UNFCCC conference of parties/meeting of parties structures. There are mechanisms to ensure equitable regional representation and a balance between developed and developing nation representation. The Executive Board is mandated with the administration of an adaptation fund to oversee allocations to adaptation projects, specifically for the poorest and most vulnerable nations, with the prioritisation of funding in accordance with criteria established from the vulnerability assessments submitted to the UNFCCC conference of parties. Figure 4.3.2 shows a complete CDM start-up process and the route that could be followed for the national programme using the CDM secretariat.

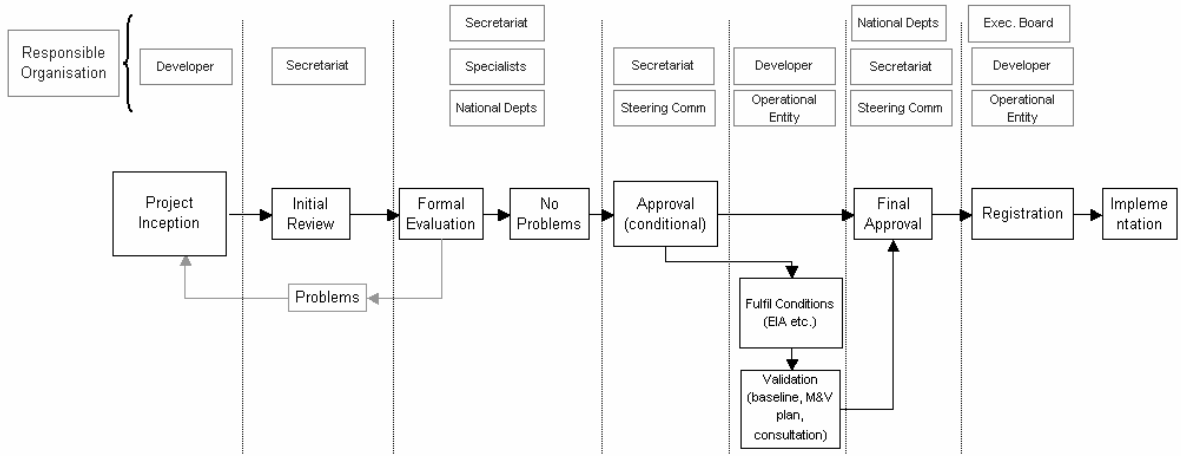

Figure 4.3.2: Process for initiating CDM projects

All information should be entered into a project information management system. However, the Secretariat could keep all proprietary information confidential at all stages. The detailed evaluation of greenhouse gas reductions needs to be done according to standard methodologies as laid down by the Executive Board and through the Designated Operational Entities (DOEs) mandated by the Board. On applying for pre-approval, a 2-month turn around time, or shorter, should be guaranteed. The project should be evaluated for economic benefits, social benefits, and technological feasibility.

The public will be consulted on the sustainable development criteria, which can be unique for South Africa. The process for the application of these criteria will be specified. The primary role of the CDM process is to assess projects against these sustainable development criteria, but those responsible will require the necessary information in order for them to do this. Technical feasibility could be evaluated through using specific members of an expert panel who have been chosen for their technical competence and willingness to respond rapidly. It is doubtful whether adequate capacity in this area would normally reside within the DNA and/or the steering committee or secretariat. However, the composition and role of this panel will need to be clearly defined as to the required level of their assessment and their terms of reference should be limited to that of acting in an advisory capacity only.

The expert panel would not be required to sit formally and review projects. Projects could be referred to the appropriate experts by Email. In cases that require an Environmental Impact Assessment (EIA), then a process of public participation will, in any event, need to be conducted and various stakeholders consulted. This type of process should not be duplicated, as it will inevitably result in the process becoming even lengthier.

It should be noted that the risk with regards to obtaining approval of EIA's is borne by the project developers and the EIA could be carried out in advance of the CDM approval process should the project developer wish to do so. In addition the initiation or carrying out of an EIA should not be considered as invalidating the proposed project on the grounds that it represents "business as usual".

The application for full approval should contain complete project specifications and a detailed account of the proposal for verifying the emissions reductions. The CDM Executive Board in Washington is likely to make approval conditional upon continued achievement of requirements. This process should not take longer than 14 weeks from start to finish, preferably much less, excluding the time taken to process the EIA, where necessary.

The allocation of certified emission reductions has not as yet been finalised. However, it is widely thought that ownership would essentially remain with the project developers to give the incentive to carry out CDM projects, with governments retaining overall custodianship of the national interests. It is expected that the CDM Executive Board would maintain a CDM registry and that South Africa, as the host party, as well as the project participants would have registry accounts into which certified emission reductions would be transferred directly by the CDM Executive Board.

4.4 Adaptation

Adaptation will be essential in South Africa due to its particularly vulnerable status in terms of the negative impacts of climate change as well as response measures. It should be noted that, although DEAT supports the suggested interventions in principle, much of the work comes under the jurisdiction of other government departments, and within all spheres of government. Further, it is emphasised that many of the suggested interventions would give rise to benefits that would assist the current development situation in South Africa, even if climate change were not a factor. These endeavours must be encouraged in no uncertain terms. Thus, as already discussed, climate change adaptation could become a mainstay of sustainable development and suitable donor funding secured for such work.

Objective: Offset South Africa's vulnerability to climate change.

Modelling suggests that there will be significant climate change impacts in South Africa, even if global emissions were to be reduced in accordance with the Kyoto Protocol. These impacts include general warming, disruption of established rainfall patterns and an increase in the frequency of occurrence of extreme weather events affecting a wide variety of sectors.

The community water supply and sanitation projects currently being undertaken by the Department of Water Affairs and Forestry (DWAF) will contribute to the prevention of infection by water-borne diseases such as cholera, scistosomiasis and gastro-enteritis by reducing reliance on untreated water supplies. However, climate change impacts may offset the progress and this will need to be monitored.

Intervention: Extension of health protection and health promotion measures.

Current monitoring and forecasting systems to warn of disease outbreaks need to be extended and upgraded to counteract possible climate change health impacts and enable prior planning for effective sustainable interventions, as do disease prevention programmes and personal protective devices. For instance, the use of bed nets and personal protective devices, which have proved successful in preventing the contraction of malaria from mosquito bites, will have to be increased. Treatment facilities and proactive preventative measures will need to be extended according to impact forecasts. Increased surveillance, monitoring and control of areas that are prone to, and will be affected by diseases such as malaria and Bilharzia will also be required, as will controls in the affected areas by the use of spraying programmes and other conventional measures. Health promotion programmes could also play a useful role in combating the impacts of climate change.

The Community Water Supply and Sanitation projects currently being undertaken by the Department of Water Affairs and Forestry will contribute to the prevention of infection by schistosomiasis over time. However, climate change impacts may offset the progress and this will need to be monitored, as will the incidences of water borne disease such as cholera.

Intervention: Water resource management and contingency planning.

Strategies for managing South Africa's water resources have been developed to take account of the country's variable and unpredictable climate and the resulting limited availability of unevenly distributed water. The strategies, which are described in the National Water Resource Strategy, scheduled to be established in terms of the National Water Act, 1998, during 2004, are sufficiently flexible to accommodate the anticipated effects of climate change without the need for special programmes or projects. However, the effects are likely to manifest themselves at different times in different parts of the country, and to vary in magnitude from area to area. A better understanding of these issues is expected from an ongoing research programme funded and managed by the Water Research Commission, which will facilitate prioritising intensified interventions in areas where the effects are greatest and/or will occur soonest. It will be necessary to improve meteorological and hydrological monitoring systems to detect the onset and development of the effects of climate change on water resources.

Approaches to water resources management that will facilitate adaptation to a changed climate can be broadly divided into strategic resource management, flexibility in water use allocations, water demand management and water conservation measures, contingency planning for extreme events such as floods and droughts, communication, optimising the operation of existing infrastructure and constructing new infrastructure.

Comprehensive and integrated planning across river catchments will allow for co-ordinated solutions, using an appropriate mix of demand and supply-side interventions, to the problems of water quantity, water quality and water supply by addressing the effects of population growth, economic growth and development, and the consequent changes in the demand for water. The management of water resources needs to be more closely integrated with water services provision via local government's integrated development planning process, particularly the water services development plans.

Replacing in-perpetuity riparian water rights with a system of time-bound administrative authorisations to use water that are subject to regular review will provide flexibility to adjust water allocations to account for changes in the availability of water. Additional flexibility will be provided by allowing water

users to trade water use authorisations, either permanently to move water from lower to higher value uses, or temporarily as a short-term coping strategy

The demand for water may be reduced in all user sectors through a range of measures that encourage efficient water use. These include implementing the pricing strategy for water use charges prescribed in the National Water Act, promoting the use of water-efficient technologies and practices, mandatory water auditing and accounting, and education in water conservation and demand management. However, although successful adoption of measures to reduce water use in the long term by increasing the efficiency of use is desirable, it could limit the extent to which users can accommodate any short-term restrictions on water use that may be necessary during times of drought without prejudicing productivity or reducing standards of living.

Water conservation measures such as clearing alien invasive vegetation from infested catchments will increase the amount of surface water runoff and recharge to groundwater, whilst water harvesting in agriculture and homes, especially those in rural areas, could reduce reliance on supplemental irrigation by optimising the effectiveness of rainfall. There is significant potential in the domestic and agricultural sectors for minimising wastage by reducing leakage from piped and open channel distribution systems.

Contingency plans for extreme events such as droughts and floods will be embodied in the disaster management framework prepared in terms of the National Disaster Management Act. The current monitoring and forecasting systems for droughts and floods would need to be improved and baselines established.

Operating procedures for all infrastructures, including inter-basin transfer schemes will be reviewed and revised where necessary to ensure optimum efficiency. The need for modifications to existing infrastructure or the construction of new infrastructure will continue to be investigated.

Public consultation programmes, mandatory under the National Water Act for all significant implementation interventions, need to put greater emphasis on making water users and the public aware of the implications of climate change. Programmes such as the Disaster Mitigation for Sustainable Livelihoods Programme, which educates communities on drought mitigation, need to be promoted and encouraged in communities.

Intervention: Adaptation of rangeland practices.

Suggested adaptation strategies for South African rangelands include improved monitoring and forecasting systems for fire hazard and droughts. These will be beneficial, even without climate change occurring. Specific intervention to adjust stocking rates are unlikely, since farmers already adjust their stocking rates in response to climatic and market conditions. Due to a possible decline in the carbon/nitrogen ratio in forage, as a result of the elevated CO_2 concentrations, it is possible that a wider use of nitrogen containing forage supplements may be needed, although this could lead to an excessive nitrate loading in the water courses and would therefore need monitoring closely. Further, although the use of feed supplements may increase livestock production and decrease methane emissions, there may be an increase in the net cost of animal production. Higher temperatures may favour those breeds that have a higher heat tolerance. Climate change may also affect the frequency and spatial extent of livestock disease outbreaks, such as foot and mouth disease. Additional preventative measures, which would support existing restrictions, would be useful in controlling such diseases.

Alternative land use and a decreased dependency on ranching may be necessary to combat the effects of climate change on organised agriculture. Agricultural management practices that recognise drought as part of a highly variable climate, rather than a natural disaster, should be encouraged. Farmers should be provided with information on climatic conditions, and incentives should be given to those farmers who adopt sound practices for drought management, and therefore do not rely on drought relief funds. Land use planning can be used to identify trends in land use that would be advantageous in the event of climate change. Suitable measures could be incorporated in national agricultural policy.

Intervention: Adaptation in agriculture.

Adaptation measures should include changes in agricultural management practices, such as a change in planting dates, row spacing, planting density and cultivar choice, and other measures, which would counteract the effects of limited moisture. Irrigation is currently used to supplement low levels of precipitation but this could become very expensive and less effective, giving conditions of increasing aridity. This would require a phasing out of irrigation farming and a relocation of the production areas eastwards, if practicable. To reduce the risk of famine, marginal production areas could be kept economically viable by, for example, decreasing input costs or planting drought resistant crops, such as sorghum or millet. Alternatively, land use could be changed to grazing.

A reduction of reliance on industrialised mono-cropping and diversification of the range of crops cultivated will reduce vulnerability as well as creating jobs and potentially reducing irrigation needs. Development of more and better heat and drought resistant crops would help fulfil current and future national food demand by improving production efficiencies in marginal areas, with immediate effect.

Seed banks that maintain a variety of seed types that preserve biological diversity and provide farmers with an opportunity to make informed choices could be used to counteract the effects of climate change, maintain food security and establish possibilities for profitable specialisation. This should be adopted as a priority and needs to maximise the role of local communities.

Many current agricultural practices, such as conservation tilling, furrow dyking, terracing, contouring, and planting vegetation as windbreaks, protect fields from water and wind erosion and assist in retaining moisture by reducing evaporation and increasing water infiltration. Management practices that reduce dependence on irrigation would reduce water consumption without reducing crop yields, and would allow for greater resiliency in adapting to future climate changes. Such methods include water harvesting. The reduced use of some pesticides could directly reduce greenhouse gas emissions and also reduce water pollution, thus contributing to both adaptation and mitigation.

Intervention: Changes in forestry practices.

More temperature tolerant cultivars within the current tree species could be selected, but it is more probable that more lucrative uses for the land, such as sub-tropical fruits, may compete for the land currently under tree plantations. Genetic engineering could be used to develop more heat and drought resistant hybrids, which would allow the forestry industry to counter the threat of climate change and also to maintain current production areas. However, it should be noted that current commercial forests make extensive use of exotic species, a practice that may influence biodiversity and other climate change sensitive factors such as excessive water use and soil properties. Further, community based forestry, using indigenous species and knowledge, has demonstrable benefits. In addition, a smaller scale approach can generate more employment, and may also be more compatible with a diversity of

crops/species, thus serving adaptation and reducing vulnerability. The benefits of all approaches need to be carefully evaluated as a matter of urgency and an appropriate action plan developed.

Intervention: Protecting plant biodiversity

Existing plant cover will have to be managed, since successful regeneration will become more difficult in some areas. A biodiversity monitoring network of areas that combine those at risk to future climate change with current high biodiversity and security of land tenure could be established in order to implement changes and management practices in the identified areas. In addition, sensitive indicator species could be identified to serve as warning entities.

Ex-situ conservation and seed banks are already important conservation tools in South Africa and may become more important in the future as a means of propagating species. However, it will probably be impossible to conserve all species, necessitating the implementation of mechanisms to prioritise intervention. These mechanisms may include the development of a cost benefit analysis based on considerations such as potential importance, genetic variation and uniqueness. For particular species, intensive rescue efforts might be warranted to the point where wild species are effectively "gardened". Conservation planning is required to ensure that a 10 percent conservation requirement is implemented for each vegetation type.

Intervention: Protection of animal biodiversity

Adaptation options for maintaining animal diversity could include the implementation of a conservation area network that would buffer the effects of climate change. The establishment of a species inventory and distribution monitoring network would focus attention on potential detector species as a point of departure and highlight areas most likely to be susceptible to climate change, the western arid zone and the escarpment areas being the most vulnerable. Land use practices and land use patterns outside conservation areas should be adapted to minimise the negative impacts of climate change on biodiversity conservation and future dispersal probabilities.

Intervention: Protecting marine biodiversity

As for plants and land animals, the establishment of a biodiversity monitoring network could be used to identify those species that will be impacted by climate change and may assist in the identification of species that could be used as indicator species.

Intervention: Formulate actions that will offset the economic vulnerability of South Africa to climate change response measures.

Intensive economic modelling studies and scenario analyses should be undertaken to establish the areas of specific economic vulnerability to climate change response measures that may critically affect South Africa. Informed policy can then be formulated to meet the challenges posed by this threat and ensure continued national economic growth. Such policy can be expected to cut across many sectors of the economy and will have to be formulated through a collaboration of many government departments, in association with a wide variety of stakeholders and interest groups.

4.5 Mitigation

Mitigation efforts should form an integral part of sustainable development and, in particular, cleaner production strategies. Mitigation action requires a long-term shift in the national economic/industrial base away from dependence on natural resource export and primary minerals beneficiation to manufacturing and other value-adding activities. To be successful, climate change action will eventually require a reversal of the global devaluation of natural resources, including energy. In this regard, a comprehensive national climate change strategy should ultimately address macro-economic considerations and not limit itself to a sector-by-sector approach. However, this is beyond the scope of the current document.

It is re-emphasized that, as a non-annex I country, South Africa is not required to meet any specific emission reduction or limitation targets in terms of its commitments under the UNFCCC or the Kyoto protocol. However, a consideration of possible mitigation options is useful and it can point the way in which trends could emerge in the future. The mitigation measures suggested in this section are based on those described in the National Communications and Country Studies documents. Thus the section is not exhaustive and many other mitigation measures may become apparent as programmes proceed. However, the mitigation measures described have, to some extent, been evaluated against current data and may thus be considered to be realistic. Further, it should be noted that, although DEAT may support the suggested measures in principle, much of the work comes under the jurisdiction of other national government departments, and within other spheres of government.

Objective: Create a national greenhouse gas mitigation plan that furthers the process of sustainable development in South Africa in the light of CDM, technology transfer, donor funding and capacity building opportunities.

The mitigation of greenhouse gases can be undertaken in many ways, including, *inter alia*, the introduction of renewable energy resources, fuel switching and energisation, domestic and industrial efficiency programmes, energy efficient housing, transport, agricultural and forestry schemes and non-biological carbon sequestration. As the South African economy is particularly dependent on coal, diversification measures that reduce this dependency should be considered, providing that such measures make economic sense and promote sustainable development. Such actions will require a comprehensive technology needs analysis to be undertaken for South Africa. This is an important component of any national strategy, as it will enable South Africa to capitalize on any financial support that may be offered for such activities, as well as feeding into and supporting capacity building initiatives.

DME and the industrial sector, amongst others, should drive renewable energy and energy efficiency programmes. A potential barrier to adopting both energy efficiency and renewable energy programmes in South Africa is the relatively low base cost of primary energy.

A collation of existing information on energy efficiency programmes in all sectors needs to be initiated, to gain knowledge of areas where such programmes are likely to bring benefits by way of lower consumer energy costs, making them attractive from an investment point of view.

The global uptake of renewable energy has been slow in many developed countries, where the cost of primary energy is considerably higher than in South Africa. Further, renewable energy schemes often need to have backup systems, as their availability can potentially be very low. However, there are niche applications that would favour such schemes and projects in this area should be facilitated. Further, research should be supported into the cost effective large-scale bulk supply of energy from

renewable resources, in support of DME's target of an additional 10 000 GWh of renewable energy supply by 2012. In particular, demonstration and technology transfer projects need to be facilitated. Further, the 10 000 GWh target should be critically reviewed on a regular basis to bring it into line with current developments and knowledge.

Intervention: The efforts of all stakeholders will be harnessed to achieve the objectives of the Government's White Paper on Renewable Energy (2003) and the Energy Efficiency Strategy, promoting a sustainable development path through coordinated government policy.

The energy sector includes emissions from the actual energy industries themselves, together with emissions related to energy use in the industrial, transport, commercial, residential, agriculture, forestry and fishing sectors. This sector is the largest source of greenhouse gases in South Africa, accounting for about half of the total emissions. A large proportion of these emissions emanate from the widespread use of South Africa's abundant coal stocks, and it can be safely assumed that coal will continue to be the primary energy source for many decades to come. The electricity industry alone has billions of Rands invested in coal fired generating plant, much of which has an expected operational life expectancy of two or more decades. Using reported current book asset values, the cost of stranding a single 3600MW power station would amount to about R3 billion. Worse, the station would cost of the order of R40 billion to replace with a similar fossil fuel plant, with approximately 70% of this amount required in foreign currency. Further, any costs incurred in moving to novel technologies would be additional to this. It is thus unlikely that the national economy would be unable to afford the large scale stranding of such assets. However, it should be recognised that where social benefits can be shown to be achievable through implementing non-fossil based energy developments, these should be encouraged where economically feasible.

The following mitigation technologies, and tools to promote mitigation, could be used:

- Integrated energy planning (IEP) at the national level, as well as within specific industrial sectors, would help to ensure the optimum overall mix of energy sources. In the electricity sector, IEP studies have shown that significant emission mitigation could be obtained through both demand side management and through an efficient supply side mix. This could include full cost accounting principles for planning and decision-making, when, and if, such practices become commonly used in the developed world.
- Analysis of net energy balances and the externalised costs of energy sector activities when, and if, such practices become commonly used in the developed world.
- Implement the Government's energy efficiency strategy.
- The development of energy efficiency guidelines and standards.
- Waste avoidance and efficiency promotion in industrial applications, including the mining and energy sectors.
- Clean coal technologies can be expected to be part of the energy mix for the medium-term future, given the abundant coal reserves in South Africa.
- Renewable energy sources are currently being investigated for both bulk and remote stand alone supply purposes. These include wind power, solar power and biomass, all of which can be expected to fulfil niche market applications in the future. The size of the niche market is expected to grow substantially in the longer term and developments taking place in the developed countries, largely subsidised by their governments, may well eventually become attractive alternatives for South Africa, given substantial economic growth and the assistance required to invest in such technologies.
- Although there are virtually no non-greenhouse gas emitting technologies if the full life-cycle of any facility is taken into account, energy sources which have zero, or low, greenhouse gas emissions

during their operational phase, such as hydro and nuclear power, can make a significant contribution to greenhouse gas mitigation.

- Technologies to promote increased efficiency in coal fired power stations are currently being developed, including supercritical steam technology, integrated gasification combined cycle systems, and fluidised bed technology using discard coal.
- Effective demand side management can be used to deliver energy more efficiently by reducing peak requirements on the system.
- Natural gas has now been found in relatively small, but commercially exploitable, quantities off the South African coast. A possible emission mitigation option would be to switch from coal to natural gas as the primary energy resource for the manufacture of synthetic liquid fuels. This would also reduce refinery emissions.
- Importing energy, particularly gas and hydroelectricity, from countries in the region could serve both as a mitigation option and a stimulus to regional development.
- Mitigation in the commercial and residential sectors can be achieved through energy efficiency and fuel switching. The design of housing and buildings is the most important factor determining energy consumption. Fuel switching options include the use of solar water heating, switching from coal to natural gas for boilers and from coal to natural gas for heating. Energy efficiency programmes could include the retrofitting of efficient heating, ventilation and cooling systems, efficient lighting systems and solar hot water heaters, as well as the efficient use of energy for lighting and hot water in the home. Similarly, in the commercial sector the greatest reduction of greenhouse gas emissions would be achieved by the implementation of energy efficient buildings and retrofitting efficient heating, ventilation and cooling systems. It has been the practice in a number of countries for governments to offer financial incentives for energy efficiency improvement schemes, based on government policy in this regard.

As a word of caution, it is emphasised that these options are not ranked in order of preference and that any technology can only be effectively implemented should it be economically and technically viable, using accepted criteria for such an assessment. This should be a pre-condition for granting Government support to any activity. Whereas it can be strongly argued that government, principally through DME and DTI, should create market conditions in favour of renewable energy and energy efficiency to attract foreign and local investment, the burden of proof that such an approach would be successful on a large scale rests with the proponents of such schemes. Indeed, such a policy would be admirable, and should be encouraged, on an appropriate scale that caters for specific niche applications. However, the South African economy, unlike those of the major developed countries, would not easily be able to recover if such schemes were to be adopted widely and then proved unviable, hindering, rather than promoting, essential investment and development.

Intervention: Initiating the Government's joint implementation strategy for the control of exhaust emissions from road-going vehicles.

Based on a Cabinet decision of 2000, DEAT and DME have been drafting and finalizing a joint implementation strategy for the control of exhaust emissions from road-going vehicles in South Africa. Although this primary deals with the removal of lead from petrol and an increased quantity of the sulphur from diesel by 2006, in the process other undesirable components are removed from the fuels and the subsequent emissions. It can be expected that this will be finalised in the near future.

Intervention: Implement a transport sector mitigation programme through the National Department of Transport, in conjunction with the Government's energy efficiency strategy (2003) and the joint implementation strategy for the control of exhaust emissions from road-going vehicles.

Significant mitigation benefits can be found in the transport sector, given the alignment of objectives for controlling climate change emissions and those related strictly to transportation service improvement. The transport sector accounted for about 19 percent of South Africa's greenhouse gas emissions in 2000. The transport sector is the most rapidly growing source of greenhouse gas emissions in South Africa, and is the second most significant source of greenhouse gas emissions in most middle and high income countries. Energy intensity in this sector in South Africa is particularly high due to the extensive use of synthetic fuels, and their production process.

Response measures should include addressing issues of urban and peri-urban planning in relation to both passenger and commercial transport. On the passenger transport side, the most significant challenge is to improve the currently inadequate public transport system significantly enough to retain most of the 86% of daily commuters it currently carries. This challenge is being addressed by the National Department of Transport (NDOT) through a number of initiatives. In terms of emissions from the commercial side of the sector – particularly freight transport, further research is required into the range of policy options for influencing transport modes, and their economic and practical implications for South Africa. Mitigation options include public transport initiatives, energy efficiency improvements, fuel switching and new propulsion technologies.

- Fuel switching could include liquefied petroleum gas, biochemical fuels, compressed natural gas, and electric and hybrid electric propulsion technology.
- Travel demand management offers significant opportunity to mitigate growth of emissions from private car users.
- The management of public transport systems must be radically improved. Measures include provision of new vehicles, security on public transport and in non-motorised transport use, integration of modes and their timetables/services, the introduction of clear information and customer service training, increased maintenance of vehicles, stops and stations, and formalization of the minibus taxi sector.
- Municipalities and operators should be encouraged to introduce a wide variety of more efficient public transport propulsion systems and pilot alternative fuel use. These technologies and systems include bus rapid transit and bio fuels.
- Non-motorised transport can be encouraged through appropriate planning, provision of infrastructure, and marketing of these emissions-free, low cost modes.

Intervention: Develop and implement an appropriate coal-mining sector mitigation programme through the Department of Minerals and Energy and the mining industry.

In the coal mining industry, methane emissions are directly linked to the volume of coal mined and the methods used in the mining. South African coal beds, however, contain relatively little methane, so the mitigation potential is somewhat limited in this country. Methods of limiting overall emissions of methane include:

- Adopting higher extraction ratios underground, as pillar methods of mining leave considerable quantities of coal not mined in the form of support pillars from which methane diffuses into the atmosphere. Ash filling could be employed to facilitate this.
- The extraction of remnant pillars that are readily accessible by opencasting would stabilise the under-mined ground permanently and would prevent spontaneous combustion.

- Improved coal utilisation resulting from improved coal washing will result in a reduced discard coal fraction.
- Improved combustion technology to burn discards that are presently not combustible due to the high ash content leading to excessive erosion of boiler internals.
- Removal of emitted methane prior to mining by draining through holes drilled from the surface can be practical and, in addition, the methane could be used for local heating applications.
- Catalytic combustion of methane to produce carbon dioxide and water with possible recovery of the generated heat.
- Prevention of spontaneous combustion of coal in abandoned mines and discard dumps and extinguishing underground fires.

Intervention: Implement sustainable industrial development through coordinated policies, strategies and incentives through the Department of Trade and Industry and the various industry sectors.

Mitigation options have been investigated for various industries, excluding those that are specifically part of the energy sector. The list of options is not exhaustive but serves as an example of what could be achieved and in which areas it might be useful to focus. The following suggestions have been advanced:

- Development of energy efficiency standards for particular sectors and/or products.
- The cement industry has already started to reduce emissions by implementing a strategy of using industrial waste products in combination with cement. The dilution of cement clinker with selected industrial waste materials such as granulated slag, fly ash, silica fume or milled limestone has the effect of reducing the net emissions per ton of cementitious material used. Other measures being considered are the reduction of energy consumption by additional pre-heating stages and pre-calcining of the feed. A further mitigating option is to phase out existing wet process clinker kilns.
- In the ferroalloys industries, two mitigating options have been considered. A potential significant reduction of emissions could be achieved by optimisation of the process conditions, an option that could be considered in many other industries as well. A long-term option is to recover the carbon dioxide off-gas from the furnace to pre-heat the raw materials or to generate electricity.
- Globally the chemical industry is considered to be responsible for 20% of greenhouse gas emissions. In South Africa, energy consumption in the sector is receiving attention and improvements in energy efficiency may be possible, particularly for steam production, but also for other processes. The industry is currently undergoing major consolidation and restructuring worldwide and, as a result, companies are likely to focus on a more limited range of products and to promote research into new technologies. It is expected that new production technology developed for these processes will include cleaner technology, which will assist in minimising greenhouse gas emissions. This should be encouraged. Further, there are many more greenhouse gases than the six listed in the Kyoto Protocol that are by products of the chemical industry. These should be defined to allow the industry to address them.
- In the pulp and paper industry, upgrading or replacing recovery boilers increases the boiler capacity and the energy values of higher black-liquor solids. The useful realisation of energy, through the incineration of organic residuals reclaimed from spent cooking liquor, has significant potential in terms of increased energy efficiency levels. The technology used in the recovery process is expensive and introducing any improvement in the efficiency of existing technology would involve significant capital expenditure. More feasible options include efficiency improvements and recycling of paper.
- For the aluminium industry, the substitution of raw materials with secondary recycled materials can reduce energy consumption during the production of aluminium by up to 95%.

Intervention: Reduce greenhouse gas emissions in the agricultural sector through the National Department of Agriculture.

Mitigating options that could be considered for the agricultural sector include the following:

- Optimisation of the herd sex, age and breed would allow the national herd to be reduced while maintaining the same level of production. Supplementing the feed with high protein forage would reduce the methane production from enteric fermentation and increase productivity.
- Extending feedlot manure management to include anaerobic digestion and the collection and use of the methane gas produced.
- Promoting the use of game in place of beef production.
- Avoiding the burning of agricultural residues, including those from sugar cane plantations, even where such methods are accepted management practice.
- Reduction of the frequency of fires by enhanced fire management practices.
- Promoting savannah thickening over substantial areas.
- Effectively managing soil organic matter.
- Adopting minimum tillage methods.
- Exploring synergies between adaptation and mitigation measures in the areas of agricultural product diversification and the application of more socially beneficial agro-technologies such as permaculture to provide sustainable livelihoods.

Intervention: Facilitate the establishment and extension of forest schemes through the Department of Water Affairs and Forestry and the forestry industry.

Afforestation schemes could be planted**,** within the limitations for land-use, land-use change and forestry defined in the Kyoto Protocol, and provided that such schemes do not compromise other commitments and requirements under any of the environmental conventions and treaties and do not compromise other environmental objectives, such as the need to promote biodiversity.

Intervention: Optimise waste management practices to minimise the emissions of greenhouse gases and develop a government position, through all relevant departments and all spheres of government and industry, to implement a waste sector mitigation programme.

Waste avoidance and minimisation should be given priority, with full recognition of the in-built energy of materials entering the waste stream. Re-use and recycling should be vigorously encouraged.

The quantity of waste requiring disposal at landfill sites is currently increasing as a result of urbanisation, with a consequent increase in the methane gas generated. As a possible mitigation measure, mechanisms are currently under investigation to promote sustainable recycling of post-consumer waste in order to minimise the amount of recyclable material that is currently disposed of in landfills. Further, as it stands, collection of the methane gas generated at the landfill sites is limited. Pilot studies are being conducted to collect the biogas and refine it, using membrane technology, so that it can be used as a fuel. Composting needs to be encouraged as a useful mitigation strategy.

The national climate change response strategy must broadly recognize and incorporate the relevant initiatives being undertaken by all relevant government departments and agencies, such as the National Cleaner Production Centre, which has been developed under the mandate of DTI. Such schemes can be used to promote the implementation of environmentally friendly technologies and include initiatives to prevent and minimise industrial waste production. Further, through proposed initiatives from the Department of Health (DoH), which incorporate health directed undertakings within all spheres of

government and industry in the waste disposal sector, climate benefits can be linked advantageously to public health benefits.

4.6 International concerns

As South Africa is now an active player in the international arena in many areas, it is important that national climate change response plans are acceptable to the broader global community. At the very least, this means demonstrated adherence to all international treaties, conventions and protocols to which South Africa is a party. However, being seen to be taking a leading role amongst the ranks of the developing countries could considerably enhance South Africa's standing in the international community. This is particularly true with regard to the UNFCCC, as South Africa stands to gain from the potential sustainable development benefits stemming from the Kyoto Protocol. Further, there is considerable potential for greater regional co-operation in Southern Africa, with sensitivity to the needs and opportunities of Least Developed Countries.

Objective: Optimise South Africa's potential to benefit from climate change mitigation by suitable international response and positioning.

To ensure appropriate access to the Kyoto Mechanisms, and other development funding, South Africa generally aligns itself with the Group of 77 and China negotiating bloc (G77+China). However, as one of the leading nations in the Africa Group, this will often take precedent if there is disagreement with the G77+China. It is important to note that it is unlikely that South Africa can take the position of the annex I and annex II countries ahead of the needs expressed by the G77+China, or the Africa Group, unless this action is specifically advantageous for South Africa. Further, South Africa must take the lead and express its concern for issues that are related specifically to its own economy and development, such as the dependency on coal.

Intervention: Maintain an appropriate attendance at UNFCCC and related meetings.

Continued attendance at the UNFCCC conference of parties and other related meetings is crucial. The Minister of Environmental Affairs and Tourism has the authority to choose the composition of the delegation. However, it is expected that the NCCC will advise the Minister in this regard. It is essential to include delegates from government departments other than DEAT in the delegation and appropriate representation will be proposed by the relevant Directors General and communicated via the NCCC. A full time negotiator could also be included in the Delegation. The inclusion in the delegation of representatives from other stakeholder groups, such as business, NGO's and labour, has provided considerable advantages in the past and this practice should continue. It will be incumbent on DEAT to operationalise any relevant actions coming out of the conference of parties meetings and, where appropriate, to enlist the cooperation of other government departments, provincial and local government and non-government entities.

4.7 Cross-cutting issues within government

There is an urgent need for all involved national government departments, other spheres of government and non-government institutions to work on a cooperative basis to deal with climate change issues. As for most environmental issues, intervention in one sector can sometimes produce an unforeseen and often unwanted response in another. Whereas DEAT has been designated as the lead agency for climate change, it should see its role as one of a coordinator, specifically providing appropriate input into the polices and actions that are the jurisdiction of other government departments, to ensure that

inter-sectoral linkages are identified and considered. Further, a high level of inter-departmental co-operation within government will greatly assist the non-governmental sectors in their interactions with government.

Objective: To ensure that government departments in all spheres work together on a cooperative basis in dealing with climate change.

A national strategy requires that all government departments and institutions that may be involved must work in a coordinated manner, to ensure that response measures are properly directed, acceptable to all and carried out with a national focus. This participation can be encouraged through regular dialogue at an individual level as well as through the use of existing government interdepartmental structures such as the Committee for Environmental Coordination (CEC). The GCCC was also set up, within government, as a forum to deal specifically with such matters at an appropriate level. This is specifically aimed at directorate level participation to ensure the operationalisation of programmes and actions. Other government departments are also represented officially on the NCCC.

Intervention: Use the Government Committee for Climate Change to consolidate the government position.

DEAT should facilitate the full participation of provincial and local governments in climate change directed projects, within the boundaries of their specific jurisdictions. This will ensure that response measures are properly directed, acceptable to all and carried out with a focus appropriate to local communities. As for other national departments, this participation can be facilitated through regular dialogue at an individual level as well as through the use of existing government structures that facilitate inter-tier communications, such as the MINMEC committee, which provides the interface between the Minister and the Provincial Members of the Executive Councils and MINTECH, which is technical committee that advises MINMEC and comprises of the Director-General of the Department of Environmental Affairs and Tourism and the relevant provincial department heads. Certain provincial governments are already officially represented at the NCCC and the further involvement of provincial and local government in climate change matters should be actively solicited.

4.8 Legislation

It is current thinking that a specific Act of Parliament to deal with climate change issues in South Africa is not warranted by present circumstances. However, specific amendments can be made to other laws that embrace environmental issues such that climate change provisions are included. Further, any new laws should provide for climate change issues as appropriate.

Objective: Ensure that South African environmental law provides for climate change issues.

It is unlikely that legal provisions should prescribe specific methods and principles by which climate change adaptation and mitigation actions should be brought about. Rather, legal provisions would set out the broad objectives of providing for climate change actions with the established linkages to other sectors.

Intervention: Use the ongoing law reform process to ensure that climate change issues are provided for in South African legislation.

There are currently several environmental law reform initiatives under way and the opportunity to use this for incorporating climate change provisions in these laws should be used. It is the government's intention that greenhouse gas emissions and inventories will be specifically dealt with in the impending National Environmental Management: Air Quality Act.

4.9 Education, training, awareness and capacity building

Education, training and public awareness regarding climate change lag behind the requisite standards in South Africa for historic reasons. This matter warrants immediate action across the whole spectrum of national activities, both within and outside the government sector.

Objective: Improve the level of education, training and awareness regarding climate change in South Africa and capacitate the government and other sectors to deal with climate change issues effectively to the benefit of the country.

In addressing this objective, existing skills need to be used where possible, together with a degree of retraining and orientation to rectify the situation. This area is one in which international donor funding can be used to maximum advantage. The experience of the donor countries should be extremely valuable in shortening the learning curve and speeding up the operationalisation of the action plans.

Intervention: Accelerate the process of relevant education, training, awareness and capacity building in South Africa to speed up the implementation of climate change response.

Climate change activities should be incorporated into educational curricula at primary, secondary and tertiary levels, in order to broaden public awareness of the issue. In this regard climate change needs to be seen as an integral part of modules on the environment and sustainable development. Industries can be encouraged to develop their own in-house training programmes and share these through industry associations, chambers of commerce and other relevant associations and institutions. DEAT should undertake a needs analysis for education and training requirements, together with the National Department of Education (DoE), within all spheres of government and formulate suitable plans accordingly for the government sector. Extensive use can be made of donor funding for actualisation of education and training needs on a national basis. Particular emphasis should be placed on 'training the trainer' programmes, through suitable interaction with overseas experts in the field and institutions. Certain tertiary education establishments could be selected to develop, or extend, 'centres of excellence' in environmental education, specifically including climate change and sustainable development, to ensure continuity of the education process. This could also be encouraged in privately funded institutions.

Regarding capacity building, there is an ill-defined dividing line separating the optimum amount of internal expertise in government and what should be bought in as a contracted service. The problem is obscured by the fact that some industrial concerns have an amount of technical expertise that far exceeds the government's in-house capabilities. If national government has a lack of expertise, there is a much greater problem at provincial and local government levels. Further, national departments, other than DEAT, who are involved in climate change related work, also lack the necessary expertise in some critical areas. A needs analysis should be undertaken that looks at the optimum staffing level for the national climate change response function within national government departments and for provincial and local governments. Further, cooperation with industry needs to be facilitated, as it is both

necessary and desirable to make full use of available expertise. Industry should be prepared to second suitable personnel to DEAT, DME, DST and other departments for specific purposes and vice-versa, building up working relationships, knowledge and broad competency between the parties. In addition, all contract work awarded to consultants should be viewed as a vehicle for training and skilling government officials and the necessary arrangements to facilitate this should be built into the contract as appropriate.

Capacity building projects should be largely funded through donor aid organizations. By building capacity, the numerous opportunities available via climate change response projects can be readily accessed for the benefit of the country as a whole, as well as for specific communities and regions. Further, appropriate adaptation measures can be undertaken, reducing the impacts of climate change on South Africa.

4.10 Research, development and demonstration

The effective coordination of climate change research in South and Southern Africa would have many benefits, not the least being the effective use of limited scientific resources. Attention needs to be focussed on projects that will assist with adaptation to climate change and address specific areas of vulnerability. Further, development and demonstration projects are required to show the advantages and acceptability of a variety of technologies related to climate change. An appropriate national research programme would provide for public participation, particularly in identifying opportunities and priorities, and must provide for transparency through a project information management system. This responsibility could be assigned to DST, either directly or through its agency, the NRF.

Objective: Ensure that there is an effective and integrated programme of climate change research, development and demonstration in South Africa.

Although DEAT is the lead agency for climate change, the department should, nonetheless, not be directly involved in research projects in its own right. It should rather function as a coordinator, ensuring that research is conducted for the national benefit in an efficient and effective manner and the results are passed on to the proper institutions. A national project information management system, as proposed, could be used to great advantage to ensure the forwarding of research information to the IPCC, for inclusion in its periodic assessment reports, and to IGBP participants. This way, the value of the research can be effectively realised.

Intervention: Set up a database of climate change related research, development and demonstration projects and integrate the research, development and demonstration programme for South and Southern Africa.

Government should ensure that projects concerned with systematic observation and climate research are carried out for South Africa, and for the Southern African Region in general. Such projects will concentrate on the areas of defining vulnerability and improved forecasting skills, in addition to building up a reliable database of information. The appropriate Southern African Development Community (SADC) structures in this regard need to be engaged and, if necessary, reviewed. The DST's SAEON programme, referred to above, is already making a vital contribution in this area. The Kruger Park site draws on some thirteen years of environmental data held by the Agricultural Research Council (ARC) and the South African Weather Services (SAWS). Fynbos ecological sites are currently being examined as the programme is further rolled out. Strong links need to be maintained with international groups working under the auspices of the IGBP and other organizations. This will guarantee an optimum return on investment for South Africa for climate related scientific projects.

4.11 Air quality management

Air pollution is a major problem in South Africa for a variety of reasons, but particularly in urban areas as a result of domestic coal use. This can affect all sectors of the population and many people are subjected to excessive air pollution levels for their entire lives, with the resultant toll on health and productivity. Much can be done to alleviate the situation and many of the possible solutions also have benefits regarding the emissions of greenhouse gases. Further, global warming will enhance the occurrence of surface temperature inversions thus exacerbating urban pollution.

Objective: Identify and put in place an information handling system that incorporates greenhouse gas data.

DEAT is the department that is responsible for ensuring that air quality in South Africa is managed to an acceptable level. As DEAT is already setting controls on emissions to atmosphere, it is a relatively simple task to include greenhouse gas emissions under the same umbrella. The same is true regarding the issue of demonstrating compliance with any regulations that may be promulgated for greenhouse gas emissions.

Intervention: Introduce greenhouse gas emissions into air quality legislation and put in place a national information handling system that incorporates greenhouse gas data alongside air pollution data.

DEAT is in an ideal situation to ensure that these measures are carried out effectively as it already has the required mandate in the area of air quality management. Present initiatives to manage air quality through ambient air quality standards will assist the matter greatly. The projected air pollution information handling system will also act as an ideal platform for drawing up the necessary greenhouse gas inventory reports for periodic submission to the UNFCCC, and the system should be designed from the outset to accommodate both greenhouse gas and air pollution data.

4.12 Accessing and managing financial resources for climate change

In addition to ensuring that adequate resources are available for the various government departments to carry out the tasks required of them in meeting climate change, South Africa is a developing country that will benefit from the financial opportunities made available through UNFCCC provisions. A strategy to access these funds is required and this includes being ready by putting appropriate systems and institutions in place. It must be noted that there is stiff competition between developing countries to attract climate change related funds with China and Latin America likely to get the biggest slice, especially CDM investment.

Objective: Ensure that South Africa gets the best possible access to available climate change funding.

South Africa, as a developing country, will be able to meet its obligations under the convention and mitigate climate change through assistance from developed country parties, providing that appropriate access to funding can be secured. However, it is important to realise that such funding must result in projects that are in line with South Africa's domestic sustainable development needs.

Intervention: Ensure that an investment friendly climate is developed and maintained to attract developed country partners to invest in climate change related projects in South Africa.

This will create a means to tackle projects with a wide range of social and economic benefits that would not be possible without such assistance.

Intervention: Coordination of Climate Change donor funds that are procured for South Africa.

South Africa receives funding from several sources and it is vitally important that these funds are effectively coordinated to serve domestic needs and at the same time satisfy the aspirations of the donor parties, even if each department retains its own responsibility for the administration of such funds.

Intervention: Involve the public sector and financing institutions linked to government, such as the Industrial Development Corporation and the Development Bank of South Africa.

In addition to NGOs and business, role-players that should be explicitly involved and who could bring funding to climate change response action include the public sector, through the Department of Public Enterprises and financing institutions linked to government, such as the Industrial Development Corporation (IDC) and the Development Bank of South Africa (DBSA).

5. CONCLUSION

It is noted that the strategy is firstly aimed at government and its associated institutions, including all public sector funding and implementing agencies. As a result, the material in each section is divided into those categories that are the primary means by which government can influence the development of climate change response in South Africa and maximise the derived benefits. These include the legal framework, the funding mechanisms, the creation of new infrastructure and institutional arrangements and the encouragement of research. In each of these fields, government has a number of instruments with which to achieve certain outcomes and this report outlines both the desired outcomes and the interventions by which such outcomes can be achieved.

However, it must be clearly understood that government alone cannot carry out the tasks identified in this document. Success will only be achieved through the total involvement of the private and non-governmental sectors. The national climate change response strategy thus needs to be owned by them as much as by the government sector if it is to represent a truly national course of action. Rather than regarding this document as a rigid prescription for what has to be done, it should be modified to accommodate new ideas and directions as the need arises, and when such issues are identified by any of the stakeholders, not just government.

The overall implementation of the strategy will require substantial financial and other resources. As climate change is a cross cutting issue, various sources of funds can be tapped. In addition donor funding is available for various aspects of climate change work. South Africa needs to develop a framework to effectively access and manage these funds. While it is extremely important to understand the reality and constraints of the South African economy, no door must be closed to any action based on sound economic principles, which can bring tangible benefits to the country and its people. Both physical and economic vulnerability are relevant.

6. KEY ACTIONS

A number of key interventions have been proposed in this document that cut across the entire spectrum of possibilities for climate change response actions. Through the implementation of this national climate change response programme, South Africa will avail itself of the potential advantages that could stem from international action on climate change, whilst at the same time minimising its vulnerability to such events. The following key actions will be taken to achieve this end:

a) Rapidly develop the DNA function within the Department of Minerals and Energy to facilitate the forwarding of CDM project proposals to the Executive Board for approval without undue delay.
b) Perform a technology needs analysis for South Africa that builds on and integrates existing knowledge, through the Department of Science and Technology.
c) Set up a contemporary database of climate change related research, development and demonstration projects for South Africa.
d) Develop and maintain an investment friendly climate to attract developed country partners to invest in climate change related projects in South Africa, primarily through the Department of Trade and Industry.
e) Access appropriate funds, as feasible, for implementation of the climate change programme, in particular for adaptation purposes.
f) Effectively coordinate climate change donor funds that are procured for South Africa.
g) Use the public sector and financing institutions linked to government, such as the Industrial Development Corporation and the Development Bank of South Africa to fund climate change projects.
h) Accelerate the process of education, training and awareness of climate change and its impacts to speed up the implementation of response actions.
i) Ensure the cooperation and buy-in of all stakeholders to climate change response through the NCCC and GCCC, to facilitate a coordinated national programme.
j) Harness the efforts of all stakeholders to achieve the objectives of the Government's White Paper on Renewable Energy (2003) and the Energy Efficiency Strategy, promoting a sustainable development path through coordinated government policy.
k) Implement a transport sector mitigation programme, in conjunction with the Government's energy efficiency strategy and the joint implementation strategy for the control of exhaust emissions from road-going vehicles, through the National Department of Transport.
l) Implement sustainable industrial development through coordinated policies, strategies and incentives through the Department of Trade and Industry and the various industry sectors.
m) Extend health protection and promotion measures to counter climate change related impacts through the Department of Health.
n) Accelerate water resource management and contingency planning through the Department of Water Affairs and Forestry.
o) Adapt agricultural, rangeland and forestry practices appropriately through the Departments of Agriculture and Water Affairs and Forestry.
p) Develop protection plans for plant, animal and marine biodiversity.
q) Develop and implement an appropriate coal-mining sector mitigation programme through the Department of Minerals and Energy and the mining industry.
r) Optimise waste management practices to minimise the emissions of greenhouse gases and develop a government position, through all relevant departments and all spheres of government and industry, to implement a waste sector mitigation programme.
s) Maintain an appropriate attendance at UNFCCC and related meetings.
t) Use the ongoing law reform process to ensure that climate change issues are provided for in South African legislation.

u) Introduce greenhouse gas emissions into air quality legislation and put in place a national ambient information handling system that incorporates greenhouse gas data alongside air pollution data.
v) Set a time frame for action, with specific milestones and responsibilities, to formulate appropriate national policies and measures for climate change action and develop a practicable plan of implementation.

COMMONLY USED ABBREVIATIONS

AGBM	Ad-hoc Group on the Berlin Mandate
AIJ	Activities to be Implemented Jointly
AMTS	Advanced Manufacturing and Technology Strategy
AOGCM	Atmosphere Ocean General Circulation Model
ARC	Agricultural Research Council
BAPA	Buenos Aires Plan of Action
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CH_4	Methane
CO_2	Carbon Dioxide
CONNEPP	Consultative National Environmental Policy Process
CoP	Conference of the Parties (to the UNFCCC)
CSIR	Council for Scientific and Industrial Research
DEAT	Department of Environmental Affairs and Tourism
DME	Department of Minerals and Energy
DOE	Department of Education
DOH	Department of Health
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DWAF	Department of Water Affairs and Forestry
EIT	Economy in Transition
ENSO	El Niño Southern Oscillation (climate pattern)
ET	Emissions Trading
FDI	Foreign Direct Investment
G77+China	Group of 77 developing countries together with China
GCC	Global Climate Change
GCCC	Government Committee for Climate Change
GCM	General Circulation Model
GDP	Gross Domestic Product
GEAR	Growth, Employment and Redistribution (government macro-economic policy)
GHG	Greenhouse gas
GTZ	Deutsche Gesellschaft für Technische Zuzammenarbeit (German Association for Technical Cooperation)
HCFC	Hyrochlorofluorocarbon
HFC	Hydrolfluorocarbon
ICCC	Interdepartmental Committee on Climate Change
IEP	Integrated Energy Planning
IGBP	International Geosphere Biosphere Programme
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
KP	The Kyoto Protocol to the UNFCCC
LULUCF	Land-Use, Land-Use Change and Forestry
MINMEC	Combined National/Provincial and Local Government Committee
MINTECH	Technical arm of MINMEC
MoP	Meeting of the Parties (to the Kyoto Protocol)
N_2O	Nitrous Oxide
NACI	National Advisory Council on Innovation
NAPAC	National Air Pollution Advisory Committee

NCCC	National Committee for Climate Change
NDOT	National Department of Transport
NEMA	National Environmental Management Act
NGO	Non-Governmental Organization
NEPAD	New Partnership for Africa's Development
O_2	Oxygen
O_3	Ozone
OE	Operational Entity
PFC	Perfluorocarbon
QELRO	Quantified Emission Limitation or Reduction Objective
RCM	Regional Climate Model
SAA	South African Airways
SABS	South African Bureau of Standards
SADC	Southern African Development Community
SANAP	The South African National Antarctic Programme
SASAS	South African Society for Atmospheric Sciences
SESSA	Sustainable Energy Society of South Africa
SDI	Spatial Development Initiative
SF_6	Sulphurhexafluoride
SAWS	South African Weather Services
TAR	Third Assessment Report (of the IPCC)
THC	Thermohaline Circulation
UNCBD	United Nations Convention on Biodiversity
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
UV	Ultraviolet
VCPOL	Vienna Convention for the Protection of the Ozone Layer
WAIS	West Antarctic Ice Sheet
WHO	World Health Organization

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This document has been prepared using the references listed below. These are mainly summary type documents that, in turn, contain detailed references to the actual work performed by the individual contributors, the volumes of work being published worldwide on climate change being truly prolific. Thus only the references to the key documents used are given here. In the case of the specialist readers, they are challenged to follow the leads given in the summary documents, and on the myriad climate change web sites, to follow their own lines of enquiry in depth.

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