

Department of Economic Development and Environmental Affairs

EASTERN CAPE CLIMATE CHANGE RESPONSE STRATEGY

Prepared for:

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In association with

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ENERGY

Eastern Cape Climate Change Response Strategy

REPORT STRUCTURE

The Eastern Cape Climate Change Response Strategy report is presented in five separate sub-reports. These are outlined below:

- Summary Report which gives a high-level synthesis of the overall process and outcomes;
- Phase I Report: Eastern Cape Climate Change Scenario where an understanding of the issues and context of climate change in the Eastern Cape was developed.
- Phase II Report: Provincial Needs and Technology Assessment where technical options for climate change mitigation most appropriate to the circumstances and needs of the Eastern Cape are identified.
- Phase III Report: Guideline Document on Sectoral Climate Change Action Plans where priority response options are identified and developed as cross-sectoral programmes. The response programmes are grouped into adaptation programmes and mitigation programmes.
- Phase IV Report: Eastern Cape Climate Communications, Education and Public Awareness Strategy.

Tables of contents, lists of figures and lists of tables are provided for each report.

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EXECUTIVE SUMMARY

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ACRONYMS AND ABBREVIATIONS

AFOLU AR4	Agriculture, Forestry and other Land Use Fourth Assessment Report of the IPCC					
CO₂e COP	Carbon Dioxide Equivalent					
DEDEA	Department of Economic Development and Environmental Affairs					
DEA	Department of Environmental Affairs					
ECCCRS	Eastern Cape Climate Change Response Strategy					
ECDC	Eastern Cape Development Corporation					
ECSECC	Eastern Cape Socio-Economic Consultative Council					
GHG	Greenhouse Gas					
GRIP	Greenhouse Gas Regional Inventory Protocol					
IPCC	Intergovernmental Panel on Climate Change					
IPPU	Industrial Processes and Product Use					
LTMS	Long Term Mitigation Scenarios					
PGDP	Provincial Growth and Development Plan					
PIDS	Provincial Industrial Development Strategy					
RD&ATS	Rural Development and Agrarian Transformation Strategy					
UNFCCC	United Nations Framework Convention on Climate Change					
WMA	Water Management Area					

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1 INTRODUCTION

It is internationally recognised that climate change is one of the greatest challenges of our time. There is an urgent need to combat climate change and to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. This is affirmed by the Copenhagen Accord adopted in 2009 by the 15th session of the Conference of the Parties (COP 15) to the United Nations Framework Convention on Climate Change (UNFCCC).

Climate change is likely to have pervasive effects. Furthermore, the far reaching impacts of climate change experienced in the foreseeable future will be felt in some way by every person and every organisation, public or private, and at all levels, from strategic management to operational activities for many years to come. The effects will impact across environmental issues, economic performance, social behaviour, infrastructure and other aspects of human existence.

South Africa, and particularly the presidency, is playing an increasingly important and respected role in international climate change negotiations. This is highlighted by the fact that South Africa will be hosting COP 17 in Durban in November and December 2011.

In keeping with the national initiative, a process to develop an Eastern Cape Climate Change Response Strategy (ECCCRS) was initiated by the Eastern Cape Provincial Department of Economic Development and Environmental Affairs (DEDEA) in January 2010. The Eastern Cape Provincial Government recognises that the Province is contributing to climate change, while at the same time it is vulnerable to the effects of climate change. Provincial government recognises the importance of initiating policy responses to facilitate planned and coordinated approaches to both climate change mitigation and adaptation.

During the course of the development of the ECCCRS, the National Climate Change Response Green Paper was released (December 2010). Section six of the Green Paper states that in order to ensure that climate change considerations and the climate change responses outlined in the Green Paper are fully mainstreamed into the work of government, all three spheres of government, all government departments and all state owned enterprises must –

- By 2012, conduct a review of all policies, strategies, legislation, regulations and plans falling within its jurisdiction or sphere of influence to ensure full alignment with the National Climate Change Response Policy.
- By 2014, ensure that all policies, strategies, legislation, regulations and plans falling within its jurisdiction or sphere of influence are fully aligned with the National Climate Change Response Policy

The Green Paper affirms the need for a provincial response process, and supports the issues and priorities identified in the ECCCRS.

The Development of the ECCCRS has entailed four phases, namely:

- Phase I Eastern Cape Climate Change Scenario, where an understanding of the issues and context of climate change in the Eastern Cape was developed. The phase includes five components, namely:
 - Legal and Policy Framework where the international, national and local policy and legislative context for climate change response in the Eastern Cape is assessed;
 - Climate Change Scenarios and Impacts where the manifestations of climate change and related impacts relevant to the Eastern Cape are identified;
 - Risk Assessments of appropriate sectors and resources of the Eastern Cape

 where a systematic process of identifying and prioritising risks to various sectors is undertaken;

- Eastern Cape provincial development priorities where development policies and strategies are reviewed in order to ensure that the ECCCRS process is informed by these priorities;
- Greenhouse gas inventory where a preliminary assessment of the greenhouse gas "footprint" of the Province is undertaken.
- Phase II: Provincial Needs and Technology Assessment where technical options for climate change mitigation most appropriate to the circumstances and needs of the Eastern Cape are identified.
- Phase III: Guideline Document on Sectoral Climate Change Action Plans where priority response options are identified and developed as cross-sectoral programmes. The response programmes are grouped into adaptation programmes and mitigation programmes.
- Phase IV: Eastern Cape Climate Communications, Education and Public Awareness Strategy.

Each phase has been documented as a separate volume. However, the substance of each phase is summarised in sections 2, 3,4 and 5.

2 PHASE 1: EASTERN CAPE CLIMATE CHANGE SCENARIO

2.1 Legal and Policy Framework

A comprehensive understanding of the policy and legislative environmental is an essential component in developing a climate change response strategy for the Eastern Cape Province. A stand alone ECCCRS legal and policy assessment was drafted for the process, which forms an annexure to Volume 1. The document provides an overview of the international and national policy and legislative environment. Internationally, South Africa is a signatory to the 1994 United Nations Framework Convention on Climate Change (UNFCCC) and its associated Kyoto protocol (1997). The most important national policy is the National Climate Change Response Green Paper 2010. The Green Paper is the key policy document framing the South African response to the challenges of climate change. In terms of the Green Paper, South Africa will implement the following strategies in order to achieve its climate change response objectives:

- Taking a balanced approach to both climate change mitigation and adaptation responses in terms of prioritisation, focus, action and resource allocation.
- Prioritising the development and maintenance of the science-policy interface and knowledge management and dissemination systems to ensure that climate change response decisions are informed by the best available information.
- The short-term prioritisation of adaptation interventions that address immediate threats to the health and well-being of South Africans including interventions in the water, agriculture and health sectors.
- The prioritisation of mitigation interventions that significantly contribute to a peak, plateau and decline emission trajectory where greenhouse gas emissions peak in 2020 to 2025 at 34% and 42% respectively below a business as usual baseline, plateau to 2035 and begin declining in absolute terms from 2036 onwards, in particular, interventions within the energy, transport and industrial sectors.
- The prioritisation of mitigation interventions that have potential positive job creation, poverty alleviation and/or general economic impacts. In particular, interventions that stimulate new industrial activities and those that improve the efficiency and competitive advantage of existing business and industry.
- Prioritising the development of knowledge generation and information management systems that increase our ability to measure and predict climate change and, especially extreme weather events, floods, droughts and forest and veld fires, and their impacts on people and the environment.
- The mainstreaming of climate change response into all national, provincial and local planning regimes.
- The use of incentives and disincentives, including through regulation and the use of economic and fiscal measures to promote behaviour change that would support the transition to a low carbon society and economy.
- Acknowledging that, with the energy intensive nature of the South African economy, the mitigation of greenhouse gases is generally not going to be easy or cheap and that Government must support and facilitate the mitigation plans of, in particular, the energy, transport and industrial sectors.
- The recognition that sustainable development is also climate friendly development and that that; the more sustainable our development path is, the easier it will be to build resilience to climate change impacts.
- Recognise that measures taken by developed countries in their efforts to respond to climate change may have detrimental effects on high carbon and energy intensive economies such as South Africa. These response measures may include trade measures including border tax adjustments, and could be reflected in a reluctance to

trade in goods with a high carbon footprint. South Africa's climate change strategy

must recognise and address this and also create mechanisms that will give high carbon sectors the support and time to move to lower carbon forms of production.

• Recognise that South Africa's response to climate change will have major implications for both the Southern African region and for Africa as a whole and ensure that national responses are aligned to, support and operate as part of a broader regional response.

The most important national legislation relating to climate change includes among others:

- The National Environmental Management Act 107 of 1998 (NEMA);
- The National Environmental Management: Air Quality Act 39 of 2004;
- The National Environmental Management: Waste Act 59 of 2008;
- The Energy Act, 2008;
- The National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM:ICMA); and
- South Africa Renewable Energy Feed-in Tariff (REFIT), Regulatory Guidelines 26 March 2009.

In the South African context, numerous opportunities related to climate change are noted, especially regarding mitigation actions, which can be classified as follows:

- Create new streams of revenue from greenhouse gases reduction projects;
- Technology transfer and development;
- Access to foreign investment;
- Cost saving from increased energy efficiency and conservation;
- Poverty alleviation through income and employment generation associated with mitigation and development programmes;
- The Clean Development Mechanism (CDM) and the carbon market and involvement in emissions trading (buying or selling carbon credit);
- Opportunities to develop new products, services or technologies;
- Carbon neutral activities or projects to offset emissions from parts of its operations by buying or acquiring carbon credits; and
- Development of strategic partnerships with national and international partners.

2.2 Climate Change Scenarios and Impacts

Climate Change is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability over comparable time periods".

Global warming is defined by the UNFCCC as "the increase in the earth's temperature, in part due to emissions of greenhouse gases (GHG's) associated with human activities such as burning fossil fuels, biomass burning, cement manufacture, cow and sheep rearing, deforestation and other land-use changes."

The manifestations of climate change in South Africa are likely to include:

- Higher temperatures;
- Altered rainfall patterns;
- More frequent or intense extreme weather events including heat-waves, droughts, storms and floods; and

• Rising sea levels (which, associated with more intense storm surges and floods, may result in local inundation and coastal erosion).

The Eastern Cape is expected to experience highest temperature increases towards the northwest interior, while lowest increases are likely along the coast (Figure 1). Associated with the higher temperature will be increases in evaporation rates and increased intensity of droughts.



Figure 1: Projected median change in maximum surface temperature by 2050 (Source: Midgley et al 2007).

In regard to precipitation, downscaling models show a wetting trend to the east and northeast of the country and a drying trend to the south and particularly the south west (Midgley *et al* 2007). Figure 2 indicates projections for South Africa.



Figure 2: Projected change in total annual rainfall (mm month-1) for July and December (mid century) (Source, Midgley *et al* 2007).

As with the national scenario, downscaling models for the Eastern Cape indicate future precipitation which is generally stable or slightly higher than present, with increasing intensity. Increased precipitation is more likely to the east of the province (Johnston *et al*, 2011).

Although little research has been conducted for sea-level rise impacts on the Eastern Cape, useful information exists for the City of Cape Town and Durban. Studies for these cities give local sea level rise scenarios ranging from 2m to 6.5m depending on exposure.

2.3 Eastern Cape Province Development Priorities

In order to assess the potential impacts of climate change and appropriate responses in the Eastern Cape, it is important to understand the local context. More specifically, it is important to understand how current development priorities for the Province will be affected. The assessment of provincial development priorities focuses on the implications of climate change on social and economic development plans in the Eastern Cape, including:

- Provincial Growth and Development Plan (PGDP);
- Provincial Industrial Development Strategy (PIDS);
- Programmes under the PGDP.

The assessment outlines the relevance of climate change to these plans and programmes. For example:

- Initiatives and programmes reflected in provincial plans and programmes need to take into consideration risks and impacts and limitations imposed by climate change, such as increased temperatures; changes in precipitation levels; increased storm events; tidal surges and sea-level rise; and consider <u>adaptation</u> measures.
- Infrastructure development needs to take into account the impact of changing variables such as higher return periods for flooding and droughts, more extreme weather events, and sea level rise. Infrastructure development should pay close attention to geographic areas at highest risk such as flood–prone areas and areas close to sea-level.
- Development plans and programmes need to take into consideration the growing need for climate change <u>mitigation</u> and clean energy projects as development direction and economic opportunity. Such a development direction is underscored by the growing <u>green economy</u>.

- Development plans and programmes need to consider co-funding opportunities through mechanisms such as trading of Carbon Credits and Climate Change Adaptation Funds.
- It should be emphasised that the successful outcomes of development plans and programmes, particularly in regard to poverty alleviation and food security, will increase the resilience of vulnerable communities to climate change.

2.4 Risk and Vulnerability Assessment of Sectors and Resources

The effects of climate change such as temperature increases and sea-level rise may have significant knock on effects which combine to threaten the environmental, economic and social systems of the province. These effects also threaten the continuity and functioning of provincial and local governance institutions and their associated mandate in the Eastern Cape

A climate change risk assessment matrix was developed as part of the ECCCRS. The risk assessment matrix aims to facilitate a step-wise approach to understanding which climate change impacts may affect the province, how serious these impacts are likely to be, and which provincial plans, agencies and departmental and municipal mandates are directly affected. The following systems, sectors or infrastructure types are included in the matrix:

- Agricultural Sector
- Air Quality Systems
- Biodiversity Systems
- Coastal and Marine Systems
- Energy Services Infrastructure
- Fisheries & Aquaculture Sector
- Forestry Sector
- Geology & Soils Systems
- Health Services Infrastructure
- Social & Economic Systems
- Tourism Sector
- Transport Infrastructure
- Water Resources Systems
- Water Services Infrastructure

Climate change risks assessed as being of extreme significance are given in the table below. Note that these risks were assessed at the scale, and in the context of, the various mandates of the Eastern Cape Provincial Government.

Table	1:	Impacts	of	extreme	significance	for	various	sectors	as	identified	in	the
prelimi	ina	ry risk as	ses	sment p	ocess.							

Climate Change Manifestation	2 nd Order Impact	2 nd Order Impact 3 rd Order Impact	
More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme, coupled with berg-wind conditions	Risk of major loss of livestock, grazing, crops and infrastructure. Threats to financial sustainability of existing commercial and subsistence farming operation and rural livelihoods; Reduced food security.	Agriculture Sector
Increased storm severity/ Extreme weather events.	Increased inundation and loss of coastal land, wetlands and estuaries	Increased damage to/loss of coastal property and infrastructure and increased insurance premiums	Coastal and Marine Systems

More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme, coupled with berg-wind conditions	Risk of major and widespread loss of standing stocks and threats to financial sustainability of existing operations.	Forestry Sector
More hot days and heat waves	Increased morbidity and mortality among elderly and infirm (e.g. HIV/AIDS patients)	Increased strain on health services	Social & Economic Systems
Higher mean temperatures	Coupled with increased rainfall, spread in range of diseases and vectors, including cholera, malaria and bilharzia.	General increase in occurrence of disease; exacerbation of effects on people with HIV/AIDS, the elderly and the poor.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Increased storm surges coupled with sea level rise and flooding from both climate change causes and catchment hardening.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Coupled with more intense rain, catchment hardening due to urban development, and reduced integrity of water catchments: increased risk of flooding or flash floods	Direct threat to infrastructure within flood-prone areas; Direct threat to human life.	Social & Economic Systems
More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme	Increased fire frequency increases direct threat to human life; threats to livelihood and infrastructure.	Social & Economic Systems
More hot days and heat waves	Increased morbidity and mortality among elderly and infirm (e.g. HIV/AIDS patients)	Direct threat to livelihoods and social services	Social & Economic Systems
Higher mean temperatures	Increased evaporation, reduced soil moisture, reduced runoff and river base flow.	Compounded by reduced MAP, systemic water shortages will limit economic growth potential to the south-west.	Social & Economic Systems
Sea level rise	Coupled with storm surges and flood events exacerbated by catchment hardening, inundation and wave damage to coastal low lying areas.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Crop damage from hail and wind and heavy rain	Increased risk of crop failure; threats to commercial and subsistence agriculture, rural livelihoods and food security.	Social & Economic Systems
Longer dry spells and increased likelihood/ severity of droughts	Increased risk/frequency of dry land crop-failure; Increased mortality and reduced productivity among livestock.	Threats to commercial and subsistence agriculture, rural livelihoods and food security.	Social & Economic Systems
More hot days and heat waves	Heat waves coupled with dry conditions may increase the risk of uncontrollable shack fires in informal settlements	Threat to human life. Threats to urban livelihoods and increased strain on urban disaster management systems.	Social & Economic Systems
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Reduced safety of personnel and increased frequency of injury or loss of life	Transport infrastructure

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2.5 Eastern Cape Greenhouse Gas Inventory

The National Department for Environmental Affairs (DEA) is responsible for the development of South Africa's National GHG Inventory. South Africa has developed three national inventories covering the years 1990, 1994 and 2000.

The 2000 GHG Inventory has been developed using the 2006 IPCC Guidelines. Data availability has been a key challenge in developing the 2000 GHG Inventory with most of the data only being available at an aggregated national level rather than at provincial, local or point source level.

A preliminary inventory for the Eastern Cape was undertaken as part of the ECCCRS. The inventory is for the year 2008, but is discussed in the context of the National Greenhouse Gas Inventory (year 2000). It should be emphasised that the Provincial inventory is not of the level of rigour and detail as the National Inventory. The results reported here are not authoritative, but rather are given for indicative purposes.

As per the 2006 IPCC guidelines, the inventory classifies emissions into the following four categories:

- Energy: emissions within this sector are from the combustion of fuel and fugitive fuel emissions from stationary and mobile energy activities including: public electricity and heat production; petroleum refining; manufacture of solid fuels; other energy industries; manufacturing industries and construction; transport; commercial; residential; agriculture; forestry; fishing; and fugitive emissions from coal mining, coal-to-liquid, oil and natural gas activities.
- Industrial Processes and Product Use (IPPU): emissions within this sector comprise by-product or fugitive emissions of GHGs from industrial processes. Emissions from the combustion of fuel in industry are reported under Energy.
- Waste: emissions within this sector are from waste management including disposal of solid waste on land and wastewater treatment.
- Agriculture, Forestry and other Land Use (AFOLU): emissions from this sector include anthropogenic emissions from agricultural activities except for fuel combustion (reported under Energy) and sewage emissions (reported under Waste). Activities include enteric fermentation, manure management, agricultural soils, prescribed burning of savannas and field burning of agricultural residues. This sector also includes total emissions from and removals by forest and land use change activities including changes in forest and other woody biomass stocks, forest and grassland conversion, and emissions from and removals by soil.

The results of the preliminary provincial inventory indicate that the energy sector is responsible for 67% of emissions, while IPPU, AFOLU and Waste are responsible for 1%, 28% and 5% respectively (see Figure 3). However, these figures are deceptive and should be used with caution in that AFOLU is overstated (sources and sinks from forestry and land use have not been included through lack of readily available data), while IPPU is understated (lack of readily available data). Likewise, the results for waste should be viewed with caution in that they are based on population data, rather than measured waste generation, treatment and disposal data.

The ratio of greenhouse gas types (expressed in carbon dioxide ton equivalent) are 60% Carbon dioxide, 27% Methane, 11% Nitrous oxide and 2% HFC, PFC and SF6. These ratios are illustrated in Figure 4.

While 435,461 Gigagrams of Carbon dioxide equivalent were emitted for the whole of South Africa in 2000, 38,991 Gigagrams were emitted for the Eastern Cape in 2008. In other words, the Eastern Cape produced 9% of national emissions (bearing in mind the 8 year gap between inventories).



Figure 3: Emissions sources in the Eastern Cape for the year 2008 in Gigagrams of Carbon Dioxide Equivalent. *Please note that sinks from forestry and other landuse/landuse change are not included, while emissions from Industrial Processes and Product Use are under-represented due to lack of data.*



Figure 4: Emissions for GHG types in the Eastern Cape for the year 2008 in Gigarams of Carbon Dioxide Equivalent. Little or no data was available for HFCs, PFCs and SF6.

3 PHASE 2: EASTERN CAPE TECHNOLOGY ASSESSMENT

The opportunities for mitigation of climate change impacts by means of technical interventions or programmes are generally well understood and are described in the international literature (IPCC, 2007). Furthermore, these technical responses can be prioritised among the non-technical mitigation opportunities in terms of cost-efficiency as illustrated in Figure 5 in the form of marginal abatement cost (MAC) curves.

Global cost curve for greenhouse gas abatement measures



Figure 5: Global cost curve for greenhouse gas abatement measures - strategic options for climate change mitigation (source: UNEP/GRID 2008)

A key observation from the analysis of the strategic options above is that, apart from some contributions from forestation, livestock and soils, the predominant opportunities for mitigation are in the energy sector.

It is clear that the highest priority opportunities are in terms of energy efficiency – both on the demand and the supply side. These are either no-cost or relatively low-cost interventions which realise savings in resource consumption, and also hence costs, and which have attractive paybacks or returns on investment. This observation is confirmed by the findings of the IEA's World Energy Outlook which highlights the opportunity for energy efficiency to achieve two-thirds of the abatement in 2020. Increased use of renewable energy would contribute approximately a fifth. These opportunities are illustrated in Figure 6.

+ 12 -		Abat (Mt	ement CO ₂)	Invest (\$2008 I	ment billion)
40 - Reference Scenario		2020	2030	2010- 2020	2021- 2030
38 -	Efficiency	2 517	7 880	1 999	5 586
36 -	End-use	2 284	7 145	1 933	5 551
34-	Power plants	233	735	66	35
32-	Renewables	680	2 741	527	2 260
30-	Biofuels	57	429	27	378
28	Nuclear	493	1 380	125	491
26 450 Scenario	CCS	102	1 410	56	646

2007 2010 2015 2020 2025 2030

Figure 6: World abatement of energy-related CO2 emissions in the 450 ppm scenario (Source: World Energy Outlook 2009, IEA)

The opportunities for technical responses in the Eastern Cape are more specific and particular to the social, economic and environmental context in the province over the short- to medium-term. The most important and promising technologies and the appropriateness of technology opportunities for conditions in the Eastern Cape have been assessed in terms of:

- Maturity of the technology;
- Opportunities for cooperation with other organizations; and
- Options for promotion within ECP Policies and Sector Plans.

Based on the assessment, key technologies for mitigation in the Eastern Cape Province have been prioritised in the table below. These represent technologies where the most significant gains in mitigation can be achieved for time, effort and finances invested. This is based on appropriateness of technology and ease of implementation in the Eastern Cape.

	Technology option	Application	Comment		
1	Energy efficiency in buildings and appliances	 GreenStar rating of buildings Efficient air- conditioning Efficient lighting 	Buildings lifetimes exceed 50 years and consequently these lock in emissions or savings for a long time All government / municipal buildings will soon be required to meet a Four Star rating		
2	Heat pump technologies	- Heat pumps and efficient water heating	Manufacturing opportunities offer a double return on investment in energy efficiency with heat pumps		
3	Solar space and water heating	 Passive solar design standards Building standards to include SWH 	Highly topical and appropriate within the context of the DoE Strategic Framework for SWH and 1 million SWH target		
4	Energy efficiency in transport	 Fuel efficiency standards Electric vehicles Plan for non- motorised transport 	Security of supply issues are important too Exposure to price risks in the future costs of carbon based fuels		
5	Industrial energy efficiency	- Efficient motors and drives	Effective frameworks and mechanisms (beyond Eskom's DSM scheme) are required to enable / accelerate these investments		
6	Smart grids and metering systems	 Upgrade metering Introduce intelligence in the network 	Local authorities (and REDs in future?) will benefit in higher levels of service delivery and deferred investments for new capacity		

Table 2: Prioritized technologies for mitigation in the Eastern Cape.

7	Biomass energy systems	-	Energy from waste Agricultural and household biogas	The E. Cape has a significant resource for on-site and distributed energy service provision
8	Wind energy systems	-	Utility-scale wind farms Small scale mini- grid and stand- alone systems	The E. Cape has some of the best wind regimes in SA Infrastructure can be implemented more quickly than other systems (subject to EIA approvals)
9	Hydro energy systems	-	Small and medium scale systems	The E. Cape has the best resource in the country and some excellent experience with existing capacity
10	Solar PV systems	-	Stand-alone systems for household electrification Grid-connected PV on buildings and for utility generation	Increased access to energy services can be rapidly addressed Grid-connected systems can also be implemented very quickly but the costs are currently still high for good ROIs

Although climate change has many negative social and economic implications, the necessary adjustment of global modes of production to a more sustainable, low carbon economy is likely to result in many opportunities for the generation of "green" jobs. Currently green job creation is taking place in both affluent countries and in some of the major developing economies. As an illustration, employment in the renewables sector in Germany increased from 66,600 to 259,100 between 1998 and 2006 (UNEP 2008). Table 3 shows that over 2.3 million jobs world-wide were attributable to the Renewable Energy Sector in 2006, with the greatest number of jobs coming from renewable biomass.

Table 3: Estimated World-wide Employment in the Renewable Energy Sector in 2006. Source: UNEP 2008.

RE Type	Number of Jobs
Wind	300,000
Solar PV	170,000
Solar Thermal	624,000
Biomass	1,174,000
Hydropower	39,000-plus
Geothermal	25,000
Renewables, Combined	2,332,000-plus

A study by AGAMA Energy in 2003 gives details of the relative number of jobs per Terawatt Hour (TWh) for different energy generation types (see Figure 7). Renewable energy technologies result in more jobs per unit energy than nuclear, coal and gas. Significant numbers of jobs are created in the Biogas, Bioethanol, Solar Water Heating and Biodiesel industries.

Comparison of Job Creation Potential of Various Energy Generation Technologies



Figure 7: Gross direct jobs for new generation capacity of various energy types (Source: AGAMA Energy 2003)

Policies and measures that can be introduced by the Eastern Cape Provincial Government to promote technical options for mitigation include requirements for market creation and development, RD&D efforts, investments in new technologies, standard setting and the development of an enabling regulatory environment.

4 PHASE 3: GUIDELINE DOCUMENT ON SECTORAL CLIMATE CHANGE ACTION PLANS

Phase III of the ECCCRS deals with the development of provincial response programmes and plans. The context of response planning in regard to the overall climate change response process is illustrated in Figure 8 below.



Figure 8: Climate Change Response Cycle (Source: IPCC 2001)

4.1 Adaptation

The impacts of climate change will, to greater and lesser degrees, affect every Provincial department, development plan and municipality. Likewise, climate change responses are cross sectoral. Effective response processes are cross-cutting and cannot be dealt with by each sector or department in isolation. Rather, integrated response programmes are required where multiple sectors and departments contribute to a common climate change issue to ensure effective adaptation responses. A programmatic framework for such multi-sectoral planning is described in Figure 9 below.



Figure 9: Programmatic framework for multi-sectoral adaptive response planning.

The impacts of extreme significance as identified in Table 1 have been grouped into adaptive response programmes as given in Table 4 below.

Adaptation Category		Adaptation objective
Coastal Infrastructure and Livelihoods	•	Increased resilience of coastal infrastructure and resources to the effects of sea-level rise, storm-surges, flooding and increased sea temperature (fisheries). Improved response to the impacts of extreme coastal events.
Water Scarcity	•	Mainstreaming climate change induced water scarcity in institutional decision-making and planning in water stressed areas in the Eastern Cape Province.
	•	Effective water resources management and efficient water use throughout the Eastern Cape Province.
	•	Flood prevention
Flood Management	•	Reducing vulnerability to flooding events;
	•	Improved response to the impacts of flooding events
Responses to increased risk of wildfires	•	Improved wildfire prevention and suppression
Managing the effects of increased temperature on human lives	•	Societal adaptation to human health impacts from temperature increases associated with climate change.
Food security	•	Incorporating Climate Change acclimatization and resilience in provincial food security programmes

Table	4:	Recommended	programmes	in	response	to	the	impacts	of	extreme
significance identified in the systematic risk assessment.										

Draft adaptive response options and response programmes have been developed in the Phase III document for each adaptation category in line with the response framework set out in Figure 9.

4.2 Mitigation

As with adaptation, mitigation activities would be relevant to many sectors. This means that integrated mitigation programmes are required where multiple sectors and departments contribute to a common mitigation objective. As with adaptation, a programmatic framework for such multi-sectoral mitigation planning is described in Figure 10 below.



Figure 10: Framework for multi-sectoral mitigation programmes.

Drawing from the preliminary greenhouse gas inventory described in Phase I, and from the technology options described in Phase II, a set of pragmatic greenhouse gas mitigation programmes is proposed. These are developed in the section below and introduced in Table 5 below.

Mitigation Category		Mitigation objective
Mainstreaming GHG Mitigation in	•	Mainstreaming GHG Mitigation in Decision-making at all levels of government within the Eastern Cape Province
Provincial and Local Government and in Industry	•	Promoting GHG Mitigation in Provincial and Local Government Operations.
	•	Promoting Greenhouse Gas Reporting in Industry.
Promotion of Renewable Energy in the EC	•	Create an enabling environment for investment in, implementation and use of clean energy in the Eastern Cape.
Mitigation and opportunities for sustainable livelihoods	•	Facilitate integrated lead projects that promote sustainable livelihoods and local economic development while achieving (tradable) emission reductions.
Mitigation in Solid Waste and Wastewater Treatment	•	Reduction in organic waste to landfill, renewable energy from waste, and methane use or destruction.
Greenhouse Gas Mitigation in Transport	•	Facilitate shift to low greenhouse gas modes of transport and transport systems.

Table 5: Proposed integrated mitigation programmes.

Draft mitigation programmes have been developed in the Phase III document for each adaptation category in line with the response framework set out in Figure 10.

It should be noted that both the adaptation and mitigation programmes are working documents which require regular review and revision by relevant departments or stakeholders

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5 PHASE 4: COMMUNICATION, EDUCATION AND PUBLIC AWARENESS STRATEGY

As climate change is a global problem with wide-ranging impacts, it is essential that the climate change message is communicated successfully to as many different and affected groups as possible. Policy makers, businesses, the media and the public are increasingly interested in the complex issue of climate change. This generates a multitude of information and opinions about climate change, and presents significant challenges in accurately and effectively communicating the issue.

With regard to the ECCCRS, it is important to consider how the outcomes and programmes coming out of the study (particularly those mentioned in Phase III) are communicated to various stakeholders. Phase IV of the process outlines a climate change communications, education and public awareness strategy. A targeted approach relevant to the types of audience, together with specific communication approaches, is recommended. Recommended target audiences are given below:

- Provincial legislature and local government councillors;
- Provincial and local government departments;
- Affected industry and service sectors;
- Relevant committees associated with the response programmes recommended in Phase III of the ECCCRS; and
- The general public.

The communication approaches are detailed in the Phase IV document. A pro-forma business plan for the further development and rollout of the ECCCRS communication, awareness and education plan is also set out in the Phase IV document.

A critical climate change message is that "Everyone has a role to play in reducing emissions (mitigation) and everyone will be affected by climate change (adaptation)".

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PHASE 1: EASTERN CAPE CLIMATE CHANGE SCENARIO

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ACRONYMS AND ABBREVIATIONS

AFOLU	Agriculture, Forestry and other Land Use		
AR4	Fourth Assessment Report of the IPCC		
CO ₂ e	Carbon Dioxide Equivalent		
COP	Conference of Parties		
DEDEA	Department of Economic Development and Environmental Affairs		
ECDC	Eastern Cape Development Corporation		
ECSECC	Eastern Cape Socio-Economic Consultative Council		
GHG	Greenhouse Gas		
GRIP	Greenhouse Gas Regional Inventory Protocol		
IPCC	Intergovernmental Panel on Climate Change		
IPPU	Industrial Processes and Product Use		
LTMS	Long Term Mitigation Scenarios		
PGDP	Provincial Growth and Development Plan		
PIDS	Provincial Industrial Development Strategy		
RD&ATS	Rural Development and Agrarian Transformation Strategy		
UNFCCC	United Nations Framework Convention on Climate Change		
WMA	Water Management Area		

1 INTRODUCTION

Climate change is one of the most serious environmental challenges facing the planet and is largely the result of combustion of fossil fuels and release of greenhouse gases into the atmosphere (mostly carbon dioxide) causing the "greenhouse effect". The Minister of (then) Environmental Affairs & Tourism (DEAT, 2008) has been quoted as saying: "Climate change is every one's problem and over the next 50 years it may well become the worst social economic and environmental challenge ever faced".

In addition, the Conference of the Parties (COP) to the United Nations Climate Change Convention (UNFCCC) at its fifteen session (COP 15) in Copenhagen (December 2009), adopted a decision that took note of the Copenhagen Accord of 18 December 2009, which amongst other reaffirms the following:

- That climate change is one of the greatest challenges of our time;
- That there is an urgent need to combat climate change and to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system;

Climate change is likely to have pervasive affects. Furthermore, the far reaching impacts of climate change experienced in the foreseeable future will be felt in some way by every person and every organisation, public or private, and at all levels, from strategic management to operational activities for many years to come. The affects will impact across environmental issues, economic performance, social behaviour, infrastructure and other aspects of human existence.

South Africa, and particularly the presidency, is playing an increasingly important and respected role in international climate change negotiations. This builds on the progress made at a national level towards the development of a National Climate Change Response Strategy. A climate change response policy framework is currently in place, which is reflected in the National Climate Change Response Green Paper which was released for comment in December 2010.

In keeping with the national initiative, a process to develop an Eastern Cape Climate Change Response Strategy (ECCCRS) has been initiated by the Eastern Cape Provincial Department of Economic Development and Environmental Affairs (DEDEA). This proactive approach reflects the recognition of the Eastern Cape Provincial Government that the Province is both contributing to climate change, while at the same time is vulnerable to the effects of climate change and that it is important that Provincial Government initiates the development of policy responses to facilitate planned and coordinated approaches to both climate change mitigation and adaptation as illustrated in Figure 1 below.



Figure 1: Climate Change Response Cycle (Source: IPCC 2001)

This document (phase 1 of the process) includes an outline of the legal and policy framework as it relates to Climate Change Response in the Eastern Cape, a review of the climate change phenomenon together with future scenarios, an outline of development priorities in the Eastern Cape, an assessment of climate change risks, and a preliminary Greenhouse Gas inventory.

2 LEGAL AND POLICY FRAMEWORK

A comprehensive understanding of the policy and legislative environmental is an essential component in developing a climate change response strategy for the Eastern Cape Province.

The current section represents a summary of the full legal and policy framework assessment which is included in Appendix A.

2.1 Overview of international policy and regulatory framework

A detailed overview of the international climate change policy and regulatory framework can be found in Part C of Appendix A.

In terms of climate change and air quality the following international Conventions are considered to be the most relevant for South Africa, particularly since South Africa is a signatory to both conventions:

- The United Nations Convention on Climate Change 1994 (UNFCCC) and its associated Kyoto protocol, 1997; and
- The Vienna Convention for the Protection of the Ozone Layer, 1985 and its associated Montreal protocol, 1990.

2.2 Overview of national policy and regulatory framework

A detailed overview of the national climate change policy and regulatory framework can be found in Part D of Appendix A.

2.2.1 National Climate Change Response Green Paper 2010

The National Climate Change Response Green Paper (2010) is the key policy document framing the South African response to the challenges of climate change. In terms of the Green Paper, South Africa will implement the following strategies in order to achieve its climate change response objective:

- Taking a balanced approach to both climate change mitigation and adaptation responses in terms of prioritisation, focus, action and resource allocation.
- Prioritising the development and maintenance of the science-policy interface and knowledge management and dissemination systems to ensure that climate change response decisions are informed by the best available information.
- The short-term prioritisation of adaptation interventions that address immediate threats to the health and well-being of South Africans including interventions in the water, agriculture and health sectors.
- The prioritisation of mitigation interventions that significantly contribute to a peak, plateau and decline emission trajectory where greenhouse gas emissions peak in 2020 to 2025 at 34% and 42% respectively below a business as usual baseline, plateau to 2035 and begin declining in absolute terms from 2036 onwards, in particular, interventions within the energy, transport and industrial sectors.
- The prioritisation of mitigation interventions that have potential positive job creation, poverty alleviation and/or general economic impacts. In particular, interventions that stimulate new industrial activities and those that improve the efficiency and competitive advantage of existing business and industry .In order to accurately identify these sectors and the job creation, industrial development potential of these, work will be done in order that the White Paper provides a clear understanding and prioritisation of these and their potential.
- Prioritising the development of knowledge generation and information management systems that increase our ability to measure and predict climate change and,

especially extreme weather events, floods, droughts and forest and veld fires, and their impacts on people and the environment.

- The mainstreaming of climate change response into all national, provincial and local planning regimes.
- The use of incentives and disincentives, including through regulation and the use of economic and fiscal measures to promote behaviour change that would support the transition to a low carbon society and economy.
- Acknowledging that, with the energy intensive nature of the South African economy, the mitigation of greenhouse gases is generally not going to be easy or cheap and that Government must support and facilitate the mitigation plans of, in particular, the energy, transport and industrial sectors.
- The recognition that sustainable development is also climate friendly development and that that; the more sustainable our development path is, the easier it will be to build resilience to climate change impacts.
- Recognise that measures taken by developed countries in their efforts to respond to climate change may have detrimental effects on high carbon and energy intensive economies such as South Africa. These response measures may include trade measures including border tax adjustments, and could be reflected in a reluctance to trade in goods with a high carbon footprint. South Africa's climate change strategy must recognise and address this and also create mechanisms that will give high carbon sectors the support and time to move to lower carbon forms of production.
- Recognise that South Africa's response to climate change will have major implications for both the Southern African region and for Africa as a whole and ensure that national responses are aligned to, support and operate as part of a broader regional response.

2.2.2 Other national policy

The following additional national policies are regarded as the most relevant in the context of climate change:

- White Paper on the Energy Policy of the Republic of South Africa, 1998, which promotes renewable energy and improvement of energy efficiency.
- A National Climate Change Response Strategy for South Africa, 2004 which sets certain strategic objectives, principles and proposals for addressing national priorities related to global climate change.
- Energy Efficiency Strategy of the Republic of South Africa, 2005, which sets a national target (not mandatory, only policy objective) for energy efficiency improvement of 12% by 2015 and provides for a number of "enabling instruments"
- White Paper on Renewable Energy, 2003, which lays the foundation for the widespread implementation of renewable energy and sets a target (not mandatory, only policy objective) of ten thousand gigawatt-hours of renewable energy contribution to final energy demand by 2013.
- Draft Policy Paper a Framework for Considering Market-based Instruments to Support Environmental Fiscal Reform in South Africa, 2006, which seeks to "explore how environmentally-related taxes and charges could assist in progressing towards the achievement of environmental goals and objectives and costs effective manner."
- The Long Term Mitigation Scenarios: Strategic Options for South Africa, 2007 (LTMS). The LTMS sets the pathway for South Africa long-term climate policy and will eventually inform a legislative, regulatory and fiscal package that will give effect to the policy package at a mandatory level. The overall goal is to "develop a plan of action which is economically risk-averse and internationally aligned to the world effort on climate change."

- The Government's vision and strategy for climate change, 2008. The Government's vision and strategy for climate change strives to set the overall framework to design the national policy for the transition to a climate resilient and low-carbon economy and society, ensuring that the mitigation and adaptation response are balanced. The climate response policy is built on six pillars which will be informed by what is required by science, namely to limit global temperature increase to 2°C above pre-industrial levels.
- The Climate Change Summit, March 2009. The Summit was intended to translate Cabinet's climate change policy decisions and directives (the Long Term Mitigation Strategy Scenarios described in the previous edition), into action. The main outcome of the Summit was the "National climate change response policy: Discussion Document" and the Conference Statement, "Towards an effective South African climate change response policy", dated 6 March 2009 which provides various guidance on the short, medium and long terms national regulatory and policy interventions to be implemented by the South African Government in the context of Climate Change.
- The South African position at international negotiation especially at COP 15 and 16.

In terms of the latest policy developments, the following national regulatory and policy interventions can be expected:

Long term (10 years or more)

(a) Laying the basis for a net zero-carbon electricity sector.

Short to medium term (5 - 10 years)

- (a) Ambitious and mandatory (as distinct from voluntary) targets for energy efficiency.
- (b) Each sector will be required to do work towards the determination of adequate actions and targets in relation to this overall framework.
- (c) Energy efficiency policies and strategies will be continuously reviewed and amended to reflect more ambitious national targets aligned with the LTMS.
- (d) Increasing carbon price through an escalating CO_2 tax, or an alternative market mechanism.
- (e) Diversification of the energy mix away from coal whilst shifting to cleaner coal.
- (f) Targets for electricity generated from both renewable and nuclear.
- (g) Renewable energy through feed-in tariffs.
- (h) Introducing industrial policy that favours sectors using less energy per unit of economic output and building domestic industries in these emerging sectors.
- (i) Setting ambitious and where appropriate mandatory national targets for the reduction of transport emissions, including through stringent and escalating fuel efficiency standards, facilitating passenger modal shifts towards public transport and the aggressive promotion of hybrids and electric vehicles."
- (j) Scaled-up of renewable energies and energy efficiency.
- (k) Energy efficiency standards for industrial equipment and processes.
- (I) Improved integrated energy planning.
- (m) Enhanced government coordination and policy alignment.
- (n) Fast-tracked implementation of the favourable tax treatment for carbon credits from Clean Development Mechanism projects.
- (o) Massively up-scaled public education, awareness, media and information on climate change.
- (p) Mobilisation of the resources required, including the significant investment in R&D for new technologies

(q) Exploring and developing carbon capture and storage (CCS) for coal fired power stations and all coal-to-liquid (CTL) plants, and not approving new coal fired power stations without carbon capture readiness.

Immediate priorities (0 -5 years)

- (a) Mandatory standards for energy efficiency, including standards for commercial and residential buildings, fuel efficiency standards, including the roll out, scaling up of solar water heaters and building of a local industry and finalising and implementing a renewable energy feed-in tariff at a level adequate to incentivise large-scale investment
- (b) Working for Energy and other initiatives to create green jobs in energy efficiency and renewable energy.
- (c) Working for Adaptation developing a green jobs programme to build climate resilience.
- (d) Ensure that the Industrial Policy Action Plan review includes promotion of green technologies to address both adaptation and mitigation.
- (e) Accelerate the development of the Risk and Vulnerability Atlas to inform adaptation responses and planning.
- (f) Developing the atlas of sites for carbon capture and storage (CCS) and establishing a CCS centre.
- (g) Finalise the Greenhouse Gas Inventory and the Second National Communications for submission to the UNFCCC.
- (h) Completion of the Treasury report on options to implement a price on carbon this year.
- (i) Developing regulations for mandatory emissions monitoring and reporting.
- (j) Convening by Government of a group to ramp up efforts on education, public awareness, media and public awareness sectors and stakeholders.

The abovementioned policy framework in terms of climate change and strategic direction "to grow with a carbon constraint" will have for a direct result to change the composition and structure of the world and national economy.

2.2.3 National legislation and regulatory framework

The following national legislation and regulations are relevant to the Provincial Climate Change Response.

2.2.3.1 The National Environmental Management Act 107 of 1998 (NEMA)

Currently it is not expressly prescribed that EIAs should address climate change related aspects and effects in terms of a proposed activity. However, considering the objectives of EIAs, read in conjunction with the environmental management principles prescribed by NEMA, climate change related concerns (adaptation and mitigation) should, and have been but not in a comprehensive and holistic manner, addressed in many proposed activities/developments.

2.2.3.2 The National Environmental Management: Air Quality Act 39 of 2004

The Act is identified in the Climate Change Response Strategy as DWEA's primary instrument in combating climate change and, as such, provides a framework for very effective future interventions in this regard. It remains to be seen whether such interventions will, indeed, be forthcoming or, if they are forthcoming, are made in time for them to contribute to resisting the climate change phenomenon. To achieve its objective, the Act provides for a number of regulatory mechanisms. Emissions trading is unlikely to be implemented in South Africa in the immediate future. Considering the latest policy statements made by DWEA regarding climate change, it is anticipated that regulations for the direct or indirect control and management of greenhouse gases emissions will be developed within the next 3 years.

2.2.3.3 The Energy Act, 2008

It is anticipated that the regulations under this Act will stimulate/require energy efficiency, energy conservation and the development of renewable energy.

2.2.3.4 The National Environmental Management: Integrated Coastal Management Act 24 of 2008 (NEM:ICMA)

NEM: ICMA recognised, indirectly, climate change related impacts (natural hazards and risks arising from dynamic coastal processes, including the risk of sea-level rise) on the coastal zone as a risk for people, property and economic activities on the coastal zone.

The Act prescribes various instruments which might be used to management adaptation measures on the coastal zone.

2.2.3.5 South Africa Renewable Energy Feed-in Tariff (REFIT), Regulatory Guidelines 26 March 2009

In terms of pending legislations, the following are considered as the ones with the most potential implications in terms of climate change:

- (a) Proposed EIA amendments, 2008 (potential implication in terms of climate change)
- (b) Draft regulations under section 12I of the Income Tax Act 58 of 1962, for public comment, 10 March 2009

2.3 Climate change opportunities

Section B of Appendix A notes that in the South African context, there are numerous opportunities related to climate change, especially regarding mitigation actions, which can be classified as follows:

- Create new stream of revenue from greenhouse gases reduction projects.
- Technology transfer and development.
- Access to foreign investment.
- Cost saving from increased energy efficiency and conservation.
- Poverty alleviation through income and employment generation associated with mitigation and development programmes".
- The Clean Development Mechanism (CDM) and the carbon market AND involvement in emissions trading (buying or selling carbon credit).
- Opportunities to develop new products, services or technologies.
- Carbon neutral activities or projects to offset emissions from parts of its operations by buying or acquiring carbon credits.
- Development of strategic partnerships with national and international partners.

3 CLIMATE CHANGE SCENARIOS AND IMPACTS

3.1 Background

The Conference of the Parties (COP) to the United Nations Climate Change Convention (UNFCCC) at its fifteen session (COP 15) in Copenhagen (December 2009), adopted a decision that took note of the Copenhagen Accord of 18 December 2009, which amongst other reaffirms the following:

- That climate change is one of the greatest challenges of our time;
- That there is an urgent need to combat climate change and to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system;
- That deep cuts in global emissions are required according to science as documented by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) (2007) with a view to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius (°C);
- That there should be global cooperation to achieve a peaking of global and national emissions as soon as possible;
- That bearing in mind that social and economic development and poverty eradication are the first and overriding priorities of developing countries (including Africa), that a low-emission development strategy is indispensable to sustainable development;
- That adaptation to the adverse effects of climate change and the potential impacts of response measures is a challenge faced by all countries;
- That enhanced action and international cooperation on adaptation is urgently required to reduce vulnerability and build resilience in developing countries; and
- That developed countries shall provide adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action in developing countries.

In addition, the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) (2007) states the following:

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level;
- Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004;
- There is very high confidence that the global average net effect of human activities since 1750 has been one of warming; and
- Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations.

3.2 Overview of the climate change phenomenon

Climate Change is defined by the UNFCCC as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability over comparable time periods".

Global warming is defined by the UNFCCC as "the increase in the Earth's temperature, in part due to emissions of greenhouse gases (GHG's) associated with human activities such as

burning fossil fuels, biomass burning, cement manufacture, cow and sheep rearing, deforestation and other land-use changes."

Figure 2 below shows diagrammatically the Greenhouse effect, while Figure 3 shows the apparent direct relationship between changes in the earth's temperature and CO_2 concentrations in the atmosphere.



Figure 2: Greenhouse effect (Source: United Nations Environmental Programme, 2009)



Figure 3: Greenhouse effect (Source: United Nations Environmental Programme, 2009)

Africa's contribution to concentrations of greenhouse gases in the atmosphere amounts to only 3.8% of the world's total. However, it is one of the most vulnerable continents to climate change impacts. In addition, South Africa is the 11th largest per capita contributor to greenhouse gas emissions of the world's total (Figure 4).



Figure 4: Emissions of CO₂ - selected countries (1995). Source UNEP - GRID Arendal.

Climate scientists see a real risk that the earth's climate will change rapidly and dramatically over the coming decades. However, no one is certain about the nature and severity of the future effects. In most scientific circles, the issue is no longer whether climate change is a potentially serious problem, but how the problem will develop, what its effects will be and how these effects can best be detected and effectively mitigated.

Climate change is likely to have pervasive affects. Furthermore, the far reaching impacts of climate change experienced in the foreseeable future will be felt in some way by every person and every organisation, public or private, and at all levels, from strategic management to operational activities for many years to come. The effects will impact across environmental issues, economic performance, social behaviour, infrastructure and other aspects of human existence. Changes are likely to develop gradually but could be also abrupt.

As discussed in more detail later in this report, the manifestations of climate change in South Africa are likely to include:

- Higher temperatures
- Altered rainfall patterns
- More frequent or intense extreme weather events such as heat-waves, droughts and storms.
- Rise in sea levels



Figure 5: Schematic framework of anthropogenic climate change drivers, impacts and responses (IPCC 2007)

3.3 Global climate change trends and scenarios

The primary source of information on climate change trends and future scenarios at a global scale is the IPCC Fourth Assessment Report on Climate Change (AR4) (IPCC 2007).

According to AR4, since the Third Assessment Report (TAR) there has been marked progress in understanding how climate is changing in space and time due to (IPCC 2007):

- Improvements and extensions of numerous datasets and data analyses,
- Broader geographical coverage, and
- Better understanding of uncertainties and a wider variety of measurements.

In addition, AR4 indicates that warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.

Summary of main findings of AR4

Current knowledge about observed impacts of climate change on the natural and human environment

• Observational evidence from all continents and most oceans shows that many

	natural systems are being affected by regional climate changes, particularly temperature increases.
•	A global assessment of data since 1970 has shown it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems.
•	Other effects of regional climate changes on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.
•	More specific information is now available across a wide range of systems and sectors concerning the nature of future impacts, including for some fields not covered in previous assessments.
Curre	nt knowledge about future impacts
•	More specific information is now available across the regions of the world concerning the nature of future impacts, including for some places not covered in previous assessments.
•	Magnitudes of impact can now be estimated more systematically for a range of possible increases in global average temperature.
•	Impacts due to altered frequencies and intensities of extreme weather, climate and sea-level events are very likely to change.
•	Some large-scale climate events have the potential to cause very large impacts, especially after the 21st century.
•	Impacts of climate change will vary regionally but, aggregated and discounted to the present, they are very likely to impose net annual costs which will increase over time as global temperatures increase.
Curre	nt knowledge about responding to climate change
•	Some adaptation is occurring now, to observed and projected future climate change, but on a limited basis.
•	Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions.
•	A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to future climate change. There are barriers, limits and costs, but these are not fully understood.
•	Vulnerability to climate change can be exacerbated by the presence of other stresses.
•	Future vulnerability depends not only on climate change but also on development pathway.
•	Sustainable development can reduce vulnerability to climate change, and climate change could impede nations' abilities to achieve sustainable development pathways.

- Many impacts can be avoided, reduced or delayed by mitigation.
- A portfolio of adaptation and mitigation measures can diminish the risks associated with climate change.

3.3.1 Some key observations of global climate change trends

Some key global observations include the following (IPCC 2007):

3.3.1.1 Temperature

- Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850).
- The 100-year linear trend (1906-2005) of 0.74°C is larger than the corresponding trend of 0.6°C (1901-2000) given in the Third Assessment Report (TAR) (Figure 6).
- The linear warming trend over the 50 years from 1956 to 2005 (0.13°C per decade) is nearly twice that for the 100 years from 1906 to 2005.
- Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3000m and that the ocean has been taking up over 80% of the heat being added to the climate system.

3.3.1.2 Sea level rise

- Increases in sea level are consistent with warming (Figure 6) where global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003 and at an average rate of about 3.1 mm per year from 1993 to 2003.
- Since 1993 thermal expansion of the oceans has contributed about 57% of the sum of the estimated individual contributions to the sea level rise, with decreases in glaciers and ice caps contributing about 28% and losses from the polar ice sheets contributing the remainder. From 1993 to 2003 the sum of these climate contributions is consistent within uncertainties with the total sea level rise that is directly observed.

3.3.1.3 Snow and ice cover

- Observed decreases in snow and ice extent are also consistent with warming (Figure 6).
- Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7% per decade, with larger decreases in summer of 7.4 % per decade.
- Mountain glaciers and snow cover on average have declined in both hemispheres.
- Temperatures at the top of the permafrost layer have generally increased since the 1980s in the Arctic by up to 3°C.



Figure 6: Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data; and (c) Northern Hemisphere snow cover for March-April. All differences are relative to corresponding averages for the period 1961-1990. Source: IPCC 2007

3.3.1.4 Rainfall

- Changing trends in precipitation amounts from 1900 to 2005 have been observed in many regions.
- Over this period, precipitation has declined in southern Africa.
- Globally, the area affected by drought has likely increased since the 1970s.

3.3.1.5 Extreme weather events

- Some extreme weather events have changed in frequency and/or intensity over the last 50 years:
- It is very likely that cold days, cold nights and frosts have become less frequent over most land areas, while hot days and hot nights have become more frequent.
- It is likely that heat waves have become more frequent over most land areas.
- It is likely that the frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) has increased over most areas.
- It is likely that the incidence of extreme high sea level has increased at a broad range of sites worldwide since 1975.
- There is observational evidence of an increase in intense tropical cyclone activity in the North Atlantic since about 1970, and suggestions of increased intense tropical cyclone

activity in some other regions where concerns over data quality are greater.

• Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years.

3.3.2 **Projections of future changes in global climatic conditions**

For the next two decades a warming of about 0.2°C per decade is projected for a range of emissions scenarios. Even if the concentrations of all GHGs and aerosols are kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected. Afterwards, temperature projections increasingly depend on specific emissions scenarios (Figure 7).

Since the IPCC's first report in 1990, assessed projections have suggested global averaged temperature increases between about 0.15 and 0.3°C per decade from 1990 to 2005. This can now be compared with observed values of about 0.2°C per decade, strengthening confidence in near-term projections.

According to the AR4, continued GHG emissions at or above current rates will cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.

Table 1 shows best estimates and likely ranges for global average surface air warming and global average sea level rise for the six emissions scenarios.

Table 1: Projected global average surface warming and sea level rise at the end of the 21st century (IPCC, 2007).

	Temperature change (°C at 2090-2099 relative to 1980-1999) ^{a, d}		Sea level rise (m at 2090-2099 relative to 1980-1999)	
Case	Best estimate	<i>Likel</i> y range	Model-based range excluding future rapid dynamical changes in ice flow	
Constant year 2000 concentrations ^b	0.6	0.3 - 0.9	Not available	
B1 scenario	1.8	1.1 - 2.9	0.18 - 0.38	
A1T scenario	2.4	1.4 - 3.8	0.20 - 0.45	
B2 scenario	2.4	1.4 - 3.8	0.20 - 0.43	
A1B scenario	2.8	1.7 - 4.4	0.21 - 0.48	
A2 scenario	3.4	2.0 - 5.4	0.23 - 0.51	
A1FI scenario	4.0	2.4 - 6.4	0.26 - 0.59	



Figure 7: Projected changes in global temperature to 2100 (Source: United Nations Environmental Programme, 2009)

3.3.3 Impacts on Africa

Boko *et al* (2007), in their contribution to AR4 entitled "Impacts, adaptation and vulnerability", the following impacts for Africa were noted:

- By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change.
- By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%.
- Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition.
- Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to 10% of GDP.
- By 2080, an increase of 5 to 8% of arid and semi-arid land in Africa is projected under a range of climate scenarios (high confidence).

3.3.4 Key scientific developments since the IPCC Fourth Assessment Report (June 2009)

Since the IPCC released AR4 in July 2006, various new information has been published that will be made before the next IPCC assessment, due in 2014. A brief overview of some key new findings is provided here (McMullen and Jabbour 2009).

The link between fossil fuel emissions and many aspects of climate change is increasingly clear.

AR4 concluded that greenhouse gas emissions from human activity are responsible for most of the increase in global average temperature with greater than 90 percent certainty. Numerous recent findings explicitly link other aspects of climate change to human activities:

- (a) Human-induced climate change is already affecting multiple systems, both physical (e.g., timing of seasonal lake freeze and thaw) and biological (e.g., seasonal timing of plant flowering and animal migration).
- (b) Changes in polar temperatures, both in the Arctic and Antarctic, have been attributed conclusively to human activity, with impacts on ecosystems, indigenous communities, ice sheet and ice shelf stability, and sea level rise.
- (c) Changes in global precipitation trends linked to human induced global warming are larger than model predictions and may already be impacting ecosystems, agriculture, and human health in certain regions.
- (d) Satellites show an increase in total atmospheric moisture content over the oceans since 1998, and this has been attributed to anthropogenic emissions of greenhouse gases, as opposed to natural causes or internal variability.

A better understanding of the behaviour of large ice sheets combined with observations of rapid melting have raised projections of 21st-century global sea level rise.

New estimates of average global sea level rise of 2 metres or more by 2100 are significantly larger than in the AR4, as shown in Figure 8. The AR4 projected an average sea level rise of 0.18 to 0.59 meters (see Table 1) by the end of the 21st century. This estimate was driven mostly by the thermal expansion of the oceans as the water warms. However, due to an inability to model how ice moves in large, land-based ice sheets (i.e., the Greenland and Antarctic ice sheets), the IPCC did "not assess the likelihood, nor provide a best estimate or an upper bound for sea level rise". The upper end of the AR4 projection should not, therefore, be interpreted as an upper limit; in fact, it likely underestimates future sea level rise.



Figure 8: Comparison of recent estimates of mean sea level rise in 2100, relative to 1990 levels.

The impacts of climate change may persist for more than 1000 years, even after humaninduced emissions of CO_2 stop completely. New studies find that warmer temperatures and changes in precipitation caused by emissions from human activity are largely irreversible. Atmospheric temperatures are not expected to decrease for many centuries to millennia, even after human-induced greenhouse gas emissions stop completely. In addition to long-term increases in temperature, climate models also suggest that a peak in CO_2 levels between 450 and 600 ppm produces irreversible rainfall reductions in many parts of the world. For example, a 15-20 percent reduction in rainfall in the south-western United States is predicted—a larger decrease than the "Dust Bowl" of the 1930s. In the models, these changes persist for more than 1000 years for two reasons:

- The long lifetime of CO₂ in the atmosphere some 25 percent of it may remain in the atmosphere for more than 5000 years.
- The long period of time required for the transfer of heat between the oceans and the atmosphere. The uptake of heat by the oceans is expected to be slow, causing atmospheric temperatures to remain elevated for thousands of years.

Unmitigated CO_2 emissions will likely generate greater warming than previously estimated. Recent observations reveal that CO_2 emissions from human activities grew faster over the past decade than the IPCC previously expected.

Some other key research findings include:

- (a) Ocean acidification severely threatens marine ecosystems and fisheries.
- (b) Surface melting of the Greenland Ice Sheet is accelerating.
- (c) Antarctic ice shelves are collapsing more rapidly than expected.
- (d) Improved analysis suggests that Antarctica is warming.
- (e) Arctic sea ice is melting more quickly than projected.
- (f) Permafrost is thawing more quickly than previously thought.

In summary the majority of the new scientific insights since AR4, as described above, are based entirely or partially on direct observations of climate change. Sea level is rising, global ice cover is diminishing, and biological systems are responding to climate change.

In general, observed climate change is proceeding at a more rapid pace than anticipated by previous estimates or model projections. Recent revisions of projected changes are higher than earlier estimates and the IPCC projections published in 2007 now appear rather conservative in light of more recent observations and improved modelling techniques.

3.4 Climate Change in South Africa and the Eastern Cape

Information on local South African climate change trends and scenarios has been obtained from the following main sources:

- A report generated by the Climate Systems Analysis Group (CSAG) for DEDEA entitled "Climate Change Projections and Impacts for the Eastern Cape region of South Africa" (Johnston *et al*, 2011).
- A Status Quo, Vulnerability and Adaptation Assessment of the Physical and Socio-Economic Effects of Climate Change in the Western Cape (Midgley *et al*, 2005);
- Framework for Adaptation to Climate Change in the City of Cape Town (Mukheibir and Ziervogel, 2006);
- A climate change strategy and action plan for the Western Cape (DEAD&P, 2008);
- A Sea-Level Rise Risk Assessment for the City of Cape Town (Cartwright, 2008); and
- Climatic Future for Durban (Shamini *et al*, 2006).

The following sections highlight some of the main outcomes from these studies.

3.4.1 Some key observations of local climate change trends

3.4.1.1 Temperature

Surface air temperature is certain to continue to increase by between 1°C and 3°C across the country over the next three to five decades at least, with the greatest increases towards the interior, and strongest trends in the daily minimum (Midgley *et al* 2007). The Eastern Cape is expected to experience highest temperature increases towards the north-west interior, while lowest increases are likely along the coast (Figure 9). Associated with the higher temperature will be increases in evaporation rates and increased intensity of droughts.



Figure 9: Projected median change in maximum surface temperature by 2050 (Source: Midgley *et al* 20007).

Durban

While current data for Durban (Shamini *et al*, 2006) indicates that daily maximum temperatures range from 20-26°C, based on the IPCC globally used 2070-2100 scenario (described above), Durban is likely to experience an increase in monthly maximum temperatures of about 2-3°C.

In addition to increased temperature averages, it is expected that during the months of in January and February, Durban will experience 5 to 6 times more days with temperatures greater than 30°C and 12-14 times more days with temperatures greater than 30 °C in March, October and November. In addition to the above, Durban is likely to experience 11 times more consecutive days of temperatures exceeding 25°C.

These projections are very significant as it implies that incidences of heat stress will increase together with evaporation rates. If rainfall decreases, it is likely that water availability will be an issue.

Cape Town

Based on data collected between 1967 and 2000 for Cape Town (DEAD&P, 2008), it is apparent that very warm days have become warmer or have occurred more regularly during the last decade, particularly during January, April and August. Mean annual Temp min and Temp max over the same time period showed significant warming trends at most stations.

In terms of future trends, temperatures in Cape Town are expected to rise everywhere, least on the coast and more as one moves inland. Typical ranges of increase to be expected by 2050 are \sim 1.5°C on the coast, and 2-3°C inland of the coastal mountains.

Eastern Cape:

Based on work undertaken by the Climate Systems Analysis Group at the University of Cape Town, downscaled projections of monthly mean temperature for the Eastern Cape show a significant change in the median monthly maximum temperatures into the future. The annual mean is projected to increase by $\sim 2^{\circ}$ C in the near-future under the A2 SRES emissions scenario and this increase is echoed in the figures with temperature increases of between 1.5°C and 2.5 °C visible at all the stations.

The stations near the coast display a smaller expected increase of around 2 °C, while the two furthest inland, Aliwal North and Middelburg show expected increases of around 2.5 °C. The maximum temperature increases appear to be marginally lower than the mean monthly minimum temperatures increases. For more information see Johnston *et al*, 2011.

3.4.1.2 Rainfall

Scenarios of regional climate change in South Africa remain uncertain, particularly with regard to rainfall projections. However, current downscaling models show a wetting trend to the east and northeast of the country and a drying trend to the south and particularly the south west. In the Eastern Cape a mirror pattern is expected where a wetting trend is expected eastwards. Figure 10 indicates projections for South Africa. In addition to increases in mean annual rainfall, it is projected that the durations of droughts will increase while the intensity of rainfall may increase (Midgley *et al* 2007).





Figure 10: Projected change in total annual rainfall (mm month-1) for July and December (mid century) (Source, Midgley *et al* 2007).

In addition, existing rainfall data also indicates that rainfall seasonal patterns in South Africa are changing, where for the months of December through to February (summer rainfall), most of the country is getting drier which will have impacts on run-off generation and reservoir storage capacity. Conversely, for the months of September to November (spring rainfall), most of the country is getting wetter (Shamini *et al*, 2006).

Durban

Similar to global trends in rainfall variability it is projected that Durban will experience an increase in rainfall events greater than 10mm and 25mm for the period 2070-2100 (Shamini *et al*, 2006). Although projections suggest that average rainfall may not deviate much from present rainfall conditions, the distribution of rainfall is likely to change where it is projected that the number of days without rain will increase and when rainfall events occur they will be heavier than current conditions.

Overall, decreases in rainfall coupled with increases in temperature and evaporation rates are likely to result in less water available for industrial and human consumption, thus placing additional pressures on Durban's already stressed water resources.

Cape Town

In general, over the years, mountainous regions inn Cape Town have shown increased precipitation (DEAD&P, 2008), while lowland regions have show decreased precipitation trends, which are consistent with the understanding of the rainfall processes, namely, increased moist atmosphere (resulting from a warmer world).

Future trends: Two general trends are projected:

- An increase in total rainfall over the eastern regions of the Western Cape during late summer (January to March) and
- A decrease in rainfall, particularly over the western regions of the Western Cape, during early winter (April to June).

As changes in the climate begin to accelerate (as they are predicted to do) the projections will become more apparent for the long term.

Eastern Cape

The future projections for precipitation generally indicate stable or slightly increasing precipitation, with increasing intensity. Increased precipitation is more likely to the east of the province. Figure 11 illustrates downscaled projections in gridded format.



Figure 11: Downscaled seasonal rainfall anomalies for the Eastern Cape:2046-2065 compared with the 1961-2000 period. From left seasons DJF, MAM, JJA, and SON. Variation from top, wettest 10%, median and driest 10%. Source: Johnston *et al*, 2011.

3.4.1.3 Sea-level rise

Although little research has been conducted for sea-level rise impacts on the Eastern Cape, useful information exists for the City of Cape Town and Durban.

Cape Town

A series of four reports under the Global Climate Change and Adaptation: A Sea-Level Rise Risk Assessment (2008), provides a comprehensive assessment of sea level rise and associated risks for the City of Cape Town (Naidu *et al*, 2006)

The study assesses the risks associated with sea level rise under three broad scenarios summarised below:

	Description	Sea level rise	Impact	Probability
Scenario	Present Day very	2m in sheltered environments,	About 25 km2 covered by	95% chance in
1	Worst Scenario	4.5m in exposed environments, and	the sea (1% of Cape	next 25 years
		6.5m in very exposed environments	time.	
Scenario	Scenario at the End	Same as above but with shorter	About 60 km2 covered by	85% chance in
2	of the Next Decade	return periods	sea (2% of total Metro) for	next 25 years
		Expected whenever an extreme	a short period.	
		storm occurs at same time as		
		Equinox spring high tide		
Scenario	Polar Ice Sheet	6.5 metre sea-level rise linked to the	Permanent inundation of	20% chance in
3	Melt Scenario	melting of the Greenland and West	about 95 km2 of land	next 25 years
		Antarctic ice shelves, and involving	around the Cape coastline	
		permanent inundation	(4% of Metro)	
		Excludes impacts of tidal surges and		
		storms		

Table 2: Sea level rise scenarios for the City of Cape Town

Also of interest from the Cape Town study is that ice melting will accelerate with a global average warming in excess of 2°C and further contribute to accelerated sea level rise. The complete elimination of the Greenland Ice Sheet will eventually lead to a contribution to sea level rise of 7m. These temperatures correspond to those of the last inter-glacial of 125,000 years ago, when sea level was 4 to 6 m higher than present levels. Around the Cape Peninsula the sea level at this time is reasonably well marked as the 18 foot wave cut platform.

Durban

The eThekwini Municipality report (Shamini *et al*, 2006) also provides a comprehensive assessment of projected sea level rise in Durban area, which included the determination of 1 in 100 year setback lines.

The Durban study uses IPCC scenarios of about 0.5 to 1.0 metre sea level rise as a starting point and taking into consideration:

- Tidal reference level (Datum)
- Tides and sea-level rise
- Wave action
- Wind and atmospheric pressure

Adding all of these set-up effects and adjusting for the probability of contributing events occurring simultaneously, probable maximum seawater levels of about 2.4 m and 2.8 m MSL are predicted.

It is important to point out that these new lines do not take account various factors i.e.:

• the increase in 1-in-50 year to 1-in-100 year maximum in natural short-term (hours to weeks) shoreline variability, which is caused by storm waves and surges;

- the increase in 1-in-50 year to 1-in-100 year progressive shoreline retreat where this phenomenon is occurring (some areas are at present already experiencing ongoing long-term coastal erosion); and
- The increase in duration and magnitude of sea storms due to climate change (or any other such impacts, other than just sea-level rise).

It is also worth noting that the recent City of Cape Town study on sea level rise (see above), indicated that the observed sea level rise in KwaZulu Natal during the storms of March 2007, amounted about 1.9 metres, of which storm surge contributed 0.55 metres.

Eastern Cape:

It can be anticipated that the Eastern Cape may be prone to similar sea level rise impacts as Durban and Cape Town.

4 EASTERN CAPE PROVINCE DEVELOPMENT PRIORITIES

In order to assess the potential impacts of climate change and appropriate responses in the Eastern Cape, it is important to understand the local context. More specifically, it is important to understand how current development priorities for the Province will be affected. It is also important to understand the focus areas of the social and economic systems, and to what extent they are vulnerable to climate change. This section focuses on the implications of climate change on social and economic development in the Eastern Cape. These include:

- Provincial Growth and Development Plan (PGDP)
- Provincial Industrial Development Strategy (PIDS)
- Programmes under the PGDP

The above development plans are intended to guide economic and social development. However, these programmes need to be reviewed in light of the implications of climate change. It should also be appreciated that the successful outcomes of these plans should, in general, increase the resilience of the Province to climate change.

4.1 **Provincial Growth and Development Plan (PGDP)**

The Eastern Cape Provincial Growth and Development Plan (PGDP) is the Eastern Cape's official economic development roadmap designed to deliver growth, employment and reduce the levels of poverty in the Eastern Cape. The PGDP provides the strategic framework, sectoral strategies and programmes aimed at a rapid improvement in the quality of life for the poorest people of the Province. To do this, the PGDP sets out a vision with quantified and sequenced targets in the areas of economic growth, employment creation, poverty eradication and income redistribution for the 10-year period 2004-2014.

4.1.1 PGDP strategy framework

The strategy framework for growth and development is expressed in terms of six strategic objectives, which are divided into three key objectives and three foundation objectives.

4.1.1.1 The three key objectives are:

- Systematic eradication of poverty through a holistic, integrated and multi-dimensional approach to pro-poor programming.
- Agrarian transformation and strengthening of household food security.
- Consolidation, development and diversification of the manufacturing base and tourism potential.

4.1.1.2 These key objectives are supported by three foundation objectives:

- Infrastructure development.
- Human resource development.
- Public sector and institutional transformation.

4.1.2 PGDP targets

At a more detailed level, the following quantified targets for growth and development in the Eastern Cape for the period 2004-2014, with 2003 as the base year, have been developed:

- To maintain an economic growth rate of between 5% and 8% per annum.
- To halve the unemployment rate by 2014.

- To reduce by between 60% and 80% the number of households living below the poverty line 2014.
- To reduce by between 60% and 80% the proportion of people suffering from hunger by 2014.
- To establish food self-sufficiency in the Province by 2014.
- To ensure universal primary education (UPE) by 2014, with all children proceeding to the first exit point in a secondary education.
- To improve the literacy rate in the Province by 50% by 2014.
- To eliminate gender disparity in education and employment by 2014.
- To reduce by two-thirds the under-five mortality rate by 2014.
- To reduce by three-quarters the maternal mortality rate by 2014.
- To halt and begin to reverse the spread of HIV/AIDS by 2014.
- To halt and begin to reverse the spread of tuberculosis by 2014.
- To provide clean water to all in the Province by 2014.
- To eliminate sanitation problems by 2014.

4.1.3 Strategic objectives

The following describes in more detail the approach to achieving the PGDP strategic objectives.

4.1.3.1 Systematic Poverty Eradication through a Holistic, Integrated and Multi-Dimensional approach to Pro-Poor Programming

The strategic approach to poverty eradication must address all these dimensions of poverty. They are summarised under the following seven platforms:

- Facilitating access to good quality employment and economic opportunities.
- Increasing the physical asset base of the poor;
- Facilitating access to basic services.
- Strengthening community management and organisation of own initiatives and external programmes.
- Enhancing democratic participation by the poor.
- Ensuring access of the poor to legal entitlements and security.
- Ensuring access to safety nets to strengthen ability to manage shocks and stresses.

4.1.3.2 Agrarian Transformation and Strengthening Household Food Security

- Establishing household food security through the promotion of small-scale farming entrepreneurs and support on a massive scale will be given to the development of homestead agricultural production.
- Promote the effective use of land to improve the livelihoods of the poor.
- Promote the expansion of commercial agricultural enterprises, especially in the former homelands.

4.1.3.3 Consolidation, Development and Diversification of the Manufacturing Base and Tourism Potential

Industrial strategy will need to include:

- Industrial planning to develop a growth strategy in each sub-sector with the Provincial social partners.
- Research to identify the highest potential areas for investment.
- The development of research partnerships for technology development, including Provincial higher education institutions.
- Promotion of skills development through the relevant Sector Education and Training Authorities (SETAs).

The Provincial strategy for industrial development must also build linkages between the modern export-led sector and other industries. This is especially important in the case of the new IDZs, which must be used as opportunities to boost growth in Provincial industry through supply linkages.

The development of the Provincial tourism potential should optimise benefits to host communities and through community-based forms of tourism. Linkages between tourism and agriculture activities in rural areas are critical.

4.1.3.4 Infrastructure Development

Infrastructure development is a foundational objective in the Eastern Cape due to its key role in social development, especially the eradication of social backlogs, and its role in leveraging economic development.

Investing in social infrastructure, especially in the former homelands should include

- Rural access roads
- School and clinic construction
- Water and sanitation need.

Investing in economic infrastructure to unlock growth: While good roads and communications infrastructure exist in and between the major towns, there are gaps in the network. Emphasis will be placed on:

- Major road links
- Rail links
- Airports
- Seaports
- Electricity

4.1.4 Human Resource Development

To align with the objective of the national strategy for the achievement of rising skill levels which promote economic and employment growth and social development. Specific objectives are:

- To improve the skills profile of the population through accredited high-quality education and training.
- To increase the quality and quantity of intermediate-level skills in the country.
- To improve social and infrastructure delivery by increasing skills.
- To raise the quality, relevance and cost-effectiveness of skills development throughout the country.

4.1.5 Public Sector and Institutional Transformation

The strategic approach will be focused on the harnessing of skills and resources in support of local priorities as articulated through the integrated development planning process. This will require:

- Effective coordination of Provincial and national programmes within the boundaries of District Municipalities.
- Improved coordination of planning and budgeting.
- Predictability and targeting of fiscal flows from agencies within the national and Provincial spheres of government.
- Strong support to capacity development through skills training and the deployment of Provincial staff to Local Government.
- Development of the structures and systems for the effective functioning of participatory democracy within the local sphere.
- Effective mobilisation of all social partners in support of the formulation and implementation of the IDPs.

Provincial and National Government should increasingly focus planning and programme implementation around the priorities of Municipalities, while maintaining clear visions of broader Provincial and national priorities.

Finally, the participatory planning process should be institutionalised as part of PGDP implementation to ensure that all social partners continue to participate and are mobilised in support of the PGDP as well as the monitoring of its outcomes.

Relevance of climate change to PGDP

- Initiatives and programmes reflected in the PGDP, need to take into consideration risks and impacts and limitations imposed by climate change, such as: increased temperatures, changes in precipitation levels, increased storm events, tidal surges and sea-level rise, etc., and consider <u>adaptation</u> measures.
- Infrastructure development needs to take into account the impact of changing variables such as higher return periods for flooding and droughts, more extreme weather events, and sea level rise. Infrastructure development should pay close attention to geographic areas at highest risk such as flood –prone areas and areas close to sea-level.
- The PGDP needs to take into consideration the growing need for climate change <u>mitigation</u> and renewable energy projects both locally and globally and the growing <u>green economy</u> as development direction and economic opportunity.
- The PGDP needs to consider co-funding opportunities through mechanisms such as trading of Carbon Credits and Climate Change Adaptation Funds.
- It should be emphasised that the successful outcomes of the PGDP, particularly in regard to poverty alleviation and food security, will increase the resilience of vulnerable communities to climate change.

4.2 **Provincial Industrial Development Strategy (PIDS)**

The Provincial Industrial Development Strategy (PIDS) was published in March 2010 and is closely linked to and builds on the strategic objectives relating to manufacturing diversification and tourism development within the PGDP.

The PIDS vision is as follows: "A state-led industrialisation path towards a robust, resilient and sustainable industrial base by 2025."

To summarise, the PIDS is best captured in the framework presented below:



The strategy emphasises the need for synergy and linkages between PIDS, the PGDP and a host of other support strategies for industrialisation such as Local and Regional Economic Development Strategy, SMME Strategy, Tourism Master Plan, Rural Development Strategy and the Cooperatives Strategy.

4.2.1 Strategic Framework for Industrial Development

Three main strategic imperatives and goals are identified that encapsulate the principal challenges that must be addressed through the PIDS:

- **Economic Growth:** Increasing economic growth through strengthening of existing sectors and investment into new high potential industrial sectors, coupled with state investment in infrastructure.
- **Labour Absorption:** Improved labour absorption through skills development, especially for the youth, and through spatial spread of sectors, especially manufacturing industry.
- Job Retention: The net retention of existing jobs through the development of sectoral industrial policies and strategies and through the utilization of bridging and retraining strategies in declining industries.

In order to realise growth objectives, protect current jobs and create new ones, the strategic framework prioritises five thematic areas, under the umbrella of strategic objectives. These are the following:

• **Stabilisation** of vulnerable and declining sectors as a result of the economic crisis and deindustrialisation.

- Protection safeguard productive capacity of existing industries and retain current jobs.
- **Diversification** deliberate efforts geared towards spreading employment and investment over a wide range of industrial activities.
- **Expansion** increase the productive capacity of the province by investing in enabling infrastructure and innovation capabilities.
- **Transformation** broadening the ownership of capital and assets; income distribution; and spatial distribution of industrial activity based on regional competitive and comparative advantages.

4.2.2 **Priority Sectors**

In terms of the PIDS specific priority sectors are targeted for industrial development in order to transform industrial structure. These sectors have been selected on:

- The basis to which they contribute to national and provincial development goals;
- The extent to which they create/protect jobs;
- The extent to which they enable industrial diversification into non-commodity tradable sectors;
- The extent to which they enable value-added linkages within and across sectors; and
- The extent to which they hold out direct benefits for BBBEE, co-operatives, SMMEs and enhance regional and local comparative and competitive advantages.

These priority sectors are reflected below:



4.2.3 Critical Success Factors

The PIDS emphasises a central coordinating role to be played by provincial government in ensuring that an enabling support environment is created. This role is defined around the following critical success factors:

- Research and development (R&D) and innovation;
- Training and skills development;
- Infrastructure and logistics;

- Industrial finance;
- Investment, trade and export promotion; and
- Institutional development.

4.2.4 High Level Interventions

The PIDS framework narrows down to three high level intervention areas over the short, medium, and long term. These are:

- Crisis support and socio-economic stabilisation
- Building a coherent economic development support environment
- Economic transformation and revitalisation

In the short term, the strategy must begin by addressing the consequences of the global economic crisis and the de-industrialising tendencies which threaten the long term industrial future of the Province. At the same time the strategy must ensure that provincial government and its entities are appropriately structured, skilled, enabled and resourced to deliver on the strategy as outlined below. This will entail ensuring that the province takes advantage of the **emerging green industries**, that it plans and implements priority sector plans and that it begins to put the building blocks in place to create a resilient and innovative economy that is able to stake its claim in the longer term capital goods sector.

4.2.5 Conclusions

In conclusion, the PIDS framework for industrialisation in the Eastern Cape outlines the Province's broad approach to transform the structure and distribution of industrial activity to meet particular economic, social, environmental and political objectives. This approach has taken account of national policy direction and the confines of legislated areas of Provincial competence in industrial development.

The PIDS identifies the next critical steps as the following:

- Development of a three-year PIDS Implementation and Action Plan that details resource impactions; institutional implications, and target setting.
- The Implementation Plan will include Priority Industry Action Plans, which should emerge from a process of engagement with all key role-players in respective sectors, and should reflect concrete outputs that will unlock opportunities and address identified constraints.
- Importantly, the Action Plans should contain details on the industry co-ordination and implementation modalities, and accountability mechanisms both to Provincial Government and other industry role-players.
- Institutional arrangements as proposed in this document also require further refinement in line with the IGR framework. Careful consideration must also be given to enhancing platforms for engagement with critical stakeholders outside the public sector.

The PIDS is also clear in stating that new capabilities will have to be urgently developed within provincial government, and the lead Department for industrial development in particular, i.e. DEDEA to ensure effective coordination and support of implementation activities, as well as and monitoring and evaluation.

Relevance of climate change to the PIDS

 Industrial development initiatives and programmes reflected in the PIDS, need to take into consideration risks and impacts and limitations imposed by climate change, such as: increased temperatures, changes in precipitation levels, increased storm events, tidal surges and sea-level rise, etc., and consider adaptation measures.

- The PIDs needs to take into consideration future restrictions on greenhouse gas emissions together with carbon taxes that will probably be imposed on industry.
 - The PIDS needs to take into consideration the growing need for climate change <u>mitigation</u> and renewable energy projects both locally and globally and the growing <u>green economy</u> as development direction and economic opportunity.
- The PIDS needs to consider co-funding opportunities through mechanisms such as trading of Carbon Credits, etc.

4.3 PGDP IMPLEMENTING AGENCIES

4.3.1 Accelerated and shared growth Initiative of South Africa (AsgiSA)

Accelerated and shared growth Initiative of South Africa (AsgiSA) Eastern Cape was launched in May 2007 and is a South African government initiative which assists the provincial government in accelerating growth and development in the eastern part of the Eastern Cape, also known as the former Transkei, and forms part of the PGDP.

The organization visualizes "a vibrant and sustainable rural economy that improves livelihoods and unlocks the dormant potential of the land and the people of the Eastern Cape".

AsgiSA Mission

"Through partnerships, high level and focused integration and coordination, AsgiSA Eastern Cape plays a direct and catalytic role in building a sustainable and modern, rural-based economy, primarily through agrarian reform".

The diagram below depicts the proposed AsgiSA – EC strategic focus and paradigm.



The development mandate that has led to the establishment of AsgiSA-EC rests on six pillars, namely:

- Agriculture and agro-processing
- Forestry Development
- Water resources development
- Hydro-power and alternative energy
- Tourism Development
- Addressing unsustainable human settlement

4.3.2 Rural Development and Agrarian Transformation Strategy (Draft 2009)

The Rural Development and Agrarian Transformation Strategy (Draft 2009) (RDATS) defines the rural agenda for the Eastern Cape, and sets down a series of objectives and attendant programmes. The strategy also outlines the necessary enabling environment for rural development, namely issues of institutions, policies and practices that can enable rural development. The strategy also suggests a number of institutional and funding mechanisms for successful implementation.

4.3.2.1 Pillars of the Strategy

The goals and objectives of RDATS will be underpinned by six strategic pillars. The pillars and priority areas of the strategy is illustrated in the table below.

4.3.3 Massive Food Production Programme

The Massive Food Production Program is a rural economic development initiative that targets grain food production through subsidising input supplies, mechanisation, marketing and agroprocessing by means of a conditional grant scheme.

Objectives

- Food security commercial field crop production to address local and provincial food needs.
- Poverty alleviation and rural economic development through the establishment of competent and economically sustainable crop farmers.
- Conservation Cropping Practices progressively establish the general use of conservation field cropping practices that optimise the sustainable and profitable use of arable areas including the practice of minimum tillage.

Land reform Restitution	Agrarian transformation and food security	Non-farm rural economy Agro-processing Local agro-industrial beneficiation Forestry New and re- afforestation Processing Marine and aqua-culture Inland fishing	Infrastructure Transport Rural transport programme Road networks Rail	Social protection Education Access and quality Social security Social grants Poverty reduction ("War-on-Poverty) Health Access and quality Human settlement
Betterment redress Fast tracking outstanding claims Redistribution	Food security Household			
Proactive Land Acquisition ABP	Agricultural production			
Expropriation Tenure reform Securing tenure rights in communal areas Securing rights of farm workers and dwellers Land use Regulation and decision	Household Small scale Commercial Marketing and distribution State markets	Investment promotion CPPP Tourism Eco- and agro tourism Branding LED and small scale industry	Bulk Infrastructure Water Sanitation Energy Energy generation Electricity distribution	Human settlement Free basic services Access HIV/AIDS Education, Prevention Treatment Social and cultural amenities
making Institutional mechanisms Coordination Fast tracking	Logistics Transport Regulation	Cultural industries Petty commodity Other Industries e.g. Mining	ICT Connectivity Telecoms Thusong centres	Infrastructure Mobile services Rural Safety and Policing

4.3.4 Eastern Cape Socio-Economic Consultative Council (ECSECC)

Eastern Cape Socio-Economic Consultative Council (ECSECC) is a Schedule 3 Public Entity established in 1996 as a formal Consultative Council comprising the social partners of Government, organised business, organised labour, the higher education sector and NGO s in the Province of the Eastern Cape. ECSECC was established to assist Provincial Government accelerate the pace of socio-economic transformation, and address the principal challenges of unemployment, inequality and poverty in the Province.

Over the past few years ECSECC has been instrumental in developing the Provincial Growth and Development Plan (PGDP), which is the blueprint for eradicating poverty and growing the economy over the next 8 years. By 2014 we aim to have achieved an average annual growth rate of between 5%-8%; halved poverty and unemployment, and achieved a number of other human development targets aligned to the Millennium Development Goals.

Much of ECSE CC's work over the past year has revolved around three programmatic areas:

- Facilitating sector strategies, such as the Skills Development Plan and the Industrial Development Strategy, which aim to strengthen the PGDP;
- Aligning the plans and budgets of Government around PGDP priorities through, for example, reviewing IDPs and the sector plans of Provincial Government departments; and
- Mobilising and co-ordinating the work of our stakeholders and facilitating active development partnerships through, for example, the Provincial Jobs Summit, in which all social partners have agreed to work together to implement programmes to rid the Province of unemployment and poverty.

Programmes

- Policy, Research & Information Unit
- Social mobilisation
- Joint Initiative for Priority Skills Acquisition (JIPSA)

4.3.5 Eastern Cape Development Corporation (ECDC)

Eastern Cape Development Corporation (ECDC) is the official economic development and investment agency for the Eastern Cape Province and is wholly-owned by the Eastern Cape Government.

The aims of the ECDC are to:

- Attract new investors and position the Eastern Cape as the investment target of choice
- Stimulate exports
- Facilitate economic development
- Derive value from our assets, including our large property portfolio
- Build existing businesses
- Facilitate start-up businesses

The work of the ECDC is closely aligned with the strategic intent of the Provincial Growth and Development Plan (PGDP).

4.3.5.1 Sectors and Industries

- Agriculture
- Aquaculture and Fisheries
- Minerals
- Automotives and Components
- Textiles and Clothing
- Pharmaceuticals
- Arts and Crafts
- Tourism
- Business Process Outsourcing
- Construction
- General Manufacturing
- Renewable Energy

Relevance of climate change to the PGDP implementing agencies

- Implementing agencies need to factor climate change risks into implementation programmes and initiatives.
- Implementing agencies need to explore economic opportunities relating to climate change mitigation projects.
5 RISK AND VULNERABILITY ASSESSMENT OF SECTORS AND RESOURCES

5.1 Impacts identified in other studies in South Africa.

Numerous Climate Change studies have been undertaken for other regions and cities in South Africa. It is useful to review the impacts identified in these studies as a context to the Eastern Cape Climate Change Response Strategy. In the following section, impacts identified for the eThekwini Municipality and City of Cape Town are considered. It should be remembered that these are only a sample of potential impacts for illustrative purposes, and should not be considered as a complete list.

5.1.1 Durban

The eThekwini Municipality climate change report (Shamini *et al*, 2006) highlights the potential impacts of temperature and rainfall variability in the Durban area. Some of these are described briefly below:

- Water availability
 - For the period 2070 to 2100, there will be a reduction in yearly water flow of approximately 158 million cubic metres, which is equivalent to the size of the Midmar Dam
- Agriculture
 - While increased temperatures may cause an increase in agricultural production, water availability could become a limiting factor, requiring increased irrigation.
 - Small scale agriculture is likely to be the most impacted due to reduced water availability.
- Biodiversity
 - Increased temperatures and variable rainfall is likely to result in species migrations and extinctions of certain plant and animal species and biodiversity hotspots.
 - Invasive species are expected to increase their ranges of distribution.
- Flooding and storm events
 - The combination of increased temperatures and changes in rainfall distribution, it is likely that flooding and storm events will increase and will impact on human settlements, infrastructure, human health and place a greater burden on particularly impoverished communities.
 - Increased temperatures will also lead to increased sea surface temperatures which could possibly lead to greater storm surges, destroying infrastructure, affecting human life and marine ecosystems.
- Human health
 - Increased temperature, precipitation and flooding will facilitate the breeding of malaria vectors which will support malaria epidemics. Recent studies project that the area of South Africa potentially prone to malaria will almost double by 2050. In terms of Durban, which is currently a malaria risk area, it is likely that increases in malaria will occur in spite of the implementation of malaria preventative measures.
 - Cholera also has the potential to increase due to water shortages which encourage unhygienic practices. Similarly, increased flooding is likely to cause

contamination of water supplies resulting in an increase in the outbreaks of disease.

5.1.2 Cape Town

The City of Cape Town climate change report (DEAD&P, 2008), identifies the following climate change impacts and vulnerabilities for the City:

5.1.2.1 Urban water Supplies

- The Greater Cape Town area has been identified as the first major urban region in South Africa where the demand for water will exceed the total potential yield for the area if growth scenarios are realised or the impact of projected climate change manifests itself.
- The Western Cape has recently experienced a drought, which can be attributed to climate variability. Climate variability is expected to alter the present hydrological resources in Southern Africa and add pressure on the adaptability of future water resources, including Cape Town.

5.1.2.2 Storm water

- In March 2003 and April 2005 the city experienced damaging floods due to cut-off lows, which cause heavy rainfall in a short period of time and gale force winds. The extent of the damage for the Western Cape Province during this period exceeded R260 million.
- The intensity of rainfall in the Western Cape can be expected to change due to climate variability. An increase in the number of extreme events will cause substantial increases in the cost of losses to the public and private sectors, as well as increasing personal hardship for the people directly affected.

5.1.2.3 Biodiversity

- The impact of climate change manifested by a warmer and dryer climate will be a contraction of fynbos, which is a bio-diverse hotspot.
- Estuaries, which need fresh water for flushing and maintaining salinity profiles, will face increased competition for water from agricultural and urban demands.

5.1.2.4 Alien invasive species

 A drier environment would restrict the spread of terrestrial alien invasive plant species, but increasing carbon and especially nitrogen fertilisation would enhance growth of alien species.

5.1.2.5 Fires

- The frequency and intensity of wildfires is expected to increase substantially due to lower rainfall (reducing the moisture content of fuels), lower relative humidity, longer droughts, and higher wind speeds.
- High fire risk conditions are projected to almost triple in the west of the province. This will have a negative effect on biodiversity, soil structure and the spread of fire-adapted alien invasive plants.

5.1.2.6 Coastal zones

Coastal areas are vulnerable to the five potential impacts listed below:

- Increased exposure to extreme events (which themselves might increase in frequency or intensity);
- Increased saltwater intrusion and raised groundwater tables;
- Greater tidal influence;

- Increased flooding (frequency and extent); and
- Increased coastal erosion.

The City of Cape Town coastline has many sandy areas that have high potential for erosion as a result of the high energy wave regime. The most significant impacts of sea-level rise are expected where problems are already experienced. In most cases these are the areas where development has exceeded the high-water line by far, or is at a too-low elevation above mean sea-level.

5.1.2.7 Livelihoods

A range of hazards associated with climate change may affect the livelihoods of people living in the city. These range from the prospect of increasingly poor health which could result from:

- Increased air pollution (the projected increase in the number of inversions will trap pollutants in the atmosphere close to the ground);
- Heat stress (the number of very hot days may increase); and
- The possibility of increased flooding (rainfall events may become fewer but heavier).

Economic sectors such as insurance, banks (through the underlying secured assets), transport and communication infrastructure and construction may all be affected to some degree by climate change.

5.1.2.8 Health

- Warmer average temperatures combined with a change in precipitation and increased flooding can alter the pattern of exposure to temperature extremes and resultant health impacts, in both summer and winter.
- While infectious diseases as malaria and dengue fever are not currently a key concern, the range of malaria could spread southwards in future and should not be ignored.
- Flooding due to the high water table in the Cape Flats area in particular can compromise sewage and storm-water systems, and can lead to water pollution associated diseases such as diarrhoea and dehydration.
- Food security is both directly and indirectly related to climate variability.

5.1.2.9 Air pollution

- In Cape Town, one of the most urgent health threats from climate change is air pollution, such as the build-up of photochemical smog which is undesirable from both a health and aesthetic standpoint.
- Brown haze episodes may occur frequently when a temperature inversion exists over the City.

5.1.2.10 Sea level rise in the City of Cape Town

Present sea level rise related concerns identified for Cape Town that will also be relevant to the coastal areas of the Eastern Cape include:

- Natural protection
 - Natural sand dune barriers Sea level rise will damage and compromise the protection provided by natural sand dune systems.
- Impacts on infrastructure
 - Throughout the Cape Town area, sea level rise will impose significant risk to various infrastructure.
- Planning
 - Cape Town City currently has no long term infrastructure development plan.

- The current building regulations only require an Environmental Impact Assessment under NEMA.
- Assessment for building within 100m from the high water mark (in terms of EIA Regulations) has proven this to be ineffective in some areas.
- The ability to protect infrastructure in future may be reduced (both natural and manmade i.e. sand dunes and seawalls).
- Areas that are currently considered protected or sheltered may become more exposed.
- Risk of flooding to private and commercial properties.
- Transport
 - The coastal railway system is expected to become increasingly effected by increasing sea levels.
 - Traffic congestion when the transport systems such as roads have been affected by flooding etc.
 - Failure of coastal defences that are currently not maintained will lead to the disruption of services such as public transport.
 - Flooding events increase erosion and can reduce the expected life span of road systems, bridges, and other infrastructure.
 - The Cape Town Harbour has been highlighted as an area of concern by the GIS inundation model (Scenarios 1 and 2). The expected increase in frequency and intensity of storms may therefore impact upon sea transport. The increase in frequency and intensity of storms may also impact on berthing, loading and storage facilities for oil and gas.
- Storm-water systems
 - Silt deposits in the storm-water infrastructure often exacerbate blockage.
 - During flooding events, some the pipes burst under the increased pressure (from the increased water levels as a result of the storm and the pipes getting clogged up with silt) and often the water is forced up to the surface contributing to further
 - The impact on large infrastructure such as main culverts and river systems in terms of monetary value.
- Sewerage/ Waste water
 - Many waste water plants are close to rivers in order to discharge thus leaving them vulnerable in the event of flooding in the localised area.
 - There are many sewerage lines and pump stations located along the coastal edge in low-lying areas. Some of these are already out of service a result of being impacted upon by the sea.
 - Already have problems with sewerage during storms in the Strand area.
- Electricity
 - Present disruption of energy supplies will be further exacerbated.
 - There are numerous substations for electrical distribution located in coastal areas.
 - Power loss from damage to overhead cables.
- Disaster/Risk Management
 - There must be a long-term plan for disaster management and implementation.
 - Current warnings are on a large scale and do not pin point precise areas that require management.

• There is a need to develop and put in place an early warning weather system that would provide warnings in greater detail than those that are currently available.

5.2 Climate Change Risk Assessment Matrix for the Eastern Cape

The effects of climate change manifestations such as changing precipitation and sea-level rise may have significant knock on effects which combine to threaten the entire economy of the province while the livelihood of a significant proportion of the population could be affected. These effects also threaten the continuity and functioning of provincial and local governance institutions and their associated mandate in the Eastern Cape. In the context of a climate change response strategy for the provincial government, it is necessary to systematically identify and assess the areas where provincial plans, agencies and departmental and municipal mandates are directly at risk. In contrast, the impacts of climate change may cause certain opportunities to arise. These opportunities should also be systematically identified so that they may be taken advantage of.

A climate change risk assessment matrix has been developed as part of the EC Climate Change Response Strategy. The Risk Assessment Matrix represents an approach towards the systematic identification of Climate Change based impacts to the systems and resources that our environment, society and economy rely on. The matrix has, and will continue to, go through a number of iterations, with reciprocal input among the project team and stakeholders. A discussion regarding the method adopted in developing and populating the matrix is given in the following sections.

The ultimate object of the matrix is to allow summary spreadsheets filtered for selected categories, such as: "Risks of high significance relevant to the Eastern Cape Department of Transport".

5.2.1 Context

Since the EC Climate Change Response Strategy is aimed particularly at Eastern Cape Provincial Governance, the impacts are considered at the scale, and from the context, of the province and associated district municipalities. Particular attention is therefore paid to the goals of the Provincial Growth and Development Plan and associated agencies and departments.

5.2.2 Approach

The risk assessment matrix aims to facilitate a step-wise approach to understanding which climate change impacts may affect the province, how serious these impacts are likely to be, and which provincial plans, agencies and departmental and municipal mandates are directly affected

The sequence of steps in populating the matrix is given together with an example below:



Figure 12: Risk assessment matrix used in this study (left) with an example for the agricultural sector on the right.

5.2.2.1 The primary impacts of Climate Change

The first column in the matrix represents primary climate change impacts (in other words climate change manifestations). The cells in this column are populated by using the associated drop down list of options namely (Christensen et al, 2007; Midgley et a 2007):

- Change in precipitation patterns
- Changes in annual average precipitation
- More intense rain
- Fewer cold/frost days
- Higher mean temperatures
- Increased number of berg wind days
- Increased storm severity
- Longer dry spells and increased likelihood/ severity of droughts
- More hot days and heat waves
- Sea level rise
- Ocean acidification

• Elevated atmospheric CO₂ concentrations

Although the above 1st order impacts are suggested, the matrix is not limited to these.

5.2.2.2 2nd and 3rd order impacts

Although climate change appears to have a limited set of direct impact categories such as increased surface temperature and changing patterns of precipitation, these in turn are likely to set in motion a chain of knock-on impacts. An example of a chain of first, second, third, and fourth order impacts is given in Figure 13.



Figure 13: Examples of a chain of impacts initiated by a 1st order climate change impact.

The risk assessment matrix is limited to the identification of 2nd and 3rd order impacts. It should be noted that numerous 2nd order impacts can arise from primary (i.e. 1st order) impacts. Likewise numerous 3rd order impacts can arise from 2nd order impacts. It follows that a large number of 3rd order impacts can be attributable to a single 1st order impact. An example of the diverse impacts of higher mean temperature in the agricultural sector is given below.

1 st Order Impact	2 nd Order Impact	3 rd Order Impact	Systems/sectors/ Infrastructure
Higher mean temperatures	ligher mean temperatures Increased evaporation and decreased soil water balance (particularly to the west)		Agriculture Sector
Higher mean temperatures Increased evaporation and decreased soil water balance (particularly to the west)		Increased irrigation requirements per hectare. Net water requirements of crops are projected to increase.	Agriculture Sector
Higher mean temperatures Increase in ranges and vigour of pests, diseases and vectors		Increased infestation of pests and diseases and reduced net revenue per hectare	Agriculture Sector
Higher mean temperatures 15-35% increase in heat units if Global Warming reaches 2°C.		Changes in the ranges, planting times, flowering and harvest times of crops.	Agriculture Sector
Higher mean temperatures	Alteration to the ranges of certain species of plant and animal	Potential for introduction of new species for commercial exploitation	Agriculture Sector

Table 3: Diverse 2 nd and 3	^d order impacts for a	given 1 st order impact.
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Since the intention of the spreadsheet is to allow diverse summary tables and filters, all line items (rows) are fully populated even if this requires repeated entries in the primary and secondary impacts columns.

The number and diversity of 2nd and 3rd order impacts is potentially unlimited. These impacts are therefore not prescribed in the spreadsheet.

5.2.2.3 Affected systems, sectors and infrastructure.

The identification and description of impacts is strongly contextualised by the system, sector or infrastructure type under consideration. It is therefore likely that different 3rd order impacts will arise for the same primary and 2nd order impacts depending on the system or sector under consideration. In the example below, the second order impact: "Alteration to the ranges of certain species of plant and animal" represents (potentially) a consequential opportunity in the agricultural sector, but a consequential risk in to biodiversity systems.

Table 4: Different meanings of a similar impact for different sectors	Table 4: Different mean	ings of a similar	impact for different	sectors.
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1 st Order Impact	2 nd Order Impact	3 rd Order Impact	Systems/sectors/ Infrastructure
Higher mean temperatures	Alteration to the ranges of certain species of plant and animal	Potential for introduction of new species for commercial exploitation	Agriculture Sector
Higher mean temperatures	Alteration to the ranges of certain species of plant and animal	Potential disruption of ecosystems	Biodiversity Systems

As with the section above, the intention of the spreadsheet is to allow diverse summary tables and filters. All line items (rows) are fully populated even though this requires duplicate entries in the primary and secondary impacts columns for different sectors, systems or infrastructure. It follows that each system, sector or infrastructure type must be assessed independently, even if this results in a certain amount of duplication.

Selectable systems, sectors or infrastructure types include:

- Agricultural Sector
- Air quality Systems
- Biodiversity Systems
- Coastal and Marine Systems
- Energy services Infrastructure
- Fisheries & Aquaculture Sector
- Forestry Sector
- Geology & Soils Systems
- Health Services Infrastructure
- Social & Economic Systems
- Tourism Sector
- Transport infrastructure
- Water Resources Systems
- Water Services Infrastructure

5.2.2.4 Risks and opportunities

Although climate change primarily presents risks, there are nevertheless certain opportunities that may arise. For example the possibility of increased mean annual runoff in the eastern sections of the province may, all things being equal, result in the opportunity for increased hydro-power generation. A column is available to define whether a given climate change impact represents a risk or an opportunity in the context of a given sector, system or infrastructure type.

5.2.2.5 Notes on the historical occurrence of this impact

Climate change will not necessarily result in the occurrence of completely new impacts. Rather, events and trends are likely to increase in frequency and severity. For example floods are historically common, but it may be useful to note particularly extreme floods to:

Illustrate examples or effects of that impact;

Understand what it means if that event or trend increased in frequency and/or severity in future.

A column has been included in the matrix in which descriptions of historical events can be included.

5.2.2.6 Assessment of likelihood, consequence and significance

Different impacts will have different degrees of significance for the province. Since there are so many potential climate change impacts, these must be ranked in order to allow the prioritisation of responses. In this study, significance is considered in terms of the likelihood of an impact taking place, and the consequences of that impact should it happen. The rating of likelihood and consequence requires a value judgement, and is therefore recognised as subjective. Given the scope of this study, it is not feasible to undertake a multi-stakeholder rating process for each impact. Therefore, and for the sake of consistency across the matrix, the rating of likelihood, consequence and significance is undertaken by the project team, guided by the scales in Table 5,

Table 6 and Table 7 below.

Rating	Recurrent risks	Single events
Almost certain	Could occur several times per year	More likely than not – Probability greater than 50%.
Likely	May arise about once per year	As likely as not – 50/50 chance.
Possible	May arise once in ten years	Less likely than not but still appreciable – Probability less than 50% but still quite high.
Unlikely	May arise once in ten years to 25 years	Unlikely but not negligible – Probability low but noticeably greater than zero.
Rare	Unlikely during the next 25 years	Negligible – Probability very small, close to zero.

Table 5: Likelihood scales	for the assessment of cli	imate change risks (AGS 2006).

	SUCCESS CRITERIA					
Rating	Public safety	Local economy & growth	Community & lifestyle	Environment & sustainability	Public administration	
Catastrophic	Large numbers of serious injuries or loss of lives	Regional decline leading to widespread business failure, loss of employment and hardship	The region would be seen as very unattractive, moribund and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fall into decay and cease to be effective	
Major	Isolated instances of serious injuries or loss of lives	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be seen to be in danger of failing completely	
Moderate	Small numbers of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under severe pressure on several fronts	
Minor	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under severe pressure	
Insignificant	Appearance of a threat but no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	There would be minor instances of public administration being under more than usual stress but it could be managed	

Table 6: Consequence so	cales for local gov	vernment risk assess	sment (AGS 2006).
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Table 7: Significance scales based on the degree of likelihood and consequence (AGS 2006).

			Consequences		
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium	Medium	High	Extreme	Extreme
Likely		Medium	High	High	Extreme
Possible		Medium	Medium	High	High
Unlikely			Medium	Medium	Medium
Rare					Medium

5.2.2.7 Identifying affected provincial plans and strategies, agencies, departments and district municipalities.

The EC Climate Change Response Strategy aims to assist provincial competencies in responding to climate change risks and opportunities. It is therefore necessary to identify the provincial plans and strategies, agencies, departments and district municipalities that may be affected by each potential climate change risk in the context of a given system, sector or infrastructure type. In the risk matrix, a column has been allocated to each entity that may be affected. Each impact has a corresponding cell for each entity. Where the entity is directly affected, the cell is blacked out.

Although it is recognised that different entities will be affected to different degrees by each impact, it is not feasible to objectively and consistently quantify or categorise these degree of impact given the scope of this study. In this study, therefore, a "yes" or "no" approach has been adopted, where:

- YES (blacked out cell) means that the entity will be directly affected by the impact; or
- NO (blank cell) means that the entity will either be indirectly affected, or will not be affected at all.

When an entity or plan is directly affected, this refers to immediate threats (or opportunities) to its mandate or goals. As an example of the difference between direct and indirect threats:

- The threat of reduced raw water quality will directly affect the local water service provider's mandate to provide adequate basic water services to the population. This is a direct threat to the water services provider.
- If the water service provider fails to provide adequate basic services due to the direct threat of reduced water quality, this could, in turn, result in negative health effects which may threaten the capacity of the EC Department of Health. Therefore reduced water quality is an indirect threat to the EC Department of Health.

The person working with the matrix should:

Examine each impact with respect to their relevant provincial plan, agency, department or district municipality and black out cells where relevant; and/or If adding an impact to the matrix, attempt to black out provincial plans, agencies, departments or district municipalities which, in their understanding, will be directly affected by that impact.

5.2.2.8 Identifying affected national departments

The EC Climate Change Response Strategy confines its scope to the Eastern Cape Province and Provincial Government. However, there are cases where certain provincial competencies are handled by a national department. A case in point is the National Department of Water. Where such as situation is relevant, a column exists for listing the affected department. Departments available in the drop-down list include:

- Department of Energy;
- Department of Agriculture Forestry & Fisheries; and
- Department of Water.

The following sections provide discussions on possible impacts to systems, sectors or infrastructure in the province, thus providing background to the risks identified in the matrix.

5.3 Biodiversity Systems

5.3.1 Background

According to IPCC AR4 there is now more specific information available across a wide range of systems and sectors concerning the nature of future impacts of climate change. The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers (e.g. land-use change, pollution, fragmentation of natural systems, overexploitation of resources) (high confidence). Approximately 20 to 30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5° C (medium confidence). For increases in global average temperature exceeding 1.5 to 2.5° C and in concomitant atmospheric CO₂ concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions and shifts in species' geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services, e.g. water and food supply (high confidence).

The southern extent of the Eastern Cape up to Nelson Mandela Bay Municipality (NMBM) incorporates the eastern-most extent of the Cape Floristic Region (CFR). According to Cape Action (www.capeaction.org.za), the CFR is recognised internationally for its high diversity of plant and animal life and despite its enormous economic importance, is one of the world's 25 most threatened hotspots. The total economic value includes plants, animals, scenery, ecosystems and ecosystem services such as water purification and erosion control. According to AR4, "there will be substantial reductions in areas of suitable climate for 81-97% of the 5 197 African plants examined" and losses of between 51 - 61% of Fynbos and succulent Karoo biomes.

The economy of the Eastern Cape is heavily dependent on natural systems which are linked directly to the success of important sectors including agriculture, forestry, fisheries (see above) and tourism. The potential implications of changes to biological systems are far-reaching and the risks need to be understood in order to allow economic systems to respond effectively.

5.3.2 Risks, Vulnerability and Opportunities

As with fisheries, biodiversity is extremely susceptible to climatic changes including rainfall and temperature. Reduced rainfall and increased temperatures may result in local extinction of marginal species and may facilitate extension of the geographical range of invasive alien species of plant an animal. These, in turn, will compete with indigenous species for scarce resources and may ultimately impair the ability of ecosystems to cope with other disturbances. This is of particular importance when indigenous species contribute to essential goods or services. Increased temperatures in particular are expected to result in increased insect outbreaks which may have negative consequences for agriculture within the province. An illustration of the global effects on biodiversity is given in Figure 14.



Figure 14: Details and extent of projected impacts on ecological systems as mean global surface temperatures increase (Source: IPCC 2007)

5.3.3 Risk Matrix: Biodiversity systems

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunity	Significance (Likelihood x consequence)
Higher mean temperatures	Alteration to the ranges of certain species of plant and animal, including shifts in endemic taxa.	Potential disruption of ecosystems and conservation targets associated with protected areas.	Risk	High
Higher mean temperatures	Local extinction of certain species	Potential disruption of ecosystems	Risk	High
Longer dry spells and increased likelihood/ severity of droughts	Alteration to the ranges of certain species of plant and animal	Potential disruption of ecosystems.	Risk	High
Longer dry spells and increased likelihood/ severity of droughts	Local extinction of certain species	Potential disruption of ecosystems	Risk	High
Sea level rise	Inundation of coastal habitats	Local extinction of certain species	Risk	High
Elevated atmospheric CO ₂ concentrations	Coupled with other climate change manifestations, increased spread of alien invasive trees and shrubs.	Disruption of ecosystems, loss of biodiversity.	Risk	Medium
More hot days and heat waves	Increased fire frequency and intensity - changes to fire regime	Changes to ecosystem processes.		Medium
Higher mean temperatures	Local extinction of certain species	Impacts to the economy, particularly the fishing, tourism and agricultural sectors	Risk	Medium

Lo ar lik se dr	onger dry spells nd increased kelihood/ everity of roughts	Alteration to the ranges of certain species of plant and animal	Impacts to the economy, particularly the fishing, tourism and agricultural sectors	Risk	Medium
Lo ar lik se dr	onger dry spells nd increased kelihood/ everity of roughts	Local extinction of certain species	Impacts to the economy, particularly the fishing, tourism and agricultural sectors	Risk	Medium
S	ea level rise	Inundation of coastal habitats	Potential disruption of ecosystems	Risk	Medium
S	ea level rise	Inundation of coastal habitats	Impacts to the economy, particularly the fishing, tourism and agricultural sectors	Risk	Medium

5.3.4 Relevance to the Provincial Government of the Eastern Cape

Seen together with other climate change impacts, losses and changes to Ecosystem Goods and Services is likely to have negative environmental, social and economic consequences for the Eastern Cape. These are likely to have implications for the following Eastern Cape Policies and Plans:

- PGDP;
- Provincial Industrial Development Strategy, particularly in connection with resourcebased industries;
- AsgiSA Eastern Cape, particularly in connection with Agriculture and agro-processing, forestry development and tourism development; and
- RD&ATS, particularly in connection with food security and the non-farm rural economy.

5.4 Coastal and Marine Systems

5.4.1 Background

Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3000m and that the ocean has been taking up over 80% of the heat being added to the climate system. Increases in sea level are consistent with warming where global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003 and at an average rate of about 3.1 mm per year from 1993 to 2003.

Since 1993 thermal expansion of the oceans has contributed about 57% of the sum of the estimated individual contributions to the sea level rise, with decreases in glaciers and ice caps contributing about 28% and losses from the polar ice sheets contributing the remainder. From 1993 to 2003 the sum of these climate contributions is consistent within uncertainties with the total sea level rise that is directly observed.

The IPCC AR4 report projects sea level rise of between 0.2 to 0.6 metres (excluding storm surges and other factors) for different development scenarios. It should be noted that the sea level projections do not include uncertainties in climate-carbon cycle feedbacks nor do they include the full effects of changes in ice sheet flow, because a basis in published literature is lacking. Therefore the upper values of the ranges given are not to be considered upper bounds for sea level rise. The projections include a contribution due to increased ice flow from Greenland and Antarctica at the rates observed for 1993-2003, but these flow rates could increase or decrease in the future. If this contribution were to grow linearly with global average temperature change, the upper ranges of sea level rise for the development scenarios would increase by 0.2m.

It is also worth noting, that AR4 indicates that current models suggest virtually complete elimination of the Greenland ice sheet and a resulting contribution to sea level of about 7m if global average warming were sustained for millennia in excess of 1.9 to 4.6 degrees Celsius relative to pre-industrial values.

Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas (very high confidence).

By the 2080s, many millions more people than today are projected to experience floods every year due to sea level rise. The numbers affected will be largest in the densely populated and low-lying mega-deltas of Asia and Africa while small islands are especially vulnerable (very high confidence). Of particular relevance to this report is that "three of the five regions shown to be at risk of flooding in coastal and deltaic areas of the world are those located in Africa" (IPCC AR4 chp 9: Africa) and one is southern Africa.

While there is little doubt that the coastal regions of the world will be affected by climate change (IPCC AR4), it is sometimes difficult to separate climate change related changes from those brought about by anthropogenic activities. Examples of human activities that could exacerbate the impacts of climate change, specifically changes in coastal geomorphology include shoreline development, clearing of mangroves and the mining of beach sand. According to AR4 (chp 1 Observed changes, Syvitski et al, 2005a), pumping of groundwater also enhances land subsidence. According to Cartwright (2009), the South African coastline's natural buffering capacity has been eroded by anthropogenic activities including development of estuaries, land reclamation, removal of coastal dunes, and sand mining.

5.4.2 Risks, Vulnerability and Opportunities

Potentially the most significant direct impacts of climate change on coastal regions are loss of land, estuaries and wetland systems due to subsidence, storm events and flooding. As mentioned above, the impacts of climate change may be exacerbated by anthropogenic activities. The relatively pristine nature of the coastal zone of the Eastern Cape Province is key to its current and future contribution to the economy of the region through sectors such tourism and fishing / aquaculture. In addition, the three provincial ports and associated infrastructure are important for expansion of the local manufacturing sector. In recent years, considerable resources have been allocated to the development of coastal infrastructure to enhance these sectors, and expected impacts of climate change, including flooding, coastal surges and subsidence could ultimately have significant direct and indirect impacts on the economy of the province. Direct impacts could include damage to infrastructure, amenities and property and loss of human life while indirect impacts within the provincial context could include loss of tourism, increased expenditure on disaster relief and increased insurance premiums for coastal property (Cartwright, 2009).

5.4.3 Risk Matrix: Coastal and marine systems

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunity ?	Significance (Likelihood x consequence)
Increased storm severity/ Extreme weather events.	Increased subsidence and loss of coastal land, wetlands and estuaries	Increased damage to/loss of coastal property and infrastructure and increased insurance premiums	Risk	Extreme

Higher mean temperatures	Increase in sea-surface temperature Changes to marine sp distribution including expansion of the range alien invasive species associated negative economic impacts		Risk	High
More intense rain	Increased erosion in coastal areas	Damage to infrastructure and property	Risk	High
More intense rain	Increased erosion in coastal areas	Increased subsidence and loss of coastal land, wetlands and estuaries	Risk	High
Higher mean temperatures	Increased sea-surface temperature	Changes to species distribution including expansion of the range of alien invasive species	Risk	Medium
Increased storm severity/ Extreme weather events.	Increased subsidence and loss of coastal land, wetlands and estuaries	Reduced tourism potential	Risk	Medium
Increased storm severity/ Extreme weather events.	Increased subsidence and loss of coastal land, wetlands and estuaries	Increased financial allocation for disaster relief	Risk	Medium
Increased storm severity/ Extreme weather events.	Loss of human life	Reputational damage	Risk	Medium
Increased storm severity/ Extreme weather events.	Damage to infrastructure and property	Disruption of normal commercial activities and subsequent loss of income	Risk	Medium
Increased storm severity/ Extreme weather events.	Damage to infrastructure and property	Increased allocation of financial resources for repair or replacement of infrastructure	Risk	Medium
Increased storm severity/ Extreme weather events.	Disruption of normal commercial activities and subsequent loss of income	Reduction in economic potential of certain industry sectors	Risk	Medium
Longer dry spells and increased likelihood/ severity of droughts	Discharge of more concentrated effluent into estuaries due to reduced dilution	Negative impacts of contaminants on coastal ecosystems with subsequent impacts on the fishing and tourism sectors	Risk	Medium
More intense rain	Increased deposition of silt in rivers and estuaries	Negative impacts on coastal ecosystems with subsequent impacts on the fishing sector	Risk	Medium
More intense rain	Flooding in coastal areas	Damage to infrastructure and property	Risk	Medium
More intense rain	Flooding in coastal areas	Disruption of normal commercial activities and subsequent loss of income	Risk	Medium

Sea level rise	Increased subsidence and loss of coastal land, wetlands and estuaries	Disruption of normal commercial activities and subsequent loss of income	Risk	Medium
Sea level rise	Increased subsidence and loss of coastal land, wetlands and estuaries	Decreased value of coastal properties	Risk	Medium
Sea level rise	Increased subsidence and loss of coastal land, wetlands and estuaries	Potential benefits to ports that become deeper and can accommodate ships with a deeper draft	Opportunity	Medium
Increased storm severity/ Extreme weather events.	Increased subsidence and loss of coastal land, wetlands and estuaries	Increased demand for emergency services	Risk	low
Increased storm severity/ Extreme weather events.	Loss of human life	Increased expenditure on social grants for dependents	Risk	low
More intense rain	Increased deposition of silt in rivers and estuaries	Increased discharge of sediment to nearshore marine systems resulting in increased turbidity with associated negative impacts on marine ecosystems	Risk	low
More intense rain	Flooding in coastal areas	Increased expenditure on disaster relief and emergency services	Risk	low
More intense rain	Flooding in coastal areas	Revision of coastal development plans	Risk	low
Sea level rise	Increased subsidence and loss of coastal land, wetlands and estuaries	Revision of coastal development plans	Risk	low

5.4.4 Relevance to the Provincial Government of the Eastern Cape

The Eastern Cape Government, through the PGDP, ECDC and other agencies, places a strong emphasis on the role coastal and marine resources play in supporting livelihoods and economic development. Furthermore, a strong concentration of critical infrastructure is established along coastal zones, including roads, bridges, ports, pipelines and wastewater treatment facilities. This infrastructure is at risk to the impacts of climate changes.

5.5 Social and Economic Systems

5.5.1 Background

5.5.1.1 Demographics and Livelihoods

The population of the Eastern Cape has grown from 6,147,244 in 1996 to 6,527,747 in 2007 (see Table 8), representing a 6.2% growth rate over 11 years. The Eastern Cape has the third largest population in the country.

Table 8: Population growth in South Africa by province (Source: Stats SA community survey).

Provinces	Census 1996	Census 2001	% Change	CS 2007	% Change
Eastern Cape	6 147 244	6 278 651	2,1	6 527 747	4,0
Free State	2 633 504	2 706 775	2,8	2 773 059	2,4
Gauteng	7 624 893	9 178 873	20,4	10 451 713	13,9
KwaZulu-Natal	8 572 302	9 584 129	11,8	10 259 230	7,0
Limpopo	4 576 133	4 995 534	9,2	5 238 286	4,9

Mpumalanga	3 124 203	3 365 885	7,7	3 643 435	8,2
Northern Cape	1 011 864	991 919	-2,0	1 058 060	6,7
North West	2 936 554	3 193 676	8,8	3 271 948	2,5
Western Cape	3 956 875	4 524 335	14,3	5 278 585	16,7
South Africa	40 583 573	44 819 778	10,4	48 502 063	8,2

Key livelihood indicators for the province include Education, HIV/Aids, Water Services, Sanitation, Energy, Housing, Telecommunication and Refuse Removal. Indicators for energy services and water services are given in Figure 15 and Figure 16 respectively. The percentage of households in the Eastern Cape with access to electricity has increased from 50% in 2001 to 65% in 2007. However, this remains among the lowest rates of electrification in the country.



Figure 15: Percentage of households using electricity for lighting by province (Source: Stats SA Community Survey, 2007)

The percentage of households that have access to piped water in the province has increased from 63% to 70.4%. This too remains one of the lowest levels of delivery in the country.



Figure 16: Percentage of households that have access to piped water by province (Source: Stats SA Community Survey, 2007)

5.5.1.2 Economy and Industry

The sustainability of the economy of the Eastern Cape is challenged by the distorted spatial nature of its development. As stated by the PGDP (2004):

The Eastern Cape is characterised by extreme levels of uneven development. This is evident through a number of dualisms: between the two urban industrial manufacturing centres and

the poverty stricken and underdeveloped rural hinterland particularly in the former homeland areas of the Transkei and Ciskei; between a developed commercial farming sector and a floundering subsistence agricultural sector; and between concentrations of fairly well developed and efficient social and economic infrastructure in the western parts of the province and its virtual absence in the east.

The Eastern Cape is the fourth-largest economy in South Africa. It contributed about 7.8 % to the total economy in 2008, and generally matches national economic growth rates. On average, the real growth rate for the period 1996 to 2009 was estimated at 2.6%, with a recent dip in growth associated with the global recession (DEDEA 2010).



Figure 17: Actual and forecast GDP growth rate for the Eastern Cape (Source: DEDEA 2010)

Agriculture, forestry and fishing have shrunk from 40.9% in the first quarter 2000 to 6.4 % in 2009. Over the same period, manufacturing and finance, insurance and business services have doubled their employment contribution. Wholesale and retail trade; catering and accommodation saw an increase in contribution from 16.5% in 2000 to 23.6% in 2009 (DEDEA 2010).

5.5.2 Risk and vulnerability

Social systems are characterised by extremely complex linkages between social conditions (e.g. settlement patterns), infrastructure (roads, railways, power generation and supply, ports, water and sanitation), livelihoods and employment and access to resources to name a few. It follows that the second, third and fourth order impacts of climate change will have extensive knock-on effects throughout social systems. It is therefore both difficult and dangerous to consider each impact simplistically and in isolation. However IPCC fourth assessment report for Industry, Settlement and Society (Wilbanks *et al* 2007) highlights the following:

- Climate-change vulnerabilities of industry, settlement and society are mainly related to extreme weather events rather than to gradual climate change (very high confidence).
- Aside from major extreme events and thresholds, climate change is seldom the main factor in considering stresses on the sustainability of industry, settlements and society (very high confidence).
- Vulnerabilities to climate change depend considerably on specific geographic, sectoral and social contexts (very high confidence).
- Vulnerabilities of industry, infrastructures, settlements and society to climate change are generally greater in certain high-risk locations, particularly coastal and riverine

areas, and areas whose economies are closely linked with climate sensitive resources, such as agricultural and forest product industries, water demands and tourism; these vulnerabilities tend to be localised but are often large and growing (high confidence).

- Where extreme weather events become more intense and/or more frequent with climate change, the economic and social costs of those events will increase (high confidence).
- Poor communities can be especially vulnerable, in particular those concentrated in relatively high-risk areas (high confidence).
- Poor communities tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies

Examples of the linkages between primary climate change impacts and stresses on social systems are given in Table 9.

Table 9: Examples of current and projected climate-change impacts on industry, settlement and society and their interaction with other processes (adapted from Wilbanks *et al* 2007).

Climate Driven	Evidence for Current	Other Processes/	Projected Future Impact/	Zones, Groups
Changes in extrem	nes	Stresses	vunerability	Allecteu
Storm surge	Flood and wind casualties and damages; economic losses: transport, tourism, infrastructure (e.g., energy, transport), insurance	Land use/ population density in flood-prone areas; flood defences; institutional capacities	Increased vulnerability in storm prone coastal areas; possible effects on settlements, health, tourism, economic and transportation systems, buildings and infrastructures	Coastal areas, settlements and activities; regions and populations with limited capacities and resources; fixed infrastructures; insurance sector
Extreme rainfall, riverine floods	Erosion/landslides; land flooding; settlements; transportation systems; infrastructure	As for storm surge, plus drainage infrastructure	As for storm surge, plus drainage infrastructure	As for storm surge, plus flood plains
Heat waves	Effects on human health; social stability; requirements for energy, water and other services (e.g., water or food storage), infrastructures (e.g., energy transportation)	Building design and internal temperature control; social contexts; institutional capacities	Increased vulnerabilities in some regions and populations; health effects; changes in energy requirements	elderly, very young, ill and/or very poor populations
Drought	Water availability, livelihoods; energy generation; migration,; transportation in water bodies	Water systems; competing water uses; energy demand water demand constraints	Water resource challenges in affected areas; shifts in locations of population and economic activities; additional investments in water supply	Semi-arid and arid regions; poor areas and populations; areas with human- induced water scarcity
Changes in means	3			Mana di ana but
Temperature	Energy demands and costs; urban air quality; thawing of permafrost soils; tourism and recreation; retail consumption; livelihoods; loss of melt water	Demographic and economic changes; land-use changes; technological innovations; air pollution; institutional capacities	Shifts in energy demand; worsening of air quality.	very giverse, but greater vulnerabilities in places and populations with more limited capacities and resources for adaptation
Precipitation	Agricultural livelihoods; saline intrusion; tourism; water infrastructures; energy supplies	Competition from other regions/sectors. Water resource allocation	Depending on the region, vulnerabilities in some areas to effects of precipitation increases (e.g., flooding, but could be positive) and in some areas to decreases (see drought above)	Poor regions and populations
Saline intrusion	Effects on water infrastructures	Trends in groundwater withdrawal	Increased vulnerabilities in coastal areas	Low-lying coastal areas, especially those with limited

				capacities resources	and
Sea-level rise	Coastal land uses; flood risk, water logging; water infrastructures	Trends in coastal development, settlement and land uses	Long-term increases in vulnerabilities of low-lying coastal areas	As for intrusion,	saline
Abrupt climate cha	ange				
	Analyses of potentials	Demographic, economic, and technological changes; institutional developments	Possible significant effects on most places and populations in the world, at least for a limited time	Most zones groups	and

5.5.3 Risk Matrix: Social and economic systems

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportuni ty?	Significance (Likelihood x consequence)
More hot days and heat waves	Increased morbidity and mortality in elderly and infirm (e.g. HIV/AIDS patients)	Increased strain on health services	Risk	Extreme
Higher mean temperatures	Coupled with increased rainfall, spread in range of diseases and vectors, including cholera, malaria and bilharzia.	General increase in occurrence of disease; exacerbation of effects on people with HIV/AIDS, the elderly and the poor.	Risk	Extreme
Increased storm severity/ Extreme weather events.	Increased storm surges coupled with sea level rise and flooding from both climate change causes and catchment hardening.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Risk	Extreme
Increased storm severity/ Extreme weather events.	Coupled with more intense rain, catchment hardening due to urban development, and reduced integrity of water catchments: increased risk of flooding or flash floods	Direct threat to infrastructure within flood-prone areas; Direct threat to human life.	Risk	Extreme
More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme	Increased fire frequency increases direct threat to human life, threats to livelihood and infrastructure.	Risk	Extreme
More hot days and heat waves	Increased morbidity and mortality in elderly and infirm (e.g. HIV/AIDS patients)	Direct threat to livelihoods and social services	Risk	Extreme
Higher mean temperatures	Increased evaporation, reduced soil moisture, reduced runoff and river baseflow.	Compounded by reduced MAP, systemic water shortages will limit economic growth potential to the south- west.	Risk	Extreme
Sea level rise	Coupled with storm surges and flood events exacerbated by catchment hardening, inundation and wave damage to coastal low lying areas.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Risk	Extreme
Increased storm severity/ Extreme weather events.	Crop damage from hail and wind and heavy rain	Increased risk of crop failure; threats to commercial and subsistence agriculture, rural livelihoods and food security.	Risk	Extreme
Longer dry spells and increased likelihood/ severity of	Increased risk/frequency of dryland crop-failure; Increased mortality and reduced productivity among livestock.	Threats to commercial and subsistence agriculture, rural livelihoods and food security.	Risk	Extreme

droughts				
More hot days and heat waves	Heat waves coupled with dry conditions may increase the risk of uncontrollable shack fires in informal settlements	Threat to human life. Threats to urban livelihoods and increased strain on urban disaster management systems.	Risk	Extreme
Changes in annual average precipitation	Decreased precipitation in the south-western portion of the province poses a threat to drinking water quantity and quality.	Reduced availability of potable water, threats to human health from poor quality drinking water in un-serviced areas.	Risk	High
Changes in annual average precipitation	Decreased precipitation in the south-western portion of the province increases risk of inadequate water supply	Gradual curtailment of industries and systems relying on bulk water supply per unit output.	Risk	High
Higher mean temperatures	Spread in range of diseases and vectors, including cholera, malaria and bilharzia.	Strain on health services, increased morbidity and reduced economic productivity of population.	Risk	High
Longer dry spells and increased likelihood/ severity of droughts	Risk of failure of water supply in the south-western portion of the province: water demand exceeds capacity to supply	Systematic shut down or curtailment of industries and systems relying on bulk water supply.	Risk	High
More hot days and heat waves	Impacts on infrastructure and services (design specifications of systems exceeded)	Interrupted, reduced or limited service provision.	Risk	High
More hot days and heat waves	Impacts on infrastructure and services (design specifications of systems exceeded)	Increased risk of unforeseen hazardous events/accidents such as train derailments or decouplings.	Risk	High
More hot days and heat waves	Increased heat stress in population	loss of economic productivity when discomfort index is high	Risk	High
More hot days and heat waves	Increased heat stress in population	Reduction in quality of life for people without appropriate housing and facilities	Risk	High
More intense rain	Increased flood runoff exacerbated by catchment hardening and settlement below floodlines	Direct threat to livelihoods, services and infrastructure in areas within the current and future 1:100 year floodline	Risk	High
More intense rain	Increased flood runoff	Spread of disease as sanitation infrastructure becomes submerged	Risk	High
Changes in annual average precipitation	Decreased precipitation in the south-western portion of the province increases risk of inadequate water supply	Systemic water shortages will limit economic growth potential to the south-west.	Risk	High
Higher mean temperatures	Increased evaporation and decreased soil water balance (particularly to the west)	Threats to the viability of dryland crops; Threats to rural livelihoods and food security.	Risk	High
Higher mean temperatures	Increase in ranges and vigour of pests, diseases and vectors;	Threats to subsistence agriculture, rural livelihoods and food security.	Risk	High
Higher mean temperatures	Increased evaporation rates resulting in lower mean soil moisture percentages	Reduced viability of rainfed agriculture threatens rural livelihoods and food security	Risk	High

Higher mean temperatures	Increased evaporation rates resulting in lower mean soil moisture percentages	Lower livestock carrying capacity of rangelands threatens rural livelihoods	Risk	High
Changes in annual average precipitation	Stresses on current ecosystems and vegetation cover resulting in changes to environmental goods and services	Threats to rural livelihoods where there is a reliance on sustainable use of environmental goods and services.	Risk	High
Increased storm severity/ Extreme weather events.	Severe flooding may increase the risk of contaminated sources of drinking water	Threats to human health, including exposure to water born disease - particularly in rural and unserviced areas.	Risk	High
Changes in annual average precipitation	Decreased precipitation in the south-western portion of the province increases risk of inadequate water supply	Increased cost of water, resulting in less competitive pricing of manufactured products.	Risk	Medium
Higher mean temperatures	Worsening of air-quality in urban areas	Effects on human health	Risk	Medium
More hot days and heat waves	Increased demand for chilling, air conditioning, water services.	Increased stress on services and associated economic consequences.	Risk	Medium
More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme	Increasing strain on disaster management services	Risk	Medium
More intense rain	Increased flood runoff	Increased strain on disaster management services	Risk	Medium
More hot days and heat waves	Increased heat stress in subsistence crops, and consequent lost productivity.	Threats to rural livelihoods and food security	Risk	Medium

5.5.4 Relevance to the Provincial Government of the Eastern Cape

Climate change is likely to have impacts on numerous aspects of human development. These impacts may be positive or negative, depending on the geographic location, the economic sector, and the extent of existing development in that location. Since these impacts are likely to affect vulnerable communities to the greatest degree, Climate Change has strong relevance in terms of threat and opportunities for the goals of the PGDP and other provincial plans and policies.

5.6 Water Resource Systems

5.6.1 Background

The Eastern Cape Province largely incorporates two National Water Management Areas (WMA), namely the Mzimvubu to Keiskamma, and Fish to Tsitsikamma WMA areas. In addition a portion of the Kraai sub-catchment of the Upper Orange WMA lies within the provincial boundary. In addition to natural stream-flow, the Fish and Sundays Rivers are augmented by inter-basin transfer from the Gariep Dam.

As with all WMAs in South Africa, over-abstraction remains a major issue for the management of water resources while threatening ecological stream-flow requirements. The While most rivers in the Fish to Tsitsikama are fully allocated, the Mzimvubu to Keiskamma remains one of the few WMAs where water resources are not 100% allocated. Water availability is summarised in Table 10.

Table 10: Water availability per sub-WMA within the Eastern Cape Province – 2000 (million m^3/a) (source DWAF, 2002)

Reporting Scale		Natural Resource		Usable Return Flow			Total	
WMAs	Sub-WMAs	Surface water	Groundwater	Irrigation	Urban	Mining and bulk industrial	in availab	resource available
	Mzimvubu	85	3	1	2	0	0	91
	Mtata	129	1	0	6	0	0	136
Mzimvubu	Mbashe	112	1	0	1	0	85	199
Keiskamma	Kei	325	14	14	6	0	0	359
	Amatola	122	1	2	25	0	0	150
	Wild Coast	4	1	0	0	0	0	5
	Fish	-21	6	77	6	0	571	639
	Bushmans	16	2	0	4	0	1	23
Fish to	Sunday	81	16	29	2	0	120	248
a	Gamtoos	119	5	7	1	0	0	132
	Algoa	21	6	1	6	0	68	102
	Tsitsikamma	49	1	1	2	0	0	53
Upper Orange	Kraai	34	10	0	0	0	0	44
Total		1076	67	132	61	0	845	2181

Water resource management issues in the Eastern Cape include:

- Over-abstraction of existing resources for irrigation, manufacturing and urban requirements, resulting in deterioration of downstream water quality, quantity and ecological integrity;
- Threats to water quality, quantity and aquatic ecosystem integrity due to catchment degradation;
- Threats to water quality, quantity and aquatic ecosystem integrity due to land-use change in catchments;
- Threats to water quality from sub-standard effluent releases as a result of poorly managed and poorly maintained waste-water treatment works and sewage reticulations.
- Threats to ecological integrity of fresh-water resources due to damming of existing resources.

It is likely that the above threats will be compounded by the impacts of future climate change.

5.6.2 Risk and vulnerability

Some of the secondary impacts of climate change on water resources include:

- Changes to baseflows and stormflows and their variabilities;
- Changes to annual streamflows and their variabilities;
- Changes to sediment yield and its variability; and
- Changes to irrigation water requirements and associated losses.

Stormflow, baseflow and sediment yield regimes and their associated variability have strong and direct influences on water quality and quantity, as well as the integrity of aquatic ecosystems.

5.6.2.1 Changes to baseflows and stormflows and their variabilities;

Baseflows constitute "dry weather" flows and are hydrologically significant in that they sustain flows into the non-rainy seasons, are important for ecological flows and also have a different water chemistry to that of stormflows. Projected future changes in baseflow with respect to

future conditions are indicated in Figure 18, which, apart from the northern sections of the province shows a general reduction of up to 50% of current conditions (Schulze *et al* 2005). However, in a more recent study, (Schulze *et al*, in press) baseflow reduction is confined to the south-western portions of the province while the remainder of the province may experience an increase in baseflow.



Figure 18: Ratios of future to present mean annual baseflow derived from ACRU simulations with C-CAM RCM daily climate outputs (Source Schulze et al 2005).

Storm flows are related to specific rainfall events. It is largely from stormflow events that reservoirs are filled and design runoffs for floodlines and other infrastructure are calculated. Stormflows are also strongly correlated to scouring and sediment transport (resulting in, for example, the silting of dams). Figure 19 indicates future scenarios where storm flows may decrease along the eastern coastal regions of the province while stormflows may increase across the remainder of the province.



Figure 19: Ratios of future to present mean annual stormflow derived from ACRU simulations with C-CAM RCM daily climate outputs (Source Schulze et al 2005).

Steamflow refers to the total runoff from a water catchment over the course of a year. Figure 20 indicates a general reduction in streamflow in the province, apart from the northern regions of the province. However, recent unpublished data shows an increase in annual streamflow to the east and a decrease to the southwest of the province.



Figure 20: Ratios of future to present mean annual accumulated streamflows derived from ACRU simulations (Source Schulze et al 2005).

Sediment yield refers to the quantity of silt or sediment entrained, transported and deposited as water flows through a catchment. Figure 21 shows a decrease in sediment yield along the eastern coastal regions of the province with an increase to the north and west of the province.



Figure 21: Ratios of future to present mean annual sediment yield and its inter-annual variability, derived from ACRU simulations with C-CAM RCM daily climate outputs (Schulze et al 2005).

Table 11 gives the results of a recent (2009) assessment of future climate change streamflow scenarios for South Africa (Schulze et al, in press). This data represents an update of the studies undertaken by Schulze et al, 2005, and contrasts with the 2005 assessment in that there are indications of wetter than anticipated conditions to the east of the province and drier than anticipated conditions to the west.

Ecological Flow Indicator		Intermediate: Present	Future: Present
	Annual Subcatchment Runoff	Moderate increase projected in the eastern half of southern Africa. Moderate decrease projected for a band of Quinaires running from Limpopo to the Eastern Cape.	A significant increase by a factor of between 2 and 5 is projected throughout southern Africa, but excluding the Western Cape, which could experience a decrease by 25- 50%.
Magnitude of Flow Events	Annual Accumulated Streamflows	Moderate increase projected in the eastern half of southern Africa. Moderate decrease projected for a band of Quinaires running from Limpopo to the Eastern Cape.	A significant increase by a factor of between 2 and 5 is projected throughout southern Africa, but excluding the Western Cape, which could experience a decrease by 25- 50%.
	CoD of Annual Subcatchment Runoff	Results do not display clear overall trends, but most Quinaries throughout southern Africa could experience a decrease in CoD.	Results do not display clear overall trends, but most Quinaries throughout southern Africa could experience a decrease in CoD.
	CoD of Annual Accumulated Streamflows	Results do not display clear overall trends, but most Quinaries throughout southern Africa could experience a decrease in CoD.	Results indicate most Quinaries throughout southern Africa could experience a decrease in CoD.
	Annual Alt-BFI	Eastern half of the country could experience an increase, while no significant change is projected for the Western and Eastern Cape.	Eastern half of the country could experience an increase, while the no significant change is projected for the Western and Eastern Cape.
Duration of Flow Events	Annual Low Flow Conditions	Moderate increase projected in the eastern half of southern Africa by approximately 50% for all flow durations.	A significant increase by a factor of between 2 and 5 is projected throughout southern Africa, but excluding the Western Cape, which
n Cape Climate Chan	ge Response Strategy		could experience a decrease in

Table 11: Results of recent hydrological assessments (Schulze et al, in press).

Eastern Cape Climate Change Response Strategy

large band of Quinaires running durations. from Limpopo to the Eastern Cape

	for all flow durations.	
Annual High Flow Conditions	Moderate increase projected in the eastern half of southern Africa by approximately 50% for all flow durations. Moderate decrease projected for a large band of Quinaires running from Limpopo to the Eastern Cape for all flow durations.	A significant increase by a factor of between 2 and 5 is projected throughout southern Africa, but excluding the Western Cape, which could experience a decrease in flows by 25-50% for all flow durations.
CoD of Annual Low Flow Conditions	Results do not display clear overall trends, but most Quinaries throughout southern Africa could experience a decrease in CoD for all flow durations.	Results indicate most Quinaries throughout southern Africa could experience a decrease in CoD for all flow durations.
CoD of Annual High Flow Conditions	Results do not display clear overall trends, but most Quinaries throughout southern Africa could experience a decrease in CoD for all flow durations.	Results indicate most Quinaries throughout southern Africa could experience a decrease in CoD for all flow durations.

Rowlston (2011) summarises potential impacts on water resources as follows:

- Increased temperature.
 - Will result in increased evaporation from open water surfaces such as impounding reservoirs, increased evaporation from the land surface reduced surface runoff, and probable increases in crop water requirements with consequential increases in the demand for irrigation water.
- Increased variability of rainfall and runoff
 - The costs of creating additional storage is likely to increase, since impounded volumes will need to be higher to maintain assurance of yield.
- Changes in annual average river flow regimes, and groundwater recharge rates.
 - If the changes are negative they will result in reductions in the availability of water for offstream uses such as domestic water supply and irrigation, and changes in the ecological functioning of rivers and streams.
 - Reduced flow rates will reduce the assimilative capacity of rivers and declines in water quality.
- Changes in the intensity and duration of flood and drought events.
 - Increased frequency and intensity of storm events is likely to increase erosion from land surfaces, resulting in sediment deposition in river channels and eventual reduction in storage capacity of in-channel impoundments.
 - Higher rainfall intensity may increase washoff of pollutants from diffuse sources into rivers, thereby affecting water quality.
 - The frequency and extent of Inundation of riparian zones is likely to increase, with concomitant increases in risk to those living in flood-prone areas.
 - Increases in the length and frequency of rainfall-related drought events will increase the requirement for irrigation water, or reduce agricultural productivity, or both.

5.6.3 Risk Matrix: Water resource systems

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunit y?	Significance (Likelihood x consequence)
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Changes in annual average precipitation	Decreased annual average precipitation to the west of the province resulting in reduced annual stream flow	Reduction in quantity of water in the system	Risk	High
Changes in annual average precipitation	Decreased annual average precipitation to the west of the province resulting in reduced groundwater recharge.	Reduction in quantity of water in the system	Risk	High
Changes in annual average precipitation	Increased annual average precipitation to the east of the province resulting in increased stream flow	Increase in quantity of water in the system	Opportunit y	High
Increased storm severity/ Extreme weather events.	Increased storm flow events	Increased scouring, erosion, turbidity and sedimentation of fresh-water systems.	Risk	High
Longer dry spells and increased likelihood/ severity of droughts	Reduced base flows during dry period	Altered freshwater flow- regimes threatens freshwater and estuarine ecological integrity and general water quality. Exacerbating current water quality issues.	Risk	High
More intense rain	Increased storm flow events	Increased scouring, erosion, turbidity and sedimentation of fresh-water systems.	Risk	High
More intense rain	Increased storm flow events	Altered flow-regimes and increased disturbance may threaten current ecosystem structures and community structure.	Risk	High
Changes in annual average precipitation	Decrease in vegetation cover of catchments in the south- western portions of the province.	Increased storm-flow and decreased, baseflow, together with a decrease in groundwater recharge.	Risk	Medium
Changes in annual average precipitation	Decrease in vegetation cover of catchments in the south- western portions of the province.	Increased sedimentation and turbidity of water resources.	Risk	Medium
Changes in annual average precipitation	Increased variability of inter- annual precipitation to the west of the province will result in an increase in the variability of inter-annual flow-regimes.	Increasing variability of flow regimes is likely to increase the stress on sensitive/highly niche species.	Risk	Medium
Higher mean temperatures	Reduced baseflows due to increased evaporation and decreased soil water balance	Altered freshwater flow- regimes threatens freshwater and estuarine ecological integrity and general water quality.	Risk	Medium
Higher mean temperatures	Higher ambient temperature of freshwater	Reduced concentrations of dissolved oxygen in freshwater. This will reduce water quality and limit the ability of certain freshwater species to exist in aquatic habitats.	Risk	Medium
Higher mean temperatures	Higher ambient temperature of freshwater	Increased eutrophication	Risk	Medium
Higher mean temperatures	Higher ambient temperature of freshwater	Increased biological activity of certain tolerant species causing changes in ecosystem community composition (e.g. algal blooms).	Risk	Medium

Higher mean temperatures	Higher evaporation rates	Increased Total Dissolved Solids/Salinity of freshwater during baseflow periods.	Risk	Medium
More hot days and heat waves	Higher evaporation rates	Increased Total Dissolved Solids/Salinity of freshwater during baseflow periods.	Risk	Medium
More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme	Increased fire frequency may change catchment landcover characteristics, in turn changing surface water flow characteristics	Risk	Medium
Sea level rise	Salt water intrusion into ground water	Reduced quality of groundwater resources	Risk	Medium
Higher mean temperatures	15-35% increase in heat units if Global Warming reaches 2°C.	Increased vigour and spread of alien invasive species resulting in increased stream flow reductions	Risk	low

5.6.4 Relevance to the Provincial Government of the Eastern Cape

It is in the interest of the Provincial Government of the Eastern Cape to ensure that the quantity and quality of water resources, together with the integrity of the biophysical systems that support them, remain adequate for the growth and development requirements of the Eastern Cape. At the same time it is necessary to ensure the adequate supply of basic water services. Climate Change projections indicate that there may be negative impacts to water resources systems in the western portion of the province, while there will be both negative and positive impacts in the central and eastern portions.

The above issues are strongly relevant to the goals of the PGDP, while the water services mandates of district and local municipalities may be threatened by the quantity, quality and unpredictability of available water supplies in the Water Management Areas of the Eastern Cape.

5.7 Agricultural Sector

5.7.1 Background

Approximately 1.7% of the Eastern Cape value added gross domestic product comes through agriculture and 2.9% of the population in the Eastern Cape is working in this sector (Provide, 2009). However, in addition to formal agriculture, it should be noted that Approximately 3.7 million people living in 594,188 (83.5%) rural households in the Eastern Cape have access to land for farming purposes (Stats SA Rural Survey, 1997). Approximately 407,000 (69.4%) of these smallholders have livestock other than poultry and 461,000 (78.4%) of these households grow farm produce (such as maize and sorghum).

The Eastern Cape is accounts for 21% of South Africa's cattle, 28% of its sheep and 46% of its goats, while the province provides approximately a quarter of the national milk supply. In terms of agricultural crops, the province is a major producer of chicory, pineapples, tomatoes, citrus fruit, deciduous fruit and tea (ECDC 2009).

Large-scale agricultural projects currently driven by the Eastern Cape Government include:

- A drive to place 30,000 hectares of land under maize production as part of the ASGISA Eastern Cape project; and
- Pans to make a further 460,000 hectares available for food and biofuel crops as part of its PGDP.

5.7.2 Risks and vulnerability

Perhaps the most pervasive of effects of climate change on agriculture is the gradual increase in mean temperature and changes in moisture condition over time. The full scale of knock-on effects is difficult to extrapolate. Changes in temperature and moisture regimes from current conditions may result in both increases and decreases in agricultural productivity depending on local circumstances and the crop type in place.

Projected climate change will alter the rate at which heat units accumulate, affecting crop yields, timing of farming operations and pest vigour. With a 2°C increase in temperature, on average, most of the agriculturally important parts of the country will experience a 15-35% increase in heat units, with most significant increases on the Highveld and eastern Escarpment which are currently amongst the coolest regions (Midgley *et al* 2007).

Conversely, warming as a result of climate change is predicted to reduce the accumulation of chill units, making it more difficult to produce chill-dependent deciduous fruits such as apples. Furthermore added heat stress will reduce the productivity of perennial and annual crops.

Due to increased evaporation and drying net water requirements for crops in the summer rainfall region are projected to increase throughout southern Africa but particularly in the eastern and central parts of South Africa. Projections for profitability of maize production are sensitive to temperature, rainfall. A 2°C temperature increase is projected to reduce profits by around R500/ha across the highveld maize region (Midgley et al 2007, Rudman 2007).

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunit y	Significance (Likelihood x consequence)
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme, coupled with berg-wind conditions	Risk of major loss of livestock, grazing, crops and infrastructure. Threats to financial sustainability of existing commercial and subsistence farming operation and rural livelihoods; Reduced food security.	Risk	Extreme
Higher mean temperatures	Increased evaporation and decreased soil water balance (particularly to the west)	Reduced net revenue per hectare for existing crop types and shifting/shrinking ranges for certain crops types and cultivars	Risk	High
Higher mean temperatures	Increased evaporation (from both soil and open water sources) and decreased soil water balance (particularly to the west)	Increased irrigation requirements per hectare. Net water requirements of crops are projected to increase.	Risk	High
Higher mean temperatures	Increase in ranges and vigour of pests, diseases and vectors	Increased infestation of pests and diseases and reduced net revenue per hectare	Risk	High
Increased storm severity/ Extreme weather events.	Threats to infrastructure due to wind damage	Increased damage to hydroponics/shade tunnels.	Risk	High

5.7.3 Risk Matrix: Agricultural Sector

More hot days and heat waves	Increased heat stress for crops and livestock,	Risk of crop failure and poorer livestock performance per hectare.	Risk	High
More intense rain	Increased soil erosion	Loss of soil resources and fertility, silting up of dams and irrigation infrastructure	Risk	High
More hot days and heat waves	Increased heat stress among livestock	Reduced productivity and product quality among non-indigenous breeds, and consequent threats to viability of commercial and subsistence farming	Risk	High
More hot days and heat waves	Increased heat stress in dryland and irrigated crops	Reduced crop productivity and quality, and consequent threat to viability of commercial and subsistence farming.	Risk	High
Higher mean temperatures	Increased evaporation of surface water resulting in increased salinisation of irrigated lands.	Reduced yields from irrigated crops in marginal areas.	Risk	High
Fewer cold/frost days	Fewer chill units per year	Decreased yield and or ranges for crops relying on cold weather (e.g. olives & apples)	Risk	High
Increased number of berg wind days	Increased danger of wild fire	Risk of major loss of livestock, grazing, crops and infrastructure. Threats to financial sustainability of existing farming operations.	Risk	High
Increased storm severity/ Extreme weather events.	Crop damage from hail and wind and heavy rain	Increased risk of crop failure; threats to financial sustainability of operations. Threats to viability of subsistence agriculture.	Risk	High
Longer dry spells and increased likelihood/ severity of droughts	Impacts on yield	Increased risk of crop failure and loss of livestock. Threats to financial sustainability of farming operations.	Risk	High
More hot days and heat waves	Increased risk of heat events damaging certain crops	Increased risk of crop failure and reduced net revenue per hectare	Risk	High
More intense rain	Increased flood run off	Threats to crops, livestock and infrastructure	Risk	High
Change in precipitation patterns	Increased inter- and intra- annual variability of rainfall	Reduced viability of dryland crops; Increased economic risks to dryland crop-farming.	Risk	High
Elevated atmospheric CO ₂ Concentrations	Increased plant productivity per hectare	Increased biomass and increased crop yield if considered apart from negative heat and water impacts.	Opportunit y	Medium
Elevated atmospheric CO ₂ concentrations	Increased growth of shrubs and trees in grassland	Increased bush encroachment and spread of alien invasive trees and shrubs.	Risk	Medium
Fewer cold/frost days	Changes in crop planting date	Potential lengthening of the growing season.	Opportunit y	Medium
Higher mean temperatures	Increase in heat units	Changes in the ranges, planting times, flowering and harvest times of crops.	Risk	Medium
Longer dry spells and increased likelihood/ severity of	Decreased water quality	Poorer quality of irrigation water may reduce net revenue per hectare	Risk	Medium

droughts				
Longer dry spells and increased likelihood/ severity of droughts	Increased evaporation and decreased water balance	Increased stress to existing crop regime. Reduced average revenue per hectare over time	Risk	Medium
Sea level rise	Salt water intrusion into ground water	Reduced viability of coastal farming operations relying on ground-water.	Risk	Medium
Higher mean temperatures	Alteration to the ranges of certain species of plant and animal	Potential for introduction of new species for commercial exploitation	Opportunit y	low

5.7.4 Relevance to the Provincial Government of the Eastern Cape

The Agricultural Sector is one of the most important primary resource bases in the Eastern Cape, is an important source of employment, and is critical to rural livelihoods and food security. Climate Change impacts are relevant to the Province in regard to:

- Threat to the goals of the PDGP
- Threat to the goals of Asgisa and the Massive Food Programme
- Threat to the goals of the ECDC.
- General threats to the Eastern Cape Economy.

5.8 Fisheries & Aquaculture Sector

5.8.1 Background

The fishing sector as a whole makes a significant contribution to the economy of South Africa and in the Eastern Cape, it is estimated that conventional fishing and the operation of fish farms contributes 1.82% to the Provincial Gross Value Add (GVA) (EC development plan REF?). According to the Eastern Cape Development Corporation (ECDC) (www.ecdc.co.za), the fishing industry in the province "generates over R400 million (US\$53 million) a year and employs 3 500 people in both primary and secondary production". If one considers this contribution relative to total exports of animals and animal products from the province, it equates to a highly significant 78% of the total R535 million. In addition to the contribution to the GVA, the sector also generates significant employment opportunities. It is estimated that in 2006 nearly 28 000 people were employed nationally by the fishing sector, with 13.6% of these jobs (~3 800) being in the Eastern Province (DEAT, SoE, 2006, http://soer.deat.gov.za).

The industry is currently concentrated around Port Elizabeth and key catch species are cuttlefish and squid that contribute approximately R300 million (72% of industry revenue) followed by sardines (R26 million or 6.3% of industry revenue) (ECDC, 2010). A number of successful aquaculture ventures are also operational within the province. Local conditions are particularly conducive to the operation of fin-fish operations and key factors such as availability of suitable sites, water temperature and the location of the East London and Coega industrial development zones are likely to contribute to the growth of this sector. Recent development in the local aquaculture sector include operations for the growth of prawns, kob and abalone.

5.8.2 Risks, Vulnerability and Opportunities

Fluctuations in rainfall, sea level and sea temperature associated with climate change are likely to have a significant impact on marine ecosystems, with potential consequences for all sectors of the industry (DEAT, 2006 – SoER). One of the most far-reaching impacts will be the continued reduction in the amount of freshwater entering estuaries. These natural systems are frequently the receptors of effluent streams, which are likely to be more concentrated due to

the lack of freshwater to dilute contaminants. This could ultimately lead to a reduction in water quality in estuaries and in-shore marine environments, with negative consequences for local ecosystems. These areas are important for local fisheries and reduced water quality could have a negative impact on local fish resources. According to DEAT (2006), "loss or reduction of estuarine habitats is likely to have serious consequences for fisheries that target estuary-associated species" including the east coast prawn trawl fishery. The total landed value of this particular industry is R8.5 million per year but it is uncertain what proportion of this falls within the Eastern Cape Province.

A change in sea-surface temperature is also predicted to have significant consequences for marine ecosystems and their function. According to DEAT (2006), sea-surface temperatures have increased by approximately 0.25°C per decade over the last four decades. Marine species, particularly those that are most sensitive to temperature, are likely to respond by shifting distribution patterns. As a consequence, the location of traditional fishing grounds may change as could the type and relative abundance of species in a particular area.

Other manifestations of climate change, including increased frequency of storm events and sea-level rise could also have negative impacts on fisheries. Impacts could include physical damage to infrastructure (both off-shore and land-based), and an increase in the number of days that fishing vessels must remain within the shelter of ports. The latter will result in a reduction in the number of fishing days per year and could reduce total annual tonnage of fish caught.

According to IPCC AR4 (2007), the ocean has become more acidic since 1750 with an average decrease in pH of 0.1 units. Although there are currently no reports on the impact of this acidification, it is expected that it will have "negative impacts on marine shell-forming organisms and their dependent species". This may be of relevance to the future success of prawn and abalone fisheries and aquaculture operations in the province.

Positive impacts could include expansion of the number of commercial fish species in certain areas due to changes in sea temperature, and increased demand for land-based aquaculture to secure supply of fish as a result of decreased reliability of natural fish populations.

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunity ?	Significance (Likelihood x consequence)
Higher mean temperatures	Increase in sea-surface temperature	Potential disruption of ecosystems and subsequent changes to local fish stocks in terms of species and abundance	Risk	High
Increased storm severity/ Extreme weather events.	Damage to infrastructure	Financial resources required for replacement or repair	Risk	High
Increased storm severity/ Extreme weather events.	Damage to infrastructure	Disruption of normal commercial activities	Risk	High
Increased storm severity/ Extreme weather events.	Disruption of normal commercial activities ie. Vessels spent more time in the port due to unfavorable or dangerous sea conditions	Loss of income	Risk	High
Increased storm severity/ Extreme weather events.	Disruption of normal commercial activities ie. Vessels spent more time in the port due to unfavorable or dangerous sea conditions	Loss of employment opportunities	Risk	High

5.8.3 Risk Matrix: Fisheries & Aquaculture Sector

Increased storm severity/ Extreme weather events.	Disruption of normal commercial activities ie. Vessels spent more time in the port due to unfavorable or dangerous sea conditions	Closure of marginal business operations	Risk	High
Longer dry spells and increased likelihood/ severity of droughts	Discharge of more concentrated effluent into estuaries due to reduced dilution	Negative impacts of contaminants on coastal ecosystems with subsequent impacts on fish stocks	Risk	High
More intense rain	Increased deposition of silt in rivers and estuaries	Negative impacts on coastal ecosystems with subsequent impacts on the fishing sector	Risk	High
More intense rain	Increased deposition of silt in rivers and estuaries	Increased discharge of sediment to nearshore marine systems resulting in increased turbidity with associated negative impacts on marine ecosystems	Risk	High
Higher mean temperatures	Increase in sea-surface temperature	Expansion of number of species that can be exploited commercially	Opportunity	Medium
Increased storm severity/ Extreme weather events.	Loss of life	Increased demand for social grants to support families of survivors	Risk	Medium
Higher mean temperatures	Increase in sea-surface temperature	Increased demand for cooling of water for land-based aquaculture operations	Risk	low

5.8.4 Relevance to the Provincial Government of the Eastern Cape

Fisheries and aquaculture are important to food security and economic development in the province. As such, threats to the sector pose a risk to the outcomes of provincial development.

- Threat to the goals of the PDGP
- Threat to the goals of the ECDC.
- General threats to the Eastern Cape Economy.

5.9 Forestry Sector

5.9.1 Background

The forestry plantations in the Eastern Cape cover 176,401 ha and represent 13% of South Africa's plantation resource. Forestry and timber products contribute R300 million a year to the national GDP, and the forestry sector employs 8,700 people (ECSECC 2007).


Figure 22: Current and potential extents of plantation forestry in South Africa (Source ECSECC 2007)

Studies have shown that the current extent of commercial forests have the potential to be expanded from 176 401 Ha to roughly 286 000 Ha (*Figure 22*). At full potential, the forestry sector is projected to account for 12000 direct jobs and R1400 million and R 7000 million in forestry and processing respectively (Table 12).

Table	9 12:	Economic	impact o	f new	afforestation	in the	Eastern	Cape	(Source	ECSECC
2007)										

Impact	Existing 175 000 Ha	Up by 100 000 Ha
Jobs Direct	7000	12000
Jobs Indirect	28000	48000
Revenue Forestry	R 300 million	R 1400 million
Revenue Processing	R 1500 million	R 7000 million

5.9.2 Risks and opportunities

The formal forestry sector is sensitive to projected rainfall change. With expected temperature increases 2°C and a reduction in rainfall of 10%, most forestry species show reduced viable production area of between 40% and 100%, but an increase of between 50% and 90% in planting area if rainfall increases by 10% with 2°C warming (Midgely 2007). In addition to temperature and rainfall changes, various studies have shown that forest productivity may increase with increasing concentrations of atmospheric CO_2 given suitable temperature and precipitation regimes (IPCC 2007). However, commercial forests are also prone to extreme events which have been modelled to increase in frequency with climate change. For example severe storm events or wild-fires driven by berg winds may result in the mass destruction of large expanses of standing stocks. The above climate change related risks must also be considered in combination. For example the likelihood of longer and more sever dry periods, coupled with increased dead matter due to disease and storm events, will severely increase the risk and severity of wild-fires driven by berg-winds.

5.9.3 Risk Matrix: Forestry Sector

More hot days and heat waves	Increased frequency of fire danger index reaching high- extreme, coupled with berg- wind conditions	Risk of major and widespread loss of standing stocks and threats to financial sustainability of existing operations.	Risk	Extreme
Increased number of berg wind days	Increased danger of wild fire	Risk of major loss of standing stocks and threats to financial sustainability of existing operations.	Risk	High
Changes in annual average precipitation	Reduced streamflows, especially to the south west of the province.	Forestry, as a legislated form of streamflow reduction, will face increased competition for water use from other sectors such as agriculture and urban demand.	Risk	High
Changes in annual average precipitation	Increased annual average precipitation to the east of the province.	If temperature regimes are suitable, increased standing stocks and yield of forest product per hectare.	Opportunity	Medium
Changes in annual average precipitation	Decreased annual average precipitation to the west of the province.	Reduction in suitable planting areas to the west of the province	Risk	Medium
Higher mean temperatures	Increase in ranges and vigour of pests, diseases and vectors	Defoliation and reduced timber quality, with the possibility of large-scale die back.	Risk	Medium
Higher mean temperatures	15-35% increase in heat units if Global Warming reaches 2°C.	Changes in ranges suitable for forestry	Opportunity	Medium
Elevated atmospheric CO ₂ Concentrations	CO ₂ Fertilisation may increase the growth rate and yield of forests per hectare given suitable precipitation regimes.	Increased standing stocks and forest product for processing per hectare.	Opportunity	low

5.9.4 Relevance to the Provincial Government of the Eastern Cape

Forestry and the processing of forest products are seen as an important element of the Provincial economy. The consequences of climate change are, among others, listed below:

- Increased risk of major loss of standing stocks threatens sustainability of local economy, job creation and livelihoods in certain regions.
- Likelihood of improved forest productivity has positive economic consequences to the east of the province.
- Likelihood of reduced suitable planting areas has negative economic consequences to the west of the province.

5.10 Water Services Infrastructure

5.10.1 Background

The Eastern Cape Province has a population of 6.5 million, of which 3 million have been provided with basic water supply services and 2.14 with sanitation services (DWA, 2010). There is a current backlog of 0.14 million households without basic water services infrastructure and 0.44 million households without basic sanitation services. Numerous infrastructure projects funded by the Municipal Infrastructure Grant system are underway. Table 13 gives a list of capital and expenditure projects for the period 2009/2010. Budget allocations increased from R 59 Million in 2008/9 to R 91 Million in 2009/10.

Table 13: List of capital expenditure and implementation projects for 2009/10 (Source: DWA, 2010)

Scheme	District Municipality	Local Municipality	Project Budget Allocation for 2008/09	Project Budget Allocation for 2009/10	Implementation/ Construction
Sterkspruit Bulk Supply Mains	Ukhahlamba				Design
OR Tambo Mthatha FS	O.R.Tambo		800,000.00	1,500,000.00	Preliminary Design
Sundays River	Cacadu	Sundays River Valley/ Paterson	0	10,000,000.00	Construction
Ibika Water supply	Amatole	Mnquma	3,200,000.00	5,000,000.00	Design
Mncwasa BWS	Amatole	Mbashe	4,300,000.00	10,000,000.00	Tender
Xhora East WS	Amatole	Mbashe	3,400,000.00	25,000,000.00	Tender
Mbhashe North	Amatole	Mbashe	4,000,000.00		Construction
Chris Hani Tsomo RDP2 (Amahlathi,IntsikaYethu, Emalahleni)	Chris Hani	Intsika Yethu			Construction/ Completed
Mbizana Regional Bulk WS	O.R.Tambo	Mbizana	4,800,346.00	22,000,000.00	Design 35%
OR Tambo regional extensions (Coffee Bay)	O.R.Tambo	King Sabata Dalindyebo	18,304,255.00	10,750,000.00	Tender
OR Tambo Mthatha Bulk Water Intervention	O.R.Tambo	King Sabata Dalindyebo/ Mhlontlo/ Nyandeni	21,095,399.00	7,250,000.00	Construction
Total			59,900,000.00	91,500,000.00	

The ability of the Department of Water Affairs and the six Water Services Authorities in the province to expand and sustain water and sanitation services in the Eastern Cape is strongly dependent on state of the water resources in the relevant Water Management Areas (see section 5.6). It is therefore critical that those responsible for water services infrastructure take into account future climate change scenarios related to water resources. Climate Change is also likely to have secondary and tertiary impacts on the technical and operational integrity of installed water services infrastructure.

5.10.2 Risks and Opportunities

The risks and opportunities outlined here are in many instances knock-on effects of climate change impacts to water resources in general. For more details of primary and secondary impacts to water resources, see section 5.6). Impacts detailed below are adapted from Cromwell et al, 2007 and IPCC 2007.

5.10.2.1 Rising Sea Levels

- Increased saline intrusion into groundwater aquifers
 - Water treatment challenges: need for desalination
- Increased salinity of brackish surface water sources
 - Water treatment challenges: need for desalination
- Increased risk of direct storm and flood damage to water utility facilities

5.10.2.2 Warmer overall

- Changes in flow regimes due to upstream changes
- Changes in recharge characteristics of major groundwater aquifers due to upstream changes

5.10.2.3 Increased water temperature

- Increased evaporation and eutrophication in surface sources
- Water treatment and distribution challenges (disinfection, byproducts, regrowth)
- 5.10.2.4 Possible increased water demand

- Increased irrigation demand
- Increased urban demand with more heat waves and dry spells
- Increased drawdown of local groundwater resources to meet the above

5.10.2.5 More intense rainfall events:

- Increased turbidity and sedimentation
 - Loss of capacity of storage dams
 - Increased water treatment costs
- Shallower, warmer water; increased evaporation and eutrophication
- Increased risk of direct flood damage to water services and treatment facilities.

5.10.2.6 Increased inter-annual variability of streamflow.

- Unpredictability of annual water supply to storage dams
 - Increased storage capacity required for assurance of the same supply, with associated increases in unit cost of supply.

5.10.3 Risk Matrix: Water Services Infrastructure

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunity ?	Significance (Likelihood x consequence)
Longer dry spells and increased likelihood/ severity of droughts	Longer periods without stream flow	Risk of inadequate raw water reserves for water services	Risk	High
More intense rain	Increased storm flow events	Increased siltation of water storage dams, reducing water storage capacity.	Risk	High
More intense rain	Increased storm flow events	Increased risk of direct flood damage to low-lying infrastructure.	Risk	High
Sea level rise	Together with increased rain intensity and storm events, increased coastal flooding	Risk of direct flood damage to water and sanitation infrastructure	Risk	High
Changes in annual average precipitation	Decreased precipitation in the south-western portion of the province increases risk of inadequate water supply	Increased cost of water supply	Risk	Medium
Changes in annual average precipitation	Decrease in vegetation cover of catchments in the south- western portions of the province.	Increased storm-flow and decreased, baseflow will cause water storage challenges	Risk	Medium
Changes in annual average precipitation	Decrease in vegetation cover of catchments in the south- western portions of the province.	Increased sedimentation and turbidity results in sedimentation of water storage dams.	Risk	Medium
Changes in annual average precipitation	Decrease in vegetation cover of catchments in the south- western portions of the province.	Increased sedimentation and turbidity results in water treatment challenges	Risk	Medium

Changes in annual average precipitation	Increased variability of inter- annual precipitation to the west of the province will result in an increase in the variability of inter-annual flow-regimes.	Decreased predictability of annual flows requires an increase in storage capacity for assurance of the same supply, at a higher cost.	Risk	Medium
Higher mean temperatures	Higher ambient temperature of freshwater	Water treatment and distribution challenges such as disinfection and byproducts.	Risk	Medium
Longer dry spells and increased likelihood/ severity of droughts	Increased evaporative losses to surface water	Reduced availability of raw water and reduced water supply	Risk	Medium
More hot days and heat waves	Increased urban demand for water services	Increased delivery challenges	Risk	Medium
More hot days and heat waves	Increased irrigation requirements	Increased competition for water allocations	Risk	Medium

5.10.4 Implications for the Provincial Government of the Eastern Cape

The broad range of second, third and fourth order impacts that could be produced by climate change on the water services sector are extensive. The threats to the sustainability of water services and resultant socio-economic consequences, particularly to the south-west of the province, are considered to be high.

5.11 Transport infrastructure

5.11.1 Background

For the purpose of this report, transport infrastructure includes roads, rail, airports, pipelines and sea ports. Any negative impacts on this infrastructure would have significant negative impacts not only for those directly involved in transportation of goods and people but also for all other sectors that rely on transport. These include manufacturing, agriculture, tourism and even health and emergency services.

Transport infrastructure serving the major industrial cities of the Eastern Cape, East London and Port Elizabeth, is well-developed and includes an airport and sea-port in each. In addition to the Port of Port Elizabeth, the nearby Coega IDZ is also served by the Port of Ngqura, a deep-water port. The high quality of this transport infrastructure is one of the keys to the future development of the IDZs in both cities. According to the ECDC, statistics show that in 2006, 17.3% of the provincial GDP was attributed to the manufacturing sector, mostly related to automotive and components sector and to a lesser extent textiles, clothing, chemicals and machinery. The growth of this sector will be highly dependent of efficient transportation of raw materials and finished products. Tourism, another potential growth sector, is also highly dependent on transport infrastructure.

Rail infrastructure in the province is extensive and is important for movement of commuters, mainline passengers and freight (ECDC, 2010). The main lines connect the cities of Port Elizabeth and East London with Gauteng. All three ports are serviced by rail infrastructure but as the main lines from the ports of East London and Port Elizabeth run close to the shoreline, they are considered vulnerable to damage resulting from more frequent storm events and, potentially, sea-level rise. The road network is also extensive but only 10% are paved.

Due to the extreme importance of transport infrastructure to the economy, the potential impact of climate change on this infrastructure has received considerable attention internationally.

5.11.2 Risks, Vulnerability and Opportunities

The United States Department of Transportation (DOT) conducted an extensive literature, review covering 1987 – 2006, to identify possible impacts to transport infrastructure. The study identified 42 possible infrastructure impacts, many of which were then associated with multiple operational impacts. Infrastructure impacts that are potentially relevant to the Eastern Cape include but are not limited to rutting and cracking of asphalt, rail buckling, failure of signals, a need for longer runways, thermal expansion of bridges, flooding and increased risk of subsidence. The increased frequency of storm events and higher wind speeds were linked to impacts such as damage to roads, pipelines, signals, electronics and signs. Positive impacts included the possible increase in the depth of ports due to sea-level rise that would allow ports to accept vessels with a deeper draft.

In 2010 a comprehensive climate change risk assessment was conducted for all of the ports in South Africa (CES, 2010), and included a preliminary assessment of the risks for the Ports of East London, Ngqura and Port Elizabeth. For the purpose of this study, risks were divided into systematic risks i.e. those that were affected by macro-concerns that could influence the entire economy, and specific risks associated with the ports themselves. Key systematic risks included increased awareness of climate change-related risks by the financial sector and subsequent increases in insurance premiums, scarcity of fresh water and a demand for reduced carbon footprints. Important specific risks for the Eastern Cape ports included erosion of coastal transport infrastructure (road and rail) and storm-related damage and disruptions including direct damage to quays, disruption of shipping schedules, closure of ports, disruption of communications and disruption of services including power and water.

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunit y?	Significance (Likelihood x consequence)
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Reduced safety of personnel and increased frequency of injury or loss of life	Risk	Extreme
Change in precipitation patterns	Increased frequency of vehicle accidents due to poor road conditions or reduced visibility	Loss of life, injury or spillage of product including hydrocarbons	Risk	High
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Flooding of coastal transport routes	Risk	High
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Storm water systems stretched beyond capacity	Risk	High
Increased storm severity/ Extreme weather events.	Increased wind speeds	Damage to infrastructure such as power lines or masts with subsequent loss of power or communications	Risk	High
Change in precipitation patterns	Flooding of key transport routes in vicinity of ports including roads and rail	Increased frequency of vehicle accidents	Risk	low
Change in precipitation patterns	Damage to sub-surface pipelines due to scouring of pipeline bed or exposure	Disruption of services including power, water and sanitation	Risk	low
Change in precipitation patterns	Damage to sub-surface pipelines due to scouring of pipeline bed or exposure	Spillage of products including hydrocarbons	Risk	low
Change in precipitation	Increased subsidence and landslides	Reduced area available for productive economic activity	Risk	low

5.11.3 Risk Matrix: Transport Infrastructure

patterns				
Change in precipitation patterns	Increased subsidence and landslides	Loss of life or injury	Risk	low
Change in precipitation patterns	Increased subsidence and landslides	Resources required for clearing of material and stabilisation of slopes	Risk	low
Change in precipitation patterns	Increased subsidence and landslides	Temporary closure of roads and rail resulting in delays	Risk	low
Change in precipitation patterns	Increased subsidence and landslides	Resources required for repair of infrastructure	Opportunity	low
Change in precipitation patterns	Flooding of construction works or work stoppages	Delay in completion of projects	Risk	low
Change in precipitation patterns	Deterioration of concrete structures	Increased financial costs related to repair	Risk	low
Change in precipitation patterns	Increased storm water flow	Increased transportation of pollutants into the port	Risk	low
Higher mean temperatures	longer runways required	Increased expenditure to upgrade facilities	Risk	low
Higher mean temperatures	longer runways required	Increased requirements for land	Risk	low
Higher mean temperatures	More frequent overheating of diesel engines	Increased frequency of stoppages and breakdowns	Risk	low
Higher mean temperatures	Additional cold storage requirements	Increased requirements for land	Risk	low
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Release of pollutants due to damage of infrastructure or vehicles	Risk	low
Increased storm severity/ Extreme weather events.	Lightning / electrical disturbances	Damage to electrical and electronic infrastructure and loss of power	Risk	low
Sea level rise	Higher tides at port and harbour facilities	Improved or reduced access to vessels depending on design and size,	Risk	low
Change in precipitation patterns	Flooding of key transport routes in vicinity of ports including roads and rail	Increased travel time due to road closures, speed restrictions & malfunction of signals.	Risk	Medium
Change in precipitation patterns	Direct destruction of property and infrastructure due to flooding	Disruption or closure of transport routes and regular port operations and costs associated with repair or claims	Risk	Medium
Change in precipitation patterns	Increased storm water flow	Changes to patterns and quantities of silt deposition within ports	Risk	Medium
Higher mean temperatures	Damage to key transport routes into and out of ports due to eg. rail buckling and expansion of bridges	Increased travel time due to delays, derailments, failure of track sensors and signals	Risk	Medium
Higher mean temperatures	Additional cold storage requirements	Increased energy consumption	Risk	Medium
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Direct damage to infrastructure including quay walls	Risk	Medium

Increased storm severity/ Extreme weather events.	Increased wind speeds	Congestion within ports	Risk	Medium
Sea level rise	Erosion of coastal transport infrastructure (roads and rail)	Increased travel time and delays due to road closures and speed restrictions	Risk	Medium
Sea level rise	Higher tides at port and harbour facilities	Increased frequency of over- topping leading to damage to infrastructure and injury	Risk	Medium
Sea level rise	Increased depth of the port	Use of port by larger vessels and reduced requirements for dredging	Opportunity	Medium

5.11.4 Relevance to the Provincial Government of the Eastern Cape

The PGDP explicitly recognises the role of infrastructure in unlocking economic growth and social development. The PGDP places emphasis on:

- Major road links
- Rail links
- Airports
- Seaports

Furthermore, the PGDP recognises the importance of good rural access roads as integral to poverty alleviation and rural livelihoods.

As outlined in the section above, climate change poses a threat to the integrity and expansion of transport infrastructure.

5.12 Energy services Infrastructure

Although energy consumption in the Eastern Cape is dominated by commercial and industrial sectors, it should also be noted that access to household energy is disparate, with numerous households relying on primary forms of energy such as fuelwood and paraffin. Figure 23 shows that although most households utilise electricity for lighting, there remains a significant number of households relying on paraffin and candles. It is notable that a large proportion of the households relying on paraffin and candles are situated to the east of the province.



Figure 23: Energy sources for lighting in households in the Eastern Cape, 2007 (Source ELIDZ 2009)

Figure 24 indicates total energy supplied to the Eastern Cape Province in 2008/9. Energy supply is dominated by electricity, petrol and diesel, with smaller proportions of paraffin, LPG, coal and heavy fuel oil.



Figure 24: Eastern Cape provincial energy supply by energy carrier expressed in Megajoules (Data sources: Eskom 2009, South African Petroleum Producers Association 2008).

Table 14 indicates energy supply to the province in physical units. In 2008/9, 8,599,000 MWh of electricity, 845,000,000 litres of petrol and 652,000,000 litres of diesel were delivered to the province.

Table 14: Eastern Cape energy supply in physical units (Data sources: Eskom 2009, South African Petroleum Producers Association 2008; compiled for ELIDZ, 2009).

Energy Carrier	Quantity	Unit
Electricity - National grid	8,411	GWh
Electricity - Small hydro	187	GWh
Total electricity (purchases)	8,599	GWh
Petrol	845	MI
Diesel	652	MI
Paraffin	131	MI
LPG	9	MI
Heavy fuel oil	24	MI
Coal	97,700	tons
Natural gas	0	tons

5.12.1 Risks and vulnerabilities

Numerous secondary and third order impacts are likely to threaten the security of energy supply in the province. Namely:

5.12.1.1 Sea level rise and storm surges

Sea level rise and storm surges may threaten the delivery and movement of liquid fuels. For example transport fuels and heavy fuel oil are delivered to the Eastern Cape Province by sea.

With rising sea levels and storm surges, the port infrastructure for the delivery and transfer of these fuels may be threatened. Likewise transport infrastructure for the distribution of fuels, such as roads and railways crossing estuaries and low lying coastal areas may be threatened.

5.12.1.2 Increased wild-fires

Increased wild fires may impact low voltage transmission lines traversing forests and vegetation prone to wildfire. This is particularly the case when wooden, rather than steel or concrete pylons are utilised.

5.12.1.3 Increased average temperature and heat waves

Increased average temperature and heat waves are likely to increase electricity demand for chilling and air conditioning purposes. In particular, demand scenarios related to air conditioning and chilling are likely to increase peak demand, placing severe strain on national reserve generation capacity. In consequence, it is possible that reserve power generation capacity will be required which will experience high levels of inter-peak redundancy.

5.12.1.4 Increased mean temperature and precipitation to the east of the province

It is possible that projected climate changes may result I an increase in biological productivity to the east of the province. This in turn may result in potential for an increase in the availability of biofuel, biogas and biomass energy feedstocks for energy generation in response to provincial needs.

Similarly, changing patterns may result in an increase in streamflows for hydro-electric generation. This is, however, countered by reduced water quality associated with increased storm-flow events.

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Risk or opportunity ?	Significance (Likelihood x consequence)
Sea level rise	Together with storm surges, inundation of liquid fuel delivery and transfer infrastructure in ports	Reduced security of liquid fuel supply	Risk	High
Changes in annual average precipitation	Increased annual average precipitation to the east of the province resulting in increased stream flow	Potentially improved viability of hydro-electric power generation	Opportunity	Medium
Changes in annual average precipitation	Increased annual average precipitation to the east of the province, together with increased mean temperature, may increase biological productivity	Increased availability of biomass, biofuel and biogas feedstocks for local and provincial energy generation and refining.	Opportunity	Medium
Higher mean temperatures	Increased demand event for chilling, air conditioning, water services.	Increased power demand over and above existing growth projections - increased stress on reserve generation capacity and transmission infrastructure.	Risk	Medium
Increased storm severity/ Extreme weather events.	Storm surges, together with sea level rise and increased flood frequency, may result in direct damage to energy transmission and distribution systems.	Threats to provincial energy security	Risk	Medium

5.12.2 Risk Matrix: Energy services Infrastructure

More hot days and heat waves	Increased demand for chilling, air conditioning, water services.	Increased peak demand may place severe stress on reserve generation margins and transmission infrastructure	Risk	Medium
Higher mean temperatures	Reduced energy demand for leating	Reduce stress on reserve generation capacity in winter months	Opportunity	low
Increased number of berg wind days	Increased danger of wild fire	Possible damage to electricity transmission infrastructure	Risk	low
Increased storm severity/ Extreme weather events.	Threats to electricity transmission infrastructure as a result of wind damage, such as trees falling onto power- lines.	Increased power outages	Risk	low

5.12.3 Relevance to the provincial government of the Eastern Cape

The security of energy supply is considered to be of strategic significance. As noted by DEDEA 2008:

"Energy security is high on the political agenda of the country and the province as whole. As the issue of energy affects different sectors of civil society and the economy, and not only economic growth and development, the Department of Economic Development and Environmental Affairs (DEDEA) considers it important that the question of energy is addressed in an integrated manner. Efforts to position the Province as a compelling place to live, work and invest require particular focus on a common approach to energy efficiency, the sustainable use of non-renewable energy sources, alternative energy sources, and other areas of intervention".

The potential risks and opportunities associated with climate change must be considered in provincial energy planning.

6 EASTERN CAPE GREENHOUSE GAS INVENTORY

6.1 Introduction

As part of the development of the Eastern Cape Climate Change Strategy, the Eastern Cape Department of Economic Development and Environmental Affairs would like to develop the greenhouse gas (GHG) inventory for the Eastern Cape Province.

There are two commonly used methods for calculating emissions, namely the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Emission Inventory Reporting and the 'Greenhouse Gas (GHG) Protocol Corporate Accounting Standard' developed by the World Business Council for Sustainable Development and the World Resources Institute.

The GHG Protocol is best suited for use by individual organisations and industries and focuses on determining emissions from specific activities (e.g. electricity generation, combustion of fuel in vehicles etc). The IPCC Inventory Guidelines look at emissions from a sector level and is best suited to categorisation of emissions on a regional and national basis as it focuses on direct emissions and reduces the risk of double counting. Using the IPCC methodology also allows for emissions from individual activities to be disaggregated into sectors to allow for more detailed analysis.

Upon review of regional GHG inventories developed for cities and provinces around the world and in discussion with the South African National Department for Environmental Affairs, it is considered appropriate for the Eastern Cape Province GHG Inventory to be developed in line with the IPCC Guidelines.

This chapter discusses the context within which GHG Inventories are developed internationally and outlines the work currently underway on a national level to formalise the processes within which the South African National GHG Inventory is developed. The final section outlines the recommended framework within which the Eastern Cape Provincial GHG Inventory should be developed in order to reduce duplication of effort and to feed directly into the National GHG Inventory development.

6.2 GHG Inventories – Context

6.2.1 International

South Africa is party to the United Nations Framework Convention on Climate Change (UNFCCC) and is required to develop, periodically update, and publish national inventories of anthropogenic greenhouse gas (GHG) emissions.

The Intergovernmental Panel on Climate Change (IPCC) has developed procedures and best practice guidance to assist countries with the development of national GHG Inventories. The 1996 IPCC Guidelines were revised and new guidelines incorporating best practice and lessons learned were issued in 2006. The 2006 IPCC Guidelines have yet to be approved by the UNFCCC and as such the vast majority of countries continue to use the 1996 IPCC Guidelines. South Africa made the decision to calculate its third National GHG Inventory in accordance with the 2006 Guidelines despite the fact that they are awaiting approval. The delay between publication and approval relates to the lengthy international negotiation process and the current focus on achieving an internationally binding emission reduction agreement. It is unlikely that there will be significant changes requiring amendment to inventories calculated in accordance with these guidelines following approval which is estimated to be in 2012.

One of the most significant changes in the 2006 IPCC Guidelines, relative to the 1996 IPCC Guidelines, was the restructuring of inventory sectors, in particular the combining of agriculture, forestry, and land use change, into one sector. GHG emissions have been classified into the following four categories:

Energy: emissions within this sector are from the combustion of fuel and fugitive fuel emissions from stationary and mobile energy activities including: public electricity and heat

production; petroleum refining; manufacture of solid fuels; other energy industries; manufacturing industries and construction; transport; commercial; residential; agriculture; forestry; fishing; and fugitive emissions from coal mining, coal-to-liquid, oil and natural gas activities.

Industrial Processes and Product Use (IPPU): emissions within this sector comprise byproduct or fugitive emissions of GHGs from industrial processes. Emissions from the combustion of fuel in industry are reported under Energy. Emissions from the mineral, metal and chemical sectors have been reported in the 2000 GHG Inventory.

Waste: emissions within this sector are from waste management including disposal of solid waste on land and wastewater treatment.

Agriculture, Forestry and other Land Use (AFOLU): emissions from this sector include anthropogenic emissions from agricultural activities except for fuel combustion (reported under Energy) and sewage emissions (reported under Waste). Activities include enteric fermentation, manure management, agricultural soils, prescribed burning of savannas and field burning of agricultural residues. This sector also includes total emissions from and removals by forest and land use change activities including changes in forest and other woody biomass stocks, forest and grassland conversion, and emissions from and removals by soil.

6.2.2 Regional GHG Inventories

A number of regions around the world have developed GHG Inventories.

The Greenhouse Gas Regional Inventory Protocol (GRIP (1)) presents a methodology to allow regions across Europe to develop and prepare emission inventories on a consistent and comparable manner. The methodology is broadly based on the IPCC guidelines and tools have been developed to allow compilers to input activity data and for emissions to be calculated automatically. This methodology incorporates Europe specific emission factors and other inputs and is not appropriate for use in the South African context.

The Wellington Region in New Zealand has developed its regional GHG inventory using local data and the IPCC sub sector emission sources and calculation methodologies.

A number if areas within the Unites States of America (e.g. San Francisco Bay Area, San Diego, Seattle and District of Columbia) have developed emission inventories with more of a focus on industrial emissions given the availability of data through existing reporting procedures.

With the exception of the GRIP project, there is no consistently used methodology for developing an emission inventory on a regional level.

6.3 South Africa's National GHG Inventory

6.3.1 Existing GHG Inventories

The National Department for Environmental Affairs (DEA) is responsible for the development of South Africa's National GHG Inventory. South Africa has developed three national

⁽¹⁾ See: <u>http://www.grip.org.uk/inventory.html</u>

inventories covering the years 1990, 1994 and 2000. The first inventory was published in 1998 using 1990 data and the second was published in 2004 using 1994 data. The 1990 and 1994 inventories were developed using the 1996 IPCC Guidelines for National GHG Inventories (IPCC, 1996) and were summarised in South Africa's Initial National Communication to the UNFCCC (DEAT, 2000).

The first inventory was published in 1998 using 1990 data. It was updated to include 1994 data and the second national inventory was published in 2004. The 1990 and 1994 inventories were developed using the 1996 IPCC Guidelines for National GHG Inventories.

South Africa's third national inventory greenhouse gas inventory has been developed for the year 2000 (2000 GHG Inventory). The 2000 GHG Inventory has been developed using the 2006 IPCC Guidelines. It was published for public comment in 2009 and following independent review is due for publication in 2010. South Africa is one of the first countries to develop a national inventory using the 2006 IPCC Guidelines.

Data availability has been a key challenge in developing the 2000 GHG Inventory with most of the data only being available at an aggregated national level rather than point source level. This has made it difficult to disaggregate data (particularly in the energy sector), and in a number of cases no information was available leading to the omission of some sources (e.g. the electronics industry, health sector and some industrial activities).

An independent review of the 2000 GHG Inventory was conducted by Environmental Resources Management Southern Africa (Pty) Ltd (ERM) and a series of suggested improvements for future inventories recommended. Key to improving data quality is the suggested development of a national inventory management and data collection framework which requires individual emitting entities above a certain threshold to submit data to government.

6.3.2 Future South African GHG Inventories

DEA have a number of plans in place to improve the completeness and accuracy of the information presented in the inventory and to simplify the data collection process.

The first step is to complete the time series of the national inventory so that an annual emissions inventory is available from 2000 to the present. This will initially require a retroactive data collection process and going forward the implementation of a national inventory management and data collection process allowing data to be collected and reviewed and the inventory to be calculated on an annual basis.

Following the National Climate Change Summit in March 2009, DEA are developing climate change policies to assist the country with meeting its voluntary commitments to reduce emissions going forward. It is thought that the Green Paper to be published in June 2010 will include an obligation on organisations to report emissions - initially on a voluntary basis with mandatory reporting following for large energy users and heavy industry. As time progresses, the number and type of organisation required by law to report data is likely to expand.

DEA are currently developing the Terms of Reference for a web-based inventory management and data collection portal which will hold a wide range of information relating to the emission of greenhouse gases and other pollutants by industry and other organisations in South Africa. This portal will provide those companies and organisations required to report data with an easily accessible platform in which to provide data and will allow DEA to develop national inventories in a simplified manner.

Future GHG Inventories will be calculated in accordance with the 2006 IPCC guidelines and/or any future revisions to these.

DEA will be issuing the Terms of Reference in spring 2010 with the aim of beginning data collection for the 2001 – 2009 National GHG Inventories in February 2011.

6.4 Recommended approach to calculating the ECP GHG Inventory

6.4.1 Approach

It is recommended that the Eastern Cape GHG Inventory be developed in close consultation with DEA and that the data collected feed directly into the National GHG Inventory in order to reduce duplicate effort. It is recommended that an annual inventory be developed for the years 2001 – 2008 with an additional year added each year that passes (e.g. add 2009 in 2011, 2010 in 2012 etc).

Data collection for the GHG Inventories is a critical challenge and improving the National Inventory will require industry and other organisation to improve their internal monitoring and reporting processes. During development of the 2000 GHG Inventory, a number of stakeholders commented that it would be useful to develop local/regional GHG Inventories in order to allow for more specific actions to be implemented and reductions monitored. Some industry associations voiced significant concern at the increased reporting burden that this could place on their already stretched resources and requested that there be one streamlined reporting procedure.

The value of developing Regional Inventories, however, still remains and it is recommended that, in order to overcome the duplicate data requests, the Eastern Cape Department of Economic Development and Environmental Affairs work closely with DEA to facilitate data collection in the province and feed this upwards for inclusion in the National Inventory.

6.4.2 Methodology

It is important that The Eastern Cape GHG Inventory is developed in accordance with the 2006 IPCC Guidelines and is approached in the same manner as South Africa's National GHG Inventory.

In order to ensure consistency, Jongikhaya Witi from DEA's Atmospheric Quality Information Greenhouse Gas Accounting Directorate should be invited to participate in meetings regarding development of the Eastern Cape Inventory. Jongikhaya has been involved in the development and review of national inventories internationally and is well placed to provide technical advice and guidance during the process. His contact details are: telephone: 012 310 3083; cell: 083 991 9913; email: JWiti@deat.gov.za.

Error! Reference source not found. lists the greenhouse gases that should be reported in a GHG Inventory. The IPCC guidelines recommend that other air pollutants are reported at the same time to gain a full understanding of the emissions from the activities in question.

Table 15 : GHG and air pollution emissions to be reported

Carbon Dioxide - CO_2 emissions Carbon Dioxide - CO_2 removals Methane - CH_4 Nitrous Oxide - N_2O Hydrofluorocarbons HFCs Perfluorocarbons - PFCs Sulphur Hexaflouride - SF_6 Carbon Monoxide - CONitrogen Oxides - NOX Non-methane volatile organic compounds -NMVOCs Sulphur Oxides - SOx

The 2006 IPCC Guidelines divide emission sources and sinks into sectors within similar characteristics. These sectors are aggregated into four broad categories: Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU) and Waste Sectors; with subsectors within each.

summarises the sectors with emission sources and sinks to be included in GHG Inventories. Given data availability issues, only those sectors in italics and emissions of CO_2 , CH_4 , N_2O and PFCs from Metal Production were included in the 2000 GHG Inventory. The aim is to develop a more complete and comprehensive inventory in the future which includes all gases in all categories.

Emission calculation templates have been developed in conjunction with the 1996 IPCC guidelines to provide a standard methodology for calculating emissions in inventories across the globe. As discussed above, the 2006 IPCC Guidelines have yet to be approved by the UNFCCC and as a result emission calculation templates have yet to be developed specific to these guidelines. During development of the 2000 GHG Inventory for South Africa, the inventory compilers adapted the 1996 IPCC calculation templates to meet the requirements of the 2006 Guidelines.

The adapted calculation templates for the IPPU and AFOLU sectors are attached at Appendix 2. These templates provide the framework within which is it recommended that the Eastern Cape GHG Inventory is calculated as they summarise the activity data required and include the equations for conversion of activity data into emissions.

EnergyA. Fuel combustion activities1. Energy industriesa. Main activity electricity and heat productionb. Petroleum refiningc. Manufacture of solid fuels2. Manufacturing industries and constructiona. Iron and steelb. Non-ferrous metalsc. Chemicalsd. Pulp, paper and printe. Food processing, beverages and tobaccordf. Non-metallic mineralsg. Transport equipmenti. Mining (ex. fuels) and quarryingj. Wood and wood productsk. Constructionl. Textile and leatherm. Non-specified industry3. Transporta. Civil aviationb. Road transportationc. Railways
 Energy industries Main activity electricity and heat production Petroleum refining Manufacture of solid fuels Manufacturing industries and construction Iron and steel Non-ferrous metals Chemicals Pulp, paper and print Food processing, beverages and tobacconf. Non-metallic minerals Transport equipment Mining (ex. fuels) and quarrying Wood and wood products Construction Textile and leather Non-specified industry Transport Civil aviation Road transportation Railways
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 e. Food processing, beverages and tobacco f. Non-metallic minerals g. Transport equipment i. Mining (ex. fuels) and quarrying j. Wood and wood products k. Construction l. Textile and leather m. Non-specified industry 3. Transport a. Civil aviation b. Road transportation c. Railways
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3. Transport a. Civil aviation b. Road transportation c. Railways
a. Civil aviation b. Road transportation c. Railways
 b. Road transportation c. Railways
c. Railways
d. Water-borne navigation
e. Other transportation
4. Other sectors
a. Commercial / Institutional
b. Residential
c. Agriculture / Forestry / Fishing / Fish farms
5. Non-specified
a. Stationary
b. Mobile
c. Multilateral operations
B. Fugitive emissions from fuels
1. Solid fuels
a. Coal mining and handling
b. Spontaneous combustion and burning coa
2. Oils and natural gas
a. Oil
b. Venting
c. Flaring
d. All other
e. Natural gas
3. Other emissions from energy production

Table 16: GHG Emission and Sink Categories

Sector	tor Source/Sink		
Energy	C. Carbon dioxide transport and storage		
(cont)	1. Transport of CO ₂		
	a. Pipelines		
	b. Ships		
	c. Other		
	2. Injections and storage		
	a. Injection		
	b. Storage		
	3. Other		
Industrial	A. Mineral Industry		
and	1. Cement		
Product	2. Lime		
Use (IPPU)	3. Glass		
	4. Other Carbonate use		
	B. Chemical Industry		
	1. Ammonia		
	2. Nitric Acid		
	3. Adipic Acid		
	4. Caprolactam, Glyoxal and Glyoxylic Acid		
	5. Ammonia		
	6. Titanium Dioxide		
	7. Soda Ash		
	8. Petrochemical and Carbon Black		
	9. Fluorochemical production		
	C. Metal Industry		
	1. Iron and Steel		
	2. Ferroalloys		
	3. Aluminium		

Sector	Source/Sink
Industrial	4. Magnesium
Processes	5. Lead
Product	6. Zinc
Use (IPPU	D. Non-Energy Products
(Cont)	1. Lubricant Use
	2. Paraffin Wax
	E. Electronics Industry
	1. IC or semiconductor
	2. TFT Flat Panel Display
	3. Photovoltaics
	4. Heat transfer fluid
	F. Fluorinated Substances
	1. Aerosols
	2. Solvents
	3. Other applications
	G. Other (please specify)
	1. Electrical equipment
	2. Other SF6 and PFC's
	3. N2O
Agriculture,	A. Livestock
Forestry	1. Enteric fermentation
Land Use	2. Manure Management
(AFOLU)	B. Land
	1. Forest land
	a. Forest land remaining forest land
	b. Land converted to forest land
	2. Crop land
	a. Crop land remaining crop land
	b. Land converted to crop land
	3. Grassland
	a. Grassland remaining grassland
	b. Land converted to grassland
	4. Wetlands
	a. Wetlands remaining wetlands
	b. Land converted to wetlands
	5. Settlements

Sector	Source/Sink
Agriculture,	a. Settlements remaining settlements
Forestry and Other	b. Land converted to settlements
Land Use	6. Other land
(AFOLU)	a. Other land remaining other land
(Cont)	b. Land converted to other land
	C. Aggregate sources and non- CO ₂ source emissions on land
	1. Biomass Burning
	a. Forest land
	b. Crop land
	c. Grassland
	d. Wetlands
	2. Liming
	3. Urea Fertiliser
	4. Direct N2O Emissions from Managed Soils
	5. Indirect N2O Emissions from Managed Soils
	6. Indirect N2O Emissions from Manure Management
	7. Rice Cultivation
Waste	A. Solid waste disposal
	1. Managed waste disposal sites
	2. Unmanaged waste disposal sites
	3. Uncategorised waste disposal sites
	B. Biological treatment of solid waste
	C. Incineration and open burning of waste
	1. Waste incineration
	2. Open burning of waste
	D. Wastewater treatment and discharge
	1. Industrial wastewater treatment and discharge
	2. Domestic wastewater treatment and discharge
	E. Land

6.5 Preliminary GHG Inventory for the Eastern Cape

6.5.1 Introduction

This section reports the results of a preliminary inventory for the Eastern Cape, which is discussed in the context of the National Greenhouse Gas Inventory year 2000 Report for South Africa. It should be emphasised that the development of an inventory at a similar level of rigour and detail as the National Inventory is a vast task requiring a staff complement working over months and years. In contrast the initial inventory for the EC has been undertaken as a task within the limited scope and budget of an overall Eastern Cape Climate Change Response Strategy. As such the results reported here are not authoritative, but rather are given for illustrative purposes.

6.5.2 Detail and Methodology

6.5.2.1 Overall Methodology

The preliminary Eastern Cape GHG inventory was guided by the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. The structure of the inventory was adapted from an

integrated format developed by Landcare Research in New Zealand for regional reporting, and which represents a consolidation of the IPCC protocol spreadsheets and reporting structure.

6.5.2.2 Emission Factors

Emission factors and fractions were drawn from IPCC 2006 defaults, from the South African Greenhouse Gas Inventory Report for the year 2000, and from other South African Sources.

6.5.2.3 Activity Data

Activity data sources are detailed in each section below.

6.5.2.4 Quality Control and Uncertainty

The confidence in, and appropriateness of, the activity data for the inventory is detailed in each section as a confidence level. Confidence in energy data is high, while confidence in others is low.

Cross checks and data quality verification did not form part of the scope of this study.

6.5.3 National Overview

The Greenhouse Gas emissions in South Africa for the year 2000 are given in Figure 25. The energy sector was responsible for 79% of emissions while the Industrial Process and Product Use (IPPU), Agriculture, Forestry and Land use (AFOLU), and Waste sectors where responsible for 14%, 5% and 2% respectively. The dominance of energy sector emissions is linked primarily to the heavy reliance on coal fired power stations for electricity generation in South Africa.



Figure 25: Greenhouse Gas emissions in South Africa for the year 2000 (DEAT 2009).

6.5.4 Overview for the Eastern Cape

In contrast to the South African inventory, the energy sector is responsible for 67% of emissions, while IPPU, AFOLU and Waste are responsible for 1%, 28% and 5% respectively (see Figure 26). However, these figures are deceptive and should be used with caution in that AFOLU is overstated (sources and sinks from forestry and land use have not been included

through lack of readily available data), while IPPU is understated (lack of readily available data). Likewise, the results for waste should be viewed with caution in that they are based on population data, rather than measured waste generation, treatment and disposal data.

The ratio of greenhouse gas types (expressed in carbon dioxide ton equivalent) are 60% Carbon dioxide, 27% Methane, 11% Nitrous oxide and 2% HFC, PFC and SF6. These ratios are illustrated in Figure 27.

The relationship between National Greenhouse Gas emissions and Eastern Cape Provincial emissions is given in Figure 28. While 435,461 Gigrams of Carbon dioxide equivalent were emitted for the whole of South Africa in 2000, 38,991 Gigrams were emitted for the Eastern Cape in 2008. In other words, the Eastern Cape produced 9% of national emissions (bearing in mind the 8 year gap between inventories). For the energy sector, the Eastern Cape produced 8% of national emissions. For IPPU the Eastern Cape produced less than 1% of national emissions (this is an under-representation as noted above). For AFOLU, the Eastern Cape produced 52% of national AFOLU emissions (this is a large over-representation as noted above). For waste, the Eastern Cape produced 20% of national emissions (it is likely that this is over represented).



Figure 26: Emissions Sources in the Eastern Cape for the year 2008 in Gigagrams of Carbon Dioxide Equivalent. *Please note that sinks from forestry and other landuse/landuse change are not included, while emissions from Industrial Processes and Product Use are under represented due to lack of data.*



Figure 27: Emissions for GHG types in the Eastern Cape for the year 2008 in Gigarams of Carbon Dioxide Equivalent. Little or no data was available for HFCs, PFCs and SF6.



Figure 28: Comparison between the South African National GHG Inventory (2000) and the initial Eastern Cape inventory for 2008.

6.5.5 Energy

The combustion of fossil fuels for energy requirements is among the principal sources of Greenhouse Gas Emissions. Energy sector emissions sources can be classified as:

- Exploitation of primary energy sources, e.g. coal mining;
- Conversion of primary energy sources into more useable energy forms, e.g. refineries and power-plants;
- Use of fuels in stationary applications, e.g. manufacturing industries; and
- Use of fuels in mobile applications, e.g. the transport sector

Whereas the South African year 2000 Greenhouse Gas Inventory uses a sector based approach, a reference approach is required for the EC preliminary inventory due to the fact that available activity data for the province has not been disaggregated into sectors.

Three major sources of GHG emissions in the Eastern Cape are Petrol and Diesel Combustion, and Electricity Consumption². Petrol and Diesel Combustion accounts respectively for 7082 and 6363 Gg CO_2 eq annually (1 Gg is equal to 1000 tons). Electricity consumption accounts for 11305 Gg CO_2 eq annually (see Figure 29).



² It should be noted that almost all electricity is imported to the Eastern Cape from other provinces. Technically, GHG emissions from electricity production occur outside of the province. Electricity consumption should be reflected as "energy indirect" emissions in this inventory. However, for the sake of indicating GHG emissions caused by anthropogenic activities in the Eastern Cape, indirect emissions from electricity consumption have been included here.

Figure 29: Emissions from combustion of fossil fuels in the Eastern Cape Province in 2008. Note that electricity consumption includes electricity imported from other provinces.

6.5.5.1 Data Sources and Confidence

Table 17: Data sources for energy emissions.					
Resource Type	Data Source	Confidence in data	Comments		
Liquid fuels	Department of Minerals and Energy Liquid fuel sales volumes for 2008 http://www.dme.gov.za/energy/2008_Energy_FSV D.stm	High	Data not disaggregated into sectors		
Coal	Data from McFail Coal, 2005 – represents coal sales from East London, Port Elizabeth and Umthatha depots only. Data initially sourced by Sustainable Energy Africa 2005.	Poor	Data is out of date and may not be fully representative of consumption in the province		
Electricity Imports July 2008 to June 2009.	Imported electricity from other provinces, excludes local hydro	High	Data supplied by Eskom		

Table 47. Data a suma sa fan an annu anda siana

6.5.5.2 Issues and recommendations for improvements

Although useful energy data exists at the national level (e.g. Department of Energy: National Energy Digest), none of this is represented at the provincial scale, and therefore cannot be used for the development of a sectoral approach to energy reporting.

6.5.6 Industrial Processes and Product Use

Whereas GHG emissions from energy are about combustion of fossil fuels (even on industrial facilities such as in furnaces), emissions from Industrial Processes and Product Use (IPPU) are released from:

- Industrial processes that involve chemical or physical transformation of materials (e.g. production of cement from lime);
- Products that use Greenhouse Gasses such as refrigerators, foams and aerosol cans (e.g. HFC-143a and other substitutes for ozone-depleting substances); and
- Non-energy uses of fossil fuel carbon e.g. use of oils and greases as lubricants.
- Likely significant sources of IPPU Greenhouse Gasses in the Eastern Cape include (among others):
- Emissions from cement manufacture;
- Emissions from primary and recycled smelting of lead in the battery industry; and
- Emissions from Carbon Black manufacture.

At the time of writing, the only useful data available in regard to IPPU was for the production of Carbon Black, which results in approximately 244.47 Gigagrams of CO₂-equivalent emitted per year.

As is shown in Table 18, serious data gaps exist, and emissions from IPPU are likely to be significantly under-reported in this inventory.

6.5.6.1 Data Sources

Table 18: Data sources for Industrial Process and Product Use emissions.

6.5.6.2 Issues and recommendations for improvements

It is clear that air quality reporting and data collection systems at the level of the province are not necessarily suited to IPPU emissions inventory development at the scale of the province.

It is likely that future industry reporting requirements in terms of SAAQIS II will cater for the development of a suitable IPPU inventory. It is noted that the SAAQIS II reporting forms will be developed in consultation with Industry. It is imperative that the EC Province participates in such consultation to ensure that data collected in a central national database can cater for the requirements of provincial reporting.

6.5.7 Agriculture Forestry and other Landuse

Emissions and Carbon Stocks and Sequestration from Agriculture Forestry and Landuse (AFOLU) deals principally with manure and enteric formation from livestock; sources and sinks associated with changing carbon stocks from landuse change; and direct and indirect emissions from cultivation.

Suitable data on changes in landuse and land-cover over time (which would be consistent with data used by the national inventory) was not readily available for the province. This means that the entire land-category has not been included in the Eastern Cape Greenhouse Gas Inventory.

AFOLU Sources and Sinks	Included in the EC Inventory
A. Livestock	
1. Enteric fermentation	Yes
2. Manure Management	Yes
B. Land	
1. Forest land	
a. Forest land remaining forest land	No
b. Land converted to forest land	No
2. Crop land	
a. Crop land remaining crop land	No
b. Land converted to crop land	No
3. Grassland	
a. Grassland remaining grassland	No
b. Land converted to grassland	No
4. Wetlands	
a. Wetlands remaining wetlands	No
b. Land converted to wetlands	No
5. Settlements	
a. Settlements remaining settlements	No
b. Land converted to settlements	No
6. Other land	
a. Other land remaining other land	No
b. Land converted to other land	No

Table 19: AFOLU Sources and Sinks included in the EC GHG Inventory

C. Aggregate sources and non- CO ₂ source emissions on land	
1. Biomass Burning	No
a. Forest land	No
b. Crop land	No
c. Grassland	No
d. Wetlands	No
2. Liming	No
3. Urea Fertiliser	No
4. Direct N2O Emissions from Managed Soils	Yes
5. Indirect N2O Emissions from Managed Soils	Yes
6. Indirect N2O Emissions from Manure Management	Yes
7. Rice Cultivation	No

Table 20 gives an indication of emissions from the assessed sources and sinks for Agriculture. Enteric fermentation and Agricultural Soils Management accounted for the majority of emissions. Total emissions are 10,734 Gigagrams of CO_2 -equivalent emitted per year. It is important to note that the national GHG inventory for the year 2000 registers carbon sinks roughly equal to sources from enteric fermentation and manure management. It is likely that the inclusion of sinks from forestry, cropland and grassland would result in a total for AFOLU which would be well below 10,734 Gigagrams of CO_2 -equivalent emitted per year.

Table 20: Emissions from Agriculture (excludes forestry and landuse change)

Emission sources and sinks	CO_2	CH ₄	N ₂ O	HFC	PFC	SF_6	Total
	[Gg CO ₂ equivalent per year]						
Enteric fermentation	0	6,228.95	0	0	0	0	6,228.95
Manure Management	0	723.08	18.27	0	0	0	741.35
Agricultural Soils (Direct N2O emissions)	0	0	64.25	0	0	0	64.25
Agricultural Soils (Grazing animals)	0	0	2,668.25	0	0	0	2,668.25
Agricultural leaching (Indirect emissions)	0	0	480.98	0	0	0	480.98
Agricultural atmospheric deposition (Indirect emissions)	0	0	549.63	0	0	0	549.63
Field burning of agri. Residues	0	0.67	0.24	0	0	0	0.91

6.5.7.1 Data Sources

Table 21: Data sources for Agricultural Emissions.

Source Type	Data Source	Confidence in data	Comments
Livestock	Department of Agriculture livestock statistics 2004. <u>http://www.daff.gov.za/</u>	Medium	Inclusion of livestock from former Transkei and Ciskei not indicated.
Crops	National Agricultural Statistics Abstract http://www.nda.agric.za/docs/Abstract 2009.pdf	Medium	
Fertilizer	Maize Production Guidelines, National Department of Agriculturewww.nda.agric.za/publications	Poor	Not based on direct or measured data

6.5.7.2 Issues and recommendations for improvements

A GHG inventory for the Eastern Cape can only be meaningfully compared with the National GHG Inventory if the same data and emissions factors are used. If an EC GHG inventory will be developed in more detail in future, it is important that this is done so in consultation with, or even as an element of, the national GHG inventory process.

6.5.8 Waste

The IPCC Guidelines list the main sources of waste emissions as:

- Solid waste disposal (Solid waste disposal sites generate methane from the anaerobic decay of organic waste);
- Biological treatment of solid waste;
- Incineration and open burning of waste; and
- Waste water treatment and discharge (generation of methane from certain anaerobic processes, together with the indirect release of nitrous oxide).

The GHG inventory for the Eastern Cape excludes biological treatment of solid waste and incineration and open burning of waste.

Emissions from waste result in 1887.60 Gigagrams of CO_2 -equivalent per year. Figure 30 gives a breakdown of the sources of GHG emissions from waste.



Figure 30: Emissions from Waste.

6.5.8.1 Data Sources

Table 22: Data sources for emissions from waste.

Source Type	Data Source	Confidence in data	Comments
Solid Waste	South African Waste Information Centre, http://www.sawic.org.za Reported waste for year 2008 – Nelson Mandela Metro Only Other data extrapolated from Stats SA Household Data – Community Survey 2007.	Low	No readily available current and reliable measured provincial solid waste data are available.

Waste Water	Extrapolated from Community Survey 2007, Statistics South Africa	Medium	No readily available current and reliable measured provincial waste-water data are available
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6.5.8.2 Issues and Recommendations for improvements

The measurement of total waste generation and disposal, let alone the measurement of particular waste streams, is chronically lacking in the Eastern Cape. Until sound waste measurement, data collection, verification and reporting systems are in place, the calculation will need to rely on population data. For purposes of comparison, the activity data, emission factors and assumptions as for the National Inventory will be required. This will require close interaction with between the province and national DEA.

6.5.9 Interaction with SAAQIS

The South African Green Paper on Climate Change Response (2010) notes the following in regard to National Greenhouse Gas reporting:

"In order to monitor, verify and report mitigation progress and the efficacy of South Africa's mitigation interventions, South Africa will –

- Develop, test and commission a web-based greenhouse gas emission reporting system as part of the National Atmospheric Emission Inventory component of the South African Air Quality Information System by 2012.
- Require the mandatory submission of greenhouse gas emission data to the National Atmospheric Emission Inventory by all significant emitters and compilers of greenhouse gas emission related data and/or proxy data by 2013.
- Publish an annual report comparing actual greenhouse gas emission data against the emission trajectory described above by 2014.
- Keep a register of climate actions that result in the mitigation of greenhouse gases and also use this to measure progress against the overall GHG emission trajectory and national reduction targets."

Based on the intentions of the Green Paper, together with communications with Jongikhaya Witi, it would appear GHG emissions activity data is intended to be collated and synthesised at the national level.

It is however essential that the province is consulted in the design of the reporting and data synthesis format of the SAAQIS Greenhouse Gas inventory so that:

- The province can play a role in supporting, monitoring and verifying GHG by provincial emitters;
- The national report can be disaggregated to show provincial emissions; and/or
- Relevant provincial activity data can be extracted from the central information system for purposes of provincial inventory reporting.

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Appendix A: Legal and Policy Framework Assessment.

Appendix B: Climate Change Projections and Impacts for the Eastern Cape Region of South Africa.

PHASE II: PROVINCIAL NEEDS AND TECHNOLOGY ASSESSMENT

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ACRONYMS AND ABBREVIATIONS

CCS	Carbon Capture and Storage
CSP	Concentrating Solar Power
DEDEA	Department of Economic Development and Environmental Affairs
ELIDZ	East London Industrial Development Zone
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
MW	Megawatt
NERSA	National Energy Regulator of South Africa
OTEC	Ocean Thermal Energy Conversion
PBMR	Pebble Bed Modular Reactor
PGDP	Provincial Growth and Development Plan
RD&D	Research, Development and Demonstration
RECs	Renewable Energy Certificates
REFIT	Renewable Energy Feed in Tariff
ROI	Return on Investment
Solar PV	Solar Photovoltaic
SWH	Solar Water Heater
UNFCCC	United Nations Framework Convention on Climate Change

1 PROVINCIAL NEEDS AND TECHNOLOGY ASSESSMENT

This section addresses the challenges and opportunities for technologies to mitigate climate change in the Eastern Cape Province. The immediate challenges in the province are to balance the high level objectives of providing:

- economic development and poverty alleviation, and
- energy security and local environmental protection

Clearly, this is a dynamic situation and the suggested approach is to identify the key principles at stake and then continuously update the strategy on the basis of technological innovation.

1.1 Technical options for climate change mitigation

1.1.1 Introduction and background

The opportunities for mitigation of climate change impacts by means of technical interventions or programmes are generally well understood and are described in the international literature (IPCC, 2007). Furthermore, these technical responses can be prioritised among the non-technical mitigation opportunities in terms of cost-efficiency as illustrated in Figure 1 in the form of marginal abatement cost (MAC) curves.

Global cost curve for greenhouse gas abatement measures



Figure 1: Strategic options for climate change mitigation (source: See UNEP/GRID Arendal Maps and Graphics Library, *Strategic options for climate change mitigation*, <u>http://maps.grida.no/go/graphic/strategic-options-for-climate-change-mitigation</u>)

A key observation from the analysis of the strategic options above is that, apart from some contributions from forestation, livestock and soils, the predominant opportunities for mitigation are in the energy sector.

It is clear that the highest priority opportunities are in terms of energy efficiency – both on the demand and the supply side. These are either no-cost or relatively low-cost interventions which realise savings in resource consumption, and also hence costs, and which have attractive paybacks or returns on investment. This observation is confirmed by the findings of the IEA's World Energy Outlook which highlights the opportunity for energy efficiency to achieve two-thirds of the abatement in 2020. Increased use of renewable energy would



contribute approximately a fifth. These opportunities are illustrated in Figure 2.

Figure 2: World abatement of energy-related CO2 emissions in the 450 ppm scenario (Source: World Energy Outlook 2009, IEA)

The importance of clean energy, or green, technology – from wind turbines to electric cars to zero-carbon buildings – is enormous (Tomlinson, 2009). Demonstrating its strength, the clean energy sector declined only 6.6 percent in 2009 despite the worst financial downturn in over half a century and Clean energy investments are forecast to grow by 25 percent to \$200 billion in 2010 (PEW, 2010).

The opportunities in the energy sector are further understood in terms of different levels of response for economies at different levels of income and development. These are summarised in the high-level recommendations of the recent UN Report on Energy for a Sustainable Future (UN, 2010). The Eastern Cape Province exhibits elements of all three of these categorisations and the responses are highly appropriate where applicable in the Province.

"Low-income countries need to expand access to modern energy services substantially in order to meet the needs of the several billion people who experience severe energy poverty in terms of inadequate and unreliable access to energy services and reliance on traditional biomass. They need to do so in a way that is economically viable, sustainable, affordable and efficient, and that releases the least amount of GHGs.

Middle-income countries need to tackle energy system development in a way that enables them progressively to decouple growth from energy consumption through improved energy efficiency and reduce energy-related GHG emissions through gradually shifting toward the deployment of low-GHG emission technologies.

High-income countries face unique challenges. As the large infrastructure investments made in the 1960s and 1970s begin to reach the end of their economic lives, they present opportunities to further decarbonize their energy sectors through new investments in lowercarbon generation capacity. In addition, they will need to reach a new level of performance in terms of energy use. (UN, 2010)" The economic sectors which are exposed to the biggest risks and opportunities as a consequence of Climate Change in South Africa are identified by Camco and TIPS (2010). These include:

- Agriculture, Forestry and Fishing
- Mining and Quarrying
- Manufacturing
- Utilities
- Construction
- Trade, Catering and Accommodation Services including retailing industry and tourism industry
- Transport, Storage and Communication including communications industry and aviation industry and public transport
- Financial, Insurance, Real Estate and Business Services

With the exception of mining perhaps, the Eastern Cape economy is exposed to risks in all these sectors.

This section of the report describes the range of technical options which are available in the Eastern Cape. The International Energy Agency (IEA) has identified the following technologies which are categorised into supply-side and demand-side opportunities (IEA, 2008):

Supply Side	Demand Side
CCS fossil-fuel power generation	Energy efficiency in buildings and appliances
Nuclear power plants	Heat pumps
Onshore and offshore wind	Solar space and water heating
Biomass IGCC & co-combustion	Energy efficiency in transport
Photovoltaic systems	Electric and plug-in vehicles
Concentrating solar power	H2 fuel cell vehicles
Coal: integrated-gasification combined cycle	CCS industry, H2 and fuel transformation
Coal: ultra-supercritical	Industrial motor systems
2nd generation biofuels	

The specific opportunities for technical responses in the Eastern Cape are more specific and particular to the social, economic and environmental context in the province over the short- to medium-term. The most important and promising technologies are described and then the appropriateness of different technology opportunities for conditions in the Eastern Cape are assessed in terms of:

- Maturity of the technology.
- Opportunities for cooperation with other organizations
- Options for promotion within ECP Policies and Sector Plans.

The appropriateness of each technology is summarised in Table 2 after the brief technology descriptions below. Excellent resources on the detailed evolution and technology roadmaps for individual technology opportunities are available via the Implementing Agreements of the IEA, (<u>http://www.iea.org/techno/ia.asp</u>), and many other online resources.

1.1.2 Technology options

The characteristics and mitigation potential of different technologies varies and is changing over time with technical innovation and improved use of technologies. Significant efforts have been undertaken internationally and within economic regions and countries to discern the most appropriate roles for different technology options. A pre-eminent series of publications is the Energy Technology Perspectives of the IEA (IEA, 2008). The technology options are summarised in Table 2

1.1.2.1 The context of technology options in the energy sector

The diagram below illustrates the overall energy system in the country as a whole, and the Eastern Cape too, with three characteristic modes of energy service provision, namely:

- i) on-site direct energy services provided from energy conversion devices located at the point of demand;
- a distributed energy conversion / generation which provides an energy carrier which can be transmitted and/or distributed to appliances for conversion into the desired energy services and,
- A centralised energy conversion / generation mode of producing the energy carriers for transmission / distribution through national transmission and distribution infrastructure.

The diagram shows the supply chains for energy services and illustrates the steps in these supply chains where interventions can be considered to mitigate GHG emissions.



Figure 3: Centralised, distributed and on-site energy service supply chains – excluding transport

In the case of the Eastern Cape the bulk of the energy services supplied to customers – apart from cooking, water heating and space heating derived from traditional fuelwood – are derived from energy carriers which are effectively imported into the province. It is clear that the opportunities for mitigation of emissions in the energy sector for the Eastern Cape will initially focus on energy efficiency in the energy service supply chains and then addressing the opportunities for i) direct conversion of renewable energy, ii) distributed generation based on renewable energy and finally, iii) consideration of centralised generation options using renewable energy. The initial emphasis on energy efficiency is consistent with the international experience and guidance noted above.

Furthermore, the role of technologies (including energy efficiency and renewable energy technologies) can be understood in terms of the maturity of i) the individual technologies and ii) the markets or market applications of the technologies. Most of the technologies described below are technically mature, namely, the technology is stable and with relatively little opportunity for significant innovations to reduce costs. However, despite the maturity of the

technologies (such as SWH, photovoltaics and wind energy systems) there is limited experience in South Africa and the EC Province with the market applications for these technologies. Scaling up of the markets provides experience which can significantly reduce the costs of energy services derived from renewable energy through scale and efficiency gains.

1.1.2.2 Energy efficiency

As indicated by the IPCC and IEA, energy efficiency is strategically the first priority for mitigation of GHG emissions in the energy sector.

Energy efficiency for energy customers

Under the prevailing mode of utility or energy commodity supply, energy efficiency on the customers' side of the meter is dealt with under the concept of "demand side management" (DSM). This approach relies on investments by customers in i) changing patterns of use/consumption and/or ii) more energy efficient machinery or appliances. Changing patterns of use are often achieved at no cost or minimal cost and are clearly the first priority.

Typical energy efficient appliance or equipment interventions would include:

- Heating and cooling systems more efficient air-conditioners for more efficient space heating and cooling
- Heat pumps to substitute immersion water heaters
- Appliances
- Lighting switch to better lighting design and technology such as LEDs, CFLs and efficient area lighting systems

Energy efficient appliances and equipment are continuously improving through R&D and innovation which is driven by a combination of policy, regulations and market forces.

Energy efficiency for energy generators / distributors

Energy efficiency in the electricity supply industry (ESI) is implemented as supply side interventions. These would include all the opportunities in the energy service supply chains on the utility side of the meter such as: smartgrids, more efficient transformers, switchgear, transmission and distribution cabling and more efficient generation.

The Eastern Cape does not yet have many energy generators (all the new capacity should be based on low-carbon technologies – see below) and the bulk of the opportunities will be implemented by the licensed electricity distributors in the Province if they are appropriately incentivised.

Energy efficiency in the transport sector

The technical opportunities in the transport sector are available at four levels, namely

- i) improved transport planning and city design;
- ii) improved public transport, for example the Bus Rapid Transit systems introduced in Johannesburg and Cape Town;
- iii) higher utilisation of non-motorised transport, for example rail (with the Gautrain representing an important advance in South Africa); and
- iv) more efficient personal cars (including internal combustion engines; hybrid vehicles and electric vehicles). Examples of advances in this area include the planned Joule Electric Car (see text box below).

Information Box: The Joule Electric Car

The Joule electric car is the first vehicle to be developed and manufactured by a wholly owned South African company. The makers of the Joule claim that the vehicle is approximately five times more energy efficient than petrol or diesel vehicles. The Joule is battery operated and recharges with electricity from any source. When electricity is obtained from clean sources such as hydro or solar, significant reductions in emissions can be achieved. The rechargeable lithium-ion batteries are recyclable and contain no heavy metals.

The company signed a memorandum of understanding with East London's Industrial Development Zone so that commercial production should begin in 2013, reaching 50000 units a year by 2015. An alternative site for assembly is the Coega IDZ. It is expected that the vehicle assembly will employ more than 2000 people in its assembly operation, while supplier and support activities could create a further 8000 downstream jobs.



Note: The greenhouse gas emissions savings achieved if electricity is sourced from conventional coal-fired sources are not known by the authors of the ECCCRS.

(Sources: Business Day, July 27, 2010; http://www.optimalenergy.co.za/)

Energy efficiency in the construction and building sector

Energy for buildings is a significant source of GHG emissions. The operation of nonresidential and residential building sectors account for around 23% of total emissions for South Africa (UNEP, 2009). In addition, it is estimated that the manufacture of building materials accounts for around 5% of total emissions.

The adoption of green building principles will rapidly drive increased energy efficiency in the building sector. 25% of the weighting for points in the GreenStar rating tools for commercial buildings and retail centres are allocated to energy (GBCSA, 2009).

1.1.2.3 Solar energy technologies

Solar water heating

Solar water heating (SWH) converts solar energy into hot water for domestic hot water, space heating, pool heating and industrial process heat. SWH is a prime example of direct on-site energy service supply. The key technologies include collectors (glazed flat-plate, unglazed and evacuated tube collectors), storage tanks and control systems.

The South African government has identified SWH as a critically important opportunity for displacing electricity demand and has launched a programme to supply and install 1 million SWH systems within five years to 2014.



Figure 4: Example of a Solar Water Heater.

Solar photovoltaics

Solar photovoltaic (PV) technology converts solar energy into direct current electricity which can be converted and connected to the national grid or stored and used in a stand-alone configuration. Solar PV systems are entirely modular and are applicable at any scale from portable appliances (such as solar lanterns/torches and radios) to multi-megawatt grid-connected power stations.

Apart from the grid-connected electricity generation opportunities (on households, businesses or at MW-scale) Solar PV systems provide high quality electricity services for communications and lighting in rural areas. The off-grid concession programme implemented under the DoE and NERSA provides access to electricity in a manner which complements grid electrification initiatives.



Figure 5: Example of a solar photovoltaic array.

Solar thermal electricity generation

Electricity generation from solar thermal technology has very significant large-scale opportunities in the longer term. The technologies include: parabolic trough, central receiver and parabolic dish systems. Collectively called concentrating solar power (CSP) plants, these systems offer utility-scale power with storage to provide power after sunset. CSP can provide combined heat and power which is particularly useful in desalination plants. CSP system are best suited for areas with high levels of direct solar radiation. Eskom has been planning a 100 MW scale CSP plant in Upington and a proportion (ZAR260 million) of a loan from the World Bank is earmarked to fund this project.



Figure 6: Example of a concentrating solar power plant.

Solar Energy Resource in the Eastern Cape

Radiation levels in the Eastern Cape Province are between 6000-8000MJ/m2/yr. Areas to the north and west of the Province have higher radiation levels that the best areas of Germany or Spain. A map generated for a Renewable Energy Study for the East London IDZ and Eastern Cape Province in 2009, showing radiation levels in the EC, is given in Figure 7.



Figure 7: Annual solar radiation levels in the EC Province. Source: AGAMA Energy 2009.

1.1.2.4 Wind energy technologies

Wind energy systems convert kinetic wind energy into electricity and shaft power (for water pumping). Large modern wind turbines operate together in wind farms to produce electricity for utilities. Small turbines are used to meet localised energy needs.



Figure 8: Example of a wind farm.

Wind energy is the fastest growing energy technology sector and accounts for more than 50% percent of worldwide clean energy investment in 2009 and almost half of installed clean energy capacity worldwide (PEW, 2010). The South African Wind Energy Association is calling for 25% of the overall electricity generation mix by 2025 to be derived from renewable energy, and, of this target, some 80% could come from wind power. By mid-2010 more than 30 separate wind farms ranging from 8 MW to over 100 MW had been planned for the Eastern Cape. A map generated for a Renewable Energy Study for the East London IDZ and Eastern Cape Province in 2009 (AGAMA Energy 2009), showing the distribution of average annual wind speed in the EC, is given in Figure 9.



Figure 9: Distribution of annual average wind speed. Source: AGAMA Energy 2009.

1.1.2.5 Hydro energy technologies

Hydro energy systems convert potential and kinetic energy in rivers or dams into electricity or shaft power. Hydropower systems are based on very established technology and globally, hydropower accounts for about 90% of all renewable energy power generation (IEA 2008). The Eastern Cape has cumulatively the best hydropower resource in South Africa (CaBEERE, 2002) with the best resources to the east of the province and to the extreme south-west.

Table 1: Summary of installed and technical potential hydropower developments in the Eastern Cape Province (CaBEERE, 2002)

Ir	nstalled capa	city	Present	Firm de	velopment p	otential	Possible
Small (<10MW)	Large (>10MW)	Load factor	production (GWh/a)	Small (<10MW)	Large (>10MW)	Load factor	production (GWh/yr)
14,7	53	0,11 to 0,25	144	25,8	1 250	0,75 to 0,3	3 455

1.1.2.6 Biomass energy technologies

Biomass energy systems convert organic matter into thermal or electrical energy. Technologies include efficient wood stoves, biogas digesters, wood gasifiers and cogeneration plant. Landfill gas utilisation relies on internal combustion gensets.

The conversion of woody biomass to energy can follow several routes as shown in Figure 10. It can be seen that there are generally four primary energy conversion technologies producing heat, gas, oil or methane. These could feed into engines, turbines or fuel cells (secondary conversion) to produce heat and/or electricity.



Figure 10: Overview of the processes whereby biomass is transformed to energy Source: Stucley et al

The potential for biomass energy in the Eastern Cape is significant for direct onsite energy and distributed energy service provision. This is particularly relevant where large tracts of alien invasive vegetation are cleared, or where there are established commercial forests where biomass residue is readily available.



Figure 11: An experimental biomass gasification and electricity generation unit at a Sawmill close to the town of Alice in the Eastern Cape.

A map generated for a Renewable Energy Study for the East London IDZ and Eastern Cape Province in 2009 (AGAMA Energy 2009), showing potential biological productivity in the EC, is given in Figure 12.



Figure 12: Potential biological productivity in the Eastern Cape. Source: AGAMA Energy 2009.

1.1.2.7 Nuclear energy

Nuclear energy systems produce electricity (and heat) by converting the energy released nuclear fission into electricity via a steam cycle. The predominant technology is the pressurised water reactor similar to the existing Eskom plant at Koeberg. New technologies include small and medium scale reactors and 3rd generation gas-cooled reactors such as the pebble bed modular reactor (PBMR).

At this stage the role for nuclear energy development is beyond the scope of the Eastern Cape Province and current plans by Eskom are to build a plant at Thyspunt in the future.

1.1.2.8 Carbon capture and storage

Carbon capture and storage systems (CCS) are designed to capture emissions from fossilfuelled generators, transport them and to store them in secure locations (or injection sinks) which are mostly gas-tight geological formations. Eskom has CCS plans for Medupi and Kusile but not applicable in the Eastern Cape in terms of this strategy. The South African Carbon Capture and Storage Atlas for the geological storage of carbon dioxide (CO₂) underground. The Atlas shows at a theoretical level the locations for a cumulative 150 Gigatons (Gt) of storage capacity. Most capacity exists offshore.

In addition to geological storage, power-plant/industrial flue gas can also serve as a source of CO_2 for enhanced microalgae cultivation. Although still at a an experimental/prototype phase, opportunities exist for the extraction of biofuels from algae, the biodigestion of algae to produce methane, the extraction of algae to produce biochar, and the co-firing of algae in power plants/furnaces.



Figure 13: Algal bioreactors which can be used for the extraction of CO₂ from power plant or industrial flue gases. Image: <u>www.evworld.com</u>

1.1.2.9 Fuel cells

Fuel cells are devices which convert gaseous reactants into electricity and by-products. The hydrogen fuel cell is a common version which utilises hydrogen as the fuel and oxygen (in air) as the reactant to produce electricity and water. Fuel cells are used in stationary (standby power) and transport (for vehicles) applications.

1.1.2.10 Geothermal energy

Geothermal energy systems provide heat and electrical power by extracting energy from the earth's core at locations where the localised geology allows access to higher temperatures near the Earth's surface.

Although geothermal energy is used extensively in countries such as New Zealand, Italy and Kenya the opportunities in the Eastern Cape are limited to leisure and tourism at hot spring spas.

1.1.2.11 Ocean energy

Ocean energy systems convert the kinetic energy of ocean currents (or tides) and waves into electrical energy. Ocean thermal energy conversion (OTEC) has been piloted. Ocean energy systems are not well developed technically and almost all the current installed capacity is based on tidal barrages (IEA, 2008). The most promising long-term opportunities in the Eastern Cape is likely to be in terms of current turbines. The commercialisation of a prototype ocean current turbine has been proposed for the Agulhas current region off the Eastern Cape, as shown in Figure 14.



Figure 14: A counter-rotational ocean current turbine system as proposed by Cyclocean. Image: Paul Greyshock.

1.1.2.12 Organic Waste and Energy

Although organic waste falls within the category of Biomass Energy Technology, energy from municipal, household and industrial solid and liquid waste is often considered separately.

Solid waste

Waste-to-energy technology converts waste to heat and electricity. In turn, the conversion process reduces the volume of solid waste for disposal or the amount of methane released to the atmosphere from the disposal site. It is important to note that waste-to-energy projects not only generate renewable energy, but that they also reduce the release of methane to the atmosphere (methane gas has a greenhouse gas effect which is approximately 23 times worse than carbon dioxide).

Mitigation options for solid organic waste before landfilling include waste separation and conversion to compost, pyrolysis/gasification and incineration. Pyrolysis and Gasification are reaction processes which break down the organic waste to form synthesis gas and other products. The synthesis gas is fired directly in internal combustion engines to generate electricity and heat.



Figure 15: A biomass/organic waste gasification prototype developed in South Africa (photograph: EECOfuels).

Where organic waste has been disposed of in landfills it usually decomposes to form methane rich landfill gas. Landfill gas energy facilities capture the methane and combust it to generate heat and/or electrical energy. A number of successful landfill gas projects exist in South Africa, most notably La Mercy and Marianhill landfill sites in KZN.



Figure 16: La-Mercy Landfill Gas Electricity Generation Unit. Photo: Engineering News, South Africa.

Anaerobic digestion of liquid waste

Anaerobic digestion as a wastewater treatment process does not require external energy inputs, but rather generates methane rich gas which can be converted to useful energy. Anaerobic digestion results in a 16% reduction in CO_2 emissions as compared to conventional sewage treatment. Anaerobic digestion of sewage is a well established treatment technology world-wide, but has not become mainstream in South Africa. The rehabilitation of the Athlone Anaerobic Treatment Works in Cape Town is currently under consideration.

In addition to anaerobic digestion of wastewater at municipal works, feasibility studies have shown that significant opportunities exist for the rollout of domestic-scale biodigesters as alternative energy sources in rural households Household-scale biogas digesters provide multiple co-benefits, including waste management (and on-site treatment), energy generation with storage, nutrient management and water management. A household energy survey for South Africa undertaken in 2007 (AGAMA Energy, 2007) included data collected in six villages in the Eastern Cape, The summary of the findings for the EC province were as follows:

	Number of eligible HHs	Biogas production (m3/day)	Capital cost (R million)	O&M cost (Rmillion/a)	Energy cost saved by day (R)	Time benefits per day (R)
Eastern Cape	109,285	95,233	820	16	191,323	31,016



Figure 17: Piggery wastewater biodigestion and electricity generation facility, Thailand.

1.1.3 Technology options for adaptation

The notion of technology options for adaptation has not been addressed with the same levels of rigour and experience as technologies for mitigation. The key technologies for adaptation are those which could address:

Coastal zones – including hard walls/structures to protect; early warning systems; improved materials and systems to cope with marine exposure

Water resources – better water management systems including supply-side management; demand side management; cooling/heating systems which operate on lower quality water; flood management; improved waste water treatment; rainwater harvesting; improved agriculture to cope with water shortages

Agriculture – encourage different crops; use drip irrigation; minimise wind erosion; adapt farming practices

Public health – better urban planning; improved air-conditioning systems; improved mobility systems (public transport, non-motorised transport); catalytic converters; vaccinations; impregnated bednets; improved water and sanitation systems

Infrastructure – urban planning to optimise energy, water and waste systems; minimise paved/hard surfaces; efficient mobility systems; protection of infrastructure against physical damage from storms/heat/wind.

Technology opportunity	Technology	Market sector application	Maturity of technology	Owner / implementer	Policy and regulatory context	Opportunities for partnerships	Comments
Energy efficiency for customers	Air conditioners Heat pumps Refrigerators Variable speed drives for motors Lighting	Commerce Industry Agriculture Households	Very mature Constantly improving Excellent international experience	Energy service customers - Public sector - Private sector	Planning approvals to include energy plans Inclining block tariffs Energy labeling of appliances	National Energy Efficiency Agency (NEEA) Local authority planning departments	The bulk (>80%) of the effort in the Eastern Cape E Cape government to lead Excellent manufacturing base in E. Cape
Energy efficiency for utilities	Smartgrids Intelligent metering Energy efficient TX and DX More efficient generation	Energy utilities	Smartgrids in first phase of implementation Mature and constantly improving	Eskom Local authorities REDs in future?	Licencing and reporting to NERSA subject to efficiency reporting		Inclining block tariffs
Energy efficiency in transport	Planning tools Public transport Non-motorised vehicles Electric vehicles	All sectors	All technologies are available Extensive experience (apart from EVs at scale)	Fleet owners / operators - Public sector - Private sector		Joule electric vehicle manufacture	E Cape government to lead
Energy efficiency in buildings	Design tools Thermal insulation High performance glazing	Construction industry Developers	Mature and constantly improving	Building owners and developers - Public sector - Private sector	SANS 0204 – thermal efficiency of buildings	Construction Industry Development Board (CIDB) Green Building Council of South Africa (GBCSA)	Focus on retrofitting of public and private sector buildings SANS 204 to be made mandatory The national Energy

Table 2: High priority technologies opportunities for mitigation of GHG emissions in the Eastern Cape

Technology opportunity	Technology	Market sector application	Maturity of technology	Owner / implementer	Policy and regulatory context	Opportunities for partnerships	Comments
							Efficiency Strategy needs to be implemented
Solar water heating systems	Flat-plate glazed systems Evacuated tube systems Unglazed systems	domestic hot water commercial hot water industrial hot water and process heat pool heating	Very mature and improving	Households Businesses - Public sector - Private sector	no regulatory barriers; emerging national policy / strategy framework; opportunities for RECs, CERs and VERs	The DoE has announced a 1 million SWH programme over 5 years The SWH programme in NMBM is the well advanced	excellent solar energy resource (6000 and 8000 MJ/m2/yr)
Solar PV systems	Mono- and poly- crystalline Thin film systems	grid- and off-grid electricity systems water pumping systems	Crystalline technology very mature Thin film technology increasingly robust	IPPs Building owners Off-grid utilities in operational for over 10 years	REFIT guideline offers 398 c/kWh for grid-connected solar PV > 1 MWp Off-grid concession agreements Domain protocol for RECs	ELIDZ IPPs	excellent solar energy resource (6000 and 8000 MJ/m2/yr)
Solar thermal electricity generation	Parabolic troughs Central receiver systems Parabolic dish systems	Utility power generation	Parabolic trough have been operational for over 20 years (Sacramento) Central receiver systems scaling up Parabolic dish systems less mature	IPPs Local authorities	REFiT guideline offers - 314 c/kWh for CSP trough without storage for > 20 MW - 213 c/kWh for CSP central receiver with 6	Eskom IPPs	excellent solar energy resource (6000 and 8000 MJ/m2/yr) transmission infrastructure may need strengthening

Technology opportunity	Technology	Market sector application	Maturity of technology	Owner / implementer	Policy and regulatory context	Opportunities for partnerships	Comments
					hours of storage for > 20 MW CDM		
Wind energy technologies	wind turbines - Horizontal axis - Vertical axis	standalone/off- grid and grid- connected household scale small wind farm wind farms	Horizontal axis machines are well- established Vertical axis less well established	IPPs Local authorities	REFiT guideline offers 125 c/kWh for > 20 MW RECs, REFSO and carbon methodologies	IPPs	the Eastern Cape has an excellent wind energy resource Wind energy is attracting massive interest
Hydro energy technologies	turbines	standalone/off- grid and grid- connected micro-hydro	Very well established and mature	IPPs Local authorities	REFiT guideline offers 94 c/kWh for > 1 MW RECs, REFSO and carbon methodologies	IPPs Working for Energy	the Eastern Cape has an excellent resource
Biomass energy technologies	Energy from waste / solid biomass Biogas Landfill gas	household waste management / thermal energy agricultural, industrial and municipal systems cogen from invasive alien and managed wood fuel lots	Combustion systems (boilers) are well established and mature	IPPs Local authorities	REFiT guideline offers: - 118 c/kWh for solid biomass for > 1 MW - 96 c/kWh for biogas for >1 MW - 90 c/kWh for biogas for >1 MW RECs, carbon project	Working for Water Working for Energy IPPs	integrated waste management, household energy, water recycling for housing excellent co- digestion potential with livestock and organic wastes

Technology opportunity	Technology	Market sector application	Maturity of technology	Owner / implementer	Policy and regulatory context	Opportunities for partnerships	Comments
					water discharge quality standards (DWA) DWA; National Environmental Management Act		
Fuel cells and electrical storage batteries	Fuel cells electrical storage batteries	off-grid, backup power, electric vehicles	Fuel cells are commercially available but not well established Electrical storage batteries are mature and evolving		NEMA; recycling and waste management	the three primary electrical storage battery manufacturers are in E. Cape	electricity backup and off-grid for energy services in buildings electric vehicles
Geothermal energy	Dry steam Flash Binary cycle District / process heat	Power generation Industry	Very well established and reliable	Utilities Industry	No specific provincial or national policy	n/a	No utilizable resources available in E. Cape
Ocean energy technologies	Ocean current Wave / tidal OTEC						

1.1.3.1 Recommendations for the most favourable technology options for the province

The key technologies for mitigation in the Eastern Cape Province are prioritised in Table 3 below. These represent technologies where the most significant gains in mitigation can be achieved for time, effort and finances invested. This is based on appropriateness of technology and ease of implementation in the Eastern Cape.

	Technology option	Application	Comment
1	Energy efficiency in buildings and appliances	 GreenStar rating of buildings Efficient airconditioning Efficient lighting 	Buildings lifetimes exceed 50 years and consequently these lock in emissions or savings for a long time All government / municipal buildings will soon be required to meet a Four Star rating
2	Heat pump technologies	- Heat pumps and efficient water heating	Manufacturing opportunities offer a double return on investment in energy efficiency with heat pumps
3	Solar space and water heating	 Passive solar design standards Building standards to include SWH 	Highly topical and appropriate within the context of the DoE Strategic Framework for SWH and 1 million SWH target
4	Energy efficiency in transport	 Fuel efficiency standards Electric vehicles Plan for non- motorised transport 	Security of supply issues are important too Exposure to price risks in the future costs of carbon based fuels
5	Industrial energy efficiency	- Efficient motors and drives	Effective frameworks and mechanisms (beyond Eskom's DSM scheme) are required to enable / accelerate these investments
6	Smart grids and metering systems	 Upgrade metering Introduce intelligence in the network 	Local authorities (and REDs in future?) will benefit in higher levels of service delivery and deferred investments for new capacity
7	Biomass energy systems	 Energy from waste Agricultural and household biogas 	The E. Cape has a significant resource for on-site and distributed energy service provision
8	Wind energy systems	 Utility-scale wind farms Small scale minigrid and standalone systems 	The E. Cape has some of the best wind regimes in SA Infrastructure can be implemented more quickly than other systems (subject to EIA approvals)
9	Hydro energy systems	- Small and medium scale systems	The E. Cape has the best resource in the country and some excellent experience with existing capacity
10	Solar PV systems	 Stand-alone systems for household electrification Grid-connected PV on buildings and for utility generation 	Increased access to energy services can be rapidly addressed Grid-connected systems can also be implemented very quickly but the costs are currently still high for good ROIs

Table 3 : Prioritized technologi	ies for mitigation in the	Eastern Cape.

1.1.4 Job creation opportunities associated with mitigation technologies

Although Climate Change has many negative social and economic implications, the necessary adjustment of global modes of production to a more sustainable, low carbon economy is likely

to result in many opportunities for the generation of "green" jobs. Currently green job creation is taking place in both the rich countries and in some of the major developing economies. As an illustration, employment in the renewables sector in Germany increased from 66,600 to 259,100 between 1998 and 2006 (UNEP 2008). Table 4 shows that over 2.3 million jobs world-wide were attributable to the Renewable Energy Sector in 2006, with the greatest number of jobs coming from renewable biomass.

RE Type	Number of Jobs
Wind	300,000
Solar PV	170,000
Solar Thermal	624,000
Biomass	1,174,000
Hydropower	39,000-plus
Geothermal	25,000
Renewables, Combined	2,332,000-plus

 Table 4: Estimated World-wide Employment in the Renewable Energy Sector in 2006.

 Source: UNEP 2008.

A study by AGAMA Energy in 2003 gives details of the relative number of jobs per Terawatt Hour (TWh) for different energy generation types (see Figure 18). Renewable energy technologies result in more jobs per unit energy than nuclear, coal and gas, while significant numbers of jobs are created in the Biogas, Bioethanol, Solar Water Heating and Biodiesel industries.



Comparison of Job Creation Potential of Various Energy Generation Technologies

Figure 18: Gross direct jobs for new generation capacity of various energy types (Source: AGAMA Energy 2003)

AGAMA Energy (2009) generated projections of the job creation potential of renewable energy in the Eastern Cape based on the following scenario (among other variables):

- 9% Renewable Energy in the provincial energy mix by 2013 and15% by 2018 as suggested by the Minister of Minerals and Energy in March 2009 (DME, 2009); and
- 27% Renewable Electricity in the provincial energy mix by 2030 as modelled in the Long Term Mitigation Scenarios (Winkler, 2007).



• A growth in provincial electricity demand to greater than 40 000 GWh/pa by 2038.

Figure 19: 30 year projection of jobs created in the RE sector for RE supply to the EC. Source: AGAMA Energy 2009.

Based on the scenario, the job creation potential for supply of RE to the Eastern Cape Province is given in Figure 19. It is projected that up to 112,000 jobs will be created if renewable energy forms 35% of the Eastern Cape energy mix by 2038.

1.1.5 Policies and measures

1.1.5.1 Market creation and development

Market opportunities attract interest from stakeholders and draw in investment in anticipation of returns. Consequently it is important to understand market approaches to stimulating investment in energy technologies which have mitigation benefits. Traditionally markets in the energy sector have been either highly regulated, as in the case of the electricity sector, or poorly understood, as in the case of biomass energy and solar water heating. A distinction can be made between markets for energy carriers – such as electricity and LPG - and energy services (as illustrated in Figure 3). The REFIT guidelines are intended to create a market for electricity generated from renewable energy. Similarly, regulations regarding Green Building codes or appliance labelling for energy efficiency will stimulate markets for more efficient buildings and energy efficient appliances. The key challenge in market making is to minimise market distortions which establish negative structural and/or institutional legacies.

The increasing trend towards disclosure of 'carbon footprints' in business is influencing management and procurement practices in terms of energy (and other inputs). This trend is creating a market for energy audits, carbon inventories and investments in energy efficiency and certified Green Power using Renewable Energy Certificates.

1.1.5.2 RD&D efforts

Research and development and demonstration (RD&D) are critical both in terms of innovation for better efficiency as well as for supporting the industrial capacity to supply, install and operate systems which can mitigate GHG emissions. Clearly RD&D efforts need to be identified and driven within the context of the industrial policy of the country and the province.

Measures to support RD&D include protecting intellectual property rights, funding and human capital development. The province has good infrastructure and institutions for RD&D in the form of universities and industrial capacity. An example of an RD&D initiative which the province could implement would be technology prizes for climate change mitigation. These could be linked to the National Science Week which is held annually in Grahamstown.

1.1.5.3 Investments in new technologies

Technologies have direct and important benefits in terms of mitigation of GHG emissions but there are deeper economic benefits of embracing new technologies. Emerging economies such as India and China have established themselves as world leaders by means of a combination of investments in new technololgies and a complementary industrial strategy. renewable energy companies in emerging economies have an important role. China's Suntech is the third largest manufacturer of solar cells in the world and India's Suzlon is one of the world's five biggest makers of wind turbines. Companies of this kind see the shift to a low carbon economy as an opportunity, not a threat, with wider implications for national policy (Findlay M and Dimsdale T, 2009).

1.1.5.4 Tax credits

Fiscal and tax incentives in the form of rebates can be an attractive mechanism for incentivising a shift towards cleaner energy service solutions and other GHG mitigation options. Credits or rebates can take the form of accelerated depreciation of assets, reduced property taxes or allowances under income tax regulations. Often these rebates can be coupled to charges or tariffs which place a surcharge on high emission practices.

1.1.5.5 Standard setting

Standards are a powerful tool for disseminating new technologies and good practices, developing global markets and supporting the harmonization of government policies on energy efficiency and renewable sources on a global scale. Energy performance standards help:

- minimize product energy performance testing and verification costs for increasingly globalized energy-using equipment markets,
- enable energy performance to be compared on a common basis across broad economic and political groupings,
- facilitate adoption of more efficient product manufacturing, and
- accelerate transfer of best practice in policy settings.

Wherever possible, it is recommended that standards are adopted or developed to drive compliance with good practice – especially in terms energy efficiency for buildings, appliances and transport.

1.1.5.6 Technology development and transfer

Clearly, and as in the case of many smaller countries or provinces, it is unlikely that the Eastern Cape Province will be able to innovate and develop all the technologies (and supporting systems) for mitigation of GHG on provincial budgets alone. The challenge then is to encourage technology development and transfer in partnership with other stakeholders. The high-level commitments from COP15 on technology development and deployment in the emerging economies – and the associated issue of NAMAs – is highly relevant to the Eastern Cape. The initiative of the ELIDZ in commissioning a study on renewable energy for the ELIDZ is an excellent example of a pro-active effort to attract technology development and transfer within the context of the 'Green Economy'. Support to build effective innovation systems not just narrow technology transfer (Tomlinson et al, 2008)

1.1.6 Regulatory environment

Effective implementation of services which can benefit from technologies which mitigate GHG emissions is highly dependent on a good regulatory environment. Key regulatory mechanisms include:

- Standards and Codes of Practice
- Access to markets
- Licencing
- Tariffs including inclining block tariffs

A key question is the institutional environment for regulatory oversight. At this stage, in the electricity sector, the centralised, highly regulated, bureaucratic energy generation and transmission market is constricting the development of an independent RE production sector. Either decentralisation and deregulation is regulation is required, or an enabling institutional framework (in which real capacity exists) should be set up. Conversely, local planners could use regulations to encourage technology rollout by linking requirements for energy efficiency and other technology options into planning permission (building plans, rezoning, EIA RODs, SDFs). However, for these requirements to have any teeth, they need to be backed up by legislation, adopted policy, guidelines and/or scientific evidence of effectiveness.

Interestingly, the requirements by the financial services sector for financing or funding infrastructure investments often provides the rate-determining regulatory constraints (or opportunities) for more effective systems.

1.1.7 Establishment of a conducive/enabling context for technical options

The question of how the province can support rollout/implementation is a complex one as it needs to address the challenge of how to shape and enable long run investment decisions under conditions of high uncertainty.

Difficult problems are often stuck in "impossible" loops which make it difficult for policy makers to see a way out; this can be addressed in several ways:

-"Reframing the problem" to bring in new constituencies and approaches: e.g. "climate change is about investing to secure the benefits of a stable climate"

-Looking to the long term: e.g. "is our fisheries management system robust to a changing climate and rising environmental consciousness?"

-Bundling multiple policy benefits: e.g. "investment to prevent instability and conflict in Central Asia will benefit the UK's WMD, terrorism, energy and OC policy priorities" (Mabey, 2006)

Ideally, the province would need to take the initiative to create a virtuous circle of demonstrating the feasibility of emissions cuts so decision makers commit to credible targets for market pull.

Linked to the vision and commitment which is required to take the initial steps it is important to work with the process of engaging with stakeholders, the politics, while developing the policy – effectively building a delivery coalition around the idea or overall goal.

Many energy efficiency technologies and practices are already highly cost-effective but are held back by additional barriers which include:

- lack of awareness of the cost-effective savings potential,
- missing or partial information on energy efficiency performance and lack of common metrics,
- lack of consideration of system and process energy efficiency issues,
- split incentives e.g. the different economic incentives which exist between developers/landlords who procure energy using equipment and tenants who pay the energy bill, and
- the fact that energy efficiency is often a minor determinant of capital-acquisition decisions and is bundled-in with more important decision factors.

A key enabling mechanism for accelerating mitigation is monitoring and evaluation (M&E). This can begin with voluntary initiatives such as the Carbon Disclosure Project (<u>www.cdproject.net</u>) which could then be adopted as mandatory, or compliance based, frameworks for driving a transition. Larger companies in SA have been reporting their

emissions under the CDP and these M&E activities are highlighting trends and priorities for investment in better systems.

It is suggested that monitoring and evaluation at the provincial level could track the following indicators which are categorised into access and quality criteria, namely (adapted from Lee H et al, 2010):

Access to clean electricity (from licensed electricity distributors / AMEU)

- Access to electricity
- Renewables % of electricity generation
- Efficiency of distribution
- Quality of supply

Intensity emissions trends

- Emissions intensity trend for the province
- · Emissions intensity trend in manufacturing sector
- Emissions trend in the five (or so) largest companies

1.1.8 Non-technical policies can significantly contribute to mitigation

As indicated above, the availability of technology is not sufficient, in isolation, to drive mitigation. An enabling environment is required within the framework of a social compact. Key considerations in motivating a broader non-technical approach include the observations that values, lifestyles and ambitions for the future are powerful drivers for change (or not).

Changes in lifestyles and behaviour patterns can contribute to climate change mitigation by means of:

- occupant behaviour, cultural patterns, consumer choices in buildings
- reduction of car usage and efficient driving, improved urban planning and more availability of public transport
- behaviour in industrial organizations

Other non-technical policies which need to be factored in include:

- Macro-economic policy: taxes, subsidies, other fiscal policies, structural adjustment
- Trade policy: "embodied carbon", removing barriers for low-carbon products, domestic energy sources
- Emery security policy: efficient energy use, domestic energy sources (low- high carbon)
- Access to modern energy: bio-energy, poverty tariffs
- Air quality policy: clean fuel
- Bank lending policies: lending for efficiency/ renewable energy, avoid lock-in into old technologies in developing countries
- Insurance policy: Differentiated premiums, liability insurance exclusion, improved conditions for green products

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PHASE III: Guideline Document on Sectoral Climate Change Action Plans

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ACRONYMS AND ABBREVIATIONS

AR4	IPCC 4th Assessment Report
DEDEA	Department of Economic Development and Environmental
	Affairs
DoE	Department of Energy
ECCCRS	East Cape Climate Change Response Strategy
FPA	Fire Protection Association
GHG	Greenhouse Gas
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
PGDP	Provincial Growth and Development Plan
PSDP	Eastern Cape Provincial Spatial Development Plan
SDF	Spatial Development Framework
UNFCCC	United Nations Framework Convention on Climate Change

1 GUIDELINE DOCUMENT ON SECTORAL CLIMATE CHANGE ACTION PLANS

The previous phases of the Eastern Cape Climate Change Response Strategy have highlighted the impacts and implications of projected future climate changes. The current section deals with response options available to the Eastern Cape Government in terms of mitigation and adaptation options.



Figure 1: Climate Change Response Cycle (Source: IPCC 2001)

The above figure indicates the elements of the overall climate change response cycle that this section will be dealing with, namely adaptation planning and mitigation planning.
2 ADAPTATION TO CLIMATE CHANGE RISKS OF EXTREME SIGNIFICANCE

Phase 1 of the Eastern Cape Climate Change Response report provides a systematic climate change impact risk assessment. This process identified (in addition to other low, medium and high significance risks) potential risks of extreme significance relating to key provincial government sectors, plans and programmes. These risks are described in the table below.

Table 1: Impacts of extreme significance to the province as identified in the systematic risk assessment

Primary Impact (Manifestation)	2 nd Order Impact	3 rd Order Impact	Likelihood	Consequence	Significance
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme, coupled with berg-wind conditions	Risk of major loss of livestock, grazing, crops and infrastructure. Threats to financial sustainability of existing commercial and subsistence farming operation and rural livelihoods; Reduced food security.	Almost certain	Major	Extreme
Increased storm severity/ Extreme weather events.	Increased erosion and inundation of coastal land, wetlands and estuaries	Increased damage to/loss of coastal property and infrastructure and increased insurance premiums	Almost certain	Major	Extreme
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme, coupled with berg-wind conditions	Risk of major and widespread loss of standing stocks and threats to financial sustainability of existing operations in the forestry sector.	Almost certain	Major	Extreme
More hot days and heat waves	Increased morbidity and mortality in elderly and infirm (e.g. HIV/AIDS patients)	Increased strain on health services	Almost certain	Major	Extreme
Higher mean temperatures	Coupled with increased rainfall, spread in range of diseases and vectors, including cholera, malaria and bilharzia.	General increase in occurrence of disease; exacerbation of effects on people with HIV/AIDS, the elderly and the poor.	Almost certain	Major	Extreme
Increased storm severity/ Extreme weather events.	Increased storm surges coupled with sea level rise and flooding from both climate change causes and catchment hardening.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Almost certain	Major	Extreme
Increased storm severity/ Extreme weather events.	Coupled with more intense rain, catchment hardening due to urban development, and reduced integrity of water catchments: increased risk of flooding or flash floods	Direct threat to infrastructure within flood- prone areas; Direct threat to human life.	Almost certain	Major	Extreme
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme	Increased fire frequency increases direct threat to human life, threats to	Almost certain	Major	Extreme

		Busilian ad an d			
		infrastructure (economic and social systems).			
More hot days and heat waves	Increased morbidity and mortality in elderly and infirm (e.g. HIV/AIDS patients)	Direct threat to livelihoods and social services	Almost certain	Major	Extreme
Higher mean temperatures	Increased evaporation, reduced soil moisture, reduced runoff and river baseflow.	Compounded by reduced MAP, systemic water shortages will limit economic growth potential to the south-west.	Almost certain	Major	Extreme
Sea level rise	Coupled with storm surges and flood events exacerbated by catchment hardening, inundation and wave damage to coastal low lying areas.	Direct threat to livelihoods, services and infrastructure in coastal low lying areas.	Almost certain	Major	Extreme
Increased storm severity/ Extreme weather events.	Crop damage from hail and wind and heavy rain	Increased risk of crop failure; threats to commercial and subsistence agriculture, rural livelihoods and food security.	Likely	Major	Extreme
Longer dry spells and increased likelihood/ severity of droughts	Increased risk/frequency of dryland crop-failure; Increased mortality and reduced productivity among livestock.	Threats to commercial and subsistence agriculture, rural livelihoods and food security.	Likely	Major	Extreme
More hot days and heat waves	Heat waves coupled with dry conditions may increase the risk of uncontrollable shack fires in informal settlements	Threat to human life. Threats to urban livelihoods and increased strain on urban disaster management systems.	Likely	Catast rophic	Extreme
Increased storm severity/ Extreme weather events.	Increased frequency of storm surges	Reduced safety of personnel and increased frequency of injury or loss of life	Almost certain	Major	Extreme

It should be noted that this chapter deals only with extreme risks as identified through the Climate Change Response Development Process. This does not diminish the importance of risks that have been identified as high, medium or low in the risk assessment process. The following should also be noted:

- This document is considered a first iteration, and should be regularly reviewed and developed further as information becomes available or as circumstances in the province change;
- The extreme risks identified and discussed in this document are considered crosscutting and broadly relevant to the province. Other risks identified as high- or mediummight have higher relevance at the local scale or in the context of a particular department.
- Although certain risks might not have been assessed as extreme from the perspective and scale of the province as a whole, certain risks might be considered extreme from the perspective of a certain department, agency or locality. For example, although the risk of reduced food security may not be an extreme threat to the social and economic collapse of the province, the same risk may be an extreme threat to a rural poor household or to the mandate of the Provincial Department of Agriculture and Rural Development.

• Each provincial department, municipality or other agency should apply the risk assessment process to their own circumstances and then develop internally relevant response plans.

2.1 Integrated programmes as a cross-sectoral framework for climate change adaptation

The impacts of extreme significance identified in Table 1 are broadly relevant to many sectors. It follows that responses to such impacts cannot be dealt with by each sector or department in isolation. Rather, integrated response programmes are required where multiple sectors and departments contribute to a common climate change issue to ensure effective adaptation responses. A programmatic framework for such multi-sectoral planning is described below.



Figure 2: Programmatic framework for multi-sectoral adaptive response planning.

Category specific response programmes are introduced in the sections below. The detailed response programmes are set out in Appendix 1.

It should be noted that the Response Programmes are working documents which require further refinement, regular review and updating. The programmes in their current format are initial proposals which require review by relevant departments or stakeholders. As such they should be considered as starter documents and not as a final product.

2.2 Adaptation Categories

The impacts of extreme significance as identified in Table 1 have been grouped into adaptive response programmes as given in Table 2 below.

 Table 2: Recommended programmes in response to the impacts of extreme significance identified in the systematic risk assessment.

Adaptation Category		Adaptation objective
Coastal Infrastructure and Livelihoods	•	Increased resilience of coastal infrastructure and resources to the effects of sea-level rise, storm-surges, flooding and increased sea temperature (fisheries). Improved response to the impacts of extreme coastal events.
Water Scarcity	•	Mainstreaming climate change induced water scarcity in institutional decision-making and planning in water stressed areas in the Eastern Cape Province. Effective water resources management and efficient water use throughout the Eastern Cape Province.
Flood Management	•	Flood prevention Reducing vulnerability to flooding events; Improved response to the impacts of flooding events
Responses to increased risk of wildfires	•	Improved wildfire prevention and suppression
Managing the effects of increased temperature on human lives	•	Societal adaptation to human health impacts from temperature increases associated with climate change.
Food security	•	Incorporating Climate Change acclimatization and resilience in provincial food security programmes.

The details of the adaptive response options and response programmes are developed in the sections below.

2.3 Coastal Infrastructure and Livelihoods

2.3.1 Overview

Coastal infrastructure and livelihoods are directly threatened by combined manifestations of Climate Change including the combined incidence of sea-level change, storm surges and flood events. Human life, coastal infrastructure and livelihoods are threatened by coastal inundation and erosion.

Recent findings subsequent to the release of the IPCC 4th Assessment Report are given below.

A better understanding of the behaviour of large ice sheets combined with observations of rapid melting have raised projections of 21st-century global sea level rise. New estimates of average global sea level rise by 2100 are significantly larger than in the AR4, as shown in the figure below. The AR4 projected an average sea level rise of 0.18 to 0.59 meters by the end of the 21st century. This estimate was driven mostly by the thermal expansion of the oceans as the water warms. However, due to an inability to model how ice moves in large, land-based ice sheets (i.e., the Greenland and Antarctic ice sheets), the IPCC did "not assess the likelihood, nor provide a best estimate or an upper bound for sea level rise". The upper end of the AR4 projection should not, therefore, be interpreted as an upper limit; in fact, it likely underestimates future sea level rise.



Figure 3: Comparison of recent estimates of sea level rise in 2100, relative to 1990 levels.

Sea level rise in the city of Cape Town

A series of four reports under the Global Climate Change and Adaptation: A Sea-Level Rise Risk Assessment (2008) provides a comprehensive assessment of sea level rise and associated risks in the City of Cape Town.

The study assesses the risks associated with sea level rise under three broad scenarios summarised below:

	Description	Sea level rise	Impact	Probability
Scenario 1	Present Day very Worst Scenario	2m in sheltered environments, 4.5m in exposed environments, and 6.5m in very exposed environments	About 25 km ² covered by the sea (1% of Cape Metro) albeit for a short time.	95% chance in next 25 years
Scenario 2	Scenario at the End of the Next Decade	Same as above but with shorter return periods Expected whenever an extreme storm occurs at same time as Equinox spring high tide	About 60 km ² covered by sea (2% of total Metro) for a short period.	85% chance in next 25 years
Scenario 3	Polar Ice Sheet Melt Scenario	6.5 metre sea-level rise linked to the melting of the Greenland and West Antarctic ice shelves, and involving permanent inundation	Permanent inundation of about 95 km2 of land around the Cape coastline (4% of Metro)	20% chance in next 25 years

	Excludes impacts of tidal surges and	
	storms	

Also of interest is that net ice loss will set in with a global average warming in excess of 2°C, marking the onset of an accelerating ice melt contribution to sea level rise. The complete elimination of the Greenland Ice Sheet will eventually lead to a contribution to sea level rise of 7m. These temperatures correspond to those of the last inter-glacial of 125,000 years ago, when sea level was 4 to 6 m higher than present levels. Around the Cape Peninsula the sea level at this time is reasonably well marked as the 18 foot wave cut platform.



Figure 4: Loss of infrastructure at Cape Town Harbour under 2.5m (blue), 4.5m (red) and 6.5 m (orange) sea-level rise scenarios.

2.3.2 Response Options

Response Options (answering the question: How can the province support/provide an enabling environment for risk reduction and impact mitigation?)

- Mapping of coastal land exposed to the risk of inundation and inclusion in national/provincial risk Atlas.
- Planning restrictions on or risk averse approaches to development in coastal low lying areas including wetlands, estuaries and shores. Inclusion of these restrictions in spatial planning.
- Promulgation of standards and specifications for applications within the coastal risk zone.
- Prioritising informal settlements within coastal risk zone for formal resettlement/allocation of social housing.
- Increased coastal defences where infrastructure is already in place (coastal roads, ports, pipelines).
- Improved catchment and stormwater management to limit compound effect of freshwater flooding.
- Development of coastal early warning systems.
- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres ((Key performance area 3: Disaster management planning and implementation).
- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres (Key performance area 4: Disaster response and recovery).

• Development of specific response and contingency plans for key coastal infrastructure within the coastal risk zone.

For further details please see Response Programmes Section.

2.4 Water Scarcity

2.4.1 Overview

Over the next 30 to 60 years, Mean Annual Runoff is projected to decrease in water catchments to the Southwest of the province (see for example Schulze *et al*, in press). Water resources in the Fish to Tsitsikama Water Management Area are already close to, or fully, allocated. This means that there is an absolute limit to the future availability of water resources for social and economic requirements, including requirements for basic human needs, agriculture and industrial processes. Water resource management issues in the Eastern Cape include:

- Over-abstraction of existing resources for irrigation, manufacturing and urban requirements, resulting in deterioration of downstream water quality, quantity and ecological integrity;
- Threats to water quality, quantity and aquatic ecosystem integrity due to catchment degradation;
- Threats to water quality, quantity and aquatic ecosystem integrity due to land-use change in catchments;
- Threats to water quality from sub-standard effluent releases as a result of poorly managed and poorly maintained waste-water treatment works and sewage reticulations.
- Threats to ecological integrity of fresh-water resources due to damming of existing resources.

Some of the secondary impacts of climate change on water resources include:

- Changes to baseflows and stormflows and their variabilities;
- Changes to annual streamflows and their variabilities;
- Changes to sediment yield and its variability; and
- Changes to irrigation water requirements and associated losses.

It is likely that the above threats will be compounded by the impacts of future climate change. The possibility of reduced precipitation together with increased rates of evaporation caused by climate change may result in an absolute reduction in the availability of water to the Southwest of the province. This will have major social and economic consequences. For example scarce water resources will limit growth in manufacturing and agro-industrial processing, both foundations of the local economy.

2.4.2 Response Options

Possible response options available to the province are given below.

- Promote effective water management systems and institutions.
- Develop effective and accountable catchment management agencies to ensure sustainable water use, regulation of water use, and improved monitoring.
- Undertake an integrated water resources study to determine the effects of climate change on future water supply and demand and to understand the consequences of not taking action¹.
- Research and implement water demand management measures (as per successes in Cape Town)².

¹ This work to this end has been initiated through the DWA reconciliation studies.

- Mainstream climate change driven water conservation and demand management in municipal decision-making (particularly Cacadu LMs and DMs).
- Optimise the re-use of waste water and avoid marine outfalls.
- Ensure avoidance of water losses through continual system maintenance and leak detection.
- Incentivise rainwater harvesting at the household and commercial scale.
- Promote education and awareness and instill a culture of water conservation.
- Promote the environmental health of water catchments including the conservation and rehabilitation of wetlands and the eradication of alien invasive vegetation.
- Promote investment in industry sectors and industrial processes that are less reliant on bulk water supply.
- Include water demand and conservation issues in the Environmental Impact Assessment Process.
- Maintain water quality standards through optimal operation and maintenance of waste-water treatment works.
- Ensure the early implementation of water restrictions during extended periods of drought.

For further details please see Response Programmes Section.

² Water Demand Management has been initiated in parts of the Algoa and Amathole systems.

2.5 Flood Management

2.5.1 Overview

Superimposed on the background of gradual increases and decreases in mean annual precipitation in the province, climate change is projected to result in less predicable, more extreme events. This will include longer and dryer dry periods; and wetter, more intense wet periods. Climate change is likely to increase not only the frequency of flooding events, but also the intensity of flood events.

The increased risk of flooding due to climate change is exacerbated by the reduced ability of water catchments to absorb flood pulses. This is caused by:

- Losses of wetlands which absorb flood waters and release them over a longer period of time; and
- Catchment hardening as a result of increased urbanization and deterioration in landcover.

A complicating factor is that poorly planned urban sprawl and informal urbanisation often results in developments and human settlement taking place in flood-prone areas or within 1:10, 1:50 and 1:100 year historical flood lines.

The combination of climate change, catchment deterioration and unplanned or poorly planned urban settlement is highly likely to result in disastrous future scenarios.

2.5.2 Response Options

Possible response options available to the province are given below.

- Maintain and improve the integrity of wetlands and other aquatic environments;
- Maintain and improve the integrity of water catchments;
- Reduce settlement and urban development in areas vulnerable to flooding;
- Encourage flood-water retention and increased infiltration in urban design and development;
- Map a standardized set of 1:50 and 1:100 year floodlines using projected, rather than historical, data;
- Increasing capacity in early warning and disaster management institutions, focusing on the implementation of best practices in communication (national, provincial and local) and integrated disaster response.

For further details please see Response Programmes Section.

2.6 Responses to increased risk of wildfires

2.6.1 Overview

As shown in the map below, the Eastern Cape Province is prone to veld and forest fires, with the greatest frequency of fires in the east and north of the province.

The risk of wildfires is a product of increased temperature and winds, reduced humidity and increased fuel load. Simulations project warmer winters and springs. Coupled with increased intensity and duration of dry periods, increased occurrence of "berg winds", and an increased fuel load from warmer, wetter summers in the east, there is a high likelihood of increased risk of wildfires in late winter and early spring.



Figure 5: Fire frequency atlas for South Africa showing the number of fires between 2000 and 2007. Light yellow indicates 1 to 2 fires; dark red indicates more than 8 fires. Source: South African Risk and Vulnerability Atlas (2010).

2.6.2 Response Options

Possible response options available to the province are given below.

- Increased provincial support to Fire Protection Associations.
- Increased presence of Working on Fire bases in the Eastern Cape Province.
- Improved fire risk awareness (especially on days of high-extreme fire danger).
- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres (KPA 2: Risk assessment and monitoring).
- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres (KPA 2: Risk assessment and monitoring).
- Increased provincial support to Fire Protection Associations.
- Increased presence of Working on Fire bases in the Eastern Cape Province.

- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres ((Key performance area 3: Disaster management planning and implementation).
- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres (Key performance area 4: Disaster response and recovery).

For further details please see Response Programmes Section.

2.7 Managing the effects of increased temperature on human lives

2.7.1 Overview

Mid- to long-term projections indicate that annual average temperatures are expected to increase by approximately 2°C at the coast and by between 3°C and 4°C inland. There is also a stronger likelihood of temperature extremes (experienced as heat waves). These climate changes are expected to have negative effects on human health, including the following:

- An increase in the frequency of heatwaves is indirectly linked to increased deaths among children, the elderly and the infirm (with particularly risk to those with HIV/AIDS). Poor communities with inadequate housing and services are particularly prone to the effects of heat-waves.
- Increased mean temperature coupled with increased rainfall has already been demonstrated to result in the spread in range of vector-borne diseases. This includes malaria, cholera and tick-borne diseases.
- Increased rainfall and temperature increases the risk of food-borne and water-borne infections.

The direct effects of increased temperature on human lives should be considered in combination with other indirect effects of climate change on social and economic systems, such as the effect of increased floods and droughts on poor communities. In particular, poor households relying on subsistence agriculture are particularly prone to a complex of health and livelihood issues that are exacerbated by climate change.



Figure 6: Diagram illustrating the link between climate change and effects to human health (Source: WHO, 2003).

2.7.2 Response Options

Possible response options available to the province are given below.

- Improved passive thermal design standards for social housing (for example adoption of SANS 204).
- Accelerated provision of formal/social housing.

- Reduction in co-stressors among urban and rural poor to improve resilience (for example improved nutrition, water and sanitation, wellness).
- Education for shack fire prevention.
- Promotion of safe fuels and cooking/lighting facilities in informal settlements (the use of paraffin, candles and open fires in informal settlements for energy needs is a primary cause of runaway shack fires).
- Increased readiness of emergency and health services during heat waves.
- Dedicated heat-stress response equipment in community clinics.
- Installation of fire hydrants in informal settlements.
- Increased support to and collaboration with Provincial and Municipal Disaster Management Centres (Key performance area 4: Disaster response and recovery).
- Development of specific response and contingency plans for key coastal infrastructure within the coastal risk zone.

For further details please see Response Programmes Section.

2.8 Food security

Poor communities and the social and economic structures of the province are sufficiently at risk to warrant the development of a "Food Security" response programme under the Eastern Cape Climate Change Response Strategy.

2.8.1 Overview

The Southern African Regional Climate Change Programme notes the following in regard to the impacts of Climate Change on food security:

"Scientists predict that the greater variability in and volatility of temperature and rainfall cycles in Africa resulting from climate change will alter the land area suitable for agricultural or livestock production, while increasing the frequency of flooding and drought. Grain yields are expected to decline due to increased rainfall variability, which may result in the need for grain imports, increasing the food prices and hence the cost of living. Desertification rates are also expected to increase.

Poor people are most vulnerable to climate change. This is due partly to the fact that poverty is often linked to a higher reliance on natural resources—for example when farming for subsistence. This exacerbates their vulnerability, leading to further degradation of natural resources and creating a vicious circle of yet more environmental degradation and even greater vulnerability. Impacts on agriculture include the degree to which crops/farmers can adapt to changing climates, the suitability of specific staple or cash crops in marginal regions, and the threat of increasing variability in the form of higher frequency of dry or wet years".

Although food security is considered as an issue which relates mostly to poor communities, it should be noted that food security also represents a strategic risk to the Province. This has particular reference to the possibility of future food price shocks related to global population expansion and issues of future water scarcity and oil scarcity associated with the notion of "peak oil". The stronger the provincial commercial and subsistence food production system, the less vulnerable the Province is to food price and scarcity shocks.

2.8.2 Response Options

Possible response options available to the province are given below.

- Promote the planting of crops that are appropriate to a climate and soil region, and that are able to withstand climate extremes.
- Promote the harvesting and storage of water at the subsistence level.
- Promote the adoption of cultivation techniques that improve soil moisture retention and general crop resilience.
- Prioritise support to existing food security programmes.

3 GREENHOUSE GAS EMISSIONS MITIGATION

Phase II introduced various technologies appropriate for Greenhouse Gas mitigation in the Province. The current section describes the greenhouse gas impact sources of highest categories and outlines possible mitigation action plans for the Province.



Figure 7: Greenhouse gas emissions in the Eastern Cape (2008) relative to emissions for South Africa as a whole (2000) – See GHG section of Phase I report.

Greenhouse gas emission mitigation programmes should respond to emission sources of the highest significance. Figure 7 highlights the emissions source category of the highest significance, which in the case of South Africa and the Eastern Cape are energy sources from the combustion of fossil fuels (power stations, transport, furnaces and boilers, and others).

A systematic method for developing mitigation opportunities and programmes involves an evaluation of emissions source categories (see Figure 8). The categories used in this report are the same as those used for the South African Greenhouse Gas Inventory and IPCC guidelines for Greenhouse Gas Inventories (2006).



Figure 8: Framework for source-category based evaluation of emissions reduction targets and opportunities.

The framework described in Figure 8 is further developed in Table 3.

	National (2000)	EC Prov (2008)	Opportunities for Abatement	Opportunities for sequestration	National Targets			Quantified Targets for EC	Activity Targets for EC
	Gg CO₂e	Gg CO₂e			Quantity	Activity	Detail		
TOTAL	435,461.00	38,991.27			Copenhagen Accord Pledge: 34% below business as usual by 2025.	Climate Change Response Policy White Paper 2010; SAAQIS.			
1.Energy	344,106.00	26,124.89	Energy Efficiency, Renewable Energy, Cogeneration including utilization of waste gases and heat.	Carbon Capture and Storage		IRP II; RE White-Paper Review.			
2. Industrial Processes and Product Use	61,469.00	244.47	Adoption of low- carbon technologies	Carbon Capture and Storage	Not known	Mandatory emissions reporting for scheduled processes.			Monitoring and Support for SAAQIS reporting
3. Agriculture, Forestry and Other Land Use (AFOLU)	20,493.00	10,734.32	Methane destruction and low carbon management practices.	Increased density and extent of soil and above- ground biomass stocks	Not known	Not known			Emission reductions mainstreamed into Landcare, WfW and DoA objectives.
4. Waste	9.392.00	1,887.60	Low Carbon Waste Management Practices and Methane Capture, Use and Destruction	Disposal of biochar	Not known	NEM:Waste Management.		Number waste sorting facilities in operation; % Landfills offering incentives for separated organic waste. Number facilities offering facilities for beneficiation of organic waste.	

Table 3: First order matrix for the	evaluation of targets and	d opportunities accordir	a to emissions categories.
			J

High confidence in input data
Medium confidence in input data
Low confidence in input data or no data available

As with adaptation, mitigation activities would be relevant to many sectors. This means that mitigation activities should not be dealt with by each sector or department in isolation. Rather, integrated mitigation programmes are required where multiple sectors and departments contribute to a common mitigation objective. As with adaptation, a programmatic framework for such multi-sectoral mitigation planning is described in Figure 9 below.



Figure 9: Framework for multi-sectoral mitigation programmes.

Drawing from phase two of the ECCCRS process and from the framework for source-category based evaluation of emissions reduction targets and opportunities, a set of pragmatic greenhouse gas mitigation programmes is proposed. These are developed in the section below and introduced in Table 4 below.

witigation Category		Mitigation objective
Mainstreaming GHG Mitigation in Provincial and Local Government		Mainstreaming GHG Mitigation in Decision-making at all levels of government within the Eastern Cape Province Promoting GHG Mitigation in Provincial and Local Government
and in Industry		Operations.
	•	Promoting Greenhouse Gas Reporting in Industry.
Promotion of Renewable Energy in the EC		Create an enabling environment for investment in, implementation and use of clean energy in the Eastern Cape.
Mitigation and opportunities for Rural Livelihoods		Facilitate integrated lead projects that promote sustainable livelihoods and local economic development while achieving (tradable) emission reductions.
Mitigation in Solid Waste and Wastewater Treatment	•	Reduction in organic waste to landfill, renewable energy from waste, and methane use or destruction.
Greenhouse Gas Mitigation in Transport	•	Facilitate shift to low greenhouse gas modes of transport and transport systems.

Table 4: Proposed integrated mitigation programmes.

Category specific mitigation programmes are introduced in the sections below. **The detailed programmes are set out in Appendix 2.**

It should be noted that the Mitigation Programmes are working documents which require regular review and revision. The programmes in their current format are initial proposals which require review by relevant departments or stakeholders. As such they should be considered as starter documents and not as a final product.

3.1 Mainstreaming GHG Mitigation in Provincial and Local Government

3.1.1 Overview of the issue and opportunity

- South Africa has a per-capita carbon footprint (Greenhouse Gas Emissions Footprint) that is higher than the international average. These emissions, no matter where they originate from, contribute directly to global warming which causes climate changes.
- South Africa is a signatory to the Kyoto Protocol and is therefore obligated to combat climate change.
- In December 2009 and January 2010 at the Copenhagen Accord the presidency pledged a 34% reduction in emissions below business as usual by 2025;
- All entities, including those in the Eastern Cape, have a responsibility to collectively contribute to a reduction in Greenhouse Gas Emissions caused by human activities.
- As per Section 29 of the National Environmental Management: Air Quality Act, the National Minister or Provincial MEC has the power to declare Greenhouse Gasses as Priority Air Pollutants. Entities emitting within the given category will need to submit and implement pollution prevention plans.
- As per Section 26 of the National Environmental Management: Air Quality Act, the National Minister or Provincial MEC has the power to declare fossil fuels as Controlled Fuels. This allows among others, the opportunity to
 - Establish standards for the use of the controlled fuel in combustion processes;
 - Establish standards for the manufacture or sale of the controlled fuel;
 - Establish specifications for the composition of controlled fuels;

3.2 Promotion of Renewable Energy in the EC

3.2.1 Overview of the issue and opportunity

Effective implementation of services which can benefit from technologies which mitigate GHG emissions is highly dependent on a good regulatory and institutional environment. Key regulatory mechanisms in the Renewable Energy (RE) Industry include:

- Procurement guidelines and procedures for renewable energy services;
- Standards and Codes of Practice;
- Secure and long-term access to markets;
- Licensing and permitting; and
- Clear guidance and mechanisms for RE inclining block tariffs.

A key question is the institutional environment for regulatory oversight. At this stage, in the electricity sector, the centralised, highly regulated, bureaucratic energy generation and transmission sector is arguably constricting the development of an independent RE production sector in the province. Either decentralisation or deregulation is required, or an enabling institutional framework (in which real capacity exists) should be set up. Conversely, local planners could use regulations to encourage technology rollout by linking requirements for energy efficiency and other technology options into planning permissions (building plans, rezoning, EIA RODs, SDFs). However, for these requirements to have any effect, they need to be backed up by legislation, adopted policy, guidelines and/or scientific evidence of effectiveness.

Furthermore, the role of renewable energy is broader than only electricity generated on the national grid from renewable energy and includes direct and on-site provision of energy services, such as heated water, and decentralized (off grid) generation of electricity or gas.

It is apparent that three bottlenecks to unlocking the industry exist in the Province, namely:

- Institutional fragmentation and lack of clarity, information and support in regard to (among others):
 - Licensing;
 - Permitting;
 - Environmental authorisation;
 - Zoning and municipal permission;
 - Power purchase agreements;
 - Grid access and transmission codes of practice;
 - Regulatory conditions; and
 - Access to incentives.

The above deterrents to investment can be overcome at the provincial level by the formation of a provincial renewable energy board or investment one-stop-shop to coordinate or streamline the regulatory process, facilitate access to decision-makers, and guide the investor through the various regulatory hurdles associated with independent power production.

Independent access to markets. In other words, where Independent Power Producers (IPPs) are not selected for Eskom/DoE/Independent System Operator Power Purchase Agreements, they should have recourse to independently supplying directly to purchasers of clean energy. The province can facilitate an independent Clean Energy Market in order to attract investors through the formation of a Clean Energy Purchasing Power Pool, or supporting the independent brokerage of clean energy. Ideally such arrangements would resolve the difference between the long term investment cycle of IPPs (20 years) and the short term purchase cycle of industry (3 to 5 years).

- Investors are currently deterred by the lack of supporting services and infrastructure in the province. In particular there is a requirement for appropriate skills, testing facilities, R&D facilities and maintenance services. The province can improve the RE investment climate by establishing a Clean Energy Centre or Clean Energy Incubator. Such a centre should incorporate, among others:
 - Technology testing and certification facilities;
 - Training and skills development facilities;
 - Research and development facilities.

3.3 Mitigation and Opportunities for Sustainable Livelihoods

3.3.1 Overview of the issue and opportunity

Although GHG emissions primarily occur as a result of urban and industrial activity, opportunities exist in rural areas for emission mitigation projects. Mitigation projects have a high employment ratio and therefore go hand in hand with rural development projects. Climate change mitigation has the potential to reform rural-urban settlement relationships and patterns.

The potential of renewable energy for sustainable settlements and local economic development is illustrated by the example of the experimental biomass gasification unit at Melanie Village near Alice in the Tyume River valley (Mamphweli and Meyer 2008). The system is designed to run a 200 kW generator at 75% capacity, utilising 150 kg of biomass per hour. Biomass feedstock is sourced from wood waste generated at a nearby sawmill. The wood waste would otherwise be incinerated. Energy generated from biomass residue is considered to be renewable. 200kW of electricity generated for 16 hours a day for a year produces 1,168 MWh of renewable electricity. This results in avoided emissions from coal fired power stations of 1,144 tons of CO_2e .

In addition to renewable energy generation, the project is intended as a rural community upliftment initiative. Ten previously unemployed people have been contracted and trained as gasifier operators. The draft business plan indicates that employee numbers could be doubled through establishment of small business enterprises. Those activities identified in the business plan will need new skills, requiring funding for skills-development. The electricity generated from the producer gas will be available to a bakery and a grain mill, and business plans for these two enterprises have been completed



Figure 10: The 200kW gassifier installed at Melani village north of the Alice Campus. Source and Photo: S Mamphweli.

Other opportunities exist in carbon sequestration from reforestation and sustainable landuse management practices; and waste to energy projects.

3.4 Mitigation in Solid Waste and Wastewater Treatment

3.4.1 Overview of the issue and opportunity

Organic waste contributes to Greenhouse Gas Emissions by the release of methane gas through decomposition under anaerobic conditions (in other words when the waste is not exposed to air). Methane gas has 21 times the greenhouse gas effect of Carbon dioxide. In other words, 1 ton of methane is the equivalent of 21 tons of Carbon dioxide. Methane gas is most often generated when organic waste such as garden waste, wood, food waste, paper and cardboard are disposed of at landfill, or when sewage sludge or wastewater/effluent is treated in anaerobic digesters or in certain settling ponds where the biogas is allowed to vent to the atmosphere.

Greenhouse gas emissions from solid waste can be avoided by the diversion of organic waste streams from landfill and the conversion to compost (composting does not generate methane) or conversion to energy.

Emissions from waste-water can be avoided through the capture of methane and use as an energy source.

Greenhouse gas emissions are also caused through the inefficient use of electricity in wastewater treatment. Certain treatments systems and technologies are more efficient than others.

3.5 Greenhouse Gas Mitigation in Transport

3.5.1 Overview of the issue and opportunity

The combustion of petrol, diesel and aviation fuel accounted for the emission of 13,494,876 tons of Carbon Dioxide in the Eastern Cape in 2008. This represents more than half of emissions from all energy sources and 35% of emissions from all sources combined in the province.

Private passenger transport is the dominant mode in the transport sector and accounts for the majority of fuel use.

Even a 10% shift from private to public modes of passenger transport will result in a significant reduction in Greenhouse Gas Emissions and local air pollution.

The deputy minister of transport, on the 26th of October 2010, noted the following in regard to green transport (Engineering News Online 27/10/2010):

- Removing excess road use and improving efficiencies on South Africa's roads seems to be the most viable option to reducing the transport sector's carbon emissions in the short term.
- South Africans, especially middle-class users, are largely still dependent on the use of private vehicles.
- It is necessary to make it more expensive for people and freight to use their cars and trucks on the roads and move them onto other modes of transport
- Viable transport alternative would be required, which would take significant investment to put in place.
- The absence of significant investment over the last 30-plus years has lead to the degradation of the country's rail system. It will cost more to refurbish the system than to recapitalise it and procure new systems.
- The recapitalisation would take place in stages over the next 18 years.
- The recapitalisation will have a strong local focus in terms of procurement and manufacturing of the fleet and technologies.

The World Watch Institute recommends the following for a shift to greener transport systems:

- Substantial and sustained investments in rail and light rail (while limiting highway spending principally to repairs of crumbling infrastructure such as bridges).
- Overhauling policies to stimulate denser settlements that permit public transit, reduce reliance on motorized transportation, and make biking and walking realistic options.
- Overall, such a course would stimulate innovation, reduce carbon emissions and air pollutants, inject urban and suburban areas with new vigor and vitality, and generate or retain large numbers of well-paying jobs.

A shift from private road transport to other forms of transport would facilitate improved fuel efficiency per passenger kilometre.

Transport Mode	Vehicle Production	Fuel Use	Total				
(megajoules per passenger-kilometer)							
Light Rail	0.7	1.4	2.1				
Bus	0.7	2.1	2.8				
Heavy Rail	0.9	1.9	2.8				
Car (Gasoline)	1.4	3.0	4.4				
Car (Diesel)	1.4	3.3	4.7				

 Table 5: Passenger fuel efficiency for five passenger transport modes (Source: UNEP 2008)

4 CLIMATE CHANGE RESPONSE FINANCE AND SUPPORT

In many instances Climate Change response projects are expected to require funding beyond local and national budgetary capacity. This is illustrated by the United Nations Convention Framework on Climate Change report on climate change finance (UNFCCC 2007). The report notes that additional investment and financial flows in 2030 to address climate change is likely to amount to 0.3 to 0.5% of global domestic product in 2030 and 1.1 - 1.7% of global investment in 2030.

The annual cost for developing countries to adapt to a changing climate has been estimated by the UNFCCC Secretariat at \$28-67 billion in 2030 (Caravani *et al* 2010).

The UNFCCC (2007) report states that mitigation measures needed to return global greenhouse gas emissions to current levels by 2030 require an increase in global investments and financial flows of between USD 200-210 billion per annum. The report notes that huge investment flows are needed in the energy sector. For energy supply US\$ 432 billion is projected to be invested annually into the power sector. Of this amount, US\$ 148 billion needs to be shifted to renewable energy, Carbon Dioxide Capture and Storage (CCS), nuclear and hydro. Investment into fossil fuel supply is expected to continue to grow, but at a reduced rate. Failure to achieve changes in investment and financial flows for mitigation will lead to unsustainable development paths and "lock-in" effects for the next 20-30 years. This will lead to higher emissions, more climate change impacts, and larger investment and financial flows needs for adaptation in the longer-term.

In regard to adaptation, particular attention will need to be given to developing countries. While only 20-25 per cent of investment currently occurs in developing countries, due to expected rapid economic growth, a large share of investment and financial flows will be needed in developing countries. As a result of their economic growth, the energy demand in developing countries will increase substantially.

4.1 Multilateral and Bilateral Finance for Climate Change Response

The obligation of developed countries to assist developing countries in responding to climate change is well recognizes. Numerous Multilateral and Bilateral sources of finance for climate change response are available. Details are given in the tables below. For a detailed list of projects, see Appendix 3.

Table 6: Multilateral and Bi-Lateral Climate Change adaptation and mitigation funds (Source: http://www.climatefundsupdate.org/listing 2010)

Fund	Туре	Administered by	Areas of focus	Date operational
Adaptation Fund	Multilateral	Adaptation Fund Board	Adaptation	2009
Amazon Fund (Fundo Amazônia)	Multilateral	Brazilian Development Bank (BNDES)	Mitigation - general, Adaptation, Mitigation - REDD	2009
Clean Technology Fund	Multilateral	The World Bank	Mitigation - general	2008
Congo Basin Forest Fund	Multilateral	African Development Bank	Mitigation - REDD	2008
Environmental Transformation Fund - International Window	Bilateral	Government of the United Kingdom	Mitigation - general, Adaptation	2008
Forest Carbon Partnership Facility	Multilateral	The World Bank	Mitigation - REDD	2008
Forest Investment Program	Multilateral	The World bank	Mitigation - REDD	2009
GEF Trust Fund - Climate Change focal area	Multilateral	The Global Environment Facility (GEF)	Mitigation - general, Adaptation	2006
<u>GEF Trust Fund - Climate Change focal area (GEF 5)</u>	Multilateral	The Global Environment Facility (GEF)	Mitigation - general, Adaptation	2010
Global Climate Change Alliance	Multilateral	The European Commission	Mitigation - general, Adaptation, Mitigation - REDD	2008
Global Energy Efficiency and Renewable Energy Fund	Multilateral	European Commission	Mitigation - general	2008
Hatoyama Initiative - private sources	Bilateral	Government of Japan	Mitigation - general, Adaptation	2008
Hatoyama Initiative - public sources	Bilateral	Government of Japan	Mitigation - general, Adaptation	2008
Indonesia Climate Change Trust Fund	Multilateral	Indonesia's National Development Planning Agency	Multiple foci	2010
International Climate Initiative	Bilateral	Government of Germany	Mitigation - general, Adaptation, Mitigation - REDD	2008
International Forest Carbon Initiative	Bilateral	Government of Australia	Mitigation - REDD	2007
Least Developed Countries Fund	Multilateral	The Global Environment Facility (GEF)	Adaptation	2002
MDG Achievement Fund – Environment and Climate Change	Multilateral	<u>UNDP</u>	Mitigation - general, Adaptation	2007
thematic window				
Pilot Program for Climate Resilience	Multilateral	The World Bank	Adaptation	2008
Scaling-Up Renewable Energy Program for Low Income Countries	Multilateral	The World Bank	Mitigation - general	2009
Special Climate Change Fund	Multilateral	The Global Environment Facility (GEF)	Adaptation	2002
Strategic Climate Fund	Multilateral	The World Bank	Mitigation - general, Adaptation, Mitigation - REDD	2008
Strategic Priority on Adaptation	Multilateral	The Global Environment Facility (GEF)	Adaptation	2004
UN-REDD Programme	Multilateral	UNDP	Mitigation - REDD	2008

Fund	Acronym	Pledged (USD mn)	Disbursed (USD mn)	Date operational
Adaptation Fund	AF	\$197.05	\$9.46	2009
Amazon Fund (Fundo Amazônia)	FA	\$1,000.00	\$59.91	2009
Clean Technology Fund	CTF	\$4,387.75	\$9.30	2008
Congo Basin Forest Fund	CBFF	\$165.00	\$17.42	2008
Forest Carbon Partnership Facility	FCPF	\$221.24	\$4.41	2008
Forest Investment Program	FIP	\$562.10	\$2.00	2009
GEF Trust Fund - Climate Change focal area (GEF 4)	GEF4	\$1,032.92	\$1,023.49	2006
GEF Trust Fund - Climate Change focal area (GEF 5)	GEF5	\$1,359.38	\$0.00	2010
Global Climate Change Alliance	GCCA	\$204.15	\$8.10	2008
Global Energy Efficiency and Renewable Energy Fund	GEEREF	\$169.50	\$0.00	2008
Hatoyama Initiative	НІ	\$15,000.00	\$5,319.89	2008
International Climate Initiative	ICI	\$519.60	\$258.02	2008
International Forest Carbon Initiative	IFCI	\$243.57	\$66.10	2007
Least Developed Countries Fund	LDCF	\$221.45	\$141.96	2002
MDG Achievement Fund – Environment and Climate Change thematic window	MDG	\$89.50	\$61.84	2007
Pilot Program for Climate Resilience	PPCR	\$981.84	\$9.01	2008
Scaling-Up Renewable Energy Program for Low Income Countries	SREP	\$300.13	\$0.00	2009
Special Climate Change Fund	SCCF	\$147.78	\$97.17	2002
UN-REDD Programme	UN-REDD	\$87.10	\$38.19	2008
		\$26,890.06	\$7,126.27	

Table 7: Multilateral and Bi-Lateral Climate Change adaptation and mitigation funds – pledged and disbursed (Source: http://www.climatefundsupdate.org/listing 2010).

4.2 National and Local Sources of finance

A sample of grants and funds available in South Africa is given below:

- Finance and Subsidies offered through the Department of Energy (DoE) Renewable Energy Finance and Subsidy Office (REFSO).
- Funds Managed by the Industrial Development Corporation (IDC). The IDC has been tasked with raising R12 Billion in capital to fund the growth of South Africa's green industrial economy. The fund will be allocated for renewable energy generation; manufacturing downstream components; resources and waste management; and energy management.
- The World Bank's Clean Technology Fund: In November 2010, the World Bank Clean Technology Fund announced its intention to invest US \$85-million in renewable energy and co-generation projects in South Africa.
- Development Bank of Southern Africa: The DBSA has a strong focus on funding environmentally beneficial projects.

4.3 Other sources of support

It should be noted that support may not necessarily be purely in the form of lump sums of money. Other forms of support include:

- The secondment of human resources for dedicated climate change posts within critical departments;
- The financing of training and capacity development;
- Mentoring programmes.

5 INSTITUTIONAL ARRANGEMENTS FOR PROVINCIAL CLIMATE CHANGE RESPONSE

5.1 National Institutional Arrangements

(The following is taken from the brief developed for this project by IMBEWU Sustainability Legal Specialists.)

Climate change is the ultimate cross-cutting issue, which concerns each sphere of the South African Government (national, provincial and municipal). It is also indicated in the South African Green Paper on Climate Change (2010) that most of the actions in terms of climate change will take place at the provincial and municipal levels (the traditional implementation spheres of the South African Government).

The national government is traditionally responsible for defining the national policy and regulatory framework in terms of a specific matter. The national government also traditionally determines the strategic direction and approach to address a specific matter. Within the national government, all national departments have to integrate climate change considerations within their area of jurisdiction. Traditionally, the role of the various national departments can be categorised as follows:

- The DEA is the lead department in terms of climate change.
- There are also other keys departments which strongly support the DEA in defining the actions to address climate change, from a mitigation and adaptation perspective.
- Then they are other departments which are qualified as supporting departments as they will strongly assist in developing and addressing the required supporting tools necessary to implement the proposed actions and interventions determine by the keys departments.

This categorisation is not an official one, but it has been developed by IMBEWU to facilitate the understating of the roles of the various national departments. According to the South African Green Paper on Climate Change (2010), climate change considerations have to be integrated and mainstreamed in the actions of all national departments, all government spheres and all organs of state.

There are also other stakeholders, which should be considered and engaged with, including business and industry, civil society, organised labour and the science community. Various coordinating entities (formal and informal) also exist to facilitate co-operative governance

The following diagram presents an overview of the current institutional framework relevant in terms of climate change.

Phase 3: Climate Change Response

SOUTH AFRICAN INSTITUTIONAL FRAMEWORK RELATED TO CLIMATE CHANGE



5.2 **Provincial Institutional Arrangements**

The development of institutional arrangements for the climate change response strategy is beyond the scope of the current process.

However, since climate change response is entirely cross-cutting and can only be achieved through coordination among many departments, the strategy is best situated in conjunction with other relevant provincial plans and policies including the Provincial Growth and Development Plan, the Provincial Spatial Development Plan and the Provincial Industrial Development Strategy.

Key supporting competencies (in addition to Department of Economic Development and Environmental Affairs) include the Office of the Premier, Treasury and Local Government and Traditional Affairs (who hold the competencies for planning, disaster management and local government).

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Appendix 1: Adaptation Programmes

Please note that the Response Programmes are working documents which require further development, annual review and modification. The programmes in their current format are initial proposals which require review by other departments or stakeholders. As such they should be considered as starter documents and not as a final product.

Coastal Infrastructure and Livelihoods
		Date: August 2010		
	CLIMATE CHANGE PROGRAMME	Revision No: Draft for development		
	Adaptation	Prepared By:		
		Approved By:		
CC Programme	Coastal Infrastructure and Livelihoods			
Programme Custodian	Provincial Coastal Committee (PCC) ³			
Objective(s):	Overall objective:			
	 Increased resilience of coastal infra rise, storm-surges, flooding and ir 	astructure and resources to the effects of sea-level ncreased sea temperature (fisheries).		
	Improved response to the impacts of extreme coastal events.			
	Sub-objectives:			
	making and planning, with co	nsolidated planning processes and frameworks.		
	2 Improved data availability (ac	ccess to and distribution of information).		
Target(s):	Targets:			
	 Inclusion of vulnerable coastal area provincial and municipal planning departmental plans) by 2012. 	as and coastal vulnerability considerations in (e.g. SDFs , SDPs, IDPs , EMFs and provincial		
	 Promulgation, development and/or standards for infrastructure within 	updating of regulations, specifications and/or vulnerable or susceptible coastal areas.		
	Inclusion of Climate Change based development planning of program	coastal vulnerability in the strategic planning and me stakeholders by 20xx		
	Completion of a high resolution coa (including sea level rise and inunc	astal vulnerability mapping exercise by 20xx dation scenarios).		
	Natural and artificial coastal defense	es need to be strengthened and maintained.		
	 Sufficient allocation of budget and l institutions in regard to coastal re coastal disaster relief fund⁴. 	human resources to disaster management lated issues by 20xx. Explore the formation of a		
	 Research on the threats to the livel vulnerable coastal resources⁵. 	ihoods of poor communities within, or relying on,		
	Development of a coastal early war	rning and response system.		

³ Note that the Membership and function of the PCC with respect to climate change response needs to be clear. The TOR on Climate Change response needs to be

 ⁴ Explore alternative funding sources such as climate change adaptation funds.
 ⁵ Explore the options for diversification from reliance on coastal resources. Consider not only subsistence livelihoods, but also commerce and tourism.

	Include sea level rise and	coastal inundation events in the	EIA authorization process.
Other key	Name	Unit	Interest
stakeholders	Yazeed Peterson	Oceans and Coasts (Marine and Coastal Management)	Coastal protection (Biodiversity)
	Christabel Gelland 021 819 2458 Cgeland@environment.gov.za	Oceans and Coasts	Coastal protection (Biodiversity)
		HLG&TA	Spatial Planning; Coastal Housing.
		DEDEA	NEM: Coastal Management
		ELIDZ	Coastal Infrastructure
		Coega IDZ	Coastal Infrastructure
		Transnet Ports	Coastal Infrastructure
		Department of Transport	Coastal Roads
		Amathole DM	Local Government
		Cacadu DM	Local Government
		OR Tambo	Local Government
		Coastal Local Municipalities	Local Government
	Catchment Management	Agencies.	
Overview of the issue:	Coastal infrastructure and livelih Climate Change including the co flood events. Human life, coasta inundation and erosion. Key scientific developments s Since the IPCC released AR4 ir will be made before the next IPC new findings is provided here. A better understanding of the be rapid melting have raised project New estimates of average globa AR4. The AR4 projected an ave 21st century. This estimate was water warms. However, due to a sheets (i.e., the Greenland and nor provide a best estimate or a projection should not, therefore, underestimates future sea level	aboods are directly threatened by or combined incidence of sea-level c al infrastructure and livelihoods an since the IPCC Fourth Assessin a July 2006, various new informat CC assessment, due in 2014. A b ehaviour of large ice sheets comb stions of 21st-century global sea al sea level rise by 2100 are signi- arage sea level rise of 0.18 to 0.5 s driven mostly by the thermal ex an inability to model how ice mov Antarctic ice sheets), the IPCC d n upper bound for sea level rise" be interpreted as an upper limit; rise.	combined manifestations of hange, storm surges and re threatened by coastal nent Report (June 2009) tion has been published that orief overview of some key bined with observations of level rise. ificantly larger than in the 9 meters by the end of the pansion of the oceans as the es in large, land-based ice id "not assess the likelihood, . The upper end of the AR4 in fact, it likely

		I	Estimated Sea Level Rise by 21	00	
		2.5			
		2			
		nete			
		1.5			
		a Lev			
		× 0.5			
		0	IPCC A4 (2007) Rahmstorf (2007) Pfe	ffer et. al. (2008)	
		Compariso	on of recent estimates of sea	level rise in 2100, rela	ative to
		1990 levels	5.		
	<u>Sea level</u>	rise in the city c	of Cape Town		
	A series of	f four reports und	ler the Global Climate Change	e and Adaptation: A So	ea-Level Rise
	associated	d risks in the City	of Cape Town.	essment of sea level h	se anu
	The study summarise	assesses the risled below:	ks associated with sea level r	ise under three broad	scenarios
		Description	Sea level rise	Impact	Probability
	Scenario 1	Present Day very Worst Scenario	2m in sheltered environments, 4.5m in exposed environments, and 6.5m in very exposed environments	About 25 km ² covered by the sea (1% of Cape Metro) albeit for a short time.	95% chance in next 25 years
	Scenario 2	Scenario at the End of the Next Decade	Same as above but with shorter return periods Expected whenever an extreme storm occurs at same time as Equinox spring high tide	About 60 km ² covered by sea (2% of total Metro) for a short period.	85% chance in next 25 years
	Scenario 3	Polar Ice Sheet Melt Scenario	6.5 metre sea-level rise linked to the melting of the Greenland and West Antarctic ice shelves, and involving permanent inundation Excludes impacts of tidal surges and storms	Permanent inundation of about 95 km ² of land around the Cape coastline (4% of Metro)	20% chance in next 25 years
	Also of intermarking the elimination of 7m. The when sea level at thi	erest is that net in the onset of an acc of the Greenlan ese temperatures level was 4 to 6 r s time is reasona	ce loss will set in with a globa celerating ice melt contribution d Ice Sheet will eventually lea correspond to those of the la m higher than present levels. bly well marked as the 18 foc	l average warming in e n to sea level rise. The ad to a contribution to s ist inter-glacial of 125, Around the Cape Pen of wave cut platform.	excess of 2°C, e complete sea level rise 000 years ago, insula the sea
Locality Existing Policies	All coastal	jurisdictions			
Programme(s)/	• TNF	PA Climate Chang	ge Risk Assessment;		
Project(s)	• Pro	vincial Spatial De	velopment Programme.		
	 Nation 	ional Climate Cha	ange Response White Paper	(2010);	
	• Whi	te Paper for Sust	ainable Coastal Developmen	t (2000)	

	Ethikwini (Durban) Climate Change Strategy
	City of Cape Town: Global Climate Change and Adaptation: A Sea-Level Rise Risk Assessment. 2008
Regulatory and	Relevant legislation
Framework	Constitution
	National Environmental Management Act
	National Environmental Management: Integrated Coastal Management Act
	Disaster Management Act [No. 57 of 2002]
Management	Climate Systems Analysis Group Climate Change Projections.
1001(5).	GIS spatial modeling.
Indicators of	
State of Risk	What is the current sea level compared to pre-industrial levels?
	Number of inundations in the Eastern Cape per year (how to define?)
	What areas are vulnerable to two metre sea-level rise?
Risk Management Performance	Number of IDPs, SDFs and Departmental Strategic Plans which explicitly recognise climate change threats to vulnerable coastal areas.
Indicators	Relevant budget allocation to disaster management;
	Publication of coastal vulnerability maps.
	Number of IDPs, SDFs and Departmental Strategic Plans which explicitly respond to climate change threats to vulnerable coastal areas.
	Relevant budget allocation to disaster management;
	Effective operation of an early warning and response system.

Ì	CLIMATE CHANGE PROGRAMMES Adaptation						
Progra	mme Title:	Coastal Infrastructure	and Livelihoods				
OBJEC	CTIVE(S)	 Overall objective: Increased resilience of coastal infrastructure and resources to the effects of sea-level rise, storm-surges, flooding and increased sea temperatures (fisheries). Sub-objectives: Mainstreaming of coastal climate change adaptation in institutional decision making and planning, with consolidated planning processes and frameworks. 					
 Target(s): Inclusion of Climate Change based coastal vulnerability in the strategic planning and development planning stakeholders by 20xx Inclusion of vulnerable coastal areas and coastal vulnerability considerations in provincial and municipal plans SDFs, SDPs, IDPs, EMFs and provincial departmental plans) by 2012. Promulgation, development and/or updating of regulations, specifications and/or standards for infrastructur vulnerable or susceptible coastal areas. 			lopment planning of programme and municipal planning (e.g. s for infrastructure within				
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	nents
1	Convene a Climate Change Coastal Vulnerability Forum	Provincial Coastal Committee Chair		January 20xx	January 20xx	May b Provin specifi	e a sub-committee of the cial Coastal Committee with a ic climate change mandate.
2	Sourcing of human and financial resources for the mainstreaming of coastal climate change vulnerability in decision-	Provincial Coastal Committee Chair	R240,000.00	March 20xx	March 20xx	Possik	ole dedicated secretariat.

	making.					
3	Deployment of human resources in support of relevant decision-makers (key-stakeholders)	Financing institution or Programme Secretariat.	R340,000.00	March 20xx	Ongoing.	May be housed within DEDEA?

k		CLIMATE CHANGE PROGRAMMES Adaptation					
Programme Title: Coastal Infrastructure and Livelihoods							
OBJE	CTIVE(S)	 Overall objective: Increased resilience of coastal infrastructure and resources to the effects of sea-level rise, storm-surge, flooding and increased sea temperature (fisheries). Sub-objectives: Improved data availability (access to and distribution of information). 				orm-surge, flooding and	
- ange	(-).	Completion of a high resolution coastal vulnerability mapping exercise by 20xx (including sea level rise and inundation scenar			rise and inundation scenarios).		
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ents
1	Commission a coastal vulnerability mapping and reporting exercise.	HLG&TA	R250,000.00	March 20xx	September 20xx	Should align, v change Should	I have a higher resolution, but with the national climate e vulnerability atlas. I align with EC PSDP.
2	Commission a coastal infrastructure risk audit.	HLG&TA	R250,000.00	March 20xx	September 20xx		
3	Output should be integrated into a climate change response spatial decision support tool.					Decisi separa	on support tool should form a ate project.

	CLIMATE CHANGE PROGRAMME Adaptation						
Progra	mme Title:	Coastal Infrastructure and Livelihoods					
OBJEC	CTIVE(S)	Overall objective:					
		Increased resilience increased sea te	ce of coastal infrastru mperature (fisheries)	cture and resources to	the effects of sea-leve	el rise, ste	orm-surges, flooding and
		Sub-objectives:					
		Improved capacity	for disaster preventi	on and response.			
 Sufficient allocation of budget and human resources to disaster management institutions in regard to coastal relate by 20XX. Explore the formation of a coastal disaster relief fund. 				egard to coastal related issues			
		 Development of a 	coastal early warning	g and response system		vuinerab	ie coastal resources.
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ents
1	Report on budgetary requirements for coastal disaster management.	HLG&TA		March 20xx	September 20xx		
2	Commission a coastal lives and livelihoods disaster risk assessment.	HLG&TA	R250,000.00	March 20xx	September 20xx		
3	Commission a coastal early warning and response system feasibility report and business plan.	HLG&TA and DEDEA	R250,000.00	March 20xx	September 20xx		

Water Scarcity Planning

DEDEA		Date: August 2010		
	CLIMATE CHANGE PROGRAMME	Revision No: Draft for development		
	Adaptation	Prepared By:		
		Approved By:		
CC Programme	Water Resource Scarcity Planning			
Programme Custodian	DWA Directorate: Water Resource Plar Committee	nning and Reconciliation Strategy Steering		
Objective(s):	Objective:			
	 Mainstreaming climate change induced water resource scarcity in institutional decision-making and planning in water stressed areas in the Eastern Cape Province. 			
	• Effective water resources management and efficient water use throughout the Eastern Cape Province.			
Target(s):	Mainstreaming climate change induced water scarcity in institutional decision-making and planning.			
	Ensure that detailed climate chang strategic perspectives and in Eas	e considerations are included in DWA internal tern Cape Reconciliation strategies ⁶ .		
	 Include detailed climate change inc demand management, and water Strategic Planning and Water Ser 	luced water resource scarcity considerations, water conservation in relevant IDPs, Departmental rvices Management Plans by 20xx.		
	Include water demand and conservent Assessment Process ⁷ by 20xx.	ation issues in the Environmental Impact		
	Effective water resources management a	nd efficient water use.		
	Undertake an integrated water reso change on future water supply an consequences on not taking action	ources study to determine the effects of climate d demand in WMA15 and to understand the on by 20xx.		
	Establish a Catchment Management future water scarcity by 20xx	nt Strategy for WMA15 that takes into account		
	Draft and implement a water consecutive (as per successes in Cape Town	rvation and water demand management strategy ⁸ and efforts in Nelson Mandela Bay) by 20xx:		
	Undertake an integrated	water resources study to determine the effects of		

⁶ Include not only projections for changes in Mean Annual Precipitation, but also changes to water balances and storage requirements as a result of increased evaporation associated with higher temperatures and more extreme and variable inter and intra

seasonal precipitation patterns. ⁷ Although DEDEA or DEA may not have authority over water licensing and services, it may include water demand and conservation in the assessment of impacts and associated conditions of authorization. ⁸ Water demand management falls under the authority of Water Services Authorities such

as district municipalities.

	climate change Eastern Cape a	on future water supply and dema nd to understand the consequence	nd to the west of the es on not taking action ⁹ .		
	 Ensure well ma levels and other 	intained measurement and record	keeping systems for dam		
	Optimise the re-	use of waste water and avoid ma	rine outfalls.		
	Incentivise rainv	Incentivise rainwater harvesting at the household and commercial scale.			
	 Ensure avoidan and leak detecti 	Ensure avoidance of water losses through continual system maintenance and leak detection.			
	Promote educat conservation.	Promote education and awareness and instill a culture of water conservation.			
	 Promote investr less reliant on b 	nent in industry sectors and indus ulk water supply.	strial processes that are		
	 Promote the ma basic water and users). 	intenance and responsible use of sanitation services are supplied	f flush-toilets where free- (i.e. non-paying water		
	Maintain water quality standards through optimal operation and maintenance of waste-water treatment works.				
	Promote the environment rehabilitation of wetland	al health of water catchments incl s and the eradication of alien inva	uding the conservation and sive vegetation		
Other key	Name and Contact Details	Unit	Interest		
stakeholders		DWA	Water Resources, Water Management and Regulation		
	Andrew Lucas	Proto CMA	Water Resources Management		
		Dept LG&TA	Provincial Spatial Development Plan		
		DEDEA	Water and Environmental Management		

⁹ Note that these essentially exist in the form of Reconciliation Strategies for Algoa, Amathole and small-town systems.

		Agri EC and Relevant Water Boards	Agricultural Water Use
		Cacadu DM	Water Service Providers/Sanitation
		NMBM	Water Service Providers
		LMs	Water Service Providers
		Department of Agriculture	Agricultural Water Use
		Coega IDZ	Industrial Water Use
		East London IDZ	Industrial Water Use
		PERCI	Commercial and Industrial Water Use
		ВКСОВ	Commercial and Industrial Water Use
		Amatola Water	Water Board, Water services.
	Note that most of the above stak town Reconciliation Strategy Ste attended.	eholders are already part of the eering Committees. However cor	Algoa, Amathole and All- nmittees may not be well
Other interacted			
parties	Tourism Associations (e.g. EC P	Parks and Tourism)	
Relevant Policies	Current drought disaster n	nanagement responses in NMBI	M;
Programme(s)/Pr	• Working for Water;		
oject(s)	Provincial Spatial Develop	oment Plan	
	• PGDP		
	Industrial Development St	rategy	
	Rural development Strateg	ду	
	Provincial Coastal manage	ement Plan	
	• DM and LM IDPs, WSDPs	s. sector pans	
Overview of the issue:	Over the next 30 to 60 years, Me water catchments to the Southwe Tsitsikama Water Management / there is an absolute limit to the fu requirements, including requirem processes. Water resource man	ean Annual Runoff is projected to est of the province. Water resou Area are already close to, or fully uture availability of water resource nents for basic human needs, ag agement issues in the Eastern C	o decrease significantly in rces in the Fish to y, allocated. This means that ces for social and economic riculture and industrial cape include:
	 Over-abstraction of existin requirements, resulting in ecological integrity; 	ng resources for irrigation, manu n deterioration of downstream w	facturing and urban ater quality, quantity and
	 Threats to water quality, q degradation; 	uantity and aquatic ecosystem i	ntegrity due to catchment
	Threats to water quality, q change in catchments;	uantity and aquatic ecosystem i	ntegrity due to land-use
	 Threats to water quality from managed and poorly managed and poorly managed. 	om sub-standard effluent release intained waste-water treatment	es as a result of poorly works and sewage
	Threats to ecological integresources.	grity of fresh-water resources due	e to damming of existing
	Some of the secondary impacts	of climate change on water reso	urces include:

	Changes to baseflows and stormflows and their variabilities;				
	Changes to annual streamflows and their variabilities;				
	Changes to sediment yield and its variability; and				
	Changes to irrigation water requirements and associated losses.				
	It is likely that the above threats will be compounded by the impacts of future climate change. Projections of reduced precipitation together with increased rates of evaporation caused by climate change will result in an absolute reduction in the availability of water to the Southwest of the province. This will be compounded by more extreme and variable rainfall/dry episodes within and between seasons. This will have major social and economic consequences. For example scarce water resources will limit growth in manufacturing and agro-industrial processing, both foundations of the local economy.				
Locality	All jurisdictions				
Legislative					
Framework	Constitution				
	National Water Act (1998)				
	Water Services Act [No. 108 of 1997]				
	Disaster Management Act [No. 57 of 2002]				
	National Environmental Management Act				
	• National Environmental Management : Integrated Coastal Management Act				
	Relevant policy				
	National Climate Change Response White Paper (2010);				
	Provincial Environmental Implementation Plan (2010)				
	Permit and reporting requirements				
	Water-use licensing under the National Water Act.				
	Links to other plans, authorities, regulations;				
	City of Cape Town Water Conservation and Water Demand Management Strategy				
	2007. http://www.capetown.gov.za/en/Water/Pages/WaterDemandManagement.aspx				
	<u>Intp://www.oupotown.gov.zu/on/watorn agoo/watorbonnanamanagomona.aopx</u>				
Management	Integrated Water Resources Management tools;				
1001(5).	 ACRU hydrological modeling (Schultze et al, UKZN) and others 				
	Various tools developed by Water Research Commission (www.wrc.org.za)				
Dorformanaa					
Indicators	Adoption of an Integrated Water Resources Plan including a Water Conservation and Water Demand Management Strategy by Water Services Authorities				
	Number of IDPs. SDEs and Departmental Strategic Plans which explicitly respond to				
	climate change threats to water availability in the Southwest.				
	• Relevant budget allocation to Water Conservation and Water Demand Management.				
	Official recognition of projected water scarcity in EIA processes				

	CLIMATE CHANGE PROGRAMME Adaptation						
Progra	amme Title:	Water Scarcity in WMA	12 & 15				
OBJE	CTIVE(S)	 Objective: Mainstreaming climate change induced water scarcity in institutional decision-making and planning in water stressed areas in the Eastern Cape Province. 					anning in water stressed
Target	 Target(s): Establish a Catchment Management Strategy for WMA15 that takes into account future water scarcity by 20XX. Include detailed climate change induced water resource scarcity considerations, water demand management, a water conservation in relevant IDPs, Departmental Strategic Planning and Water Services Management Plans 20XX 				r scarcity by 20XX. nd management, and Management Plans by		
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ents
2	Sourcing of human and financial resources for the mainstreaming of water scarcity in Municipal decision- making.	DWA	R240,000.00	March 20xx	March 20xx	Possib	le dedicated secretariat.
3	Deployment of human resources in support of relevant decision- makers (key- stakeholders)	DWA	R340,000.00	March 20xx	Ongoing.	May be	housed within DWA?

Ì	CLIMATE CHANGE PROGRAMME Adaptation						
Progra	mme Title: Water Scarcity in WMA 12 & 15						
OBJEC	CTIVE(S)	Overall objective: Effective water resources management and efficient water use throughout the Eastern Cape Province.					Province.
Target	(s):	 Undertake an integrated water resources and supply study to determine the effects of climate change on future v supply and demand in WMA15 and to understand the consequences of not taking action by 20xx. Research and implement a water conservation and water demand management strategy in District Municipalities Project Initiated by August 20xx. 					e change on future water y 20xx. District Municipalities.
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	nents
1	Commission an Integrated Water Resources Study to investigate the impact of future water scarcity.	DWA	R500,000.00	March 20xx	September 20xx		
2	Draft a water conservation and water demand management strategy for western regions	DWA or Cacadu DM	R500,000.00	September 20xx	September 20xx		

Flood Management

		Data: August 2010
		Date: August 2010
	CLIMATE CHANGE PROGRAMME	Revision No: Draft for development
	Adaptation	Prepared By:
		Approved By:
CC Programme	Flood Management	
Programme Custodian	Dept Local Government and Traditiona Development.	al Affairs (EC) - Spatial Planning and Land
Objective(s):	Overall objective:	
	Flood prevention;	
	Reducing vulnerability to flooding e	vents;
	• Improved response to the impacts	of flooding events
	Sub-objectives:	
	1 Ensure landuse planning and	development that promotes reduced storm water
	2 Mainstreaming of increased r	isk of flooding in institutional decision making and
	planning;	
	4 Improved capacity for disaste	er prevention and response.
Target(s):	Targets:	
	Promulgation and effective enforce regulations and guidelines (both i	ment of stormwater management measures, n rural and urban areas).
	Maintain and improve environment wetlands in order to ensure infiltration	al integrity of catchments, watercourses and ation and abatement.
	Inclusion of zones vulnerable to flo	oding in SDFs and SDPs ¹⁰ by 20xx
	 Promulgation of regulations, specif areas vulnerable to flooding. 	ications and/or standards for infrastructure within
	Inclusion of Climate Change based planning of programme stakehold	flooding in the strategic planning and development lers by 20xx
	Completion of a high-resolution prostandardized methodology, and urrainfall data) by 20xx. This should system to relevant authorities and the system of the system to relevant authorities and the system of th	ovincial floodline mapping exercise (to a using projected rainfall data rather than historical the coupled with an information dissemination the planners.
	Sufficient allocation of budget and institutions by 20xx.	human resources to disaster management
	• Research on the threats to the live	ihoods of poor communities within flood zones.
	Development of a flooding early wa	arning and response system.

¹⁰ Prioritise informal settlements in flood-prone areas.

	Develop disaster response disaster areas (national sector)	se plans based on lessons learne l and international).	d from historical flood	
Other key	Name	Unit	Interest	
stakeholders		LG&TA	Provincial Planning	
		LG&TA	Provincial Disaster Management	
		DEDEA	Integrated Environmental Management and EIA	
		DWA	Integrated Water Resources and Catchment Management	
		Working for Water	Catchment Management	
		Working for Wetlands	Catchment Management	
		Transnet Ports	Flooding of ports	
		Department of Transport	Transport infrastructure prone to flooding	
		District Municipalities	Local Government Spatial Planning and Authorisation	
		Local Municipalities	Local Government Spatial Planning and Authorisation	
.				
Other interested parties	Catchment Management Agend	cies.		
Overview of the issue:	 Superimposed on the background of gradual increases and decreases in mean annual precipitation in the province, climate change is projected to result in less predicable, more extreme events. This will include longer and dryer dry periods; and wetter, more intense wet periods associated with increased energy in the systems. Climate change is likely to increase not only the frequency of flooding events, but also the intensity of flood events. The increased risk of flooding due to climate change is exacerbated by the reduced ability of water catchments to absorb flood pulses. This is caused by: Losses of wetlands which absorb flood waters and release them over a longer period of time; and Catchment hardening as a result of increased urbanization and deterioration in landcover. A complicating factor is that poorly planned urban sprawl and informal urbanisation often results in developments and human settlement taking place in flood-prone areas or within 1:10, 1:50 and 1:100 year historical flood lines. The combination of climate change, catchment deterioration and unplanned or poorly planned urban settlement is highly likely to result in disastrous future scenarios. 			
LOCAIITY Existing Policios	Low-lying and flood prone areas	s in all jurisaictions.		
Programme(s)/Pr oject(s)	EC Provincial Spatial De	velopment Plan;		
	Local and district spatial	development frameworks and lan	iduse planning tool;	
	National Water Act: DWA	A 1 in 100 year floodline.		
Regulatory and	Relevant legislation			

Legislative Framework	 Municipal Systems Act (2000) National Water Act (1998)
	 Permit and reporting requirements Municipal planning approval processes;
	Environmental Authorisations under the 2010 EIA regulations.
Management Tool(s):	Climate Systems Analysis Group Climate Change Projections.
	GIS spatial modeling.
	Existing floodline determinations
Indicators of State of Risk	Number of flood-events reported per year in the province;
	Number of human lives lost to floods in the Province.
	Total infrastructure and human settlement exposed to flooding.
	• Total infrastructure lost due to flooding events in the Province.
Risk Management Performance	 Number of IDPs, SDFs and Departmental Strategic Plans which explicitly recognise flood risk zones.
Indicators	Relevant budget allocation to disaster management;
	Generation of a provincial map of flood-lines under a standardised methodology.
	Relevant budget allocation to disaster management;
	• Effective operation of an early warning and response system.

Progra	mme Title:	Flood Management					
OBJEC		Overall objective:					
		Reducing vulner	ability to flooding e	vente:			
		 Improved response 	nse to the impacts of	or nooding events			
		Sub-objectives:					
		Mainstreaming	of increased risk of	flooding in institutional	l decision making and pl	anning	
Target	(s):	Inclusion of zon	es vulnerable to floo	oding in SDFs and SE	DPs by 20xx.		
		• Promulgation of regulations, specifications and/or standards for infrastructure within areas vulnerable to flooding.					
		Inclusion of Clin stakeholders b	nate Change based by 20xx.	flooding in the strateg	ic planning and develop	ment planning of programme	
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments	
1	Convene a flood- vulnerability and prevention forum.	LG&TA		January 20xx	January 20xx	May be a sub-committee of an existing committee, but with a specific climate change mandate.	
2	Sourcing of human and financial resources for the mainstreaming of flood vulnerability in decision- making.	LG&TA	R240,000.00	March 20xx	March 20xx	Possible dedicated secretariat. Could be the same secretariat as for coastal climate change risk.	
3	Deployment of human resources in support of	Financing institution or Programme	R340,000.00	March 20xx	Ongoing.	May be housed within LG&TA or DEDEA?	

relevant decision-makers	Secretariat.		
(key-stakeholders)			

CLIMATE CHANGE PROGRAMMES Adaptation						
Progra	amme Title:	Flood Management				
OBJECTIVE(S) Overall objective: • Reducing vulnerability to flooding events; • Improved response to the impacts of flooding events. Sub-objectives: • Improved data availability.						
Target	t(s):	Completion of a h projected rainfa dissemination s	high-resolution provir Il data rather than his ystem to relevant au	ncial floodline mapping storical rainfall data) b thorities and planners	g exercise (to a standard by 20xx. This should be o 3.	lized methodology, and using coupled with an information
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments
1	Commission a floodline and vulnerability mapping and reporting exercise.	HLG&TA	R500,000.00	March 20xx	September 20xx	Should align with EC PSDP and coastal risk mapping exercise. Output should be integrated into a climate change response spatial decision support tool. Decision support tool should for a separate project, but should align with the coastal risk mapping exercise.

		CLIMATE CHANGE PROGRAMME Adaptation					
Programme Title: Flood Management							
OBJECTIVE(S) Overall objective: • Reducing vulnerability to flooding events; • Improved response to the impacts of flooding events. Sub-objectives: • Improved capacity for disaster prevention and response.							
	· ,	 Sufficient allocation of budget and human resources to disaster management institutions by 20xx. Research on the threats to the livelihoods of poor communities within flood zones. Development of a flooding early warning and response system. 					
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comme	ents
1	Report on budgetary requirements for flood disaster management.	LG&TA		March 20xx	September 20xx		
2	Commission a flooding and livelihoods disaster risk assessment.	LG&TA	R250,000.00	March 20xx	September 20xx		
3	Commission a flooding early warning and response system feasibility report and business plan.	LG&TA and DEDEA	R250,000.00	March 20xx	September 20xx		

Responses to Increased Risk of Wildfires

		Date: August 2010	
	CLIMATE CHANGE PROGRAMME	Revision No: Draft for	r development
	Adaptation	Prepared By:	
		Approved By:	
CC Programme	Responses to increased risk of	f wildfires	
Programme Custodian	Provincial Disaster Manageme	nt	
Objective(s):	Overall objective:	an and our procession	
	Improved wildlife prevention	and suppression.	
	1 Increased collaborati	ion among, and provincial supp	ort to, Working on Fire and
	2 Improved fire risk aw	vareness (especially on days of	high-extreme fire danger).
	3 Improved response of	capacity within Provincial Disas	ter Management
Target(s):	Targets:		
	 Convene a provincial fire p Fire and all FPAs; 	protection forum including Disas	ter Management, Working on
	Completed survey of effect all FPAs in the Eastern C	tiveness of, and institutional and Cape Province by 20xx;	d material support required by,
	Initiate general public fire c (undertaken annually dur	langer and burning prohibition a ing fire season).	awareness campaigns
	Increased budget allocation the following KPAs:	n to Provincial Disaster Manage	ement in relation to wildfires for
	KPA 2: Risk assessment a	nd monitoring;	
	KPA 3: Disaster managem	ent planning and implementation	on;
	KPA 4. Disaster response	and recovery.	
Other key	Name	Unit	Interest
stakeholders		National Department of Agriculture, Forestry and Fisheries.	Forestry as competent authority for National Veld and Forest Fire Act 101 of 1998
		Dept LG&TA	Disaster Management Centre
		Provincial Department of Agriculture	Threats to agricultural infrastructure, assets and operations including threats to rural livelihoods.
		All Fire Protection Associations in the Province	Structure for implementing fire prevention and control measures.

			Structure for assistance in
		Working on Fire	fire prevention and control
		DEDEA	Strategic Responses to Climate Change Risks
		DWA	Working for Water and links to fire risk
Other interested parties	Municipal Disaster Managemen	t.	
Overview of the issue:	As shown in the map below, the the greatest frequency of fires ir	Eastern Cape Province is prone the central, east and north of the	to veld and forest fires, with e province.
	The risk of wildfires is a product increased fuel load. Simulations intensity and duration of dry per fuel load from warmer, wetter su of wildfires in late winter and ea	of increased temperature and wi project warmer winters and sprir iods, increased occurrence of "be ummers in the east, there is a high rly spring.	nds, reduced humidity and lgs. Coupled with increased lrg winds", and an increased n likelihood of increased risk
	Fire frequency atlas for South A Light yellow indicates 1 to 2 fires Risk and Vulnerability Atlas (201	frica showing the number of fires s; dark red indicates more than 8 10.	hozambogue termine gradient and the second se
Locality Existing Policies	All jurisdictions		
Programme(s)/Pr	Working on Fire		
oject(s)	Provincial, District and Lo	cal Municipal Risk and Disaster N	lanagement Plans
Regulatory and	Relevant legislation		
Legislative	National Veld and Forest	Fire Act 101 of 1998	
Framework	Disaster Management Ac	t [No. 57 of 2002]	
Management Tool(s):	NDVI for fuel load;		

	 GIS for monitoring and spatial data collection; South African Weather Service early warning.
Indicators of State of Risk	• Number of days in year when fire danger index reaches <i>high-extreme</i> in the Eastern Cape.
	 Number of fire days per year relative to number of days in the year with a fire danger rating of <i>high-extreme</i>;
Risk Management Performance	 Total number of hectares burned by uncontrolled fires per year (separate for veld and forests);
Indicators	Financial cost of damage caused by uncontrolled fires per year;
	Number of human lives lost to uncontrolled fires per year.

Ì	CLIMATE CHANGE PROGRAMMES Adaptation						
Progra	mme Title:	Responses to increase	ed risk of wildfires				
OBJE	CTIVE(S)	Overall objective: Improved fire Sub-objectives: - Increased coll	Overall objective: Improved fire prevention and suppression Sub-objectives:				
Target	(s):	 Convene a prov Completed surv Cape Province 	vincial fire protection vey of effectiveness of e by 20xx.	forum including Disa of, and institutional ar	ster Management, Workir nd material support requir	ng on Fir ed by, al	e and all FPAs; ll FPAs in the Eastern
No	Activity	Responsible Person	Budget Reguirements	Starting Date	Completion Date	Comm	ients
1	Convene a provincial fire protection forum including Disaster Management, Working on Fire and all FPAs	Dept LG & TA	R50,000.00	March 20xx	Ongoing		
2	Undertake survey of effectiveness of, and institutional and material support required by, all FPAs in the Eastern Cape Province.	Dept LG & TA	R100,000.00	March 20xx	March 20xx	Review Umbre KZN F	v opportunities for EC Ila FPA along the lines of PA.

	CLIMATE CHANGE PROGRAMMES Adaptation					
Progra	mme Title:	Responses to increased	risk of wildfires			
OBJECTIVE(S) Target(s):		 Overall objective: Improved wildfire Sub-objectives: Improved fire risk Initiate general pu season). 	prevention and suppr awareness (especial blic fire danger and b	ression. ly on days of high-extra purning prohibition awa	eme fire danger). areness campaigns (un	dertaken annually during fire
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments
1	Initiate general public fire danger and burning prohibition awareness campaigns (undertaken annually during fire season).	Dept LG & TA or Working on fire	R1000,000.00	March 20xx	Ongoing	Coordinate with provincial fire plan.

	CLIMATE CHANGE PROGRAMME Adaptation						
Programme Title: Responses to increased risk of wildfi							
OBJE	CTIVE(S)	Overall objective:					
		 Improved wildfire i 	prevention and suppr	ression.			
		Sub-objectives:					
Improved fire risk awareness (especially on days of high-extreme fire danger);							
Target	(s):	Increased budget	Increased budget allocation to Provincial Disaster Management in relation to wildfires for the following KPAs:				
		KPA 2: Risk assessment and monitoring;					
		• KPA 2: Disaster management planning and implementation:					
		• KPA 4: [Disaster response an	d recovery.			
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	nents
1	Report on budgetary	LG&TA	Internal?	March 20xx	September 20xx		
	requirements for	Provincial Disaster					
	improved wildfire	Management Centre					
	prevention and						
	SUDDFESSION.	1	1			1	

Managing the effects of increased temperature on human lives

						
DEDEA		Date: August 2010				
	CLIMATE CHANGE PROGRAMME	Revision No: Draft for	development			
	Adaptation	Prepared By:				
		Approved By:				
CC Programme	Managing the effects of increased	temperature on human lives				
Programme Custodian	Eastern Cape Department of Heal	Ith; Municipal Health Services, I	EC Agriculture.			
Objective(s):	Overall objective:					
	Societal adaptation to hun associated with climate c	nan health impacts from temper change.	rature increases			
	Sub-obiectives:					
	1 Improved health preparedness for heat waves including education					
	programmes.					
	2 Prevention of vector borne diseases associated with temperature increases.					
		Tural inventions (including agr				
Target(s):	Targets:					
	 Development of a heat-wav 	e management and response p	blan ¹¹ by 20xx.			
	Development of a vector borne-disease and infection prevention and					
	plan by 20xx.					
	Introduction of a water born	e and vector borne disease mo	nitoring programme ¹² by			
	20xx.					
Other key	Name l	Unit	Interest			
stakeholders	EF	Eastern Cape Department of Health	Healthcare Responses			
	H	Housing Eastern Cape	Passive thermal design and technology interventions for social housing;			
	E	Eastern Cape Department of Social Development	Social services as it relates to marginal communities and community resilience			
	[[District Municipalities	Water services and sanitation			
	L	Local Municipalities	Water services and sanitation			
	[District Municipalities	Environmental Health			
		_ocal Municipalities	Environmental Health			

¹¹ Should include both a prevention and a management element. ¹² Includes a system for surveillance of rodents and water courses. It should be noted that municipal health departments have a strong role to play in regard to monitoring and surveillance in the context of a provincial reporting system.

		Eastern Cape Department of Local Government and Traditional Affairs	Disaster Management				
		Eastern Cape Department of Agriculture	Rural Development and Agriculture.				
		5	5				
Other interested							
parties	Rhodes University Environmental Science Department; South African Institute of Environmental Health;						
	Dramation of Dural Livelik	Linnonmentar neattin,					
	Fromotion of Rural Liven						
	Eastern Cape Social and Economic Consultative Council (ECSECC)						
Overview of the	 Other affected and interest Mid- to long-term projections inc 	licate that annual average tempe	eratures are expected to				
issue:	increase by approximately 2°C a also a stronger likelihood of tem climate changes are expected to following: An increase in the frequency of	at the coast and by between 3°C perature extremes (experienced b have negative effects on huma heatwayes is indirectly linked to	and 4°C inland. There is as heat waves). These n health, including the increased deaths among				
	children, the elderly and the infir	m (with particularly risk to those	with HIV/AIDS). Poor				
	communities with inadequate ho heat-waves.	busing and services are particula	rly prone to the effects of				
	Increased mean temperature co	upled with increased rainfall has	already been demonstrated				
	tick-borne diseases.	or vector-borne diseases. This in	ciudes maiaria, cholera anu				
	Increased temperature coupled	with local air pollution is likely to	exacerbate existing				
	Increased rainfall and temperatu	are increases the risk of food-bor	ne and water-borne				
	infections. The direct effects of increased temperature on human lives should be considered in						
	combination with other indirect effects of climate change on social and economic systems,						
	such as the effect of increased floods and droughts on poor communities.						
		Modulating	Haalsh offerte				
		influences	- Health enects				
			illness and death				
		- ÷	Extreme weather-				
	Human		elated health effects				
	CLIMATE Regional weath changes	er Contamination pathways	Air pollution-related health effects				
	CHANGE · Heatwaves • Heatwaves • Extreme weather dynamics Water and food- borne diseases						
	Temperatur Precipitatio		Vector-borne and				
	Changes in agro-ecosystems, rodent-borne diseases						
	<u>1</u>	hydrology	Effects of food and water shortages				
		Socioeconomic and demographic	Mental, nutritional,				
		disruption	infectious and other health effects				
	Diagram illustrating the link between climate change and effects to human health.						

Locality	All jurisdictions
Existing Policies, Programme(s)/Pr oject(s)	Provincial Spatial Development Plan; Department of Agriculture and Rural Development: Rural Development and Agrarian Transformation Strategy.
Regulatory and Legislative Framework	 Relevant legislation Constitution; National Health Act (2003) Disaster Management Act [No. 57 of 2002] International Health Regulations Act (1974) National building regulations. Permit and reporting requirements None to date.
Management Tool(s):	 Municipal health and environmental inspections; Food licensing and pest control; Water quality monitoring; Local weather stations and disease early warning systems.
Indicators of State of Risk	 Recorded annual average temperature, records of extreme heat conditions against comparative records of mortality. Disease Incidence. Number and geographical distribution of reported water-borne and vector-borne diseases and infections per year (against population in the province). Disease surveillance including the spread of disease vectors.
Risk Management Performance Indicators	As per targets above

CLIMATE CHANGE PROGRAMME Adaptation								
Progra	mme Title:	Managing the effects of i	increased temperatur	e on human lives				
OBJEC	CTIVE(S) (s):	Overall objective: Societal adaptation Sub-objectives: Improved health Development of a heat-w	ion to human health i preparedness for hea vave management an	mpacts from temperatu at waves including edu id response plan by 20	re increases associate cation programmes. xx.	ed with c	limate change.	
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ents	
1	Convene an Integrated Climate Change and Health Response Committee	Department of Health and District Municipal Health Departments.		Convene an Integrated Climate Change and Health Response Committee	Department of Health			
2	Develop an Integrated heat-wave management and response plan.	Department of Health and District Municipal Health and Disaster Management Departments.		Develop an Integrated heat- wave management and response plan.	Department of Health	An initi gap an undert	al preparedness audit and alysis should be aken.	
3						1		
Programme Title: Managing the effects of increased temperature on human lives								
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OBJEC	CTIVE(S)	Overall objective: Societal adaptat Sub-objectives: Prevention of ve	Overall objective: Societal adaptation to human health impacts from temperature increases associated with climate change. Sub-objectives: Prevention of vector, and waster borne diseases associated with temperature increases					
Target	(s):	Prevention of vector and waster borne diseases associated with temperature increases						
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments		
1	Convene an Integrated Climate Change and Health Response Committee	Department of Health	R20,000	March 20xx	Ongoing	Committee to manage both heat wave and temperature related disease risk.		
2	Development of a vector borne-disease and infection prevention and management plan by 20xx.	Department of Health	R250,000	March 20xx	March 20xx			
3	Introduction of a water borne and vector borne disease monitoring programme by 20xx.	Department of Health	R250,000	March 20xx	Ongoing			

Food Security¹³

¹³ Currently under review by Eastern Cape Department of Agriculture and Rural Development Eastern Cape Climate Change Response Strategy

			Date: August 2010			
DEDEA	CLIMATE CHANGE PROGRAMME		Revision No: Draft for	development		
	Adaptation		Prepared By:			
			Approved By:			
CC Programme	Managing Risks to Food Security					
Programme Custodian	Eastern Cape Department of Agr	iculture a	and Rural Development			
Objective(s):	Overall objective:					
	Incorporating Climate Chair security programmes.	nge Accl	imatization and Resilier	nce in provincial food		
Target(s):	Targets:					
	 By 20xx , include awarenes deal with climate change 	By 20xx, include awareness, training, mechanisms and techniques that s deal with climate change risk, in existing rural food security programmes				
Other key	Name	Unit		Interest		
stakeholders		Eastern Cape Department of Agriculture and Rural Development		Agriculture and Rural Development.		
		Eastern Cape Department of Social Development		Food security projects under the umbrella of Social Development.		
		Eastern Econom Council	Cape Social and ic Consultative (ECSECC)	Rural development		
Other interested						
parties	Rhodes University Environ	mental S	Science Department;			
	Promotion of Rural Liveliho	oods Pro	gramme (RuLiv).			
	• Eastern Cape Appropriate	Technol	ogy Unit			
Overview of the	•					
issue:	The Southern African Regional C the impacts of Climate Change of	limate C n food se	hange Programme note ecurity:	es the following in regard to		
	 the impacts of Climate Change on food security: Scientists predict that the greater variability in and volatility of temperature and rainfall cycles in Africa resulting from climate change will alter the land area suitable for agricultural or livestock production, while increasing the frequency of flooding and drought. Grain yields are expected to decline due to increased rainfall variability, which may result in the need for grain imports, increasing the food prices and hence the cost of living. Desertification rates are also expected to increase. Poor people are most vulnerable to climate change. This is due partly to the fact that poverty is often linked to a higher reliance on natural resources—for example when farming for subsistence. This exacerbates their vulnerability, leading to further degradation of natural resources and creating a vicious circle of yet more 					

	·
	suitability of specific staple or cash crops in marginal regions, and the threat of increasing variability in the form of higher frequency of dry or wet years.
	Many poor rural South African communities rely on low input, low tech subsistence agriculture. Without resources and technology at their disposal, these subsistence farmers are vulnerable to the threats of climate change.
	Although numerous food security projects and programmes exist in the Eastern Cape, these projects and programmes should take cognizance of the threat of climate change. In other words the programmes should build in awareness, practices and mechanisms for resilience to climate change. This might include selection of resilient and appropriate crops, appropriate cultivation techniques and rainwater harvesting or storage.
	Although food security is considered as an issue which relates mostly to poor communities, it should be noted that food security also represents s strategic risk to the province. This has particular reference to the possibility of future food price shocks related to global population expansion and issues of future water scarcity and oil scarcity associated with the notion of "peak oil". The stronger the provincial commercial and subsistence food production system, the less vulnerable the province is to food price and scarcity shocks.
Locality	All jurisdictions
Existing Policies,	
oject(s)	Department of Agriculture and Rural Development: Rural Development and Agrarian Transformation Strategy.
	Massive Food Programme
	Mechanisation Conditional Grant Scheme
	Mechanisation Conditional Loan Scheme
	Eastern Cape Communal Soil Conservation Scheme
	Landcare Programme
	Soil Conservation Scheme (CARA, Act 43 Of 1983)
	Siyazondla Homestead Food Production
	Siyakhula Step-Up Food Production Programme
	Comprehensive Agricultural Support Program
	Livestock Production Improvement Program
Regulatory and	Relevant legislation
Legislative Framework	Conservation of Agricultural Resources Act, Act 43 Of 1983
	Permit and reporting requirements
	None to date
Management Tool(s):	Food Insecurity and Vulnerability Information Mapping System (FIVIMS)
Indicators of	Records of droughts and floods in rural areas.
State of RISK	Records of crop failures in rural areas.
	•
	•

Risk	As per targets above
Management	
Performance	
Indicators	

	CLIMATE CHANGE PROGRAMME Adaptation					
Progra	Programme Title: Managing Risks to Food Security					
OBJECTIVE(S) Overall objective: • Incorporating Climate Change Acclimatization and Resilience in provincial food security programm					rity programmes.	
Target(s):		By 20xx, include awaren rural food security progra	ess, training, mechai ammes.	nisms and techniques t	hat specifically deal wit	th climate change risk, in existing
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments
1	Update existing provincial food security programmes to include training, techniques and appropriate technology that specifically responds to climate change risks.	Eastern Cape Department of Agriculture and Rural Development		20xx	20xx	A useful starting point would be a gap analysis of existing food security programmes.

Appendix 2: Mitigation Programmes

Please note that the Mitigation Programmes are working documents which require further development, annual review and modification. The programmes in their current format are initial proposals which require review by other departments or stakeholders. As such they should be considered as starter documents and not as a final product.

Mainstreaming GHG Mitigation in Provincial and Local Government

	Date: August 2010						
DEDEA	CLIMATE CHANGE PROGRAMME	Revision No: Draft for development					
	 Mitigation	Prepared By:					
		Approved By:					
CC Programme	Mainstreaming GHG Mitigation in Prov	incial and Local Government and in Industry					
Programme Custodian	Office of the Premier						
Objective(s):	Objective:						
	Mainstreaming GHG Mitigation in E the Eastern Cape Province	Decision-making at all levels of government within					
	Promoting GHG Mitigation in Provi	ncial and Local Government Operations.					
	Promoting Greenhouse Gas report	ing in Industry.					
Target(s):							
	Mainstreaming GHG Mitigation in Decision-making.						
	Situate Eastern Cape as a champio	on for energy and carbon efficiency					
	 Conduct regular awareness campa example link GHG mitigation to cl sustainable), service delivery mod government. 	igns and ensuing political championship (for hanges in economic model (status quo not del, savings and efficiency in operations of					
	Include climate change mitigation c and Municipal IDPs and other Ser	Include climate change mitigation considerations in Provincial Departmental Planning and Municipal IDPs and other Sector Plans by 20xx					
	Formally include requirements for 0 Assessment Processes by 2012.	GHG Impact Assessment in Environmental Impact					
	Formally include the requirement for planning permission by 20xx	or energy conservation in the granting of municipal					
	Undertake a study to consider the of fossil fuels as Controlled Fuels re	declaration of GHGs as Priority Pollutants, and spectively, in terms of NEM: AQA 2004 (by 20xx).					
	• Building public sector technical competency to address Climate Change and GHG Mitigation (policy analysis, strategy development, technology development, strategy application, monitoring and reporting)						
	Promoting GHG Mitigation in Provincial and Local Government Operations						
	 20% energy savings in provincial a announcement) by 2014. 	nd local government buildings (as per DoE DG					
	 Development of GHG inventories (provincial government department industries). 	carbon footprints) and mitigation activities in ts by 2014 (including upstream in supplier					
	Include GHG mitigation in SMS per	formance agreements by 2014					
	Adopt Green Building codes/energy Government Building	y saving requirements for new and refurbished					

	 Set targets for and commence pilot retrofitting of social and RDP housing, and government institutions like schools and clinics by 2012. 							
	Promoting Greenhouse Gas Re	eporting in Industry						
	Understand the nature o balancing the need for	f emissions from industry in EC and carbon emissions reductions and	nd set informed targets, job creation.					
	 Assist large industrial greenhouse gas emitters in the province in reporting Scope 1 Greenhouse Gas emissions to the South African Air Quality Information System by 20XX. 							
	Assist large industrial greenhouse gas emitters in the province in establishing Greenhouse Gas Inventories and reporting protocols in terms of ISO 14064 by 20XX.							
Other key	Name and contact details	Unit	Interest					
stakeholders		DEDEA	NEM: Air Quality Act					
		Office of the premier	Strategy Custodian					
		Department of Health	Environmental Health and Municipal Health					
		Department of Local Government	Municipal Support					
		Department of Public Works	Construction and building specifications					
		Department of Agriculture	Alternative Agriculture					
		Fleet Management						
		Eskom						
		SALGA	Mitigation in local government and in IDPs					
		All sister departments	Mitigation and decision- making in Provincial Departments					
		District Municipalities	Mitigation and decision- making in local government. Awareness and Learning. Environmental Health					
		Local Municipalities	Mitigation and decision- making in local government. Awareness and Learning. Environmental and Municipal Health.					
		Metros	Mitigation and decision- making in local government.					
		Coega IDZ	Greenhouse Gas Reporting in Industry					
		East London IDZ	Greenhouse Gas Reporting in Industry					
		ECDC	Greenhouse Gas Reporting in Industry					
		PERCI	Greenhouse Gas Reporting in Industry					
		ВКСОВ	Greenhouse Gas Reporting in Industry					

Other interested	ECSECC					
parties	Rural Development Agency					
Overview of the						
issue:	• South Africa has a per-capita carbon footprint (Greenhouse Gas Emissions Footprint) that is higher than the international average. These emissions, no matter where they originate from, contribute directly to global warming which causes climate changes.					
	• SA is a signatory to the Kyoto Protocol and is therefore obligated to combat climate change.					
	 In December 2009 and January 2010 at the Copenhagen Accord the presidency pledged a 34% reduction in emissions below business as usual by 2025; 					
	• All entities, including those in the Eastern Cape, have a responsibility to collectively contribute to a reduction in Greenhouse Gas Emissions caused by human activities.					
	• As per Section 29 of the National Environmental Management: Air Quality Act, the National Minister or Provincial MEC has the power to declare Greenhouse Gasses as Priority Air Pollutants. Entities emitting within the given category will need to submit and implement pollution prevention plans.					
	 As per Section 26 of the National Environmental Management: Air Quality Act, the National Minister or Provincial MEC has the power to declare fossil fuels as Controlled Fuels. This allows among others, the opportunity to 					
	 Establish standards for the use of the controlled fuel in combustion processes; 					
	 Establish standards for the manufacture or sale of the controlled fuel; 					
	 Establish specifications for the composition of controlled fuels; 					
	• Valerie Geen (National Business Institute) notes the following in the 2010 South African Carbon Disclosure Report: "Globally the green race is on and South Africa has also joined the trend by beginning the process of transforming the country's economy to a low carbon intensive one. Companies that identified opportunities associated with this change will have the competitive advantage whilst those who procrastinate are likely to be faced with reputational, physical and regulatory risks that can undermine their competitiveness. As international and local investors become increasingly interested in the long term safety of their assets and investments on behalf of their clients and as weather patterns change and threats to energy and water security become in themselves, drivers of change, business is required to take the lead in forecasting and finding solutions to new challenges.					
	• 74% of South Africa's JSE top 100 companies reported to the Carbon Disclosure Project in 2010. This is the fourth highest reporting rate in the world.					
Locality	All provincial and local government jurisdictions in the Eastern Cape					
Relevant Policies.	Kyoto Protocol					
Programme(s)/Pr	Copenhagen Accord (2009)					
oject(s)	• Pledge by the president of South Africa under the Copenhagen Accord: 34% reduction in emissions below business as usual by 2025;					
	2008 Cabinet 2°C policy and Long Term Mitigation Scenarios.					
	Outcome 10					
	• IRPII					
	Power Conservation Programme (Reintroduced by DoE);					
	National Climate Change Response Policy White Paper 2010 (In Draft);					

	National Greenhouse Gas Inventory Programme;
	• SAAQIS
	Climate Change Strategy and Action Plan for the Western Cape.
	Eastern Cape Renewable Energy Study (DEDEA and ELIDZ)
Regulatory and	Relevant legislation
Legislative Framework	Constitution
	National Environmental Management: Air Quality Act.
	Permit and reporting requirements
	• Permitting and reporting of emissions for scheduled activities under the National Environmental Management: Air Quality Act.
	Links to other plans, authorities, regulations; <u>www.capegateway.gov.za//climate_change_strategy_final_draft_june2007.pdf</u>
Management	ISO 50001 Energy Management Systems;
	ISO 14064 Guidelines for Greenhouse Gas Inventories;
	World Resources Institute and World Business Council for Sustainable Development Greenhouse Gas Protocol.
Performance	
Indicators	 Number of IDPs, SDFs and Departmental Strategic Plans which explicitly deal with sustainable energy, GHG inventories and GHG mitigation;
	 Number of government and local government institutions that have initiated GHG inventories;
	Relevant budget allocation for GHG mitigation activities;
	Official recognition of GHG impacts in EIA processes;
	Combined GHG footprint of all provincial and local government operations.

Ì		CL	IMATE CHANG Projec	E MITIGATION cts				
Progra	amme Title:	Mainstreaming GHG Mi	itigation in Provin	cial and Local Gove	rnment and in Industry			
OBJE	CTIVE(S)	Objective: Mainstreaming G	Objective: • Mainstreaming GHG Mitigation in Decision-making at all levels of government within the Eastern Cape Province.					
Target	:(S):	 Include climate change mitigation considerations in Provincial Departmental Planning and Municipal IDPs and other Sector Plans by 20xx Formally include requirements for GHG Impact Assessment in Environmental Impact Assessment Processes by 20xx Formally include the requirement for energy conservation in the granting of municipal planning permission by 20xx 						
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments		
1	Convene a Provincial GHG Mitigation Forum/Committee	DEDEA or Office of the Premier		January 20xx	January 20xx			
2	Sourcing of human and financial resources for the mainstreaming of GH mitigation in decision-making.	DEDEA	R240,000.00	March 20xx	March 20xx	Possible dedicated secretariat.		
3	Deployment of human resources in support of relevant decision- makers (key- stakeholders)	Financing institution or Programme Secretariat.	R340,000.00	March 20xx	Ongoing.	Housed within DEDEA		
4	Commission a study of, and adopt, criteria for	DEDEA Integrated Environmental	R200,000	March 20xx	March 20xx			

	Assessing Greenhouse Gas Impacts in the Environmental Authorisation Process.	Management.	2050.000		M 1 00	
	commission a study of, and adopt, energy conservation criteria for approving building and development plans.	SALGA	R250,000	March 20xx	March 20xx	
	Undertake a study to consider the declaration of GHGs as Priority Pollutants, and fossil fuels as Controlled Fuels respectively, in terms of NEM: AQA 2004 (by 20xx).	DEDEA	R500,000	March 20xx	March 20xx	The study should focus on the opportunities for mitigation that might be facilitated by the activation of sections 26 and 29 of NEM:AQA. The study should focus on ensuring that mitigation could be achieved through pragmatic and practical implementation of the legislation. The study should include an impact assessment of the implementation of the legislation. The implementation of the legislation should not unduly burden the local economy.

Progra	mme Title:	Mainstreaming GHG M	itigation in Provinci	al and Local Governn	nent and in Industry		
OBJEC	CTIVE(S)	Overall objective: • Promoting GHG	Mitigation in Provinc	ial and Local Governme	ent Operations.		
Target(s):		 20% energy savings in provincial and local government buildings (as per DoE DG announcement) by 20xx Development of GHG inventories (carbon footprints) and mitigation activities in provincial government departments by 20xx (including upstream in supplier industries). 					
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments	
1	Formulate and adopt a common framework and guidelines for reporting and auditing energy use and savings in Government Buildings.	DEDEA	R250,000.00	March 20xx	September 20xx	Need to align with the updated Power Conservation Scheme introduced by Dept of Energy.	
2	Formulate and adopt a common framework and guidelines for reporting GHG emissions caused by Provincial and Local Government Dept operations in the EC.	DEDEA	R250,000.00	March 20xx	September 20xx	Reporting and auditing guidelines should conform to principles of ISO 14064.	
3	Commission the development of a GHG Emissions Inventory for DEDEA Operations	DEDEA	R250,000.00	September 20xx	March 20xx	Reporting and auditing guidelines should conform to principles of ISO 14064.	

(Excluding Coega	IDZ		
and ELIDZ)			

	CLIMATE CHANGE MITIGATION Projects						
Progra	Programme Title: Mainstreaming GHG Mitigation in Provincial and Local Government and in Industry						
OBJEC	BJECTIVE(S) Objective: • Promoting Greenhouse Gas Reporting in Industry						
Target	(s):	 Assist large indust South African Air Assist large indust reporting protoco 	rial greenhouse gas Quality Information rial greenhouse gas ols in terms of ISO 14	emitters in the province System by 20XX. emitters in the province 064 by 20XX.	e in reporting Scope 1 (e in establishing Greenl	Greenho house G	ouse Gas emissions to the Gas Inventories and
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ents
1	Promote the formation of Greenhouse Gas reporting sub- committees in the BKCOB and PERCI.	DEDEA Air Quality Management		January 20xx	January 20xx		
2	Initiate Greenhouse Gas reporting awareness and technical training workshops among the largest industrial emitters in the province.	DEDEA Air Quality Management	R150 000,00	January 20xx	January 20xx		

Promotion of Renewable Energy in the Eastern Cape

NOTE: This programme draws from the outcomes of the Eastern Cape Renewable Energy Working Group workshop held on the 22nd of November 2010.

		Date: August 2010
DEDEA	CLIMATE CHANGE PROGRAMME	Revision No: Draft for development
	 Mitigation	Prepared By:
~		Approved By:
CC Programme	Promotion of clean energy in the EC	
Programme Custodian	DEDEA MEC's Clean Energy Champion (Ultimately the custodian is the MEC for E sits with ELIDZ)	Group DEDEA – in mean time the programme
Objective(s):	Goal:	
	That the EC is the most enabling provinci investment and implementation in the cou	al environment for Clean Energy intry.
	Overall objective:	
	 Create an enabling environment fo use of clean energy¹⁴ in the Eastername 	r investment in, and implementation and ern Cape ¹⁵
	Sub-objectives:	
	1 Initiate a provincial renewable promote and facilitate renewa in the Eastern Cape (includin	e energy coordination body to able energy markets and investment g renewable energy one-stop-shop).
	2 Development of enabling reg	ulatory mechanisms and incentives.
	by 20xx	renewable energy centre/incubator
	4 Initiate a clean energy purcha	asing pool by 20xx
Target(s):	Targets:	
	 Formation of a provincial renewable and facilitate renewable energy m Cape. The functions of the body s 	e energy coordination body to promote narkets and investment in the Eastern should include:
	National lobbying	
	Provincial policy alignment	nt
	Investor interface (one-st	op-shop)
	Implementation.	
	Development of enabling regulatory	y mechanisms and incentives.
	 Initiate a renewable energy 	gy Strategic Environmental Assessment

 ¹⁴ Clean Energy should be aligned with the objectives the national growth path and "Green Economy" imperative.
 ¹⁵ Ensure alignment with the provincial Renewable Energy Strategy.

	by 20xx
•	Undertake an exercise to map out a flow diagram/process structure/decision diagram in regard to the role of provincial and local government in regulating and promoting renewable energy investment ¹⁶ .
•	Develop a terms of reference for the role of each institution in the promotion, authorization and regulatory process associated with renewable energy investment.
•	To service above, ensure appropriate institutional capacity development at the Province and Local Government.
 Initiate a includir 	provincial renewable energy investment one-stop-shop by 20xx, ng:
•	Quantifying and characterization of the markets for renewable energy utilization in the EC province
•	Determination of energy targets for utilization of renewable energy
•	Development of departmental, municipal and industrial procurement guidelines for energy services or energy provided from renewable energy
•	Facilitated access for energy suppliers / generators to utilities such as transmission grid, water services etc;
•	Facilitated licensing and permitting for suppliers / generators – energy generation licenses, water use licenses, civil aviation regulations;
•	Facilitated environmental authorization for suppliers / generators – provincial RE Strategic Environmental Assessment (to engage with national process)
•	Facilitated Power Purchase Agreements.
•	Facilitated access to incentives.
•	Overcome institutional obstacles – MFMA, PFMA.

¹⁶ In other words each institution needs to understand how it fits in to the investment and regulatory process and what is at stake.

Other key stakeholders	 Initiate a renewable energy centre/incubator by 20xx, incorporating: Technology testing and certification facilities; Training and skills development facilities; Research and development facilities. Initiate a clean energy purchasing pool by 20xx Name Unit Interest DEDEA Environmental Authorisation 							
	DEDEA Provincial Emiss Reductions EC Provincial Renewable Energy Promotion and coordination of I Working Group							
	Eskom Grid Connection, Transmission and Power Purchase.							
	ECDC Renewable Investment Promotion							
		IDC	Green Energy Investment					
	of Energy administrative support							
		DNA	projects under the CDM					
		NERSA	Licensing.					
		DEDEA	Climate Change Risks					
		Local Municipalities	and Power Purchase					
		ELIDZ and Coega	Investment promotion and technology support.					
		Border-Kei Chamber of Commerce	Investment and Market Development					
		Regional Chamber of Commerce and Industry	Investment and Market Development					
Other interested parties	 Businesses (and other) customers for renewable energy services Regional Electricity Distributor Private sector suppliers and service providers 							
Overview of the issue:	of the Effective implementation of services which can benefit from technologies wh mitigate GHG emissions is highly dependent on a good regulatory and instituenvironment. Key regulatory mechanisms in the Renewable Energy Industry include:							
	 Procurement guidelines Standards and Codes o Secure and long-term a 	and procedures for rene of Practice access to markets	wable energy services					

 Licensing and permitting Clear guidance and mechanisms for RE – inclining block tariffs
A key question is the institutional environment for regulatory oversight. At this stage, in the electricity sector, the centralised, highly regulated, bureaucratic energy generation and transmission sector is arguably constricting the development of an independent RE production sector in the province. Either decentralisation or deregulation is required, or an enabling institutional framework (in which real capacity exists) should be set up. Conversely, local planners could use regulations to encourage technology rollout by linking requirements for energy efficiency and other technology options into planning permission (building plans, rezoning, EIA RODs, SDFs). However, for these requirements to have any teeth, they need to be backed up by legislation, adopted policy, guidelines and/or scientific evidence of effectiveness.
Furthermore, the role of renewable energy is broader than only electricity generated on the national grid from renewable energy and includes direct and on- site provision of energy services, such as heated water, and decentralised generation of electricity or gas.
It is apparent that three bottlenecks to unlocking the industry exist in the province, namely:
 Institutional fragmentation and lack of clarity, information and support in regard to (among others):
Licensing;
Permitting;
 Environmental authorisation;
 Zoning and municipal permission;
Power purchase agreements;
 Grid access and transmission codes of practice;
Regulatory conditions; and
Access to incentives.
• The above deterrents to investment can be overcome at the provincial level by the formation of a provincial renewable energy board or investment one-stop-shop to coordinate or streamline the regulatory process, facilitate access to decision-makers, and guide the investor through the various regulatory hurdles associated with independent power production.
• Independent access to markets. In other words, where Independent Power Producers (IPPs) are not selected for Eskom/DoE/Independent System Operator Power Purchase Agreements, they should have recourse to independently supplying directly to purchasers of clean energy. The province can facilitate an independent Clean Energy Market in order to attract investors through the formation of a Clean Energy Purchasing Power Pool, or supporting the independent brokerage of clean energy. Ideally such arrangements would resolve the difference between the long term investment cycle of IPPs (20 years) and the short term purchase cycle of industry (3 to 5 years).
 Investors are currently deterred by the lack of supporting institutions, services and infrastructure in the province. In particular there is a requirement for appropriate skills, testing facilities, R&D facilities and maintenance services. The province can improve the RF investment

	climate by establishing a Clean Energy Centre or Clean Energy Incubator. Such a centre should incorporate, among others:
	 Technology testing and certification facilities;
	 Training and skills development facilities;
	Research and development facilities.
Locality	All jurisdictions
Existing Policies, Programme(s)/Pr	Provincial Energy Strategy Development Process (In Process)
oject(s)	ELIDZ Renewable Energy Study (AGAMA Energy)
	 Renewable Energy Feed-in Tariff (REFIT), Regulatory Guidelines (National);
	The Biofuels Industrial Strategy of South Africa (2007)
	• White Paper on Renewable Energy Policy, 2003 (currently under review)
	National Industrial Policy Action Plan.
Regulatory and	Relevant legislation
Legislative Framework	Electricity Act, 1987
	National Energy Regulator Act, 2004 (No. 40 of 2004)
	 Energy Act, 2008 Electricity Distribution Industry (EDI) Restructuring Bill (April 2003)
	National Environmental Management Act (Act 107 of 1998)
	• National Environmental Management: Air Quality Act (Act 163 of 2004)
Management	
Tool(s):	Wind Atlas for South Africa (South African Wind Energy Programme)
	Data in Renewable Energy Strategy (DEDEA and ELIDZ)
Indicators of State	Access to energy services
	Proportion of renewable energy in provincial energy mix;
	 Ration of installed energy in the Eastern Cape against National total installed energy.
	Provincial GHG emissions avoided through renewable energy generation
	Employment in the renewable energy sector
	Water consumption by the renewable energy sector
	Economic activity.
Management	As for targets
Performance Indicators	

	CLIMATE CHANGE PROGRAMMES Mitigation
Programme Title:	Promotion of Renewable Energy in the EC
OBJECTIVE(S)	Overall objective:
	• Create an enabling environment for investment in, and implementation and use of clean energy in the Eastern Cape. Sub-objectives:
	Initiate a provincial renewable energy body to promote and facilitate renewable energy markets and investment in the Eastern Cape (including renewable energy one-stop-shop).
Target(s):	
	Initiate a provincial renewable energy investment one-stop-shop by 20xx, including:
	 Quantifying and characterization of the markets for renewable energy
	Determination of energy targets for utilization of renewable energy
	 Development of departmental, municipal and industrial procurement guidelines for energy services or energy provided from renewable energy
	 Facilitated access for energy suppliers / generators to utilities such as transmission grid, water services etc;
	 Facilitated licensing and permitting for suppliers / generators – energy generation licenses, water use licenses, civil aviation regulations;
	 Facilitated environmental authorization for suppliers / generators – provincial RE Strategic Environmental Assessment (to engage with national process)
	Facilitated Power Purchase Agreements.
	Facilitated access to incentives.
	Overcome institutional obstacles – MFMA, PFMA.

No	Activity	Pesponsible Person	Rudget	Starting Date	Completion Date	Comments
	Activity	Responsible r erson	Requirements			Comments
1	Commission a concept study and business plan for the formation of a provincial renewable energy facilitatory body	DEDEA Economic Development	R250,000.00	March 20xx	August 20xx	Study to assess and recommend an institutional structure and lines of communication to suit the goals of the renewable energy body Study to assess the potential legal position and potential statutory powers of the body.
2	Commission a study to quantify and characterise the markets for renewable energy utilization in the EC province	DEDEA Economic Development	R500,000.00	March 20xx	August 20xx	The study should be aligned to the Purchasing Pool action plan.

Ż						
Programme Title: Promotion of Renewable Energy in the EC						
OBJE	CTIVE(S)	IVE(S) Overall objective: - Create an enabling environment for investment in, and implementation and use of clean energy in the Eastern Sub-objectives: - Initiate a clean energy purchasing pool by 20xx): - - Initiate a clean energy purchasing pool by 20xx				
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments
1	Commission a Renewable Energy Purchasing Pool feasibility study and business plan.	DEDEA Economic Development	R350,000.00	March 20xx	August 20xx	Study should generate a database of willing buyers with data on how much renewable energy is required, over what period the energy is required and what the customer is willing to pay for certified renewable energy.

Ì	CLIMATE CHANGE PROGRAMME Mitigation						
Progra	amme Title:	Promotion of Renewable	e Energy in the EC				
OBJE	CTIVE(S)	Overall objective: Create an enabling environment for investment in, and implementation and use of clean energy in the Eastern Cape Sub-objectives: 					
Targe	t(s):	 Initiate a renewable energy centre/incubator by 20xx, incorporating: Technology testing and certification facilities; Training and skills development facilities; Research and development facilities. 					
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ients
1	Commission a feasibility study and business plan for a provincial renewable energy centre or incubator.	DEDEA Economic Development	R 500,000.00	March 20xx	August 20xx	Study Techn certific Trainir facilitie Resea facilitie Possik include Facilita	to incorporate: ology testing and cation facilities; ng and skills development es; irch and development es. ole functions of the body to e: ated access to utilities such

						as transmission grid, water services etc; Facilitated licensing and permitting – energy generation licenses, water use licenses, civil aviation regulations; Facilitated environmental authorization – provincial RE Strategic Environmental Assessment (to engage with national process) Facilitated Power Purchase Agreements. Facilitated access to incentives. Overcome institutional obstacles – MFMA, PFMA.
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Mitigation and Opportunities for Rural Livelihoods

			_				
DEDEA			Date: August 2010				
	CLIMATE CHANGE PROGRAMME Mitigation		Revision No: Draft for development				
			Prepared By:				
			Approved By:				
CC Programme	Mitigation and Opportunities for Sustainable Rural and Urban Settlement.						
Programme Custodian	DEDEA (Economic Development)						
Objective(s):	 Overall objective: Facilitate integrated lead projects that promote sustainable livelihoods and local economic development¹⁷ while achieving (tradable) emission reductions. 						
Target(s):	 Targets: Initiate provincial indigenous reforestation/rehabilitation programmes for registration as a carbon offset project by 20xx Initiate provincial rural lead projects: rural renewable energy generation and use centre and carbon offset project by 20xx. 						
	Initiate provincial rural lead projects: emission reductions and renewable energy from the diversion and utilization of organic waste by 20xx.						
Other key	Name Ui	Unit		Interest			
stakeholders	DI	EDEA		Economic Development			
	DI	EDEA		Environmental Rehabilitation			
	DI	DEDEA		Provincial Emissions Reductions			
	DI	EDEA		Energy from Waste			
	E	Eskom		Grid Connection, Transmission and Power Purchase.			
	E	CDC		Renewable Investment Promotion			
National Department of Energy		Department of	Regulatory				
	NI	ERSA		Licensing.			
	DI	EDEA		Strategic Responses to Climate Change Risks			
	W	/orking	for Energy	Biomass Residue to Energy			
	Sc Re	outh Af esearc	rican National Energy h Institute (SANERI)	Resources			
	S/	ANBI		Climate Change and Biodiversity			
	W	/orking	for Water	Biomass Revenue			

¹⁷ Rural renewable energy and mitigation programmes may have implications for ruralurban configurations, population migration, and transport.

		Expanded public works programme.	Job creation.			
Other interested parties	 Rhodes University Environmental Science Department R3G Restoration Research Group (Rhodes University and NMMU). Eastern Cape Social and Economic Consultative Forum (ECSECC) RuLiv. 					
Overview of the issue:	Although GHG emissions primarily occur as a result of urban and industrial activity, opportunities exist in rural areas for emission mitigation projects. Mitigation projects have a high employment ratio and therefore go hand in hand with rural development projects. Climate change mitigation has the potential to reform rural-urban settlement relationships and patterns. The potential of renewable energy for sustainable settlements and local economic development is illustrated by the example of the experimental biomass gasification unit at Melanie Village near Alice in the Tyume River valley (Mamphweli and Meyer 2008). The system is designed to run a 200 kW generator at 75% capacity, utilising 150 kg of biomass per hour. Biomass feedstock is sourced from wood waste generated at a nearby sawmill. The wood waste would otherwise be incinerated. Energy generated from biomass residue is considered to be renewable. 200kW of electricity generated for 16 hours a day for a year produces 1,168 MWh of renewable electricity. This results in avoided emissions from coal fired power stations of 1,144 tons of CO2e.					
Locality	All jurisdictions					
Existing Policies,	Provincial Energy Strateg	y Development Process (In Proce	ess)			
oject(s)	ELIDZ Renewable Energy	y Study	,			
	Renewable Energy Feed-	in Tariff (REFIT), Regulatory Gui	delines (National);			
	The Biofuels Industrial Str	The Biofuels Industrial Strategy of South Africa (2007) White Paper on Renewable Energy Policy, 2003 (currently under review)				
	White Paper on Renewab					
	National Industrial Policy Action Plan.					
Regulatory and Legislative Framework	 Relevant legislation Electricity Act, 1987 National Energy Regulato Energy Act, 2008 Electric National Environmental N National Environmental N 	or Act, 2004 (No. 40 of 2004) ity Distribution Industry (EDI) Res lanagement Act (Act 107 of 1998 lanagement: Air Quality Act (Act	structuring Bill (April 2003)) 163 of 2004)			

Management Tool(s):			
Indicators of State	Ratio of renewable energy in provincial energy mix;		
	• Ratio of installed energy in the Eastern Cape against National total installed energy.		
	Provincial GHG emissions avoided through renewable energy generation.		
	Ratio of renewable energy in provincial energy mix;		
	• Ratio of installed energy in the Eastern Cape against National total installed energy.		
	• Provincial GHG emissions avoided through renewable energy generation.		
Management Performance Indicators	• As per targets, and tons of CO ₂ e avoided through these projects.		

Ì									
Progra	mme Title:	Mitigation and Opportunities for Rural Livelihoods							
OBJE	OBJECTIVE(S) Overall objective: • Facilitate integrated lead projects that promote sustainable livelihoods and local economic development while achieving (tradable) emission reductions.					conomic development while			
Target	Target(s): • Initiate provincial indigenous reforestation/rehabilitation programme for registration as a carbon offset projec				n as a carbon offset project by 20xx				
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments			
1	Commission a concept study and business plan for a reforestation/rehabilitation programme which takes advantage of formal/informal carbon finance and climate change mitigation funds.	DEDEA Economic Development	R250,000.00	March 20xx	August 20xx	Draw from work already undertaken by the R3G Restoration Group in regard to rehabilitation with Spek Boom.			
k	CLIMATE CHANGE PROGRAMMES Mitigation								
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Programme Title: Mitigation and Opportunities for Rural Livelihoods									
OBJE	CTIVE(S)	Overall objective: Facilitate integra achieving (trac	 Overall objective: Facilitate integrated lead projects that promote sustainable livelihoods and local economic development while achieving (tradable) emission reductions. 						
Target	(S):	 Initiate provincia 20xx. 	 Initiate provincial rural lead project: rural renewable energy generation and use centre and carbon offset project by 20xx. 						
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments			
1	Commission a concept study and business plan for a rural renewable energy generation and use centre and carbon offset project by 20xx.	DEDEA Economic Development	R250,000.00	March 20xx	August 20xx	Draw from lessons learned at Fort Hare community biomass electricity generation project. Draw from research of CSIR and Steve Szewczuk on rural off-grid energy in the EC. Distributed rural energy generation centres should be seen as catalysts for local economic development. Emphasis should be placed on the development or testing of a rural energy model for further rollout.			

Ì	CLIMATE CHANGE PROGRAMMES Mitigation							
Progra	mme Title:	Mitigation and Opportu	inities for Rural Livel	ihoods				
OBJEC	CTIVE(S)	Overall objective:						
		 Facilitate integrated lead projects that promote sustainable livelihoods and local economic development while achieving (tradable) emission reductions 						
Target(s):		 Initiate provincia organic waste 	ıl rural lead projects: by 20xx.	emission reductions a	nd renewable energy f	rom the diversion and utilization of		
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments		
1	Commission a concept study and business plan for a waste-based emission reductions and renewable energy project.	DEDEA Economic Development	R250,000.00	March 20xx	August 20xx	Elements of the project include: Waste separation at source; Waste sorting post-separation; Formalised measurement of organic diverted from landfill; and Renewable energy generation from organic waste.		

Mitigation in Solid Waste and Wastewater Treatment

		Date: August 2010						
DEDEA	CLIMATE CHANGE PROGRAMME	Revision No: Draft	for development					
	 Mitigation	Prepared By:						
		Approved By:						
CC Programme	Mitigation in Solid Waste and V	Vastewater Treatment						
Programme Custodian	DEDEA Waste Management							
Objective(s):	 Overall objective: Reduction in organic waste to landfill, renewable energy from waste, and methane use or destruction 							
	1Reduction in organic2Conversion of organimethane use or destr	waste to landfill c portion of waste to composi ruction.	t or energy; and					
	3 Promote provincial pi	lot waste to energy projects.						
Target(s):	 Targets: Campaign for reduction in a Separation of organic cante waste-stream at source o Promotion of organic waste projects and waste to energincineration and bio-diges 	organic waste streams in hou een, industrial, catering and g r through waste-sorting facilit e beneficiation projects, includ ergy projects from pyrolysis, g stion.	sehold waste; jarden waste from ies; ding composting jasification,					
Other key	Name	Unit	Interest					
stakeholders		DEDEA	Provincial Integrated Waste Management					
		NMBM	Nelson Mandela Bay BRT					
		BCM	Solid Waste					
		Local Municipalities	Management					
		District Municipalities	Water Treatment					
		IWMSA-EC	Industry Association					
			1					
Other interested parties	BusinessesPrivate Waste Managemer	nt Companies.						

Over ious of the						
issue:	Organic waste contributes to Greenhouse Gas Emissions by the release of methane gas through decomposition under anaerobic conditions (in other words when the waste is not exposed to air). Methane gas has 23 times the greenhouse gas effect of Carbon dioxide. In other words, 1 ton of methane is the equivalent of 23 tons of Carbon dioxide. Methane gas is most often generated when organic waste such as garden waste, wood, food waste, paper and cardboard are disposed of at landfill, or when sewage sludge or wastewater/effluent is treated in anaerobic digesters or in certain settling ponds where the biogas is allowed to vent to the atmosphere.					
	Greenhouse gas emissions from solid waste can be avoided by the diversion of organic waste streams from landfill and the conversion to compost (composting does not generate methane) or conversion to energy.					
	Emissions from waste-water can be avoided through the capture of methane and use as an energy source.					
	Greenhouse gas emissions are also caused through the inefficient use of electricity in waste-water treatment. Certain treatments systems and technologies are more efficient than others.					
Locality	All iurisdictions					
Existing Policies, Programme(s)/Pr oject(s)	 National Waste Management Strategy Eastern Cape Integrated Waste Management Plan District and Local Municipal Waste Management Plans 					
	National Green Economy Summit.					
Regulatory and	Relevant legislation					
Legislative	National Environmental Management: Waste Management Act;					
Tranework	National Environmental Management: Air Quality Act.					
Management Tool(s):	National Waste Information System					
Indicators of	Organic waste-stream as a percentage of total waste going to landfill;					
Sidle	 Tons of organic waste disposed of in landfill per year; 					
	 Tons of organic waste composted or beneficiated as energy per year. 					
	 Number of successfully operating waste sorting facilities operating in the province; 					
	 Number of garden refuse stations or composting facilities operating at landfills in the province; 					
	Number of waste-to-energy projects successfully operating in the province;					
	Established pilot programmes of recycling, biogas or composting.					
Management Performance Indicators	As for targets					

Ì	CLIMATE CHANGE PROGRAMMES Mitigation								
Progra	mme Title:	Mitigation in Solid Was	ste and Wastewater	Treatment					
OBJECTIVE(S) Overall objective: • Reduction in organic waste to landfi Sub-objectives: • Reduction in organic waste to landfi				II, renewable energy f	from waste, and methane	e use or	destruction		
Target	(S):	 Campaign for re Separation of or sorting facilitie 	eduction in organic w ganic canteen, indu s.	aste streams in hous strial, catering and ga	ehold waste; arden waste from waste-s	stream a	t source or through waste-		
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	nents		
1	Initiation of a feasibility study and business plan for a household organic waste separation and recycling/composting plan and awareness campaign.	DEDEA Waste Management	R250,000.00	March 20xx	August 20xx	Should house cardbo syster Projec potent The pro the ind words Bunke	d be integrated with a hold waste paper and bard collection or drop-off n. et to focus on job-creation ial of waste management. roject needs to cut across come range. In other from Duncan Village to ers Hill.		
	Initiate a provincial review	DEDEA Waste	R250,000.00	March 20xx	August 20xx	Organ	ics have value and should		

of incentives for waste separation at source, and disincentives for disposal or organic waste at landfill sites.	Management				stay in the community.
Initiate a provincial management audit of current and planned waste sorting facilities in the province. This should be in parallel with an awareness campaign for such facilities.	DEDEA Waste Management	R250,000.00	March 20xx	August 20xx	The audit should aim to understand success stories and obstacles to the successful operation of such facilities. The Audit should highlight lessons learned to date and recommendations for the successful operation of waste sorting facilities.
Engage with retail outlets in regard to the development of corporate green policies/waste management policies where recycling is promoted.	DEDEA Waste Management		Ongoing	Ongoing	

Ì	CLIMATE C Mitigation	HANGE PROGRAMMES					
Programme Title: Mitigation in Solid Waste and Wastewater Treatment							
OBJECTIVE(S) Overall objective: • Reduction in organic waste to landfill, renewable energy from waste and methane use or destruction Sub-objectives: • Promote provincial pilot waste to energy projects.					struction		
Target	(s):	 Promotion of organ pyrolysis, gasificati 	nic waste beneficiati ion, incineration and	on projects, including bio-digestion.	composting projects and	d waste to	o energy projects from
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	ients
1	Identify and promote the development of at least one waste separation or diversion and conversion to energy project.	DEDEA Waste Management	R300,000.00	March 20xx	August 20xx	Strong studies sewag and m A DBS underv treatm curren outfall.	opportunities exist and s are under way for e anaerobic biodigestion ethane-to-energy projects. A feasibility study is way for the anaerobic ent of sewage that is tly released as a marine

Greenhouse Gas Mitigation in Transport

Note that the programme detailed below focuses on modal shift in transport and efficient transport systems and planning. The programme does not deal with fuel efficiency in motor vehicles since it is expected that incentives and penalties associated with fuel efficiency will be dealt with at a national level (for example the National Carbon Tax on new passenger vehicles introduced in September 2010).

			Date: August 2010				
	CLIMATE CHANGE PROGRAMME		Revision No: Draft for development				
	 Mitigation		Prepared By:				
			Approved By:				
CC Programme	Greenhouse Gas Mitigation in Transport						
Programme Custodian	MEC for Eastern Cape Departme	ent and Tr	ansport				
Objective(s):	Overall objective: • Facilitate shift to low greenhouse gas modes of transport and transport systems Sub-objectives: 1 Effective mass transit and rail systems in cities integrated with regional transport systems; 2 Disincentives ¹⁸ and incentives for shift from private to public modes of transport. 3 Urban planning and SDFs to support urban/settlement densification and alignment around transport corridors to make mass transport more feasible.						
Target(s):	 Targets: Effective and integrated city and regional transport systems (including mass transport) operational by 2013. Undertake a study of options and mechanisms for promoting a modal shift towards the use of public transport systems, including a study of possible incentive schemes Reassess urban planning and transport infrastructure to optimize use in terms of GHG emissions. Provincial government and municipalities to shift to carbon efficient fleets by 201X¹⁹ 						
Other key	• Name	Unit		Interest			
stakeholders		NMBM		Nelson Mandela Bay BRT			
		BCM		BCM BRT			
		EC Dept	Roads and Transport	Provincial Transport Planning			

¹⁸ A shift from private to public modes of transport will require an extensive mindset

change. ¹⁹ Appropriate procurement by provincial and local government will influence public perception and support the local manufacture of low carbon vehicles.

		Treasury	Finance and subsidies
		Metrorail	Urban Passenger Rail
		Passenger Rail Agency of South Africa	Urban and Regional Passenger Rail
		National Transport Response Strategy.	
		National DoT	Management of Subsidies.
Other interested parties	Businesses (and other) custome Private transport corporations a	ers for renewable energy services nd taxi industries.	;
Overview of the issue:	 The combustion of petrol, diese 13,494,876 tons of Carbon Diox more than half of emissions from sources combined in the provine. Private passenger transport is thaccounts for the majority of fuel Even a 10% shift from private to significant reduction in Greenhood. The deputy minister of transport (Engine). Removing excess road roads seems to be the most vial emissions in the short term. South Africans, especia the use of private vehicles. It is necessary to make cars and trucks on the roads anti-Viable transport alternation in the degradation of the countries system than to recapitalisation word. The recapitalisation will and manufacturing of the fleet at The world watch institute recomsystems: Substantial and sustain 	I and aviation fuel accounted for t tide in the Eastern Cape in 2008. In all energy sources and 35% of o ce. The dominant mode in the transpor- use. To public modes of passenger trans- buse Gas Emissions and local air t, on the 26th of October 2010, no neering News Online 27/10/2010) use and improving efficiencies on ble option to reducing the transpo- lly middle-class users, are largely it more expensive for people and d move them onto other modes o tive would be required, which wou ant investment over the last 30-plu y's rail system. It will cost more to d procure new systems. Ild take place in stages over the r have a strong local focus in terms and technologies.	he emission of This represents emissions from all t sector and sport will result in a pollution. ted the following in the fol
	 Substantial and sustainal highway spending principally to Overhauling policies to transit, reduce reliance on moto realistic options. Overall, such a course v and air pollutants, inject urban a generate or retain large number 	repairs of crumbling infrastructure stimulate denser settlements that rized transportation, and make bil would stimulate innovation, reduct and suburban areas with new vigo rs of well-paying jobs.	e such as bridges). permit public king and walking e carbon emissions or and vitality, and
	A shift from private road transpo	ort to other forms of transport wou	ld facilitate

	improved fuel officier	ov por passonger kilon	notro Efficionaisa	for difforent transport					
	modes are given in Table 4.								
	Passenger fuel efficiency for five passenger transport modes (Source: UNEP								
Transport Mode Vehicle Production Fuel Use Total									
	Light Rail	0.7	1.4	2.1					
	Bus	0.7	2.1	2.8					
	Heavy Rail	0.9	1.9	2.8					
	Car (Gasoline)	1.4	3.0	4.4					
	Car (Diesel)	1.4	3.3	4.7					
Locality Existing Policies.	All jurisdictions								
Programme(s)/Pr	Proposed BRT system for BCM;								
	 Proposed BRT project for Nelson Mandela Bay municipality; 								
	Provincial and	Provincial and Municipal Transport Plans;							
	 Metrorail Plan (sections relevant to EC) 								
	 Transnet Plan (sections relevant to EC) 								
Regulatory and	Relevant legislation								
Legislative Framework	White Paper o	n National Transport Po	olicy (1996)						
Management									
Tool(s):									
State	Passenger mo	dal split;							
	Number of new	v passenger vehicles re	egistered per year						
	Annual Province	cial Petrol and Diesel co	onsumption.						
	•								
Performance	As for targets								
Indicators									

X	CLIMATE CHANGE PROGRAMMES Mitigation							
Programme Title: Greenhouse Gas Mitigation in Transport								
OBJEC	CTIVE(S) (s):	Overall objective: • Facilitate shift to Sub-objectives: • Effective mass t • Effective and int	o low greenhouse ga ransit and rail syster egrated city and reg	s modes of transport a ns in cities integrated v ional transport systems	nd transport systems with regional transport s s (including mass transp	ystems; port) operational by 20xx		
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comments		
1	Formation of a provincial integrated passenger transport task team with a greenhouse gas emission reduction mandate.	EC Dept Roads and Transport	R100,000.00	March 20xx	Ongoing			

		CLIMATE CHANGE PROGRAMMES Mitigation							
Programme Title: Greenhouse Gas Mitigation in Transport									
OBJE	CTIVE(S)	 Overall objective: Facilitate shift to le Sub-objectives: Disincentives and 	 Overall objective: Facilitate shift to low greenhouse gas modes of transport and transport systems Sub-objectives: Disincentives and incentives for shift from private to public modes of transport. 						
Target	:(S):	Undertake a study including a study	<pre>v of options and mec v of possible incentiv</pre>	hanisms for promoting e schemes	g a modal shift towards	the use o	of public transport systems,		
No	Activity	Responsible Person	Budget Requirements	Starting Date	Completion Date	Comm	nents		
1	Undertake a study of options and mechanisms for promoting a modal shift towards the use of public transport systems, including a study of possible incentive schemes	EC Dept Roads and Transport	R500,000.00	March 20xx	March 20xx				

Appendix 3: List of Climate Change Adaptation and Mitigation Projects Funded by Multilateral and Bilateral Climate Change Funds (March 2011)

List of Climate Change Adaptation and Mitigation Projects Funded by Multilateral and Bilateral Climate Change Funds (Source: Climate Funds Update²⁰)

Disbursed to: name and link	Fund (click for overview)	Amount disbursed (USD millions)
25.000 Seler Deefe		типона) Флеб
20,000 Solar Rools		Φ4.00 Φ4.40
100% renewable Island of Santa Cruz, Galapagos Islands		\$1.13
1000 Roots Programme: Disseminating Solar Thermal Hot Water Production	International Climate Initiative	\$1.55
A Policy Forum of Power Sector Regulatory Frameworks for On-grid Renewable Energies	GEF Trust Fund - CC focal area	\$1.00
Achieving Conservation and Improving Livelihoods through the Sustainable Management of Community-Based Forest Operations in Cameroon	Congo Basin Forest Fund	\$1.72
Achieving Reduction in GHG Emissions through Advanced Energy Efficiency Technology in Electric Motors	GEF Trust Fund - CC focal area	\$0.25
Action for the Development of Marshall Islands Renewable Energies (ADMIRE)	GEF Trust Fund - CC focal area	\$0.98
Action Plan for Sustainable Energy Supply for the 2014 Winter Olympics in Sochi	International Climate Initiative	\$0.28
Adaptation in the coastal zones of Mozambique Adaptation in the coastal zones of Mozambique	Least Developed Countries Fund	\$4.43
Adaptation to CC and Conservation of Biodiversity through Protection and Sustainable Use of Wetlands	International Climate Initiative	\$1.35
Adaptation to CC Impacts in Mountain Forest Ecosystems of Armenia	Strategic Priority on Adaptation	\$1.05
Adaptation to CC Impacts on the Coastal Wetlands	Special CC Fund	\$4.50
Adaptation to CC in Arid Lands (KACCAL)	Special CC Fund	\$6.50
Adaptation to CC in the Nile Delta Through Integrated Coastal Zone Management	Special CC Fund	\$4.00
Adaptation to CC through Effective Water Governance	Special CC Fund	\$3.00
	MDG Achievement Fund – Environment	
Adaptation to CC to Sustain Jordan's MDG Achievements	and CC thematic window	\$1.33
Adaptation to CC Using Agrobiodiversity Resources in the Rain Fed Highlands of Yemen	Strategic Priority on Adaptation	\$4.62
Adaptation to CC - Responding to Coastline Change and its Human Dimensions in West Africa through Integrated Coastal Area Management	Strategic Priority on Adaptation	\$4.36
Adaptation to coastal erosion in vulnerable areas	Adaptation Fund	
Adaptation to the effects of drought and CC in Agro-ecological Zone 1 and 2 in Zambia	Least Developed Countries Fund	\$3.45
Adapting to CC and Conserving Biological Diversity	International Climate Initiative	\$3.64
Adapting to CC by Improving Water Resources Management	International Climate Initiative	\$2.25
Adapting to CC through the Improvement of Traditional Crops and Livestock Farming	Strategic Priority on Adaptation	\$1.09
Adapting Water Resource Management in Comoros to Increase Capacity to Cope with CC	Least Developed Countries Fund	\$3.40
Addressing CC Risks on Water Resources in Honduras: Increased Systemic Resilience and Reduced Vulnerability of the Urban Poor	Adaptation Fund	

Addressing CC Risks on Water Resources in Honduras: Increased Systemic Resilience and Reduced Vulnerability of the Urban Poor

²⁰ <u>http://www.climatefundsupdate.org/</u>

Adequação ambiental da propriedade rural: controle de desmatamento de conservação da biodiversidade da Amazônia Legal (TNC- Brasil)	Amazon Fund (Fundo Amazônia)	\$8.80
Adrar Solar Initiative and Decentralized Electrification in the Northern Coastline of Mauritania through Hybrid (Wind/Diesel) Systems	GEF Trust Fund - CC focal area	\$2.70
Advancing the Micronesia Challenge through New Protected Areas	International Climate Initiative	\$2.09
Advice on Implementing the Sustainable Energy Financing Facility	International Climate Initiative	\$2.91
African Carbon Asset Development (ACAD) Facility	International Climate Initiative	\$1.62
African Rift Geothermal Development Facility (ARGeo)	GEF Trust Fund - CC focal area	\$17.75
Alternatives to Mangrove Destruction for Women's Livelihoods in Central Africa	Congo Basin Forest Fund	\$0.38
Armenia Energy Efficiency Project	GEF Trust Fund - CC focal area	\$1.82
ARPA (Fundo Brasileiro para a Biodiverdidade - Funbio)Programas Bolsa Floresta Associação, Renda e Programas de Apoio (Fundação Amazonas Sustentável - FAS)	Amazon Fund (Fundo Amazônia)	\$11.00
Asia Pacific Forestry Skills and Capacity Building	International Forest Carbon Initiative	\$6.60
Barrier Removal to Namibian Renewable Energy Programme (NAMREP), Phase II	GEF Trust Fund - CC focal area	\$2.60
Barrier Removal to the Cost-Effective Development and Implementation of Energy Standards and Labeling Project (BRESL)	GEF Trust Fund - CC focal area	\$6.80
BECCAP: Basic Energy CC Adaptation Programme	International Climate Initiative	\$2.40
Benin Energy Efficiency Program	GEF Trust Fund - CC focal area	\$1.82
Bilateral package of support on forests and climate	International Forest Carbon Initiative	\$6.50
Biodiversity Conservation through Preparatory Measures for Avoided Deforestation (REDD) in the Merang Peat Forest Area	International Climate Initiative	\$2.18
Bioenergy for Sustainable Rural Development	GEF Trust Fund - CC focal area	\$3.00
Bioenergy in the Caribbean	International Climate Initiative	\$0.40
Biomass Energy for Employment and Energy Security Project	GEF Trust Fund - CC focal area	\$0.97
Bonobo Conservation Concession in Equateur Province in Democratic Republic of Congo	Congo Basin Forest Fund	\$0.00
Building Adaptive Capacity and Resilience to CC in Afghanistan	Least Developed Countries Fund	\$4.90
Building Adaptive Capacity and Resilience to CC in the Water Sector in Cape Verde	Least Developed Countries Fund	\$3.00
Building Capacity to Establish National Greenhouse Gas Inventories for the Forestry Sector	International Climate Initiative	\$4.65
Building Foundations for Success: Community Participation is Central to REDD	Congo Basin Forest Fund	\$2.03
Building the Capacity of the Agriculture Sector in DR Congo to Plan for and Respond to the Additional Threats Posed by CC on Food Production and Security	Least Developed Countries Fund	\$3.00
Building the Local Capacity for Promoting Energy Efficiency in Private and Public Buildings	GEF Trust Fund - CC focal area	\$0.98
Buildings Sector Energy Efficiency Project (BSEEP)	GEF Trust Fund - CC focal area	\$5.00
Bus Rapid Transit and Pedestrian Improvements in Jakarta	GEF Trust Fund - CC focal area	\$5.81
Business Networks for Climate Protection and Energy Efficiency	International Climate Initiative	\$0.67
Capacity Development for Climate Protection	International Climate Initiative	\$2.55
Carbon Accounting data purchase	International Forest Carbon Initiative	\$3.00
Carbon-Financed Forest Management in Tropical Rainforest Heritage of Sumatra	International Climate Initiative	\$0.78
Catalytic Investments for Geothermal Power	GEF Trust Fund - CC focal area	\$2.73
CDM Watch: strengthening civil society participation in Southern countries in implementing and developing the CDM	International Climate Initiative	\$0.46

CD-REDD: Reducing Emissions from Deforestation in Developing Countries	International Climate Initiative	\$1.12
CF Industrial Energy Efficiency for Malaysian Manufacturing Sector (IEEMMS)	GEF Trust Fund - CC focal area	\$4.20
CF: Industrial Energy Efficiency	GEF Trust Fund - CC focal area	\$3.17
CF: Industrial Energy Efficiency	GEF Trust Fund - CC focal area	\$3.62
CF: Promoting Energy Efficiency in the Industries through System Optimization and Energy Management Standards	GEF Trust Fund - CC focal area	\$2.18
Chiller Energy Efficiency Project	GEF Trust Fund - CC focal area	\$2.60
Chiller Energy Efficiency Project	GEF Trust Fund - CC focal area	\$3.66
Chiller Energy Efficiency Project - under the Programmatic Framework for Energy Efficiency	GEF Trust Fund - CC focal area	\$6.30
China Energy Efficiency Promotion in Industry	GEF Trust Fund - CC focal area	\$4.00
CIFOR	International Forest Carbon Initiative	\$2.30
Cities in Asia develope Climate Sensitive Adaptation Plans	International Climate Initiative	\$2.18
CleanTech Fund	GEF Trust Fund - CC focal area	\$1.00
Climate Adaptation for Rural Livelihoods and Agriculture (CARLA)	Least Developed Countries Fund	\$3.00
CC adaptation project in the areas of watershed management and water retention	Least Developed Countries Fund	\$5.00
CC Adaptation Project, Phase I	Special CC Fund	\$4.97
CC Mitigation and Primary Forest Conservation – A Best-Practice Management Scheme for Wild Coffee Forests in Ethiopia	International Climate Initiative	\$4.78
CC Mitigation in Five Representative Ecosystems	International Climate Initiative	\$2.33
	<u>MDG Achievement Fund – Environment</u>	
CC Risk Management in Egypt	and CC thematic window	\$2.86
CC scenarios for the Congo Basin	International Climate Initiative	\$2.28
Climate Finance Innovation Support Facility	International Climate Initiative	\$2.98
Climate Impacts: Global and Regional Adaptation Support Platform (CI: GRASP)	International Climate Initiative	\$2.70
Climate Protection and Distributed Energy Supply - Indo-German Energy Forum	International Climate Initiative	\$1.83
Climate protection and electric transport	International Climate Initiative	\$5.25
Climate Protection and Renewable Energy as an Opportunity for the Private Sector, Policy-Makers and Civil Society	International Climate Initiative	\$0.23
Climate Protection in Nature-Based Tourism	International Climate Initiative	\$1.23
Climate Protection Programme in Support of the South African Department of Environmental Affairs	International Climate Initiative	\$3.87
Climate-Neutral Energy Supply for Rural Areas	International Climate Initiative	\$3.89
Climate-Related Modernisation of National Forest Policy and Piloting of REDD Measures	International Climate Initiative	\$4.05
Climate-resilient Infrastructure Planning and Coastal Zone Development	Special CC Fund	\$3.40
Climate-Tolerant Restoration of Degraded Bioregions	International Climate Initiative	\$1.78
Coal Fired Generation Rehabilitation Project	GEF Trust Fund - CC focal area	\$45.40
Coastal and Marine Resources Management in the Coral Triangle of the Pacific	Strategic Priority on Adaptation	\$1.00
Coastal and Marine Resources Management in the Coral Triangle: Southeast Asia	Strategic Priority on Adaptation	\$1.00
Cogen for Africa	GEF Trust Fund - CC focal area	\$5.25
Community Based Adaptation to CC through Coastal Afforestation	Least Developed Countries Fund	\$3.30
Community Based Adaptation (CBA) Programme	Strategic Priority on Adaptation	\$5.51

ComSolar: Marketing solar energy in urban regions and industrial zones	International Climate Initiative	\$7.35
Concentrating Solar Power Technology Transfer for Electricity Generation in Namibia (NAM CSP TT)	GEF Trust Fund - CC focal area	\$1.72
Conservancy Adaptation Project	Special CC Fund	\$3.80
	MDG Achievement Fund – Environment	
Conservation and Sustainable Management of the Natural and Cultural Heritage of the Yasuní Biosphere Reserve	and CC thematic window	\$2.95
Conservation of the Altai-Sayan ecoregion in Russia	International Climate Initiative	\$4.49
Conservation of the Altai-Sayan Region	International Climate Initiative	\$2.70
Conserving biodiversity in Peru's tropical rainforest from the climate perspective	International Climate Initiative	\$4.50
Conserving Forest Ecosystems in Amazonia	International Climate Initiative	\$2.92
Conserving Mountain Forests	International Climate Initiative	\$3.25
Conserving the Atlantic Coastal Forests	International Climate Initiative	\$3.00
Conserving Virgin Forests in the Bikin Region	International Climate Initiative	\$3.76
Conserving Wetlands in the Cape Floristic Region	International Climate Initiative	\$3.00
Conserving Wetlands in the Cape Floristic Region 1	International Climate Initiative	\$3.00
Contribution Agreement with UNEP	Global CC Alliance	\$0.00
Converting a Production Facility to the Manufacture of Climate-Friendly Air-Conditioning Equipment	International Climate Initiative	\$3.00
Converting Air-Conditioning Equipment in Public Buildings to Natural Refrigerants	International Climate Initiative	\$1.27
Converting the Production of Commercial Refrigeration Equipment to Natural Refrigerants	International Climate Initiative	\$1.94
Cooperation Platform for the Conservation of Species-Rich and Carbon-Storing Ecosystems	International Climate Initiative	\$1.58
Coping with Drought and CC (ET)	Special CC Fund	\$1.00
Coping with Drought and CC (MZ)	Special CC Fund	\$0.96
Coping with Drought and CC (ZB)	Special CC Fund	\$0.98
Coral Triangle Initiative	International Climate Initiative	\$2.04
Country Advisory Services	Forest Carbon Partnership Facility	\$1.59
CO-EFFICIENCY: Improving Energy Efficiency in Buildings in Colombia through Synergies between Environmental Conventions	GEF Trust Fund - CC focal area	\$0.98
Creating Markets for Renewable Power in Ukraine	GEF Trust Fund - CC focal area	\$8.45
Credit Programme for Balkan Energy Efficiency Initiative	International Climate Initiative	
Credit Programme for Balkan Green Financing	International Climate Initiative	
Credit Programme for Climate Protection CHI	International Climate Initiative	
Credit Programme for Climate Protection CRO	International Climate Initiative	
Credit Programme for Climate Protection TUR	International Climate Initiative	
Credit Programme for Climate-Friendly Refrigeration Equipment	International Climate Initiative	
Credit Programme for Energy Efficiency CHI	International Climate Initiative	
Credit Programme for Energy Efficiency PHI	International Climate Initiative	
Credit Programme for Energy Efficiency UKR	International Climate Initiative	
Credit Programme for Renewable Energy Sources	International Climate Initiative	
Demonstration of Fuel Cell Bus Commercialization in China, Phase 2	GEF Trust Fund - CC focal area	\$5.77

Design and Implementation of Pilot CC Adaptation Measures in the Andean Region	Special CC Fund	\$6.90
design of national Strategic Programs for Climate Resilience (SPCR	Pilot Program for Climate Resilience	
design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
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design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
design of national Strategic Programs for Climate Resilience (SPCR)	Pilot Program for Climate Resilience	
Developing a Climate Adaptation Strategy for Santiago de Chile and a Network of Megacities	International Climate Initiative	\$2.14
Developing a climate strategy for the SOCAR company	International Climate Initiative	\$0.19
Developing a National Energy Action Plan	International Climate Initiative	\$0.23
Developing Core Capacity to Address Adaptation to CC in Productive Coastal Zones	Least Developed Countries Fund	\$3.10
Development and Implementation of a Standards and Labeling Programme in Kenya with Replication in East Africa	GEF Trust Fund - CC focal area	\$2.00
Development and Implementation of Climate Policy	International Climate Initiative	\$3.54
Development of a National Adaptation Program of Action (NAPA) ERI	Least Developed Countries Fund	\$0.20
Development of a National Adaptation Programme of Action YEM	Least Developed Countries Fund	\$0.20
Development of a Strategy for the Deployment of Mini-Biogas Systems in Pig Production for a Distributed Energy Supply	International Climate Initiative	\$0.33
Disaster Prevention and Adaptation to CC in Remote Himalayan Villages	International Climate Initiative	\$0.20
Documentary Film: Energy Efficiency in Buildings	International Climate Initiative	\$0.59
Economic Analysis of Adaptation Options in Support of Decision Making	Special CC Fund	\$1.00
Economics of CC	International Climate Initiative	\$0.79
Eco-Industrial Parks in Andra Pradesh	International Climate Initiative	\$1.02
Eco-Transport in City Clusters: Model Development & Pilots	GEF Trust Fund - CC focal area	\$4.80
Effective Management of Protected Areas in the Peruvian Amazon Region, Phase II	International Climate Initiative	\$4.50
Elaboration du Programme d'Action National pour l'Adaptation aux Changements Climatiques	Least Developed Countries Fund	\$0.20
Electricity Sector Efficiency Improvement Project	GEF Trust Fund - CC focal area	\$4.50
Emergency program for solar power generation and lighting for Haiti, as a consequence of the Earthquake in Port au Prince.	GEF Trust Fund - CC focal area	\$1.00
Enabling activities for Preparing India's Second National Communication to UNFCCC	GEF Trust Fund - CC focal area	\$3.50
Enabling Activities for the Preparation of a National Adaptation Plan of Action ANG	Least Developed Countries Fund	\$0.20
Enabling Activities for the Preparation of National Adaptation Programmes of Action (NAPAs) AFG	Least Developed Countries Fund	\$0.20
Enabling Activities for the Preparation of Turkey's Second National Communication to the UNFCCC	GEF Trust Fund - CC focal area	\$0.50
Enabling Activities to Facilitate the Preparation of a National Adaptation Plan of Action (NAPA) HAI	Least Developed Countries Fund	\$0.20
Enabling Activities to Facilitate the Preparation of a National Adaptation Plan of Action (NAPA) RWA	Least Developed Countries Fund	\$0.20
Enabling China to Prepare Its Second National Communications to UNFCCC	GEF Trust Fund - CC focal area	\$5.00

	MDG Achievement Fund – Environment	
Enabling pastoral communities to adapt to CC and restoring rangeland environments	and CC thematic window	\$1.35
Encouraging the Setting Up and Consolidation of an Energy Service Market in Chile	GEF Trust Fund - CC focal area	\$2.36
Energy Campaign for the Hotel and Restaurant Industry	International Climate Initiative	\$0.21
Energy Conservation in Small Sector Tea Processing Units in South India.	GEF Trust Fund - CC focal area	\$0.95
Energy Conservation (to the Ministry of Industry)	Indonesia CC Trust Fund	
Energy Development and Access Project (formerly) Development of Renewable Energy and Energy Efficiency	GEF Trust Fund - CC focal area	\$5.50
Energy Efficiency Action Plan for the Kho Khao Holiday Island	International Climate Initiative	\$0.71
Energy Efficiency and Cogeneration Investment Scale-Up and Biomass Pilot	GEF Trust Fund - CC focal area	\$2.41
Energy Efficiency Codes in Residential Buildings and Energy Efficiency Improvement in Commercial and Hospital Buildings in Morocco	GEF Trust Fund - CC focal area	\$3.00
Energy Efficiency Financing	GEF Trust Fund - CC focal area	\$13.50
Energy Efficiency Improvements in the Indian Brick Industry	GEF Trust Fund - CC focal area	\$0.70
Energy Efficiency in New Construction in the Residential and Commercial Buildings Sector in Mongolia (under Frame Work for		
Promoting Low Greenhouse Gas Emissions in Buildings: 3787)	GEF Trust Fund - CC focal area	\$0.98
Energy Efficiency in the Industrial Sector	GEF Trust Fund - CC focal area	\$2.73
Energy Efficiency Investment Support Framework	GEF Trust Fund - CC focal area	\$1.00
Energy Efficiency Loan Programme	International Climate Initiative	
Energy Efficiency Programme for Mountainous Regions	International Climate Initiative	\$0.15
Energy Efficiency Project	GEF Trust Fund - CC focal area	\$15.16
Energy Efficiency Standards and Labeling of Building Appliances	GEF Trust Fund - CC focal area	\$0.97
Energy Efficiency Standards and Labels in Colombia (S&L Colombia)	GEF Trust Fund - CC focal area	\$2.50
Energy Efficiency Standards and Labels in Peru	GEF Trust Fund - CC focal area	\$2.00
Energy Efficient Design and Construction in Residential Sector	GEF Trust Fund - CC focal area	\$4.57
Energy Efficient Lighting in Residential and Public Buildings	GEF Trust Fund - CC focal area	\$6.50
Energy for Sustainable Development in the Caribbean (ESD-Caraibes)	GEF Trust Fund - CC focal area	\$4.86
Energy Recovery from Sludge Gases at a Municipal Sewage Treatment Plant	International Climate Initiative	\$2.89
Energy-efficiency in Urban Districts	International Climate Initiative	\$6.75
Engaging the Banking Sector in Financing Sustainable Energy	International Climate Initiative	\$0.31
Enhancing Adaptive Capacity and Resilience to CC in the Agriculture Sector in Mali	Least Developed Countries Fund	\$3.00
Enhancing Climate Risk Management and Adaptation in Burundi (ECRAMB)	Least Developed Countries Fund	\$3.08
Enhancing Resilience of Vulnerable Coastal Areas to CC Risks	Least Developed Countries Fund	\$2.90
Enhancing Resilience to CC by Mainstreaming Adaptation Concerns into Agricultural Sector Development in Liberia	Least Developed Countries Fund	\$2.38
	MDG Achievement Fund – Environment	
Environment and CC	and CC thematic window	\$6.98
Environment and climate training for managers	International Climate Initiative	\$0.39
Environment Mainstreaming and Adaptation to CC	<u>MDG</u> Achievement Fund – Environment and CC thematic window	\$5.21

Establishing an African Eco-label	International Climate Initiative	\$3.90
Establishing and implementing an innovation platform for a German-Russian modernisation partnership with the Sverdlovsk region	International Climate Initiative	\$0.17
Establishing Sustainable Liquid Biofuels Production Worldwide (A Targeted Research Project)	GEF Trust Fund - CC focal area	\$0.97
Estado do Pará	Amazon Fund (Fundo Amazônia)	\$8.75
Evaluation and Development of a Modernised, Expanded Network of Protected Areas	International Climate Initiative	\$2.99
Excellence Enhancement Centre	International Climate Initiative	\$2.49
	MDG Achievement Fund – Environment	
Expanding access to environmental finance - Reversing the decline in forest ecosystem services	and CC thematic window	\$3.17
Expansion Strategy for Grid Connected Renewables	International Climate Initiative	\$4.50
FA for Sector Budget Support on Environment and Natural Resources	Global CC Alliance	\$3.06
FA with the Ministry of Finance and Economic Affairs+ TA	Global CC Alliance	\$0.78
Fifth National Communication to the UNFCCC	GEF Trust Fund - CC focal area	\$2.71
Financing Agreement for GBS	Global CC Alliance	\$0.00
Financing Agreement for GBS	Global CC Alliance	\$0.80
Financing Agreement + TA	Global CC Alliance	\$0.11
Financing Energy Efficiency and Renewable Energy Investments for CC Mitigation	GEF Trust Fund - CC focal area	\$3.00
Financing Energy Efficiency at Micro, Small and Medium Enterprises (MSMEs)	GEF Trust Fund - CC focal area	\$11.30
Financing Public Building Efficiency	GEF Trust Fund - CC focal area	\$4.57
First Regional Micro/Mini-Hydropower Capacity Development and Investment in Rural Electricity Access in Sub-Saharan Africa	GEF Trust Fund - CC focal area	\$18.58
Forest Restoration	International Climate Initiative	\$7.23
Formulation of a National Adaptation Programme of Action (NAPA) for Solomon Islands	Least Developed Countries Fund	\$0.20
Formulation of the National Adaptation Action Plan	Least Developed Countries Fund	\$0.20
From Halogenated Refrigerants to Climate-Friendly Hydrocarbons - Showcase Production of Environmentally Sound Air-Conditioning Systems	International Climate Initiative	\$3.00
GEF-World Bank-China Urban Transport Partnership Program (CUTPP)	GEF Trust Fund - CC focal area	\$21.00
Geothermal Power Generation Development Program	GEF Trust Fund - CC focal area	\$4.00
Ghana Urban Transport	GEF Trust Fund - CC focal area	\$7.00
GHG Mitigation and Waste Management in Marga-Marga	International Climate Initiative	\$3.59
Global Adaptation Learning Mechanism: Learning By Doing Lake Balaton Integrated Vulnerability Assessment, Early Warning and Adaptation Strategies	Strategic Priority on Adaptation	\$0.79
Global Energy Assessment: Developing Policy Tools for Jointly Reducing Energy Poverty and Greenhouse Gas Emissions	GEF Trust Fund - CC focal area	\$1.00
Global Knowledge Transfer on Energy Efficiency	International Climate Initiative	\$0.29
Greening the Tea Industry in East Africa	GEF Trust Fund - CC focal area	\$2.85
Grid-connected Photovoltaic Project	GEF Trust Fund - CC focal area	\$1.00
Grid-Connected Rooftop Photovoltaic Systems	GEF Trust Fund - CC focal area	\$1.16
Hanoi Urban Transport Development	GEF Trust Fund - CC focal area	\$9.80
Harapan Rainforest – Pilot Restoration of a Degraded Forest Ecosystem on Sumatra	International Climate Initiative	\$10.07

IBRD's Egypt: Wind Power Development Project	Clean Technology Fund	
Identification and Implementation of Adaptation Response Measures in the Drini-Mati River Deltas	Strategic Priority on Adaptation	\$0.98
Implementation of a CDM Project for CO2 Savings with Rural Electrification in Villages and Small Towns	International Climate Initiative	\$4.12
Implementation of Pilot Adaptation Measures in Coastal Areas of Dominica, St. Lucia and St. Vincent & the Grenadines	Strategic Priority on Adaptation	\$2.62
Implementing NAPA Priority Interventions to Build Resilience and Adaptive Capacity of the Agriculture Sector to CC NIGER	Least Developed Countries Fund	\$3.50
Implementing NAPA Priority Interventions to Build Resilience in the Agriculture and Water Sectors to the Adverse Impacts of CC SUD	Least Developed Countries Fund	\$3.00
Implementing NAPA Priority Interventions to Build Resilience in the most Vulnerable Coastal Zones in Djibouti	Least Developed Countries Fund	\$2.00
Implementing Pilot CC Adaptation Measures in Coastal Areas of Uruguay	Strategic Priority on Adaptation	\$1.10
IMPROVE: Increase Product Efficiency in Venezuela (RESUBMISSION)	GEF Trust Fund - CC focal area	\$4.09
Improvement of a protected area system in the Komi Republic	International Climate Initiative	\$4.49
Improvement of Early Warning System to Reduce Impacts of CC and Capacity Building to Integrate CC into Development Plans	Least Developed Countries Fund	\$1.60
Improving Conditions for Sustainable Energy and Climate Policy	International Climate Initiative	\$7.39
Improving Conditions for Sustainable Energy and Climate Policy	International Climate Initiative	\$7.39
Improving Energy Efficiency and Promoting Renewable Energy in the Agro-Food and other Small and Medium Enterprises (SMEs) in Ukraine	GEF Trust Fund - CC focal area	\$5.14
Improving Energy Efficiency in Buildings	GEF Trust Fund - CC focal area	\$0.90
Improving Energy Efficiency in Industry	GEF Trust Fund - CC focal area	\$5.90
Improving Energy Efficiency in the Water Sector	International Climate Initiative	\$1.68
Improving Kiln Efficiency in the Brick Making Industry in Bangladesh	GEF Trust Fund - CC focal area	\$3.00
Improving Know-How for the Application of Renewable Energy Technologies	International Climate Initiative	\$0.97
Improving the energy efficiency of lighting and building appliances	GEF Trust Fund - CC focal area	\$4.45
Improving the Energy Efficiency of Small and Medium-Sized Enterprises	International Climate Initiative	\$1.95
Improving the Energy Policy Setting for Renewable Energies and Grid-Connected Pilot Wind Energy Project	International Climate Initiative	\$1.50
Improving the Resilience of the Agriculture Sector in Lao PDR to CC Impacts	Least Developed Countries Fund	\$4.45
Increased Access to Electricity Services	GEF Trust Fund - CC focal area	\$4.50
Increased Resilience and Adaptation to Adverse Impacts of CC in Guinea's Vulnerable Coastal Zones	Least Developed Countries Fund	\$2.97
Increasing Resilience of Coastal Areas and Community Settlements to CC	Least Developed Countries Fund	\$3.00
Increasing Resilience to CC and Natural Hazards	Least Developed Countries Fund	\$2.58
Increasing resilience to climate impacts of vulnerable communities and critical ecosystems in the Eastern Himalayas of India	International Climate Initiative	\$0.26
Increasing Resilience to Climate Variability and Hazards	Least Developed Countries Fund	\$3.00
IND Energy Efficiency Improvements in Commercial Buildings - under the Programmatic Framework for Energy Efficiency	GEF Trust Fund - CC focal area	\$5.20
IND Improving Energy Efficiency in the Indian Railway System - under the Programmatic Framework for Energy Efficiency	GEF Trust Fund - CC focal area	\$5.20
Industrial Energy Efficiency in Key Sectors	GEF Trust Fund - CC focal area	\$5.45
Industrial Energy Efficiency (IEE)	GEF Trust Fund - CC focal area	\$3.95
Information and Knowledge Management for REDD Pilot Project in the Merang Peat Forest Area	International Climate Initiative	\$0.93
Innovative Insurance Products for CC Adaptation	International Climate Initiative	\$3.50

Insurance Instruments for Adaptation to CC	International Climate Initiative	\$3.00
Integrated Adaptation Programme to Combat the Effects of CC on Agricultural Production and Food Security	Least Developed Countries Fund	\$3.10
	MDG Achievement Fund – Environment	
Integrated and adaptive management of environmental resources and climatic risks in High Andean micro-watersheds	and CC thematic window	\$2.89
Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin	Strategic Priority on Adaptation	\$2.20
Integrated Approach for Zero Emission Project Development in the New Town of Boughzoul	GEF Trust Fund - CC focal area	\$8.24
Integrated Carbon Sequestration Project in Sudan	GEF Trust Fund - CC focal area	\$3.65
Integrated Coastal Zone Management	Least Developed Countries Fund	\$4.50
Integrated Energy Services for Small Localities of Rural Mexico	GEF Trust Fund - CC focal area	\$15.00
Integrated Land and Ecosystem Management to Combat Land Degradation and Deforestation in Madhya Pradesh	Strategic Priority on Adaptation	\$0.22
Integrated Microhydro Development and Application Program (IMIDAP), Part I	GEF Trust Fund - CC focal area	\$2.00
Integrated National Adaptation Plan: High Mountain Ecosystems, Colombia's Caribbean Insular Areas and Human Health (INAP)	Strategic Priority on Adaptation	\$6.17
Integrated Protected Area in the Ngiri Rainforest	International Climate Initiative	\$1.99
Integrated Renewable Biomass Energy Development Project	GEF Trust Fund - CC focal area	\$9.20
Integrating Adaptation to CC into Agricultural Production and Food Security in Sierra Leone	Least Developed Countries Fund	\$2.64
Integrating CC in Development Planning and Disaster Prevention to Increase Resilience of Agricultural and Water Sectors	Special CC Fund	\$4.35
Integrating CC into the Management of Priority Health Risks	Special CC Fund	\$1.72
Integrating CC Risk into Community-Level Livestock and Water Management in the Northwestern Lowlands	Least Developed Countries Fund	\$3.00
Integrating CC Risks into Resilient Island Planning	Least Developed Countries Fund	\$4.25
Integrating CC Risks into the Agriculture and Health Sectors in Samoa	Least Developed Countries Fund	\$2.00
Integrating CC risks into water and flood management by vulnerable mountainous communities in the Greater Caucasus region of Azerbaijan	Special CC Fund	\$2 70
Integrating Climate Resilience into Agricultural Production for Food Security in Rural Areas	Least Developed Countries Fund	\$2.11
Integrating Vulnerability and Adaptation to CC into Sustainable Development Policy Planning and Implementation in Southern and		~ =···
Eastern Africa	Strategic Priority on Adaptation	\$1.09
	<u>MDG Achievement Fund – Environment</u>	
Integration of CC Adaptation and Mitigation Measures in the Management of Natural Resources in Four Priority Watersheds of Panama	and CC thematic window	\$1.53
Integration of CC Risk and Resilience into Forestry Management (ICCRIFS)	Least Developed Countries Fund	\$2.40
	MDG Achievement Fund – Environment	^
Integration of ecosystems and Adaptation to CC in the Colombian Massif	and CC thematic window	\$3.98
International Climate Protection Scholarships for Young Management Professionals from Developing and Emerging Countries	International Climate Initiative	\$8.90
Investing in Energy Efficiency in China's Industry	International Climate Initiative	\$0.61
Involving Bagyeli Indigenous Peoples in the Sustainable Management of Campo Ma'an National Park	Congo Basin Forest Fund	\$0.00
Kalimantan Forests and Climate Partnership (FFCP)	International Forest Carbon Initiative	\$12.20
Kathmandu Sustainable Urban Transport (SUT) Project	GEF Trust Fund - CC focal area	\$2.82
Kiribati Adaptation Program - Pilot Implementation Phase	Strategic Priority on Adaptation	\$2.07
LAC Regional Sustainable Transport and Air Quality Project	GEF Trust Fund - CC focal area	\$20.80
Lac Tumba & Ngiri Forest Reserves	International Climate Initiative	\$1.65

Lake Balaton Integrated Vulnerability Assessment, Early Warning and Adaptation Strategies	Strategic Priority on Adaptation	\$1.13
Land and Water Optimization Project	Strategic Priority on Adaptation	\$0.70
LGGE Energy Efficiency Buildings Codes	GEF Trust Fund - CC focal area	\$3.46
LGGE Improving Energy Efficiency in Buildings	GEF Trust Fund - CC focal area	\$1.05
LGGE Improving Energy Efficiency in Low-Income Households and Regions of Romania	GEF Trust Fund - CC focal area	\$2.97
LGGE Improving Energy Efficiency in Residential Buildings in the Republic of Belarus	GEF Trust Fund - CC focal area	\$4.50
LGGE Improving Energy Efficiency in the Residential Building Sector	GEF Trust Fund - CC focal area	\$2.52
LGGE Policy Reforms and Market Transformation of the Energy Efficient Buildings Sector in the I.R. Iran	GEF Trust Fund - CC focal area	\$4.00
LGGE Promoting Energy Efficiency and Renewable Energy in Buildings in Jamaica	GEF Trust Fund - CC focal area	\$2.36
LGGE Promoting Energy Efficiency in Buildings in Eastern Africa	GEF Trust Fund - CC focal area	\$2.85
LGGE Promoting Energy Efficiency in Commercial Buildings in Thailand (PEECB)	GEF Trust Fund - CC focal area	\$3.64
LGGE Promotion of energy efficient lighting in Kazakhstan	GEF Trust Fund - CC focal area	\$3.40
Liaison office for Sino-German climate dialogue	International Climate Initiative	\$0.39
Lighting and Appliances Efficiency Project	GEF Trust Fund - CC focal area	\$7.12
Lighting Market Transformation in Peru	GEF Trust Fund - CC focal area	\$1.64
Lighting the "Bottom of the Pyramid"	GEF Trust Fund - CC focal area	\$5.40
	MDG Achievement Fund – Environment	
Local and regional environmental management for the management of natural resources and provision of environmental services	and CC thematic window	\$3.44
Low Carbon Campaign for Commonwealth Games 2010 Delhi	GEF Trust Fund - CC focal area	\$0.80
Low Carbon Economic Zones	International Climate Initiative	\$0.61
Mainstreaming Adaptation to CC Into Water Resources Management and Rural Development	Special CC Fund	\$5.00
Mainstreaming CC in Integrated Water Resources Management in Pangani River Basin	Special CC Fund	\$1.00
	MDG Achievement Fund – Environment	
Mainstreaming environmental governance: linking local and national action in Bosnia and Herzegovina	and CC thematic window	\$1.34
Mainstreaming Local Environmental Management in the Planning Process	MDG Achievement Fund – Environment	\$3.82
Management and Innovative Sustainable Evoloitation of Ecret Descurses	Congo Rosin Forost Fund	φ3.02 ¢1.54
Market Development and Promotion of Solar Concentrators based Process Heat Applications in India	CEE Truet Fund CC feed area	φ1.0 4 ¢4.40
Market Development and Fromotion of Solar Concentrators based Frocess Real Applications in India	GEF Trust Fund - CC focal area	φ4.40 ¢0.09
Market Transformation for Encient Biomass Stoves for Institutions and Small and Medium-Scale Enterprises	GEF Trust Fund - CC focal area	ΦU.90
Market Transformation for Energy Efficiency in Buildings	GEF Trust Fund - CC focal area	\$13.50
	GEF Trust Fund - CC focal area	\$2.71
Market Transformation of Energy-Efficient Bricks and Rural Buildings (MTEBRB)	GEF Trust Fund - CC focal area	\$7.00
Market Transformation through Energy Efficiency Standards and Labelling of Appliances in South Africa	GEF Trust Fund - CC focal area	\$6.00
Master Plan to Harness Biogas Potential in Rio Grande do Sul	International Climate Initiative	\$0.17
Mata Atläntica Forest Conservation II	International Climate Initiative	\$4.50
Mechanism for Voluntary Mitigation of Greenhouse Gas Emissions in Colombia	GEF Trust Fund - CC focal area	\$2.70
Mexico Efficient Lighting and Appliances	Clean Technology Fund	

Mexico Renewable Energy Plan	Clean Technology Fund	
Mexico Rural Development	GEF Trust Fund - CC focal area	\$10.50
Mexico's Private Sector Wind Development (Sub-Project- IFC's EDF La Ventosa)	Clean Technology Fund	
Mexico's Urban Transport Transformation Program	Clean Technology Fund	
Micro-turbine Cogeneration Technology Application Project (MCTAP)	GEF Trust Fund - CC focal area	\$2.59
Mini-Grids Based on Small Hydropower Sources to Augment Rural Electrification	GEF Trust Fund - CC focal area	\$3.35
Mitigation Options of Greenhouse Gas (GHG) Emissions in Key Sectors in Brazil	GEF Trust Fund - CC focal area	\$4.18
Modernisation of Transport in Lviv	International Climate Initiative	\$0.61
Mokshda Green Cremation System for Energy and Environment Conservation	GEF Trust Fund - CC focal area	\$0.98
Mongolia Livestock Sector Adaptation Project	Special CC Fund	\$1.50
Multi Donor Trust Fund Office (International Support)	UN-REDD Programme	\$8.69
Multiplying Best Practice in Adaptation to CC	International Climate Initiative	\$1.29
Municipal Credit Programme for Climate Protection	International Climate Initiative	
Municipios verdes (Imazon)	Amazon Fund (Fundo Amazônia)	\$5.34
Namibia Energy Efficiency Programme (NEEP) In Buildings	GEF Trust Fund - CC focal area	\$0.86
National Adapation Programme of Action BAN	Least Developed Countries Fund	\$0.20
National Adaptation Plan of Action for the Central African Republic CAR	Least Developed Countries Fund	\$0.20
National Adaptation Plan of Action GUI	Least Developed Countries Fund	\$0.20
National Adaptation Plan of Action MAL	Least Developed Countries Fund	\$0.20
National Adaptation Plan of Action MAU	Least Developed Countries Fund	\$0.20
National Adaptation Plan (NAPA) for United Republic of Tanzania	Least Developed Countries Fund	\$0.20
National Adaptation Program of Action BUR	Least Developed Countries Fund	\$0.20
National Adaptation Program of Action LAO	Least Developed Countries Fund	\$0.20
National Adaptation Program of Action MAL	Least Developed Countries Fund	\$0.20
National Adaptation Program of Action SEN	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action COM	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action DJI	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action GAM	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action to CC NEP	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action to CC (NAPA) Formulation Project TL	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action VAN	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) BHU	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) CON DR	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) ETH	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) KIR	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) LES	Least Developed Countries Fund	\$0.19
National Adaptation Programme of Action (NAPA) MOZ	Least Developed Countries Fund	\$0.20

National Adaptation Programme of Action (NAPA) SUD	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) TUV	Least Developed Countries Fund	\$0.20
National Adaptation Programme of Action (NAPA) UGA	Least Developed Countries Fund	\$0.20
National Communications to the UNFCCC	GEF Trust Fund - CC focal area	\$25.00
NGO Development Grants	International Forest Carbon Initiative	\$0.70
Nigeria Urban Transport	GEF Trust Fund - CC focal area	\$4.50
Olhos D'Água da Amazônia (Municipio de Alta Floresta)	Amazon Fund (Fundo Amazônia)	\$1.49
Organisation of Municipal Climate Initiatives	International Climate Initiative	\$0.74
Ouagadougou Transport Modal Shift	GEF Trust Fund - CC focal area	\$0.91
Pacific Adaptation to CC Project (PACC)	Special CC Fund	\$13.13
Pacific Mangroves Initiative	International Climate Initiative	\$3.44
Package of bilateral support	International Forest Carbon Initiative	\$0.40
Pakistan Sustainable Transport Project	GEF Trust Fund - CC focal area	\$4.85
Participatory Coastal Zone Restoration and Sustainable Management in the Eastern Province of Post-Tsunami Sri Lanka	Strategic Priority on Adaptation	\$2.10
Partnership for the Development of Community Forests	Congo Basin Forest Fund	\$1.79
PAS Low Carbon-Energy Islands - Accelerating the Use of Energy Efficient and Renewable Energy Technologies in Tuvalu, Niue and Nauru	GEF Trust Fund - CC focal area	\$1.30
PAS: Promoting Energy Efficiency in the Pacific	GEF Trust Fund - CC focal area	\$5.25
Phasing out Incandescent Lamps through Lighting Market Transformation in Vietnam	GEF Trust Fund - CC focal area	\$3.00
Phasing out slash-and-burn farming with biochar	Congo Basin Forest Fund	\$0.47
Phasing-out Incandescent Lamps & Energy Saving Lamps Promotion (PILESLAMP)	GEF Trust Fund - CC focal area	\$14.00
Philippines Sustainable Energy Finance Program	GEF Trust Fund - CC focal area	\$5.30
Pigs for Kilowatts - Utilising Pig Slurry to Produce Biogas	International Climate Initiative	\$0.17
Pilot Project for Methane Mitigation and Recovery from Hydroelectric Power Reservoirs	GEF Trust Fund - CC focal area	\$2.65
Piloting CC Adaptation to Protect Human Health	Special CC Fund	\$4.50
Policy Board (International Support)	UN-REDD Programme	\$13.33
Portfolio Approach to Distributed Generation Opportunity (PADGO) (Phase 1)	GEF Trust Fund - CC focal area	\$3.60
Power Sector Policy Reform to Promote Small Hydropower Development in the Republic of Montenegro	GEF Trust Fund - CC focal area	\$0.98
Preparation of a National Action Plan for Adaptation in Mali	Least Developed Countries Fund	\$0.20
Preparation of a National Action Program to Adapt to CCs MADAG	Least Developed Countries Fund	\$0.20
Preparation of a National Adaptation Plan of Action STP	Least Developed Countries Fund	\$0.20
Preparation of a National Adaptation Plan of Action (NAPA) LIB	Least Developed Countries Fund	\$0.20
Preparation of a National Adaptation Programme of Action CV	Least Developed Countries Fund	\$0.20
Preparation of a National Programme of Action for Adaptation to CC SL	Least Developed Countries Fund	\$0.20
Preparation of National Adaptation Programme of Action (NAPA) MYA	Least Developed Countries Fund	\$0.20
Preparation of the National Adaptation Programme of Action (NAPA) ZAM	Least Developed Countries Fund	\$0.20
Preparatory Workshops for Negotiators from Developing Countries on the UNFCCC Bali Road Map	International Climate Initiative	\$3.71

Preserving Biodiversity in the Nyungwe Forest	International Climate Initiative	\$2.42
PREVENT - Providing Support to Delegations from Least Developed Countries and Small Island Developing States for the Post-2012 Climate Negotiations	International Climate Initiative	\$1.74
PROBIO - Electricity Production from Biomass in Uruguay	GEF Trust Fund - CC focal area	\$0.95
Producing energy from waste and sewage	International Climate Initiative	\$3.04
Productive Uses of Renewable Energy in Chitral District, Pakistan (PURE-Chitral)	GEF Trust Fund - CC focal area	\$0.95
Programas Bolsa Floresta Associação, Renda e Programas de Apoio (Fundação Amazonas Sustevel - FAS)	Amazon Fund (Fundo Amazônia)	\$10.56
Programme of Action for Adaptation to CC CAM	Least Developed Countries Fund	\$0.20
Programme of Action for Adaptation to CC SAM	Least Developed Countries Fund	\$0.20
Programme of Activities (PoA) for Energy Efficiency Improvement in Buildings	International Climate Initiative	\$0.19
Project for the Elaboration of the National Programme of Action for Adaptation for CC (NAPA)	Least Developed Countries Fund	\$0.20
Projects unknown	Hatoyama Initiative - public sources	
Projects unknown	Hatoyama Initiative - public sources	
Projects unknown	Hatoyama Initiative - public sources	
Projeto Sementes do Portal (Instituto Ouro Verde)	Amazon Fund (Fundo Amazônia)	\$2.97
Promote Energy Efficiency in Buildings	GEF Trust Fund - CC focal area	\$2.62
Promoting and Strengthening an Energy Efficiency Market in the Industry Sector	GEF Trust Fund - CC focal area	\$2.64
Promoting Autonomous Adaptation at the community level in Ethiopia	Least Developed Countries Fund	\$5.31
Promoting Clean Electric Buses for the Beijing Olympics (CEBBO)	GEF Trust Fund - CC focal area	\$1.00
Promoting Climate-Resilient Water Management and Agricultural Practices	Least Developed Countries Fund	\$1.85
Promoting Community Land Tenure Rights in the Congo Basin	Congo Basin Forest Fund	\$0.73
Promoting Energy Efficiency and Renewable Energy in Selected Micro SME Clusters in India - under the Programmatic Framework for Energy Efficiency	GEF Trust Fund - CC focal area	\$7.17
Promoting Energy Efficiency in Public Buildings	GEF Trust Fund - CC focal area	\$3.25
Promoting Energy Efficient Room Air Conditioners (PEERAC) Project	GEF Trust Fund - CC focal area	\$6.26
Promoting Leadership in Developing CCS	International Climate Initiative	\$0.15
Promoting Low Carbon Transport in India	International Climate Initiative	\$2.60
Promoting Renewable Energy in Mae Hong Son Province	GEF Trust Fund - CC focal area	\$2.99
Promoting Sustainable Biomass Energy Production and Modern Bio-Energy Technologies	GEF Trust Fund - CC focal area	\$2.00
Promoting Sustainable Energy in the Bahamas	GEF Trust Fund - CC focal area	\$1.00
Promoting Sustainable Energy Production and Use from Biomass in Pakistan	GEF Trust Fund - CC focal area	\$1.82
Promoting Sustainable Rural Biomass Energy	GEF Trust Fund - CC focal area	\$1.70
Promoting Sustainable Transport in Latin America (NESTLAC)	GEF Trust Fund - CC focal area	\$0.96
Promoting Sustainable Transport Solutions for East Africa	GEF Trust Fund - CC focal area	\$2.85
Promoting Wind Energy and Other Renewables in Morocco	International Climate Initiative	\$1.99
Promotion of a Wind Power Market	GEF Trust Fund - CC focal area	\$6.00
Promotion of Energy Efficient Cooking, Heating and Housing Technologies (PEECH)	GEF Trust Fund - CC focal area	\$0.98

Promotion of Environmentally Sustainable Transport in Metropolitan Managua	GEF Trust Fund - CC focal area	\$3.88
Promotion of Sustainable and Climate-Compatible Rural Development in Lara and Falcon States PROSALAFA-GEF:	GEF Trust Fund - CC focal area	\$3.64
Protecting Health from CC 6 1 1	International Climate Initiative	\$1.50
Protecting Health from CC - Albania	International Climate Initiative	\$1.50
Protecting Health from CC Tajikistan	International Climate Initiative	\$1.50
Protecting Health from CC - Kyrgyzstan	International Climate Initiative	\$1.50
Protecting Health from CC - Macedonia	International Climate Initiative	\$1.50
Protecting Health from CC - Russia	International Climate Initiative	\$1.50
Protecting Health from CC - Uzbekistan	International Climate Initiative	\$1.50
Provincial Energy Efficiency Scale-Up Program	GEF Trust Fund - CC focal area	\$13.39
Préparation du Plan d'Action National d'Adaptation du Burundi aux changements climatiques	Least Developed Countries Fund	\$0.20
Préparation du Programme d'Action National pour l'Adaptation aux Changements Climatiques (NAPA) NIGER	Least Developed Countries Fund	\$0.20
Préparation du Programme d'Action National pour l'Adaptation aux Changements Climatiquesn (NAPA) CHAD	Least Developed Countries Fund	\$0.20
Public Awareness on CC (to the Bureau of Met, Climate and Geophysics, BMKG)	Indonesia CC Trust Fund	
Public Private Partnership Programme and Climate Protection	International Climate Initiative	\$2.66
Quantifying carbon stocks and emissions in the forests of Cameroon and the Republic of Congo	Congo Basin Forest Fund	\$1.74
Readiness preparation formulation grant - Lao	Forest Carbon Partnership Facility	\$0.09
Readiness preparation formulation grant - Costa Rica	Forest Carbon Partnership Facility	\$0.16
Readiness preparation formulation grant - DRC	Forest Carbon Partnership Facility	\$0.19
Readiness preparation formulation grant - Ethiopia	Forest Carbon Partnership Facility	\$0.19
Readiness preparation formulation grant - Gabon	Forest Carbon Partnership Facility	\$0.00
Readiness preparation formulation grant - Ghana	Forest Carbon Partnership Facility	\$0.20
Readiness preparation formulation grant - Guyana	Forest Carbon Partnership Facility	\$0.00
Readiness preparation formulation grant - Kenya	Forest Carbon Partnership Facility	\$0.17
Readiness preparation formulation grant - Liberia	Forest Carbon Partnership Facility	\$0.08
Readiness preparation formulation grant - Nepal	Forest Carbon Partnership Facility	\$0.15
Readiness preparation formulation grant - ROC	Forest Carbon Partnership Facility	\$0.09
Readiness preparation formulation grant - Uganda	Forest Carbon Partnership Facility	\$0.10
Readiness preparation formulation grant - Vanuatu	Forest Carbon Partnership Facility	\$0.00
Reconciling the Needs of the Logging Industry with those of Forest Dependent People	Congo Basin Forest Fund	\$0.00
Reducing CC-induced Risks and Vulnerabilities from Glacial Lake Outbursts in the Punakha-Wangdi and Chamkhar Valleys	Least Developed Countries Fund	\$3.45
Reducing Disaster Risks from Wildfire Hazards Associated with CC	Special CC Fund	\$3.54
Reducing GHG Emissions from Road Transport in Russia's Medium-sized Cities	GEF Trust Fund - CC focal area	\$5.40
Reducing Greenhouse Gas Emissions through Improved Energy Efficiency in the Industrial Sector	GEF Trust Fund - CC focal area	\$1.24
Reducing Greenhouse Gas Emissions through Improved Energy Efficiency in the Industrial Sector in Moldova	GEF Trust Fund - CC focal area	\$0.96
Reducing Greenhouse Gases by Recovering Volatile Hydrocarbons at Petrol Stations	International Climate Initiative	\$0.40
Reducing methane emissions using a mechanical-biological waste-treatment plant (MBT) in the city of Gaobeidian	International Climate Initiative	\$4.80

Reducing the Carbon Footprint of Major Sporting Events, FIFA 2010 and the implementation of the national greening programme in liaison with 2010 FIFA LOC	GEF Trust Fund - CC focal area	\$1.00
Reducing Vulnerability to CC by Establishing Early Warning and Disaster Preparedness Systems and Support for Integrated Watershed Management in Flood Prone Areas	Least Developed Countries Fund	\$3.16
Reforestation of Degraded Areas and Promoting Value-Addition for Non-Timber Forest Products in the Sanaga Maritime Region of Cameroon	Congo Basin Forest Fund	\$0.40
Refrigerator Recycling Programme	International Climate Initiative	\$6.02
Removal of Barriers to Energy Efficiency and Energy Conservation in Buildings	GEF Trust Fund - CC focal area	\$0.91
Removal of Barriers to Solar PV Power Generation in Mauritius, Rodrigues and the Outer Islands	GEF Trust Fund - CC focal area	\$2.01
Removing Barriers to Energy Efficiency Improvements in the State Sector in Belarus	GEF Trust Fund - CC focal area	\$1.40
Renewable Energy Accelerator Program (REAP	Clean Technology Fund	
Renewable Energy and Rural Electricity Access (RERA)	GEF Trust Fund - CC focal area	\$3.50
Renewable Energy Project	GEF Trust Fund - CC focal area	\$3.00
Renewable Energy Project (RREP)	GEF Trust Fund - CC focal area	\$10.00
Restoration of Forests in the Talish Region	International Climate Initiative	\$0.24
Restoring Peatlands	International Climate Initiative	\$3.86
Reversing Environmental Degradation and Rural Poverty through Adaptation to CC in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach	Strategic Priority on Adaptation	\$1.00
Reversing Environmental Degradation and Rural Poverty through Adaptation to CC in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach (under India: SLEM)	GEF Trust Fund - CC focal area	\$0.86
Rural Electrification	GEF Trust Fund - CC focal area	\$10.00
Rural Electrification Phase II	GEF Trust Fund - CC focal area	\$1.82
Rural Infrastructure (Electrification Sector)	GEF Trust Fund - CC focal area	\$2.35
Rural Livelihoods CC Adaptation Support Programme	Special CC Fund	\$2.63
RUS Improving Efficiency in Public Buildings in the Russian Federation - under the Energy Efficiency Umbrella Program	GEF Trust Fund - CC focal area	\$9.21
RUS Improving Urban Housing Efficiency in the Russian Federation - under the Energy Efficiency Umbrella Program	GEF Trust Fund - CC focal area	\$9.67
RUS Market Transformation Programme on Energy Efficiency in GHG-Intensive Industries in Russia	GEF Trust Fund - CC focal area	\$15.39
RUS: Building Energy Efficiency in the North West of Russia	GEF Trust Fund - CC focal area	\$5.84
RUS: Standards and Labels for Promoting Energy Efficiency	GEF Trust Fund - CC focal area	\$7.81
RUS: Transforming the Market for Efficient Lighting	GEF Trust Fund - CC focal area	\$7.02
Sankuru Community "Fair Trade" Carbon Initiative: Innovative Management of Community-controlled Protected Areas	Congo Basin Forest Fund	\$0.00
Second National Communication of Brazil to the UNFCCC	GEF Trust Fund - CC focal area	\$3.40
Second National Communication of Peru to the UNFCCC	GEF Trust Fund - CC focal area	\$1.80
Second Natural Resource Management Project	Strategic Priority on Adaptation	\$0.69
Secretaria de Desenvolvimento Sustentável - Governo do Amazonas	Amazon Fund (Fundo Amazônia)	\$11.00
Securing natural carbon sinks and habitats in the Heart of Borneo	International Climate Initiative	\$1.30
SFM Mitigating CC through Sustainable Forest Management and Capacity Building in the Southern States of Mexico (States of Campeche, Chiapas and Oaxaca)	GEF Trust Fund - CC focal area	\$5.00

Sino-German Platform for Renewable Energies - Wind Environment Research & Training Center	International Climate Initiative	\$5.79
Sino-Singapore Tianjin Eco-City Project (SSTECP)	GEF Trust Fund - CC focal area	\$6.16
Small Hydro Power Development	GEF Trust Fund - CC focal area	\$0.95
Small Scale Hydro Power Development in Haiti	GEF Trust Fund - CC focal area	\$0.98
SMILE: Solar-Hybrid Microturbine Systems for Cogeneration in Agro-Industry	International Climate Initiative	\$2.30
Solar pilot project, Florianopolis	International Climate Initiative	\$0.66
Solar Thermal Tower Power Plant	International Climate Initiative	\$1.10
Solar Water Heating Market Transformation and Strengthening Initiative, Phase 1	GEF Trust Fund - CC focal area	\$12.00
SolarChill: Deploying Solar-Powered Environmentally Sound Freezers and Refrigerators in Off-Grid Areas	International Climate Initiative	\$3.00
Solidarity and (Gender) Justice in the Greenhouse	International Climate Initiative	\$0.20
South Africa Energy Efficiency Program	Clean Technology Fund	
South Africa Sustainable Energy Acceleration Program	Clean Technology Fund	
SPWA-CC Energy Efficiency Project	GEF Trust Fund - CC focal area	\$1.82
SPWA-CC Installation of multi purpose mini-hydro infrastructure (for energy & irrigation)	GEF Trust Fund - CC focal area	\$1.76
SPWA-CC Mini-grids based on Renewable Energy (small-hydro and biomass) Sources to Augment Rural Electrification	GEF Trust Fund - CC focal area	\$2.62
SPWA-CC Promoting Energy Efficiency in Residential and Public Sector in Nigeria	GEF Trust Fund - CC focal area	\$2.68
SPWA-CC Promoting market based development of small to medium scale renewable energy systems in Cape Verde.	GEF Trust Fund - CC focal area	\$1.72
SPWA-CC Promoting Mini Grids Based on Small Hydropower for Productive Uses in Sierra Leone	GEF Trust Fund - CC focal area	\$1.76
SPWA-CC Promoting of Appliance Energy Efficiency and Transformation of the Refrigerating Appliances Market in Ghana. (under West Africa Energy Pgrogram: 3789)	GEF Trust Fund - CC focal area	\$1.72
SPWA-CC Promoting Renewable Energy Based Mini Grids for Productive Uses in Rural Areas in The Gambia	GEF Trust Fund - CC focal area	\$1.76
SPWA-CC Promoting renewable energy based mini-grids for rural electrification and productive uses	GEF Trust Fund - CC focal area	\$1.76
SPWA-CC Promotion of Jatropha Curcas as a resource of Bioenergy in Burkina-Faso	GEF Trust Fund - CC focal area	\$1.31
SPWA-CC: Integration of Greenhouse Gas Emission Reductions in Niger's Rural Energy Service Access program	GEF Trust Fund - CC focal area	\$1.77
Stabilizing carbon emissions in the Sangha Tri-National forest complex through sustainable financing and improved livelihoods	Congo Basin Forest Fund	\$0.92
State-Owned Properties for Projects to Generate Electricity from Renewable Sources	International Climate Initiative	\$1.38
State-Owned Properties for Projects to Generate Electricity from Renewable Sources	International Climate Initiative	\$1.38
Stimulus facility for Programmes of Activities	International Climate Initiative	
Strategic Environmental Policy Dialogue Forums with Newly Industrialising Countries (Phase II)	International Climate Initiative	\$1.95
Strategic Environmental Policy Dialogue Forums with Newly Industrialising Countries	International Climate Initiative	\$0.89
Strategic Support for the Autonomous Village Energy Programme 'Desa Mandiri Energi'	International Climate Initiative	\$0.37
	MDG Achievement Fund – Environment	
Strengthened Approach for the Integration of Sustainable Environmental Management into the ANDS/PRSP	and CC thematic window	\$4.03
Strengthening Adaptation Capacities and Reducing the Vulnerability to CC in Burkina Faso	Least Developed Countries Fund	\$2.90
Strengthening Adaptive Capacities to Address CC Threats on Sustainable Development Strategies for Coastal Communities in Haiti	Least Developed Countries Fund	\$3.50
Strengthening Environmental Governance in the face of Climate Risks in Guatemala	MDG Achievement Fund – Environment and CC thematic window	\$2.52

Strengthening National Climate Policy and Strategies for Adapting to CC	International Climate Initiative	\$1.05
Strengthening of The Gambia's CC Early Warning Systems	Least Developed Countries Fund	\$0.93
Strengthening Resilience and Adaptive Capacity to CC in Guinea-Bissau's Agrarian and Water Sectors	Least Developed Countries Fund	\$4.00
Strengthening the Capacity of Vulnerable Coastal Communities to Address the Risk of CC and Extreme Weather Events	Special CC Fund	\$0.87
	<u>MDG Achievement Fund – Environment</u>	
Strengthening the Philippines' Institutional Capacity to Adapt to CC	and CC thematic window	\$2.49
Sugarcane Renewable Electricity (SUCRE)	GEF Trust Fund - CC focal area	\$7.80
Support for Implementation of the Finance Facility 'Sustainable Energy and Carbon Market'	International Climate Initiative	\$3.63
Support for the Sustainable Use of Protected Areas in Amazonia (ARPA)	International Climate Initiative	\$8.25
Support to Sustainable Transport Management in Dushanbe	GEF Trust Fund - CC focal area	\$0.97
Support to Sustainable Transportation System in the City of Belgrade	GEF Trust Fund - CC focal area	\$0.95
Support to the Adaptation of Vulnerable Agricultural Production Systems	Least Developed Countries Fund	\$3.50
Supporting Structures for the LifeWeb Initiative	International Climate Initiative	\$1.35
Supporting the Introduction of Standards for Natural Refrigerants	International Climate Initiative	\$0.45
Sustainability of the Miombo Ecoregion through the Enlargement and Improved Management of Protected Areas	International Climate Initiative	\$3.09
Sustainable and climate-friendly development in Veraguas Province -Proyecto Participa	GEF Trust Fund - CC focal area	\$1.50
Sustainable Development of Coastal Protected Forests in Bac Lieu Province	International Climate Initiative	\$2.40
Sustainable Economic Development through Renewable Energy Applications (SEDREA)	GEF Trust Fund - CC focal area	\$0.98
Sustainable Energy Advisory Facility (SEAF) for Latin America and the Caribbean	International Climate Initiative	\$0.54
Sustainable energy and water supply for the University of Accra	International Climate Initiative	\$1.66
Sustainable Energy Development Project (SEDP)	GEF Trust Fund - CC focal area	\$4.50
Sustainable Energy Finance Program	Clean Technology Fund	
Sustainable Energy Finance Program (V-SEF)	Clean Technology Fund	
Sustainable Energy Financing	GEF Trust Fund - CC focal area	\$9.48
Sustainable Energy Framework for Barbados	GEF Trust Fund - CC focal area	\$1.00
Sustainable Energy Program	GEF Trust Fund - CC focal area	\$5.50
Sustainable Forest Management	International Climate Initiative	\$2.14
Sustainable Land, Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand Watershed Sector	Strategic Priority on Adaptation	\$0.34
Sustainable Land-use Management for the Production of Biomass	International Climate Initiative	\$3.62
Sustainable Management of the Water Resources of the la Plata Basin with Respect to the Effects of Climate Variability and Change	Strategic Priority on Adaptation	\$1.09
Sustainable Mobility in the City of Bratislava	GEF Trust Fund - CC focal area	\$0.93
Sustainable Palm Oil Production for Bioenergy	International Climate Initiative	\$5.14
Sustainable Participatory Management of Natural Resources to Promote Ecosystem Health and Resilience in the Thar Desert	Stratogic Priority on Adaptation	¢0.25
Sustainable Peat Land Management (to the Ministry of Agriculture)	Indonesia CC Trust Fund	ψ0.20
		\$11.00
		φ11.00

Sustainable Regeneration of Alluvial Forests in Gorno-Badakhshan	International Climate Initiative	\$1.56
Sustainable Rural Livelihood Security through Innovations in Land and Ecosystem Management	Strategic Priority on Adaptation	\$2.95
Sustainable Transport	GEF Trust Fund - CC focal area	\$6.90
Sustainable Transport in the City Of Almaty	GEF Trust Fund - CC focal area	\$5.00
Sustainable Urban Mobility	International Climate Initiative	\$1.63
Sustainable Urban Transport Project	GEF Trust Fund - CC focal area	\$22.50
Sustainable Use of Biogas from Agro Industrial and Solid Waste Applications	GEF Trust Fund - CC focal area	\$2.91
Sustaining Agricultural Biodiversity in the Face of CC	Strategic Priority on Adaptation	\$1.10
Switching from Fossil Fuels to Biofuels on the Galapagos Islands	International Climate Initiative	\$1.47
Switching from Fossil Fuels to Biofuels on the Galapagos Islands	International Climate Initiative	\$1.47
Switching Supermarkets from Halogenated to Natural Refrigerants	International Climate Initiative	\$2.40
Switching XPS Foam Production from F-Gases to Climate-Friendly CO2 Technology	International Climate Initiative	\$4.63
São Tome and Príncipe: Adaptation to CC	Least Developed Countries Fund	\$3.25
Tanzania Energy Development and Access Project (TEDAP)	GEF Trust Fund - CC focal area	\$6.50
Technical Assistance to Francophone LDCs to Implement the UNFCCC8/CP8 Decision	Least Developed Countries Fund	\$0.21
Technical Assistance - Nepal	Pilot Program for Climate Resilience	\$0.22
Technical Assistance - Zambia	Pilot Program for Climate Resilience	\$1.50
Technology Need Assessment on CC	GEF Trust Fund - CC focal area	\$5.00
Technology Needs Assessments	Special CC Fund	\$8.18
Technology Transfer and Market Development for Small-Hydropower in Tajikistan	GEF Trust Fund - CC focal area	\$2.00
Thailand's Renewable Energy Accelerator Program	Clean Technology Fund	
The carbon market and China's new buildings	International Climate Initiative	\$1.95
	MDG Achievement Fund – Environment	
The China CC Partnership Framework	and CC thematic window	\$11.98
Thermal Power Efficiency	GEF Trust Fund - CC focal area	\$19.70
Third National Communication to the UNFCCC	GEF Trust Fund - CC focal area	\$5.72
Third National Communication to the United Nations Framework Convention on CC	GEF Trust Fund - CC focal area	\$2.44
To promote the implementation of national and transboundary integrated water resource management that is sustainable and equitable		64 0 7
	Special CC Fund	\$1.67
Togo Efficient Lighting Program (under West Africa Energy Program: 3789)	GEF Trust Fund - CC focal area	\$1.82
Training Local 'Gold Standard' Experts	International Climate Initiative	\$1.47
Transfer Renewable Energy & Efficiency (TREE)	International Climate Initiative	\$1.61
Transformation of the Rural PV Market (prev. Energy Sector Reform)	GEF Trust Fund - CC focal area	\$1.70
TREE Programme - Transfer Renewable Energy & Efficiency	International Climate Initiative	\$3.04
I rigeneration in I amil Nadu House, Delhi	International Climate Initiative	\$1.50
Trinational Forest Conservation Area	International Climate Initiative	\$2.17
Tropical Forest Conservation in the Guiana Shield Ecoregion	International Climate Initiative	\$3.37

TT-Pilot : Promotion and Development of Local Wind Technologies in Mexico	GEF Trust Fund - CC focal area	\$5.00
TT-Pilot (GEF -4): Bamboo Processing for Sri Lanka	GEF Trust Fund - CC focal area	\$2.36
TT-Pilot (GEF-4): CC Related Technology Transfer for Cambodia: Using Agricultural Residue Biomass for Sustainable Energy		
Solutions	GEF Trust Fund - CC focal area	\$1.69
TT-Pilot (GEF-4): Construction of 1000 Ton per day Municipal Solid Wastes Composting Unit in AKOUEDO Abidjan	GEF Trust Fund - CC focal area	\$2.63
TT-Pilot (GEF-4): DHRS Irrigation Technology Pilot Project to face CC Impact	Special CC Fund	\$2.00
TT-Pilot (GEF-4): Introduction of Renewable Wave Energy Technologies for the Generation of Electric Power in Small Coastal Communities in Jamaica	Special CC Fund	\$0.72
TT-Pilot (GEF-4): Overcoming Policy, Market and Technological Barriers to Support Technological Innovation and South-South Technology Transfer: The Pilot Case of Ethanol Production from Cassava	GEF Trust Fund - CC focal area	\$2.60
TT-Pilot (GEF-4): Promotion and Development of Local Solar Technologies in Chile	GEF Trust Fund - CC focal area	\$2.73
TT-Pilot (GEF-4): Realizing Hydrogen Energy Installations on Small Islands through Technology Co-operation	GEF Trust Fund - CC focal area	\$2.68
TT-Pilot (GEF-4): Renewable CO2 Capture and Storage from Sugar Fermentation Industry in Sao Paulo State	Special CC Fund	\$2.65
TT-Pilot (GEF-4): Solar Chill: Commercialization and Transfer	GEF Trust Fund - CC focal area	\$2.58
TT-Pilot (GEF-4): Technology Transfer: Typha-based Thermal Insulation Material Production in Senegal	GEF Trust Fund - CC focal area	\$2.00
TT-Pilot (GEF-4)- Green Truck Demonstration Project	GEF Trust Fund - CC focal area	\$4.20
Turkey Private Sector Sustainable Energy Financing Facility (TurSEFF)	Clean Technology Fund	
Turkey's Commercializing Sustainable Energy Finance Program	Clean Technology Fund	
Turkey's Private Sector Renewable Energy and Energy Efficiency Project	Clean Technology Fund	
TV programme initiative on sustainability	International Climate Initiative	\$2.80
Ukraine Renewables Direct Lending Facility	Clean Technology Fund	
Unknown	Adaptation Fund	\$0.00
UN-REDD national programme - Bolivia	UN-REDD Programme	\$0.00
UN-REDD national programme - Democratic Republic of Congo	UN-REDD Programme	\$7.38
UN-REDD national programme - Indonesia	UN-REDD Programme	\$5.64
UN-REDD national programme - Panama	UN-REDD Programme	\$2.17
UN-REDD national programme - Papua New Guinea	UN-REDD Programme	\$0.00
UN-REDD national programme - Tanzania	UN-REDD Programme	\$4.28
UN-REDD national programme - Viet Nam	UN-REDD Programme	\$4.38
UN-REDD national programme - Zambia	UN-REDD Programme	\$1.68
UN-REDD Programme Cambodia	UN-REDD Programme	\$0.00
UN-REDD Programme Paraguay	UN-REDD Programme	\$0.00
UN-REDD Programme Philippines	UN-REDD Programme	\$0.00
UN-REDD Programme Solomon Islands	UN-REDD Programme	\$0.00
Uruguay Wind Energy Programme (UWEP)	GEF Trust Fund - CC focal area	\$0.95
Utilising Alcoholic Fermentation Residues	International Climate Initiative	\$0.25
Vietnam Clean Production and Energy Efficiency Project	GEF Trust Fund - CC focal area	\$2.37

Vulnerability Assessment and Adaptation Programme for CC in the Coastal Zone of Cambodia Considering Livelihood Improvement and Ecosystems	Least Developed Countries Fund	\$1.64
Wind Hybrid Power Generation (WHyPGen) Marketing Development Initiatives	GEF Trust Fund - CC focal area	\$2.16
Yemen Geothermal Development Project	GEF Trust Fund - CC focal area	\$1.00
YUS Indigenous Forest Reserve	International Climate Initiative	\$7.20
Zambezi Valley Market Led Smallholder Development	Strategic Priority on Adaptation	\$1.69
	Least Developed Countries Fund	\$0.63
	Forest Carbon Partnership Facility	\$2.09

IMBEWU ASSESSMENT OF NATIONAL INSTITUTIONAL ARRANGEMENTS
PHASE 4: COMMUNICATIONS, EDUCATION AND PUBLIC AWARENESS STRATEGY

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1 EASTERN CAPE CLIMATE COMMUNICATIONS, EDUCATION AND PUBLIC AWARENESS STRATEGY

Policy makers, businesses, the media and the public are increasingly interested in the complex issue of climate change. This generates a multitude of information and opinions about climate change, and presents significant challenges in accurately and effectively communicating the issue.

The purpose of this section of the Eastern Cape Climate Change Response Strategy (ECCCRS) is to provide a framework and approach to communicating climate change issues in the Eastern Cape Province. While the recently released National Climate Change Response Green Paper (2010) does not provide specific strategies relating to climate change communications, it does provide the following guidance:

Information and Communication technology

One of the key information challenges is to get required information to interested and affected people as quickly as possible and to ensure that the information is provided in a format that is accessible and useful to the target audience. This is especially important in respect of early warning systems where people need to take specific actions to reduce risks to themselves, their families and property. In order to meet this challenge, South Africa will:

- Ensure that all information systems referred to above implement effective communication strategies that ensure that information reaches the target audience efficiently and effectively.
- Explore and develop new and novel ways of communicating information, especially the communication of information to people who have no access to telephonic or other forms of electronic communication. In this regard, the use of radio and also of community networks, such as messages disseminated through schools, hospitals, churches etc should also be explored.

In addition to the National Greenhouse Gas Response Green Paper, the South African Long Term Mitigation Scenarios (2007) notes the following in regard to Greenhouse Gas Mitigation (p22).

"One of the most compelling results of LTMS is that although most of the significant emissions reductions need to be within the energy sector, the technology-based actions, even when all carried out together, do not "close the gap". Hence one must turn to the least studied of the possible options – social behaviour. Changes in social behaviour, whether driven by policy, education, or awareness, may yet prove to have large scale and low cost mitigation effects.

Changes in social behaviour may be relevant to a number of sectors.

- Human habitation, urban planning and the built environment are all areas where social change and new patterns, approaches and expectations will likely have significant mitigation effects.
- The distance between work, home and other life functions is also a factor.
- Modal shifts to public transport, moves away from individual car ownership towards the operation of shared vehicles, and other transport shifts deserve study. Business, commerce and consumption are currently heavily linked to transport of people. Much of this could potentially be replaced by, for example, internet-based interfaces.
- Food production and consumption, as well as the localisation of these activities, are also examples worthy of study.
- Population growth, but more importantly the growth of an urbanised population with high commodity expectations, could also be studied to see which changes may result in emissions reductions and how these might be driven.

• Tree planting and greening of towns is important."

It follows that climate change communication and awareness may be one of the most important elements in climate change response.

The communications of climate change issues can be broken into two main components:

- Communication aimed at promoting climate change awareness among broader society, including communities, business, community groups (e.g. NGOs), and government.
- Communication aimed at fostering effective implementation of climate change mitigation and adaptation projects and programmes involving various stakeholders or participants (e.g. government, climate change specialists, project implementing agencies.)

The ECCCRS needs to consider how the outcomes and programmes coming out of the study (particularly those mentioned in phase III) are communicated to various stakeholders ranging from the general public to government officials and participants in adaptation and mitigation action plans. This phase of the process therefore outlines a climate change communications, education and public awareness strategy for the ECCCRS.

According to the proposed scope of the project, the following specific communication elements needed to be addressed:

- Education and the dissemination of relevant climate change information, to the general public, the media, laypeople and schools.
- Communications, education and training relating to climate change and the ECCCRS, with a focus on provincial and local government departments and officials.
- Communications and information about climate change and relevant adaptation and mitigation responses, with a focus on specific sectors (including vulnerable sectors) for example industry, agriculture, vulnerable communities.

1.1 Communication of climate change issues

As climate change is a global problem with wide-ranging impacts, it is essential that the climate change message is communicated successfully to as many different groups as possible, including the general public, the private sector, the public sector, and politicians.

As discussed in previous phases, action on climate change consists of two complementary elements. **Mitigation** is concerned with the causes of global warming and calls for the reduction of greenhouse gas emissions while **adaptation** is concerned with the impacts of a changing climate on society, the economy and the environment, and promotes activities to reduce vulnerability to extreme weather events and other longer term changes in our climate.

This section provides an approach to raising the level of awareness of the opportunities and threats brought about by climate change, and to encourage people to accept their responsibilities to adapt to, and mitigate against its impacts. This approach provides a framework for delivering key messages on climate change issues to target audiences and discusses the actions recommended to raise awareness of climate change and its impacts, and the communication of these actions.

1.1.1 Communicating Climate Concerns

Climate change is a complex issue. The complexity of the issue makes it difficult to understand, and causes controversy. It is also difficult to discern changes over short timeperiods (five years) as normal variability masks the climate change trends.

The messages that need to be clearly communicated are:

- That climate change is real and the effects are long-term;
- It is possible to adapt to the impacts of climate change and to mitigate the causes; and
- There are risks to the "do-nothing" option

It is also important to recognise the potential conflicts that exist between the long-term changes climate change will bring and the short-term priorities that individuals and organisations work according to.

The mechanisms available include:

- Promoting credible sources of information;
- Preparing and utilising material on climate change;
- Integrating the climate change issue in related communications;
- Responding to questions and requests for information from the community; and
- Proactive outreach to community groups and leaders

It is also vital that champions from within the private and public sector are identified and educated of the importance of climate change and the actions that they and others can take to climate change.

1.1.2 Communicating differently

Based on work done in the UK (ESPACE 2007), it has been found that there are 6 themes that should drive work to raise awareness. These 6 themes can serve as a checklist against which any suggested initiatives on communication and awareness raising should be selected and judged (see Appendix 1). They are described as the "Rules of the Game", and excerpts are given below.

Challenging the habits of climate change communication

There is a need to communicate climate change in a different way from traditional approaches. People are rarely motivated to act by threats to their long-term survival. In fact, when it comes to climate change, people are not even normally motivated by concern for their children's future.

It is also important not to create fear about climate change without showing what people can do about it. If people can simply avoid frightening issues, or put them to the back of their minds, they will. It is often not helpful to criticise behaviour that people consider normal in their home or family. Instead, it is useful to make behaviour that reduces the threat of climate change seem positive and desirable. It is not useful to rely solely on logic, facts or even money-saving incentives – people need to be inspired and provoked.

To raise awareness and stimulate change, people need to better understand the big picture and be able to relate this to specific or limited action. This relates strongly to feedback of how small actions are part of the biggest picture. Information should be appropriate and should be given where it matters.

Recommendations for the ECCRS:

A communications plan should ensure that people and organisations understand the general concept of climate change and how their individual actions can contribute to the overall climate change adaptation and mitigation process.

Awareness of climate change is widespread, but at the 'wrong' level

"Climate change" by itself is too wide and too remote a subject for the general population without a link to immediate issues. Meeting people on their own terms is crucial

It is difficult to create a meaningful link between the wider climate change issues and local or individual experience and action. Initiatives that people regard as relevant can then be linked to the wider climate change agenda and to raising climate change awareness.

For adaptation and mitigation messages to be effective, it is necessary to provide examples of people and organisations doing something about climate change.

Recommendations for the ECCRS:

A communications plan should ensure that people and organisations understand the linkages between their local experience of climate and weather and the wider and future ramifications of climate change.

Action is a much better starting point than information for raising awareness

Any initiative needs to stimulate greater awareness through change. Limited or apparently superficial change may lead to deeper behavioural change. Evidence suggests that people are more likely to move to awareness from action than the other way around. However, awareness- raising will not happen automatically with action, but needs to be a planned goal of any programme.

Most people are already doing something they think will help. A key theme is the relationship between this specific action of individuals, groups and organisations to a larger picture. The larger picture is ultimately climate change itself. Action must therefore be linked to information.

Recommendations for the ECCRS:

"Learning by doing" is a highly effective form of education and awareness raising. The ECCCRS communication process should be action oriented and linked to specific information and learning outcomes.

People's internal sense of agency (the feeling that their actions are meaningful) must be reinforced

Agency will be created when people know what to do, decide to do it and have the infrastructure necessary to allow them to do it. People will not sustain action if there are barriers preventing them from taking meaningful action. Each person's contribution is so small that we must create a wider context and remove as many barriers as possible. Experience has shown that external barriers will lead to a resistance in establishing awareness. Groups and networks are vital for awareness raising and initiatives

This relates to social groups that may already exist, e.g. schools, communities, etc., or to networks that may be established for specific actions/ initiatives. This relates to both individual initiatives and to the linking or 'networking' of initiatives.

Recommendations for the ECCRS:

As with the previous recommendations, the ECCCRS communication process should be action oriented and linked to specific information and learning outcomes. People need to understand how their individual action fits into the bigger picture.

1.1.3 Communication methodologies

As with the previous section, the substance of the following paragraphs is largely based on ESPACE (2007).

Target audiences

Targeting the communication according to stakeholder type can often be crucial to increasing awareness. Therefore, the most appropriate media needs to be selected for each sector or type of stakeholder.

Recommendations for the ECCRS:

The ECCRS should structure the communication according to the target community or sector. Different types of communication will be required for government departments, business and industry sectors, and schools and community groups respectively. Attention should be paid to appropriate use of language, particularly among rural communities where English is not the common language of communication.

Branding and key messages

Branding messages is important in helping to develop a recognisable link to the project. The private sector acknowledges the tremendous 'brand value' to be gained from an established identity. Familiarity often brings reassurance and competitive 'edge'. It is therefore important to develop brands or messages that:

- Utilise formats that build awareness;
- Develop a single minded proposition that will be attractive to all communities/ businesses;
- Educate on the reasons for changing to illustrate key success factors;
- Encourage the community to convert good for the environment = good for you = 'feel good' factor; and
- Builds on established branding and key messages (e.g. "Tomorrow's Climate, Today's Challenge").

A key message of a communication strategy is that:

- Everyone has a role to play by reducing their contribution to climate change (mitigation); and
- Climate change will impact everyone we all need to adapt (adaptation).

In addition, the following should be taken into account:

- Climate change advice can add value and credibility;
- Climate change policies and measures should be integrated with other environmental issues and mainstream policies;
- Flexibility in policy making should be maintained to deal with uncertainty; and
- Flexibility in policy and regulation should also allow innovation.

There are also a number of risks that should be considered:

- Lack of resources reduces ability to deliver messages;
- Lack of effective partnership for communication of messages; and
- Other immediate policy pressures squeeze out incorporation of climate change in other partner's activities.

Recommendations for the ECCCRS:

The Eastern Cape Climate Change Response Strategy should ensure alignment in branding and delivery of messages with the National Strategy. A key message of the strategy should be that "everyone has a role to play in reducing emission (mitigation) and everyone will be affected by climate change (adaptation).

It is critical to ensure that resources are available to deliver climate change messages. To this end, the EC Province should ensure alignment and access to the national strategy and resources.

It is critical to ensure that the EC Province facilitates partnerships with other entities (both national and local) in delivering the climate change message.

Public Relations

Maintaining good relations with the public is very important for creating an environment in which the audience is receptive to the message. PR practice looks after reputation with the aim of earning understanding and can help to influence opinion and behaviour. Public relations should aim to:

- Build a strong and positive reputation of the organisation over time;
- Engage the reader, listener or viewer more fully;
- Provide credibility through endorsement of third parties;
- Foster prestige and reputation;
- Attract media attention thereby promoting the project;
- Display commitment to stakeholders (customers, partners and target audience) through demonstration;
- Create and maintain respectability in the eyes of the stakeholders; and
- Maintain resources through the goodwill of partners, politicians and managers

PR activities include media briefings, celebrity management, media releases, media launches, community consultation and media coverage evaluation.

Recommendation:

The ECCCRS should ensure credibility in following through with publicised aims and objectives;

The ECCCRS should seek endorsement from high profile figures within the community. This can include local celebrities, ambassadors, or people in influential positions. These relationships are important and should be carefully fostered.

Seasonality

Climate change issues are most likely to be raised in people's minds at times of extreme weather (storms, floods, droughts, heat waves). It is important to be in a position to exploit these times to maximum benefit.

Recommendation

The ECCCRS should pre-prepare press releases that put climate change perspective on extreme weather events to enable quick response times.

Using Different Channels

A key part of successful promotion is in knowing the most effective channels of communication to reach the target audience. The pros and cons of the available options have to be considered.

The core approach should be to target press and radio to reach households and businesses in the community. The priority of the communications work is to convey the message that all sectors and communities need to do, is to undertake simple changes. The mixed media of visual press and aural radio can be used to convey a variety of messages and spur to action in different ways. All media usage needs to be cost effective in their reach of the target audience and the communities as a whole.

Recommendation:

The ECCCRS should work through existing communication channels and networks; and utilise organisations such as the business associations, professional associations and community groups.

Television and Radio

The cost of using this form of media for advertising can be restrictive. Radio broadcasts especially on local stations are both more affordable and can be used to target more specific audiences.

Recommendation:

The ECCCRS should work with the existing departmental communications team to identify good opportunities for TV and Radio coverage and work to ensure initiatives are promoted to TV and Radio where appropriate.

Printed Media

Surveys have shown that the public do like to receive information via leaflets or newsletters. As such they are heavily relied upon as a key promotional tool. They are also relatively inexpensive to produce and provide relatively low cost advertising. Posters in particular are suitable for placing in public places. There are however, sustainability questions surrounding the publication of excess numbers of leaflets.

Recommendation:

The ECCCRS should work with the existing departmental communications team to ensure printed media are utilised effectively.

Electronic media

As the availability of electronic media increases, the internet offers the ability to provide up-todate and creative information. A website can have lower cost advantages and can act as a primary focus for campaigns and a source of contact for the target audience. Direct mail can appear "faceless", whereas marketing via direct-e-mail helps overcome this potential barrier. On-line activities also enable closer contact with the audience, enabling awareness building.

Recommendation

Continue to develop the Eastern Cape climate change web pages and intranet pages, incorporating interactive elements where appropriate and possibly link to the PSDP.

Stakeholder Engagement

Stakeholder engagement is an effective way of embedding messages and achieving long-term change. Stakeholder engagement allows the creation of active networks through establishing contacts. In short, stakeholders help provide:

- Endorsement for the communication campaign, extend the campaign reach and maintain momentum;
- Reassurance of the target audience that the scheme is official, reputable and trustworthy;
- Financial and in-kind contributions enabling cost effective use of resources (time and money);

Although anyone can be considered a stakeholder, in this context stakeholders are those influential individuals or groups that have a vested interest in the campaign success. They could be funders / contributors, decision makers or influencers.

Recommendations:

Develop a programme of contact with District and Local Municipalities, and important associations, organisations and sectors, to ensure climate change is on the agenda of key partnerships.

Ensure the dissemination of the ECCCRS message to District and Local Municipalities through district and local municipal environmental forums.

Facilitate Climate Change workshops and summits focussing on climate change issues directly relevant to the Eastern Cape and affected sectors and groups.

Direct Engagement

To establish community based initiative it is necessary to identify the range of community groups that are accessible, and to understand their values. This will help target specific messages to engage the group to support your objectives. Community groups that have the following characteristics should be targeted.

- An established community activity;
- A good communications vehicle; and
- Clear community boundaries to help monitor impact.

Recommendation:

The ECCCRS should support climate change response projects among community groups, sectors and businesses. This will facilitate the process of "learning by doing". Examples of existing projects include the Wildlife and Environment Society of South Africa (WESSA) Eco-Schools programme.

Advertising

Advertising is a non-personal communication tool with the principal aim of creating awareness. Although it doesn't focus on a specific target audience it can have powerful impact and a wide reach. Traditional awareness raising campaigns rely extensively on advertising using any on or a combination of radio, TV, newspapers, posters, leaflets and direct marketing.

Advertising is thought to be a powerful influence on consumers especially when the benefits are aligned with the target audience values and aspirations or the intended action is convenient and tangible. Advertising repetition is important in maintaining awareness. Advertising and awareness raising alone is not strong enough to achieve sustainable behaviour change particularly for social issues. Advertising also has inherent cost implications.

Recommendations:

The ECCCRS should work with the existing departmental communications team to develop posters / banners to use in public places and include advertising and promotion of the other climate change communication elements.

1.2 Communications relating to the ECCCRS

Five types of audience, and associated communication approaches, are recommended for the ECCRS. These are:

- Provincial legislature and local government councillors;
- Provincial and local government departments;
- Affected industry and service sectors;
- Relevant committees associated with the response programmes recommended in Phase III of the ECCCRS; and
- The general public.

These are outlined in more detail below. Please note that a pro-forma business plan for the further development and rollout of the ECCCRS communication, awareness and education plan is set out in Appendix 2.

1.2.1 Focussed communication: Provincial Legislature and Local Government Councillors.

It is critical that the ECCCRS is endorsed by provincial and local politicians. Without effective communication to the politicians, it is unlikely that the ECCCRS will be accorded appropriate priority in regard to provincial and local governance.

Aim

• All political members of provincial legislature and local councils should understand and embrace the reality of climate change, and acknowledge the role of provincial and local government in climate change response.

Target groups

- The Premier;
- MECs;
- Members of the provincial legislature;
- Mayors;
- Councillors of District and Local municipalities;

Content and message

All political members of provincial legislature and local councils should embrace the fact that:

- Everyone has a role to play in reducing emissions (mitigation) and everyone will be affected by climate change (adaptation);
- Climate Change will directly impact the priority objectives of the province and district and local municipalities, including food security, poverty alleviation and job creation, and that climate change adaptation needs to be incorporated into future plans and objectives;
- Greenhouse Gas Mitigation includes, among others, opportunities for local economic development and job-creation;
- Through the National Climate Change Response Green Paper, Provincial and Local Government will play a critical role in climate change response;

- The ECCCRS is the mechanism through which prioritised, coordinated and cross cutting climate change response actions can take place.
- Appropriate resources should be allocated in support of the prioritised outcomes of the ECCCRS.

Methodologies

- Presentations to key portfolio committees;
- Workshops for the provincial legislature;
- Workshops for councillors;
- The development of ECCCRS policy briefs with key policy recommendations for each portfolio committee.

Branding

Development and adoption of a brand by legislature.

General comment

- One a provincial climate change message is adopted all sections of provincial and local government should conform to this single clear message. If each government department and DM/LM takes up different messages, there would be confusion among the general public and private sector.
- Climate Change Response considerations should be formally included in appropriate portfolio committees.
- All politicians to be invited to a formal launch of the ECCCRS.

1.2.2 Focussed communication: Provincial and Local Government Departments.

Aim

• Communications, education and training relating to climate change and the ECCCRS, with a focus on provincial and local government departments and officials.

Target groups

- Premier's office and Treasury;
- Departments (DEDEA, Agriculture, transport, health, LG & TA, public works and others);
- Relevant District and Local municipal departments.

Content and message

- Every department has a role to play in reducing emission (mitigation) and every department will be directly and/or indirectly affected by climate change (adaptation);
- The mandates and objectives of most departments will be affected by climate change;
- Through the National Climate Change Response Green Paper, Provincial and Local Government will play a critical role in climate change response;
- The ECCCRS is the mechanism through which prioritised, coordinated and cross cutting climate change response actions can take place. To this end departments and municipalities must participate in appropriate provincial climate change programmes;

Methodologies

- Workshops;
- Focus group meetings for departments with high vulnerability;
- Presentations to key cluster and planning meetings, particularly IDP meetings;
- Intranet;
- Internal informational material;
- Technical briefs should be developed for provincial and municipal managers.

Branding

• Consider branding the EC climate change strategy.

General comment

- Each department must understand its impacts on other departments, and the crosscutting nature of climate change response. A silo approach to climate change response will not work;
- Initiate a discussion for a policy;
- Each Climate Change response programme, policy or action should develop an associated communication plan for relevant and specific target groups;
- The communication strategy should be associated with the gazetting of a policy;
- The challenge is to target interventions to make sure that departments work together or relate to programmes;
- There is the need for a tiered communication approach where the message sent out to different levels must be appropriate to those levels;
- At the higher level, the message is that a consolidated and cooperative approach to climate change is essential;
- The competency in each municipality or department should be catered to and where there are common issues to many municipalities or departments, focus-group meeting between these departments should be encouraged. Although Climate Change should be included in IDP and sector plans, it will be necessary to review the capacity required to assist local government to achieve this. The possibility of a dedicated municipal support unit, with a particular focus on supporting climate change in the IDP consultative process, may be required.
- It would be useful to have a uniform set of presentations appropriate for use by all departments.
- Relevant representatives to be invited to a formal launch of the ECCCRS.

1.2.3 Focussed communication: Affected sectors

Climate change is likely to affect all sectors, systems and plans.

Aim

• Communications and information about climate change and relevant adaptation and mitigation responses, with a focus on specific sectors (including vulnerable sectors) – for example industry, agriculture, vulnerable communities.

Target groups

- Priority sectors for adaptation and mitigation should be identified and targeted initially;
- Industry organisations such as farming co-ops, business chambers and professional associations;

• Municipal sector departments.

Content and message:

- Every sector has a role to play in reducing emission (mitigation) and every sector will be directly and/or indirectly affected by climate change (adaptation);
- Sector specific technical briefs should be developed from the ECCCRS;
- Climate Change response should be included in all sector plans, including IDPs, WSDPs, SDFs, IWMPs and LED.
- Relevant sector representatives must actively participate in the ECCCRS response programmes and actions.

Methodology

- Direct presentations to industry and sector organisations;
- Sector specific working groups;
- Glossy reports and brochures similar to the Provincial Spatial Development Plan, 2010
 (PSDP)
- Website (Similar to PSDP)

Branding

As with PSDP

General comment

- Open a two way communication between government and industry;
- Initiate a discussion for a policy;
- Each Climate Change response programme, policy or action should develop an associated communication plan for relevant and specific target groups and sectors;
- Relevant representatives to be invited to a formal launch of the ECCCRS.

1.2.4 Focussed communication: Response Programme Committees

The ECCCRS proposes 11 response programmes which would be lead by specially constituted committees, or which would form part of existing structures, forums or committees. The response programmes are likely to be effective only if there is full buy-in from the appropriate stakeholders, while in turn, the outcomes of the programmes should be communicated to the relevant target groups.

Aim

- The ECCCRS should ensure that target stakeholders for each programme are informed to the extent that sufficient buy-in and commitment to the relevant programme is achieved;
- The outcomes of each programme should be communicated to the relevant target groups.

Target groups

• Stakeholders as listed in each response programmes;

Content and message:

• As listed in each response programme;

Methodology

- Direct presentations to relevant stakeholder groups;
- Targeted communication with specific (or champion) individuals from each group;
- Programme specific workshops;
- Email circulars;
- Website (Similar to PSDP)

Branding

As with PSDP

General comment

- Each Climate Change response programme, policy or action should develop an associated communication plan for relevant and specific target groups and sectors;
- These committees should inform further communication objectives/targets;
- Relevant representatives to be invited to a formal launch of the ECCCRS.

1.2.5 General climate change education and awareness

There has been a growing realisation by Government and climate change specialists that there is a need for a co-ordinated climate change communications campaign to change public attitudes and behaviour relating to climate change. Although climate change is increasingly given attention in the media, messages directly relevant to the ECCCRS should be disseminated to the public.

Aim

• Education and the dissemination of relevant climate change information, to the general public, the media, laypeople and schools.

Target groups

The following target groups have been identified:

- General public;
- Schools;
- Community based organisations;
- Appropriate NGOs; and
- Appropriate media representatives.

Content and message

- Every person has a role to play in reducing emission (mitigation) and every person will be directly affected by climate change (adaptation);
- The ECCCRS is the mechanism through with Climate Change response in the province is going to be coordinated;
- Priority impacts and responses relevant to the province should be communicated;
- The mitigation and adaptation responses can offer important opportunities for social and economic development;
- Response projects and success stories should be showcased.

Methodologies

- Inclusion of climate change in the school curriculum;
- Learning by doing (introducing and publicising adaptation and mitigation projects in schools and communities);
- General climate change communication through traditional media (press, radio, TV, leaflets);
- Climate Change events (leveraging publicity opportunities for the ECCCRS on days such as world climate day);
- Partnerships (for example promoting awareness of the ECCCRS through existing channels such as environmental interest groups).

Branding

• Consider branding the EC climate change strategy

General comment

- Need to link in with existing strategies e.g.
 - HIV/Aids;
 - Nelson Mandela Bay communication strategy for saving water;
 - PSDP.
- Consider engaging a communications company to develop a full communications programme and strategy;
- Ensure that indigenous language media are effectively used;
- Relevant representatives to be invited to a formal launch of the ECCCRS.

2 AWARENESS WORKSHOP

To date the development of the Eastern Cape Climate Change Response Strategy (ECCCRS) has included engagement and consultation workshops involving relevant stakeholders. It is recommended that a broader awareness workshop is held in order to expand the exposure of the ECCCRS to a broad set of stakeholders. It should be remembered that climate change response is a dynamic process which must factor in changing circumstances. The ECCCRS is intended to be a "live" document, which should be constantly revised in response to, among others, ongoing workshops, meetings and other communications.



Figure 1: Internal working group meeting.



Figure 2: Stakeholder meeting - breakaway session.



Figure 3: Stakeholder meeting.

3 **REFERENCES**

Government of the Republic of South Africa, 2010: National Climate Change Response Green Paper. Pretoria.

Scenario Building Team 2007. Long Term Mitigation Scenarios: Technical Summary, Department of Environment Affairs and Tourism, Pretoria, October 2007

European Spatial Planning: Adapting to Climate Events (ESPACE), 2007: Climate Change Communication Strategy: A West Sussex Case Study. UK Department of Communities and Local Government,

Appendix 1 - The Rules of the Game

Principles of Climate Change Communication

(Note that this section is taken from ESPACE, 2007)

Section 1: Blowing Away Myths

1. Challenging habits of climate change communication.

Don't rely on concern about children's future or human survival instincts.

Recent surveys show that people without children may care more about climate change than those with children. "Fight or flight" human survival instincts have a time limit measured in minutes – they are little use for a change in climate measured in years.

Don't create fear without agency.

Fear can create apathy if individuals have no 'agency' to act upon the threat. Use fear with great caution.

Don't attack or criticise home or family.

It is unproductive to attack that which people hold dear.

2. Forget the climate change detractors.

Those who deny climate change science are irritating, but unimportant. The argument is not about *if* we should deal with climate change, but *how* we should deal with climate change.

3. There is no 'rational man'.

The evidence discredits the 'rational man' theory – we rarely weigh objectively the value of different decisions and then take the clear self-interested choice.

4. Information can't work alone.

Providing information is not wrong; relying on information alone to change attitudes *is* wrong. Remember also that money messages are important, but not *that* important.

Section 2: A New Way of Thinking

5. Climate change must be 'front of mind' before persuasion works.

Telling the public to take notice of climate change will only be successful when people realise (or remember) that climate change relates to them.

6. Use both peripheral and central processing.

Attracting attention to an issue can change attitudes, but peripheral messages can be just as effective.

7. Link climate change mitigation to positive desires/aspirations.

Traditional marketing links products to the aspirations of their target audience. Linking climate change mitigation to home improvement, self-improvement, green spaces or national pride are all worth investigating.

8. Use transmitters and social learning.

People learn through social interaction, and some people are better teachers and trendsetters than others. Targeting these people will ensure that messages are transmitted effectively.

9. Beware the impacts of cognitive dissonance.

Confronting someone with the difference between their attitude and their actions on climate change will make them more likely to change their *attitude* than their *actions*.

Section 3: Linking Policy and Communications

10. Everyone must use a clear and consistent explanation of climate change.

The public knows that climate change is important, but is less clear on exactly what it is and how it works.

11. Government policy and communications on climate change must be consistent.

Don't 'build in' inconsistency and failure from the start.

Section Four: Audience Principles

12. Create 'agency' for combating climate change.

Agency is created when people know what to do, decide for themselves to do it, have access to the infrastructure in which to act, and understand that their contribution is important.

13. Make climate change a 'home' not 'away' issue.

Climate change is global issue, but we will feel its impact at home – and we can act on it at home.

14. Raise the status of climate change mitigation behaviours.

Research shows that energy efficiency behaviours can make you seem poor and unattractive. We must work to overcome these emotional assumptions.

15. Target specific groups.

A classic marketing rule, and one not always followed by climate change communications from government and other sources.

Section Five: Style Principles

16. Create a trusted, credible, recognised voice on climate change.

We need trusted organisations and individuals that the media call upon to explain the implications of climate change to the average citizen.

17. Use emotions and visuals.

Another classic marketing rule: changing behaviour by disseminating information doesn't always work, but emotions and visuals usually do.

Section Six: Effective Management

18. The context affects everything.

The prioritisation of these principles must be subject to ongoing assessments of the UK situation on climate change.

19. The communications must be sustained over time.

All the most successful public awareness campaigns have been sustained consistently over many years.

20. Partnered delivery of messages will be more successful.

Experience shows that partnered delivery is often a key component for projects that are large, complex and have many stakeholders.

		Date [,] March 2	2011
DEDEA		Date: March 2	
to the state	CLIMATE CHAN PROGRAMM	NGE Revision No:	0
	Communicati	Prepared By:	
		Approved By:	
CC Programme	Rollout of a Climate C	hange Communication Program	mme in the Eastern Cape
Programme Custodian	Department of Econor	nic Development and Environn	nental Affairs
Objective(s):	Development of a detaile Cape Climate Change F	d communications plan and set c Response Strategy;	f materials for the Eastern
	Initiation of procedures to programmes to relevant	o resource and rollout the Climate t stakeholders in the Eastern Cap	Change communications be.
Target(s):	Completion of a detailed Response Strategy, tog 20XX	communications plan for the Eas ether with budget, and initial com	tern Cape Climate Change imunication materials by
	• The communications prog	gramme is sufficiently resourced	to allow follout by 20XX.
Other key	Name and contact details	Unit	Interest
stakeholders	Lyndon Mardon	DEDEA	NEM: Air Quality Act
	Sixolile Makaule	DEDEA	Communications
		Office of the premier	Strategy Custodian
	Tony Williams	Department of Local Government and Traditional Affairs.	Communication with local government.
		SALGA	Communication with local government.
		Government Communication and Information Service	Alignment with national message.
			Alignment with national
Other interested		DEA	communications process.
			communications process.
parties	ECSECC	DEA	communications process.
parties	ECSECC All sister departments	DEA	communications process.
parties	 ECSECC All sister departments District Municipalities 	DEA	communications process.
parties	 ECSECC All sister departments District Municipalities Local Municipalities 	DEA	communications process.
parties	 ECSECC All sister departments District Municipalities Local Municipalities Metros 	DEA	communications process.
parties	 ECSECC All sister departments District Municipalities Local Municipalities Metros Coega IDZ 	DEA	communications process.

Appendix 2 – Draft Communications Programme for Rollout

	• ECDC
	Port Elizabeth Regional Chamber of Commerce and Industry
	Border-Kei Chamber of Commerce
	Rural Development Agency
Overview of the issue:	Climate change communication and awareness may be one of the most important elements in climate change response.
	The communications of climate change issues can be broken into two main components:
	• Communication aimed at promoting climate change awareness among broader society, including communities, business, community groups (e.g. NGOs), and government.
	• Communication aimed at fostering effective implementation of climate change mitigation and adaptation projects and programmes involving various stakeholders or participants (e.g. government, climate change specialists, project implementing agencies.)
	The Eastern Cape Climate Change Response Strategy (ECCCRS) sets out a number of desired and required outcomes and programmes in order to ensure effective climate change response in the Province. Without effective communication and engagement with all relevant stakeholders, the ECCCRS is unlikely to gain suitable traction and achieve broad uptake.
	The communications challenge is broad in that stakeholders range from the general public, to provincial and local government officials, to politicians, to the private sector and to participants in adaptation and mitigation action plans. It follows that a tiered, focussed and suitably resourced communications development and rollout process is necessary.
	The ECCCRS sets out certain recommendations and messages to be incorporated into a communications programme that incorporates individually tailored approaches to different classes of stakeholders. These recommendations need to be developed further into a detailed plan, together with suitable communications materials. Thereafter, a full rollout programme needs to be resourced and executed.
Relevant	National Climate Change Response Green Paper (2010);
Programme(s)/Pr	Long Term Mitigation Scenarios (2007);
oject(s)	Outcome 10 of the 12 Presidential service level outcomes;
	 National commitment to greenhouse gas reductions (January 2010);
	• COP 17, UNFCCC, Durban 2011.
Regulatory and	National Environmental Management Act (Act 107 of 1998):
Legislative Framework	 National Environmental Management: Air Quality Act (Act 163 of 2004)
Management Tool(s):	To be determined by DEDEA communications
Performance Indicators	To be determined by DEDEA communications

		Cape Climate Change Response	Response Strategy, together with	Comments	The communication plan should set up the roadmap, budget requirements and human resource requirements for the full rollout phase. It is critical that the communications process promotes individual ownership of the climate change issue.	Materials to draw from details of the ECCCRS reports, and from other credible sources such as IPCC AR4 and other South African submissions to the UNFCCC. Peoples' direct experience of potential climate change should
	e in the Eastern Cape	aterials for the Eastern	Cape Climate Change	Completion Date	November 2011	November 2011
GE MITIGATION ects	unication Programme	ons plan and set of ma	is plan for the Eastern erials by 20XX	Starting Date	June 2011	June 2011
CLIMATE CHANO Proje	nate Change Comm	detailed communicati	stailed communication Il communication mat	Budget Requirem ents	R200,000.00	R300,000.00
	Rollout of a Clin	 Development of a Strategy 	 Completion of a de budget, and initia 	Responsible Person	DEDEA Environmental Affairs together with DEDEA communications.	DEDEA Environmental Affairs together with DEDEA communications
	Programme Title:	OBJECTIVE(S)	Target(s):	Activity	Develop a detailed communications plan building on the recommendations from phase IV of the ECCCRS	Develop suitable materials, including key messages, branding, pamphlets, booklets, media releases, technical briefs and policy briefs for publication at rollout.

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be appealed to. For example, experiences of extreme weather events.

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ATION	Programme in the Eastern Cape Climate Change communications programmes to relevant stakeholders	ut the Climate Change communications programmes to relevant stakeholders	tly resourced to allow rollout by 20XX.	Starting Completion Comments Date Date	ober 2012 Open Programme to include mass engagement with the general public and schools, inclusion of climate change in school curricula, and
	e Communication Programme	urce and rollout the Climate Cha	me is sufficiently resourced to all	ldget Starting equirem Date ts	000.00 October 2012
	Rollout of a Climate Chang	Initiation of procedures to reso in the Eastern Cape.	The communications program	Responsible Bu Person Re	DEDEA Environmental R10,000, C Affairs together with DEDEA communications.
	ogramme Title:	BJECTIVE(S)	arget(s):	Activity	ull rollout of the Communications A cogramme as set up in Coerious coious objective.

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