

TOWARDS A

LOW CARBON CITY

focus on Durban



May 2011

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PO Box 72135, Lynnwood Ridge, Pretoria, South Africa, 0040
Tel: +27 12 349 6600 • Fax: +27 86 576 9520
E-mail: admin@assaf.org.za

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A **low carbon** city is clearly a normative concept implying that a city has achieved an **acceptable state** in terms of its **GHG** emissions





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List of Acronyms

AD	Anaerobic Digestion
ANC	African National Congress
ARD	Afforestation, Reforestation and Deforestation
ASSAf	Academy of Science of South Africa
BAU	Business-as-Usual
BEEH	School of Bioresources Engineering and Environmental Hydrology
BMA	Bangkok Metropolitan Government
BMW	<i>Bayerische Motoren Werke</i>
BP	British Petroleum
BRT	Bus Rapid Transit
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
CBD	Central Business District
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CERs	Certified Emission Reductions
CFL	Compact Fluorescent Light
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
COP	Conference of the Parties
CRC	Carbon Reduction Commitment
CSIR	Council for Scientific and Industrial Research
DCCP	Durban Climate Change Partnership
D'MOSS	Durban Metropolitan Open Space System
DANIDA	Danish International Development Agency
DEAT	Department of Environmental Affairs and Tourism
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DICCPP	Durban Industry Climate Change Partnership Project
DIPA	Durban Investment Promotion Agency
DNA	Designated National Authority
DSW	Durban Solid Waste
DTP	Dube Tradeport
DWAF	Department of Water Affairs and Forestry
EbA	Ecosystem-based Adaptation
ECCP	European Climate Change Programme
EDD	Economic Development Department
EDS	Economic Development Strategy
EDU	Economic Development Unit
EIA	Environmental Impact Assessment
EPCPD	Environmental Planning and Climate Protection Department

ERPA	Emissions Reduction Purchase Agreement
ESCO	Energy Service Company
ESP	Energy Saving Partnership
ETA	EThekweni Transport Authority
ETS	Emissions Trading Scheme
EU	European Union
EWASA	E-Waste Association of South Africa
EWS	EThekweni Water and Sanitation
FY	Financial Year
GCOS	Global Climate Observation System
GCP	Global Carbon Project
GDP	Gross Domestic Product
GEF	Grid Emissions Factor
GEF	Global Environmental Fund
GHG	Greenhouse Gas
HCCAS	Headline Climate Change Adaptation Strategy
HPPTN	High Priority Public Transport Network
IAC	InterAcademy Council
IAMP	InterAcademy Medical Panel
ICLEI	International Cities for Local Environmental Initiatives
ICSU	International Council for Science
IDP	Integrated Development Plan
IDS	Institute of Development Studies
IEA	International Energy Agency
IGBP	International Geosphere Biosphere Programme
IGES	Institute for Global Environmental Strategies
IHDP	International Human Dimensions Programme
IPCC	Intergovernmental Panel on Climate Change
ISCLC	Institute for Sustainable Communities and Living Cities
ITA	Information Technology Association
ITP	Integrated Transport Plan
ITS	Intelligent Transportation System
KSEF	KwaZulu-Natal Sustainable Energy Forum
LACMP	Local Authority Carbon Management Programme
LAP	Local Area Plan
LCEA	Low Carbon Economic Area
LCCP	Low Carbon Cities Programme
LCD	Low Carbon Development
LED	Light-emitting Diode
LSP	Local Strategic Partnership
LTMS	Long-term Emission Scenarios

LULUCF	Land-use, Land-use Change and Forestry
MCPP	Municipal Climate Protection Programme
MDGs	Millennium Development Goals
MFMA	Municipal Finance Management Act
MRV	Measuring, Reporting and Verifying
Mt	Million Tons
NAMA	Nationally Appropriate Mitigation Action
NASAC	Network of African Science Academies
NCCC	National Climate Change Committee
NGO	Non-government Organisation
NMT	Non-motorised transport
NRW	Non-revenue Water
NSI	National System of Innovation
OECD	Organisation for Economic Cooperation and Development
PDD	Project Design Document
PET	Polyethylene terephthalate
PIN	Project Idea Notes
PPA	Power Purchase Agreement
ppp	Purchasing Power Parity
PV	Photovoltaic
REDD	Reduced Emissions from Avoided Deforestation and Degradation
RSA	Republic of South Africa
SACN	South African Cities Network
SADC	Southern African Development Community
SALGA	South African Local Government Association
SAWS	South African Weather Services
SBT	Scenario Building Team
SDF	Spatial Development Framework
SDMPP	South Durban MultiPoint Plan
SDP	Spatial Development Plan
SEAP	Sustainable Energy Action Plan
SPP	Scholarly Publishing Programme
Stats SA	Statistics South Africa
SWH	Solar Water Heating
TEPCO	Tokyo Electric Power Company
TMG	Tokyo Metropolitan Government
TWAS	Academy of Sciences for the Developing World
UCT	University of Cape Town
UD	Urine Diversion
UEM	Urban Environmental Management
UKCIP	United Kingdom Climate Impacts Programme

UKZN	University of KwaZulu-Natal
UN	United Nations
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
US	United States
VERs	Voluntary Emission Reductions
VKT	Vehicle Kilometres Travelled
WB	World Bank
WESSA	Wildlife and Environment Society of South Africa
WMO	World Meteorological Organisation
WWTWs	Wastewater Treatment Works

Prefixes

The following prefixes are in common use and will be found throughout this report:

Prefix	Symbol	Power
milli	m	10^{-3}
Kilo	K	10^3
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}
Peta	P	10^{15}

Units of measurements

Unit	Definition
g	gram
h	hour
ha	hectare
J	Joule
l	litre
m	metre
t	ton
W	Watt
y	year

Gases

unit	
C	Carbon
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
CH ₄	Methane
N ₂ O	Nitrous oxide
SO ₂	Sulphur dioxide

foreword

Climate change is one of the most significant global issues of our time. Its importance to the continent of Africa rests on the vulnerability of its population to the impacts of climate change and the potential threat that it poses to sustainable development. South Africa, in addition to being vulnerable to the effects, is also a major contributor to climate change, through the dependence of the country on fossil fuels, primarily coal. Cities are recognised as major contributors to climate change as they are densely populated areas with high levels of energy-use.

This report on *Towards a Low Carbon City: Focus on Durban* aims to address both mitigation and adaptation opportunities for the city of Durban. The critical issue of transitioning to a low carbon city in the face of serious unemployment and the need for economic development is addressed by emphasising the need to shift to a green economy. The study provides 12 key overarching recommendations, as well as sector-specific recommendations, which the city needs to address in order to transition to a low carbon city. The recommendations are generally applicable to developing country cities and can be used as a guideline for local governments in other cities.

The eThekweni Municipality commissioned the Academy of Science of South Africa (ASSAf) to conduct this study. A consensus study approach was used, in which a panel of experts approved and appointed by the ASSAf Council, deliberated on the topic and based on the evidence assembled, was able to produce a set of recommendations. Studies of this kind are common to academies around the world and aim to provide strong consensus recommendations to government based on the best available evidence. The value of the Academy approach lies in its use of evidence to offer objective and unbiased advice.

The city of Durban has been a leader in South Africa with regard to climate change adaptation and mitigation initiatives. This study will contribute to the city's reputation as a leader. The release of the report ahead of the city's hosting of the 17th Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change in 2011 is significant and offers Durban an opportunity to establish further its standing amongst global cities.

The report was guided and brought to its successful conclusion by a study Panel of experts, under the proficient leadership of Professor Roseanne Diab. The Members of the study Panel, the contributing authors and the peer reviewers are thanked for the care and attention with which they carried out their task.

Professor Robin Crewe
President: Academy of Science of South Africa

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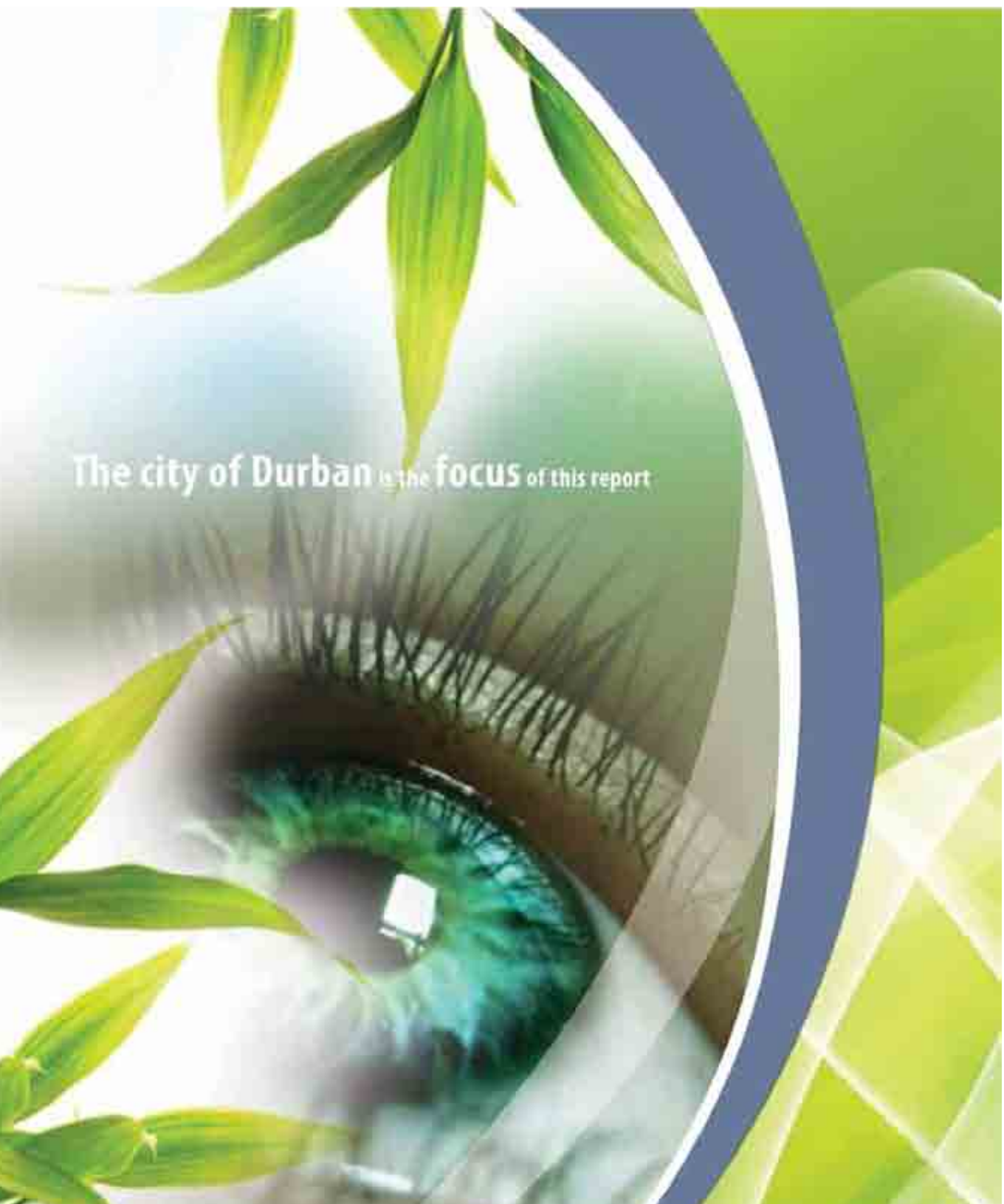
This study was a collaborative effort of many dedicated people. I should like to thank the following people and organisations, in particular:

- The Danish International Development Agency (DANIDA) for funding the study;
- Dr Debra Roberts and Ms Meggan Lewis of the Environmental Planning and Climate Protection Department of eThekweni Municipality for their assistance with information, arranging of meetings and general support;
- Officials of eThekweni Municipality, who shared their knowledge and experience with us as we sought to understand the local context;
- The Panel Members, who contributed to the report through their written submissions and lively discussions;
- The contract researchers who filled the gaps in the Panel's expertise and added great value to the final product;
- The peer reviewers, who provided valuable suggestions for improving the report and who conducted their reviews in record time;
- The Council of the Academy for their support and encouragement;
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- Finally, Ms Zarina Moolla, for her outstanding role as Programme Officer, particularly her attention to detail, support of the panelists and written contributions to the report.

Professor Roseanne Diab
Chair: ASSAf Consensus Study on Low Carbon Cities



The city of Durban is the **focus** of this report





executive summary

More than half the world's population resides in cities and the proportion is expected to increase to 60% by 2030 and 70% by 2050. Globally, cities account for about 80% of global greenhouse gas emissions. Logically, therefore cities have a major role to play in the low carbon agenda. They present the greatest opportunities for mitigation and adaptation interventions as higher population densities mean that interventions have a greater reach and potentially a greater impact. Higher levels of service delivery and infrastructure also imply that interventions are more likely to succeed. Rapid urbanisation and the growing role of cities as centres of formal and informal economic production have made cities key sites for action. Cities have the potential to play leadership roles in their countries - to raise their profile and reinforce their image as being progressive and responsible from a climate change perspective. Local government in South Africa, with its constitutionally defined roles as a sphere of government in its own right, has the opportunity to be at the international frontier in helping to engineer the necessary horizontal and vertical governance innovations that climate change threats make a growing imperative.

A low carbon city is a normative concept and is defined in this study as one that strives to reduce its greenhouse gas emissions and increase its carbon sinks, while simultaneously adapting to anticipated climate change impact. The achievement of a low carbon state requires a transition process that is characterised by low carbon development. In the context of a developing country, where the imperatives of economic growth, increased employment opportunities, alleviation of poverty and the need to address issues of inequality, dominate, it is important that the transition to a low carbon city be appropriately

framed. In this respect, a low carbon pathway should be viewed as an opportunity to deliberately shape future development such that it accords with low carbon principles and to shift the rhetoric of climate change policy from words such as 'limitation', 'constraint' and 'reduction' to one in which there is an emphasis on 'investing in new technology' and 'creating low-carbon jobs'. Low carbon development also offers significant co-benefits that are pertinent for developing countries, such as improved public health as a result of reduced air pollution, greater agricultural productivity, and greater water and energy security, amongst others.

The city of Durban and its local government, the eThekweni Municipality, is the focus of this report. The city has been at the vanguard of efforts to address climate change in South Africa and has shown great leadership. Opportunities to capitalise on this progress and to advance the agenda even further are addressed in the report. The timing of the release of this report, just ahead of the hosting of the COP-17 meeting in the city in November/December 2011, is significant and provides an opportunity for the city to reaffirm its commitment to low carbon development and to showcase some of the steps that it has taken, as well as low carbon plans for the future.

The overall goal of this study is to identify key areas of intervention that would position Durban on a pathway towards a low carbon city. The starting point was to review mitigation and adaptation policies and actions already in place in the city to provide a baseline against which further interventions could be recommended. Climate change activities are scattered across several local government departments, with the Environmental Planning and Climate Protection

Department taking the lead in adaptation activities and the recently established Energy Office, the lead in mitigation. In some respects, the spread is a strength as it shows awareness in various departments and has fostered innovative responses in some, particularly water and sanitation, and solid waste departments.

A review of carbon reduction strategies and adaptation measures in key cities in Asia, Europe, North America and Latin America followed. Best practice examples and key lessons learnt were highlighted. The review allows the city of Durban to benchmark its climate change activities and to identify and adapt actions that resonate with the local situation.

The local context is relevant as it will shape the interventions and their implementation. In this respect, it was important to outline the spatial, socio-economic, environmental and institutional characteristics of the city.

The picture that emerged was one in which one-third of the population is characterised as poor; over one-third of the economically active sector of the population is unemployed; the city is characterised by low density, urban sprawl; large portions of the city are under customary law and are rural in character; neighbourhoods differ significantly in terms of their characteristics; the economy is dominated by the tertiary sector and the anticipated growth in the services sector is not expected to address the problem of unemployment at the unskilled and semi-skilled levels.

The national context, particularly with regard to national policies and strategies that are emerging, is critical. For South Africa to achieve its commitment made at the Copenhagen climate meeting in 2009 (reduction below current emissions baseline of 34% by 2020 and 42% by 2025), cities would have to play a major role and demonstrate leadership.

The starting point for the identification of mitigation opportunities was the greenhouse gas inventory, which showed that the industrial sector comprises 45% of the city's total greenhouse gas emissions, the transportation sector 25%, the residential sector 17%, the commercial sector 8% and the municipality 5%. Clear direction is

provided on which sectors should be targeted. Energy supply and demand is the common theme cutting across all these sectors. Opportunities for mitigating greenhouse gases in industries and buildings were identified and, because of their importance, are highlighted again in the recommendations.

Durban, as a coastal city with high rates of poverty and unemployment, is especially vulnerable to the impacts of climate change. The city is advanced in its consideration and institutionalisation of climate change adaptation. Further opportunities to build resilience and reduce risk were identified. These included extending the boundary of the urban system to ensure that adaptation interventions, which are more appropriate at a larger scale are not constrained by narrow views of boundaries. Examples are upstream catchment management and integrating climate change adaptation into wider sustainability and development agendas.

Natural processes in cities can be manipulated to increase or decrease their climate benefits. Enhancing carbon sinks through the management of urban open spaces and green plants was found to make a minor contribution to mitigating greenhouse gases, but nevertheless was regarded as a valuable activity. Ecosystem services benefits are a stronger driver of green area management activities, with carbon sinks as a co-benefit. It was noted that in order to maintain carbon benefits over time, a resource has to be in a productive state, which paradoxically usually means periodically disturbing it by harvest, rather than strictly protecting it. The harvested material must then be diverted into a secure long-term storage, e.g. timber houses, furniture or biofuels.

Governance issues were considered in a separate chapter. It was noted that a global shift in climate change responses has taken place, from an early focus on mitigation to one focused on adaptation, as the local risks from climate change become more of a reality. The central role of local government is thus reinforced. The importance of multi-level governance was stressed to strengthen the ability of local government to manage adaptation and improve resilience. Some of the recommendations included: raising the profile of climate change matters on

council agendas; institutionalising coordination around climate change matters; working to build a knowledge base to enhance adaptability; establishing demonstration projects in highly visible locations; and partnering with business/industry and citizens.

An important component of the transition process to a low carbon city is behavioural change. Under the broader theme of achieving low carbon citizenry, strategies to persuade citizens to change to a low carbon lifestyle were identified. Key pointers for carbon reduction awareness-raising programmes were identified as integrating technical and values approaches to focus on 'ethics of care'; tailoring the messages to appeal to different sectors of society; and integrating green and brown issues. Targeting groups or collectives, such as neighbourhoods or schools, have demonstrated more success than focusing on individuals.

The concept of a green economy formed an important component of the report and was taken up as one of the major recommendations. Faced with high levels of poverty, inequality and unemployment, there is an overriding imperative of economic growth and creation of jobs in the city. Emphasis was placed here on transitioning to a green economy; one that is decoupled from resource exploitation and environmental impacts, yet still ensuring socio-economic growth and quality of life for present and future generations. Green economic development has the potential to create more job opportunities, particularly in skilled and semi-skilled levels ('green collar jobs'), as well as more small and medium-scale business opportunities than non-green development. The concept of a green economy is recommended as the overarching framework to coordinate climate change policies and actions that are spread across many departments in the city to bring about more profound and fundamental change in the economic basis and behavioural landscape of the city.

Finally, opportunities for financing low carbon initiatives were discussed. The city of Durban has taken advantage of Clean Development Mechanism financing through its waste-to-energy projects at landfill sites. However, there are many other innovative market-based financ-

ing mechanisms that should be explored by the city to assist in financing its long-term low carbon goals. These include the voluntary carbon market, incentives and subsidies, energy service companies and municipal bonds, amongst others. The Energy Office of eThekweni Municipality should be tasked with coordinating a financing strategy for a low carbon Durban, with the prime objective of identifying innovative financing schemes that derive funds from both public and private sectors, and at local, national and international levels.

Throughout the report, sector-specific recommendations for transitioning to a low carbon city were made. These were consolidated into a set of 12 core strategic recommendations:

- 1. Ensure a Shift Towards a Green Economy:** EThekweni Municipality must promote the transition to a green economy by ensuring that every action, investment, regulation or decision contributes towards nurturing and building a strong green economy that is low carbon, resource efficient and socially inclusive. The green economy provides an overarching framework in which all activities can be steered in a coordinated way in a low carbon and sustainable direction.
- 2. Emphasise Climate Change Co-benefits:** To ensure that climate change policies and actions can be developed and implemented effectively and efficiently, with the full support of the political leadership of the city and local citizens, it is essential for co-benefits to be emphasised. In this way, climate change can be accorded the importance it deserves.
- 3. Ensure a Multi-level Governance Approach:** A strong drive to ensure multi-level governance is necessary for low carbon development in the city of Durban. A partnership-based approach with national government and other stakeholders must be enhanced.
- 4. Promote Low Carbon Consumption:** The city of Durban must promote low carbon lifestyles and play a leadership role in reducing upstream carbon emissions. An understanding of the carbon footprint of the city from a consumption perspective is important.

5. **Ensure the Implementation of Low Carbon Land Use Planning:** Land use planning plays a key role in low carbon development. Key principles include combating urban sprawl, compacting city form, decentralising urban opportunities, promoting sustainable neighbourhood planning, and a shared vision of spatial development in the city amongst all stakeholders.
6. **Ensure the Integration of Mitigation and Adaptation Activities:** Traditionally, mitigation and adaptation activities have developed separately in cities, frequently residing in different municipal departments. There is a need to develop a strong drive to integrate mitigation and adaptation activities across the municipality.
7. **Ensure and Recognise Visionary Leadership:** International experience demonstrates the role of leadership in advancing the climate change agenda. eThekweni Municipality must entrench its reputation as South Africa's leading city in terms of climate change actions and should strive to be South Africa's first 'zero-carbon' city. The city must also seek to identify and support individuals with the commitment, charisma and public image to act as local champions or ambassadors for climate change action.
8. **Give Urgent Attention to the Transport Sector in the Transition to a Low Carbon Durban:** The transport sector is central to the transition to a low carbon city and requires urgent attention in eThekweni Municipality. The main overarching efforts of the municipality must be on reducing the need to travel by focusing on accessibility rather than mobility. The mobility demand then needs to be assessed and addressed in the most efficient and sustainable manner.
9. **Ensure a Strong Mitigation Focus in the Industrial Sector:** The industrial sector is the major contributor to greenhouse gas emissions in the city, contrary to the pattern in many global cities. eThekweni Municipality should ensure that through regulation, investment and incentives, local industry plays a central role in mitigating greenhouse gas emissions and in the development of a green economy that fulfils the social and economic needs of the municipality.
10. **Ensure a Broader Focus on the Built Environment:** Energy efficiency in buildings is often hailed as the 'low-hanging fruit' in the low carbon transition process, as actions can be implemented more easily than in other sectors such as transport. It is recommended that eThekweni Municipality extends its focus on energy efficiency in municipal buildings to the broader built environment in the city.
11. **Maximise Local Opportunities in the Low Carbon Transition Process:** While the underlying principles of a low carbon city are universal, the transition process requires capitalising on local opportunities to achieve sustainability. It is recommended that eThekweni Municipality actively identifies these local opportunities and exploits them to best advantage.
12. **Encourage Innovation through a Partnership-based Approach:** Innovation, both technological and social, is key to a low carbon transition. It is recommended that eThekweni Municipality fosters innovation by developing partnerships with local universities, businesses and communities.

chapter 1



The city of **Durban** has been at the vanguard of efforts to address **climate** change. The initiatives have spanned a ten-year period and have included **institutional changes** and mitigation and adaptation responses.



introduction

BACKGROUND TO THE STUDY

This study was commissioned by the Environmental Planning and Climate Protection Department (EPCPD) of the eThekweni Municipality (Durban), and funded by the Danish International Development Agency (DANIDA).

The project was initiated as a result of the growing consensus that the world's climate is changing and the need to mitigate and adapt to these changes. Cities are especially vulnerable to climate change as they contain large populations, and extensive infrastructure and economic activity.

The Academy of Science of South Africa (ASSAf)

was tasked with conducting the study due to its unique position as a nationally recognised body, which provides scientific and evidence-based advice to government on critical scientific issues. The Academy is also well-placed to address the matter of climate change mitigation and adaptation and to provide recommendations that will support national government's commitment of transitioning to a low carbon economy. As the body that holds the membership of the most prominent scientists in the country, the Academy can draw on a pool of committed expertise across science disciplines to address questions on the scientific and policy matters related to climate change.

The study brief and specific objectives of this study are presented in Box 1.1

Box 1.1: Statement of Task

The overall goal of this study is to identify key areas of intervention that would position Durban on a pathway towards a low carbon city. Specific objectives are to:

- review carbon reduction strategies in key cities around the world to identify lessons learned. This would include an examination of the actual strategies that influence carbon mitigation, the trade-offs and synergies of carbon management, the roles of institutions and carbon governance structures;
- review mitigation and adaptation policies that are already in place in the city of Durban;
- identify key areas of intervention in terms of reduction in energy use and implementing energy efficiency measures. This would include, *inter alia*, an examination of options to improve energy efficiency in existing and new buildings; and a consideration of transport and land use planning;
- identify opportunities for renewable energy applications and/or cleaner fossil fuel technology;

Box 1.1: Statement of Task (continued)

- identify opportunities to reduce the city's carbon footprint in areas of infrastructure provision, waste management, waste water management, water provision, food production, biodiversity management and protection;
- identify opportunities to reduce the city's carbon footprint that also have adaptation advantages;
- identify opportunities for neutralising unavoidable emissions through carbon offsetting schemes;
- consider carbon storage options;
- make recommendations on the transition to a low carbon city with a particular emphasis on low carbon technologies;
- make recommendations regarding appropriate institutional and governance structures in a low carbon city;
- consider the broader application of the recommendations to other cities in South Africa.

APPROACH AND METHODOLOGY

The study was approved by the ASSAf Council on 19 March 2009 and the 8-member Panel, chaired by Roseanne Diab, was appointed. The full membership of the Panel is presented in Table 1.1 and membership biographies in Appendix 1.

The Panel operated independently of the eThekweni Municipality and DANIDA. Information was gathered from a wide variety of published literature sources. Expert input was solicited through a number of commissioned studies, which are listed in Appendix 2. In addition, extensive local information was gathered through a series of in-

terviews with eThekweni Municipality city officials, as well as selected officials in the cities of Johannesburg and Cape Town listed in Appendix 2.

The study was conducted over the period January 2010 to May 2011. The Panel met three times; at the first meeting from 2 to 4 February 2010, a presentation was made by Dr Debra Roberts, Deputy Head of the EPCPD, to provide the background to the study, the expectations of the city and local climate change initiatives. At the second meeting from 4 to 6 October 2010, the committee discussed the draft chapters and recommendations. A series of teleconference meetings was held between 6 to 12 April 2011 to finalise the recommendations.

Table 1.1: Composition of the study Panel

Name	Affiliation
Prof Roseanne Diab	Panel Chair and Executive Officer of ASSAf
Prof James (Jim) Longhurst	Associate Dean and Professor, Environmental Science, University of the West of England
Dr Shobhakar Dhakal	Executive Director, Global Carbon Project, Japan
Dr Robert (Bob) Scholes	Systems Ecologist, Council for Scientific and Industrial Research (CSIR)
Prof Dave Dewar	Professor, School of Architecture and Planning, University of Cape Town (retired end of 2010)
Dr Mongameli Mehlwana	Alternative Energy Futures Convenor, CSIR
Prof Coleen Vogel	Professor, School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand
Mr Peter Lukey	Chief Director: Air Quality Management and Climate Change, Department of Environmental Affairs

The final draft report was submitted for peer review in April 2011. Following peer review by four experts, listed in Appendix 2, the Panel finalised the report and submitted it to the ASSAf Council for approval. The ASSAf Council approved its publication at a Council meeting on 11 May 2011.

THE GLOBAL THREAT OF CLIMATE CHANGE

Climate change is the most important global scientific issue of our time, with significant policy implications for local and national governments. Climate change embraces far more than temperature change and may include changes in rainfall patterns, sea-level rise, the spread of infectious diseases such as malaria, increased alien vegetation invasion, loss of biodiversity and a loss of tourism and recreation functions.

Climate change impacts will vary across the globe, but it is widely acknowledged that Africa as a continent will experience the greatest impacts, largely because of the vulnerability of its population, which consists of some of the poorest nations in the world. Likewise, in cities, the poor communities, with fewer adaptive options, are expected to be most affected.

Climate change predictions for the city of Durban are summarised in the following section. They convey a sombre message, highlighting the need for adaptive and mitigation responses.

CLIMATE CHANGE PROJECTIONS AND IMPACTS FOR ETHEKWINI MUNICIPALITY

TEMPERATURE

Temperature projections for the immediate future (2045 – 2065) and distant future (2081 – 2100) are expected to increase 1.5 – 2.5°C and 3.0 – 5.0°C respectively. Heat-waves (3 or more consecutive days with maximum temperatures reaching 30°C) are expected to increase by approximately 30% and extreme heat-waves (3 or more consecutive days with maximum temperatures reaching 35°C) are expected to double in the immediate future (School of Bioresources Engineering and Environmental Hydrology (BEEH), University of KwaZulu-Natal (UKZN) cited in Golder Associates (2010)).

RAINFALL

In general, the climate in South Africa is expected to show a net drying in the western two-thirds of the country and is expected to become wetter in the east coast regions (Tadross, 2005). Results of modeling undertaken by BEEH cited in Golder Associates (2010), showed that rainfall variability is expected to increase significantly from the immediate to the distant future. Furthermore, there will generally be no change in short duration rainfall for the immediate future and an increase in longer duration rainfall (1 or more consecutive days).

WATER AVAILABILITY

Water availability is expected to decrease as a result of increases in temperature and evaporation (Golder Associates, 2010). Schulze (2005) notes a reduction in annual water flow in the Mgeni catchment that feeds Durban of 157.8 million m³ by 2100. Longer periods without rainfall, as indicated above, will have repercussions for water availability and affect water storage and irrigation requirements (Golder Associates, 2010).

SEA-LEVEL RISE

Being a coastal city with 97 km of highly-developed coastline, Durban is particularly vulnerable to sea-level rise. Various projections for sea-level rise exist. The Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2007) predicts an increase in mean sea-level of 0.13-0.38 m and 0.26-0.59 m in 2090-2099 relative to 1980-1999, for low and high scenarios respectively. A study by Hughes *et al.* (1991) for Durban predicted an increase between 0.5 to 1.0 m by 2100. Hounsome and Iyer (2006) give a figure of 0.44 m for the 2003 to 2100 period and Mather (2007) estimated an average annual increase in sea-level of 2.7+/- 0.5mm/yr for Durban.

According to Hughes (1992), the coastline could probably withstand a 0.2 m sea-level rise, provided there were no major storm events, but beyond that, adaptive measures would be needed. A 0.5 m sea-level rise would severely erode beaches and have an impact on tourism. Activities such as shore stabilisation, protecting natural biological defences and increasing the height of the national shoreline would need to be considered to protect the coastline (ERM, 2009).

BIODIVERSITY

Research addressing the impacts of climate change on biodiversity in Durban is limited, but in general it can be expected that increases in temperature and variability in rainfall may result in species migrations and extinctions. For South Africa as a whole, the South African Country Study undertaken for the Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC) requirements (DEAT, 2000) noted a reduction in the area covered by current biomes of 38%, and predicted that by 2050, there will be a reduction by 55%. The same study also drew attention to the negative effect of climate change on biodiversity hotspots - areas that are particularly species-rich and consist of a number of endemic species with restricted distributions. Marine ecosystems are also expected to be affected due to increases in sea-surface temperatures. In addition, invasive species are likely to spread due to increased temperatures that favour their growth (Richardson and Van Wilgen, 2004).

The city of Durban has a rich biodiversity. It contains three of South Africa's eight biomes, seven broad vegetation types and over 2 000 plant species (EPCPD, 2010a). Many are at risk due to development pressures, and a changing climate will add even greater stress (Working Group on Climate Change and Development, 2005).

HEALTH

Projected changes in temperature and rainfall are likely to lead to increased negative health effects. A modeling study indicated that malaria-prone areas in South Africa would double by 2050, essentially spreading malaria to previously unaffected areas (DEAT, 2000). Heat related vector and water-borne diseases (particularly malaria and cholera) are expected to increase as a result of increased flooding that could lead to contamination of water supplies, higher temperatures and humidity levels.

ECONOMY

In a study of the economic impacts of climate change for South Africa, Turpie *et al.* (2002) drew attention to the costs associated with impacts on agriculture, forestry, rangelands, fisher-

ies, tourism, human health and biodiversity. The overall conclusion was that the greatest economic impact was likely to be experienced in the tourism industry with up to 3% of Gross Domestic Product (GDP) at risk. This was followed by non-market related impacts, such as biodiversity and human health.

A study by Kretzinger (2009) has also indicated that the city's wastewater infrastructure will be impacted by sea-level rise due to their low elevation and proximity to the coast. Likewise, infrastructure adjacent to the harbour is at risk resulting in potentially large impacts on the economy.

AGRICULTURE

Major impacts on food production are expected to follow changes in temperature, rainfall and water availability as discussed above. The majority of crops grown in South Africa depend on seasonal rainfall. Small-scale agriculture is likely to be most severely affected due to reduced water availability, affecting human livelihoods and intensifying poverty. A study by the Biore-source Unit of the KwaZulu-Natal Department of Agriculture and Environmental Affairs and Rural Development, cited in Golder Associates (2008), for example, showed that with a mean temperature increase of 1°C (3°C), that most (all) of the eThekweni Municipality area would become unsuited to maize production.

ADDRESSING CLIMATE CHANGE

International policies and other initiatives to address climate change, as well as national efforts, are summarised in Chapters 3 and 4 respectively. At the local level, the city of Durban has been at the vanguard of efforts to address climate change. An historical overview of the key initiatives follows.

The origin lies in the participation of the municipality, through the (then) Environmental Branch, in the International Council for Local Environmental Initiatives (ICLEI's) International Cities for Climate Change campaign launched in 2000. By the time the project ended in 2006, the city had completed its first greenhouse gas (GHG) inventory and had implemented a municipal buildings' energy efficiency pilot project (Roberts, 2008). The next major milestone was in 2004 with the establishment

of a Municipal Climate Protection Programme (MCP) to mainstream climate change issues into all aspects of work undertaken by the municipality (EPCPD, 2010b). The MCP was developed in a number of phases (Roberts, 2008).

1. First, the Climatic Future for Durban report in 2006, undertaken in partnership with the CSIR (Naidu *et al.*, 2006), assessed the potential local impacts of climate change and outlined responses that could assist the city with mitigation and adaptation to climate change.
2. The second phase of the MCP involved the preparation of a Headline Adaptation Strategy, as adaptation to climate change emerged as a more immediate priority than mitigation (Roberts, 2008). The strategy highlighted some key interventions required for the municipality to adapt to climate change, specifically in the areas of human health, water and sanitation, biodiversity, coastal zone (sea-level rise), infrastructure, food security and agriculture, strategic planning and economic development and disaster management (Hounscome and Iyer, 2006). A Carbon Storage and Sequestration Analysis (Glenday, 2007) was also undertaken, which indicated that although the sequestration rates were small compared to the city's GHG emissions, rehabilitation of open space would improve its capacity to act as a carbon sink. Phase 2 also included the three sectoral municipal adaptation plans (water, health and disaster management), 'climate smart' D'MOSS project, 'climate smart' communities project, community reforestation projects, green roof pilot project, and aspects of the Greening Durban 2010 programme, amongst others. The municipality is currently commissioning a cost-benefit analysis of the three municipal adaptation plans as part of this phase.
3. The third phase of the MCP turned to addressing the need to incorporate climate change considerations into the city's planning processes. A computer-based, Geographic Information System (GIS)-type platform Urban Integrated Assessment Tool has been developed, in collaboration with the Tyndall Climate Change Research Institute, to simulate, evaluate and compare the city's strategic plans and policies in the

context of climate change impacts, so that it can further inform future planning. The tool is in a GIS-type platform to ensure that aspects can be viewed visually. Preliminary work has shown that the tool is difficult to use and will require further work.

4. A fourth phase of the MCP is currently seeking to mainstream climate change into city planning and development. Thus far, a Climate Protection Branch has been established within the re-named EPCPD; the Greening Durban 2010 programme focused on achieving carbon neutrality for the 2010 World Cup was undertaken (EPCPD, 2010b). Initial work is also underway to determine the terms of reference for a Strategic Environmental Assessment of the city's Spatial Development Plans (SDPs).

The municipality hosted its first Climate Summit in 2009, where the terms of reference for a Durban Climate Change Partnership (DCCP) was drawn up based on workshop discussions. It was agreed that the partnership should include public and private representatives and that it should be run by a facilitator external to the municipality. The first steps to initiate an Advisory Forum which will provide guidance on the establishment of a Steering Committee for the partnership were taken early in 2011.

In recent years, there has also been considerable work undertaken in the municipality on the implications of sea-level rise (Mather, 2009a). The coastal storms which severely impacted the Durban coastline in March 2007 added further impetus to this work. A GIS computer model, the Sea-Level Rise Viewer, has been developed to model sea-level rise along the city's coastline (Mather, 2009b). The results are intended to assist in the preparation of Shoreline Management Plans and Municipal Adaptation Plans.

The first of these, the South Durban Shoreline Management Plan, is being undertaken as a pilot project along approximately 25-30 km of shoreline in the south of Durban to prepare a guiding framework to respond to potential impacts of sea-level rise (WSP Environmental, 2009). The Sea-Level Rise Viewer has been used to indicate the potential biophysical and social effects of sea-level rise for each of three sea-level rise scenarios (0.3 m, 0.6 m and 1 m). The

potential impact on affected land parcels and infrastructure has been spatially represented, affected landowners and users and opportunities for relocation of facilities identified. Potential responses are being investigated, including: various options to hold, retreat or advance the current coastal erosion line, modification of the human environment (buildings and infrastructure), adaption measures, policy controls, and modification of human behaviour.

The South Durban Basin area based management department has recently begun a separate climate change initiative with the assist-

ance of the Wildlife and Environment Society of South Africa (WESSA), using a participatory approach to climate risk assessment and adaptation (WESSA, 2010). The process began with a stakeholder capacity-building workshop in April 2010, followed by a climate risk screening where the initiative was launched. The next step will be to develop specific projects.

Considerable impetus was given to the climate change initiatives in the city with the creation of the Energy Office in 2009. A number of projects focused on energy efficiency have been implemented (see Chapter 2).

Key Messages:

- The city of Durban has been at the vanguard of efforts to address climate change.
- The initiatives have spanned a ten-year period and have included institutional changes and mitigation and adaptation responses.

CITIES AS KEY DRIVERS OF CLIMATE CHANGE AND CLIMATE CHANGE ACTIONS

More than half of the world's population resides in cities and the proportion is expected to increase to 60% by 2030 and 70% by 2050 (UN, 2007). Globally, cities are substantial contributors to GHG emissions, accounting for approximately 80% of global emissions (World Bank, 2010a). According to the International Energy Agency (IEA, 2008), cities contribute more than 67% of energy-related global GHGs, which is predicted to increase to 74% by 2030. In South Africa, the three largest metropolitan areas of Johannesburg, Cape Town and Durban comprise 21% of South Africa's GHG emissions, with Durban contributing 7% (Sustainable Energy Africa, 2006).

On a *per capita* basis, Durban's GHG emissions of 6.9 t CO₂e *per capita* in 2005/6¹ is lower than the *per capita* value for South Africa at 9.92 t CO₂e for the year 1994 (World Bank, 2010a). Comparative statistics for other major cities are presented in Figure 1.1 and show that South African cities have *per capita* values equivalent to cities in China and the United States and are far higher than cities in Europe.

Because cities contain the highest population densities and most of the activities that produce GHGs, they present the greatest opportunities for mitigation and adaptation. Interventions thus have a greater reach and higher levels of service delivery and infrastructure mean that they are more likely to succeed. Cities have authority over the sectors such as water, waste and transport, in which most interventions are likely to be introduced, and are able to introduce policies and financial incentives to initiate climate change actions. City governments tend to be more closely linked to the public because of their focus on routine services (World Bank, 2010a) and are therefore more likely to be able to build partnerships with the public, although this may be compromised in some cities in South Africa due to a history of poor service delivery.

Cities have the potential to play leadership roles in their countries, with their actions reaching beyond their jurisdictional areas. Proactive cities can set the example for smaller municipalities, and even for the nation as a whole, as is the case in the United States, where cities have taken action despite the country not having signed the Kyoto Protocol. A recent World Bank

¹ This value is based on the total 2005/2006 GHG emissions for Durban divided by the population for that year. Assumptions underpinning the GHG emissions estimate are given in Chapter 5.

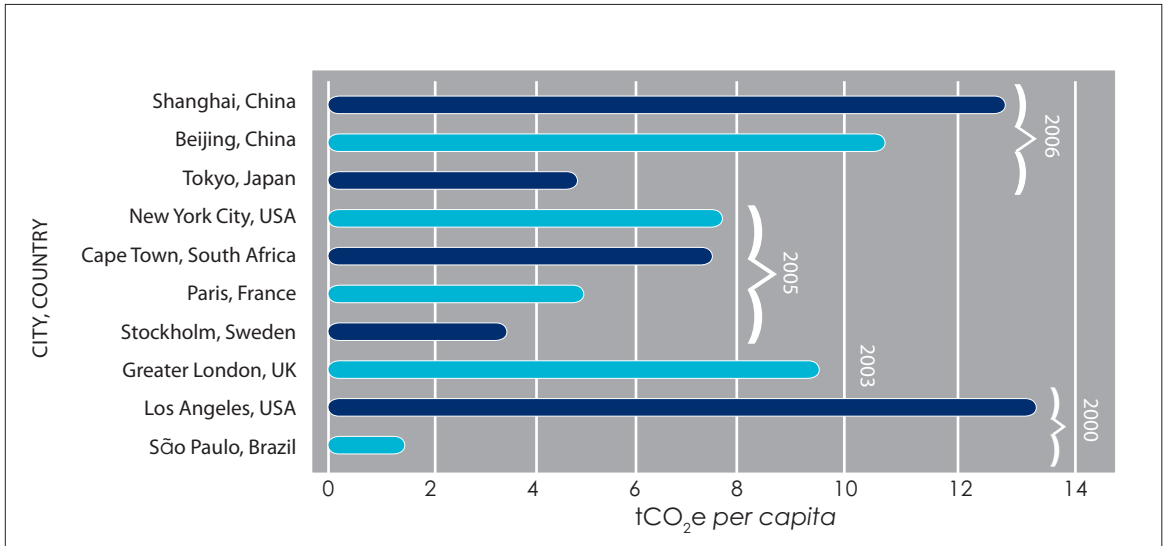


Figure 1.1: Per capita greenhouse gas emissions (tCO₂e /capita) for selected cities for the indicated year (World Bank, 2011)

report (World Bank, 2010a) argues that climate change presents an opportunity for cities to raise their profile and reinforce their image as being progressive and responsible by belonging to the 'green cities' club.

The important role of cities in the climate change agenda is underscored by the recognition given to the issue of cities and human settlements as separate chapters in the adaptation and mitigation reports of the forthcoming fifth assessment of the IPCC.

Key Messages:

- Cities account for about 80% of global greenhouse gas emissions.
- The city of Durban contributes 7% of South Africa's greenhouse gas emissions.
- The emission of greenhouse gases in Durban is 6.9 tCO₂e per capita.
- Cities present the greatest opportunities for mitigation and adaptation because of their high population densities and higher levels of service delivery and infrastructure.

WHAT IS A LOW CARBON CITY?

A low carbon city is clearly a normative concept implying that a city has achieved an acceptable state in terms of its GHG emissions. However, what constitutes acceptable in this context is unclear. It could be argued that developing country cities are already relatively low carbon and that the use of the term low carbon pre-empt the need for them to pursue low carbon

planning. Further, climate change action plans of many cities focus exclusively on sources of GHGs and by not extending the coverage to carbon sinks fail to answer what makes them low carbon. In addition to sinks, a link to and the need for, simultaneous planning for climate change adaptation is necessary. The definition of a low carbon city posited here is that a low carbon city is one that strives to reduce its GHG emissions and increase its carbon sinks, while si-

Key Message:

- The definition of a low carbon city is one that strives to reduce its GHG emissions and increase its carbon sinks, while simultaneously adapting to anticipated climate change impacts.

multaneously adapting to anticipated climate change impacts.

The achievement of a low carbon state requires a transition process that is characterised by low carbon development (LCD). Various types of LCD have been identified (IDS, 2009) each focusing on either the productive or consump-

tive side of an economy and requiring varying degrees of technological, sectoral or behavioural change (Table 1.2). Elements of each approach are endorsed where appropriate. The approach proposed as providing the most suitable framework is that of the green economy (see Chapter 10), although emphasis is also placed on lowering consumption.

Table 1.2: Types of low carbon development (IDS, 2009)

Type	Description	Focus	Approach
Green economy	Focused on production aspects of an economy. Aims to decouple economic growth from carbon emissions	Mainly mitigation but also adaptation	Technological change, sectoral change
Green lifestyles	Focused on consumption aspects of an economy. Implies lifestyle and behavioural changes. Also aims to decouple economic growth from carbon emissions	Mitigation and adaptation	Behavioural change, technological change, sectoral change
Equilibrium economy	Focused on production aspects of an economy. Aimed at development not growth and so no decoupling is necessary as growth is neutral	Mainly mitigation but also adaptation	Technological change, sectoral change
Coexistence with nature	Focused on consumption aspects of an economy. Aimed at development not growth and so no decoupling is necessary as growth is neutral	Mitigation and adaptation	Behavioural change, technological change, sectoral change

The world's first carbon-neutral and zero-waste city is planned at Masdar City in Abu Dhabi. It is a new development initiated as a clean technology research hub that aims to accommodate a population of 50 000 people. Development of the city has been hampered by the economic downturn but plans include prohibiting the use of motor vehicles and having a transport system comprising public mass transit and individual rapid transport systems. The city will acquire its power solely from renewable energy sources, viz. solar, wind, geothermal and waste to energy. All biological waste will be used as fertiliser and all industrial materials will be reduced or recycled. The city plans to recycle its water and

grey water will be used for irrigation. Research is currently being undertaken to desalinate water in an energy efficient way. Research and innovation are priorities for the success of the city, hence a university is a central component of the plan².

RELEVANCE OF LOW CARBON DEVELOPMENT IN A DEVELOPING COUNTRY CONTEXT

Faced with the overwhelming imperative of economic growth, to increase employment opportunities, eradicate or alleviate poverty, and address issues of inequality, one may question the relevance of a low carbon city in a devel-

² <http://www.masdarcity.ae/en/index.aspx>.

oping country such as South Africa. Indeed, with the Least Developed Countries contributing only 6% of global GHG emissions, it could be argued that it is neither feasible nor morally correct for them to reduce emissions (Funder *et al.*, 2009).

The argument adopted here is that the transition to a low carbon city should be construed not as an economic burden but as an economic opportunity. The transition offers opportunities to couple economic development imperatives with low carbon options. In the Least Developed Countries there may even be justification for no reductions in absolute carbon emissions (Funder *et al.*, 2009). A low carbon pathway should not be viewed as one that precludes economic growth, but rather as an opportunity to deliberately shape future development such that it accords with low carbon principles (see Chapter 10 on a green economy for Durban). Increasingly, the rhetoric of climate change policy is shifting from a negative frame in which words such as 'limitation', 'constraint' and 'reduction' dominate to one in which there is an emphasis on 'investing in new technology', 'stimulating economic growth' and 'creating low-carbon jobs' (Global Climate Network, 2009).

In their quest to reduce poverty and achieve the Millennium Development Goals (MDGs), developing countries are faced with enormous challenges. Issues of climate change mitigation and adaptation cannot be separated from poverty reduction efforts (IDS, 2009) as it is widely recognised that the poor are most vulnerable to climate change impacts. Despite the lack of an energy-related MDG, energy poverty underpins all MDGs and according to the IDS (2009), low carbon development (LCD) addresses the issue of energy poverty and hence contributes to the achievement of the MDGs.

LCD may also offer significant co-benefits, which are seldom emphasised, but which are pertinent for developing countries. These include improved public health because of reduced air pollution (IAMP, 2010), greater agricultural productivity, greater water and energy security and opportunities to leap frog to new technologies (World Bank, 2010a). There can also be substantial financial benefits due to increased energy efficiency, as well as increased business

opportunities and employment creation. A city also stands to attract more investment as a result of positioning itself amongst a global group of leaders.

At an international level, South Africa has ratified the Kyoto Protocol. At the 2009 Conference of the Parties (COP)-15 meeting in Copenhagen, South Africa announced that it was willing to cut carbon emissions from a Business-as-Usual trajectory to 34% by 2020 and 42% by 2025. Even though this is premised on a number of conditions, chief of which is available funding, it demonstrates that South Africa is committed to fulfilling its obligations in terms of this agreement, both now and into the future (see Chapter 3). It is widely speculated that South Africa, along with other emergent economies, will be faced with far greater commitments that may involve reductions in GHG emissions post-2012 when the current commitment period of the Kyoto Protocol is due to end. Whatever the nature of the outcome, a large part of the responsibility for mitigation efforts will rest with local government, in particular, the three largest metropolitan areas.

The timing of this report for the city of Durban, which is host to the seventeenth session of the COP and the seventh session of the Conference of the Parties serving on the Meeting of the Parties (CMP) to the Kyoto Protocol (COP-17-CMP-7) meeting in November 2011, is critical. Large events, particularly one directly related to climate change have the potential to nudge local government in a desired direction. The COP-17-CMP-7 meeting presents an opportunity for Durban to be proactive and to announce its commitment to becoming a low carbon city and to put in place structures and policies to ensure that this happens.

In the future, according to Fakir (2010), South Africa faces the prospect of border carbon adjustments on exports, dramatically reducing export competitiveness and resulting in job losses. Although the implementation of border carbon adjustments is still uncertain, it clear that a low-carbon future is unavoidable.

In developing countries, climate change issues have tended to focus on adaptation. This is understandable given that the impacts are experienced on a local scale. Adaptation efforts tend

to focus on the particular needs, for example sea-level rise protection works. Relatively less attention has been given to the potential co-benefits that may accrue from mitigating emissions and following a low carbon pathway. Mitigation efforts tend to be capital intensive (e.g. public transport system) and are often thought

to be the business of the developed world. The recent report by the World Bank (World Bank, 2010a) argues for the integration of adaptation and mitigation with urban development, stating that by focusing on the improvement of city services, one is developing a resilient city and a city with reduced GHG emissions.

Key Message:

- The argument adopted here is that the transition to a low carbon city should be construed not as an economic burden but as an economic opportunity. The transition offers opportunities to couple economic development imperatives with low carbon options.

SUMMARY

The eThekweni Municipality has taken significant strides in addressing climate change. That it could do more, there is no doubt, as is revealed in the chapters that follow.

The report commences with an overview of the local context (Chapter 2), takes account of the national situation in terms of key policies and legislation (Chapter 3), and presents the international perspective (Chapter 4) as an opportunity to learn from interventions and approaches adopted abroad.

Against this contextual background, the opportunities for the eThekweni Municipality to transition to a low carbon city are explored for various sectors such as water, transport and energy (Chapter 5). A number of recommendations,

focused primarily on mitigation options, are presented. Chapter 6 gives attention to developing the resilience of the city through adaptation options. Opportunities to enhance carbon sinks are addressed in Chapter 7.

Underpinning all the mitigation and adaptation options presented, are governance and citizenship aspects that are presented in Chapters 8 and 9 respectively. With the strong global emphasis on the green economy, a separate chapter on a green economy for Durban is presented in Chapter 10. This is followed by a chapter on financing opportunities for a low carbon city (Chapter 11).

The final chapter (Chapter 12) draws together the findings and recommendations and captures the key recommendations of this report.

chapter 2

A large circular inset image showing a blurred crowd of people walking on a city street. The image is framed by a dark blue border. In the foreground, there are green leaves and branches, partially obscuring the view. The background shows a city street with buildings and a crowd of people walking away from the camera.

One-third of the city's population is characterised as **poor** and over one-third of the **economically active** sector of the population is **unemployed**



local context

CITY PROFILE

Durban is a metropolitan area located on the east coast of KwaZulu-Natal, South Africa. It is one of the major economic and urban centres in South Africa.

This chapter provides an overview of the spatial, socio-economic, environmental and institutional characteristics of eThekweni Municipality (the local government responsible for planning and managing the city) that will shape the strategies, interventions and implementation of low carbon programmes in the city.

DEMOGRAPHICS

Durban has a population of approximately 3.357 million people (IHS Global Insight, 2010) and a

population growth rate of 0.8% per annum (between 2004 and 2009), which is above the national average of 0.7%, but represents a decline compared to past years. It is estimated that by 2014 the city will have a population of 3.429 million people (IHS Global Insight, 2010), with the highest growth rate amongst the African population. Notwithstanding the population growth rate decline, the population and household growth are expected to continue as people move into informal settlements on the periphery of the city from neighbouring rural municipalities in an attempt to access services from the city (eThekweni Municipality, 2010a).

The apartheid legacy has resulted in a socio-economically segregated city that is still highly racialised (Table 2.1).

Table 2.1: Population statistics by racial group (Source: IHS Global Insight, 2010)

Population group	Percentage of city population (2009)	Population growth rate per annum (2004-2009)	Estimated percentage of city population (2014)	Percentage living in poverty (of each race group)
African	69.5	1.1%	70.8	41.8
White	9.2	-0.8%	8.5	0.2
Indian	18.8	0.2%	18.2	9.5
Coloured	2.5	0.7%	2.5	18.2

The city has high levels of poverty and unemployment, with 33.1% of the population being classified as poor (just over 1 million) and 35.5% of the economically active population being unemployed (SACN, 2006; Breetzke, 2009; IHS Global Insight, 2010). The official unemployment is given as 20.6% (IHS Global Insight, 2010). The racial in-

equality in the city is reflected in the fact that 93.5% of poor households are African, 0.1% White, 1.2% Coloured and 5.2% Asian. A total of 81% of unemployed people in the city are African (IHS Global Insight, 2010). The Gini coefficient, which ranges between 0 (indicating total equality) and 1 (indicating total inequality), is 0.639.

The population of the city is young (35.5% of the population is less than 20 years and 57.8% is less than 30 years). Only the White population reflects the pattern of an aging population. The other racial groups are characterised by high infant mortality, high dependency rates and low life expectancy (IHS Global Insight, 2010).

Further statistics relevant to children and which highlight the vulnerability of the population are provided by the Children's Institute at the University of Cape Town (Kibel *et al.*, 2010). For the province of KwaZulu-Natal, only just over 28% of children (defined as less than 18 years) live with both parents, compared with over 50% in the Western Cape and Gauteng. Over 40% of children in KwaZulu-Natal live in a household without an employed adult.

Functional literacy (number of people over 20 with at least Grade 7) is 83.7% (in 2009). This rate is lower than other metropolitan municipalities, with the exception of Ekurhuleni (East Rand) (IHS Global Insight, 2010).

Population densities reveal high densities in the Central Business District (CBD), relatively low densities (2-10 dwellings per hectare) around

10 km (middle and upper income suburbs) and then a density spike (40-50 dwellings per hectare) at 10-18 km from CBD, which reflects the townships located on the periphery of the city (Breetzke, 2009).

In summary, the population of eThekweni Municipality reflects a relatively vulnerable population, with one-third being classified as poor and a relatively high HIV/AIDS prevalence rate.

The statistics presented in this section have important implications for transitioning to a low carbon city:

- High levels of poverty and unemployment contribute greatly to the vulnerability of the population and affect their ability to adapt.
- They emphasise that the creation of jobs is critical.
- Transformation to a low carbon city requires individuals to have an understanding of the concept and to make important choices about how they use resources, both of which hinge on having an educated public.
- The inequalities present in society underscore the need to address the issue of inequality in the design and implementation of low carbon programmes.

Key Message:

One-third of the city's population is characterised as poor and over one-third of the economically active sector of the population is unemployed.

SPATIAL STRUCTURE AND LAND USE

The eThekweni Municipality covers an area of approximately 2 300 km² (Fig. 2.1). The spatial configuration of the city has been shaped by a number of forces.

- *Apartheid ideology* - Durban, and other South African cities in general, have been powerfully shaped by the political ideology of apartheid and post-apartheid class divisions, in which racial groups are separated and buffered from each other, with the poorer groups located on the periphery of the city.
- *Modernism* - the dominant planning para-

digm of the past seventy years or more has been that of modernism, which has promoted the concept of the single dwelling on its own plot of land, as well as the separation of urban activities, both of which have contributed to low density sprawl.

- *Consolidation of local authorities* - the land area of Durban increased by 68% under the Municipal Systems Act (*Act 32 of 2000*) (IHS Global Insight, 2010), resulting in a large portion of rural areas under customary law being included within the metropolitan area. In the years leading up to the consolidation in 2000, there was an attempt to foster integration between the previously separate local authorities, and six local councils were

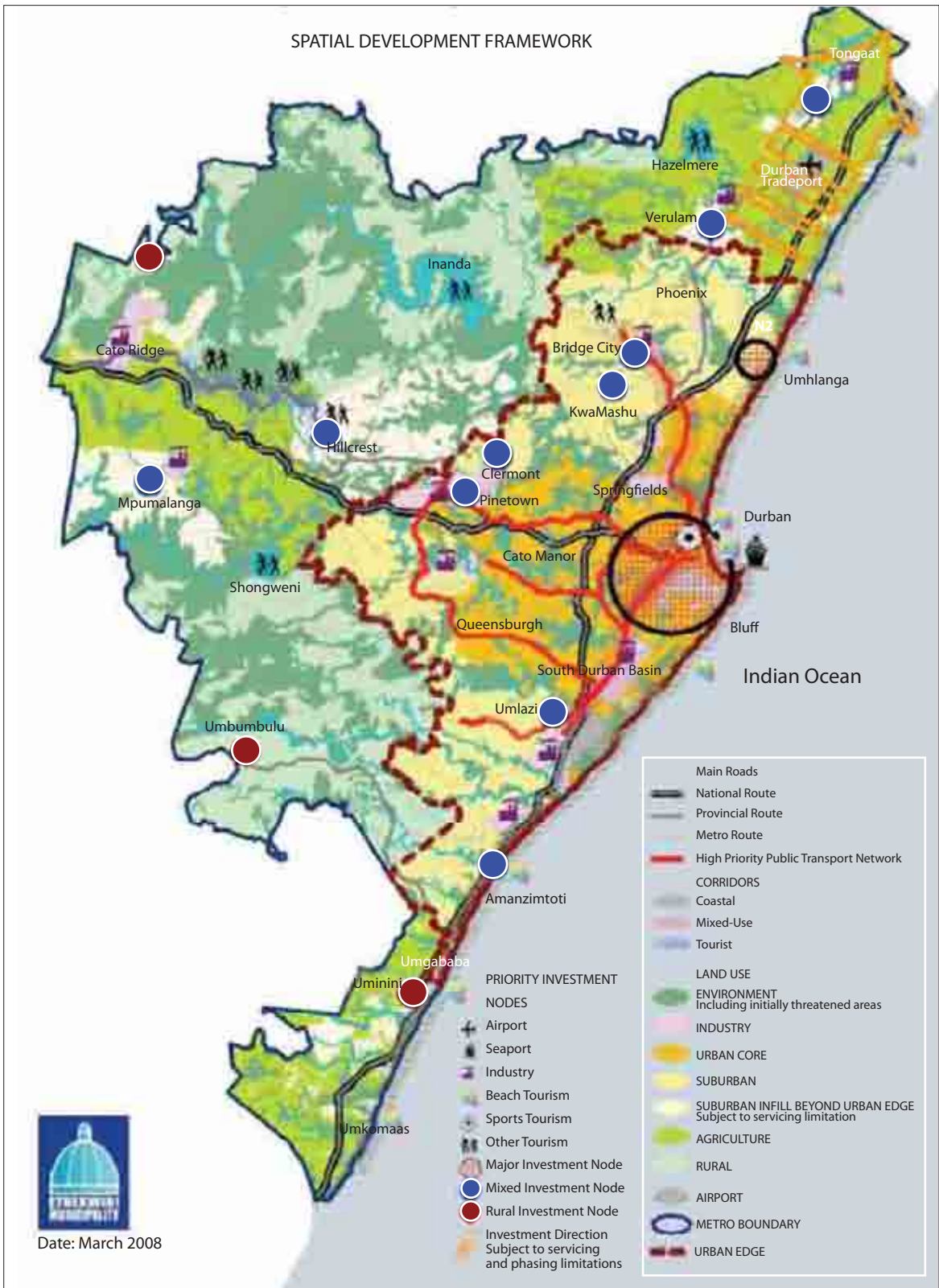


Figure 2.1: EThekweni Municipal Area (Source: eThekweni Municipality, 2009b)

established. However, rather than leading to integration, there was heightened competition between the different areas of the city, further fragmenting development, as each council sought to attract development to its area (Breetzke, 2009). Although the redefined metropolitan area has been in place for ten years, the divisions between the six local planning offices are still evident and still shape spaces in the city.

- *Power of local capital and major developers* - it was during this critical period prior to the 2000 consolidation of local authorities that the Umhlanga Ridge developed as a public-private partnership, with Moreland Properties playing a dominant role in the creation of the development node of Umhlanga/Gateway. The power that Moreland Properties was able to exert was achieved through their ownership of large tracts of land and their strong vision for the area, which was supported by the North Local Council politicians and officials who were focused on economic development.
- *National housing policy* - the model of the single house on its own plot is strongly fuelled by national housing policy which, through its subsidy system, makes the generation of alternatives difficult. In particular, it leads to an increasing search for cheap, large new land parcels, ever beyond the urban edge.

The result of these influences is a low density, sprawling city, such that South African cities are acknowledged as amongst the most inefficient cities in the world (UN Habitat, 2008). Furthermore, the city contains a diverse and complex set of spaces, activities and connections that impact differently and will require different responses in terms of achieving a low carbon future. High-income areas will need to lower their consumption, and development of low-income areas must

happen in a manner that does not lead to a replication of the high consumption patterns of other groups. The inner city is now dominated by decay, as the Umhlanga Ridge has taken over much of the business functions. There are a large number of informal settlements located within well-established formal residential areas, a unique feature of Durban, due largely to the city's topography. The undulating terrain has left vast expanses of undeveloped land within developed areas, leading to land invasions, but also allowing informal settlements to be hidden from view.

Neighbourhoods (functioning elements of the city that can be residential, business, mixed-use, etc.) differ significantly in terms of access to urban resources such as employment, services and social and economic facilities. Peripheral townships are characterised by poor access to resources, which leads to inefficient movement across the city.

The role of planning in transforming the city into a low carbon city is critical. Later in this chapter, a more detailed analysis of planning policies in eThekweni Municipality is provided, emphasising how planning tools have thus far failed to contain the demands and pressures of the market. Developers have driven new growth to the periphery of the city in their search for 'greenfield' sites.

The implications of these pressures and trends for transitioning Durban into a low carbon city are underscored by Breetzke (2009), who argues that the city needs a long-term vision of spatial growth that is shared by major stakeholders, including the city's senior management and politicians, major landowners and civil society groups. In the absence of an integrated vision, the main planning tools will not be able to achieve their objectives.

Key Messages:

- The city is characterised by low density, urban sprawl.
- Large portions of the city are under customary law and are rural in character.
- Neighbourhoods differ significantly in terms of their characteristics.
- The inner city is characterised by urban decay and the Umhlanga Ridge to the north of the city has taken over many of the business functions.

HOUSING

There are approximately 948 000 households in the eThekweni Municipality, 75.5% of which are formal houses, with the remainder (almost 200 000 households) being informal or traditional dwellings (IHS Global Insight, 2010). These households differ considerably in their energy consumption as they represent very different standards of living and resource use.

The current housing backlog is 234 000 units³. Through the Housing Department's Informal Settlement Programme, the city aims to provide 16 000 housing units per annum (eThekweni Municipality, 2010a). However, this was reduced to approximately 9 500 households in 2009, due to budgetary constraints³. According to the IDP (eThekweni Municipality, 2009b), given the current budget the backlog will only be cleared by 2040.

The approach of the municipality is to upgrade informal settlements in their existing locations, provided the land is developable (eThekweni Municipality, 2010). Relocation is considered a last resort due to the loss of social support networks, considered important for communities with high poverty and high unemployment levels.

In parallel to the municipality's Informal Settlements Programme, 'greenfield' projects are implemented to provide housing for those not accommodated in the informal settlement upgrades due to the density reduction or where relocation is unavoidable. Vacant land audits

have been undertaken to identify 'greenfield' sites for development.

As an interim measure until housing projects are implemented, services are provided through ablation blocks and water dispensing devices in the urban areas, and at a lower level in the rural areas, i.e. urine diversion (UD) toilets, ground tanks (with a free water supply of 300 litres/day) and household electricity connections (eThekweni Municipality, 2010a). Provision of services to households in rural areas presents a challenge due to low densities and hilly terrain.

Housing interventions in the city present a significant opportunity to transform low-cost domestic housing towards a low carbon future, although Swilling (2006) argues that transformation needs to happen across all housing types, from low-income to upper-income housing. Some of the interventions already underway by the eThekweni Municipality in its provision of low-cost housing are described later in the chapter. A key factor is that of location. Inappropriate location of low-cost housing can be extremely costly both to residents and the environment if travel distances are large (Sowman and Urquhart, 1998; Oelofse, 1999; Oelofse, 2003; Swilling, 2006). In this respect, Breetzke (2009) describes how energy and carbon costs can be integrated through the Cost Surface Model and how the Accessibility Model could be used to evaluate the eco-efficiency of the location of settlements in relation to social facilities. High infrastructure costs incurred at peripheral locations need to be weighed up against higher land costs in central locations in the city.

Key Messages:

- Approximately 25% of households are informal or traditional.
- Informal settlements are preferably upgraded in their existing locations.
- Location is a key factor for low-cost housing – inappropriate location can be costly to residents and the environment.

ECONOMIC PROFILE

The city contributed 64.1% and 10.4% to the provincial and national GDP respectively in 2009 (IHS Global Insight, 2010). The eThekweni Municipality

is the third largest municipality in terms of economic activity in South Africa (after Johannesburg and Cape Town), the fourth highest in terms of GDP *per capita* and it has the second highest level of poverty of the six metropolitan

³ M. Byerley and F. Seedat, Housing Department, eThekweni Municipality, September 2010, personal communication.

municipalities in the country (IHS Global Insight, 2010).

Between 2004 and 2007, the economy grew by 5.8% per annum, but dropped to 3.5% in 2008 (IHS Global Insight, 2010). The economy of the city shrank by 2% between 2008 and 2009, mainly because of the global economic crisis. Only the construction sector showed a positive growth in 2009 (11.3%), primarily due to the development of mega-projects such as Dube Tradeport (DTP), Bridge City, the Point Development and the World Cup 2010 facilities and upgrades (IHS Global Insight, 2010).

The economy of the city is dominated by tertiary industries that include wholesale and retail trade (15.2%), communication, transport and storage (12.9%), financial and business services (22.3%) and community services (general government services, 19.2%). Manufacturing has declined in importance and contributes 22.8%, comprising fuel and petroleum production, food and beverages, and chemical and rubber products (IHS Global Insight, 2010). Wholesale and retail trade is the largest employer in the city, followed by employment in the community services and manufacturing sectors. There has been a decline in employment levels in the manufacturing sector from 22.3% in 2004 to 19.1% in 2009 (IHS Global Insight, 2010). The primary sector makes a very small contribution to the economy (1.5%), although subsistence farming is important in a city with a large rural footprint. Rural residents produce approximately 50% of their monthly food needs (Golder Associates, 2010a).

The port clearly plays a significant role in the city's economy. Exports are dominated by transport equipment (34.9%) and wood and paper products (20.4%), and major imports include transport equipment (29.4%) and fuel, petroleum, and chemical and rubber products (17.7%) (IHS Global Insight, 2010). Port functions and activities are not within the control of the municipality and so a partnership between Transnet and the city would be required for the adoption of a low carbon approach.

The annual economic growth rate for the city between 2009 and 2014 is expected to be between 4.0% and 5.5% (IHS Global Insight, 2010).

The Economic Development Strategy (EDS) (EDU, 2008) predicts that 60% of future growth will occur in the services sectors. While this shift is favourable from a low carbon perspective, it is difficult to see how the unemployment problem in the municipality will be solved through this growth trajectory, as it is mainly in the unskilled and semi-skilled levels that employment opportunities are lacking. It is predicted that a high portion of this growth will occur in the North Corridor, in association with the DTP, expansion in Tongaat and in relation to the proposed Cornubia development, west of the Gateway-Umhlanga hub. According to the eThekweni Economic Review, the most important economic project is the DTP, which has been planned as a freight and passenger logistics facility that will attract other investments. It includes the international airport, a trade zone, support zones and agri-zones (IHS Global Insight, 2010). The DTP has contravened many of the basic low carbon planning principles by 'leap frogging' catchments where services are not provided and encouraging development beyond the urban development line, however, the potential for economic growth and job creation is substantial. Already the development has created a large number of jobs, with a substantial proportion in the semi-skilled and unskilled sectors. The challenge will be to ensure that development associated with the DTP is appropriately low carbon and that anticipated higher GHG emissions linked with increased freight handling and greater commuting distances are taken into account in the city's GHG inventory.

In line with national government imperatives that emerged from the April 2009 elections, eThekweni Municipality has chosen to focus strategically on economic development and job creation to alleviate poverty (IHS Global Insight, 2010).

The pro-growth programmes of the city present an opportunity to integrate low carbon principles (see Chapter 10). The focus on job creation is significant. In tackling unemployment, growth is required in primary and secondary industries, which includes farming, manufacturing and construction. The tertiary sector, which dominates economic activity in the city, cannot easily absorb the unemployed as this sector requires skilled labour.

Key Messages:

- The economy of the city is dominated by the tertiary sector; the manufacturing sector has declined in importance, although it is still the largest employer.
- It is predicted that future growth will occur mainly in the services sector, with most occurring to the north of the city in association with the Dube Tradeport.
- The city has a strategic focus on economic development and job creation.
- The anticipated growth in the services sector will not address the problem of unemployment at the unskilled and semi-skilled levels.

ENERGY

The municipality's State of Energy Report lists energy-use as follows: industry, commerce and agriculture (47%), transport (42%), with the residential sector (10%) and the municipality (1%) taking up the remainder (Mercer, 2006).

Characteristics of the sectors in terms of energy-use are as follows:

- *Industry, commerce and agriculture* - Energy usage is dominated by electricity, followed by coal and refinery gas. The city's petroleum sub-sector is the highest energy consuming industry in the city.
- *Transport* - Road-based transport dominates the public transport sector and is predominantly fossil fuel based.
- *Domestic* - Electricity is the predominant energy used (80.8%) for domestic cooking, heating and lighting (Stats SA, 2007); about 19% of households use a mix of electricity and other sources; and 9% primarily use other sources (Mercer, 2006). However, there is still substantial use of paraffin for cooking (14.8%) and heating (10.3%), wood for heating (4.4%), and candles for lighting (8.9%). Poor households (approximately 40% of users) spend a disproportionately high percentage of their monthly income on fuel sources.
- *Municipality* - Electricity is the main energy source used by the municipality. The majority of electricity use can be attributed to distribution losses (77%), followed by street-lights (13.2%), water and sanitation (4.9%) and buildings (4.6%). Petrol and diesel fuel to operate the municipality's vehicle fleet are the other energy source used by the municipality, accounting for 1.8% of the city's transport-related liquid fuels usage.

From an energy supply side, the following sources are important:

- *Electricity* - Electricity from Eskom is the dominant energy supply in the city. Electricity demand in the eThekweni Municipality grew by 25% from 1994 to 2004 (Mercer, 2006) and is expected to continue increasing with the growth in the economy and the provision of electricity to outstanding households (89.1% of households had been supplied with electricity in 2008 (Mercer, 2006)). Electricity supply in eThekweni Municipality contributes to 54% of the city's energy-related CO₂ emissions (Mercer, 2006).
- *Coal* - Coal is used by industry and contributes a fairly low 7% to the city's CO₂e footprint (Mercer, 2006).
- *Liquid and gaseous fuels* - The Durban port receives approximately 80% of national crude oil imports, of which 73% is processed locally (Mercer, 2006). The combined impact of all petroleum products combusted in eThekweni Municipality, including refinery gas, is estimated at 39% of CO₂e emissions in the municipality. The majority is attributed to road transport.
- *Renewable energy* - There are few data available on the current use of renewable sources of energy in the city. The State of Energy Report (Mercer, 2006) draws attention to their potential, however, little has been achieved in this area.

Key Messages:

- Industry, commerce and agriculture comprise nearly 50% of energy use; with electricity being the main source of energy, followed by coal and refinery gas.
- Over 80% of households use electricity for cooking, heating and lighting.
- Electricity supply in the city contributes over half of the city's energy-related CO₂ emissions.
- Renewable energy sources do not yet make a significant contribution.

TRANSPORT

In eThekweni Municipality, transport comprises 47% of energy-use (compared with 54% in Cape Town (Swilling, 2006)) and it is one of the highest contributors to air pollution (ETA, 2010). The transport system of the city is thus fundamental to the transition to a low carbon city. Transport is predominantly road-based, with the dominant transport routes being the N2 (north-south) and the N3 (west), supported by the lower order municipal road system. The rail line extends both north and south of the municipal area along the coast, with three spur lines that serve the major residential areas of Umlazi, Chatsworth and Kwa-Mashu. The main line into the hinterland carries commuters in an east-west direction, together with another line from Rossburgh to Pinetown. The taxi and major bus routes system provides extensive coverage throughout the municipality, both covering similar routes, and generally in direct competition with the rail service (ETA, 2010).

The north-south commuter rail line and the N2 highway comprise the municipality's high-priority public transport network (HPPTN), the city's main commuter corridor. This route links a number of the city's major nodes and three of its public transport hubs, i.e. Isipingo, Durban CBD and Bridge City, serving the majority of the city's commuters (ETA, 2010).

The modal split, i.e. the split between use of all modes of public transport versus the private car, in 2005 was 52:48 (public: private), with 699 000 person trips taking place during the peak period. It is estimated that the modal split will change to 42:58 in 2020 and the number of person trips will increase to 853 000 (22% increase) (ETA, 2005b). The projected decline in the use

of public transport is attributed to the ongoing decline in the public transport service, together with a rapid growth in car ownership.

However, the eThekweni Transport Authority (ETA) intends, through the implementation of its Integrated Transport Plan and Public Transport Plan to change the modal split to 55:45 by 2020 (public: private) (ETA, 2010).

The Department of Transport's national survey (Department of Transport, 2005) reveals the levels of dissatisfaction with the public transport system and indicates that once people earn over R 6 000 per month they tend to shift from public to private transport. Once they make the transition, it is very unlikely that they will revert to using public transport.

The same survey revealed that 23% of households in KwaZulu-Natal have access to a car compared with 45.5% in the Western Cape.

Growth of ownership and the resulting demand for road space will be one of the major challenges to transport authorities in the future (Department of Transport, 2005).

Durban as a port city is a major attractor and generator of freight to and from the hinterland. Freight carried by road is more than twice the tonnage carried by rail and represents over 3 million truck movements per annum, of which the majority is from/to the west (Gauteng) (ETA, 2005b). The result is severe road congestion and heavy traffic volumes. The main rail line between Durban and Gauteng operates at 35% of the line capacity, having declined significantly since the 1980s due to the decline in reliability and efficiency of rail services, and the increased reliability, affordability and availability of road-

based services. The rail link could handle much greater long-distance freight volumes if the system was upgraded (ETA, 2005b).

The new international airport about 30 km north of the CBD offers the opportunity to increase air freight volumes as it can accommodate long-haul freight aircraft with its longer runway. Currently freight can only be transported to the airport by road, which will have an impact on the city's transport movement patterns. A rail link is planned in the longer term, which may also pro-

vide for commuter rail services (ETA, 2010).

Road ownership in the city is divided amongst eThekweni Municipality, and the national and provincial Departments of Transport. Each is responsible for maintenance of its own roads. Within the municipality, a strategic needs assessment is undertaken every two years to evaluate future network needs, future maintenance requirements and budgetary needs. Road maintenance is also pertinent to a low carbon city as the surface condition of roads impacts on fuel consumption.

Key Messages:

- Transport is predominantly road-based.
- The use of public transport is expected to decline; the predicted modal split for 2020 is 42:58 (public:private), which the eThekweni Transport Authority aims to change to 55:45.
- The port is a major generator of freight that is carried by road.
- The main rail line between Durban and Gauteng operates at 35% of capacity.

INFRASTRUCTURE SERVICES

Access to service infrastructure is measured using four indicators: access to water, access to proper sanitation, access to refuse removal and access to electricity. The levels of servicing have increased over the past few years, most notably in regard to electricity access (IHS Global Insight, 2010). However, there is still a significant backlog to address and this has implications for the transformation to a low carbon city. New approaches and technologies need to be adopted to shift the implementation of services in the remaining un-serviced households, as well as new households, to more sustainable options.

The current situation with regard to infrastructure services is described below. Electricity was covered previously.

WATER

A total of 84.4% of households had access to piped water, including communal piped water less than 200 m from the dwelling, in 2008 (IHS Global Insight, 2010). The concept of free basic water (6kl/month/household-currently 9kl/month/household) for all residents was pioneered by the municipality and has been adopted across the country as water policy. A number of water plans have been produced by the eThekweni Water Services (EWS) to address the backlog in water supply and to meet future demand (see later in this chapter).

Implications for transitioning to a low carbon city are as follows:

- Water losses in the potable water distribution system have a high environmental burden and must be addressed as a priority.
- Addressing consumer demand through water saving devices and local by-laws or restrictions is important.

Key Messages:

- Over 80% of households have access to piped water.
- For every kilolitre of potable water supplied, 0.13 kWh of electricity is used for pumping and in water losses.
- Water losses in the potable water distribution system have a high environmental burden and must be addressed as a priority.
- Addressing consumer demand through water saving devices and local by-laws or restrictions is important.

SANITATION

The central and suburban regions of the municipality are serviced with a water-borne sewerage system that transports sewage to a number of sewage treatment plants for treatment prior to final discharge in the Indian Ocean. There is spare capacity in the Central core area of the city (approximately 100 Ml/day), less in the North and South and very limited capacity in the Outer West (less than 2 Ml/day). In line with the planned growth trajectory to the North, the municipality is planning upgrades and a new regional works on the Umdloti River. Based on an estimate of 1 Ml/day for 1 500 low to middle-income households, there is capacity for around 150 000 new households in the Central area (EWS, 2010).

The outer peri-urban and rural areas, as well as informal settlements, are provided with on-site sewage disposal. The supply of basic sanitation to poor households (ventilated improved pit latrines for dense settlements and UD toilets for less dense settlements) is funded by national government (DWAF, 2008). The UD toilet is the

municipality's preferred method of sanitation for less dense settlements.

Energy consumption on the wastewater collection side is estimated at 0.14 kWh/kl of wastewater moved in the system (Friedrich *et al.*, 2009a). Research into the carbon footprint of each of the five processes in the municipal water supply and sanitation system (i.e. production of potable water, distribution of potable water, collection of wastewater, treatment of wastewater and water recycling), based on a life-cycle approach, indicated that the treatment of wastewater is the process with the highest environmental impact (Friedrich *et al.*, 2009a).

Implications for transitioning to a low carbon city are as follows:

- Wastewater treatment plants that have activated sludge units have a high impact due to their energy requirements;
- Where appropriate, safe on-site sanitation is an acceptable low carbon solution;
- Water recycling is a good low carbon solution.

Key Messages:

- The treatment of wastewater using activated sludge units is energy-intensive.
- On-site sanitation and water recycling are low carbon solutions.
- Water recycling is a good low carbon solution.

SOLID WASTE

Disposal of waste in landfills, the dominant method of disposal in South Africa and the eThekweni Municipality, is a source of GHGs, contributing 2.1% of total emissions in South Africa (DEAT, 2009a) and 1.4% of total emissions in Durban,

respectively (Antoni, 2007). Over 1 million tons of waste per annum are accepted by the five main landfills in the municipal area (eThekweni Municipality, 2004). Solid waste contributes 43%, garden refuse 9% and landfill cover material constitutes 25%. In 2003, almost 120 000 tons of waste paper was recycled per annum, along with over

780 000 tons of cans (eThekweni Municipality, 2004). In the year 2008/2009, 7% of waste was recycled. The target was to increase this to 12% by 2009/2010 (eThekweni Municipality, 2009a).

A total of 296 vehicles are involved in the collection and transportation of waste in the municipal area, with related impacts on the carbon footprint of the city. More than 50 additional vehicles (tankers, loaders, excavators) are involved in handling the waste at the landfill sites (grading, compaction, covering waste, etc.) (eThekweni Municipality, 2004).

As with other services, an individual's 'waste footprint' increases with income level. Waste generated per person per day increases from 0.18 kg/person/day for informal settlements, to 0.4 kg/person/day for township dwellers, and approaches 0.8 kg/person/day for those living in the suburbs (eThekweni Municipality, 2004).

Key Messages:

- The waste sector contributes 1.4% to greenhouse gas emissions in Durban.
- Significant opportunities, suited to local municipality control, exist in the waste sector.

NATURAL ENVIRONMENT

Durban is located in a global biodiversity hotspot and it contains a diverse range of both robust and damaged environmental systems. The main environmental challenges in the city are the impacts of manufacturing and heavy industry on both community health and the natural environment, especially in South Durban; protecting and sustaining the natural environment in the face of intense growth and development pressure; the impact of the sprawling form of the city on the natural environment and open spaces; the lack of services in many poor residential areas which results in pollution and poor environmental health; the impact of development on riverine and coastal systems; and managing and adapting to the impacts of climate change on the city (Roberts, 2008).

The open space system of the city (known as D'MOSS – Durban Metropolitan Open Space System) aims to ensure that a representative

sample of the biodiversity in eThekweni Municipality is conserved. The D'MOSS also connects parcels of land which enables the various processes that support the biodiversity to function effectively. This ensures that the supply of ecosystem services (e.g. water supply, flood protection, building materials, medicinal products, clean air and water) which are critical to quality of life and the functioning of the city, are protected and enhanced. D'MOSS can make a significant contribution to a low carbon future by supplying free services, without which, technological and energy demanding solutions would have to be provided. For example, the flood retention services of the environment reduce the energy costs of moving surface water through the wastewater systems of the city. The value of D'MOSS in terms of carbon storage and sequestration is also worth noting (Glenday, 2007). According to Glenday (2007), the eThekweni open space area has a carbon store of 6.6 ± 0.2 MtC and a sequestration rate of 8.4 to 9.8×10^3 tC/y. Estimates given in Chapter 7 of this report suggest that these values could be even higher.

Key Messages:

- Durban is located in a global biodiversity hotspot, but the biodiversity is under threat from development pressures.
- D'MOSS has value in terms of carbon storage and sequestration, over and above its supply of ecosystem services such as water supply, flood protection, medicinal products.

CITY POLICIES AND INITIATIVES

While the former section gave a descriptive overview of the local context, this section provides a critical analysis of the policies that are in place, and sector initiatives aimed at a low carbon future for Durban. It is against this background that further recommendations are made for a low carbon Durban.

SPATIAL STRUCTURE AND LAND USE POLICIES AND INITIATIVES

INTEGRATED DEVELOPMENT PLAN

The city's Integrated Development Plan (IDP) provides the policy direction for city growth and development. It is a critical barometer of change in city policy and thinking as it is reviewed year-on-year. The main development challenges of eThekweni Municipality are those that are typical of all South African cities, viz. economic development, job creation and poverty reduction (eThekweni Municipality, 2009b). Low carbon principles have been an IDP theme for at least five years, and are reflected in a number of statements, particularly with respect to increasing city densities, and related improvements to the transport system.

One of the city's priorities for 2009/2010 was implementing energy efficiency strategies (eThekweni Municipality, 2009b).

The vision for the city as stated in its IDP is to be "Africa's most caring and livable city by 2020" (eThekweni Municipality, 2009b). To achieve this vision there must be ease of movement in the city, a safe environment, a clean and green city, access to economic opportunities, homely neighbours, and access to services.

The IDP provides the framework for the city's integrated spatial planning system in the form of a hierarchy of plans, moving from a strategic level to implementation through land use schemes.

SPATIAL DEVELOPMENT FRAMEWORK

The main spatial tool that reflects the strategic thrust of the IDP is the Spatial Development Framework (SDF). The SDF of 2002 focused on restructuring and re-integrating the apartheid city, espousing the vision of a compact city with higher densities and greater accessibility (Breetzke, 2009). An urban edge, defined by the capacity to supply water-borne sanitation systems, was introduced as a means of containing urban sprawl and the further development of the secondary urban core that was developing in Umhlanga, in competition with the CBD.

The 2002 SDF also contained development nodes with a strong focus on development along the north-south corridor. The two key nodes identified were the CBD and the South Durban Industrial Basin. It promoted intensification along the north-south rail link in an attempt to support public transport viability and usage. The need to reduce travel time and to increase local economic activity was strongly supported through the development of activities within poor areas (Breetzke, 2009).

At the strategic level, the city's SDF as outlined in the IDP (eThekweni Municipality, 2009b) supports, in principle, the transition to a low carbon city as it reveals the need to develop the urban core, increase densification, reduce sprawl, improve public transport, protect strategic environmental assets so that they can provide free services and support the health of the entire metropolitan area, and prevent inefficient expenditure

on infrastructure. It reinforces the original urban edge concept, which requires all development proposals to be carefully assessed in terms of extending bulk infrastructure as to whether they are cost effective, sustainable, and in eThekwin Municipality's best interests. The SDF also supports the utilisation of excess infrastructure capacity in developed areas inside the urban edge rather than extending platform infrastructure to new areas, an approach that is considered eco-efficient.

A newly introduced spatial concept is the Urban Development Line, which demarcates the extent to which urban development will be permitted in the long term, with the primary objective being to protect agricultural land.

However, notwithstanding its commendable principles, the SDF has failed in a number of respects:

- It has not been successful in containing development within the urban edge. There is increasing investment in a northward direction in response to private sector development needs, for example DTP and other public investment projects, which are taking place beyond the urban edge. It is proposed that the thrust of development outside the current urban edge in the next five to ten years will be restricted, with the movement of the urban edge northwards to include the next catchment (i.e. Umdloti catchment).
- It discourages 'leap frogging' due to increased servicing costs for development that happens in a 'leap frog' pattern rather than being extended sequentially from existing infrastructure networks and catchments (eThekwin Municipality, 2010a). Yet the development to the north of the city traverses three sewer catchments where services have not yet been budgeted for, and indicative development thresholds are extremely uneven and inefficient.
- By nature, SDFs are conceptual and strategic, providing little detail to guide infrastructure planning (Harrison *et al.*, 2008; Breetzke, 2009; Todes *et al.*, 2009). Engineers have argued that developments that have been approved are not aligned with the principles of the SDF, creating infrastructure problems. Breetzke (2009) suggests that infrastructure

has been developed on a largely *ad hoc* basis as new developments require interventions in a manner that is not co-ordinated and integrated.

- Although the SDF identifies the urban core as a node of regional significance, the urban core has not attracted investment and growth, but rather has experienced further decline and neglect.
- It has failed to counteract the power of private developers. Landowners and developers compile their plans based on sound research and economic feasibility and in situations where they contradict the Spatial Development Plans (SDPs), the municipal Planning Department has lacked the capacity to defend the SDP, and politicians and senior city management have failed to support the principles in the SDPs. Hence, developers have driven new growth out to the periphery of the city, preferring 'greenfield' to 'brownfield' sites as they are cheaper to develop and the environmental impact assessment processes from a social perspective are less onerous and subject to fewer conflicts.
- The SDF relied on a fundamental restructuring of the public transport system which has not been achieved.
- The high cost of accessible land within the urban core resulted in housing not being developed in the more centrally accessible areas.

As a result of a lack of bold decision-making and integration of sustainability concerns related to the SDF, alternative processes have developed to link spatial, housing and infrastructure planning. A GIS modeling exercise has been undertaken, resulting in the North Region being identified as the most cost-effective area for development (Breetzke, 2009).

'IMAGINE DURBAN'

This is a long-term, visionary planning project that aims to capture people's main aspirations for the city and translate them into planning strategies (Imagine Durban, 2009). Themes and strategies most relevant to a low carbon city are those summarised in Table 2.2. To ensure that the vision of 'Imagine Durban' becomes city

policy, the municipality has adopted the 'Imagine Durban' plan as a revision of its current 25-year long-term development framework. The IDP will also be updated to align with the 'Imagine Durban' plan.

In addition to the long-term plan, 'Imagine Durban' has published 'Innovations in Local Sustainability' (Njokweni and Dray, 2010), a publication that documents innovative sustainable projects in the city. Some of these include:

- The Green Roof Pilot Project: Creating the first green roof on a municipal building in South Africa.
- The Solid Waste Management Programme: Tackling the challenge of waste management in a growing city and harnessing the resources of local people to provide a waste disposal service to their local communities.
- Polyethylene terephthalate (PET) Plastic Products Project: Combating pollution and creating jobs by encouraging Durban communities to recycle used plastic bottles.
- Warwick Flyover: Curbing congestion and protecting pedestrians with inbound and outbound viaducts over Durban's busiest transport hub.
- Working for Ecosystems: A project to clear noxious weeds, while simultaneously creating jobs and protecting indigenous ecosystems.
- City Hall Food Garden Project: A vegetable garden inside a municipal building aimed at encouraging people to grow their own food.

Key Messages:

- Low carbon principles have been a theme of the key planning tool for the city, the Integrated Development Plan, for at least five years.
- The Spatial Development Framework, despite its commendable low carbon principles, has failed to contain development within the Urban Development Line, has allowed 'leapfrogging', and has failed to counteract the power of private developers, who have driven growth out to 'greenfield' sites on the periphery of the city.
- 'Imagine Durban' is a long-term, visionary planning project that offers hope for a low carbon Durban by incorporating under its umbrella, a portfolio of small, innovative projects.

HOUSING POLICIES AND INITIATIVES

The eThekweni Municipality Housing Plan makes implicit reference to a number of low carbon principles. It states "the Municipality is striving towards creating integrated and sustainable human settlements. In this regard, land that is well located in relation to economic and social opportunities, public transport, etc. will be developed utilising innovative medium to high-density housing typologies" (eThekweni Municipality, 2010a:17).

The Comprehensive Infrastructure Plan states the municipality's objective to ensure location

of housing projects where there is capacity to provide services, rather than locate them in areas where new services must be provided (eThekweni Municipality, 2010a).

A key housing development, focusing on the principles of sustainability, is the Cornubia mixed-housing development project in Umhlanga, which is a partnership between the city and Tongaat Hulett. The project aims to create a high-density mixed-income, mixed land use community, which includes open spaces and efficient public and non-motorised transport facilities. The development plans to provide 15 000 subsidised households and 50 000 residential units (Tongaath Hulett Developments, 2011).

Table 2.2: Imagine Durban – relevant themes and strategies (Imagine Durban, 2009)

Theme	Strategies
1. Promoting an accessible city	A. Develop high density nodes & corridors
	B. Promote & encourage the provision & use of public transport
	C. Support development of non-motorised public transport
	D. Ensure equitable location of retail & social facilities
	E. Ensure universal access to facilities & public transport
	F. Ensure access to housing & household services
3. Creating a prosperous city where all enjoy sustainable livelihoods	A. Enhancing livelihood choices & prospects of citizens, especially the poor
	F. Food production
5. Ensuring a more environmentally sustainable city	A. Incentives & disincentives to ensure sustainable practice
	B. Information & education
	C. Integrated waste management systems
	D. Pollution prevention
	E. Water conservation
	F. Energy efficiency
	G. Alternative energy production
	H. Climate change prevention & preparedness
	I. Productive ecosystems

Key Messages:

- Policies to locate housing projects in areas where services already exist and to create integrated and sustainable human settlements are intrinsically incorporating low carbon principles.

ECONOMIC DEVELOPMENT

The Economic Development Strategy (EDS), the Economic Review and the Industrial Strategy are the three main documents framing economic development plans in the city. The EDS, published in 2008, strategises around five key performance areas, which are: economic growth, reduced inequality, reduced unemployment, improved business confidence and equitable access to opportunities. An important target highlighted in the EDS is to halve unemployment by 2014 (EDU, 2008). The most recent economic review was released in 2010 and fore-

cast an annual average economic growth rate from 4.0% – 5.5% between 2009 and 2014 (IHS Global Insight, 2010). This is important to achieve to alleviate unemployment and poverty, but will also have implications for a low carbon city. The draft eThekweni Industrial Strategy's main goal is to grow the industrial economy, while promoting sustainable industrial development (Urban-Econ, 2010).

The EDS makes little or no mention of green economic opportunities or the need for sustainable development in the eThekweni Municipality (EDU, 2008). The themes of greening and sustainability

are taken up in later documentation, especially the Industrial Strategy (Urban-Econ, 2010) and 'Imagine Durban' (2009), which recognises the critical threat that climate change, in particular, presents to the challenge of long-term sustainability in the municipality.

The imperative of job creation is an overarching refrain at both national and local levels. Interventions that are able to capitalise on the co-benefits of carbon reduction and job creation are the most likely to succeed.

Local production of food is one such opportunity to create employment at a lower skill level and simultaneously reduce the city's carbon footprint, and further contribute to food security. The Soya Bean Project of the eThekweni Municipality's Agribusiness Forum is an example of how agriculture can be integrated into urban life and production. The municipality has taken a strategic decision to institutionalise agribusiness by creating a special Agricultural Management Unit (BuaNews, 2009).

Key Messages:

- Economic development is critical for the creation of jobs in the city.
- Interventions that are able to capitalise on the co-benefits of carbon reduction and job creation are the most likely to succeed.
- Local production of food presents an opportunity to create employment at the lower end of the skills spectrum.

ENERGY POLICIES AND INITIATIVES

Substantial progress has been made in terms of energy policies and initiatives. Initially, the issue of energy usage in response to climate change concerns was managed by the city's (then) Environmental Branch as part of its involvement in the Cities for Climate Change campaign as there was no institutional home at the time for energy-reduction policy and strategy (see Chapter 1).

The municipality's first State of Energy Report, which was intended to provide a platform for

the development of an Energy Strategy, was prepared in 2006 (Mercer, 2006). The report presented the municipal energy balance and proposed a series of sustainability objectives for both demand-side and supply-side sectors. Priority areas highlighted were the need to address the unacceptably high levels of road-based transport by a co-ordinated effort involving all levels of government; the low uptake of renewable energy technologies; the huge potential of energy efficiencies; the poor quality of energy data; and the negative health impacts of inappropriate fuel usage.

Following on the State of Energy Report, an En-

Table 2.3: EThekweni Municipality energy strategy targets (Mercer, 2008)

Sector	% CO ₂ e reduction by 2020	Annual saving by 2020 (kt CO ₂ e)
Residential	24.5	1 530
Local Authority and Public	33.0	357
Industry, Commerce and Agriculture	30.0	5 739
Transport	24.0	2 269
Total	27.6	9 895

ergy Strategy was developed, embracing an open and participatory process, to ensure the successful implementation of sustainable energy practices in the municipality (Mercer, 2008). The objectives of this strategy were derived from those contained in the national Energy Efficiency Strategy (Mercer, 2008). The Energy Strategy's vision statement reflects a commitment to sustainability in the energy sector and in energy-use. Targets are set for the percentage reduction of CO₂ emissions by 2020 in various sectors as set out in Table 2.3, with an overall reduction target of 27.6% from forecast future emissions. Action plans unpack how these theme targets are to be achieved, spanning a wide range of technical, managerial and institutional interventions, and have been designed to deliver energy efficiency and renewable energy improvements across all sectors. The Energy Strategy was approved by the eThekweni Council in January 2010.

A number of activities emerged from the Energy Strategy. A Catalogue of Renewable Energy Sources was produced in 2007 (Marbek Resource Consultants, 2007). It provided tech-

nical guidance on the potential of renewable energy technologies and guidelines for their implementation. A resource assessment reviewed the potential of wind, solar and biomass technologies for eThekweni Municipality, resulting in six proposed interventions with potential, viz. solar water heating projects for low and middle-income housing; solar water heating project for commercial buildings starting with municipal building stock; transformation of municipal petrol fleet to 10% bio-ethanol blend; transformation of municipal diesel fleet to 100% bio-diesel; feasibility assessment of conversion of sewage gas and solids as energy sources; and feasibility assessment for use of landfill gas at Buffelsdraai landfill as an energy source (Marbek Resource Consultants, 2007).

A number of other projects were initiated with the assistance of the DANIDA Urban Environmental Management (UEM) Programme, as shown in Table 2.4, cutting across various sectors in the municipality. The first was managed by the EPCPD, the next two by the Electricity Department (still underway), and the last by 'Imagine Durban' (eThekweni Municipality, 2009a).

Table 2.4: EThekweni Municipality energy projects until 2008 (Source: EThekweni Municipality, 2008)

Project Name	Project Description
Energy efficiency clubs	Establishment of energy efficiency clubs in industrial sectors
Light-emitting diode (LED) street lights	Pilot retrofit of existing street lights to LED technology and monitor performance
Solar water heating	Retrofit of municipal depot geyser systems to solar power
Communication of energy efficiency	Communication of energy reduction strategies to all sectors of the community Energy Efficiency Guideline as part of Greening Durban 2010

An institutional home for energy issues was created in February 2009, with the establishment of an Energy Office, linked to the city's Treasury Department. The issue of climate change and energy efficiency was elevated in importance by municipal leadership from 2008 onwards. This change can be attributed to a combination of factors around this time – mainly the national electricity crisis in early 2008, as well as the city's involvement in the DANIDA UEM Programme which provided substantial funding for energy projects. The initial role of the Energy Office was to create a central platform to coordinate city-wide energy saving initiatives. However, recently

(since Council approval of the Energy Strategy in January 2010) this role has broadened to include the implementation of the Energy Strategy in the municipality; essentially a climate mitigation function which includes renewable energy, energy efficiency and low carbon alternatives. The Durban Industry Climate Change Partnership Project (DICCPP) was initiated in 2008 by the United Nations Industrial Development Organisation (UNIDO) in partnership with the Durban Investment Promotion Agency (DIPA), the eThekweni Municipality and the Durban Chamber of Commerce and Industry. The aim of the project is to contribute towards climate change

mitigation and adaptation through a partnership between the industrial and public sectors in Durban (DICCPP, 2010).

The Energy Office has initiated a number of projects. Some are summarised as follows:

- A Solar Water Heating (SWH) Programme, called Shisa Solar, to facilitate the roll-out of SWH in middle to high-income households. The programme aims to install 50 000 SWHs by 2015 (Morgan, 2010).
- The installation of SWHs in low-income households with funding from the service provider, through the Eskom subsidy, grant funding and carbon finance. The first phase of the programme aims to install 34 000 units by mid-2011.
- Wind energy initiatives: Production of a wind map for the city, wind data collection and

the erection of four wind turbines donated by Bremen City.

- To increase education, awareness and outreach through the Residential Energy Efficiency Campaign, the establishment of a Cleaner Production Centre, Municipal Schools Energy Programme, Sustainable Energy Demonstration Centre and the Industrial Energy Efficiency Technical Training Facility.
- Implementation of a municipal energy management policy and system for the municipality that will target traffic lights, street lights and municipal buildings.
- The KwaZulu-Natal Sustainable Energy Forum (KSEF), created in 2010, to serve as an information portal as well as attract and provide support to business investment in the energy sector and the broader green economy.

Key Messages:

- The city took a significant step forward when it created the Energy Office, which is strategically positioned so that it reports to the Treasury Department.
- Commendable targets have been set for CO₂ emissions reduction, viz. 27.6% on average.

TRANSPORT POLICIES AND INITIATIVES

The eThekweni Transport Authority (ETA) prepared two policy documents in 2005 to direct and manage the transport sector, viz. the Integrated Transport Plan (ITP) (ETA, 2005a) and a Public Transport Plan (ETA, 2005b). Both plans cover the period 2005 to 2010, and are developed within the context of national and provincial transport imperatives and support the IDP. In 2010, the ETA released the Integrated Transport Plan update for 2010 – 2015 (ETA, 2010), which highlights its mission statement as follows:

“To provide and manage a world-class transport system with a public transport focus, providing high levels of mobility and accessibility for the movement of people and goods in a safe, sustainable and affordable manner.” (ETA, 2010: 2.5)

The ITP (ETA, 2010), emphasises five focus areas, which are: public transport, freight, safety, roads

and traffic management and control. The 2010 FIFA World Cup had a notable influence on the transport sector, which provided the ETA with funding through the Public Transport Infrastructure and System Grant. Some key projects that were fast-tracked through this grant were:

- The King Shaka International Airport
- Public Transport Lanes on the M4 Inkosi Albert Luthuli Freeway
- The Intelligent Transportation Systems (ITS) Freeway Management System
- Inner City Distribution System – the People Mover
- Warwick Junction inbound and outbound flyover structures
- Improving non-motorised transport facilities, through the beach promenade upgrade and pedestrian routes and sidewalk upgrades within the CBD
- Major and minor passenger rail upgrades.

While there has been a step forward in introducing efficient public transport, through the

People Mover and the upgrade of the passenger rail, the transport sector still requires major

intervention, especially since it is the second highest GHG emitter in the city (see Chapter 5).

Key Messages:

- There is a disjuncture between the eThekweni Transport Authority's policy documents and the reality on the ground.
- There have been few climate change related initiatives in this sector.

INFRASTRUCTURE SERVICES POLICIES AND INITIATIVES

WATER

Relevant policy documents are the Water Services Development Plan, which has been produced by eThekweni Water and Sanitation (EWS) and the Umgeni Water Master Plan, which predicts that substantial growth in the urban and peri-urban housing sector, as well as development associated with DTP, will drive continued growth in water sales in the eThekweni Municipality (Umgeni Water, 2010). However, the city's new intensive water demand management programme (Umgeni Water, 2010) aims to reduce the quantity of non-revenue water (NRW), which is water that is lost due to leaks and illegal connections. Currently, 37% of water is lost, and if this is reduced to 20%, it will result in a major saving of water. One initiative the EWS has embarked on is to replace pipelines, which will significantly reduce water losses through burst pipes and leakages⁴ (Umgeni Water, 2010).

EWS has been particularly innovative in initiating projects that aim to reduce water demand and generate electricity⁵. These include:

- Pre-feasibility study to determine potential of hydro-turbine projects in Hillcrest, Wyebank Road and Inanda. The estimated potential is 9 MW and it is anticipated that they will be commissioned by 2013.
- Mini-turbines at a water reservoir. Total generation capacity is 600-700 kW and they have the potential to be replicated at other reservoirs. Currently this project is at the tendering stage.
- Investigation of the potential of pico-turbines on the water reticulation system downstream of water reservoirs. A pilot project is planned.
- Pre-feasibility study of a large-scale desalination plant with a projected capacity of 450 Ml/day. This would result in the availability of a new water source but it is recognised to be energy-intensive.
- NRW programme, the primary objective of which is to reduce water losses from approximately 40% by volume at present to 23% within five years. This programme includes activities such as the implementation of new supply pressure zones to reduce average water pressure (most effective), maintenance of the water supply system, continued leak detection surveys on reticulation and trunk mains, improvements in leak repair efficiency, rectification of unmetered connections and informal settlement metering. A co-benefit of this programme is that it contributes to a reduction in the carbon footprint of the city.
- Feasibility study of recycling domestic wastewater to potable drinking standard.
- Water recycling for industrial use.

Key Messages:

- EThekweni Water and Sanitation has been particularly innovative in initiating projects that aim to reduce water demand and generate electricity.

⁴ S. Moodliar, eThekweni Water and Sanitation, personal communication, August 2010.

⁵ N.McLeod, eThekweni Municipality, personal communication, June 2010.

SANITATION

Again, a number of innovative projects⁶ are under consideration. These include:

- Biodiesel project to transform algae from maturation ponds at the city's wastewater treatment works (WWTWs) to biodiesel and other products.
- Sludge disposal plan that aims to accelerate stockpiling for agriculture and to make pellets, for soil improvement in the agriculture and forestry industry with the remainder (a process that requires electricity).
- Installation of about 90 000 UD toilets in the peri-urban areas of the city where there are no sewerage systems. Such on-site sanitation systems require no electricity and small amounts of water, and therefore do not contribute to the carbon footprint of the city. EWS is researching the extraction of phosphorous (essential for agriculture) from urine.
- Wherever appropriate, safe on-site sanitation is being promoted to avoid the high electricity requirements of WWTWs. Small on-site anaerobic digesters are being tested to digest agricultural wastes and sewage. A small scale system using the sewage from a community centre and adjacent houses is already operational in Cato Crest and yields 60 kW of electricity for use at the community centre. The treated water from the digester is used in a local food garden attached to the centre and there are plans to use some of the effluent for aquaculture of tilapia fish⁷.
- The viability of a biogas to energy initiative in the first phase of an upgrade of the eThekweni Southern WWTW is being investigated (Greening Durban, 2010). It entails the treatment of raw sewage sludge by way of anaerobic digestion biological processes, the generation of electricity using the methane-rich biogas produced from the AD plants, and the production of compost and nutrient-rich fertiliser materials from the digestate of the AD processes at the Southern WWTW. It is anticipated that it will create 21 jobs, result in 97 038 Certified Emission Reductions (CERs) and yield 18 679 900 kWh electricity output per annum, as well as agricultural pellets and fertiliser.

SOLID WASTE

eThekweni Municipality's waste management agency, Durban Solid Waste (DSW), has been responsible for ensuring that the waste sector is one of the most active in initiating actions that contribute towards a reduction in carbon emissions. In terms of the IDP (eThekweni Municipality, 2009b), the municipality plans to promote source-based management, i.e. at the household and manufacturing plant level. The IDP emphasises the need for the development of a culture of recycling. Current initiatives fall broadly into four groups, viz. materials recovery for recycling, composting, energy recovery and waste minimisation.

Materials recovery for recycling

DSW has promoted a number of options for recovering materials that would otherwise end up on a landfill. These include:

- Separation at source with curbside collection – so-called 'orange bag' system (see Box 2.1)
- Materials Recovery Facilities where recyclables contaminated by other waste are recovered. They include drop-off centres, buy-back centres and mixed waste Materials Recovery Facilities (see Box 2.2).

Composting

At a small scale, an indeterminate number of households in eThekweni Municipality practise recycling in the form of backyard composting. On a larger scale, at the municipal level, the National Plant Foods low-technology composting operation in Cato Ridge (Gromor Products) has been operating successfully for several decades. High-quality compost is manufactured using chicken litter, abattoir lairage, paunch contents and ingesta from slaughtered animals, along with knottings and finely divided material from Sappi Saiccor, a pulp and paper company.

Composting pilots were also run at the Bisasar Road landfill in conjunction with the University of KwaZulu-Natal.

Energy Recovery

Landfill gas to electricity projects (see Box 2.3). The municipality has been a frontrunner in Clean Development Mechanism (CDM) proj-

⁶ N. McLeod, eThekweni Water and Sanitation, personal communication, June 2010.

⁷ R. Lombard, Lombard & Associates, personal communication, August 2010.

Box 2.1: Orange Bag Collection System

The Mondi Recycling Company's orange bag collection system for mixed paper and plastic (www.paperpickup.co.za) has been successfully implemented in approximately 800 000 households and there are plans to extend the system to more residential areas and to include glass and metal. Mondi supplies the orange plastic bags to households and contracts their agents to collect the orange bags on the same day that the municipal curbside collection of black bags takes place. The materials are transported to the company's MRF, where the waste is sorted and sent to appropriate recycling companies for processing. Education of residents to use the orange bag system is carried out in a variety of ways. Approximately 60% of the orange bags distributed are returned and some 1200 tons per month of recyclable materials are recovered (pers. comm., N. Govender, DSW), equivalent to 1.5% of the total waste mass sent to landfills.

Box 2.2: Materials Recovery for Recycling

Facilities where recyclables contaminated by other waste are recovered include:

Drop-off centres: Facilities where recyclable materials are delivered by the general public on a voluntary basis. There are numerous drop-off centres operating in more affluent areas, as well as a privately-owned centre at the Pavilion Shopping Centre in Westville, and numerous community recycling centres that accept both recyclable materials and garden waste.

Buy-back centres: Facilities where people are paid for recyclable materials brought to the centre. They generally operate successfully in lower income areas. DSW has established a number of buy-back centres and provides training for the entrepreneurs operating the centres.

Mixed Waste MRFs: These are "dirty MRFs", which recover recyclable materials from the mixed waste stream at formally established facilities. The Mariannhill MRF is owned and operated by a private company (Re-). This facility diverts 30% by volume of the domestic waste stream collected from landfill, equivalent to approximately 10% of the total waste stream entering the site. According to Re-, far more of the waste stream could be diverted if more space was allocated (pers. comm. S. Purchase, Re- (Pty) Ltd., 2010). Almost 50% of the waste entering this landfill site is industrial waste, all of which is landfilled because Re- cannot handle this material due to space constraints. This MRF employs approximately 100 people, mainly unskilled. This MRF remains viable because of the formal commitment by DSW and Re- to diverting waste and recovering recyclables as part of the eThekweni Municipality carbon footprint reduction and metro greening effort. At the time of writing this facility had closed down.

ects in South Africa through the eThekweni Landfill Gas to Electricity CDM project operating at Mariannhill and Bisasar Road landfills, capable of generating 1 MW and 6 MW of electricity respectively. The electricity produced is sold to eThekweni Electricity through a ten-year Power Purchase Agreement (PPA) at parity with the Eskom Local Authority Tariff. The project has had a significant impact for the following reasons:

- it has provided South Africa with a working reference case;
- it has established eThekweni Municipality as a leader in the field;
- it has demonstrated that it is possible to build and operate a renewable energy power plant; sell the electricity back to the municipality; and achieve CDM registration and CER verification;
- the project is reproducible and contributes to technology and knowledge transfer – even more so because this type of project is uncommon in developing countries.

Other carbon reduction projects

- Mechanical Biological Waste Treatment to Energy

This is a planned project at Mariannhill landfill due for operation in 2012 (Greening Durban, 2010). It represents a partnership between EPCPD and DSW. The project will entail the removal of organic wastes from the existing mixed municipal solid waste streams in the western regions of the municipality and subsequent composting, anaerobic digestion and electricity generation. It is expected to generate 34 jobs at various levels; produce 4 032 000 kWh of electricity per year, 24 872 CERs per annum, 5 940 tons of compost and 405 tons of fertiliser per year.

Anticipated benefits include:

- carbon capacity building;
- financial return through the sale of carbon credits;
- production of a compost and fertilizer blend;
- landfill airspace savings;

- provision of renewable electrical energy;
- job creation and sustainable development;
- combating global climate change.

• Electric vehicles

In 2010, Durban Solid Waste had one electric vehicle which is used for sweeping. The vehicle has resulted in a great decrease in fuel consumption, however, the costs and environmental impacts of replacing the battery pack are unknown⁸.

Waste Minimisation Clubs

In 1997, there was an initiative to establish two Waste Minimisation Clubs in the metal finishing industry and in the Hammarsdale area amongst mainly textile finishing companies. A Waste Minimisation Club is a group of companies working together to improve productivity through waste reduction (UNIDO, 2009). Over the three-year period that the programme ran, the Hammarsdale Club was able to save up to 43 600 tCO₂e and the Metal Finishing Club 1 400 tCO₂e in emissions (UNIDO, 2009). In 2001, the programme was re-established through the National Cleaner Production programme, which used the clubs to implement a number of cleaner production methodologies. Currently, the activity of these clubs is quite limited.

INSTITUTIONAL CHARACTERISTICS

eThekweni Municipality is run by a City Manager, who reports to the Council. Under the City Manager, there are Deputy City Managers, then heads of units and then departments. According to the City Manager, the various units and departments operate in a fragmented way⁹ and he has proposed converting them to project clusters to achieve strategic focus.

For example, in terms of climate change activities, climate change adaptation projects are run by the EPCPD, while the Energy Office heads up the mitigation aspects. However, certain aspects of adaptation and mitigation lie scattered throughout various units or departments (Fig. 2.2).

⁸ J. Parkin, Durban Solid Waste, personal communication, 5 July 2010

⁹ http://www.durban.gov.za/durban/government/cm/structure/intro?-C=&plone_skin=eThekweniPrint

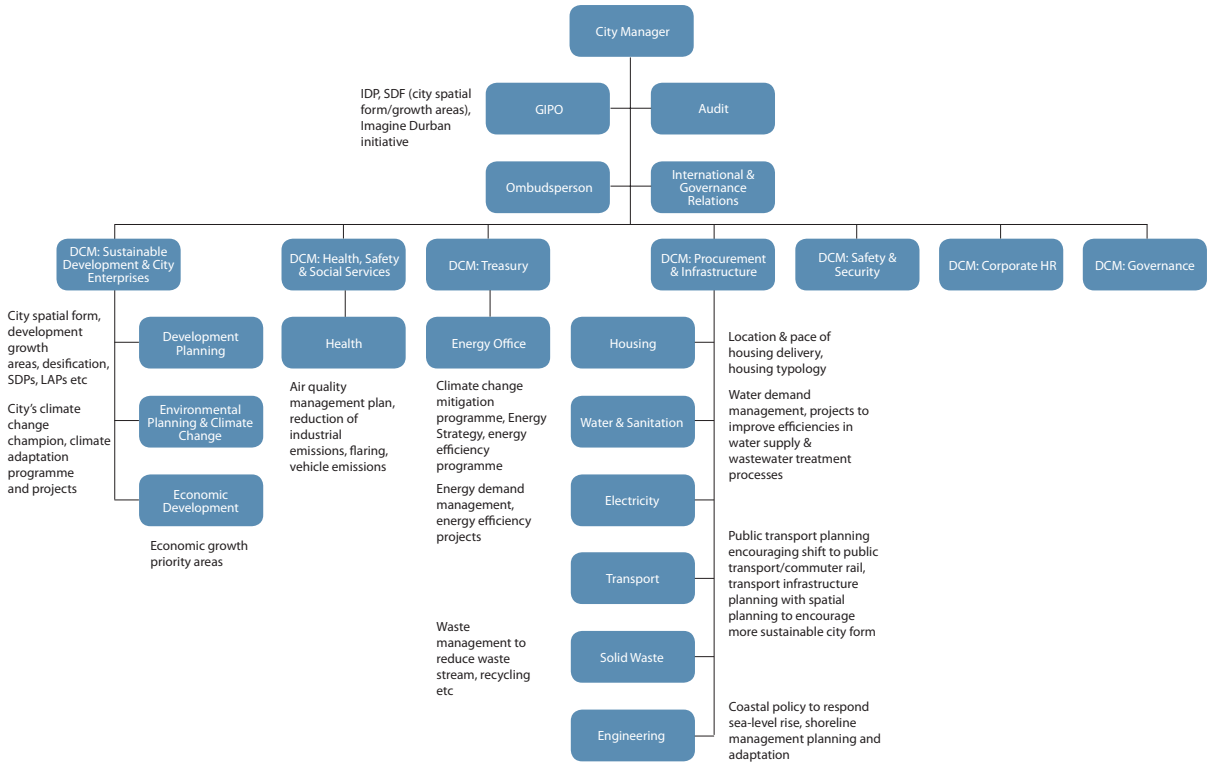


Figure 2.2: Organogram of the eThekweni Municipality. (Source: EPCPD)

SUMMARY

Certain departments in eThekweni Municipality have exhibited commitment and leadership and are responsible for innovative and successful projects. Examples include energy, water,

sanitation, solid waste departments and EPCPD. In stark contrast, there are others that have thus far responded minimally to the climate change challenge, providing considerable opportunity to initiate innovative projects.

Box 2.3: Landfill Gas to Electricity Project

The municipality has been a frontrunner in CDM projects in South Africa. The eThekweni Landfill Gas to Electricity CDM project was conceptualised in 2003, when it was decided to install landfill gas extraction and electricity generating plants at the three DSW landfills, viz. La Mercy, Mariannhill and Bisasar Road, with potential to produce 10MW of electricity. An Emissions Reduction Purchase Agreement for Certified Emission Reductions (CERs) was signed with the World Bank in 2004 for all three sites, although this later excluded the Bisasar Road site due in part to Environmental Impact Assessment (EIA) delays (DSW, 2009). A 1 MW plant at Mariannhill has been in operation since 2006. A much larger operation has been developed at the Bisasar Road landfill - a first phase 4MW plant was completed in April 2008, and was then expanded to 6.5MW in 2009. The project is Africa's largest CDM project, worth 3.1 million CERs (UNIDO, 2009). An ERPA agreement for this site was signed with Trading Emissions plc from the United Kingdom, which came into effect after CDM registration in March 2009. The La Mercy site has not been able to operate as gas flows were too low, and the machinery was relocated to Bisasar Road.

It is expected that Mariannhill landfill will be in operation until 2024 and Bisasar Road until at least 2020. Over the course of the initial seven-year carbon reduction crediting period, the generators are projected to produce nearly 350,000 MWh, amounting to an estimated CO₂ reduction of 340 000 tons. It is estimated that the project will reduce an aggregated 2 466 957 tons of CO₂ in the first seven-year crediting period. The Bisasar Road project was commissioned in January-February 2008. The lessons learnt from Component One have made it possible to achieve almost double the gas yield in Component Two. The current emission reduction at Bisasar Road is about 15 – 20 000 t CO₂e per month (pers. comm., J. Parkin, DSW, July 2010).

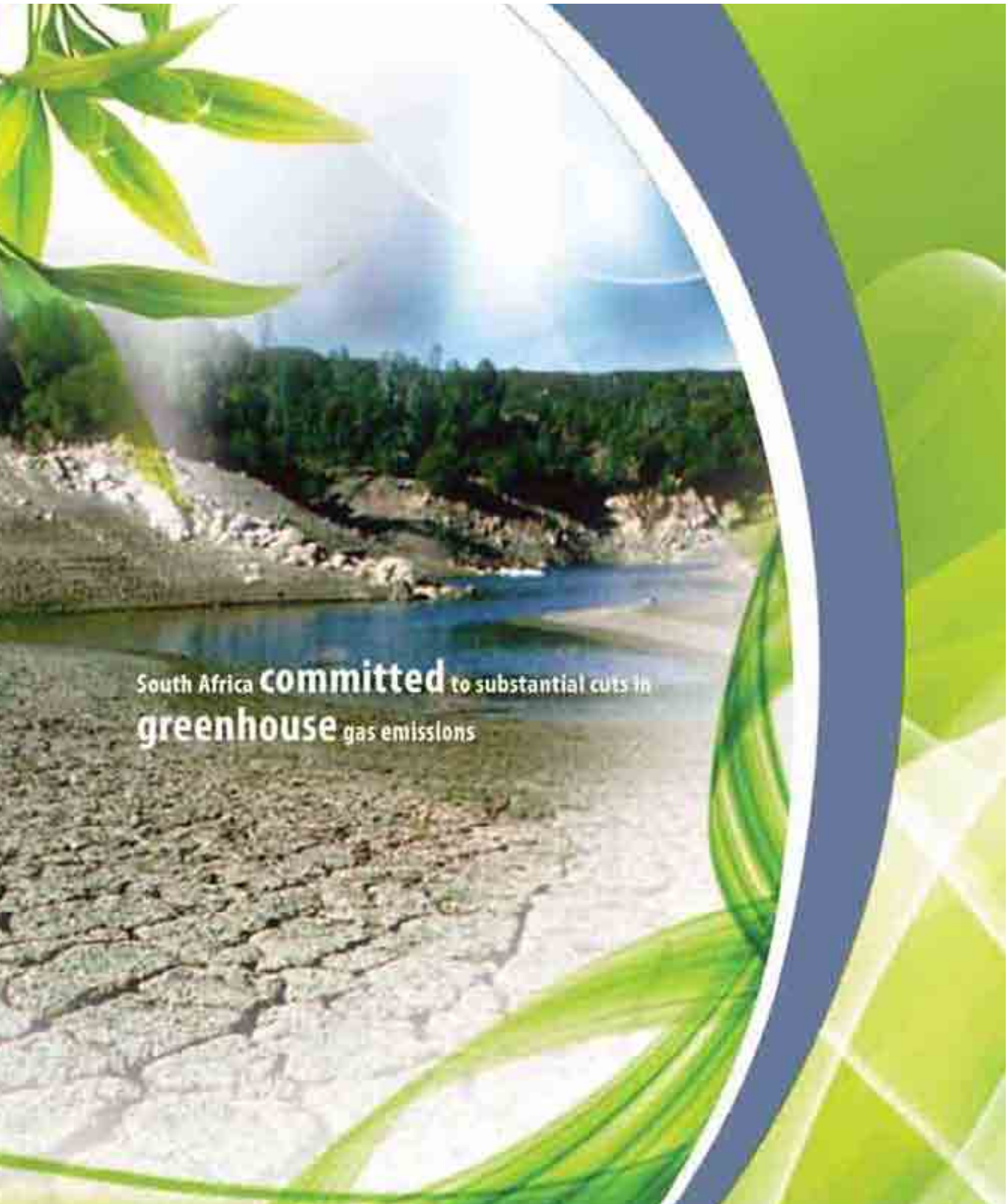
Carbon Emission Reduction Credits (CERs)

The 2009 world market (AFD, 2009) for carbon credits showed that eThekweni Municipality could negotiate a price around €11.00 per CER over a project period of 10-14 years for Component Two. This price was substantially different to the US\$ 3.95 per ton gained from Component One. While there was consensus on the substantial benefit to be derived from CERs, the process leading up to receipt of the revenue is arduous and protracted, and greatly increases the management burden and administrative costs. A timeline of no less than three years to achieve a possible income must also be factored into the preparation phase.

Bisasar Road landfill produces a high flow of landfill gas, in excess of 7 000 m³ per hour (equivalent to 7 tons of coal per hour) that is neither extracted nor utilised. Every day that the financial transaction of the CER is delayed translates to a loss by eThekweni Municipality of almost R100 000 in potential sales of CERs and electricity. Approximately 2 500 m³ of landfill gas per hour (equivalent to 2.5 tons of coal per hour) is captured on a continuous basis. All the electricity produced is sold to eThekweni Electricity through a ten-year Power Purchase Agreement (PPA) at parity with the Eskom Local Authority Tariff.

The project has had a significant impact, providing South Africa with a working reference case, and establishing eThekweni Municipality as a leader in the field. The project has demonstrated that, it is possible to build and operate a renewable energy power plant; sell the electricity back to the municipality; and achieve CDM registration and CER verification. The project is reproducible and contributes to technology and knowledge transfer – even more so because this type of project is uncommon in developing countries.

There have been obstacles to overcome including those posed by the Municipal Finance Management Act (MFMA).



South Africa **committed** to substantial cuts in
greenhouse gas emissions



the national context

BACKGROUND – PUTTING CLIMATE CHANGE ON THE NATIONAL POLITICAL AGENDA

During the mid to late-1980s, there was an emerging body of scientific evidence that human-induced global warming was taking place with severe predicted consequences for climate patterns. With this, the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to synthesise the scientific evidence relating to climate change.

The 1st IPCC Assessment Report published in 1990 (IPCC, 1991) presented sufficient scientific evidence of climate change to elicit worldwide concern and the negotiation of the United Nations Framework Convention on Climate Change (UNFCCC), which was opened for signature at the Rio Earth Summit in 1992 and came into force in 1994.

In 1994, in response to the growing international concerns around climate change, the South African Department of Environmental Affairs and Tourism (DEAT) established the National Climate Change Committee (NCCC), a multi-stakeholder forum aimed at discussing and informing South Africa's response to these concerns.

The 2nd IPCC Assessment Report (IPCC, 1996) demonstrated that the actions outlined in the UNFCCC were insufficient and this motivated the negotiation of the Kyoto Protocol which was finalised in 1997 as a first step towards a more ambitious international response to the global climate change threat. In response to the findings of the IPCC's 2nd Assessment Report and supported by recommendations from the

NCCC, the South African government ratified the UNFCCC in August 1997.

The 3rd IPCC Assessment Report in 2001 (IPCC, 2001) gave further scientific certainty that climate change was indeed largely caused by human activity and provided impetus for the further development and implementation of the Kyoto Protocol, that finally came into force in 2005. By 2001, South African research on climate change and its implications were also becoming well established (e.g. Davidson and Tyani, 2001).

Arguably, climate change took a leap up the South African political agenda when, in 2002, the Heads of State of over 180 countries met at the World Summit on Sustainable Development in Johannesburg. In July, 2002 the South African government acceded to the Kyoto Protocol (Blignaut *et al.*, 2005).

By 2003, South Africa had concluded its Climate Change 'Country Studies' and 1990 and 1994 GHG inventories and had submitted these in the form of its Initial Communication to the UNFCCC Secretariat (RSA, 2000). In compiling and finalising this briefing document on South Africa and climate change, it became clear that South Africa was not only potentially a significant victim of the negative impacts of climate change, but also a significant contributor to GHG emissions. Given this difficult position of both climate change victim and perpetrator, South Africa's negotiation efforts were seen to rise several notches at this time resulting in comments that South Africa 'punches above its weight' in the climate change negotiations.

By 2005, based on evidence from the 3rd IPCC Assessment Report and new emerging science,

it was increasingly clear that the measures agreed to in the UNFCCC and its Kyoto Protocol were an inadequate international response to the threats posed by climate change; in particular, since the legally binding provisions of the Kyoto Protocol only covered less than 40% of the world's GHG emissions (Tladi, 2005). It also became clear that South Africa, along with other more advanced developing countries (e.g. China, India, Brazil, Mexico, South Korea and Saudi Arabia), would have to start considering its responsibility for climate change more seriously, and that, as a fossil fuel-powered nation, this would have dramatic policy implications.

The following sections provide further detail on the important developments from 2005 to the present.

EARLY DAYS – THE NATIONAL CLIMATE CHANGE COMMITTEE (NCCC)

The National Climate Change Committee (NCCC) was established in 1994. Its purpose is to advise and consult the Department of Environmental Affairs (DEA) on matters relating to national responsibilities with respect to climate change, and in particular, in relation to the UNFCCC and the Kyoto Protocol and the implementation of climate change related activities.

2005 'CLIMATE ACTION NOW' CONFERENCE

A key event in shaping the national government's climate change response was the 'Climate Action Now' Conference held in Midrand in October 2005. The conference unanimously agreed that climate change was a reality, and government affirmed that South Africa would accept its responsibility to address climate change and would mobilise different economic sectors to meet the challenge.

The conference further acknowledged the urgency of stabilising concentrations of GHGs and called on all nations to join in support of the international effort to reduce GHG emissions, with developed countries taking stronger action. It was also agreed that the time for countries such as South Africa to take further action on the basis of differentiated responsibility had come and there was an expressed wish to see the emer-

gence, after 2012, of a strengthened Kyoto or Kyoto-plus regime that was more inclusive, flexible, cooperative and environmentally effective. In addition, the conference noted that the issue of adaptation needed to become a more prominent global priority in the climate regime.

An outcome of the conference was the Midrand Plan of Action, which described a number of activities representing the undertakings by government, and which was intended to lead the country's climate change programme into the future (DEAT, 2005). The Midrand Plan of Action included an acknowledgement of Eskom's re-statement of its commitment to displacing 10% of its coal-fired generating capacity with alternative sources by 2012 and its commitment to further reductions beyond 2012.

LONG-TERM EMISSION SCENARIOS (LTMS)

One of the activities described in the Midrand Plan of Action was the initiation of a detailed scenario-building process to map out how South Africa could meet its UNFCCC Article 2 commitment to GHG stabilisation, whilst simultaneously ensuring sustained focus on poverty alleviation and job creation.

To this end, in March 2006, Cabinet mandated a national process of building scenarios of possible GHG emission futures, which became known as the Long-Term Mitigation Scenarios (LTMS) development process. A LTMS Scenario Building Team (SBT), comprising over 80 individual stakeholders from government, industry, labour, civil society, as well as other relevant players, was constituted. The results of their work were published in October 2007 in a series of reports (*The Long-Term Mitigation Scenarios - Strategic options for South Africa* (SBT, 2007a); *The Long-Term Mitigation Scenarios – Technical Summary* (SBT, 2007b); *The Long-Term Mitigation Scenarios – Technical Report* (SBT, 2007c)).

The LTMS developed two scenarios that provide the envelope for possible GHG interventions (Fig. 3.1). The upper limit of the intervention envelope is termed the 'Growth without Constraints' Scenario. In this scenario, South Africa's emissions in the base year, 2003, stand at 440 Mt CO₂e. By 2050, emissions have quadrupled to around 1 600

Mt. The lower limit of the intervention envelope is termed the 'Required by Science' Scenario. Globally, the IPCC states that reductions by 2100 of between 60% to 80% from 1990 levels must be achieved. The burden-sharing between nations of this target is the subject of international negotiations. The burden to be taken up by South Africa is not exact, but is seen rather as a target band ranging between a reduction of 30% and 40% from 2003 levels by 2050, assuming a burden-sharing discount, which, in itself, is considered to be difficult to negotiate.

A further trajectory, termed 'Current Development Plans' is added - this assumes that government policy in place at the time of the study is implemented (e.g. renewable energy targets, energy efficiency accords, etc.). For example, energy efficiency interventions achieve a final energy demand reduction of 12% by 2015. The target of 10 000 GWh renewable energy contribution to final energy consumption by 2013 is also included. When simply extended to 2050, however, the figure illustrates that the trajectory under the 'Growth without Constraints' Scenario would not be radically changed; it would

continue climbing, and would still see emissions reach a point above 1 500 Mt.

Within this envelope, three strategic options were considered to drive GHG emissions (Fig. 3.1).

- In the first of the strategic options, known as the 'Start Now' option, mitigation actions are suggested that are implemented through state action. The actions suggested should be taken for good economic reasons and other sustainable development co-benefits, quite independent of climate change.
- In the second strategic option, the 'Scale Up' option, South Africa increases its level of ambition, and achieves it through regulatory decision. The effect of this on the emissions trajectory can be seen in Figure 3.1, and gets about halfway to the objective if taken through to 2050.
- The third option, the 'Use the Market' option, aims to get the market to work and promote the uptake of the accelerated technologies and social behaviour through incentives and taxes. At the tax levels considered here, 'Use

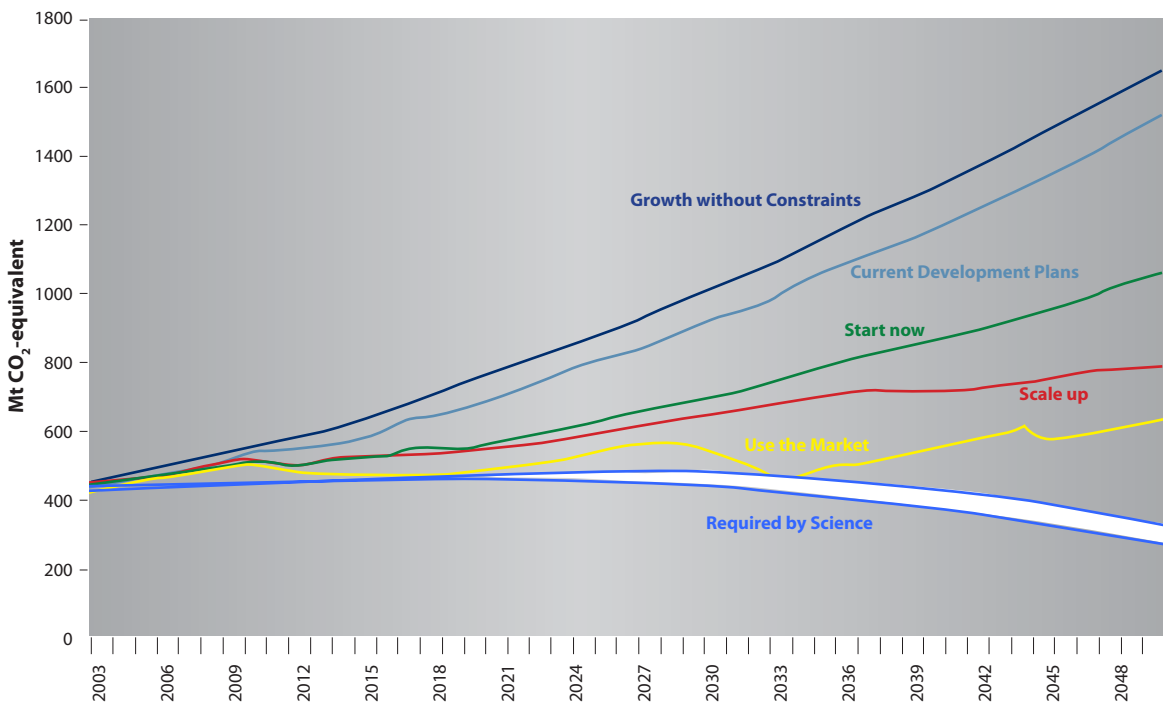


Figure 3.1: Greenhouse gas emission scenarios (2003-2050) described by the LTMS (SBT, 2007a)

the Market' results in emissions reductions beyond those seen in the 'Scale Up' option. 'Use the Market' thus includes a package that prepares South Africa to make use of economic instruments, both taxes and incentives, to shift patterns of domestic investment. The key driver of 'Use the Market' is a CO₂ tax. This price change makes the use of fossil fuels much less attractive, and induces an indirect effect of greater investment in low-carbon technologies.

Given the above, the key findings of the LTMS process are:

- Growing without carbon constraints may be good for South Africa's economic growth, but will result in rapidly increasing emissions. A four-fold increase in emissions by 2050 is likely to be unacceptable to the international community and is a high-risk approach on other grounds, such as rising oil prices and carbon constraints in trade.
- If all countries, including high emitters in the developing world, adopted this approach, climate change impacts in South Africa would be extensive.
- A massive effort by South Africa would be required to achieve emissions reduction sufficient to meet the 'Required by Science' target. The gap between where South Africa's emissions are going and where they need to go is large.
- Certain quantifiable strategic mitigation options are immediately implementable, even if they require significant effort. These include energy efficiency, especially in industry; electricity supply options; carbon capture and storage (CCS); transport efficiency and shifts; people-oriented strategies; supported by awareness. These potential strategies

show good emissions reduction results, with costs to the economy ranging from affordable to significant.

- Within the quantifiable mitigation strategies, South Africa can choose both regulatory and economic instruments. Neither of these, however, completely closes the gap. With an escalating tax, economic instruments go the furthest in closing the gap, by almost three-quarters, but they are not intrinsically more effective than regulation.
- Hence, much preparation of a range of further, more uncertain, and for now, less understood actions need immediate exploration. These range from future technology to changes in social behavior.
- Key to success will be strong, committed South African/national leadership, coupled with international alignment and active support.

The LTMS process has analysed a range of quantifiable mitigation objectives, which provide information for South Africa to negotiate. For domestic policy-makers, business leaders and leaders in South African society, LTMS has revealed that action will be required across the board, and that extensive further work is required.

2007 ANC CLIMATE CHANGE RESOLUTION

A few weeks following the sign-off of the LTMS, the African National Congress (ANC) made a strong climate change resolution (see Appendix 3) at its 52nd National Conference in Polokwane. This resolution, *inter alia*, recognised the need for immediate action by all governments and supported the setting of a target for the reduction of GHG emissions. With this, it was clear

Key Lessons:

- The Long-term Mitigation Scenarios (LTMS) process provides various strategic options for South Africa to achieve greenhouse gas reductions. These are:
 - 'Start Now'
 - 'Scale Up'
 - 'Use the Market'.
- A massive effort is required by South Africa to meet the 'Required by Science' target.

that, not only had climate change moved well up the political agenda, but that there was strong support and political will for the development of a progressive National Climate Change Response Policy.

NATIONAL CLIMATE CHANGE RESPONSE POLICY

JULY 2008 CABINET DECISIONS

In July 2008, the ANC's Climate Change Resolution, the LTMS conclusions and other climate change related submissions, were discussed and debated by Cabinet and six broad policy directions themes to be addressed in a National Climate Change Response Policy approved:

- Theme 1: GHG Emission Reductions and Limits – under this theme climate change mitigation interventions should be informed by, and monitored and measured against a 'peak, plateau and decline' emission trajectory where GHG emissions stop growing (start of plateau) in 2020- 2025 and begin declining in absolute terms (end of plateau) in 2030-2035.
- Theme 2: Build on, Strengthen and/or Scale Up Current Initiatives – under this theme current energy efficiency and electricity demand-side management initiatives and interventions must be scaled-up and reinforced through available regulatory instruments and other appropriate mechanisms (made mandatory) and, based on the electricity crisis response, government's energy efficiency policies and strategies must be continuously reviewed and amended to reflect more ambitious national targets aligned with the LTMS. In addition, Treasury will study the implications of a carbon tax.
- Theme 3: Implementing the 'Business Unusual' Call for Action – under this theme the renewable energy sector was identified as a key 'business unusual' growth sector and policies and measures are to be put in place to meet a more ambitious national target for renewable energy. Government must promote the transition to a low carbon economy and society. In addition, the transport sector was identified as another key 'business unusual' growth sector and was targeted for ambitious and mandatory national targets for the reduction of GHG emissions.
- Theme 4: Preparing for the Future – under this theme there was increased support for research and development, especially in the field of carbon-friendly technologies, with the focus on the renewable energy and transport sectors. The importance of education and outreach was also emphasised.
- Theme 5: Vulnerability and Adaptation – under this theme vulnerabilities to climate change must continue to be identified and adaptation interventions prioritised and initiated. Monitoring of implementation across affected government departments will be included as departmental key performance areas.
- Theme 6: Alignment, Coordination and Cooperation – under this final theme the roles and responsibilities of all stakeholders, particularly the organs of state in all three spheres of government, will be clearly defined and articulated; the structures required to ensure alignment, coordination and cooperation will be clearly defined and articulated; and climate change response policies and measures will be mainstreamed within existing structures.

Second, the Cabinet also approved, amongst others, the following key messages that reinforce what needs to be included in the National Climate Change Response Policy:

- The socio-economic transition – a transition to a climate resilient and low-carbon economy and society that balances South Africa's mitigation and adaptation response and, in the long term, redefines our competitive advantage and structurally transforms the economy by shifting from an energy-intensive to a climate-friendly path as part of a pro-growth, pro-development and pro-jobs strategy.
- Below 2°C – South Africa's climate response policy, built on the six pillars (themes) described above, will be informed by what is required by science – to limit global temperature increase to below 2°C above pre-industrial levels.
- Adapt to the inevitable - continue to proactively build the knowledge base and capacity to adapt to the inevitable im-

pacts of climate change, most importantly by enhancing early warning and disaster reduction systems and in the roll-out of basic services, infrastructure planning, agriculture, biodiversity, water resource management and in the health sector.

- GHG reduction and limits - GHG emissions must peak, plateau and decline - stop growing at the latest by 2020-2025, stabilise for up to ten years, then decline in absolute terms.
- Six policy themes - implementing policy under the six themes described above will lay the basis for measurable, reportable and verifiable domestic emission reduction and limitation outcomes.
- Contribution to the global efforts - This would constitute a fair and meaningful contribution to the global efforts, demonstrating leadership in the multi-lateral system by committing to a 'substantial deviation from baseline', enabled by international funding and technology.

Finally, a number of immediate mitigation tasks were identified, including:

- 'Start Now' based on accelerated energy efficiency and conservation across all sectors (industry, commerce, transport, residential – including more stringent building standards);
- invest in 'Reach for the Goal' by setting ambitious research and development targets focusing on carbon-friendly technologies, identifying new resources and effecting behavioural change;
- combine regulatory mechanisms under 'Scale Up' and economic instruments (taxes and incentives) under 'Use the Market' options;
- mandatory energy efficiency targets;
- use of economic instruments;
- favouring energy-efficient industry;
- promoting carbon capture and storage;
- diversifying the energy mix and laying the basis for a net zero-carbon electricity sector in the long term;
- reducing transport emissions.

2009 SUMMIT

In March 2009, a second Climate Change Sum-

mit was held in Midrand to initiate a consultative process to develop the South African Climate Change Response Policy (DEAT, 2009b). The gathering affirmed South Africa's commitment and determination to act on climate change and to shape policy informed by the best-available science. The then President, Kgalema Motlanthe, emphasised the need for South Africa to act now on climate change as it presented the best opportunity to overcome the "challenges of the global economic crisis through investment in pro-poor, job-creating and sustainable 'green growth'". He also reiterated that "Government has agreed to a strategic policy framework for our emissions to peak between 2020 and 2025, and then stabilise for a decade, before declining in absolute terms towards mid-century." (RSA, 2009)

Various Ministers confirmed commitments of their departments, and of relevance here, it was noted by the representative from the South African Local Government Association (SALGA), that local government is "strategically positioned to be in the frontline tackling climate change" (RSA, 2009).

It was also noted as an action item that local government, through SALGA and associated provincial associations, must initiate and facilitate the development of the municipal components of the National Climate Change Response Policy that fall within their mandate, jurisdiction or sphere of influence, including undertaking vulnerability and risk assessments in their areas and the integration of climate adaptation and mitigation actions into IDPs.

CURRENT POLICY POSITIONS

The DEA has produced the National Climate Change Response Policy Green Paper 2010 that is expected to be finalised and used as the basis for a White Paper by mid-2011 (DEA, 2010). The Green Paper aims to ensure that South Africa's international commitment to GHG reduction is met and aims to protect and enable the country to adapt to the unavoidable impacts of climate change.

The Paper follows the trajectory of 'peak, plateau and decline' of GHGs, as emphasised in

the LTMS. However, the paper does not commit to any legal obligations regarding climate change. Some key strategies that government will introduce to respond effectively to climate change are (DEA, 2010: 6-7):

- To focus equally on climate change mitigation and adaptation.
- To prioritise short-term climate change adaptation interventions.
- To prioritise mitigation interventions that address the country's GHG reduction goals, reduce unemployment and stimulate industrial growth.
- To focus on improving knowledge generation and information management systems, to facilitate the measurement and prediction of climate change and extreme weather events.
- To mainstream climate change mitigation and adaptation into all national, provincial and local planning initiatives.
- To promote behavioural change through economic and fiscal measures to enable a transition to a low carbon society.
- To recognise that sustainable development initiatives will assist in building the resilience to climate change.

In order to achieve the above-mentioned strategies the Green Paper sets out policy approaches and actions for key adaptation and mitigation sectors, which are: water, agriculture, human health, energy, industry and transport. Other significant sectors included are: disaster risk management, natural resources sectors and human society, livelihoods and services (DEA, 2010).

Cities are included in all the sectors, but are specifically highlighted in the human society, livelihoods and services sector.

The Green Paper acknowledges the vulnerability of cities and coastal areas to the impacts of climate change. The strategy aims to address the various climate change issues in cities by encouraging and supporting research on factors that would determine urban resilience and monitoring and evaluation.

It also aims to support the development of energy efficient and renewable energy initiatives

in towns and cities, ensuring that green building construction practices are implemented on commercial buildings and improving water management through water sensitive urban design (DEA, 2010).

SOUTH AFRICA AND THE INTERNATIONAL NEGOTIATIONS¹⁰

SOUTH AFRICA AND THE UNFCCC

South Africa's point of departure for engaging in climate change discussions has been that the UNFCCC is the only legitimate forum for international negotiations on climate change. Other fora in which international discussions on climate change are taking place, such as the Major Economies Forum on Energy and Climate, the G8, the G20, etc., are viewed as only making contributions to the formal UNFCCC process (DEAT, 2009b).

CURRENT STATUS OF NEGOTIATIONS

The key challenge of the negotiations is how to ensure a fair and equitable outcome, and how to give expression and content to the UNFCCC key principles of 'equity' and 'common but differentiated responsibilities and respective capabilities', as the basis to defend South Africa's national interest to ensure that the international climate change regime provides developing countries with the 'carbon space, the time and the financial and technology resources' to develop, as well as taking the action that would mean that the impacts of climate change are as minimal as possible.

The current negotiations are taking place under the 2-track mandate agreed in Montreal in 2005 and reinforced through the Bali Roadmap in 2007.

This mandate gives expression to the principle of 'common but differentiated responsibilities and respective capabilities' by setting up a structurally balanced negotiation in two tracks: one track under the Convention and another under its Kyoto Protocol, to reach agreement on:

- Developed countries' internationally legally binding commitments to emissions reductions, specifically: (i) quantified emission re-

¹⁰ This section is based on: DEAT, 2009b. The National Climate Change Response Policy - Discussion Document for the 2009 National Climate Change Response Policy Development Summit, Gallagher Convention Centre, Midrand, 3-6 March 2009.

duction commitments for developed countries that are Party to the Kyoto Protocol (the Kyoto Track); (ii) comparable binding quantified emission reduction commitments under the UNFCCC for developed countries that have not joined the Kyoto Protocol, specifically for the USA (a part of the Convention track).

- Developing countries' contribution through enhanced implementation of adaptation (with financial and technological support), and measurable, reportable and verifiable mitigation action by developing countries, conditional on technology, finance and capacity building from developed countries, also measurable, reportable and verifiable (Convention Track).

This 2-track balance in the negotiations has been severely weakened by developed countries insisting on collapsing the Convention and Kyoto Protocol negotiation tracks into a single track outcome, thereby undermining the principle of 'common but differentiated responsibilities and respective capabilities'.

KEY NEGOTIATION ISSUES

Adaptation

The socio-economic impacts of climate change are predicted to be severe for South Africa and even more severe for Africa, and will require extensive action to adjust and adapt to a changing climate. The deal must therefore deliver a comprehensive international programme on adaptation that provides access to significantly up-scaled finance, technology and capacity building for all developing countries, recognising the particular vulnerability of countries in Africa.

Mitigation by Developed Countries

South Africa seeks an outcome that would restrict the global temperature increase to a maximum of 2°C, thereby limiting the impacts of climate change. This requires that, in accordance with the science and in line with their historical responsibility for emissions, all developed countries (as listed in Annex I of the Convention) must commit to ambitious, economy-wide legally binding emission reduction targets, of at least 40% reduction below 1990 levels by 2020. Annex

1 Parties to the Kyoto Protocol must take these commitments for the second and subsequent commitment periods under the Kyoto track. Annex 1 Parties that have not ratified the Kyoto Protocol (particularly the USA) must be brought into a framework of comparable legally binding emission reduction targets under the Convention track.

Mitigation by Developing Countries

South Africa recognises that the 2°C goal cannot be achieved by one part of the world on its own. The IPCC scientific assessment requires both deep absolute cuts in Annex I countries (consistent with their historical responsibility) and a decline in emissions relative to business as usual in some developing regions by 2020 and in all regions by 2050 (consistent with responsibility for the future).

South Africa, along with other developing countries, is already taking leadership to reduce its emissions using its own limited resources, but in order to undertake increased levels of mitigation effort it must be supported and enabled, through technology, finance and capacity building. The deal must therefore deliver a framework for nationally appropriate mitigation action by developing countries, supported and enabled by finance, technology and capacity building, all of which are measured, reported and verified.

Finance, Technology and Capacity Building

Climate change threatens to undermine many of the development objectives of countries in Africa and in the rest of the developing world, in particular in the areas of water, energy, health and agriculture. In order to enable lower carbon and resource efficient sustainable development in the developing world, a climate change agreement requires developed countries to comply with their obligations under article 4 of the Convention, on provision of finance, as well as development, transfer and diffusion of technology. Therefore, the deal must deliver a significantly up-scaled package of new and additional finance and technology, as well as the necessary transparent, efficient, effective and geographically balanced institutional arrangements for delivery. In this package, there must be a prominent role for public finance in-

cluding grant finance as well as concessional loan financing.

PROGNOSIS OF WHAT IS ACHIEVABLE

Following the Conference of the Parties (COP)-15 meeting held in Copenhagen in December 2009 and the failure to achieve a legally binding and comprehensive outcome, the core issues in the negotiations remain unresolved. It is likely that achieving the desired deal will be extremely difficult and that final agreements may only be reached at COP-17-CMP-7 in Durban in 2011, although this seems increasingly unlikely.

In order to move towards this agreement, South Africa would require, at a minimum during the period leading up to this meeting, the implementation of some practical elements of the Copenhagen Accord. These should include:

- **Finance:** short-term finance of at least \$10 billion in 2010 and each of the next two years delivered through the Copenhagen Fund. For long-term finance, the High Level Panel should report on its findings on sources of finance and share of contributions.
- **Technology:** implementation of the technology mechanism.
- **Adaptation:** finalisation of the adaptation framework and associated programmes, with a long-term finance commitment.
- **Mitigation – A1:** the rules relating to land-use, land-use change and forestry (LULUCF), dubious mitigation accounting (so called 'hot air') and offsets need to be clarified to properly understand how low their targets are.
- **Mitigation – NA1:** Elaborate Nationally Appropriate Mitigation Actions (NAMAs) and the support they require; launch a register for NAMAs; agree on guidelines and full costs for National Communications; establish agreed guidelines for Monitoring Reporting and Verification; and finalise funding for REDD+. (Reducing Emissions from Deforestation and Forest Degradation).
- **Measuring, Reporting and Verifying (MRV):** Establish verification mechanisms for the finance and technology that is provided by developed, to developing countries to enable their mitigation efforts.

In addition to this incremental progress, there

must be progress in at least initiating discussions on a globally agreed Legally Binding Outcome. The question of the legal form of a final outcome of the climate change negotiations remains unresolved.

COPENHAGEN ACCORD AND SOUTH AFRICA'S LISTING

On the eve of the United Nations climate negotiations in Copenhagen (December, 2009), the South African Presidency announced that "South Africa will undertake mitigation actions which will result in a deviation below the current emissions baseline of around 34% by 2020 and by around 42% by 2025" (The Presidency, 2009). The commitment was premised on a number of conditions, namely:

- A fair, effective and inclusive deal being reached in Copenhagen/Mexico, and support from developed countries.
- Provision of significantly scaled-up, binding public funding.
- Binding commitment by developed countries to technology development, transfer and diffusion, including the climate-friendly energy technologies that South Africa needs to achieve the deviation.
- Support to enhance the institutional capacities in South Africa in order to implement the Nationally Appropriate Mitigation Actions (NAMAs).
- South Africa's approach is based on science. It is recognised that the lowest stabilisation levels assessed by the IPCC's Fourth Assessment Report cannot be achieved without a) developed countries taking responsibility for historical emissions, and b) the common and differentiated responsibility of both developed and developing countries of their share of emissions into the future.
- Existing action should be recognised and supported by the international community: energy efficiency in commerce, energy and industry; mechanisms to support the roll-out of renewables and alternative energies; working towards integrated rapid transit systems; and the roll-out of solar water heaters.

The Copenhagen listing recognised that the mitigation potential and potential low carbon solutions identified in the LTMS study could be realised, contributing to a green economy. It

also takes forward the work of the LTMS, notably looking at a shorter time frame (2020 and 2025 as opposed to 2050). This medium-term time frame aligns the initial challenge arising from LTMS, for GHG emissions to peak between 2020 and 2025. The listing took into account developments since the work was published in 2007: incorporating the Integrated Resource Plan for the Electricity Sector (Department of Energy, 2011), the approval of concessional loan finance by the Clean Technology Fund and the World Bank for climate friendly developments in the energy sector.

CURRENT NATIONAL POLICY PAPERS

In addition to the National Climate Change Response Policy Green Paper 2010, other significant national policy papers underway that have climate change implications are the draft revised White Paper on Renewable Energy Policy 2010, which if promulgated aims to provide a minimum of 27% of national energy demand from renewable energy sources by 2030 (Department of Energy, unpublished).

In terms of climate change mitigation, a carbon tax that would put a price on carbon and affect consumer and producer behaviour is under discussion and is planned to be finalised by mid-2011 (DEA, 2010). This could have major implications for GHG emissions particularly in the industrial sector.

From an economic and job creation perspective, national government is currently developing a Green Economy Strategy. Furthermore the New Growth Path Framework (EDD, 2010) and the Industrial Policy Action Plan have recognised the importance of the green economy for sustainable development, global competitiveness and job creation (DTI, 2010). The New Growth Path, which plans to create 5 million jobs in the next ten years, sets a target of providing 300 000 additional green economy direct jobs by 2020 (EDD, 2010).

ENERGY – THE MOST SIGNIFICANT NATIONAL ISSUE IMPACTING ON THE LOCAL CONTEXT

The GHGs contributing to South Africa's GHG profile are mostly CO₂, (~80%), CH₄ (~15%) and

N₂O (~5%). As illustrated in Figure 3.2, the main sources of South Africa's GHGs are: energy-related emissions (~80%); emissions from industrial processes and product use (~15%); emissions from agriculture, forestry and land use (~6%); and emissions from waste and other sources of emissions (~2%).

The main sources of South Africa's energy-related GHG emissions are: emissions from energy industries, e.g. the burning of coal to make electricity (~62%, ~48% of total emissions); fugitive emissions from fossil fuels, e.g. CH₄ released during coal mining (~12%, ~9% of total); emissions from transport, e.g. the use of petrol or diesel in cars and trucks (~11%, ~9% of total); emissions from energy production in the manufacturing and construction industries, e.g. coal-fired industrial boilers (~11%, ~9% of total); and other energy-related emissions, including commercial/institutional, residential, agriculture, forestry, fishing and others (~4%, ~3% of total).

In 1950, South Africa was emitting around 60 Mt CO₂e into the atmosphere per year – about 90% of sub-Saharan Africa's total emissions and about the same as India's annual emissions (Letete *et al.*, 2010). However, by 1990, South Africa was emitting 347 Mt CO₂e/annum – about 70% of sub-Saharan Africa's total emissions and about 33% of what India was emitting each year (Letete *et al.*, 2010).

In 1995, South Africa was emitting less than 1% of global GHG emissions, as compared to the USA's 15%, Brazil's 6%, European Union's (EU) 14%, China's 12% and India's 5% (Letete *et al.*, 2010). However, in terms of global cumulative GHG emissions from 1950 to 2000, South Africa is ranked as the 21st highest emitter (ranked 63 when measuring Mt CO₂e/capita) (Letete *et al.*, 2010) and, in terms of global cumulative energy-related GHG emissions from 1950 to 2000, South Africa is ranked as the 14th highest energy-related emitter (ranked 46 when measuring Mt CO₂e/capita) (Letete *et al.*, 2010).

In terms of global cumulative energy-related GHG emissions from 1950 to 2000, South Africa's Mt CO₂e/capita emissions are: 74% higher than the global average; 344% higher than China; 471% higher than Brazil; 900% higher than the

SOUTH AFRICA'S GREENHOUSE GAS EMISSION PROFILE - 2000

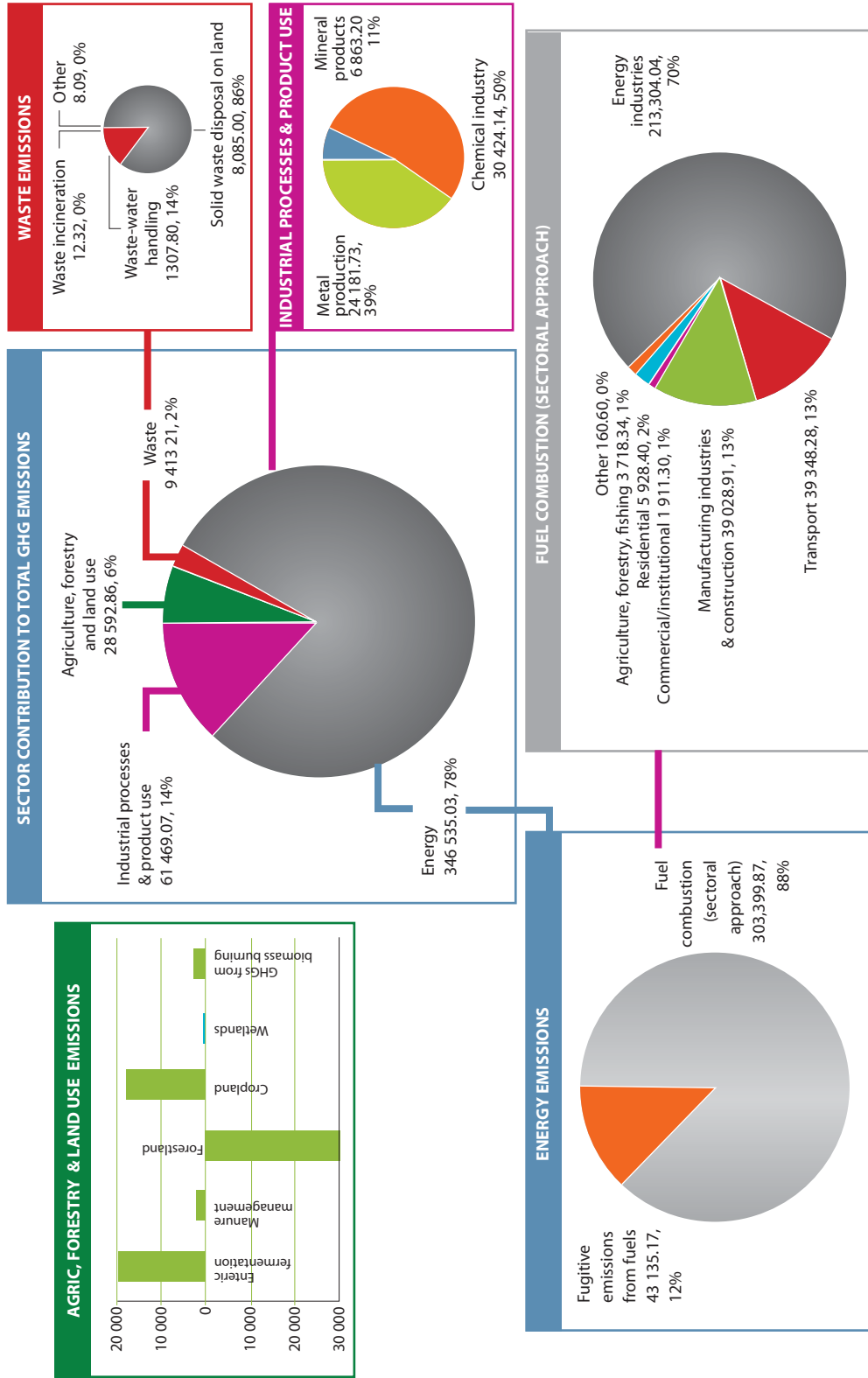


Figure 3.2: The South African greenhouse gas emission profile, base year 2000 (DEA, 2010)

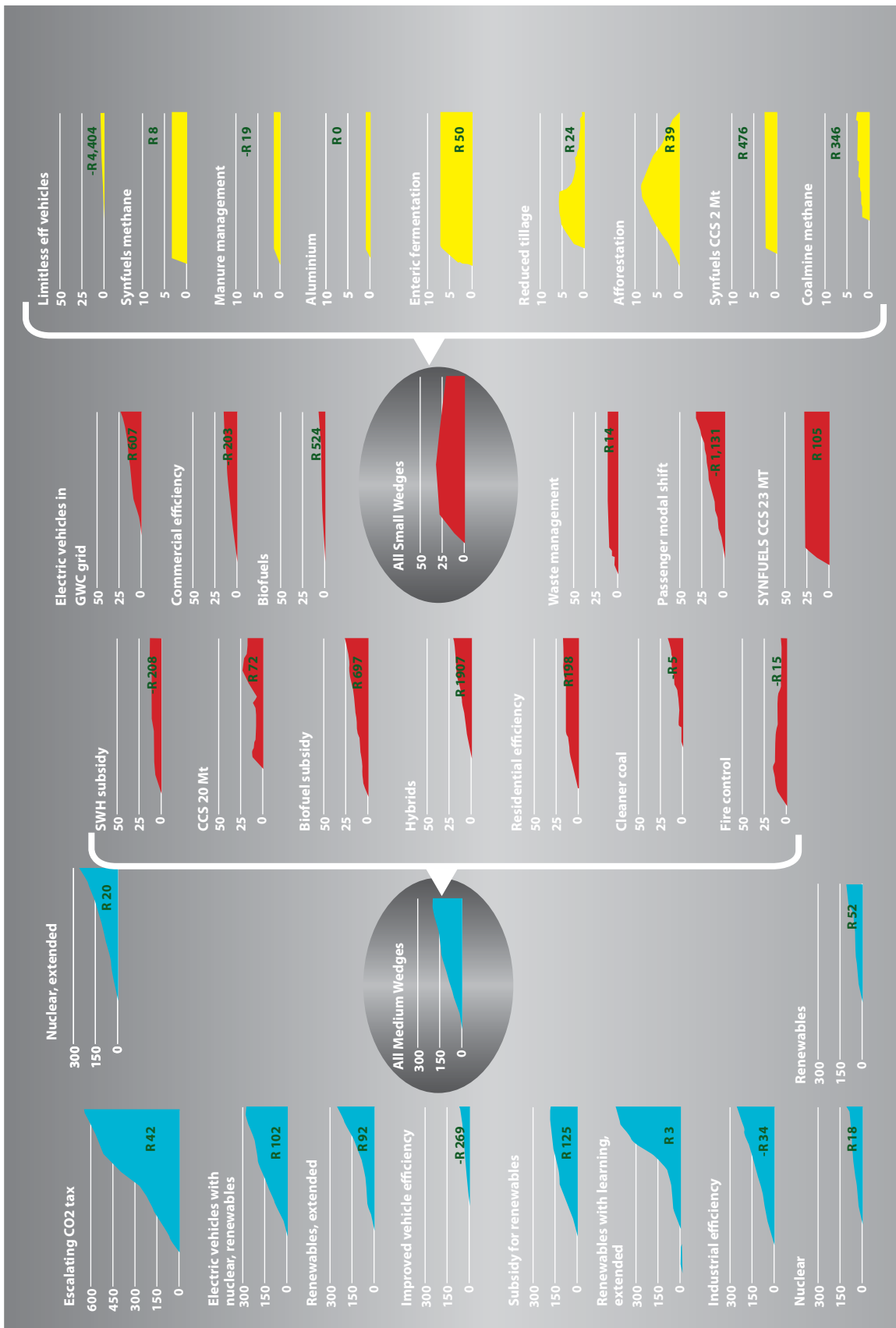


Figure 3.3: The LTMS mitigation 'wedges' (Note: The large wedges at left are on a scale up to 300 Mt CO₂e; the middle wedges up to 50 Mt and the small wedges at right up to 10 Mt) (SBT, 2007a)

Table 3.1: Unpacking the Copenhagen mitigation undertakings - deviation below Business-as-Usual (BAU) from contributions by various nationally appropriate mitigation actions (RSA, 2010)

Mitigation Intervention – National Appropriate Mitigation Action (NAMA)	BAU: Projected emissions		Deviation:		Percentage deviation below BAU		Percentage of total reduction	
	Mt CO ₂ e		Mt CO ₂ e		%		%	
	2020	2025	2020	2025	2020	2025	2020	2025
ENERGY	482	563	124	205	16.29	22.73	47.33	53.95
Improved efficiency in industry			61	83	8.02	9.20	23.28	21.84
Efficient commercial building and public buildings			5	7	0.66	0.78	1.91	1.84
Sustainable housing development			8	11	1.05	1.22	3.05	2.89
Lower CO ₂ electricity supply			50	104	6.57	11.53	19.08	27.37
TRANSPORT AND LIQUID FUELS	134	169	67	105	8.80	11.64	25.57	27.63
Sustainable transport development			5	10	0.66	1.11	1.91	2.63
Advanced transport options			5	10	0.66	1.11	1.91	2.63
Liquid fuel supply options			57	85	7.49	9.42	21.76	22.37
NON-ENERGY EMISSIONS	145	170	71	70	9.33	7.76	27.10	18.42
Reducing industrial process emissions			28	29	3.68	3.22	10.69	7.63
Waste minimisation			11	11	1.45	1.22	4.20	2.89
Improved agriculture			14	11	1.84	1.22	5.34	2.89
Emission reductions in LULUCF			18	19	2.37	2.11	6.87	5.00
Totals	761	902	262	380	34.43	42.13	100.00	100.00

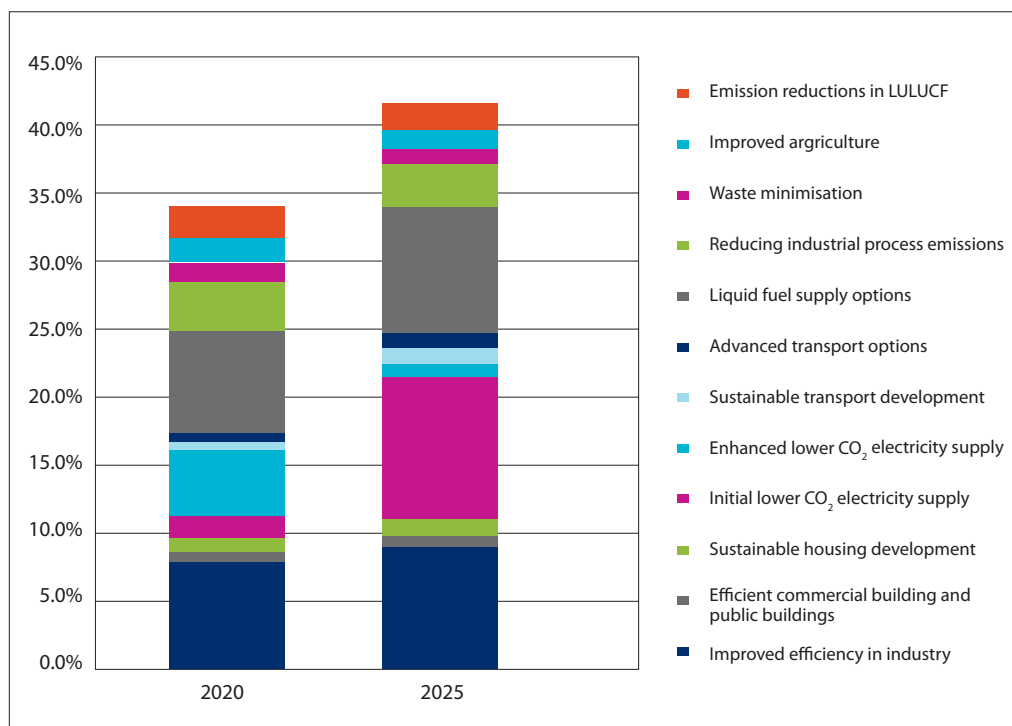


Figure 3.4: Unpacking the Copenhagen mitigation undertakings - deviation below Business-as-Usual (BAU) from contributions by various nationally appropriate mitigation actions (RSA,2010)

average for sub-Saharan Africa; 33% lower than the EU; and 70% lower than the USA (Letete *et al.*, 2010).

In 2000, South Africa was ranked as the 21st highest emitter (ranked 63 when measuring Mt CO₂e/capita) and as the 14th highest energy-related emitter (ranked 39 when measuring Mt CO₂e/capita) (Letete *et al.*, 2010). In 2000, South Africa's energy-related Mt CO₂e/GDP purchasing power parity (ppp) (2000 US\$) were: 54% higher than the global average; 21% higher than China; 41% higher than the USA; 97% higher than India, 212% higher than Brazil; and 1575% higher than the average for sub-Saharan Africa (Letete *et al.*, 2010).

What this means is that, whichever way you look at it, South Africa's almost total reliance on fossil fuels makes it one of the top-ranking global climate change contributors. Importantly, the GHG emission profile of South African cities is

likely to be very similar to the national profile, implying that city mitigation efforts will have to consider, at least, the various mitigation interventions investigated in the LTMS as illustrated in Figure 3.3.

However, from this it should be clear that, unless cities actively engage in the energy supply-side, their efforts are likely to be largely limited to the 'small' and 'medium wedges'.

To further emphasise this point, Table 3.1 and Figure 3.4 summarise the results of an, as yet, unpublished exercise, based on the LTMS, showing how a combination of various mitigation interventions (so-called NAMAs) may contribute to meeting South Africa's Copenhagen Accord undertaking of "...34 per cent deviation below the 'business as usual' emissions growth trajectory by 2020 and a 42 per cent deviation below the 'business as usual' emissions growth trajectory by 2025 (UNFCCC, 2011: 43)." From this it is

clear that between 20 to 30% of the reductions are due to 'lower CO₂ electricity supply' – something cities have little control over unless, as in the past, municipalities actively involve themselves in electricity supply.

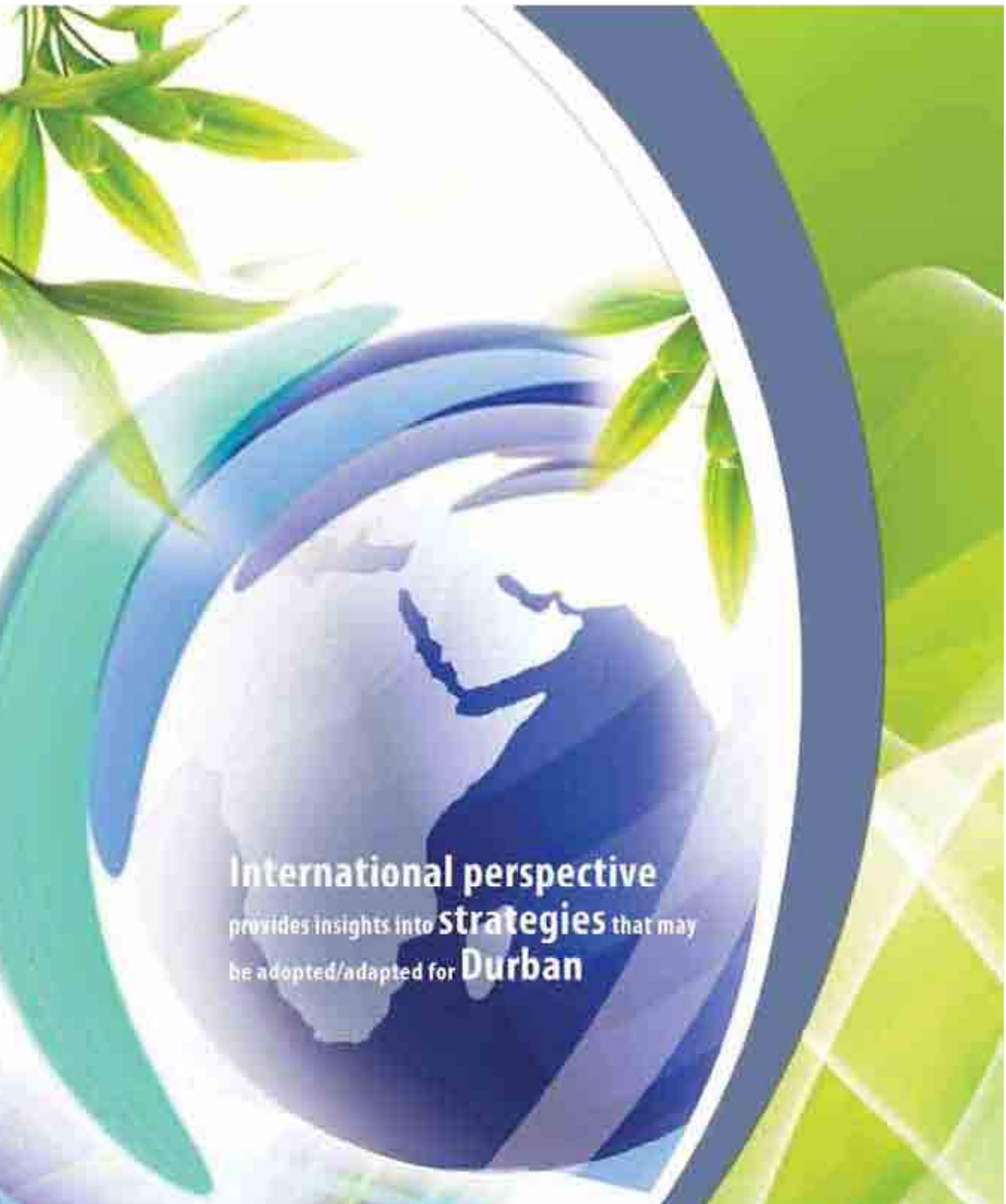
CONCLUSION

National government plays a major role in climate change mitigation in cities. The policies and strategies emerging from national government recognise that cities are major GHG emitters and are vulnerable to the impacts of climate change. For South Africa to achieve the

Copenhagen target of a reduction in emissions around 34% by 2020 from projected levels, cities would have a pivotal role to play. By focusing on providing their own electricity supply, aligning their climate change mitigation targets with the LTMS where relevant and ensuring that climate mitigation and adaptation issues are integrated into their IDPs, cities will be well aligned with national policy. Furthermore, national government has prioritised the need for growth in the green economy and an increase in green jobs. Local governments need to capitalise on these aspects to promote economic growth in their cities, while realising the climate change co-benefits.

Key Lessons:

- National government has made a clear commitment to support the setting of a target for the reduction of greenhouse gas emissions and to develop a progressive National Climate Change Response Policy through the 2007 Polokwane ANC Climate Change Resolution, the July 2008 cabinet decisions and the 2009 Climate Change Summit in Midrand.
- At the Copenhagen meeting in 2009, South Africa announced that it will reduce greenhouse gas emissions below the current emissions baseline by 34% by 2020 and 42% by 2025. This commitment was premised on a number of conditions.
- For South Africa to achieve these targets, cities will have to play a pivotal role.



International perspective
provides insights into **strategies** that may
be adopted/adapted for **Durban**



international perspectives on low carbon cities

INTRODUCTION

Globally, cities are implementing climate change action plans with the aim of reducing GHG emissions, and many are committing to voluntary CO₂e reduction targets (Crocì *et al.*, 2009). Some cities have set targets to become carbon neutral, for example Melbourne (City of Melbourne, 2008a) and Copenhagen (City of Copenhagen, 2009), which aim to become carbon neutral by 2020 and 2025 respectively. Many others have committed to reduce emissions by a certain percentage below a baseline year's emissions. Certainly, achieving a carbon neutral status is relatively easier to accomplish in cities such as Melbourne and Copenhagen, as their base year emissions are lower than in mega-cities and developing country cities (e.g. 5.97 MtCO₂e for Melbourne in 2008 compared with 45.1 MtCO₂e for London in 1990 and 63.1 MtCO₂e for New York in 2005) (Crocì *et al.*, 2009). Of the mega-cities, London has the most ambitious emission reduction target of 60% from the 1990 base year levels by 2025. Cities in developing countries tend to have lower emission reduction targets, e.g. Bangkok has a 15% reduction target by 2012.

Carbon reduction plans consist of a set of strategies to reduce emissions within various sectors within a city. Most involve reduction measures in the energy sector, while some also include reducing emissions from waste and sequestering emissions by planting trees.

A study conducted for the Carbon Disclosure Project (CDP, 2011), revealed that it is valuable for cities to report on their GHG emissions and mitigation activities for the following reasons:

- It can increase and improve economic

competitiveness by ensuring that industries and businesses become more efficient, and it also attracts innovation and investment in the city.

- It can improve climate change adaptation and management.
- It illustrates the impacts of climate change strategies to the community and can potentially stimulate behavioural change.

Kennedy *et al.* (2009) also endorsed carbon disclosure, noting that cities can learn from examining and modifying strategies adopted in other cities. While the emphasis in cities in most developed countries is on mitigation, adaptation measures feature high on the agenda of some climate change action plans, particularly those in the United Kingdom (UK).

The international perspective given in this chapter provides valuable insights into possible strategies that may be adopted and/or adapted for the city of Durban. Some of the foci of the climate change action plans, the underpinning policies and key lessons learnt from cities in various regions of the world (Asia, Europe and North and Latin America) are summarised in the sections that follow. Detailed information on various city initiatives is provided in Appendices 4 to 7. Not all are expected to be relevant, but it is anticipated that amongst the range of innovative actions listed, there will be some that will resonate with those officials tasked with implementing a climate change action plan for the city of Durban.

KEY LESSONS FROM ASIAN CITIES

Despite many years of climate change awareness internationally, global CO₂ emissions have

increased from 6.2 PgC annually in 1990 to 8.4 PgC in 2009 (1 Pg = 1 billion tons), with an accelerated rate of increase in recent years¹¹. Asia is at the forefront of this growth in emissions. China surpassed the United States as the largest CO₂ emitter in 2006 and India overtook Russia to become the third largest emitter. As of 2008, Japan is the fifth largest emitter.

Japan is the only country in Asia that has mandatory GHG mitigation obligations. Hence, GHG reduction efforts of cities are generally undertaken voluntarily and are pursued in a variety of degrees reflecting diverse local motivation. In Japan, the law requires prefectures and cities to develop climate change mitigation action plans to share the burden of the nation's Kyoto Protocol target. At the COP-15 meeting in Copenhagen, the Japanese government committed a 25% reduction of its GHGs by 2020 from 1990 levels. South Korea announced a target of 30% reduction below projected levels by 2020, which equates to a target of approximately 4% below 2005 levels.

Climate change actions in selected Asian cities are described in full in Appendix 4. The analysis that follows highlights the main features of the action plans and extracts the key lessons learnt.

Cities in Japan are mandated by legislation to develop local climate change mitigation action plans, but the level of implementation varies. Tokyo, and to some extent, Yokohama and Kyoto, have strong overarching policies, clear targets, and well-developed future roadmaps with mandatory provisions (Tokyo Metropolitan Government, 2008). Tokyo is way ahead of other cities and has become the world's first city to implement a Cap-and-Trade Programme for reducing CO₂ emissions. In terms of this programme, large facilities are obliged by law to set targets, and to submit five-year reduction plans and annual progress reports. The scheme was implemented on a voluntary basis in 2002, but the failure to achieve the desired results prompted the shift to a mandatory programme (World Bank, 2010b).

Tokyo, as well as Yokohama and Kyoto, have considerable subsidy systems for residential so-

lar power and thermal installations, in addition to the availability of national funding. Japanese cities also have good operational plans and targets for buildings and other sectors, such as energy and transport. However, since there is not always legal backing, the level of success is variable.

With the exception of Japan and Korea, city governments in other Asian countries, rather than having overarching climate policies and developing climate policy actions, use co-benefits of local actions on their priority issues such as air pollution, transport, energy efficiency etc. (which are not formulated as a climate policy) for GHG reduction and to rationalise their actions for the achievement of climate change actions (Dhakal and Poruschi, 2010). This applies to many East Asian cities including Chinese cities (Teng and Gu, 2007). Cities, without an overarching climate policy, also carry out many activities that may contribute to dampening the growth of GHG emissions in an uncoordinated and isolated manner. In such cases, GHGs may be mitigated in one sector, but their implications for, or impact on, the city as a whole are largely unknown.

In addition, there are large numbers of cities in Asia that are indifferent to climate change issues, either due to a lack of awareness and knowledge or a focus on other more immediate and pressing priorities. Many cities responded to the call of international networks such asICLEI - Local Governments for Sustainability to join climate movements and to carry out awareness-raising campaigns, usually supported by external donors on an *ad hoc* basis. Such a diversity of actions comes as no surprise since the stage of development, income, and commitment of nations to global climate change varies considerably across Asia (Dhakal and Poruschi, 2010).

One of the fundamental requirements for any climate change action plan is a robust GHG accounting of cities. Good GHG accounting not only provides information on emission sources but also where to focus climate change action and the scale of potential GHG mitigation. A general survey shows that cities (even large cities that have an active climate change agenda, such as Delhi, Bangkok and Jakarta) do not

¹¹ <http://www.globalcarbonproject.org/carbonbudget/09/hl-full.htm>

have a reliable GHG inventory for a single year, let alone annual updates (Dhakal and Poruschi, 2010). Without such a GHG inventory, a realistic climate change action plan is not possible.

Bangkok has an ambitious plan to reduce GHG emissions (Bangkok Metropolitan Administration, 2007), but it is regarded as aspirational because the resources and capacity to carry out the plan are not in place. Nonetheless, such plans and planning procedures in cities of developing countries are deemed essential to push the climate change agenda forward.

Some of the key lessons from Asian experiences on climate change action plans are:

- Tokyo's experience demonstrates that a mandatory climate change action planning system is able to achieve intended results more effectively than a system that relies only on voluntary measures and anticipating good outcomes. Tokyo, Yokohama and Kyoto have shown that their planning systems have relied on evidence-based information, which in-turn, has helped to develop consensus for action.
- A robust GHG inventory is a prerequisite for a climate change action plan so that planning is evidence-based and real impacts of various GHG mitigation actions can be pursued.
- Many cities have pursued the co-benefits approach as a stepping stone to enforcing climate change mitigation measures. In such cases, an evidence-based, co-benefit analysis of various synergies and conflicts would be useful.
- Interventions in energy efficiency and pilot activities involving renewable energy are attractive and good initial steps, but should not be regarded as the final goal in climate change action plans. Cities must address low carbon development as an overarching and long-term development goal, and move beyond an energy-centric action view.
- Cities need to avoid the *Pizza Diet Syndrome* to reduce rebound effects. Essentially, this

means that the scale of activities themselves needs dampening or reducing, not only the energy or carbon emissions per unit of activities. What this calls for is a fundamental re-consideration of the manner in which we commute, use building space, consume energy and materials, and our lifestyle in general. Further, cities may be able to make a large difference to global GHG emissions by rational consumption of water, construction materials, buildings, packaging and other goods and services. The scope of cities' GHG mitigation could go beyond production-based GHG accounting and focus more on a consumption-based approach.

- Integrated urban system planning is essential for low carbon city development. Fragmented mitigation measures implemented sporadically and haphazardly may have unintended consequences and are prone to GHG 'leakage', unless GHG emissions are evaluated at a city-wide level. Climate change action plans are generally applicable within a city's administrative boundaries, but regional consideration and coordination is essential to optimise urban development and avoid 'leakage' when a city is only a small fraction of a larger agglomeration unit.
- Cities are governed in a complex fashion by multiple levels of authorities. The role of city government in technical, financial and jurisdiction matters is often limited. Low carbon development is a process where multiple levels of authorities need to coordinate their jurisdiction, resources, implementation capacity and sphere of influence for collective planning and implementation (Dhakal and Poruschi, 2010).

The appeal of the Asian cities lies in the diversity of their climate change actions, which includes a wide spectrum of experience from Japan to South Asia. Tokyo is at the global forefront in terms of city action, whereas, South Asia has little or no priority on climate change mitigation. Such a reality accords with the African context and learning from Asia could be of use to South African cities.

Key Lessons from Asian Cities:

- Mandatory climate change action programmes are more effective than voluntary measures.
- A robust greenhouse gas emission inventory is essential.
- The co-benefits approach is a stepping stone to enforcing climate change mitigation measures.
- Cities need to focus on consumption as well as production of greenhouse gases.
- Integrated urban system planning is essential for low carbon development.

KEY LESSONS FROM EUROPEAN CITIES

There are a number of important policies and initiatives in place in Europe to address climate change. The European Climate Change Programme (ECCP) was launched in 2000 as a comprehensive package of policy measures to reduce GHG emissions, in addition to the domestic actions put in place by the European Union's (EU) 25 Member States (European Commission, 2006). The ECCP was founded on a multi-stakeholder consultative process that brought together all relevant players, such as the European Commission, national experts, industry and non-government organisations (NGOs). The second ECCP (ECCP II) was launched in 2005. One of the most important and innovative initiatives to come out of the ECCP is the EU Emissions Trading Scheme (ETS).

The EU ETS was launched in 2005 and is based on the assumption that creating a price for carbon through the establishment of a market for emission allowances offered the most cost-effective way for countries to reduce emissions (European Commission, 2007). This works as a 'cap and trade' system for large industrial emitters in Europe, whereby an emissions limit is set (the 'cap') and tradable emissions allowances are given to emitters or bought from the 'carbon market'. The cap ensures that the total level of emissions is not exceeded.

There are also many agreements that bind cities together in a quest to address climate change. The international association of local governments known as ICLEI is one such network. EUROCIITIES is another that was founded in 1986 and brings together the local governments of more than 130 large cities in over 30 European countries to share knowledge, exchange ex-

periences, analyse common problems and develop innovative solutions. In October 2008, EUROCIITIES launched its 'Climate Change Declaration', signed by over 50 major European cities. The declaration highlights further commitment at the local level to ensuring that action is undertaken against climate change: "*Cities are best placed to speak with their citizens on global matters such as climate change, and to show how changes made at the local level in all areas of public life, from waste management, to public transport, to cultural events, among others, can contribute to facing this global challenge*"¹².

The Covenant of Mayors is an ambitious initiative of the European Commission that gives the lead to Europe's pioneering cities to mitigate climate change through the implementation of local sustainable energy policies that create stable local jobs and increase citizens' quality of life and address critical social issues. It involves a commitment by signatory towns and cities to go beyond the objectives of EU energy policy in terms of reduction in CO₂ emissions through enhanced energy efficiency and cleaner energy production and use. Although the commitment and reporting requirements are stringent, approximately 2 000 mayors have signed the covenant.

Another initiative that has been launched by the European Commission, is the 'smart city' initiative, the main aim of which is to aid European cities to progress rapidly towards energy and climate objectives at a local level, while proving to citizens that their quality of life and local economies can be improved through investments in energy efficiency and reduction of carbon emissions (Meeus *et al.*, 2010). The 'smart city' initiative focuses on three main aspects: to

¹² <http://www.eurocities.eu/content/climatechange.php>

reduce the demand for energy services; to increase the uptake of energy efficient technologies; and, to increase the uptake of renewable energy (Meeus *et al.*, 2010).

Although there is considerable variation in the extent of climate change commitments in cities across Europe, a general trend of engagement with climate mitigation and adaptation in European capital cities can be observed. It

is clear that the more economically advanced western European cities have engaged most intensively, with some having adopted ambitious policies and targets for reducing GHG emissions. Examples of climate change actions in selected European cities are given in Appendix 5. Within the United Kingdom (UK) specifically, the government has responded to the challenge of reducing emissions, more so than many countries both in Europe and globally. Progressive

Key Lessons from European Cities:

- There are many policies (e.g. the European Climate Change programme) and networks of cities (e.g. EUROCITIES and the Covenant of Mayors) in place to address climate change.
- The Emissions Trading Scheme is an innovative scheme to encourage countries to reduce emissions by putting a price on carbon.
- More economically advanced western European cities have engaged most intensively with climate change action plans.

legislation such as the Climate Change Act of 2008, influential reports such as the Stern Review on the Economics of Climate Change (Stern *et al.*, 2006) and mechanisms such as the Climate Change Levy¹³ and UK Emissions Trading Scheme¹⁴, puts the UK at the forefront globally on action to reduce GHG emissions. The Climate Change Act committed the UK to an 80% cut in GHGs by 2050 from 1990 levels, thereby making it the first country in the world to have a legally binding long-term framework to cut carbon emissions (HM Government, 2008).

However, the UK is faced with challenges in meeting its reduction targets. It is evident that a step change in GHG emissions reduction relative to the trend in recent years is required to meet their 2020 reduction target. Most of the emissions reductions in recent years have been in the non-CO₂ gases, where potential for further cuts in coming years is limited. The focus for the future will have to be more on CO₂ emissions reductions.

While the UK's national carbon management strategy is impressive in its scope, it is fragmented and inconsistent in its application. The actual implementation of the national policy intentions is conditional on the availability of necessary in-

stitutional capacity at both the central and local government levels.

The UK government has accepted the critical role to be played by local authorities. Speaking before the Local Government Association's annual conference in July 2007, the newly appointed Environment Secretary, Hilary Benn, said: *"Tackling climate change is the greatest challenge of our generation. Local government is not just a partner in this fight. You are one of the leaders of this fight.... As councils and national governments we need to work together with citizens and businesses to provide a clean and green local environment and make sure that we are all tackling climate change and making best use of the world's limited resources. It's a task for all of us - G8 leader and council leader alike - and citizens too. This is the new politics."*¹⁵

This statement is grounded in the vision statement of the UK Climate Change Programme which states: *"They (local authorities) are uniquely placed to provide vision and leadership to their local communities, and their wide range of responsibilities and contacts means that they are critical to delivering this programme"* (UK Department for Environment, Transport and the Regions, 2000).

¹³ http://customs.hmrc.gov.uk/channelsPortalWebApp/channelsPortalWebApp.portal?_nfpb=true&_pageLabel=pageExcise_InfoGuides&propertyType=document&id=HM_CE_CL_001174.

¹⁴ http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/ccas/uk_ets/uk_ets.aspx.

¹⁵ <http://www.lga.gov.uk/lga/core/page.do?pagelid=18290>.

Appendix 6 highlights the climate change actions of selected cities in the UK, many of which stem from the initiatives listed as follows:

Nottingham Declaration

The Nottingham Declaration on Climate Change was launched in October 2000 as a voluntary declaration in the English city of Nottingham¹⁶. Signatory councils to this declaration pledge to address the causes of climate change and to prepare their community for its impacts. The declaration was signed by 300 local authorities, comprising over 90% of English municipalities and numerous other partner organisations, such as hospital trusts. Equivalent climate change declarations exist for Scottish¹⁷ and Welsh authorities.

Signing commits authorities to three broad aims: (1) acknowledging that climate change is occurring; (2) welcoming and engaging with the government targets; and, (3) committing to working at a local level on climate change management. This declaration further underscores the commitment of British local authorities towards taking action in the absence of a mandate to do so. However, its non-obligatory nature means that it has no checks or monitoring regimes, which potentially allows councils to become signatories without necessarily taking action.

Carbon Trust LACMP

The Carbon Trust Local Authority Carbon Management Programme (LACMP) provides councils with technical and change management support and guidance tools to help them realise savings in carbon emissions. The primary focus of the work is to reduce emissions from activities or sources under the control of the local authority, such as buildings, vehicle fleets, street lighting and landfill sites¹⁸.

Carbon Reduction Commitment

The Carbon Reduction Commitment (CRC) was announced in the Energy White Paper of 2007 (UK Department of Trade and Industry, 2007). It is central to the UK's strategy for improving energy efficiency and reducing carbon emissions, as set out in the Climate Change Act, 2008. It has been designed to raise awareness in large organisations, especially at senior level, and en-

courage changes in behaviour and infrastructure.

The CRC is a mandatory 'cap and trade' scheme, focusing on electricity use and direct energy-use emissions not covered by the EU ETS and Climate Change Agreements. The scheme applies to organisations that have half-hourly metered electricity consumption greater than 6 000 MWh per year¹⁹. Currently, such organisations account for around 10% of the UK carbon emissions. These include supermarket and hotel chains, office-based corporations, government departments, universities and large local authorities.

At the end of each year, company performance, mainly based on absolute carbon reductions since the start of the scheme, will be summarised, outlining the best and worst performers in terms of carbon emissions and reduction. The auction revenues generated through the initial sale of credits will be recycled back to participants, with companies receiving payments from government in relation to their first year emissions, plus (or minus) a bonus (or penalty) dependent on their performance. The CRC began in 2010 and the first capped phase will begin in 2013. Allowances will be sold to participants at a fixed price of £12/tCO₂ and the first sale is due to take place in April 2011, but will be allocated through auction from 2013. The scheme is expected to save 1.2 Mt of CO₂ by 2020²⁰.

National Indicators

In October 2006, the local government white paper, *Strong and Prosperous Communities*, proposed a radical streamlining of the local authority performance framework in England (HM Government, 2006). A set of 198 National Indicators was adopted by all local governments in England in April 2008. Performance against each of the 198 indicators will be reported for every single tier and county council Local Strategic Partnership (LSP).

For the first time, the performance reporting framework for local government includes three indicators relating to climate change abatement and adaptation, and one indicator for local air quality. These are:

¹⁶ <http://www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/The-Declaration/About-the-Declaration>

¹⁷ <http://www.sustainable-scotland.net/climatechange/>

¹⁸ <http://www.carbontrust.co.uk/climatechange/policy/CRC.htm>

¹⁹ <http://www.defra.gov.uk/environment/climatechange/uk/business/crc/index.htm>

²⁰ <http://www.carbontrust.co.uk/climatechange/policy/CRC.htm>

- NI 185: CO₂ reduction from local authorities' operations
- NI 186: *Per capita* reduction in CO₂ emissions in the local authorities' area
- NI 188: Planning to adapt to climate change
- NI 194: Air quality – % reduction in NO_x and primary PM₁₀ emissions through local authority's estate and operations

NI 185 and NI 188 were selected as priority indicators by 35 and 56 LSPs respectively. NI 186 was selected by 100 LSPs as a priority indicator, making it the fifth most selected priority indicator. Clearly, climate change and carbon management is becoming an increasingly high priority for local government in England.

The new National Indicator set is expected to provide a more consistent method and framework for monitoring emissions at the local level, thereby leading to comparability of local authorities.

Low Carbon Cities Programme

The Low Carbon Cities Programme (LCCP) supports three major UK cities, Bristol, Leeds and Manchester, in developing city-wide carbon reduction strategies²¹. The programme aims for significant carbon savings through city-wide low carbon strategies. The vision is that of a city-wide carbon reduction target led by the public sector, supported by the private sector and owned by the entire community.

The key partners in the LCCP are the main public sector bodies with other major influencers of city carbon emissions such as the local governments, National Health Service, universities, housing associations, large businesses, regional governing bodies and energy suppliers, consumers, community, faith and voluntary groups.

A clear city-wide carbon reduction strategy process was used within each of the three core cities, which included:

- developing shared goals between the key public sector components of that city;
- agreeing governance arrangements and ownership;
- carrying out a carbon footprint for the city;
- identifying key carbon saving options;

- developing a tailored and appropriately resourced action plan and implementing the plan.

The programme assists government in meeting its commitment to engage with core cities and has developed valuable lessons.

Core Cities Group

The Core Cities Group is a network of England's major regional cities: Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield. These city regions are home to more than 16 million people and are responsible for around 30% of England's carbon emissions, some 135 Mt annually. The Core Cities can help to greatly reduce England's overall impact on the environment, by:

- increasing local renewable energy supplies;
- improving public transport;
- addressing the energy efficiency of buildings;
- improving waste and water management.

One of the planning tools used by these cities to create a carbon reduction strategy is the VantagePoint carbon scenario planning tool²². The tool is simple to use and allows local authorities to generate and compare a range of scenarios made up of energy generation, behaviour change, infrastructure and policy measures, and to select the most appropriate option. The model identifies the capital cost and other economic implications of any given strategy, providing a thorough cost-benefit analysis.

The policy intentions of European (including the UK) cities, with regards to climate change are commendable. However, the test of the policy strength in individual cities will be the achievement of reasonable reductions in emissions or implementation of adaptation measures within realistic timescales.

In the post credit-crunch climate, where deficit reduction and financial neo-liberalism in government policy is prioritised in contemporary Europe, the ability or willingness of city authorities to implement ambitious low-carbon transition measures, perceived by many as costly and unwelcome, will be at best problematic.

²¹ <http://www.lowcarboncities.co.uk/cms/>

²² <http://www.carbondescent.org.uk/pages/vantage-point.html>

Some of the key lessons learnt from the UK experience are as follows:

- Indicators for success include local government commitment and leadership, both strategically and politically; true partnerships with delivery bodies, including shared goals and targets; clear responsibilities for each party with clear accountability; and imaginative financing arrangements with 'buy-in' from finance directors.
- National government in the UK has clearly recognised the critical role of local authorities in tackling climate change.
- Embedding climate change indicators into the performance reporting framework of local authorities provides a consistent framework for monitoring GHG emissions at the local level and allows for comparisons between local authorities.

Key Lessons from UK Cities:

- National government in the UK has recognised the critical role of local municipalities in addressing climate change.
- Embedding climate change indicators into the performance reporting framework of municipalities provides a consistent framework for monitoring GHG emissions at the local level and allows for comparisons between municipalities.

KEY LESSONS FROM NORTH AMERICAN AND LATIN AMERICAN CITIES

Despite the United States (US) national government not having signed the Kyoto Protocol, which binds signatory countries to reducing their emissions, many US cities have independently adopted their own climate action plans (Engel, 2006). In 2003, approximately 140 cities and counties set GHG emission reduction targets. These cities are part of ICLEI's Cities for Climate Protection Campaign (Kousky and Schneider, 2003).

Kousky and Schneider (2003) noted that the main reason for US cities adopting climate action plans, is as a result of the cost benefits and co-benefits of these interventions. US cities have realised that it is advantageous to recognise the co-benefits, as it allows municipalities to draft policies that address many issues simultaneously. However, this can prove to be problematic as it can slow down higher level mitigation actions that are more costly (Kousky and Schneider, 2003). Another main driving force for climate change mitigation in US cities was the prevalence of an 'issue' champion to drive the action. Local mitigation policy is predominantly top-down in US cities and in general, public interest is often missing (Kousky and Schneider, 2003).

According to a study by Betsill (2001), the best strategy to get local governments to mitigate for global climate change is to 'think locally and act locally'. However, Betsill (2001) also acknowledged that there are many institutional, administrative and budgetary barriers in US cities that make it difficult to implement climate change policies. A key lesson learnt from US cities is the need to adopt an indirect strategy for mitigating climate change, where climate change mitigation is embedded in broader public concerns. The main benefit of this approach is that it avoids the political climate change debates within local government (Betsill, 2001).

In Canada, the lead cities for climate change action are Toronto and Vancouver. Toronto was one of the first cities to recognise the need for a climate change action plan and in 1990 declared a target for reducing emissions by 20% based on the 1988 levels by 2005 (Dodman, 2009). Other cities in Canada have been slow to respond to climate change, with only 122 out of more than 4 000 municipalities having responded to climate change in 2005 (Robinson and Gore, 2005).

According to these authors, one of the main reasons for lack of action is that cities do not recognise that global climate change is a mat-

ter of local concern. Awareness in local government combined with political and public will is critical. Finally, it is important that financial, technical and capacity barriers are addressed (Robinson and Gore, 2005).

Latin American cities are not major GHG emitters, however, emissions in these cities are growing. Examples of climate change actions in selected Latin American Cities are highlighted in Appendix 7. Many cities are vulnerable to the impacts of climate change yet have been slow to respond (Hardoy and Lankao, 2011). In terms of energy supply, Latin American cities rely heavily on hydropower and as a result have a good record in terms of renewable energy. São Paulo

for example, has combined their renewable energy supply, with sound energy policies and climate action plans (Economist Intelligence Unit, 2010). However, often cities that have the highest renewable energy contribution, have weak climate change policies. A leader in sustainable cities in Latin America is Curitiba, Brazil, which is regarded as one of the most sustainable cities in the world. Since the 1960s, Curitiba has implemented a holistic, long-term approach to the environment. They have introduced strategies to reduce urban sprawl and to promote the use of public and non-motorised transport (Economist Intelligence Unit, 2010). Key lessons that can be learnt from Latin American cities relate to integrated public transport systems and opportunities for greening the energy supply.

Key Lessons from North American and Latin American Cities:

- US cities have adopted an indirect strategy for mitigating climate change that emphasises co-benefits.
- Latin American cities have focused on integrated transport systems and greening the energy supply.

GENERAL LESSONS FROM GLOBAL CITIES

In general, cities in developed countries focus their climate change strategies on the energy sector, addressing specifically:

- energy efficiency and energy saving initiatives in communities and businesses, using a variety of incentives;
- applying high energy efficiency and renewable energy standards for new buildings, through various means, such as policies and incentives;
- increasing plans to promote the use of renewable energy, decentralising the energy supply, increasing use of combined heat and power (CHP) technologies and in other cases lowering the carbon intensity of the main energy supplier (Crocì *et al.*, 2010:30).

Developed countries also focus on the transport sector, where the main emphasis is on improving and enhancing public transport and using instruments that will decrease the use of private vehicles.

Developing country cities, focus mainly on transportation strategies and are strongly dependent on strengthening their public transport system. While energy efficiency is also a target area of interest, efforts to green the energy supply are relatively limited (Crocì *et al.*, 2010; Dhakal, 2008).

In general, there appears to be a lack of emphasis on adaptation measures in developing country cities and developed country cities have only recently increased their emphasis on adaptation. Successful climate change policies simultaneously address mitigation and adaptation (Corfee-Marlot *et al.*, 2009).

The Organisation for Economic Cooperation and Development (OECD) (OECD, 2010) has recently compiled a report on 'Cities and Climate Change' which highlights that city governments need to work together with national government to strategise on effective ways to respond to climate change. Some of the key recommendations that emerged from the report are:

- Lifestyles and sprawl, not urbanisation, are at the heart of the problem.
- Successful compact cities rely on transportation linkages, mixed land uses, and high-quality urban services.
- Cities serve as policy laboratories for action on climate change.
- Important opportunities exist at the urban level to develop and exploit adaptation and mitigation win-wins.
- Local fiscal policies can be greened.
- Cities can be effective in greening industrial production and fostering eco-innovation.
- A robust framework for multilevel governance can advance climate change action.
- National policies and enabling frameworks can empower local governments.
- Central governments will need to create a sound institutional foundation; and knowl-

edge base to support local decision-makers in identifying cost-effective actions (OECD, 2010).

There has been recognition globally of the need to develop integrated frameworks for climate change, where various issues within a city are addressed in an integrated manner to ensure that synergies are recognised and new development paths emerge. Furthermore, the need to highlight the co-benefits of climate change mitigation and adaptation is essential, as is the recognition by local government that climate change policies and economic development do not always contradict each other and in many cases complement each other. Finally, a forward-looking stewardship in the politics within a city can have very positive impacts for transitioning towards a low carbon economy (Dhakal, 2008).

A large, semi-transparent circular graphic that dominates the right side of the page. It contains a composite image: the top part shows a blue sky with white clouds; the middle part shows a large, dark solar panel array; the bottom part shows a sandy beach with waves crashing. The circle is bordered by a thick, dark blue ring. To the right of the circle, there are abstract, overlapping green and yellow geometric shapes, resembling a stylized leaf or a modern architectural element.

The city's **greenhouse gas** inventory provides
the basis for identifying which **sector/s** to
target

opportunities for transitioning to a low carbon city

INTRODUCTION

A wide array of climate change mitigation activities undertaken in eThekweni Municipality were described in Chapter 2. The objective of this chapter is to identify further opportunities. The starting point is the city's GHG inventory, which provides the basis for identifying which sector/s to target and where the greatest impacts are likely to be.

GREENHOUSE GAS EMISSIONS BY SECTOR

The city's first GHG emissions inventory was undertaken in 2002, but was limited to emissions from municipal operations. A second GHG inventory in 2003/04 was followed by a third comprehensive inventory for the 2005/06 financial year that reported on emissions from both the municipality and the broader community (Antoni, 2007). It forms the basis for the statistics presented here.

A third GHG inventory has recently been commissioned, but the results were not available at the time of preparing this report.

The following statistics from the 2005/06 emissions inventory for eThekweni Municipality (Antoni, 2007) are relevant:

- The total energy consumed was 133.7 million GJ.
- The total GHG emissions was 22 531 967 tCO₂e.
- This total represents approximately 5% of South Africa's GHG emissions.
- Of the total for eThekweni Municipality, 5% is attributed to municipal emissions and 95% to emissions from the community sector.
- The industrial sector emits 45% of the city's total GHG emissions, followed by the transportation sector (25%), the residential sector (17%) and the commercial sector (8%) (Fig. 5.1).

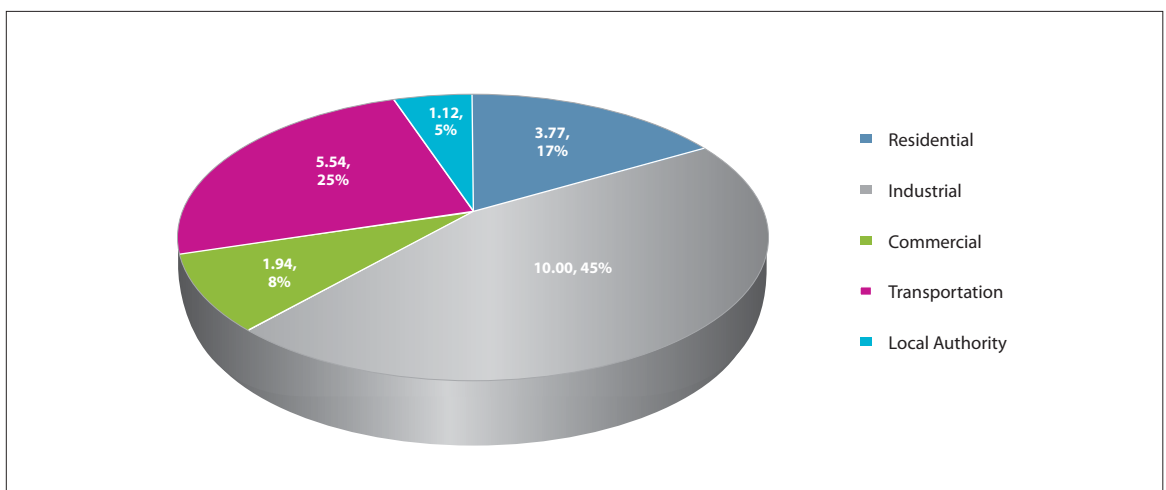


Figure 5.1: CO₂e emissions (Mt) per sector in the eThekweni Municipality for 2005/06 (Source: Antoni, 2007)

INDUSTRIAL AND COMMERCIAL SECTOR EMISSIONS

The industrial sector is the largest GHG emitter in Durban and therefore represents a clear target for mitigation. In this sector, electricity consump-

tion comprises 52% of total industrial emissions, followed by coal (17%) and refinery gas (15%), which is produced and used by the two oil refineries, Sapref and Engen, as feedstock (Antoni, 2007) (Fig. 5.2).

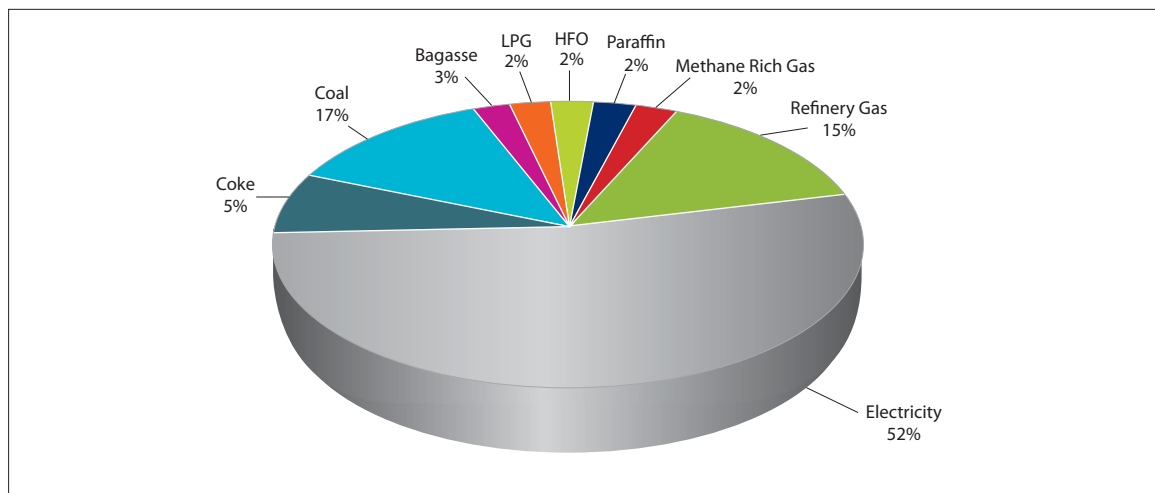


Figure 5.2: Percentage of industrial GHG emissions in Durban by fuel/energy type (Source: Antoni, 2007)

The top 20 electricity consumers in eThekweni Municipality are listed in Table 5.1.

Table 5.1: Electricity consumption and related CO₂e emissions for the top 20 electricity consumers in eThekweni Municipality for 2007/2008 (EThekweni Electricity, 2009) [the top five consumers are highlighted]

Sub-sector	GWh	GJ	tCO ₂ e
Petrochemical and rubber			
Dunlop	40	143 095	47 698
SAPREF	303	1 089 760	363 253
Petronet	29	105 183	35 061
Tioxide	36	130 029	43 343
Engen	138	495 909	165 303
Textiles, clothing and leather			
Frame Textiles	113	408 555	136 185
Hosaf	36	129 383	43 128
Food, beverages and tobacco			
Isegen	42	152 866	50 955
Unilever	26	93 802	31 267
Clover	30	106 324	35 441
SAB	50	181 405	60 468

Wood, wood products, paper and pulp			
Mondi	783	2 818 634	939 545
Transport equipment			
Toyota	136	488 903	162 968
Shopping malls			
Old Mutual (Gateway)	79	282 987	94 329
Pareto (Pavilion)	59	212 697	70 899
Non-metallic minerals			
NPC Cimpor	44	157 067	52 356
Education			
University of KwaZulu-Natal	28	101 140	33 713
Land and water transport			
National Ports Authority	57	204 557	68 186
Hotels, restaurants and entertainment			
Durban Marine (uShaka)	31	110 484	36 828
Tsogo Sun (Suncoast)	27	98 737	32 912
Total	2 087	7 511 518	2 503 839

Table 5.2: Coal consumption in eThekwi Municipality for 2002 (Natal Associated Collieries, 2009)

Sector	GJ	tCO ₂ e
Agriculture, fisheries, forestry and mining	232 900	22 382
Petroleum, chemical and rubber products	721 490	69 335
Wood and wood products	4 548 720	437 132
Food, beverages and tobacco products	3 971 170	381 629
Textiles, clothing and leather goods	765 830	73 596
Other manufacturing	2 005 875	192 765
Trade	-	-
Financial and real-estate services		
Transport services	13 700	1 317
Public administration and services	241 120	23 172
Other business and services	7 398	711
Total	12 508 203	1 202 038

The total GHG emissions of these 20 industries/organisations is equivalent to 11% of the total GHG emissions for the city and 40% of the electricity consumed in the industrial and commercial sectors. Within this group, the largest consumers are the wood and wood products sector, the petroleum sector, textiles and transport equipment. However, the entertainment industry, shopping centres and the university are also relatively high consumers of electricity. There are clear opportunities for improving energy efficiency. If these 20 companies are each set a 10% reduction target in electricity consumption, this would be equivalent to a saving of 250 383.9 tCO₂e per annum.

Besides for electricity, the industrial sector also makes use of coal as a fuel. Coal is often the fuel of choice as it is more affordable than other energy sources, but because it is more carbon-intensive it is a greater polluting source in comparison to other fuel sources. Emissions from coal are approximately 5% of total GHG emissions and 12% of industrial emissions (Table 5.2). The coal quantities given in Table 5.2 are less

than those given in the GHG inventory (Antoni, 2007), most likely because some of the coal accounted for in the inventory is used outside the municipal boundaries. Clearly some of these sectors could be targeted to switch from coal to other cleaner fuels.

Important statistics are the energy intensity (energy consumption per unit GDP) and carbon intensity (CO₂e emissions per unit GDP). They give an idea of which sectors to target for future development, bearing in mind that they would reflect low carbon development opportunities and not necessarily job opportunities. Table 5.3 gives the results for 740 highest electricity consumers, classified into various categories, in eThekweni Municipality (Moolla, 2009). Based on this analysis, the petroleum, chemical and rubber products sector, the food, beverages and tobacco products sector, and the wood and wood products sectors are the most energy and carbon intensive. Sectors that should be targeted for development in view of their lower carbon intensities include the service industry sectors.

Table 5.3: Energy and carbon intensity by economic sub-sector for eThekweni Municipality 2007/2008
(Moolla, 2009)

Economic sub-sector	Percent contribution to GDP (%)	Energy consumption (GJ)	tCO ₂ e emissions	Energy intensity (GJ / R'000)	Carbon intensity (kg CO ₂ e/R'000)
Agriculture, fisheries, forestry and mining	1	930 786	90 719	0.59	57.62
Petroleum, chemical and rubber products	5	32 845 142	2 552 297	5.64	438.50
Wood and wood products	3	14 679 603	2 032 463	4.70	650.84
Food, beverages and tobacco products	4	25 343 066	889 837	5.58	196.03
Textiles, clothing and leather goods	2	2 190 384	361 345	0.97	160.05
Other manufacturing	9	7 525 503	1 114 421	0.70	103.53
Trade	17	3 373 325	937 035	0.18	48.98
Financial and real estate-services	15	3 345 430	929 286	0.19	52.43

Transport services	11	1 598 149	259 339	0.13	21.33
Public administration and services	24	4 908 356	1 291 409	0.18	47.01
Other business and services	9	3 562 256	774 871	0.34	73.69
Total		100 302 001	11 233 023		

TRANSPORT SECTOR EMISSIONS

The transport sector accounts for 25% of GHG emissions. This sector includes GHG emissions from aviation transport and road transport; however, it does not account for emissions from marine and rail transport. When emissions from this sector only are examined on a *per capita* basis, Durban has a *per capita* figure of 1.70 tCO₂e, similar to *per capita* figures of London, New York and Mexico City, but lower than the corresponding value for Bangkok (3.53 tCO₂e/*capita*) (Croci *et al.*, 2009).

According to Winkler (2009), the transport sector is the fastest growing contributor to GHG emissions in the country, therefore it is important that emissions from the transport sector are mitigated.

RESIDENTIAL SECTOR EMISSIONS

The residential sector is the third largest contributor (17%) to GHG emissions in eThekweni Municipality. According to Stats SA (2007), 77.8% of the total energy consumed in the municipality is from electricity and more than 80% of households use electricity. A significant number

of households, however, use a combination of electricity and other energy sources for heating and cooking, such as paraffin, LPG and candles. In terms of climate change mitigation in the residential sector, the prime target should be electricity consumption.

MUNICIPAL SECTOR EMISSIONS

The municipality contributes 5% to GHG emissions and consumes 3% of total energy (Antoni, 2007). Local government is responsible for street-lighting, waste, water and sanitation, municipal vehicles and buildings. GHG emissions associated with each of these activities are illustrated in Figure 5.3, indicating that the highest emissions derive from the 'other' sector, which includes electricity distribution losses due to technical errors and theft. The second largest emitter is the waste sector as a result of methane (CH₄) emissions from landfill sites. The observed decrease in 2005/06 compared with the previous year is most likely due to the initiation of the eThekweni landfill gas to electricity project (Antoni, 2007).

There is great potential to reduce emissions from the municipal sector as the municipality exercises control over its own activities.

Key Messages:

- The city of Durban produces 7% of South Africa's greenhouse gas emissions.
- The relative contributions of sectors to the total emissions provides guidance on which sectors to target for reduction.
- The industrial sector, which contributes 45% of total emissions, is clearly a key sector to target.

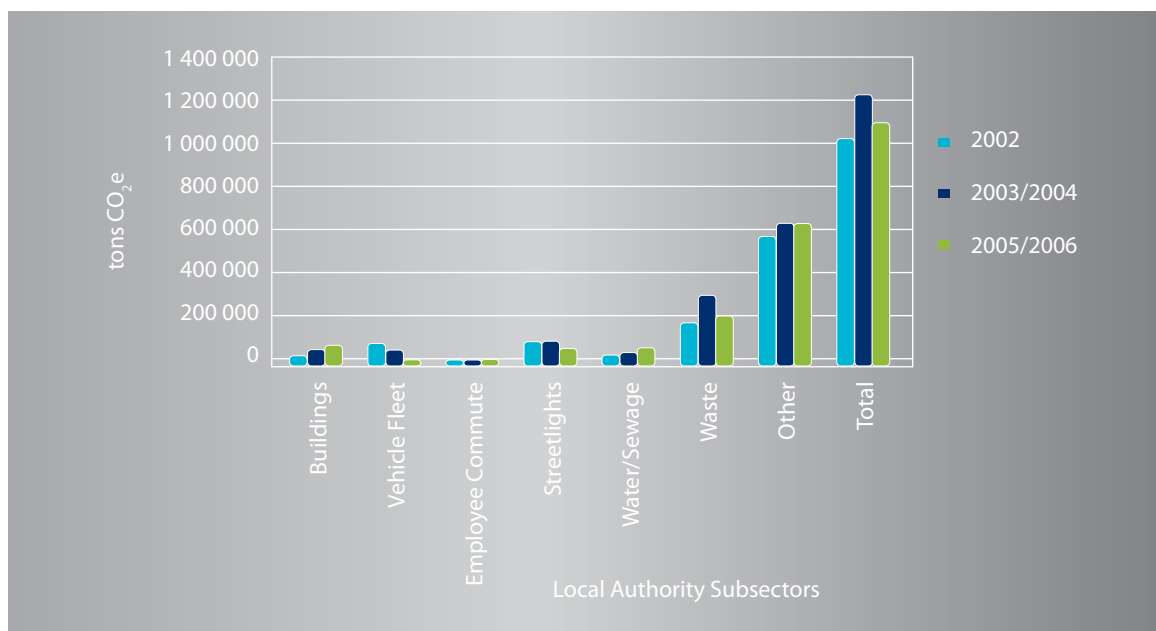


Figure 5.3: Comparison of municipal sub-sector emissions (adapted from Antoni, 2007)

MITIGATION OPPORTUNITIES

There are various frameworks for considering mitigation opportunities. The first is source-based, based on the source categories defined in the GHG inventory, viz. industrial, transportation, commercial, residential and municipal sectors. A second is implementation-based, referring to categories such as energy, transport, planning, etc. that align with departments in the eThekweni Municipality. The latter is used as the basis in this study.

OPPORTUNITIES IN PLANNING

There are a number of planning principles that can contribute towards the transition to a low carbon city. Commendably, many of these have been recognised in eThekweni Municipality's planning policies, as was noted in Chapter 2. However, for various reasons, they have been partly unsuccessful in their implementation and hence warrant reiteration and justification here. In order to achieve greater alignment between development on the ground and accepted planning policies, some key pointers are given. While it is recognised that there are powerful political drivers operating, the sugges-

tions are aimed at making the principles easier to defend.

Combating urban sprawl

A fundamental principle of a low carbon city is one in which urban sprawl is controlled for the following reasons:

- It leads to a situation where food supplies are sourced from increasingly distant places necessitating transport over great distances. Further, it effectively destroys small-scale agricultural production, since local markets are too thin and small farmers cannot afford the transport costs associated with accessing central markets.
- It generates enormous amounts of movement and by implication, high carbon emissions.
- It fails to deliver the potential benefits of city, because densities, and thus thresholds, are too low.
- It makes the achievement of efficient and viable public transportation very difficult.

It is clear that the current model based on the modernist planning paradigm and characterised by urban sprawl must be reversed (Dewar and Todeschini, 2004). To do this, the central

question is not about defining where development should go, but in determining where urban development should not go (on ecological, agricultural and landscape character grounds) and fiercely defending these defining edges. New developments that promote urban sprawl and go against the IDP should be disallowed.

Compacting city form

Urban compaction is essential in order to increase densities (and thus thresholds) within urban settlements, in order to obtain the benefits of urbanity (higher levels of social services and facilities, improved public transportation, greater generation of small-business opportunities, more pedestrian-friendly urban environments, greater economic efficiency, etc.).

It is acknowledged that there has to be a balance between compactness and the retention of significant open space to satisfy other social and environmental needs.

Two generic actions are required to pursue compaction. The first is identifying edges to the city, which may not be transgressed by lateral spread, and which should be fiercely policed. A number of principles apply in respect of the process of identifying edges.

- The edges should not fully enclose the town or city to avoid an increase in land prices as demand increases relative to supply and resulting in a situation in which fewer people are able to afford the escalating land prices. Rather, the process of boundary definition should define a limited number of paths of possible lateral spread, though clearly subject to much higher densities than those occurring currently.
- The edges should not follow cadastral boundaries; they must be sharp and design-driven and, wherever possible, should be reinforced by natural features (such as rivers or steeper land), to make them easily identifiable and enforceable. Where this is not possible, the edges should be strongly defined (either through buildings, small-scale agricultural schemes, fire breaks, berms and so on) in a manner which firmly discourages future lateral spread.
- If development is to occur in the peri-urban zone (and some may be possible with the

intensification of agriculture in this zone), its logic must be peri-urban-based (it should seek to open up agricultural or tourism-based opportunities). Similarly, the form of development should not be suburban but should seek to capture the qualities of hamlet or rural village. This development should not be large or random. It should take the form of small 'beads on a string' in response to the logic of regional infrastructure (particularly movement).

The second generic action is encouraging higher density mixed-use infill projects within the city boundaries. Such projects should be small (generally in the range of 250-300 housing units but often much smaller than this). They should be used to reinforce public structure, particularly public transportation spines. They should not be high-rise and should take walk-up forms. There is considerable international evidence to show that very adequate densities in highly liveable forms can be achieved without exceeding 3-4 storeys (DAG, 2010). Conversely, there is a great deal of evidence to show that high-rise schemes are costly, both socially and economically (the need for an elevator – which is continually needing maintenance – alone rules them out as an effective urban solution, particularly for the urban poor). They should be organised around high-quality public spaces that effectively operate as extensions to the private dwellings. It is noted that this recommendation contrasts sharply with the national housing policy that favours large mass-housing schemes which are yielding so little at this moment in time (Jenks and Burgess, 2004).

Urban edges are defined in the eThekweni SDF but the logic behind their determination is frequently hard to discover. Commonly, too, they follow cadastral boundaries and as a consequence, these boundaries are frequently contested and they are not effective in containing lateral sprawl.

Decentralising urban opportunities

The key message here is decreasing movement across the city as opposed to increasing mobility (as implied, for example by the current emphasis on Bus Rapid Transit (BRT) systems in South Africa). This can only be achieved by decen-

tralisering urban opportunities to follow the growth pattern of settlement. A pre-condition for this to occur, in turn, is again achieving much higher densities.

The inevitable outcome of a low-density, sprawling, form of development is that, structurally, very few places of higher accessibility emerge (commonly only at the cross-over points of major transportation channels). Since accessibility largely determines the locational distribution of higher order activities (those activities which serve, and are supported by, the public at large), the structural pattern of land uses tends to be one of highly nodal centres of intensive activity at a limited number of places, with large areas remaining unserved. Accordingly, the system generates large amounts of movement, with severe consequences for carbon emissions. An additional negative outcome is that these (limited) points of higher accessibility tend to be appropriated by larger enterprises, which can afford to pay higher rents. The system is highly exclusionary in terms of small entrepreneurs. This pattern is evident in eThekweni Municipality, particularly in the newer parts of the city.

Promoting urban corridors

Urban corridors seek to promote intensity, to encourage non-motorised and public transportation, to stimulate a mix of activity, to promote small business, to pursue urban integration vigorously and to improve equity and convenience. (The tendency for more intensive activities to agglomerate in linear forms in association with most continuous movement routes.)

Corridor formation can be observed in cities in many parts of the world, however, it has been actively discouraged internationally as a result of the dominant modernist urban paradigm, which promoted land use separation, and increasing mobility and the unfettered flow of vehicular traffic. A third factor was a concern about ribbon development, which began in the UK in relation to regional, inter-town development. However, the idea of discouraging mixed-use development along continuous routes was applied to intra-urban routes in South Africa and was entrenched in law. With hindsight, it is apparent that all of these concerns were wrong.

A concern with the promotion of corridor is not, in the first instance, a transportation issue (as it has been promoted in places like Curitiba, Brazil), although public transportation is an important part of any corridor project. The term 'corridor' refers to an urban corridor. This represents a broad (commonly at least a kilometre wide) band of mixed-use activity, continually intensifying around one or an interlinked system of transportation routes or spines of different lengths.

More continuous transport routes in urban areas represent energy flows. They carry flows of people and finance and it is to these that more intensive activities (activities requiring public support) respond locationally. They are links or planes of higher accessibility. These flows, in turn, represent markets (for goods or services, including social services) to which both the public and private sectors can respond. The greater the volume of movement along a route, the greater is the potential market. The potential of the market at any point, therefore, is a consequence of three factors: the number of people in the local area served by the route; the volume of through traffic; and the combined income of all these people.

In effect, since the continuous routes 'tie' together a number of local areas through which they pass, no one area is entirely dependent on its own resources to provide support for more intensive activities and facilities. Local areas 'lean upon' each other in a symbiotic way. In this way, the corridor can be used as an integrator to break down introverted neighbourhood cells. The idea of corridor is not the opposite of nodal development. Intensive activities almost never occur evenly along the length of the spine. They tend to agglomerate or cluster, according to the relative accessibility of different points along it. The common pattern, therefore, is one of 'beads on a string' with different clusters tending to grow towards each other over time.

Commonly, too, the corridor tends to be made up of an hierarchically differentiated system of larger and smaller corridors and hierarchies of activity occur in response to these. More local corridors, aligned with less significant but still relatively continuous routes, frequently exist and interpenetrate with the main spine. These smaller corridors essentially respond to pedes-

trian flows. To increase this generative capacity, it is therefore sensible to reinforce and increase these flows by placing generators of pedestrian movement (particularly schools and other social services) adjacent to, or near, these routes. These smaller routes should also be the target of non-motorised transport (NMT) programmes to make walking and cycling as pleasant as possible, and to promote people-friendly neighbourhoods.

The SDF for eThekweni Municipality (eThekweni Municipality, 2009b) promotes the concept of 'corridors'. However, the term is used in an entirely different way to that discussed here. In the SDF, the term refers to the promotion of development along intra-regional freeways, a classic form of inter-town ribbon development that is highly undesirable as it promotes urban sprawl, destroys nature and agricultural development, intensifies car dependencies, and increases carbon emissions. Freeways are limited access routes designed to increase mobility. Access to and egress from, them occurs infrequently. They are 'space-bridgers', in the sense that they connect a number of relatively dispersed points, and except at these points, the freeway operates as a barrier. Developments on either side of the route are entirely unrelated to each other and public activities are not attracted to them.

Corridors as conceptualised here are related to intra-urban arterials, which are zones of urban intensification within the city, and which allow stop-start movement along their length. They create linear patterns of access in space and activities can respond directly to them on the edges. They are 'space-integrators' in the sense that they link a number of local areas together and the more intensive activities which are attracted to them, because of their superior access are, in effect, shared by all of these connected areas. Further, they are operationally two-sided: pedestrians can cross them at regular intervals.

Corridors are an effective form of decentralisation of urban opportunities as thresholds and patterns of accessibility are automatically co-ordinated. They tend to break down urban fragmentation and increase integration; they can be used to tie many local areas into an integrated system.

Promoting sustainable neighbourhood planning

Spatial Development Plans can play a key role in integrating low carbon development into the planning process of the city. This is especially true if the planning is done at the scale of the Local Area Plans (LAPs) as they provide the most detailed level of planning and it is at this scale that the concept of sustainable neighbourhood planning, as suggested by Swilling (2006), is pertinent.

In South Africa, where cities have been shaped by apartheid ideology and a modernist planning paradigm, separation of land uses and income groups are the norms. The carbon footprint of these diverse 'neighbourhoods' provides a useful departure point for defining interventions and in building towards sustainable neighbourhoods. The sustainable neighbourhoods approach also plays a critical role in building the resilience of the city. While the term neighbourhoods is used here to reflect international practice, it could conveniently be equated to 'wards' in city governance terminology. In this respect, ward-based interventions have been tried in some services sectors (e.g. water) and have yielded a great deal of success.

Sustainable neighbourhoods are characterised by the attributes illustrated in Figure 5.4. (UK Presidency, 2005). While the transition to sustainable neighbourhoods is not simple, particularly in South Africa, where cities are characterised by modernist planning (see Chapter 2), a start has been made by applying the neighbourhoods approach to the eThekweni Municipality. Neighbourhoods have been defined according to land use and carbon footprint, based on principles discussed by Scott and Sutherland (2009) and Sutherland and Scott (2010) and adapted after a similar analysis for Cape Town by Swilling (2006). Figure 5.5 illustrates the neighbourhoods defined for eThekweni Municipality. Based on a consideration of the consumptive patterns of the various neighbourhoods, Figure 5.6 provides a spatial representation of the carbon footprints in the city and a departure point for defining the interventions needed in the drive towards a sustainable neighbourhoods approach.



Figure 5.4: Key elements of a sustainable community (adapted from: UK Presidency, 2005)

Shared vision of spatial growth

The city needs a shared vision of spatial growth involving key sectors (e.g. planning, housing and infrastructure) in the municipality, senior city management and politicians, and major landowners and civil society groups, as noted by Breetzke (2009). Only through a shared vision can a low carbon city be achieved. The new DTP and international airport is being developed in principle as a green site, but this cannot be done in isolation of the broader planning and infrastructure planning that needs to take place in the city as a whole. The role of planning in transforming the city into a low carbon city is critical. However, as noted above (Chapter 2),

these planning tools are not powerful enough to shift the demands and pressures of the market. A shared vision of the spatial development of the city is necessary to support the role that these tools can play.

Finally, it should be noted that the most effective forms of mitigation relate to sensible future land management decisions which circumvent problems and which interface with some of the adaptation measures being applied. Examples include avoiding building below the 5 m contour in coastal zones, in the 1:100 year flood line and in areas prone to flooding.

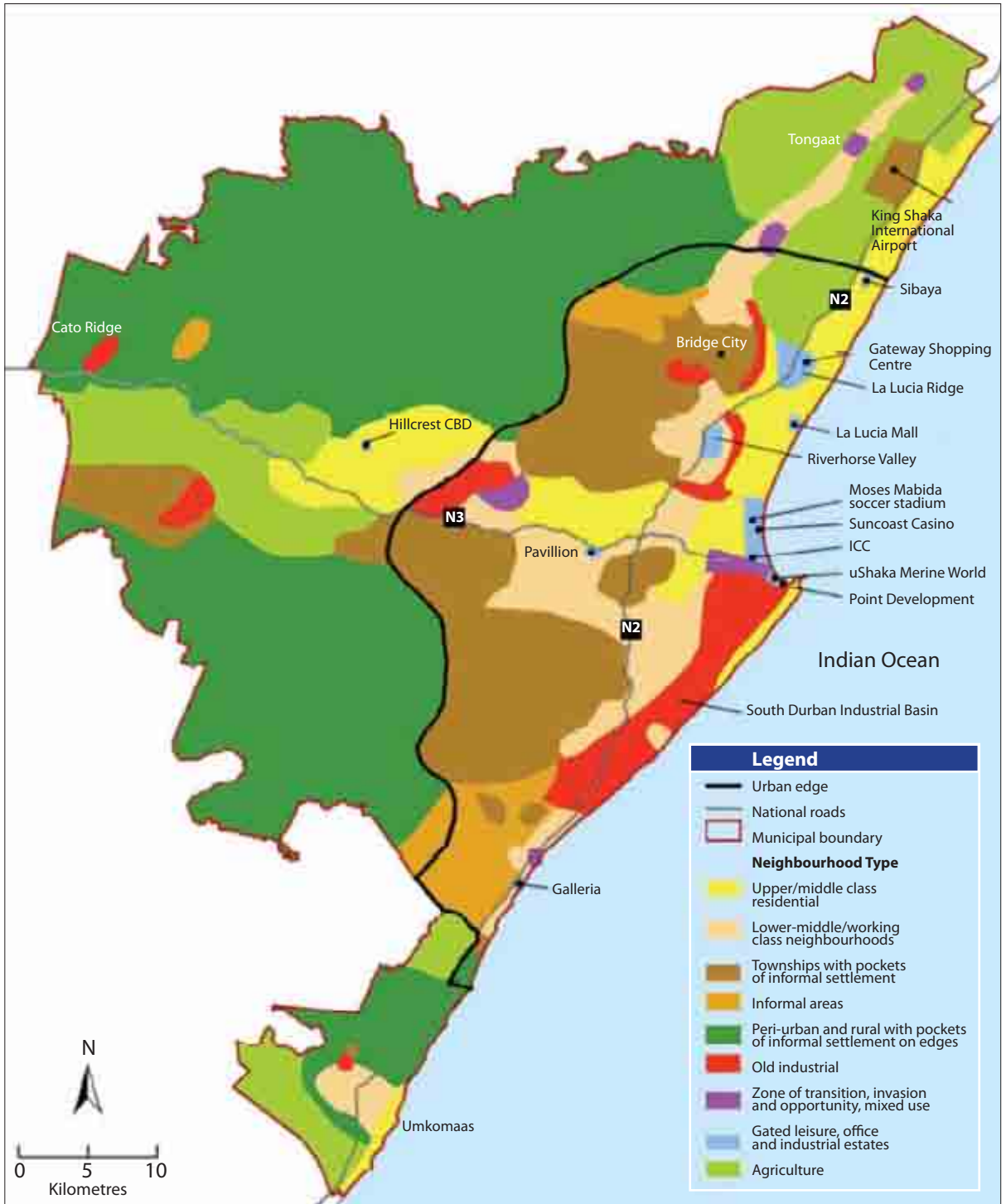


Figure 5.5: EThekweni Municipality neighbourhood map

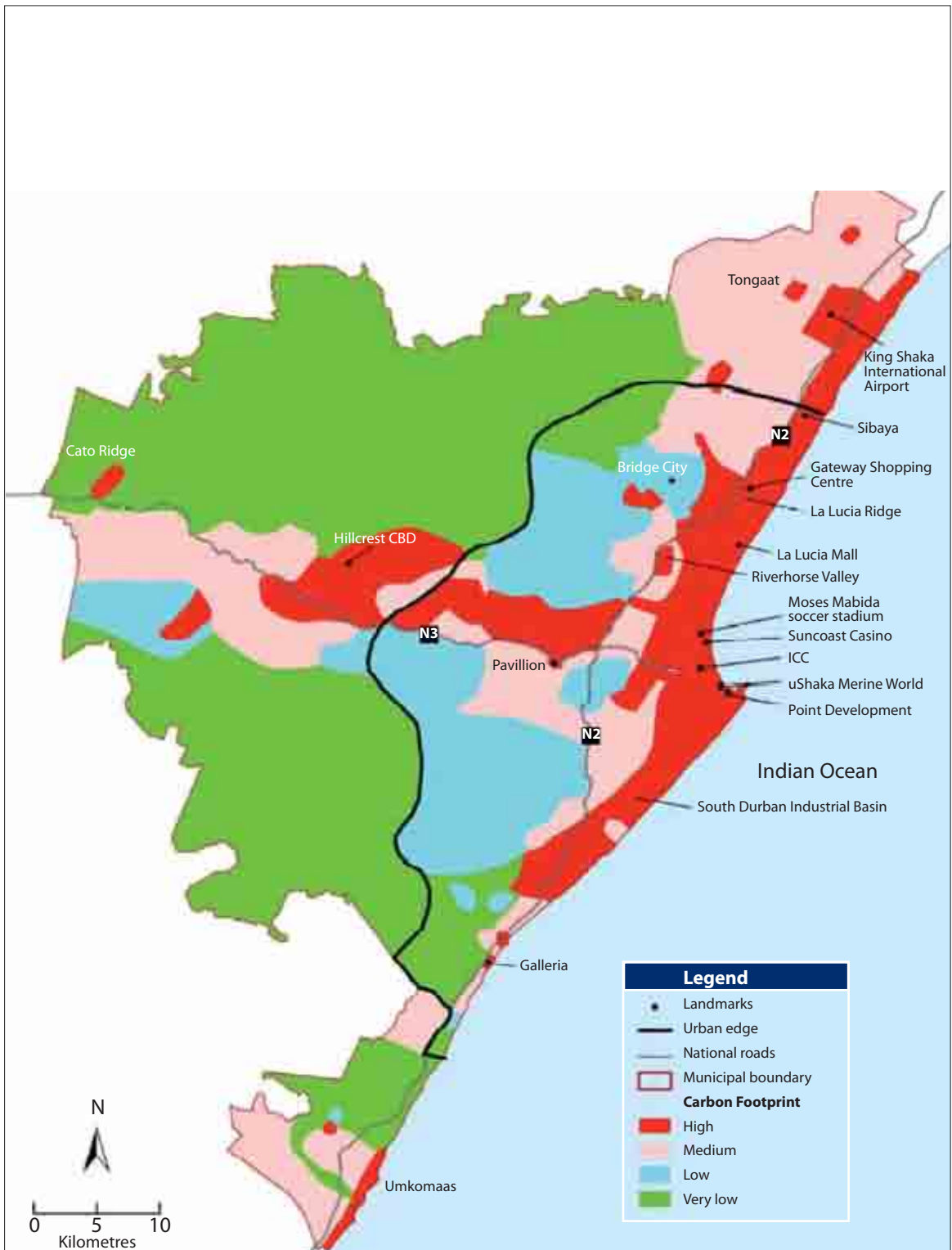


Figure 5.6: EThekweni Municipality ecological footprint map

Key Messages:

- There are fundamental planning principles that can contribute to the transition to a low carbon city. These include: combating urban sprawl, compacting city form, decentralising urban opportunities and promoting urban corridors.
- Whilst many of these are present in urban planning policy documents for Durban, they have not been successfully applied.
- To ensure greater success in implementing these principles, the following recommendations apply:
 - Designate no-development zones in the city (on ecological, agricultural and urban character grounds) and fiercely defend these edges.
 - Urban edges should be defined, wherever possible, by natural features (rivers or steep land) rather than cadastral boundaries.
 - Housing projects should be small to allow for higher density, mixed-use infill projects within the city boundaries.
 - Urban opportunities should be decentralised and follow the growth pattern of settlements.
 - Revisit the concept of corridors as currently applied in city planning to ensure that the corridors are linear zones of urban intensification that function as space integrators and allow stop-start movements along their length.
 - Promote sustainable neighbourhood planning.
 - Drive towards a shared vision of spatial growth in the city.

OPPORTUNITIES IN ENERGY

The Energy Office of eThekweni Municipality has very comprehensive policies in place that guide their initiatives (see Chapter 2). Hence, the identification of opportunities in the energy sector may list some that are already underway or under consideration by the Energy Office. This should be viewed as endorsement of actions and a means to garner further political and public support for these initiatives.

ENERGY EFFICIENCY IN BUILDINGS

In terms of energy savings, energy efficiency in buildings represents the 'low hanging fruit', where results can be achieved more rapidly than in other sectors, such as transport (Levine *et al.*, 2007). This view is endorsed by the latest IPCC report (IPCC, 2007) and has led to a series of country-specific reports on 'Greenhouse Gas Emission Reduction Potentials from Buildings' (UNEP Sustainable Buildings and Climate Change Initiatives, undated). There are sev-

eral arguments for improved energy efficiency in buildings, over and above that of climate change mitigation. They include:

- reduced energy costs to consumers;
- security of energy supply;
- cheaper option than investing in increased energy capacity;
- improved comfort;
- contribution to the objective of sustainable development (Janssen, 2004).

These co-benefits should be emphasised, particularly in a developing country context, where climate change considerations are sometimes marginalised.

The potential to reduce energy consumption in buildings still remains largely untapped in most countries, but is receiving increasing attention. The role of buildings is likely to play a far more important part in the renegotiation of the Kyoto Protocol (UNEP SBCI, undated). A noteworthy trend in highly developed countries, such as Ja-

pan, is a decline in energy-related CO₂ emissions in the industrial sector and an increase in the commercial sector, predominantly from buildings (TMG, 2008), indicating the importance of addressing energy efficiency in buildings.

In addition to GHG emissions related to operational activities, there are additional emissions related to the manufacture of building materials and the construction process. Both these need to be taken into account in a transition to green buildings or zero-carbon buildings. An overview of mitigation potential of the building sector in South Africa and the relevant national policies is given by UNEP SBCI (undated).

Opportunities to address energy efficiency in eThekweni Municipality are as follows:

Municipal Buildings: The Energy Strategy (Mercer, 2008) has identified energy efficiency in public buildings as a prime target for savings. It is estimated that savings of about 15% are achievable through practical interventions, most of which would incur few or no costs. Significant energy efficiency initiatives in municipal buildings have already been implemented. These have included retrofitting buildings with energy-saving devices such as insulation; energy efficiency standards for new public buildings; municipal building energy audits and savings implementation; capacity development in energy efficiency; maximising the use of solar water heating in public buildings; and maximising the use of energy efficient lighting in public buildings (Mercer, 2008).

Energy efficiency in government-controlled buildings can be achieved with relative ease, especially if there are policies and guidelines in position. Whilst the interventions in municipal buildings are to be greatly commended, it is important not to lose sight of the relatively small contribution of this sector to the city's overall energy consumption, and to ensure that energy consumption through municipal transport is addressed with as much vigour, and that energy efficiency targets are applied to buildings in other sectors as well.

Residential Buildings: There are significant opportunities for improving energy efficiency in

the residential sector, some of which are ongoing in the municipality. Energy efficiency can be realised through both the physical structure of the building and through energy-use behaviour, with the latter expected to achieve greater impact than the former (Mercer, 2008).

There are many existing and planned initiatives for households that are mentioned in the Energy Strategy (Mercer, 2008). For example, energy efficiency standards for new residential buildings; promoting and enabling energy efficiency in the home (through awareness-raising initiatives, promotion of energy efficient lighting initiatives, etc); mandatory energy efficiency and renewable energy training and certification for utility service providers; and household appliance energy efficiency labeling. The key to successful implementation of many of the proposed energy efficiency interventions in homes is changing behaviour. It is pointed out in Chapter 9 that behaviour changes do not necessarily follow from the provision of information. The recommendations for successful awareness-raising programmes given in that chapter apply equally to energy efficiency interventions and should be followed.

Commercial and Industrial Buildings: Energy efficiency initiatives should emphasise cost savings. While the industrial sector presents excellent opportunities for energy efficiency, it possesses the most barriers in terms of realising its potential. Lack of data is the single most important obstacle. Energy end-use in this sector is often related to the productive activities of companies, and hence individual companies may be reluctant to provide data that could compromise their competitive edge.

Incentives have a role to play and in this respect the Energy Strategy identifies incentives such as the launch of a certificated, voluntary Energy Management Best Practice programme within groupings in this sector; the linking of this programme to an annual 'Energy Champions' award; and the promotion of Energy Efficiency Clubs in Industry and Commerce (Mercer, 2008).

Some recommendations for energy efficiency in buildings, based on international best prac-

tice (see Appendices 4 to 7) follow:

- Emphasise co-benefits, particularly cost-savings, to encourage uptake of energy efficiency strategies.
- Set mandatory electricity reduction targets for organisations above a certain electricity consumption threshold (see Table 5.1) and require a five-year reduction plan and an annual progress report.
- Strengthen energy efficiency standards for new buildings with a move towards green buildings or zero-carbon buildings.
- Place emphasis on awareness-raising about the value and importance of energy efficiency and green buildings.
- Ensure effective diffusion of actions and experiences gained in addressing energy efficiency in municipal buildings to industrial, commercial and residential buildings.

Key Messages:

- Energy efficiency in buildings is regarded as the 'low hanging fruit'.
- The potential to reduce energy consumption in buildings is largely untapped and is likely to play an important role in the post-Kyoto Protocol era.
- Recommendations for energy efficiency in buildings include:
 - Emphasise co-benefits, particularly cost savings, to encourage uptake.
 - Set mandatory electricity reduction targets for large electricity consumers.
 - Strengthen energy efficiency standards for new buildings.
 - Place emphasis on raising awareness.
 - Ensure that actions and experiences gained in municipal buildings are spread to industrial, commercial and residential buildings.

ENERGY EFFICIENCY AND AIR QUALITY AND CLIMATE CHANGE CO-BENEFITS IN THE INDUSTRIAL SECTOR

As a result of a country-wide electricity shortage in 2008, large industrial consumers of electricity were requested to reduce their consumption by 10% (eThekweni Municipality, 2009b). In the eThekweni Municipality, a 3% drop in industrial electricity consumption in 2008 compared with 2007 yielded a saving of almost 70 000 tons of CO₂ and over 600 tons of SO₂ emissions (Thambiran and Diab, 2010). Other longer term projects, aimed at reducing electricity consumption by improving boiler efficiencies and introducing combined heat and power (CHP) or cogeneration systems in which waste heat is used as power in a secondary process, have also been initiated (Thambiran and Diab, 2010).

An additional consideration that is frequently overlooked in the industrial sector is the need to integrate air quality and climate change concerns to avoid counteracting influences or trade-offs. City initiatives to address poor air quality in the south of Durban have centred on the implementation of the South Durban MultiPoint Plan (SDMPP). The imperative of the

SDMPP is a reduction in ambient SO₂ concentrations. Pollution-control measures introduced included:

- The phasing out of 'dirty fuels' (fuel in the petroleum refining industries was changed from heavy furnace oil to refinery gas and methane-rich gas), resulting in SO₂ emissions declining from over 33 000 tons per annum to less than 800 tons per annum over the period 1997 to 2008.
- Change in fuel used by other industries in South Durban from high-sulphur coal to low-sulphur coal.
- Implementation of other 'end of pipe' pollution control devices.

These interventions resulted in ambient SO₂ air quality targets being met, but as noted by Thambiran and Diab (2010) increased CO₂ emissions markedly because of a reduction in plant efficiency levels and hence greater energy consumption. Such trade-offs need to be taken into account when planning air quality interventions. It is recommended that climate change considerations are integrated into air quality management planning in the city to ensure that such trade-offs are minimised.

Key Lessons:

- Combined heat and power systems in which waste heat is used as a power source in a secondary process offer great potential in the industrial sector.
- It is important to integrate air quality and climate change considerations when introducing interventions to improve air quality to ensure that increases in greenhouse gases do not occur.
- Climate change issues should be considered in the compilation of air quality management plans.

RENEWABLE ENERGY OPPORTUNITIES

The Energy Strategy (Mercer, 2008) of eThekweni Municipality encourages increased uptake of renewable energy sources. However, to date, investment in renewable energy remains minimal and there appear to be some significant barriers to its implementation in the municipality. Certainly, the Electricity Department's focus is firmly on grid electricity as the preferred carrier.

Renewable energy potential for eThekweni Municipality has been assessed by Marbek Resource Consultants (2007), who concluded that both wind and solar energy have low potential compared with other sites in South Africa, although it was acknowledged that the solar resource was sufficient to provide a major source for thermal energy through domestic solar water heating. According to their analysis, the options offering the greatest potential are as follows:

- Sugar cane residue, i.e. bagasse, from the sugar industry to generate electricity.
- Woody biomass waste from saw milling and pulp and paper industries to generate electricity.
- Waste water and sewage effluent as a source of methane gas to generate electricity and production of pellets from the dry solids.
- Landfill gases for electricity generation or direct thermal use.
- Oil-producing crops, such as soya, sunflower, maize, jatropha and possibly algae, which can be used in the production of biofuels.
- Charcoal production from waste wood.

- Production of biofuels (bio-ethanol and biodiesel) owing to the municipality's proximity to sugar producers (ethanol production) and availability of industrial land for the development of algae-based biodiesel.

It is pertinent to note that the use of wood waste to generate electricity would release gaseous pollutants that would cause a deterioration in air quality and should therefore not be considered as a top priority. The value of a co-benefits approach that optimises both climate change and air quality considerations was underscored in the previous section. The economic viability of the wood waste option is also in question, according to Norris and Volschenk (2007).

The dismissal of wind energy as an option by Marbek Resource Consultants (2007) is based on measured mean annual wind speeds of between 2 to 4 ms⁻¹, certainly low by conventional wind energy standards. However, since the conclusions were based on relatively few discrete measurements, it is recommended that a more thorough wind energy modeling study be undertaken to identify potential sites in elevated positions close to the coast.

The potential of bagasse to generate electricity is largely untapped and warrants detailed investigation. Electricity generation from bagasse is widely and successfully practised throughout the world, including the island of Mauritius (Bhurtun *et al.*, 2004; Deepchand, 2005; Deenapanaray, 2009). Sugar cane, as a C-4 species, has one of the highest conversion efficiencies (2.59%) for the transformation of solar energy into chemical

potential energy compared with other plants, for example, corn (0.79%) and tropical trees (0.95%) (Deenapanray, 2009). Indeed, electricity production from bagasse has operated successfully in KwaZulu-Natal for many years, but for the most part, the electricity has been consumed by the sugar industry itself. Historically low

feed-in tariffs for electricity fed into the national grid have hampered expansion.

However, recent policy changes and changes in refit tariffs make electricity production from bagasse potentially more attractive (see Box 5.1 for further details).

Box 5.1: Use of Bagasse for Electricity Production

Typically, for every 100 tons of sugar cane harvested and milled, 28 tons of bagasse are produced (Tongaat Hulett, 2005). The sugar cane areas concentrated around eThekweni Municipality provide excellent biomass potential with an estimated 100-500 GJ/ha/year of energy able to be produced. Currently, in the eThekweni Municipality area, bagasse created from sugar cane by-products accounts for 210 GWh electricity per year, while it is estimated that 1 400 GWh per year could potentially be generated using this fuel (EC, 2006).

There are a number of options for the use of bagasse, of which direct combustion, in which the residue is fired in a boiler to produce electricity, is only one. Others include processing into pulp for use in the paper industry, use as a reactant in the chemical industry, use as an additive in animal feed and use as a feedstock in the manufacture of activated carbons (Devnarain *et al.*, 2002). Of these, the production of electricity is the most common and it is based on a mature technological process (Norris and Volschenk, 2007).

Co-generation power facilities that combine bagasse and coal exist at the Maidstone, Amatikulu and Felixton sugar mills with a total installed capacity of 72 MW and 8.5 MW available to feed into the grid.

Combustion of bagasse produces few harmful gases; there is very little to no SO₂ emitted and the emission of nitrogen oxides can be reduced through the use of the Spreader-Stoker technology (Bhurtun *et al.*, 2004). In terms of CO₂, combustion of bagasse is deemed to be carbon neutral as the CO₂ emissions are balanced by the uptake of CO₂ during the growth of the sugar cane (Bhurtun *et al.*, 2004). A feasibility study to determine the viability of electricity generation from bagasse should be undertaken. Some of the issues that need to be addressed include financial incentives available through CDM and seasonal availability of the bagasse.

Key Lessons:

- Investment in renewable energy sources is currently minimal in eThekweni Municipality.
- A feasibility study should be undertaken to investigate the viability of using bagasse for the generation of electricity.
- A comprehensive modeling study of wind power potential in eThekweni Municipality should be undertaken.

OPPORTUNITIES IN TRANSPORT

The transport sector is pivotal to the transition to a low carbon city. The current transport pattern in the city, with its heavy reliance on private transport as opposed to public transport, and the central role of the port as an attractor and generator of freight, the vast majority of which is transported by road, do not support the fundamental principles of a low carbon city.

Little progress has been made in this sector in improving public transport systems in the city to provide motorists with a feasible alternative to private vehicles. Public awareness campaigns aimed at shifting consumer preference from private to public transport would therefore be fruitless at this point in time. However, the drive to increase the public:private ratio is a key objective of transport policy in eThekweni Municipality (ETA, 2010), mainly for traffic congestion reasons. Increased reliance on public transport is also an imperative of low carbon development in general, and particularly cities striving to become low carbon cities.

There is a sense of paralysis in the city on this critical issue of improved public transport. Strong leadership is needed, the barriers need to be articulated and unlocked through interventions at the highest political level. A high-level, multi-stakeholder, participatory transport summit is recommended as a way forward to address the key issue of public transport systems for the benefit of all the citizens of Durban.

The international perspective presented in Chapter 4 highlighted a vast array of potential interventions in the transport sector, ranging from the introduction of cycle paths to the promotion of tele-commuting. All should be considered with a view to finding those most applicable to the local context and those likely to make a significant contribution to carbon reduction. The fundamental and most pressing question for eThekweni Municipality presently is how to prioritise or how to identify the intervention that is likely to have the greatest impact in reducing emissions? Budgets are limited and the options are overwhelming, both of which can contribute to the paralysis described above.

Some guidance on prioritisation is provided in a recent study by Thambiran and Diab (2011), who investigated interventions in the road transport sector in Durban using the Computer Program to Calculate Emissions from Road Transport model (Gkatzoflias *et al.*, 2007), with a view to identifying those interventions that would simultaneously reduce air pollution and GHG emissions. The various scenarios modeled for the passenger vehicle fleet included:

- 20% replacement of the older petrol vehicles with newer petrol vehicles that are Euro 2 and 3 compliant;
- 20% replacement of the older petrol vehicles with new diesel vehicles;
- 20% use of biodiesel as a fuel substitute;
- 20% reduction in vehicle kilometres travelled (VKT).

Results showed that compared with the baseline, Euro 2- and Euro 3-compliant vehicles emitted more CO₂, as well as more of the 'traditional' air pollutants, such as sulphur dioxide (SO₂). The introduction of diesel vehicles and the use of biofuels resulted in a decrease in GHG emissions, but increased 'traditional' air pollutants. The scenario that allowed for a reduction in VKT produced a simultaneous reduction in GHGs and air pollutants, thus realising substantial co-benefits (Thambiran and Diab, 2011).

With regard to the heavy-duty vehicles, the same study concluded that significant reductions in air pollution and GHG emissions could be achieved by reducing VKT. For a 20% reduction in VKT in the heavy-duty and passenger vehicles, 24% and 18% reductions in CO₂ emissions were achieved respectively.

These model results assist in prioritising interventions and point to the following:

- The road freight sector is the top priority target, with a reduction in VKT being the main goal. This sector also offers the greatest potential for achieving co-benefits, such as reduced air pollution, reduced traffic congestion, reduced damage to roads and improved public health. The long-term solution is the replacement of a large proportion of road freight by rail. In the short to medium-term, attention should focus on a road freight traffic management system, with a

view to reducing inefficiencies (Hull *et al.*, 2008). Chapman (2007) gives many examples of how efficiency can be improved, such as the use of freight internet-based systems to match up spare vehicle capacity and freight needs, and reducing 'empty' trips by finding return loads.

- Reducing VKT in the passenger fleet should be the second point of intervention. This can be achieved through education awareness programmes, offering incentives for car-pooling, introducing penalties for single-driv-

er vehicles and forming strategic partnerships with business to assist in reducing VKT.

A final observation relevant to the transport sector and based on interviews conducted with city officials is that the eThekweni Transport Authority has relatively few strategic linkages with other key departments engaged in climate change activities. Improved co-ordination between relevant departments and support for eThekweni Transport Authority is important if the critical role of the transport sector is to be realised.

Key Lessons:

- The transport sector is pivotal to the transition to a low carbon city.
- There is a paralysis in the city on the critical issue of public transport. A high-level, multi-stakeholder, participatory transport summit is recommended to address this issue.
- The top priority for intervention is to reduce the vehicle kilometres travelled in the road freight sector. In the long-term, a shift to rail is the solution and in the short to medium-term, attention should focus on a road freight traffic management system.
- A reduction in vehicle kilometres travelled in the passenger fleet should also be targeted through education awareness programmes.

OPPORTUNITIES IN WATER AND SANITATION

In terms of the water supply system's contribution to the city's carbon footprint, the greatest contribution is through the use of electricity. This translates to a value of 0.10 kWh/kl of potable water (Friedrich *et al.*, 2009a). If the loss of 30% of water in the distribution system is taken into account, the energy figure increases to 0.13 kWh/kl. The energy required relates to the length of the distribution network (14 600km) and the topography that results in frequent changes in elevation within the network. On the wastewater collection side, energy consumption is 0.14 kWh/kl of wastewater moved in the system.

The consumption of water, which then translates into wastewater discharge (which has the highest ecological footprint), increases with household income. The carbon footprint of each of five processes in the municipal water supply and sanitation system (i.e. production of potable water, distribution of potable water, collection of wastewater,

treatment of wastewater, and recycling) is highest for the treatment of wastewater, followed by the distribution of potable water and then the collection of wastewater (Friedrich *et al.*, 2009b). Recycling has the lowest score, implying that recycling wastewater is a better option than treating raw water. Supplying industries close to wastewater treatment plants with recycled water would be an appropriate carbon reduction response.

The Durban wastewater recycling plant, commissioned in 2001, is the first of its kind in South Africa (Friedrich *et al.*, 2009a). The plant, which is located adjacent to the Southern WWTW, has a capacity of 40 Ml/day. It produces industrial grade water from treated sewage which is used by an adjacent paper mill and oil refinery, reducing the demand for potable water in the municipality.

Recommendations to reduce carbon emissions from the water sector, many of which are

already being addressed, and hence should be viewed as endorsement of actions and as a means to garner further political and public support for these initiatives, are as follows:

Address water losses

Water losses in the distribution of potable water have a high environmental burden in addition to financial implications. This should be the first and most important step in reducing GHG emissions. Taking into account the high-proportion of unaccounted water (e.g. due to leakage, illegal connections, etc.) reducing supplier demand will have the highest environmental and financial improvement impact without negatively affecting the quality of the supply.

Address consumer demand

Consumer demand should also be addressed through water-saving devices and local by-laws or restrictions.

Promote safe, onsite sanitation

Wastewater treatment plants, which have activated sludge units, have a high impact on GHG emissions due to their energy requirements. Therefore, where appropriate, safe, onsite sanitation should be promoted because it has environmental advantages in terms of energy requirements (collection and secondary treatment are not necessary) and sustainability.

Revert to anaerobic digestion technology

The aerobic waste water treatment processes used at most municipal WWTWs are energy-intensive, consuming large amounts of electricity to drive the activated sludge process. Anaerobic digesters have much lower energy requirements, which is why all larger municipalities in South Africa, including eThekweni Municipality, are refurbishing their WWTWs and returning to anaerobic digestion technology. Anaerobic digesters, when managed correctly, produce significant quantities of biogas, which can be used to generate electricity (see next Section).

Investigate ozonation technology

Ozonation is viewed as a clean technology for the disinfecting of water, however, due to its relatively high-energy requirements it has a high environmental burden. The efficiency of the process itself is another issue to be investigated.

Treat all water supplied for households to drinking water standards

In general, in developing countries, the environmental burden of providing partially-treated water together with bottled water are high and this method of supplying safe water should not be encouraged. In other words, it is more beneficial, environmentally, to treat all the water supplied for households to drinking water standards.

The environmental costs of supplying water that is not properly treated are high, adding to the health costs, and it will affect mostly the poor since they are more likely to be in a position where access to bottled water does not exist (affordability, distribution, etc).

OPPORTUNITIES IN SOLID WASTE

The solid waste sector is one where there are many opportunities to mitigate GHG emissions and to generate employment opportunities at the same time.

WASTE AVOIDANCE AND RECYCLING

There are many current initiatives underway in eThekweni Municipality (see Chapter 2), but waste recovery should continue to be practised and promoted and expanded through education awareness programmes emphasising the benefits of waste recovery [see Box5.2].

Further opportunities for waste avoidance and recycling and hence a reduction in GHG emissions in the solid waste sector in eThekweni Municipality are as follows:

Promote E-waste recovery

The E-Waste Association of South Africa (EWA-SA), a non-profit organisation, is driving the recovery and recycling of e-waste, supported by the Information Technology Association. Comprising all formal Information and Communication Technology (ICT) industry players, the ITA's membership represents 85% all ICT hardware and software sold in the country. Recovery and recycling of e-waste will be achieved by the levying of an Advanced Recycling Fee. The process of establishing the required infrastructure to implement this is at an advanced stage²³.

²³ <http://www.ewasa.org>

Box 5.2: Benefits of Waste Recovery

- Plastics recovery reduces emissions related to the refining of fossil fuels, from which plastics are derived.
- Production of any type of paper involves the capture of carbon through the growth of trees used as raw material. Approximately 30% less energy is required to produce good-quality recycled paper than to produce virgin paper.
- Recovered metals, whether ferrous or non-ferrous, may be re-smelted with substantial energy savings.
- Glass re-smelted saves substantial energy.
- Opportunities for job creation.

Starting with the municipality, procurement policies should state that hardware should be purchased only from members of EWASA to ensure that its recovery and recycling is assured. Similarly, electronic hardware should not be disposed of except to EWASA-accredited recyclers²⁴. A similar policy should be promoted through industrial, commercial and educational organisations in the city.

Promote green procurement policies

The use of paper with guaranteed recycled fibre content should be written into municipal procurement policy and procedures.

Promote cleaner production processes

Cleaner production in industry, supported through the formation of Waste Minimisation Clubs²⁵, will significantly reduce wastage and the quantities of waste going to landfill. This requires the commitment of industry and will need to be driven by a champion, whether this is an organisation or an individual, with strong support from the municipality.

Promote waste exchanges

Industry and municipalities can implement waste exchanges, in which waste products from one industrial process may be used as feedstock for another process by a different industry, thus reducing material sent to landfill (especially chemical wastes). Such initiatives have been operating successfully in Cape Town, but are highly dependent on being driven by a champion.

MECHANICAL BIOLOGICAL TREATMENT INCORPORATING WASTE-TO-ENERGY SYSTEMS

Mechanical Biological Treatment, as well as waste-to-energy systems and combined heat and power (CHP) technologies, are relatively new in South Africa, although fairly popular in Europe as options aimed at the reduction of the carbon emissions from the waste sector. Mechanical Biological Treatment aims to pre-treat municipal solid wastes prior to disposal to reduce volumes of waste sent to landfills and to reduce emissions from organic material. Pre-treatment consists of appropriate Mechanical and/or Biological Treatment technologies (see Box 5.3). Mechanical treatment sorts the waste and separates the organic fraction for biodegradation. Biological treatment can be aerobic or anaerobic and wet or dry (see Box 5.3). Although dry anaerobic technology is in the very early stages of development worldwide, it would seem to be very appropriate for a water deficit country such as South Africa. Some processes use agricultural waste such as chicken litter, while others process the biodegradable organic fraction extracted from municipal waste streams by Materials Recovery Facilities in Mechanical Biological Treatment processes. Initial indications are that this is a technology of the future.

Mechanical Biological Treatment technologies require a high degree of management. Technically, the processes are more complicated than landfill disposal and eThekweni Municipality would have to ensure that the operator of such a plant is technically competent, the plant

²⁴ E-Waste Association of South Africa: www.ewasa.org

²⁵ National Cleaner Production Centre: www.ncpc.co.za

Box 5.3: Mechanical Biological Treatment

Mechanical treatment begins with pre-sorting and recovery of recyclable fractions from the waste stream at a Materials Recovery Facility to reduce the need for extracting and processing virgin materials. Separating out the organic fraction of the waste stream for biodegradation is also necessary to then apply either aerobic or anaerobic, and wet or dry biological treatment.

Biological Treatment can be low-technology aerobic biodegradation (in the presence of oxygen) of the organic fraction of waste and could range from composting at source at household level to a larger scale regionalised operation. Aerobic biodegradation could also involve more complicated, enclosed systems, where there is a high degree of automation, full process control, and complex technologies and may be carried out under 'wet' or 'dry' conditions. Anaerobic biodegradation (in the absence of oxygen) could also be used, usually in combination with in-vessel (enclosed) aerobic biological degradation. These combinations represent the most advanced Mechanical Biological Treatment technologies.

Mechanical Biological Treatment options may also include the production of refuse-derived fuel and conversion of waste gas to electricity. The residual material left after processing according to Mechanical Biological Treatment principles is greatly reduced i.e. 5% of the original mass which can then be disposed of in a landfill.

Benefits are as follows:

- Energy recovery from anaerobic digesters is in the form of methane which can then be used to produce electricity.
- Soil ameliorant/cover material: Anaerobic digestate from the anaerobic digesters is dried and milled for use as a soil ameliorant.

is well managed and would have to mount an awareness-raising and education campaign to drive the separation of waste at source. The feasibility of Mechanical Biological Treatment options is under investigation at the Mariannhill Landfill as reported in Chapter 2.

CARBON SEQUESTRATION – CO₂ FERTILISER

Methane gas (either natural gas or that from anaerobic biodegradation processes) may be utilised in carbon sequestration (also known as CO₂ fertiliser projects. This is common practice in the EU, particularly in the Netherlands, where gas-powered cogeneration systems provide electricity and heat for greenhouses. CO₂ derived from the exhaust gas serves as a fertiliser for the crop. Excess electricity can be supplied

to the public grid, thus generating income.

BIOFUELS

The use of biofuels, defined as fuels derived from biological matter reduces GHG emissions from fossil fuels. The following opportunities exist:

- **Bio-ethanol** is an alcohol made by fermenting the sugar components of plant material and is derived mostly from sugar and starch crops but also from non-food cellulosic biomass, such as trees and grass. Ethanol can be used directly as a fuel for vehicles or, more commonly, as an additive to petrol to increase the octane rating and improve ve-

hicle emissions. Bio-ethanol is not commonly used in South Africa but is widely used in the US and in Brazil. In the eThekweni Municipality there are significant improvements that can be made within the sugar and related industries pertaining to the use of biofuels to reduce GHG emissions. Wastes from sugar refinery by-products have long been used for the production of ethanol from the fermentation of molasses. Ethanol in itself could be used as a fuel additive for vehicles. The ethanol production process leaves a residue, vinnasse, which is rich in nitrogen, phosphorous and potassium, but is typically disposed of to land farming, thus losing the valuable phosphorous content and posing a potential pollution threat from leachate and GHG emissions. There is a worldwide shortage of phosphorous, a macronutrient essential for plant growth. It is recommended that the vinnasse be anaerobically digested further under controlled conditions to harvest the methane gas. Electricity could be generated, or the gas could be burned for process heat. The solid residue can then be used as a fertiliser.

Ethanol from cane sugar is also used to produce phthalates for the manufacture of plastics in eThekweni Municipality. A by-product of this process is glycerol from which soaps can be made. There is a surfeit of glycerol for soap-making, however, and therefore its marketability is low. A recommended alternative, again, is to recover the energy from the glycerol by anaerobic digestion that yields energy-rich methane which can be utilised for heat and/or power generation.

- **Biodiesel** is the combustible fraction extracted from oil seeds and vegetable matter (e.g. jatropha seeds), animal fats or recycled greases. The pressed crude oil is treated with solvents to separate the fuel oil fraction from the fatty acid glycerol fraction. The biodiesel can be used directly as a fuel for vehicles or as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel, although not commonly used in South Africa, is the most common biofuel in Europe.

The by-product of the biodiesel process is glycerol which offers a further opportunity for energy recovery in that it can be anaerobically digested to produce methane, a fuel for heating or for electricity production from a suitable gas engine. This should be considered in the eThekweni Municipality context as well.

A cautionary note is expressed here in respect of species that may be introduced. Given Durban's subtropical climate, some species may be potentially invasive. Their use must be preceded by field trials to test their invasiveness.

COMPOSTING

Vermiculture can also be considered as a suitable system for individual households and restaurants in eThekweni Municipality²⁶. A worm farm or wormery is a cost effective and efficient method to compost vegetable wastes. Rapidly breeding earthworms digest organic wastes to form a rich organic soil conditioner (vermicompost), as well as a liquid fertiliser called 'worm tea' or plantonic that can greatly enhance plant growth.

OTHER OPTIONS

- **Incineration**
Incineration of the waste stream under controlled conditions in purpose-built incinerators with the use of necessary gas-scrubbing devices allows the use of heat energy to produce electricity by means of steam turbines. However, the implacable opposition to incineration of the 'green lobby group' in the eThekweni Municipality makes this a doubtful option.
- **Refuse Derived Fuel**
Refuse derived fuel is produced by processing the waste stream to extract the more combustible fractions which are pelletised, briquetted or converted into "fluff" for burning under controlled conditions in purpose-built incinerators (ly moving hearth, rotary kiln or fluidised-bed type incinerators). In this way, energy is recovered and used to raise steam to produce electricity. The process

²⁶ Wizzard Worms www.wizzardworms.co.za

heat from the generation of electricity or the heat generated by aerobic biodegradation processes can be utilised to dry the combustible fraction.

- Co-incineration of tyres in cement kilns

A new national policy²⁷ has recently been published on the co-incineration of waste, e.g. waste tyres, as a fossil fuel substitute in cement kilns. The closest cement kiln to eThekweni Municipality is at Simuma to the south of Durban. eThekweni Municipality has recognised this option²⁸ as a way to deal

with the difficult tyre waste stream, however transport logistics will have to be considered.

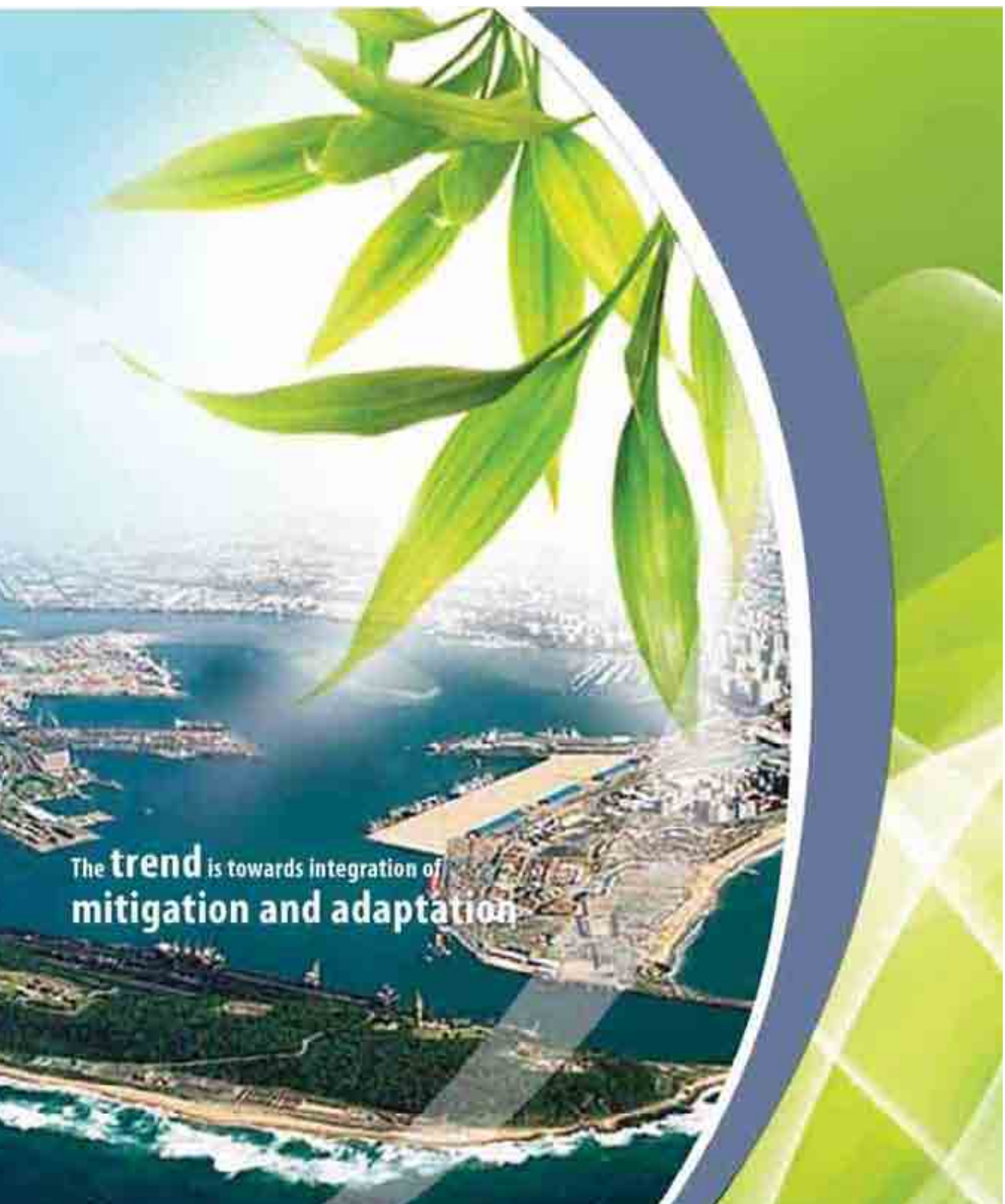
CONCLUDING REMARKS

While eThekweni Municipality has many climate change initiatives, particularly in the energy, water and sanitation, and solid waste sectors, this chapter focused on identifying additional opportunities that could contribute to the mitigation of GHGs.

²⁷ Govt Notice 777 National Policy On Thermal Treatment Of General And Hazardous Waste in terms of National Environmental Management: Waste Act, 2008 (Act 59 Of 2008)

²⁸ <http://www.durban.gov.za/durban/services/cleansing/environmental-education/recycling/waste-minimisation-and-recycling/tyres>

chapter 6



The **trend** is towards integration of
mitigation and adaptation



building resilience and risk reduction

INTRODUCTION

Notwithstanding global and local efforts to mitigate GHG emissions, global emissions are unlikely to decline at the rate and magnitude necessary to prevent climate change. Thus, it is likely that adaptation to both changes in mean climate and increased climate variability will be necessary to reduce vulnerability, loss of life and livelihoods.

South Africa is particularly vulnerable to the devastating impacts of climate change. Water, disease, food security and environmental migration have been identified as some of the main areas where climate change will exacerbate existing development challenges. For Durban, projected changes in climate have been modeled (Naidu *et al.*, 2006) and were presented in Chapter 1. Given such projections, a range of impacts arise: increases in vector-borne diseases; increase in the frequency and intensity of floods and droughts; extinction and changes in the geographical distribution of plants and animals; increased infrastructure damage; increased erosion of coastal areas; decreased food security; decreased water availability; and increased heat stress (Hounsome and Iyer, 2006). These impacts can result in a number of additional knock-on effects on the economy (e.g. decreases in tourism revenue; increased economic losses due to property damage) and other sectors of society (primarily water, health and food). It should also be noted that some changes in climate might have positive repercussions (e.g. increased sugar cane yields).

Thus, climate change and climate variability are two closely coupled stressors to which the city will have to adapt, in addition to meeting the

challenges presented by widespread poverty, inequality, unemployment, service delivery, food insecurity, energy insecurity and HIV/AIDS.

This chapter begins by unpacking some of the definitions used (often interchangeably) when discussing climate change adaptation: e.g. reducing vulnerability, increasing resilience, risk reduction, climate-proofing. This is followed by a review of current approaches and frameworks to climate change adaptation. It must be recognised at the outset that there are no 'recipes' for successful adaptation due to the complex nature of the urban system, the fact that adaptation interventions are necessarily site and location-specific, and that decisions need to be made in the light of significant uncertainties. Thus, the review covers guiding principles for developing adaptation strategies as opposed to suggesting specific interventions. Here, the common constraints to implementation of adaptation strategies are also listed.

eThekweni Municipality is advanced in its consideration and institutionalisation of climate change adaptation. The evolution of this focus area in the city is reviewed, highlighting what has been achieved to date, and the challenges faced.

The chapter concludes with a number of recommendations for the eThekweni Municipality to consider when taking adaptation forward.

DEFINING CLIMATE CHANGE ADAPTATION, RESILIENCE AND RISK REDUCTION

Adaptation in its broadest sense refers to any changes or adjustments in ecological, social and/or economic systems in response to actual

or anticipated climate change effects and impacts (IPCC, 2001). Adaptation therefore encompasses all initiatives, processes, practices and structures put in place to moderate or offset potential impacts and reduce the vulnerabilities of systems (regions and communities) to climate change and variability (IPCC, 2001; 2007).

In order to develop appropriate adaptation strategies it is necessary to understand the characteristics of the system and how it is likely to respond to changes in climate. Here terms such as vulnerability, resilience and adaptive capacity, amongst others, are often used (e.g. Smit *et al.*, 2000; Klein *et al.*, 2003). These terms are defined as follows (IPCC, 2001; 2007; Leichenko, 2011):

- **Vulnerability:** is the degree to which human or ecological systems are susceptible to harm or damage from climate change. It is a function both of the exposure to climate change effects and the ability of the system to respond to these stresses.

- **Resilience:** is the ability of a system to withstand, rebound or recover from stresses including those which are as a result of climate change.
- **Adaptive capacity:** refers to the ability of a system to both prepare for and respond to climate change effects.

Both vulnerability and adaptive capacity are unevenly distributed within regions and society and are a function of the state of development and infrastructure; access to economic resources, information and technology; skill levels; and prior stresses (IPCC, 2001; 2007). In particular, marginalised communities who rely on natural resources for their livelihoods are often most vulnerable to climate change impacts that affect these resources (IPCC, 2007). The type of climatic effect can also influence adaptive capacity, for example a system that can adapt well to gradual changes in temperature, may not respond well to extreme events (IPCC, 2001).

Key Lessons:

- **Vulnerability:** is the degree to which human or ecological systems are susceptible to harm or damage from climate change. It is a function both of the exposure to climate change effects and the ability of the system to respond to these stresses.
- **Resilience:** is the ability of a system to withstand, rebound or recover from stresses, including those which are as a result of climate change.
- **Adaptive capacity:** refers to the ability of a system to both prepare for and respond to climate change effects.

CHARACTERISING TYPES OF ADAPTATION

Adaptation approaches and interventions can be characterised in a number of different ways. Activities may be differentiated based on: (IPCC, 2010; Adger *et al.*, 2007)

- purposefulness (e.g. autonomous or planned);
- timing (e.g. anticipatory or reactive);
- temporal dimension (e.g. short term or longer term, strategic);
- spatial scale (local, regional, national);
- sector (e.g. water, agriculture, tourism, health etc.);
- function (e.g. protect, prevent, change)

- form (e.g. physical, technological, investment, regulatory, market);
- actor (e.g. government, private sector, international donors, non-governmental organisations (NGOs), local communities, individuals); and
- performance (e.g. cost, efficiency, effectiveness).

One such characterisation approach is depicted in Figure 6.1. Here adaptation interventions are classified according to the systems (natural vs human), timing of interventions (anticipatory vs reactive) and the actors (government vs individuals).

		Anticipatory	Reactive
NATURAL SYSTEMS		X	<ul style="list-style-type: none"> • Changes in length of growing season • Changes in ecosystem composition • Wetland migration
	HUMAN SYSTEMS	Private	<ul style="list-style-type: none"> • Purchase of insurance • Construction of house on stilts • Redesign of oil-rigs
Public		<ul style="list-style-type: none"> • Early-warning systems • New building codes, design standards • Incentives for relocation 	<ul style="list-style-type: none"> • Compensatory payments, subsidies • Enforcement of building codes • Beach nourishment

Figure 6.1: Classification system for climate change adaptation interventions (Klein, 1999 in IPCC, 2001)

In natural systems, changes in response to climate change are by their nature reactive and autonomous or self-directed. In human systems there is scope for anticipatory or proactive adaptation activities that are planned, which consist of proactive measures taken against changes usually before the impacts associated with such changes are observed. These may occur autonomously by private actors taking action or may be precipitated by government policy decisions and interventions (Klein *et al.*, 2003). These include increasing the robustness of infrastructural designs and enhancing the adaptive capacity of natural systems in the city (e.g. through developing natural eco-corridors and by creating awareness). If no planning is done for climate change effects, human systems will still adapt through reactive strategies, although it is likely that costs will be higher and options limited to emergency responses, disaster recovery and migration (IPCC, 2001). A consequence of poor planning for climate change may also be energy-intensive mal-adaptations (e.g. pumped drainage or desalination) or lock-in to specific technologies (Dawson, 2007).

ADAPTATION FRAMEWORKS, STRATEGIES AND INTERVENTIONS

At present, a consolidated and coordinated approach to municipal level adaptation is still lacking (Mukheibir and Ziervogel, 2007). However, there are many examples of adaptation

strategies and frameworks that vary in complexity. The Economics of Climate Adaptation (ECA) working group, for example, provides a simple framework for assessing and addressing climate risks, which consists of five steps (ECA, 2009) as shown in Figure 6.2. Mukheibir and Ziervogel (2007) have developed a ten-step approach to developing a Municipal Adaptation Strategy. In contrast, Dawson (2007) has devised a comprehensive framework that considers climate impacts and adaptation together with mitigation and broader sustainability (Fig. 6.3). Although these frameworks differ in complexity and scope, there are a number of features and steps involved that are common.

Common to these approaches are the following five broad activities that are explored in more detail below:

- Identifying climate risks and vulnerabilities.
- Identifying available adaptation options and interventions.
- Prioritising actions.
- Implementation of prioritised actions.
- Monitoring and review.

STEP 1: IDENTIFICATION OF CLIMATE CHANGE RISKS AND VULNERABLE AREAS AND POPULATIONS

The first step in developing an appropriate municipal level adaptation strategy is to identify climate change risks and vulnerable areas and populations. This also includes understanding

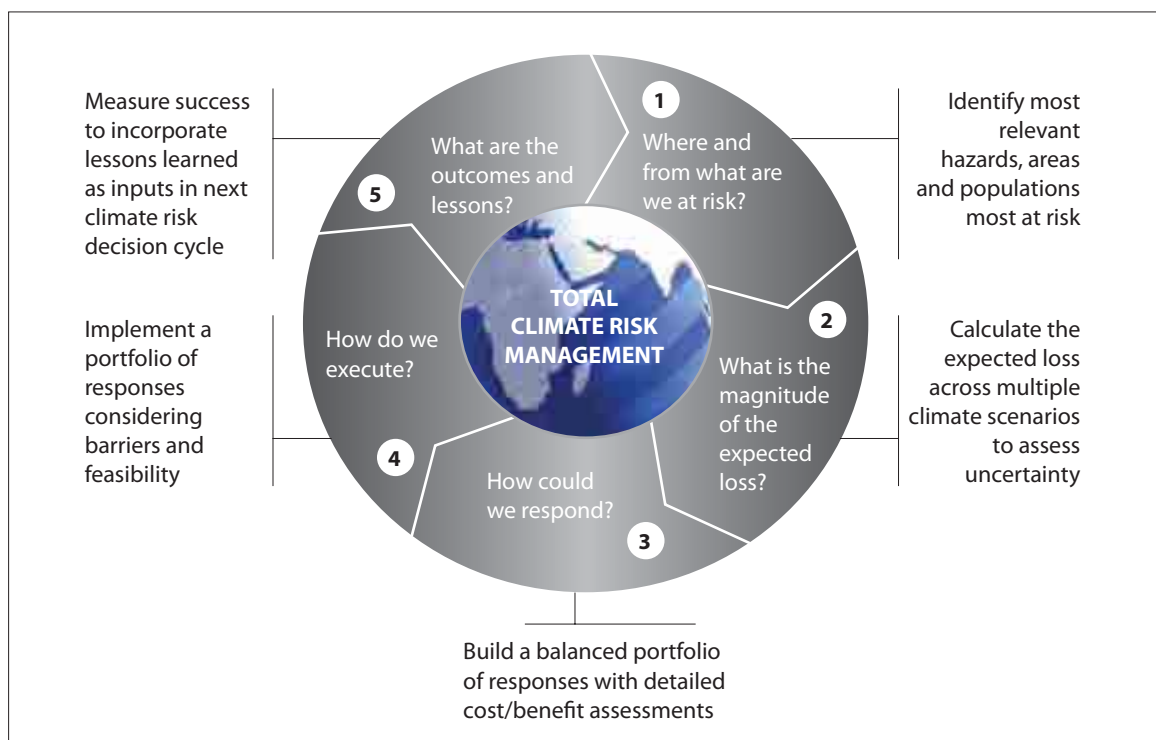


Figure 6.2: A framework for assessing and addressing climate risks (Source: ECA, 2009)

what drives or shapes vulnerability to risks (Bulkeley *et al.*, 2010; Sippel and Jenssen, 2010; Sullivan and Walsh, 2010).

Mukheibir and Ziervogel (2007) suggest the following activities at the municipal level in the South African context, which not only focus on climate risks but also on existing vulnerabilities and development priorities:

- Assessment of current climate trends and down-scaled future climate projections for the region.
- Assessment of climate vulnerability, which includes identifying current sectoral and cross-sectoral vulnerabilities based on current climate variability risks and trends; identifying future potential vulnerabilities based on future projected climate risks.
- Development of local climate vulnerability maps based on the above using GIS and other tools.
- Identification of vulnerability hotspots by considering and overlaying other development priorities contained in current development

plans (e.g. IDPs, SDFs, other strategic plans).

The ECA (2009) takes this analysis a step further by quantifying the expected damage and loss in terms of costs under different climate scenarios.

STEP 2: IDENTIFICATION OF AVAILABLE INTERVENTIONS

Given the diversity of climate change impacts, and the unique characteristics of the regions and communities impacted upon, the range of activities that can be taken up under the adaptation banner are many and varied (Pelling, 2003; de Sherbinin *et al.*, 2007; Willbanks *et al.*, 2007; Romero-Lankao, 2008). It is not practical to list all possible adaptation interventions here. Instead, examples are given of various modes of adaptation as characterised by Dawson (2007):

- Engineering infrastructure: (e.g. ensuring bridges, roads and buildings can withstand floods).
- Increasing the resilience of natural systems

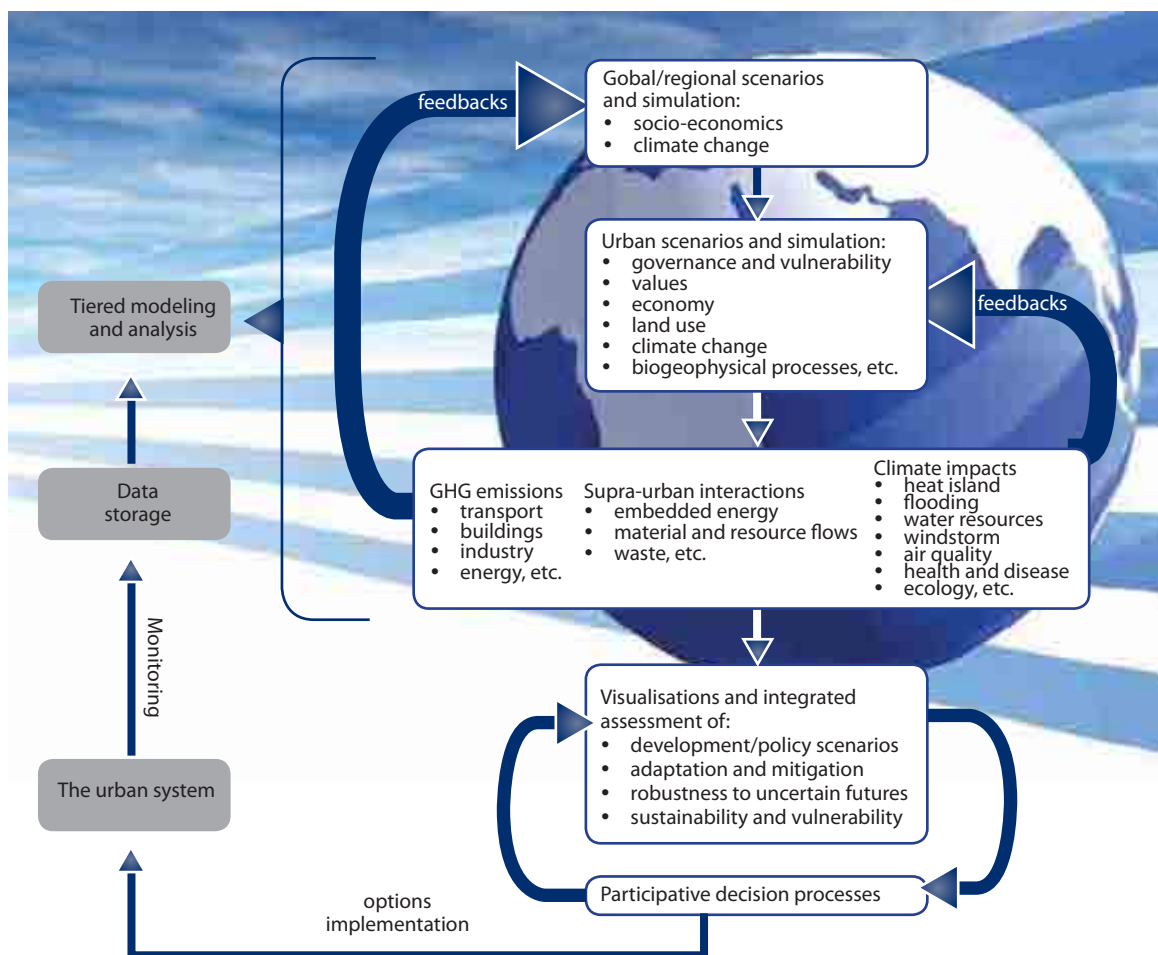


Figure 6.3: Framework for integrated urban analysis, which is characterised by a continuous cycle of monitoring, modeling, assessment and implementation (Source: Dawson, 2007)

(e.g. restoration of wetlands). Here, ecosystem-based adaptation, which focuses specifically on the role of biodiversity and ecosystems services in adaptation, may provide a useful approach (Secretariat of the Convention on Biological Diversity, 2007).

- Reducing impacts in the built environment (e.g. retrofit existing buildings so as to improve human comfort and reduce risks of excessive heat).
- Reducing vulnerability (e.g. education programmes, good governance).
- Risk transference (e.g. insurance).
- Monitoring (e.g. remote-sensing).
- Emergency and disaster management (e.g.

development of early-warning and climate forecast information (Stern and Easterling, 1999); evacuation planning and disaster risk management).

By default, adaptation responses in cities have usually clustered around ensuring more rigorous building and infrastructure standards, and identifying land that is 'vulnerable' or at risk (Bartlett *et al.*, 2010).

This is because these activities are more in line with existing municipal functions. However, there is a growing acknowledgement that it is not only such areas and sectors of activity (e.g. technical issues)

that require attention, but that adaptation efforts should expand to identify and examine the social dimensions underlying and shaping risk (Mosser and Satttherthwaite, 2009).

In this context, communities and households have an important role to play in climate change adaptation (e.g. households choosing to move to safer sites to avoid flooding and community-based disaster response and preparedness training). Reducing vulnerability also requires modifying human behaviour both for wider civic society and for managers guiding urban adaptation. The role of networks, partnerships, and effective engagement with communities to enhance education is key. Here one needs to caution against adopting an approach that tries to change behaviour without appropriate and ethical considerations of the communities and individuals with whom one is engaging.

STEP 3: PRIORITISATION OF INTERVENTIONS

Once the risks and vulnerabilities have been assessed, and adaptation interventions identified, it is necessary to prioritise these as resources for implementation are almost always constrained. The prioritisation and selection of interventions should be conducted using a defensible tool, such as those offered under the umbrella of Multi-Criteria Decision Analysis. Such tools provide guidance in the engagement of stakeholders, the identification of criteria sets for assessment, quantification of performance of the interventions, trade-offs and weighting between criteria and the management of uncertainty. Following such a rigorous and defensible decision approach, rather than an *ad hoc* rating of interventions, allows for decisions that are transparent, repeatable and defensible, and are likely to obtain the most buy-in from stakeholders.

STEP 4: IMPLEMENTATION OF PRIORITISED ACTIONS

Once the preferred interventions have been selected, these are implemented within budget and resource capacity constraints. This is a critical step as it is in the implementation phase that most schemes fail. An implementation strategy with clear accountability and time lines must be developed.

STEP 5: ONGOING MONITORING AND REVIEW

Adaptation is not an 'end point', as no part of the system (ecological, social, economic) is static (Dawson, 2007). Ongoing monitoring and review, not only of the uptake or success of adaptation actions, but also the down-scaled climate projections and vulnerability assessments that underpin the selected interventions, must be undertaken. This 'continuous management' improves the robustness of the overall adaptation strategy, by ensuring that any unanticipated negative effects are detected and corrected timeously (Dawson, 2007).

BARRIERS TO EFFECTIVE ADAPTATION

There are many barriers to effective adaptation that can hamper even the most well-thought out and carefully designed adaptation strategy. These include (Sippel and Jensen, 2010; IPCC, 2007):

- Financial barriers: Problems with incentives and securing adequate financial resources. Access to external, international funding, particularly for 'early adapters' (Roberts, 2010a).
- Physical and ecological limits: Ecological systems have critical thresholds, which once surpassed may not be reversed, leading to an altered state and function. Similarly, for some climate impacts (e.g. sea-level rise) the physical challenges presented by attempting to retain current land function may be too great, leaving migration as the only viable adaptation intervention.
- Technological limits: Appropriate technologies may not develop in time for certain adaptation interventions. In addition, certain technological options while effective may be too expensive or culturally inappropriate.
- Informational and cognitive barriers: Uncertainty about climate change together with perceptions of risk and values influence judgement and decision-making regarding climate change (IPCC, 2007). Public awareness and enhancement and concentration of local competencies are thus required. Another limitation is the lack of credible studies that address adaptation and, in particular, the links to planning and policy (Granberg and Elander, 2007; Bulkeley *et al.*, 2010). Other constraints include lack of local data.

- Social and cultural barriers: Technically sound and financially viable adaptation interventions may fail if they do not take into account the social dimension (i.e. the cultural and social norms of the communities for which the interventions were designed).
- Governance barriers: The lack of capacity in local government, poor governance, lack of

accountable governments and poor leadership can hinder implementation of adaptation strategies. Enhanced transparency to ensure basic planning actions are implemented and that city leaders are held accountable, while essential elements for any policy action, are also needed for adaptation policy in cities (Bulkeley *et al.*, 2010).

Table 6.1: Examples of co-benefits of adaptation actions (adapted from Hamilton and Akbar, 2010)

Risk	Adaptation Action	Co-benefits
Floods	Removal of infrastructure and housing from floodplains	<ul style="list-style-type: none"> • Reallocation of land to agriculture • Proactive siting decisions may preserve ecosystems and their services
Storm surges	Planting mangroves	<ul style="list-style-type: none"> • Improved local fisheries • Access to adaptation finance
Severe storms	Upgrading roads	<ul style="list-style-type: none"> • Reduced traffic-related emissions (mitigation benefit) • Reduced vehicle maintenance
Reduced water availability	Rain water harvesting	<ul style="list-style-type: none"> • Reduced water demand • Reduced energy requirements (mitigation benefit)

DESIRABLE FEATURES OF AN ADAPTATION STRATEGY

The previous section has outlined the basic characteristics of climate change adaptation frameworks, detailed the different types of interventions and described some of the common barriers to implementation encountered. This section identifies some of the desirable features of an adaptation strategy or framework, which could serve to enhance risk reduction and resilience.

TAKING A BROADER DEFINITION OF THE URBAN SYSTEM

It is common for municipal-level adaptation strategies to focus on the areas and populations vulnerable to climate change contained within their geographical and administrative boundaries. However, as Adger *et al.* (2007) note, adaptation typically applies at the scale of the impacted system, which may not coin-

cide with these municipal boundaries. Thus it is important to ensure that adaptation interventions, which are more appropriate at regional or even national or international scales, are not constrained by narrow views of boundaries. For example, upstream catchment management and storage can reduce the probability of flooding within the city's boundaries (Dawson, 2007).

A broader view of the urban system is also required to take account of the many resources consumed by the city's residents that are produced beyond the physical city boundaries. The supply of these resources (including energy, food, consumables) may also be vulnerable to changes in climate. Thus, a comprehensive climate change adaptation strategy should consider the impact of climate change on other regions that are relied upon by the city's residents to meet their basic needs.

EMPHASISING INTEGRATION BETWEEN ADAPTATION AND MITIGATION

Traditionally, mitigation and adaptation activities in cities have developed separately, frequently in different municipal departments. This is the case in eThekweni Municipality, where mitigation is the responsibility predominantly of the Energy Office (although this is not an officially acknowledged role) and adaptation the responsibility of the Environmental Planning and Climate Protection Department. The more recent trend is, however, towards integration of mitigation and adaptation, which is based on the realisation that adaptation and mitigation activities can reinforce each other, either positively or negatively. These inter-relationships can either be direct, involving the same resource base (e.g. land), indirect (e.g. effects through public budget allocations) or remote, affecting other parts of the country outside the area of analysis.

For example, a move towards mitigating emissions through implementation of renewable electricity supply options, such as hydropower and some of the solar technologies, may result in a higher water footprint than for electricity generated from coal-fired power. This increases competition for water, especially if increased irrigation is required to cope with climate change impacts in agriculture. An example of a positive link between mitigation and adaptation is that of carbon sequestration in agricultural soils. The sequestered carbon potentially represents an income stream for the farmers, while at the same time improving soil quality and water conservation, thus enhancing both the economic and environmental components of adaptive capacity.

The reverse consideration, of adaptation affecting mitigation, can be illustrated through the increased energy-use associated with adaptation. This includes once-off energy inputs for building large infrastructure, such as coastal protection zones and flood protection systems, and the incremental energy inputs required to counterbalance climate impacts in providing goods and services. The latter includes energy associated with increased pesticide and fertiliser use, and pumping increased volumes of water for irrigation, and individuals using air-conditioners to adapt increased temperatures.

EMPHASISING INTEGRATION BETWEEN ADAPTATION, MITIGATION, SUSTAINABILITY AND DEVELOPMENT GOALS

In addition to the need for simultaneously planning for adaptation and mitigation, it is increasingly being recognised that these two factors need to be integrated into the broader spheres of sustainability and development planning (Leichenko, 2011). A number of reasons for this suggestion are offered.

First, efforts to cope with the impacts of climate change and attempts to promote sustainable development share common goals and determinants including access to resources (including information and technology), equity in the distribution of resources, consideration of stocks of human and social capital, access to risk-sharing mechanisms and abilities of decision-support mechanisms to cope with uncertainty. Second, vulnerability to specific climate change impacts are most severe when considered along with other stresses, such as poverty, environmental degradation and food security, and the ability to adapt to them depends on the pace of development. Finally, climate change adaptation actions have co-benefits in the broader sustainability and development space. Some examples of adaptation actions and their corresponding co-benefits are given in Table 6.1.

Identifying and quantifying the co-benefits of adaptation actions is not trivial. Having said this, exploring the co-benefits, and especially the financial co-benefits, can drive the climate change agenda and make adaptation actions more attractive. Fankhauser and Schmidt-Traub (2010) suggest that treating adaptation independently encourages project-based design and implementation of adaptation measures. The high transaction costs resulting from the small-scale implementation of project-based measures can result in inferior outcomes, constrain scalability, and thereby fail to make a compelling case for increasing resources for climate change adaptation.

ALIGNMENT OF ADAPTATION ACTIVITIES WITH EXISTING DISASTER RISK MANAGEMENT

Responses to extreme events arising as a result of climate change need to build on current

experiences and capacity in disaster risk management as climate change is likely to place an even higher premium on existing municipal capacity and management structures in this respect. Thus, an important feature of adaptation plans is that they complement existing risk and hazard management strategies rather than existing as new actions that may incur additional costs (Yohe and Leichenko, 2010).

Risks facing the municipality, for example, are framed in emergency language and the Disaster Management Unit "should enhance its capacity to actively manage and cope with disasters by developing a comprehensive Disaster Management Plan incorporating emergency planning, response and recovery" (ERM, 2009: 30). Little mention is given here to the role of Disaster Management in reducing risks to climate change as specified in the Disaster Management Act (*Act 57 of 2002*). Here the emphasis is decidedly more reactive than proactive. As Quarentelli (2003) and Carmin *et al.* (2009) note, however, the incentive for such interaction must also be provided. A 'passive' willingness to accept disaster planning is not enough and funding sources will have to be obtained with the benefit for alignment across planning entities made clear (Quarentelli, 2003).

FLEXIBLE, DIVERSE AND CONTINUOUS ADAPTATION

The urban system is dynamic and coupled with the wide range of potential hazards and vulnerabilities, means that discrete, isolated or 'one-size-fits-all' approaches are not appropriate. In contrast, resilient cities are characterised by diversity, flexibility, adaptive governance structures and the capacity for learning and innovation (Leichenko, 2011).

Yohe and Leichenko (2010) define 'flexible adaptation pathways' as an approach based on a series of escalating responses, that can build from basic inputs and that can be ramped-up for future scenarios, allowing for mid-course correction. Thus adaptation planning should be iterative, and continually updated as new information becomes available. Dawson (2007) suggests that flexibility and robustness of a climate change adaptation strategy can be achieved by developing portfolios of options that con-

sider the performance of the system over a full range of future scenarios.

EFFECTIVE INSTITUTIONAL ARCHITECTURE

Good governance and effective institutional arrangements are key if effective and proactive management of climate change impacts is to be realised. This requires building upon existing institutional structures and using available policy instruments and processes to effect change (Dawson, 2007). Given the likely synergies between adaptation and development and/or sustainability agendas, opportunities may arise to achieve adaptation actions through these avenues.

At the urban governance level, more engagement by city managers can be obtained if appropriate incentives for action are applied (see Carmin *et al.*, 2009). A different kind of leadership, when compared to mitigation, is required in urban adaptation - it requires a leadership that is mindful of the adaptation links to issues of social access and assets, particularly for the urban poor (Bulkeley *et al.*, 2010).

ENGAGED PUBLIC FOR EFFECTIVE RISK REDUCTION

The role of engaging stakeholders, ward councillors and wider civic society is critical for creating awareness and buy-in for adaptation planning (Carmin *et al.*, 2009). Even more important than setting up such fora, however, is the shaping of agendas at the outset. Communities, stakeholders and other participants from wider civic society should not be an 'add on' or passive set of actors. Issues of co-production of agendas, activities and other forms of 'poly-centric governance' approaches, as well as ethical and justice concerns are fundamental. It should be noted that effective engagement can be time-consuming and may require the initial assistance of NGOs.

OVERVIEW OF CLIMATE ADAPTATION, RESILIENCE AND RISK REDUCTION ACTIVITIES IN ETHEKWINI MUNICIPALITY

Durban is considered a lead city in South Africa in terms of climate change adaptation (Carmin *et al.*, 2009; Bulkeley *et al.*, 2010; WESSA,

Key Lessons:

Desirable features of an adaptation strategy include:

- Taking a broader definition of the urban system.
- Emphasising integration between adaptation and mitigation.
- Emphasising integration between adaptation, mitigation, sustainability and development goals.
- Aligning adaptation activities with existing disaster risk management.
- Ensuring flexible, diverse and continuous adaptation.
- Ensuring effective institutional architecture.
- Ensuring an engaged public for effective risk reduction.

2010). This is due to the eThekweni Municipality being an 'early adapter' in that it has put significant energy and focus into developing climate change adaptation strategies at a time when other cities and regions have been more focused on climate change mitigation (Roberts, 2010a). The city, guided by a number of champions, is advanced in its adaptation strategies and has undertaken many activities to begin ensuring reduced climate change risks and increased resilience.

The evolution of this climate change adaptation focus is well documented by Roberts (2008, 2010a). In brief, the Environmental Planning and Climate Protection Department of the eThekweni Municipality initiated a project to identify and better understand the impacts of climate change on the city (Hounsome and Iyer, 2006). The results of this study stimulated the development of the adaptation work stream of Durban's Municipal Climate Protection Programme (MCPP) and resulted in the high-level Headline Climate Change Adaptation Strategy (HCCAS) in 2006.

The purpose of the HCCAS was to identify adaptation options for sectors within the municipality likely to be affected by climate change, as well as consider crucial cross-sectoral activities (Hounsome and Iyer, 2006). Development of the strategy brought to light some interesting observations, most notably the key role the Disaster Management Unit had to play in climate change adaptation and the institutional constraints in place that limited its ability to be proactive (Roberts, 2010a).

The HCCAS, while a useful discussion document, did not achieve much uptake outside of the EP-CPD. The usual suspects were to blame: the lack of institutional ability, awareness, capacity and/or funding available; existing heavy workloads and more pressing priorities; together with perceptions and attitudes towards climate change and environmental issues in general which see them relegated to 'nice-to-haves' (Roberts, 2010a).

To overcome practically some of these limitations, a more bottom-up approach was taken with sector-specific adaptation plans developed for a number of pilot sectors, namely: water, health and disaster management. These were aligned with existing plans (e.g. IDPs), development objectives, capacities and funding (Roberts, 2010a). Interventions were prioritised using Multi-Criteria Decision Analysis, responsibilities and timelines for implementation assigned (ERM, 2009).

The criteria used for prioritisation were as follows (ERM, 2009):

- Impact on risk: the level of climate risk that the intervention will reduce.
- Ancillary benefits: how beneficial is it to undertake this intervention regardless of climate change impacts, as the intervention promotes sustainable development?
- Reversible or flexible: climate change science is not perfect and hence interventions that can be reversed or adjusted based on the latest science are better than those that cannot.
- Impact on emissions: how does the interven-

tion affect the level of GHGs in the atmosphere?

- Allows complementary options: are there complementary options in association with the intervention? Does the intervention reduce, retain or enhance the set of options available for responding to climate change?
- Ease of implementation: indicates the likelihood of the intervention being successfully implemented.
- Institutional complexity: also indicates the likelihood of the intervention being implemented. If the intervention requires complex municipal processes and procedures and many departments working together, its likelihood of success is reduced.
- Cost-benefit: a broad judgement of whether the intervention has 'high cost: low benefit' or 'high benefit: low cost'.
- Risk of mal-adaptation: ill-considered implementation of an intervention is considered 'mal-adaptation' as it may have unintended adverse impacts.

Sector-based adaptation plans for the water and health sectors have been developed (ERM, 2009). In addition, eThekweni Municipality has undertaken vulnerability assessments to better understand what shapes and drives vulnerability to climate change and related behaviour (Roberts, 2010b). These include sector-specific vulnerability assessments for health and agriculture (Golder Associates, 2010a). In addition, the Sustainable Livelihoods Framework, a well-trying method used to identify vulnerabilities, was applied to the Amaoti community and focused on livelihoods and demographics, food security, infrastructure and services, water and sanitation and social networks in shaping vulnerabilities to climate risks (Golder Associates, 2010b).

In the latter study, water and sanitation emerged as a few of the key vulnerabilities confronting the community. In addition, there were factors, other than those most closely coupled to the hazard (e.g. flooding and/or shortage of water) that influenced vulnerability. These were linked to perceptions (e.g. cultural beliefs and fears linked to xenophobia) and past experiences of poor service delivery or changes in water supply (e.g. provision of ground water tanks). Additional activities to map and better understand

the physical risk context of the city also included better understanding of storm surge risks and possible sea-level rise. Sea-level vulnerability and hazard assessments are being undertaken, as well as those linked to hazards and vulnerabilities in the water sector (Mather, 2010; WSP Environmental, 2009).

The city thus has a good emerging sense of physical vulnerability, and some of the social drivers of vulnerability. A challenge going forward will be to find ways to update this information on a regular basis so that they do not remain only as 'snapshots' of vulnerability.

More recently, the city has begun developing an urban integrated assessment framework as part of a research collaboration with the Tyndall Climate Change Research Institute in the UK (Roberts, 2010b). This computer-based modeling platform provides a means to simulate, compare and evaluate all the planning efforts that are taking place. It thus has potential to provide strategic input into a city's IDP, thus allowing climate change considerations to be factored into long-term planning and budgeting and the development of appropriate adaptation and mitigation responses (Roberts, 2010b), but has proven difficult to use.

RECOMMENDATIONS FOR BUILDING RESILIENCE AND RISK REDUCTION TO CLIMATE CHANGE IN ETHEKWINI MUNICIPALITY

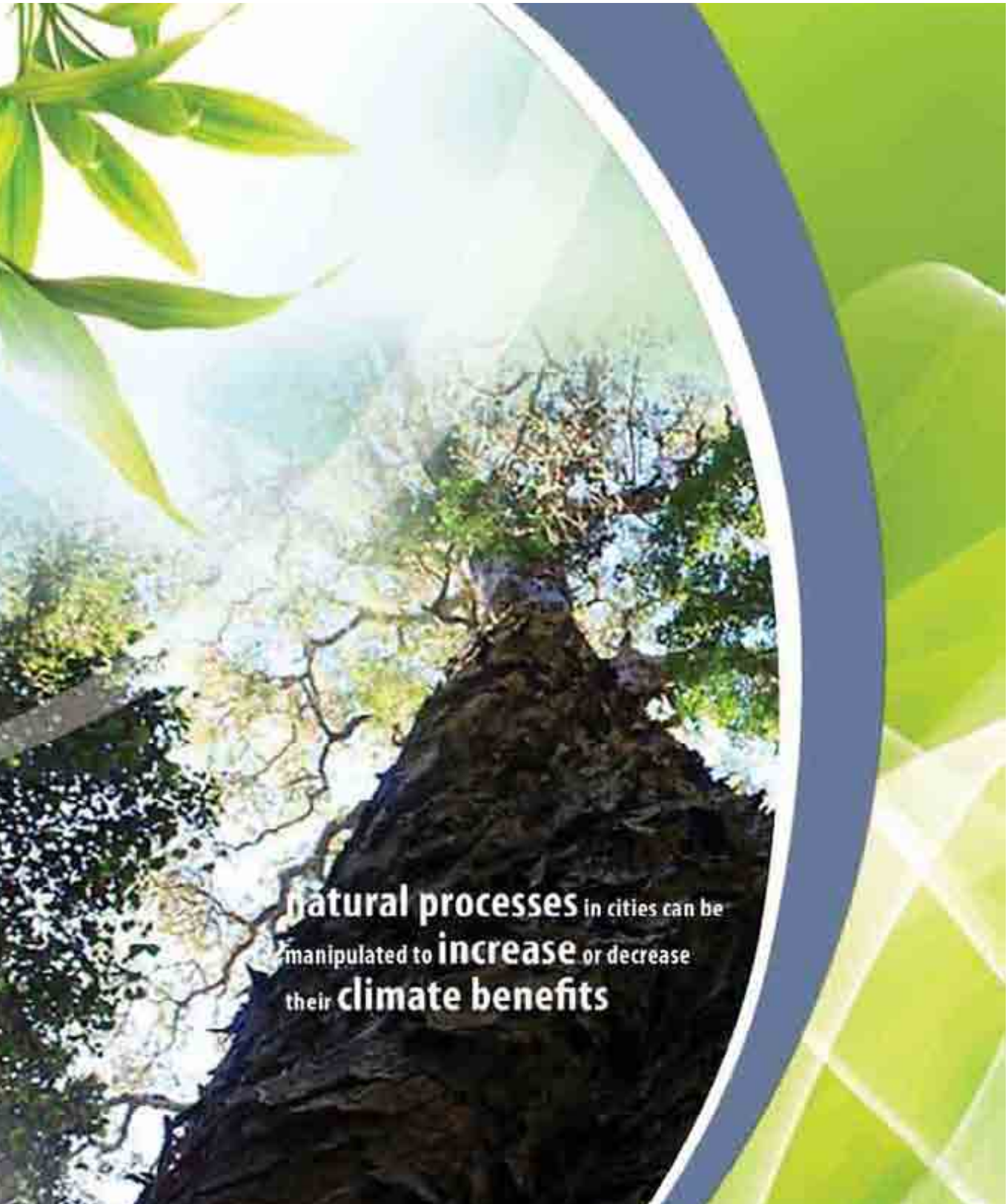
Although the city has created awareness of these issues within city governance structures and also commissioned and undertaken a great deal of work to raise the profile of climate change adaptation locally, embedding and institutionalising climate change adaptation has not been without its challenges. As noted throughout this review, adaptation is a process, and thus 'early-adaptation' is not necessarily synonymous with 'well-adapted' or 'climate-proofed'.

Based on the overview presented above on desirable features for adaptation strategies, the following recommendations can be made for the eThekweni Municipality, which may serve to augment their existing strategies and plans or highlight additional opportunities to push the adaptation agenda forward:

- Extend the boundary of the urban system: The set of adaptation interventions considered for eThekweni Municipality could be diversified by taking a broader view of the urban system and not constraining interventions to administrative boundaries.
- It appears the city has prioritised adaptation activities over mitigation activities, or at the very least is considering them separately. It is important that synergies between these equally important responses to climate change are not neglected or overlooked and that co-benefits are maximised.
- Integrating climate change adaptation into wider sustainability and development agendas as is being attempted through the city's urban integrated assessment framework is strongly recommended; not only as a means to take advantage of synergies and co-benefits, but also as a means to win over colleagues by demonstrating that adaptation and development agendas are not necessarily opposed or competing for funding.
- A particular concern for the eThekweni Municipality is the mismatch between the current disaster risk management responsibilities (which are largely reactive) and those required for climate change adaptation (necessarily proactive) and thus the inability of disaster management to inform critically the IDP process (Roberts, 2010a). This inability to couple local disaster risk reduction efforts with development planning efforts is a major draw-back to ensuring that a city-wide risk assessment is undertaken and that capacity is built for climate change adaptation (as noted by Bulkeley *et al.*, 2010).
- The city should continue developing and refining both its sectoral and overarching adaptation strategies to ensure a robust and flexible approach to adaptation. This includes continued efforts to collect information on the systems, as well as responding to monitoring information through updating adaptation plans (Dawson, 2007).

Key Recommendations for Building Resilience and Risk Reduction:

- Extend the boundary of the urban system when thinking about adaptation.
- Integrate mitigation and adaptation.
- Integrate climate change adaptation into wider sustainability and development agendas.
- Continue developing and refining both the sectoral and overarching adaptation strategies.



natural processes in cities can be
manipulated to **increase** or decrease
their **climate benefits**



enhancing carbon sinks

INTRODUCTION

Urban landscapes are ecosystems, albeit highly transformed and managed ones. Ecological processes, such as carbon uptake, storage and loss, evaporation and trace-gas production continue to function – often with magnitudes that are comparable or larger than processes of human origin. The natural processes in cities can be manipulated to increase or decrease their climate benefits. These actions are sometimes grouped together as 'carbon sinks'. The following discussion will illustrate that more than carbon sinks are involved.

RELATIVE IMPORTANCE OF CARBON SINKS AS AN INTERVENTION

The rubric of this entire report is carbon, but it is important to remember that carbon is just a convenient shorthand and currency for a whole range of mechanisms that lead to net forcing of the global climate by humans. Changes in the uptake or release of CO₂ is overall the single most important mechanism, which is why the carbon shorthand has been adopted. There are several other mechanisms that are important in the context of the Agriculture, Land Use and Forestry Sector under which the activities described in this chapter reside in IPCC accounting terms. It is a broad category that includes essentially everything that is non-energy, non-transport, and non-industrial, and thus embraces urban open spaces, urban trees and gardens, etc. The key non-carbon processes are the climate forcing by non-CO₂ radiatively-active trace gases and aerosols, notably methane (CH₄) and nitrous oxide (N₂O), black carbon (soot) and direct changes in the radiation balance at the Earth's surface by changes in its reflectivity ('albedo'). Changes to radiatively-active particles in the

atmosphere (referred to as aerosols), minor GHGs (e.g. methyl bromide) and precursors to the GHG ozone are also in principle included, but very difficult to quantify, so are not covered here.

Mitigating climate change by adjusting the management of urban green plants and open spaces is a minor, but real, contribution to the overall climate impact of cities. Such activities are favoured, not because they are quantitatively large, but because

- they have a symbolic importance, as something that ordinary citizens can do and see;
- they are generally rapid and cheap to implement;
- they generally have co-benefits in terms of an improved environment and quality of life;
- they often work in positive synergy with actions taken to adapt to climate change.

Arguments that have been raised against this category of activities include:

- They allow entities to seem to be taking action on climate change without tackling the real and difficult issues.
- The improvements effected may be transient, easily lost, vulnerable to climate change itself, may have happened anyway, or simply result in the displacement of the impacts to another location.

The potential for carbon sinks, narrowly defined, is broadly constrained by three factors:

- the land area available for such sinks;
- the climate that permits them to grow; and,
- the soils in which they store most of their carbon.

The first factor is controlled by the city physical

planning (discussed in later sections). The second factor is outside of local control, but does mean that such actions are at least theoretically sensitive to future climate change. However, the Durban environment is very favourable, in global terms, for plant production. If carbon sinks cannot work here, they are unlikely to work anywhere. The third factor is less favourable in eThekweni Municipality. Many of the soils are sandy and nutrient-poor, with a low capacity to store carbon (Glenday, 2007)

Long-term carbon storage ('sequestration' – by convention, at least 20 years, and preferably much more) is orders of magnitude less than the short-term carbon uptake by plants. The only way to avoid this inefficiency is by diverting plant biomass directly into storage or other uses (see section on Managing Biomass Flows below). As a rough guide, maximum plant production in the eThekweni Municipality environment is about 20 tons of dry matter per hectare per year, i.e. about 10 tC/ha/y, or 36 t CO₂/ha/y. Sequestration rates are unlikely to exceed 1 tC/ha/y (3.6 tCO₂/ha/y) in the decadal timeframe, and total stocks are unlikely to exceed 50 tC/ha above-

ground as biomass (usually much less), 20 tC/ha below-ground as roots, and about 100 tC/ha in the soil as soil organic carbon.

Judged against these upper limits, the measured carbon stock values reported by Glenday (2007) are highly plausible, and for the carbon sink rates, probably conservative. For the eThekweni Municipality open space area of 64 037 ha, Glenday (2007) calculated a C store of 6.6 + 0.2 MtC (the uncertainty range is optimistically small), compared to a maximum by the above guidelines of around 10 MtC. The same study suggests a current sequestration rate of 8.4 to 9.8 x 10³ tC/y over the whole open space; the guideline above suggests this could reach about 64 x 10³ tC/y, and could potentially be sustained at this level for a decade or two. Even at this elevated level, the rate is small compared to the city's CO₂e emissions of about 17 000 x 10³ tCO₂e/y (4300 x 10³ tC/y) (Mercer, 2006). Note that the inclusion of the full area of eThekweni Municipality (2 229 700 ha) would increase these numbers substantially, even if the non-open space area had a substantially lower carbon density and exchange potential.

Key Messages:

- Enhancing carbon sinks in cities makes a relatively minor contribution to mitigating climate change, but there are other benefits such as: symbolic and tangible value; rapid and cost-effective implementation; environmental and quality of life co-benefits; synergy with adaptation actions.
- There is still capacity in Durban for further carbon storage in natural sinks.

THE D'MOSS OPEN SPACE SYSTEM

The eThekweni Municipality open space system (D'MOSS) at present comprises 74 857 ha, which comprises approximately 29% thicket, 22% woodland, 17% forest, 10% grassland, 9% freshwater wetland, 3% estuary, and 3% artificial waterbody. (These figures are not fixed and are pending further adjustments.) The mean annual precipitation ranges between 500 and 1000 mm, with a spatial average of 930 mm. The soils are principally sands and sandy loams. The ownership and land stewardship of the open space system resides mostly with private landowners and as such is not formally protected, resulting in

the EPCPD trying to restrict development in these areas (EPCPD, 2010a).

THE VALUE OF COMPACT CITIES IN ENHANCING ECOSYSTEM SERVICES

There are many cogent arguments for limiting the area over which the built environment extends, and for limiting the fraction of that physical footprint dominated by hard surfaces, such as roads, rooftops and paved areas. It makes service provision to the inhabitants cheaper, prevents the encroachment of urban sprawl into areas of agricultural potential and scenic beauty, and leaves a larger fraction of the landscape to provide 'ecosystem services', the mul-

multiple benefits that nature provides to people. These ecosystem services include macroclimate and microclimate regulation (through many mechanisms, not only carbon sequestration), water yield and purification, the capture and detoxification of atmospheric pollutants, the suppression of certain pests and diseases and the provision of habitat for biodiversity, among many others.

As a generalisation, the built part of the environment has a lower carbon density (quantity of carbon per unit land area occupied) than the natural environment it replaces, and a lower potential to take up carbon in the future. Therefore, the climate impact of cities with respect to land use change broadly scales with the built area footprint. The transport-related emissions also scale roughly in this fashion, since people generally need to travel further in larger cities. Densification (i.e. more people per unit land area) would also reduce the building-related emissions *per capita*. There are many specific exceptions to these generalisations, which provide opportunities to mitigate the effects of area expansion to some degree – for instance, by promoting low-embodied energy, high-carbon content materials in the building codes.

There are powerful social reasons why South African cities have tended to urban sprawl rather than densification. These drivers will need to be either neutralised or balanced by positive incentives to live in denser settlements if the objective of achieving cities that are more compact is to be reached.

OPPORTUNITIES FOR ENHANCING ECOSYSTEM SERVICES

AFFORESTATION, REFORESTATION AND AVOIDED DEFORESTATION

These activities broadly refer to managing the trees in the landscape. The wood of trees represents one of the important ways in which nature stores carbon; hence, in general, more and bigger trees mean more stored carbon, and cutting down trees leads to carbon loss to the atmosphere. In fact, at a global level and in the specific case of the Durban, the largest natural carbon store is below-ground, in the form of

plant roots and soil carbon, but because these are perceived to be hard to verify and manage they are currently excluded from the accountable carbon in terms of the Kyoto Protocol to the UNFCCC. That protocol has a specific section (Article 4.1) that deals with 'Afforestation and Reforestation', and in a negative sense, with 'Deforestation' (together abbreviated as ARD). In terms of the land use-based activities that are eligible for support under the CDM, only the ARD actions as defined in Article 4.1 currently count. The definitions prescribe what is a forest, which forest management actions count (and when) and which carbon pools may be counted (basically, only the above-ground wood). The forest definitions are covered by the Marrakesh Accord, which allows countries to choose their own definitions, within limits. South Africa chose a maximally permissive definition (trees at least 2 m tall, with a crown cover of at least 10%, and a minimum dimension of the forested area of 20 m. This means that many activities can be claimed as forestry (parks, gardens, some street trees); but the implication of this is that many activities also count as deforestation. The COP-16 meeting at Cancun approved, in principle, a new mechanism called REDD (Reduced Emissions from avoided Deforestation and Degradation). This should reward the preservation of intact forests, but it is as yet unclear exactly how this will work.

The above rules are essentially legalisms, and bear only an oblique relation to the real climate effects of land use change. Therefore it is required to follow strictly and narrowly the rules in order to claim CDM credits, but this will not necessarily maximise real climate benefits (in extreme cases, no net benefit may result at all). In the informal 'voluntary' carbon market, the rules are much more flexible – to the point, in the extreme, of also allowing practices which may be of very questionable real climate value.

The transaction costs of ARD activities are extremely high in relation to the benefits that can be claimed and the price of carbon that can be realised. The costs have two main components: a fixed cost that relates mostly to doing the formal paperwork and certifying the project, which can amount to millions of Rand; and a recurrent cost incurred mostly through proving, on a regular basis, that the claimed carbon

is in fact accruing. Currently carbon stocks cannot be claimed as a credit, only the increase in stock over a period of time (and then, in principle, only that change in stock which can be attributed to a deliberate action taken to enhance climate mitigation – the so-called 'additionality' clause – in practice, hard to prove or disprove). The consequence of these costs is that only large-area ARD projects can be profitable, and even then, great vigilance is needed to keep the monitoring costs from getting out of control. Places with a high potential plant growth rate (such as Durban) fare better than marginal lands, but even so, it makes sense to group projects up to a large scale (tens of thousands of hectares, and thousands of tons of carbon) to make them economically viable.

The land use-based activities that qualify for credits may expand in two ways in future. The first is that 'other land use activities', broadly listed in Article 4.2 (including soils, wetlands and many others) may at some stage qualify. The second is the REDD initiative. REDD recognises that globally about a fifth of carbon emissions originate from (tropical) forest loss, and that it makes much more sense to slow the rate of loss than try to restore forest after it is gone. There are important biodiversity conservation co-benefits (which often are the main objective of the proponents), and resonances with the emerging field of 'payment for ecological services'. The problems are several: it introduces a 'rental' for stock maintenance, rather than payments for

stock changes; how does one protect against 'leakage' (the displacement of deforestation to other locations); and even the billions of dollars pledged for REDD globally become tiny when divided equitably across all forested land.

In summary:

- Real and lasting carbon benefits can accrue from increasing the cover and density of trees in the urban landscape, but can also accrue in the soil of vegetated but non-treed landscapes such as grasslands.
- Only a fraction of these benefits qualify under current UNFCCC accounting rules.
- The costs of verification may make such projects unprofitable if the purpose is sale of carbon credits into formal markets.
- The main reason for undertaking these activities are because a greener, better managed natural area system enhances a much larger set of ecosystem services, including biodiversity support, pollution reduction, flood control, recreational and aesthetic landscapes. The increased carbon sinks and microclimate regulation are a co-benefit.
- A well-designed green area network is an important adaptation strategy for climate change. It provides buffer space enabling future options, corridors for biodiversity migration, climate amelioration and flood and erosion risk reduction.

Key Messages:

- Increasing the cover and density of trees in the urban landscape has lasting carbon benefits, but only a fraction of the carbon stored qualifies for carbon credits under current UNFCCC accounting rules.
- Ecosystem services benefits are a stronger driver of green area management activities, with carbon sinks as a co-benefit.

WETLAND MANAGEMENT

Wetlands are important foci for ecosystem services. They provide clean water, regulate flood flows and are a habitat for specialised plants and animals. They are also unsuitable places to build houses and roads, so it makes sense to

preferentially manage them for their ecosystem services. That has seldom been the case in the past, where they have either been ignored, or actively drained to make them available for other purposes or to remove a perceived nuisance, such as mosquitoes.

Wetlands are close to climate-neutral, since they have opposing processes, which almost exactly cancel each other out. A climax wetland (one that has been there for a long time) takes up as much CO₂ as it loses, and is a (significant) source of CH₄. But this is not an additional or anthropogenic source, since it has always been present. Wetland soils are high in carbon because they are saturated with water for much of the year. If the wetland is drained this carbon decomposes, becoming a source of CO₂ to the atmosphere. At the same time, the wetland stops producing CH₄. By coincidence, the two processes are numerically very similar in global warming terms, just opposite in sign. Conversely, if a wetland is created or restored, carbon will accumulate (a sink), but CH₄ will be generated (a source), again cancelling each other out.

Therefore, wetlands are very important for ecosystem services, but have almost no potential as climate mitigation interventions.

MANAGING BIOMASS FLOWS

The problem with accumulating natural carbon stocks, such as through ARD, is that they have an intrinsic upper limit. Therefore, at some stage, the carbon uptake ceases and the stock becomes carbon neutral (and vulnerable to catastrophic loss). In order to make the carbon benefits ongoing, the key method is to keep the resource in a productive state, which, paradoxically, usually means periodically disturbing it by harvest, rather than strictly protecting it. The harvested carbon must be diverted either into a secure long-term storage - such as timber in houses or quality furniture - or into biofuels which then substitute for fossil fuels. Harvesting and use can take place without significantly reducing

their other desirable properties. The productivity of the site then becomes a sustainable climate benefit. Such biomass flows, in the urban context, include amongst others: organic garden and park refuse; street tree-fellings and trimmings and mowed grass from grasslands. From a climate change perspective, this is a much more efficient use of biomass than landfilling, incinerating or composting. In the case where biofuels substitute for fossil fuels, a carbon credit accrues automatically through reduction in the use of the latter.

A particular case in the Durban environment is the burning of veld and sugar cane within the broader metropolitan area. Whereas veld-burning (within limits, i.e. no more than once every two years on average in this environment) is carbon neutral, non-additional in terms of other GHGs and beneficial for biodiversity, it is in some circumstances a risk to human safety or infrastructure and an air pollution hazard. Elimination of burning will lead to forest formation in the long term. If there is a desire to maintain a grassland, but without using fire, annual mowing can substitute. Grazing is not a substitute for fire from a climate change perspective, since more methane is generated by the ruminant than would have been produced by the fire.

Sugar cane is burned to prepare it for harvesting, especially on slopes where hand harvesting is required. This is a pollution problem and a net source of CH₄ and aerosols. Burning can be avoided by harvesting the cane mechanically. The crop residues can then be combusted at the mill in a cogeneration plant where they substitute for fossil fuels. This applies equally to existing or reestablished natural vegetation and to plantations, gardens or street trees. Harvesting and use can take place without significantly re-

Key Messages:

- Wetlands have almost no potential to mitigate climate change, but are very important for ecosystem services.
- In order to maintain carbon benefits over time, a resource has to be in a productive state, which means it must be disturbed periodically by harvest, rather than strictly protecting it.
- Harvested biomass must be diverted into secure long-term storage (e.g. timber houses, furniture, biofuels) rather than landfilling, composting or incinerating.
- Veld-burning, within limits, is near-carbon neutral, but sugar cane burning should be discouraged and cane residues rather used in a cogeneration plant as a substitute for fossil fuels.

ALTERNATIVE CARBON SINKS

These are three broad ways in which building materials contribute to climate change and mitigation:

- The embodied energy of their manufacture, with locally-sourced natural materials, such as grass, wood, mud and stone being low, fired brick and tile intermediate and high-energy materials, such as glass, plastic and metal being high. The embodied energy of buildings is typically the equivalent of many years of energy-efficient operation.
- The carbon content in the materials themselves, which is sequestered for the life of the building (and longer, if the material is recycled) – this is high for wood, thatch, asphalt and plastics.
- Through their insulation and thermal mass properties, which assist with the energy efficiency of the building over its lifetime. Foams, some types of particle boards and double glazing have good insulating properties. Mud, stone and brick have good thermal mass properties, stabilising the temperature fluctuations through the day and thus saving both cooling and heating energy.

Cement can contain up to 25% fly ash without reducing its qualities, but reducing the emissions from cement manufacture by an equivalent amount, and helping solve a waste problem at the same time. Many South African cements and concrete products already contain fly ash, so additional dilution is not possible.

Geo-energy can substitute for fossil-fuel derived energy in both heating and cooling. A heat pump makes use of the relative stability of the soil temperature below about 600 mm to cool buildings in summer and warm them in winter. The mean annual temperature in eThekweni Municipality is around 25°C – very close to the human ideal, even though the summers are too hot and the winter nights can be too cool. The ocean could be used in a similar way.

Intelligent building design is also an important climate change adaptation strategy.

GREEN ROOFS AND PAVED AREAS

Covering dark, impervious surfaces such as roofs, roads and parking areas with green vegetation serves several purposes.

- If the vegetation is lighter (higher albedo) than the surface it covers, it reflects the sun's energy back to the sky, counteracting the effects of increased GHGs in the atmosphere. The reverse is true if the vegetation is darker than the surface it covers, which may be the case for unpainted concrete, aluminised surfaces, unpainted galvanised iron, light-coloured painted surfaces or beach sand. The albedo of green vegetation is about 13%, which is higher than tar, dark-painted surfaces, some bricked surfaces and deep open water.
- Transpiration from the green leaves cools the air, reducing the need for air-conditioning. This comes at a water cost – a problem if water is scarce – and is less effective in humid environments such as Durban.
- A layer of soil on a roof adds to its insulation and thermal mass properties.
- The moist inside of the leaves acts as a trap for pollutants (notably ozone and its precursors) and the rough foliage traps dust particles. This, like transpirational cooling, works best with leafy plants with high stomatal conductance, as opposed, for instance, to water saving, sparse succulent gardens ('xeriscaping').

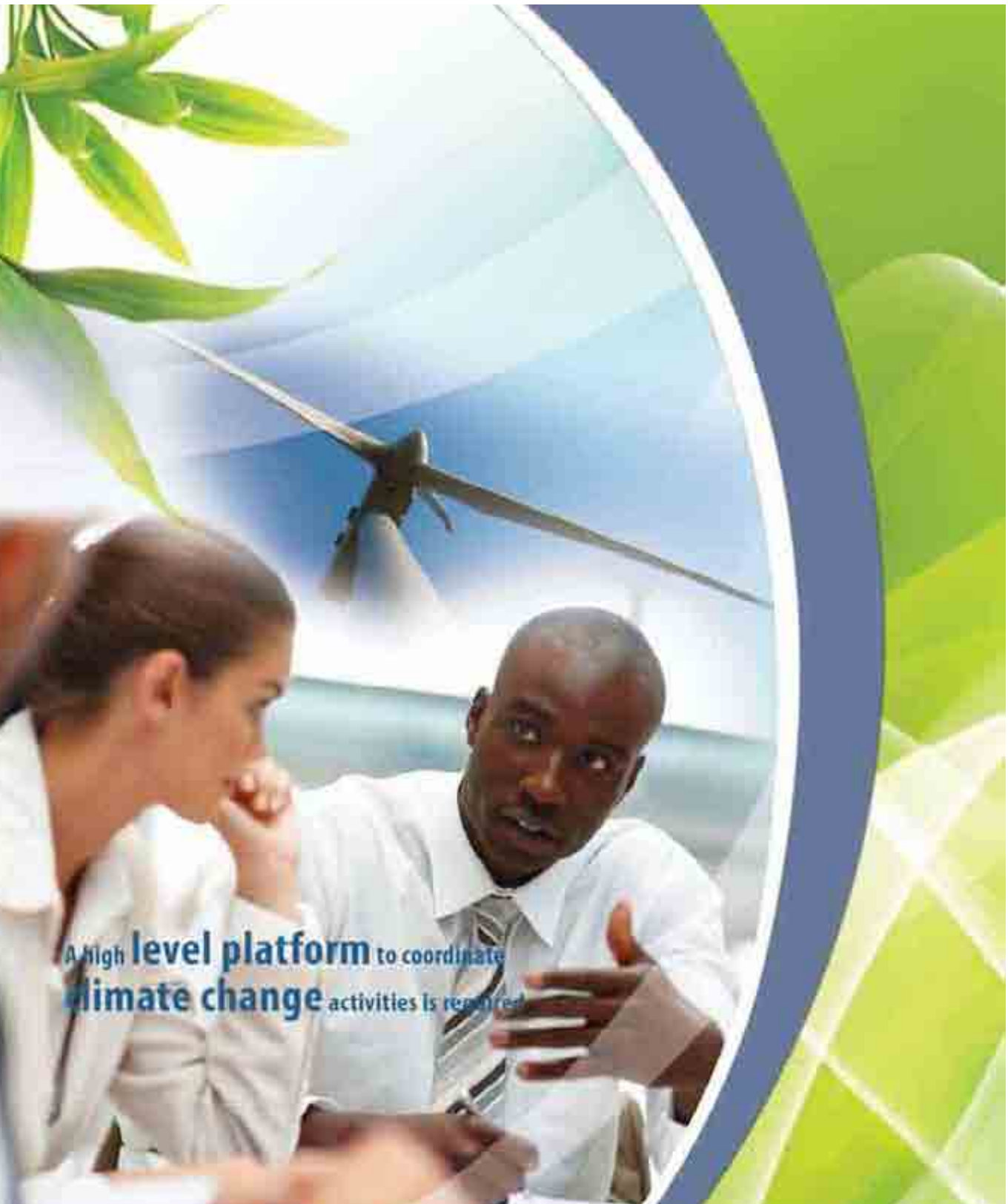
CONCLUSION

Enhancing carbon sinks through the activities described in this chapter makes a minor contribution to climate change mitigation when compared with the city's GHG emissions. However, there are many other positive benefits, both in terms of ecosystem services and climate change adaptation. Together, they make this a very worthwhile area in which to invest.

Key Messages:

- Building materials can contribute to climate change mitigation through the embodied energy of their manufacture; the carbon content of the materials themselves; and through their thermal properties that assist with energy efficiency of a building.
- Greening dark, impervious surfaces with light-coloured vegetation may reflect more sunlight back to the sky and thus mitigate climate change. There are other benefits such as cooling through transpiration, insulation of buildings and trapping of pollution.

chapter 8



A high level platform to coordinate
climate change activities is required



achieving low carbon governance

INTRODUCTION

It is widely accepted that urban centres, home to over half of the world's population, are key sites for action in generating proactive and sustained responses to climate change challenges facing the globe. City administrations and their accompanying political structures, varied as they might be, in the past decade or so have begun to take steps to identify and test some of their possible roles in confronting environmental challenges such as global climate change and contributing to new solutions.

The importance of cities and the scale of the challenges facing them, particularly in the developing world, is not just a product of rapid urbanisation, but also their growing role as centres of formal and informal economic production. These processes are occurring side-by-side with evolving forms of government and processes of governance.

This chapter seeks to understand the nature of urban governance challenges that arise in the context of a low carbon city and sets out some of the essential elements of a low carbon governance framework for eThekweni Municipality.

GOVERNANCE CONCEPTS

One of the most widely cited definitions is that of the United Nations Development Programme (UNDP), which describes governance as: "the system of values, policies and institutions by which a society manages its economic, political and social affairs through interactions within and among the state, civil society and private sector. It is the way a society organises itself to make and implement decisions – achieving

mutual understanding, agreements and action (UNDP, 2004, cited in UNDP, 2009: 1).

Styles of governance are frequently judged as good or bad (Cloete, 2005). According to Hyden and Braton (1993), four criteria can be used to assess style of governance, viz. the degree of trust in government; the degree of responsiveness in the relationship between government and civil society; the government's degree of accountability to its voters; and, the nature of the authority that the government exercises over its society.

There is no universal model of good governance; experiences vary significantly across country boundaries and even within countries, as do the values that might underpin any one notion of what constitutes good governance and the best modes to realise the goals behind this.

Urban governance has achieved prominence as urban settlement has become increasingly the dominant form of settlement the world over. Added to this is the process of decentralisation that has taken root in much of the world in the past few decades. This is seen by many commentators as a move to improve governance by giving citizens a greater role in influencing their affairs through access to local democratic instruments and a local state with some capacity.

The past two decades has seen a steady rise in attention given to environmental concerns, specifically climate change matters, at local government level and in cities. This raised awareness and the action taken by various groups have combined to stimulate a variety of responses that include: translation into policies and strategies; the creation of state capacity

to attend to environmental challenges and the implementation of policies; and, a growing civil society presence in public discourses and action around the environment.

However, as Alber and Kern (2008) note, in many instances, much of the key authority remains vested with the national state. In most countries there is no direct link between national GHG reduction goals, derived from national climate protection programmes and international agreements and the implementation of these goals at local level. The absence of mandatory provisions in national legislation makes local cli-

mate action a voluntary task for most local authorities.

Satterthwaite (2007) argues that effective local governance is more important to people than good national or global governance. Further, he suggests that national governments can only meet their global responsibilities by partnering with local government. He underscores the local role by noting that: "most global environmental problems will be resolved only through the aggregate impact of actions undertaken by local governments" (Satterthwaite, 2007: 72).

Key Messages:

- Effective local governance is more important to people than good national or global governance.
- Global environmental problems can only be resolved through the collective impact of actions by local governments.

LOCAL GOVERNANCE FRAMEWORK

Alber and Kern (2008) provide a useful framework within which to examine the local state and governance. The four modes of governance are described as follows:

- **Self-governing** can be defined as the capacity of local government to govern its own activities. This mode relies on reorganisation, institutional innovation and strategic investments. An example of this mode of governance is the improvement of energy efficiency in government offices and other municipality-owned buildings.
- **Governing through enabling** refers to the role of local government in coordinating and facilitating partnerships with private actors and encouraging community engagement. Tools, such as persuasion and incentives, are most important for this mode of governance.
- **Governing by provision** means that practice is shaped through the delivery of particular forms of services and resources. This is accomplished through infrastructure and financial means.
- **Governing by authority** involves the use of traditional forms of authority, such as regulation and the use of sanctions.

They then went on to classify various types of action taken by local governments according to this framework (Table 8.1), providing a useful insight into the relationship between governance and climate change activities.

Alber and Kern (2008) also highlighted the global shift that has taken place in the focus of climate change responses. Initially, the focus was on mitigation measures. Some of the responses included the compilation of emission inventories, followed by carbon disclosure projects, with municipalities sometimes taking a lead in disclosing municipal-generated carbon emissions. ICLEI's Carbon Disclosure Project is an example of such an initiative, which by using city-city networks demonstrated the ability of networked interaction between role-players to enhance prospects for improved governance.

Carbon disclosure projects were followed by GHG reduction targeting, with specific targets being set around key emission categories to inform decision-making and stimulate responsible action by those responsible for emissions. Alber and Kern (2008) suggest that, in general, targeting has not been too successful, with problems being faced in terms of institutional coordina-

Table 8.1: Modes of urban governance and climate change activities (after Bulkeley and Kern, 2006 and reproduced in Alber and Kern, 2008)

Self-governing	Governing through enabling	Governing by provision	Governing by authority
Energy			
Energy efficiency schemes and use of CHP within municipal buildings (e.g. schools) Procurement of energy-efficient appliances Purchasing of green energy Eco-house and renewable energy demonstration projects	Campaigns for energy efficiency Advice on energy efficiency to businesses and citizens Promotion of the use of renewable energy	Clean energy service provision Energy service companies Provision of incentives and grants for energy-efficiency measures	Strategic energy planning to enhance energy conservation Ordinances on the mandatory use of renewable energy Energy efficiency requirements in zoning ordinances
Transport			
Mobility management for employees Green fleets	Education campaigns Green travel plans Quality partnerships with public transport providers	Public transport service provision Provision of infrastructure for alternative forms of transport Logistics centres for goods transport	Transport planning to limit car use and provide walking and cycling infrastructure Workplace levies and road-user charging
Waste			
Waste prevention, recycling and reuse within the local authority Procurement of recycled goods	Campaigns for reducing, reusing and recycling waste Promotion of the use of recycled products	Waste service provision Installations for recycling, composting and waste to energy facilities Recycling, composting and reuse schemes	Regulations on methane combustion from landfill sites
Urban Planning and Land Use			
High energy-efficiency standards and use of CHP in new public buildings Demonstration projects - house or neighbourhood scale	Guidance for architects and developers on energy efficiency and renewables		Strategic land use planning to enhance energy efficiency and the utilisations of renewables Planning of sites for renewable installations Strategic land-use planning to enhance public transport

tion, where many large emission impact decisions get taken outside the influence of environmental units in local government, or even outside local government itself. This point emphasises the need for multi-level governance as discussed later.

More recently, there has been a shift to actions related to adaptation to likely climate changes, as the risks from climate change become more of a reality (Alber and Kern, 2008). This has tended to reinforce a more central role for relevant departments in municipalities (also reported by Roberts, 2008). There exists a very strong imperative for local government to take a lead in local adaptive responses as the impact of climate change across space is likely to be highly variable. However, the requirement of a very strong technical foundation for the development of adaptation strategies has meant that many are very much at their preliminary stage.

Satterthwaite (2007) remarks how cities in high-income countries possess a relatively high adaptive capacity, and thus will be able to improve resilience and manage adaptation, provided there has been awareness-raising and guidance is available. In contrast, in middle-income and low-income countries, the lack of adaptive capacity "calls for extensive support, both in terms of capacity-building and investments in infrastructure and services." (Alber and Kern, 2008: 16)

One of the major themes emphasised by Alber and Kern (2008) and Corfee-Morlot *et al.* (2009) is that of multi-level governance, specifically in horizontal terms (across departments within municipalities or between municipalities) and in vertical terms (between municipalities and communities or between municipalities and national or international spheres of decision and policy-making).

Much potential exists for horizontal collaboration, with various departments within a municipality and even adjacent (and sometimes more distant) municipalities sharing their knowledge and experiences of self-governing actions around climate change. There is also scope for planning joint provision in fields, such as energy or transportation, as there are opportunities for collaborative forms of regulation. Alber and Kern

(2008) also propose a number of areas in which collaboration can be extended vertically, for example capacity-building. If it is accepted that local action is important in achieving national goals then national actors must examine their roles in terms of fields such as capacity-building (enabling), resource allocation (provision) and delegations of responsibility (authority).

Key Messages:

- A global shift in climate change responses has taken place, from an early focus on mitigation to one focused on adaptation, as the risks from climate change become more of a reality.
- Adaptive responses tend to be local in nature, reinforcing the central role for local government.
- Multi-level governance (including both horizontal and vertical levels) is imperative to strengthen the ability of local government to manage adaptation and improve resilience.

GOVERNANCE IN ETHEKWINI MUNICIPALITY

HISTORICAL PERSPECTIVES

A historical perspective is necessary as South African cities come from a history in which government was organised to benefit a minority and governance processes were highly influenced by an authoritarian state culture. Whilst the apartheid state did take significant steps to preserve wilderness areas, it tended more often than not to favour economic growth prospects over other concerns, both social and environmental. Both city form and city services delivery patterns were highly unequal, leaving the majority of poor black urban residents on the periphery of cities with little in the way of effective services (see Chapter 2). Formal governance structures did little to take account of these conditions and there were even active attempts to suppress the voice of black urban residents. As a result, these residents often had little or no access to appropriate measures to improve their circumstances, and had to bear the brunt of polluting industries (with South Durban being a case in point).

Since the early 1990s, with the process of dem-

ocratic reform in the country, there has been considerable attention given, initially to the re-organisation of government at the local level and the creation of democratised electoral processes, but in subsequent years to a range of governance-related reforms aimed at enhancing the accountability of local government and in giving citizens a greater voice. In legislative terms, the importance of the Local Government Structures Act (*Act 117 of 1998*) and the Local Government Systems Act (*Act 32 of 2000*) stand out as critical elements in helping to craft both the government reforms and governance processes that have followed.

It is notable that in South Africa, the Constitution (*Act 108 of 1996*) gives formal recognition to local government as a sphere of government (it is not merely an administrative creation as it is in many other countries). The Constitution has also been central to the processes of trying to craft new governance arrangements. Apart from the significant scope of the rights and duties accorded specifically to local government in the Constitution, there are also rights accorded to the citizenry, in a Bill of Rights, which create an important bedrock for governance at the local sphere. Indeed, there has been widespread use of the Constitution by communities in their

struggles to have rights respected in situations where local government has acted in ways that do not align with key constitutional provisions or interpretations. However, this strength of the Constitution, in that it seeks to protect the rights of individuals or groups, has also been raised as a concern when it comes to some aspects of governance, in that the benchmark often used in determining whether a party should take action is based on whether it affects the rights of another party. Many critics hold the view that primary protection for the environment is weakened; for example, a river can be polluted as long as it does not affect the health of communities in a direct manner or reduce access to rights of clean drinking water.

A key element of local government changes in South Africa since 1994 has been the introduction of metropolitan-scale government in the major cities. This was driven by a number of imperatives. Probably the most significant of these was to create opportunities for redistributive action by the local state across space from a single city tax base. This was aimed at avoiding a situation where local state revenue generated from commercial or higher income areas could not be re-allocated to neighbourhoods without any significant local tax base. It also forced a much greater degree of coordination between highly uneven and fragmented local government units that had been operating in the past. A further motivation was to secure a greater degree of integration with peri-urban and surrounding rural areas by drawing them into city administration.

Along with these local government reforms has come a reformed political process with new electoral processes and municipal structures. The eThekweni Municipality currently has 100 electoral wards, with 100 elected ward councillors. This is matched by 100 proportional representation councillors, who are nominated by parties in proportion to their share of the electoral vote. Under the Local Government Structures Act (*Act 117 of 1998*), the Council has opted for an Executive Committee decision-making system as opposed to having an Executive Mayor, as was done in most other cities in South Africa. This was due in a large part to the fact that an outright majority eluded the dominant party, the African National Congress (ANC), in past lo-

cal government elections. In forming a coalition with a smaller party, it chose the Executive Committee system to be able to offer some access to decision-making structures for smaller parties, as well as the opposition, as the Executive Committee system is based on a proportional allocation of seats. In both the Executive Mayor and the Executive Committee system, the full elected Council is the ultimate decision-making body and all councillors are represented on this and on an array of Council committees, with specific responsibility for fields of mandated local government decision-making.

In the exercise of its governance responsibilities, it is probably the Local Government Systems Act (*Act 32 of 2000*) and the Municipal Finance Management Act (*Act 56 of 2003*) that have the greatest impact on how citizens and various stakeholders experience interaction with local government in its more formal mechanisms. Both the acts mentioned above require local government to act in a participatory manner by engaging the citizenry in planning, budgeting and policy-making processes. The former sets out the process for generating municipal IDPs as the central tool for municipal planning and action. These are to be supplemented by medium term (three year) and annual budgets to align expenditure to specific municipal goals and targets. In the legislation, the IDPs are seen as an element to enhance democracy and not just an administrative exercise.

The eThekweni Municipality has consistently produced IDPs as required and has moved in recent years to align budgetary expenditure to these frameworks as they have been adopted. These are core governance tools in the municipal environment as they are used to justify actions and choices on a consistent basis. Most municipalities tend to keep the frameworks relatively open-ended to allow for a measure of discretionary action, both in terms of political choices and in terms of administrative allocations. These are further supported by a range of other formal policy documents and frameworks that are more often than not specific to a local municipality in their content but are required to be present in all municipalities. An example of these would be spatial planning frameworks such as the SDF which sets out broad land use imperatives, as well as an array of planning

frameworks related to land use that operate under these, such as sub-regional spatial development frameworks and local area plans with greater and greater levels of specificity. These too provide important points of governance interaction between citizens and the state.

Municipalities also have powers to determine some forms of local legislation through promulgating municipal by-laws which cover a wide range of fields such as health and safety, land-uses, permitting, charges, penalties and the like. These were much in evidence in the municipality prior to 1994 and have tended to be seen as somewhat less important in that the bulk of them were not reviewed or extended to areas covered by broader municipal boundaries, until recently. However, of late, there has been a renewed focus on municipal by-laws as a key element of the local state's governing machinery in recent years.

The manner in which the local state organises itself is also important in governance terms. Since 1994, the dominant move has been to create a single, centralised local government administration to replace the highly uneven and fragmented local government structures of the past. After the 2000 local government elections this was accelerated with the bulk of the remnant local government offices being centralised.

In recent years, there has been some movement to create a measure of a more localised presence. This has included investment in refurbishing facilities for local councillors closer to their wards, opening up municipal contact offices for the payment of services and related queries and in the allocation of responsibilities in many line departments. A notable experiment was the setting up of five area-based management and development zones with funding from the European Commission between 2003 and 2008. This involved setting up of dedicated local development teams in five pilot areas of the city to help drive more localised programmes. These were seen to bring noticeable benefits to areas, such as Cato Manor and the Inanda-Ntuzuma-KwaMashu area where the benefit of enhanced participation and the application of local knowledge by administrators based in the area allowed for more effective municipal delivery and more refined local projects. However,

it appears that a decision has been taken to reintegrate these teams into municipal line departments as the idea of a further restructuring of the already much-restructured local administrations along the area based management lines has not found favour with senior politicians or officials.

CRITICAL ANALYSIS OF GOVERNANCE IN eTHEKWINI MUNICIPALITY

As one might expect, in any one context, there are many different perspectives in terms of what constitutes good governance, as well as whether or not local government in Durban has contributed to enhancing the good governance experience of citizens in Durban. Undoubtedly, the move from apartheid era local government to the present-day democratic local government has seen major strides to enhance good governance. Local government today, for the majority of citizens, is far more responsive to their needs and has increasingly been enabled through national legislation and new funding frameworks to play an effective developmental role. The introduction of the many varied processes at the local government level, such as those related to the IDP, have introduced possibilities that were not contemplated prior to 1994. Municipal publications and the Mayor's Annual Reports produced in recent years provide evidence that local government is aware of the major challenges it faces and is confident that the steps it is taking in the delivery of housing, basic services, improved living environments and economic development are making major strides to realising the municipal vision statement.

It is notable that the eThekweni Municipality has received a range of accolades and is regarded in many circles as being the best municipality in South Africa. It has won Vuna awards from the former Department of Provincial and Local Government for its delivery performance and has received international recognition for some of its programmes. These are further supported by the municipality having the best credit rating of any city in South Africa, having delivered more public housing units and more electrical and water connections than other cities, and having achieved clean audits throughout recent years of turmoil. These are by no means insignificant

and suggest, at least in relative terms, a highly capable administration under the guidance of political leadership with a strong orientation to meeting developmental commitments.

Notwithstanding these accolades, or in some cases because of them, the municipality has come in for some considerable criticism. Much of the criticism relates to the tendency by the local municipality to revert to its own formal processes in terms of decision-making without engaging more meaningfully with the citizenry (Ballard *et al.*, 2007). Although there are consultative processes around the bulk of municipal processes, with active involvement from ward councillors, there has been an ongoing concern amongst many civil society groups that the local municipality tends towards a one-size-fits-all approach in its models of delivery to the poorer urban communities making up the majority of the city's residents. Allied to this, there have been concerns that decisions are made before being brought through Council processes for rubber-stamping (Ballard *et al.*, 2007).

In particular, there have been concerns that these processes have come to characterise so-called strategic decision-making around major projects and initiatives, where there is a limited tendency to engage with broader interest groups. Examples cited include the commitments made around mega projects and events such as the Point Waterfront developments and the FIFA World Cup 2010. Some have suggested that these processes have been further complicated by very close working relationships of senior Council political leaders and a powerful network of local business people (Moffet and Freund, 2004). Others have argued further that the municipality has embraced a market-based development strategy as a result of these close relations, which aggravates inequality and poverty (Bond, 2004).

There are also criticisms that the municipality has, through its reform of government structures, denuded localities within the city with a meaningful level of accessible administrative presence. This has two dimensions; the first of these would be that accessing responsive local officials with some measure of decentralised authority can be very difficult for both citizens and ward councillors alike; the second aspect is that

various forms of local knowledge and insight are not captured by officials with a neighbourhood beat and incorporated into decision-making processes at a municipal-wide level. Finally, there are those who argue, perhaps because of the fact of the claimed capacity of the municipality, that it really should have done more than it has in terms of delivery (Robbins, 2010). Once again, there are two elements here that have been raised. The first is that a bolder municipal leadership might have pushed for greater flexibility and low adaptation in programmes such as housing where the core policies are set at a national level (Charlton and Kihato, 2006). The second set of concerns would be that while delivery might have been impressive in relative terms in Durban, it still falls far short of the need that exists (Pithouse, 2008).

Democratic local government in Durban remains a relatively young project. In the period since democratic local government reforms started in 1994, major changes have been instituted to render significant changes in the form and content of local government processes and actions. Facing the considerable structural problems of the city and the considerable levels of poverty have been major pre-occupations of local government. However, there have been sustained efforts to develop a deeper and more complex set of responses as time has passed.

ENVIRONMENT AND GOVERNANCE LINKS

Durban has been hailed often as a leading actor around environmental challenges in the South African local government context. There has been sustained action around environmental matters over the past two decades. In the late 1980s, initial commitments were made around D'MOSS, and in the last 20 years this has expanded as the metropolitan boundaries have been established and it has been incorporated fully into municipal planning frameworks with a recognition, not just of the conservation benefits it might offer, but also in terms of protection of biodiversity and for the provision of environmental services.

In the post-1994 era, Durban was also one of the first cities, under the aegis of Local Agenda 21 to initiate a major review of the state of the environment.

In line with the arguments made by Alber and Kern (2008), some of the progress made has been due to growing realisation that the city needs to act now in response to climate change threats. Very significant spring tides and wave damage in recent years helped bring home this message to local government officials and politicians who might otherwise have been sceptical. Roberts (2008) points to some key factors that have helped secure progress around environmental governance in the eThekweni Municipality, including processes that built the awareness and capacity of officials in a range of departments such as town planning and coastal engineering. Roberts (2008) suggests that this capacity development has enabled institutional change and the mainstreaming of environmental concerns in municipal policy. Indeed, significant attention is given to environmental constraints, challenges and the required actions needed in key planning documents for the city, as was outlined in Chapter 2.

In recent years, the degree of attention paid to carbon emissions and responses thereto have begun to garner more responses. Whilst air pollution matters have been traditionally dealt with through the Health Department of the municipality, the issue of carbon emissions is now receiving broader attention. Scarce resources in terms of staff with skills around environment issues are being allocated to attend to these matters and efforts are being made to develop models to project climate change impacts that result from major developments being proposed by the public and private sector. For example, Transnet in its planning with eThekweni Municipality around the expansion of the Port of Durban and the related Durban-Gauteng Corridor process has begun processes to explore the varied long-term environmental impacts, including those around, for instance, the emissions impacts of different transport modes. The recent hosting of the FIFA 2010 World Cup and the related investments made were accompanied by a programme aimed at reducing the net carbon impact of the new stadium. These activities, despite the fact that they are relatively recent and embryonic, do nonetheless demonstrate Roberts' assertion of growing mainstreaming of climate change awareness in the eThekweni Municipality (Roberts, 2008).

A summary of examples of actions classified according to the Alber and Kern (2008) governance modes (Table 8.2) reveals that there has been considerable attention on the self-governing processes, noted too by Roberts (2008). This has sought to encourage responsible action by the municipality and its various departments, not just internally, but also in the manner in which they interact with the broader city. There has been a growing focus on enabling activities, where partnerships and interaction with other stakeholders, both locally and internationally, become highly relevant. Of the four categories presented by Alber and Kern (2008), it is probably the last, viz. governing by authority that has received most attention as the country and cities have sought to adjust their regulatory frameworks to reduce negative impacts and guarantee greater protection for citizens.

Roberts (2008) notes that political support for these efforts in Durban has by no means been consistent, and at times has been opposed to the efforts to enhance environmental governance capabilities where these efforts are seen to compromise shorter term development imperatives (such as using available open land for public housing). The main parties that contest the local government elections tend to have little focus on the environment in their manifestos. It is also noticeable that informal and formal networks with active civil society formations in the environment field are by no means pronounced. These networks are stronger with professionals active in the environment field, but there is an absence of regular formal and informal interaction. These factors have tended to influence municipal programmes very much towards a technical bias and ultimately to focus on regulatory outcomes rather than mobilising a wider range of social actors. In a country with a dominant set of political actors and a very focused set of policies, it is perhaps not surprising that mobilising this sphere and broadening engagement can be difficult. However, the evidence from other cities (Satterthwaite, 2007) suggests that sustaining sound governance processes and their continuous review and enhancement depends very much on an open deliberative type decision-making environment.

Table 8.2: Some examples of possible municipal actions organised according to the Bulkeley and Kern (2006) framework cited in Alber and Kern (2008)

Modes of urban climate change governance and sectors of climate change mitigation			
Self-governing	Governing through enabling	Governing through provision	Governing by authority
<ul style="list-style-type: none"> • Compiling an emissions inventory for municipality under CCPP. • Setting energy management and reduction targets for municipal departments. • Making savings in municipal departments through energy efficiency. • Decentralising mechanisms for citizen participation at neighbourhood scales. 	<ul style="list-style-type: none"> • Sharing information on energy reduction strategies with the public and businesses. • Sponsoring local level/community organisation capacity building around environment issues. • Providing services on behalf of neighbouring municipal entities unable to provide services internally. 	<ul style="list-style-type: none"> • Using billing systems to incentivise or advise on energy impacts of service use. • Using water, waste and energy metering technology to inform municipal service users. • Providing access to partially treated water to companies for industrial use. • Promoting D'MOSS which provides key measurable environmental services 	<ul style="list-style-type: none"> • Using planning frameworks to require developers to begin to respond to climate change imperatives (e.g. integration of public transport, green building codes). • Introducing by-laws to inform building codes, vehicle emission standards etc. • Creating capacity in municipal courts for legal enforcement of by-laws related to environment matters.

FOUNDATIONS FOR A LOW CARBON GOVERNANCE FRAMEWORK FOR ETHEKWINI MUNICIPALITY

Some of the proposed elements of a low carbon governance framework are as follows:

- *Citizen and civil society engagement and partnerships*

Local government is only one of a number of actors that are important. It is imperative to engage not only with other spheres of government, but with the business community and the public to craft climate change action plans and strategies.

- *Political responsibility*

Within the municipality, matters related to environment tend to get heard in sub-committees related to Planning/Economic Development and Health/ Safety. The centrality of climate change matters to the agendas of the Council structures is a matter of concern as their agendas are often dominated by other matters. There is a need to give attention to environmental matters in structural terms within the Council committee system, in order to accord environment greater political attention and also support political accountability of different departments to low carbon policy imperatives. Having a political leader with explicit responsibility for this portfolio would be a significant development.

- *Institutional consolidation*

There is a need to enhance coordination and to improve capacity. The improved coordination around development plan applications and Environmental Impact Assessments is certainly commendable. However, there is some value in this being enhanced around climate change matters. The present shared perspectives and awareness rely quite heavily on individuals with a high level of trust and shared knowledge working together. In a fast-changing local government environment this might not survive institutional changes and might benefit from greater institutional formalisation, as well as further deepening of capacity. This could also benefit from the kinds of partnerships

and relationships mentioned above where, for instance, the creation of enhanced scientific capacity, as well as civic capacity in the city, could provide a very useful resource in taking forward future low carbon commitments. Progress that has been made in the fields of open space, town-planning and energy should find its way into areas such as transportation and finance. Transportation has large carbon ramifications and is a field that needs considerable attention. The manner in which the municipal finances and revenue systems operate also sends very important signals to both city planners and citizens. For example, at present, generating property rates is helped by rapid growth in property development but this might present major challenges to a low carbon future. Finances will also be key in changing incentives to citizens around their consumption behaviour. These must be explored together with regulatory approaches.

- *Demonstration projects*

Much of the work to date around the environment has been in the field of knowledge creation, capacity enhancement, institutional re-alignment and regulation. Visible projects (with the exception of the Green Roof Pilot Project and the Buffelsdraai and Inanda reforestation projects) that communicate relevance are relatively rare. Regulatory focused initiatives, although essential, should be nested in a mix of other approaches that engage the public and others in neighbourhood and citywide collaborative action. Compared to some cities, Durban may appear to have considerable open space but it should also seek to make areas such as parks work to help meet not only long-term carbon mitigation and adaptation goals but also to serve as communicators to citizens of key messages in relation to a low carbon city.

- *Poverty reduction and low carbon initiatives must be integrated*

In a context of high levels of poverty and inequality, it is imperative that the environmental agenda is relevant to the immediate needs of the urban poor to access services, shelter and economic activities. This is not only about more innovative communication

strategies but must involve direct engagement with key municipal policies that impact on the poor, such as those related to housing, basic services and economic development. Environmental justice groups tend to see the municipality as somewhat distant from their concerns and there could be scope for the municipality to seek to narrow the gap between the local state and these civil society entities that are often active in poorer communities. Later in the report (Chapter 10), the argument is made for a green economic development path which addresses most appropriately the long-term challenge of poverty reduction. Political will to shift the current unsustainable growth path to one that will simultaneously address poverty and climate change challenges is needed.

- *Develop alternative economic growth paths*
Various lower carbon future development paths for Durban also require considerable attention to be paid to economic development paths and how the city may influence these. Although environmental matters have

begun to feature as relevant considerations in economic programmes, they remain somewhat marginal. Mitigation and adaptation initiatives need to engage business actors as partners but should also inform discussions about future growth paths. Continuous striving for higher levels of economic growth needs to be tempered with both distributional and climate impact considerations (see Chapter 10 on the Green Economy).

- *New regulatory opportunities to be explored*
Whilst cautioning against too heavy a focus on regulatory processes, there are grounds for creative and appropriate use of by-laws and policies to support greater alignment around carbon reduction intentions. At present, municipalities have relatively limited scope in terms of powers to use these more effectively but there are grounds to begin to push for greater local freedom to set standards around matters such as vehicle emissions, licensing of activities, etc. Internationally, allowing increased scope for local regulation has helped engineer important local debates and testing of approaches to tackle climate change.

Key Messages:

A low carbon governance framework for eThekweni Municipality requires the following:

- Citizen and civil society engagement and partnerships.
- Political responsibility – give climate change matters greater prominence in Council.
- Institutional consolidation – enhance coordination among departments.
- Demonstration projects to enhance viability of climate change initiatives.
- Integration of poverty reduction and low carbon initiatives.
- Development of alternative growth paths.
- Explore new regulatory opportunities, particularly the use of by-laws.

CONCLUSIONS AND RECOMMENDATIONS

The argument put forward by Satterthwaite (2007) on the pivotal role of local government is widely supported in the literature. Drawing on the frameworks discussed by Alber and Kern (2008), Cloete (2005) and Corfee-Morlot *et al.* (2009) amongst others, there exists considerable scope for local governments and other local

stakeholders to develop shared governance frameworks to face climate change and other threats. Local government in South Africa, with its constitutionally defined roles as a sphere of government in its own right, has the opportunity to be at the international frontier in helping to engineer the necessary horizontal and vertical governance innovations that climate change threats make a growing imperative. However,

the character of challenges arising from the imperative to tackle underlying causes and effects of issues such as high carbon emissions requires a form of distributive and deliberative governance. This is not just because enhanced democracy is necessary for better governance processes but crucially because such an approach will help mobilise societal stakeholders who all need to play a role in a context where formal government structures will not have the capacity or the knowledge to lead actions in all required arenas.

As the processes are crafted, local governments will need to pay particular attention to some of the following:

- **Raising the profile of climate change matters on Council agendas:** This has two elements to it. The first is that which relates to mainstreaming climate change issues so that they do not necessarily get dealt with only through the lens of Council development and planning processes. Already eThekweni Municipality has seen some progress in this regard with the Energy Office reporting to the Treasury Department. Issues affecting all Council committee structures should be tested in terms of the climate change dimensions in the same way that councillors might examine matters from a poverty impact perspective. Some international practice suggests that this can begin with relatively simple procedures, such as for instance, colour-coding reports to committees in terms of their potential climate change ramifications (red signalling a notable threat; green suggesting the proposal would enhance resilience or adaption; orange a moderate threat; and blue a neutral impact). This not only enhances awareness but encourages reflection on all issues.
- **Institutionalising coordination around climate change matters:** This tends to be easier said than done. However, there are different requirements that should be examined. First, there would be benefit in having climate change portfolio responsibilities in all relevant departments (e.g. parks, economic development, treasury, planning, social, legal etc.). This might not require specific posts in these departments but would involve a progressive building of capacity and having some level of defined responsibility

to help drive processes – those internal to departments and in collaboration with other departments in city-wide processes. A single overarching structure or platform should also be identified as being a hub of capacity and a driver of city-wide programmes and programmes beyond the city, including the resourcing of initiatives. Scope should exist to set up specialist time-bound project teams to drive particular processes that might require specific attention. This platform should also seek to carry the role of managing institution-wide coordination. It is often said that the departments with the most influence in Council processes are those that manage the most resources. Entities that limit themselves to policy interventions have the benefit of being able to have a focused role but evidence suggests that influence over specific resource allocation choices and management of larger scale projects enables the securing of attention of decision-makers. Specific departments might also need to build units to help drive activities under their responsibility – for example green building codes and the building inspectorate, where this entity could apart from its regulatory role have a role to advise builders at a site to adopt better practices.

- **Working to build a knowledge base to enhance adaptability:** Access to information will be crucial to enable a more focused set of responses as will the capacity to analyse this information and its potential climate change ramifications. In a developing country context, this means the municipality must support the production of these skills (for instance in partnership with a university) as well as create its own internal resources and network effectively with others to draw on their knowledge. The more this can be placed in the public domain the better other actors will be able to act around this information.
- **Establishing demonstration projects in highly visible locations:** Climate change issues despite being regularly part of public and official discourses remain relatively abstract to many of the stakeholders in the city. Demonstration projects in many different fields offer the opportunity to make the adaption responses identified as important appear more accessible.

- **Partnering with business/industry and citizens:** Some of the above points, if not all of them, depend heavily in terms of their potential to be effective on the ability of government to act in partnership with other stakeholders. Limitations to the regulatory role and the provision role of government means that other actors must be enabled and supported to act. This should also be seen as part of a process to build wider consciousness around environmental issues so that this percolates into the agendas of political parties and a wide range of other institutions. For instance, the Chamber of Commerce might set up a committee to look at energy issues faced by the threat of higher energy prices or blackouts. Local government could work to support the evolution of such a group to help develop a broader agenda.

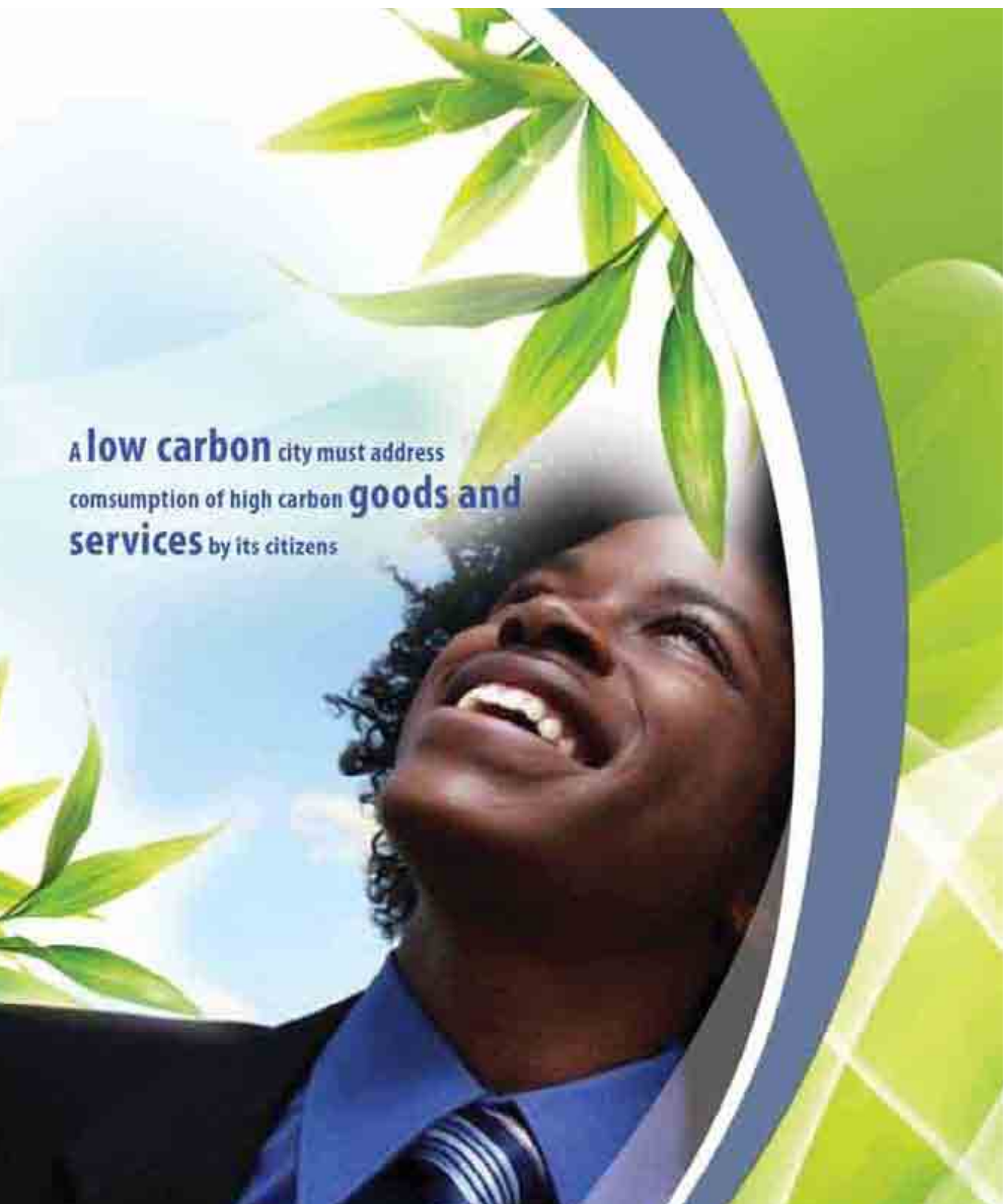
These suggestions are by no means exhaustive but do point to areas where there is scope for the pragmatic development of a differentiated set of activities at the local scale. Ultimately, the success of these endeavours will require the evolution of existing governance arrangements that will often be seen to be inadequate to the demands presented by climate change. Local government has the potential to wield considerable influence over these processes but the sustainability of its actions will depend heavily on how it might be able to insert itself as a collaborator in networks of societal actors in a manner that is inclusive and empowering for the widest possible range of participants in these spaces of social engagement.

Key Recommendations:

- Raise the profile of climate change matters on Council agendas by scrutinising all agenda items for their potential climate change ramifications.
- Institutionalise coordination around climate change matters.
- Build a knowledge base and skills to enhance adaptability.
- Establish demonstration projects in highly visible locations.
- Partner with business/industry and citizens.



A **low carbon** city must address
consumption of high carbon **goods and
services** by its citizens





achieving low carbon citizenship

INTRODUCTION

Achieving low carbon citizenship suggests that people change their attitude and behaviour, in relation to normative goals that exist around activities such as energy consumption, and hence contribute to reduced carbon emissions (Owens and Drifill, 2008). These normative goals are most often proposed by government, but increasingly, civil society organisations and non-government organisations are advocating that low carbon behaviour can make a significant contribution to the creation of a low carbon society.

Low carbon citizenship is a form of citizenship that operates at a global scale, due to the global nature of the issue of climate change. However, low carbon citizenship can also operate at a local scale, where citizens in a local municipality may be motivated to contribute to their city's low carbon programme by changing their behaviour. Low carbon citizenship can be viewed as part of global climate governance (Paterson and Stripple, 2010), which includes efforts by all spheres of government to respond to climate change by introducing mitigation and adaptation measures.

Evidence (e.g. the Greenhouse East project²⁹) suggests that the main drivers of low carbon behavior are price shocks, coupled with climate change impacts. In the past three years, events within South Africa have significantly raised the profile of climate change. These events include the Eskom load-shedding (power outages) experienced by all consumers in 2008/2009 and the coastal flooding along the KwaZulu-Natal coast in April 2007. Such catastrophic events served to alert South Africans to the realities of climate change, energy shortages and the need to reduce GHG emissions.

APPROACHES TO LOW CARBON CITIZENSHIP

The mainstream approach to low carbon citizenship is based on the behavioural approach, in which a low carbon citizen is someone who has been persuaded to modify his/her behaviour voluntarily to be more carbon friendly. This approach is framed in a 'cause and effect' model of explanation, where information/awareness is the independent variable which impacts on human behaviour (the dependent variable) in a linear, one-way direction to create and shift attitudes, which in turn results in action and new forms of environmentally responsible behaviour. Two important assumptions of this model are that people have endless motivation to alter their behaviour based on what is considered optimal behaviour, and that knowledge generated through the internalisation of information is linked to action (Weiss, 2002).

This linear, mechanistic model of behaviour change has been widely critiqued. This relationship between knowledge and action is not readily seen in practice. Finger (1994), for example, claims that the majority of people in developed countries is highly aware of environmental issues, but may not act on this knowledge. Smith and Pangasapa (2008) point out that rather than using this knowledge to shift behaviour, people take it in and reproduce this received knowledge in their own everyday discourses. This behavioural approach has also been criticised for being too individualistic, suggesting that a collective approach by groups of people, would be a more successful model for shifting civil society towards reducing carbon emissions. Owens and Drifill (2008: 4413) further maintain that "attitudes themselves are influenced by a variety of social, political and cultural factors aside from information provision".

²⁹ <http://www.tyndall.ac.uk/publications/other-tyndall-publications/greenhouse-east>

A second approach that is contrary to the individualist, behavioural approach described above, is the broader societal approach of ecological modernisation. In the 1970s, in response to the environmental crisis, ecological modernisation emerged as an approach by governments in the developed world to internalise the crisis and prevent the polarisation of economic development and the environment. Developing countries globally have taken on this approach following the policies of the industrialised nations (Barnett and Scott, 2007). The approach is based on the assumption that economic efficiency and growth can be maintained if the environment is sustainably managed, with environmental problems generally being resolved through technological solutions.

The most recent trend in contemporary neoliberal society is a focus on the individualisation of environmental responsibility (Brand, 2007), giving rise to what may be termed the individualist approach. Since the early 2000s, in addition to government programmes that focus on individuals, there has been an explosion of projects aimed at encouraging individuals to contribute to and participate in efforts to limit climate

change (Paterson and Stripple, 2010). These practices are informed by social networking cultures which encourage individuals to measure themselves in relation to others and publicly reflect their identity through Internet communication.

This process of individualisation in neoliberal society is considered by Paterson and Stripple (2010) to be problematic because it diverts attention from the real origin of GHG emissions and the state's responsibility to regulate these. They maintain that the impact of individual actions in the face of the powerful structures of state and capital is negligible. Responsibilities are being shifted from the state to individuals and governments are increasingly using 'technologies of rule' to induce people to carry out the state's mandates (Rutland and Aylett, 2008). In this way, green subjectivities are created in which individuals, in their homes and everyday lives are increasingly pressured to assume green behaviour. This governmentality framework allows for a more nuanced understanding of the relationship between state and citizen in the contemporary neoliberal society.

Table 9.1: Theoretical approaches to low carbon behavior

Approaches	Theoretical approaches to low carbon behaviour		
	Behavioural	Ecological modernisation	Social and environmental justice (values and ethics)
Main theme	People's behaviour is determined by information received	Climate change can be managed with technological tools. Economic efficiency of behaviour is the main goal	Issues of justice and ethics have to be applied to decide on climate change impacts. Individuals encouraged to adopt a moral code
Impact	Dominant in 1970s – still having a residual impact on policies	Mainstream approach in environmental management	Marginal approach but growing in importance
Critique	Mechanistic and simplistic	'Weak' form neglects issues of social and environmental justice and public participation	Too normative

In summary, there is a range of approaches to low carbon behavior (Table 9.1) which influences the kind of policies and programmes that governments can produce. While there is a high level of critique of the behavioural and weak ecological modernisation approach, these approaches are still influential in directing government policies. The shift towards strong ecological modernisation and approaches that emphasise the moral and values-based dimension of low carbon behaviour, reveals the need to consider social issues in low carbon policy-making rather than relying only on deterministic and technological policies.

LOW CARBON SOCIETY

The concept of a low carbon society is broader than that of the individual, low carbon citizen. Achieving such a society would involve actions taken by government, industry and business, as well as the public/civil society. An interesting example is the Japan-UK Low Carbon Society project, which was set up in 2006 to create a vision of a low carbon society and to work out the stages that would be necessary to achieve this vision (Skea and Nishioka, 2008).

The creation of a low carbon society has significant implications for developing countries such as South Africa. The Japan-UK project mentioned above proposed that creating a low carbon society should not be divorced from the goal of broader sustainable development in order that environment and development do not become polarised (Skea and Nishioka, 2008; Huq and Reid, 2009). One of the recommendations of the project was that governments must play a central role in moving towards a low carbon society. It was also recognised that the process of carbon reduction is a long-term process. While technology obviously plays an important role, changes must penetrate to a deeper social level if climate and developmental goals are to be reconciled (Skea and Nishioka, 2008). It was also recommended that policies and frameworks should be implemented to remove high carbon choices and provide consumers with the chance to benefit from low carbon approaches (Skea and Nishioka, 2008).

A low carbon society promotes a society that is

geared to reduce carbon emissions by limiting the demand for energy, using renewable energy and using energy more efficiently. It is important to note that achieving low carbon citizenship is also a goal of a low carbon society.

Increasingly, the notion of consumption is being emphasised within the context of a low carbon city. A low carbon city does not only mean reducing CO₂e from its municipal area but also to understand the impacts of its actions elsewhere and to take a leadership role in reducing upstream carbon emissions. Current GHG inventories for cities generally do not take into account the GHG emissions for goods produced out of the city boundaries but consumed within the city. Similarly, they account for goods produced within a city but exported and consumed elsewhere. As a result, some cities CO₂e emissions *per capita* are higher than the actual amount that is consumed within the area, whereas in other cities, especially service-based and developed cities, they are much lower (Dhakal, 2004; Satterthwaite, 2011). For example, in London, if consumption-based GHG accounting was taken into account, *per capita* GHG emissions would increase from 6 to 12 tCO₂e per annum (Bioregional and London Sustainable Development Commission, 2010).

Consumption-based accounting was applied in the case of electricity consumption in eThekweni Municipality, where the electricity produced in power stations outside of the municipality, but consumed within the city's boundaries, was accounted for in the city's emissions. Consumption-based accounting, however, should not be done in isolation but in conjunction with production-based accounting. The benefit of this dual approach is that production-based accounting would identify energy-intensive industries to enable appropriate mitigation, while consumption-based accounting would identify high consumption households and neighbourhoods for appropriate intervention (McGrath, 2005; Satterthwaite, 2011).

Consumers, in many cases, are unaware of the production process and resultant GHG emissions associated with the manufacturing of goods that they consume. The further the origin of the goods, the higher the carbon emissions from transport. Hence, promoting goods and servic-

es that have low life-cycle CO₂e emissions, will contribute towards low carbon development globally. A better understanding of patterns of consumption and life-cycle CO₂e emissions of items such as food, construction materials, consumer goods and water is needed. This can potentially be integrated with understanding the ecological consequences of production and consumption in the city (Dhakal, 2004; Satterthwaite, 2011).

By creating awareness about goods and services that have low life-cycle CO₂e emissions, the city is indirectly addressing the need for a behavioural shift in consumption (Dhakal, 2006; Satterthwaite, 2011). By combining the promotion of locally produced and low CO₂e life-cycle goods, the city will not only achieve a decline in consumer CO₂e levels, but will also benefit from an increase in economic growth and employment.

Key Lessons:

- The process of carbon reduction is a long-term process.
- Technology plays an important role but change must penetrate to a deeper social level.
- Consumption-based accounting is important and should be integrated with production-based accounting to facilitate the identification of high consumers, as well as high producers of carbon.
- Goods and services that have low life-cycle CO₂e emissions must be promoted.

STRATEGIES TO PERSUADE CITIZENS TO CHANGE TO A LOW CARBON LIFESTYLE

Strategies to promote low carbon lifestyles are as follows:

REGULATION

Regulation involves the introduction and implementation of policies, laws and by-laws to influence people's behaviour regarding their carbon emissions. Regulation of this nature has tended to be relatively weak in both developed and developing countries (While, 2008). While (2008) has also noted that regulation via direct green taxes is politically risky as it can result in citizens rejecting the carbon-control agenda. It is noted that South Africa has recently announced the introduction of a carbon tax on new vehicles.

ECONOMIC INCENTIVES

Market-based incentives can be formal, direct economic incentives given by governments for low carbon actions, as well as the more indirect method of appealing to the cost-effectiveness of a low carbon lifestyle,

e.g. savings generated by the use of solar power.

Voluntary carbon offset markets could also provide economic benefits for individuals (see Chapter 11 on Financing), although such schemes/markets have been widely criticised as a political distraction as they divert attention away from the need for collective actions against those structures that are responsible for GHG emissions (Paterson and Stripple, 2010). Consumers of carbon offsets are also criticised for purchasing a 'quick fix' in order to continue their high carbon consumption lifestyles, without necessarily caring about climate change.

AWARENESS-RAISING

Awareness-raising aims to provide more information about the challenges of climate change in the hope that, the more knowledge and understanding individuals have, the more likely they are to change their behaviour (Pykett *et al.*, 2010). Awareness-raising can be defined as 'education about the environment' and is termed 'free choice learning' as there is little compulsion to take up the information provided.

Awareness-raising is most often a product of the information deficit model that assumes that the public has little knowledge about the environment. Alternatively, awareness-raising can also be theorised as part of 'neoliberal subjectification' (Pykett *et al.*, 2010).

DEVELOPING VALUES AND ETHICS OF CARE

Through a change in values and embedding a caring approach to the earth, where morality and ethics are important, a change in behaviour and action is anticipated. Governments are also relying, to an extent, on such ethical, voluntary measures of carbon reduction by citizens (White, 2008). Randalls (2010) has noted that the predominance of market-based economic solutions to curbing GHG emissions dominates, leads to the marginalisation of issues of ethics.

THE USE OF RHETORIC

Rowley and Phillips (2010) point out that the current framing of the environment is incorrect, arguing that to propose that people must protect the environment assumes that the environment is external to human beings and does not reflect that environmental risk and impacts are embedded in and caused by human activities and behaviour. The term 'smart living' is a more user-friendly term for encouraging individuals to try to practise a low carbon lifestyle and emphasises that people are part of the environment. The City of Cape Town (2010) has produced a 'Smart Living Handbook' for the public, schools, industry and business, which defines smart living as the "efficient use of natural resources, such as water and energy, the reduction of waste, and the protection of our natural biodiversity". Low carbon lifestyles of individuals would thus be a smart way of living.

THE ROLE OF GOVERNMENT IN INDIVIDUAL CARBON REDUCTION

Governments should play a critical role in providing policies, instruments and information to incentivise the public to shift their attitudes and behaviour (Skea and Nishioka, 2008). Government policy discourses regarding raising awareness for the public and providing information about the need to reduce carbon emissions

in the context of climate change are mostly based on the rationalist 'information deficit model' or 'public deficit' model. The 'information deficit model' is a model of the relationship between the public and government wherein "the need to 'inform' the public (is) implicitly premised on public ignorance" (Irwin, 2001: 15). The model assumes that people will understand the relationship between policy issues and the underpinning science and then act accordingly. The belief in the 'information deficit model' is why, in many developed countries, the problem of a lack of citizen engagement around environmental issues, such as reducing carbon emissions, is assumed to be caused by a lack of information or awareness, since the public cannot easily access the science behind the policy (Smith and Pangasapa, 2008).

Since the societal goals of achieving low carbon citizenship, as espoused by government, are to reduce an individual's carbon consumption in order to contribute to securing sustainable energy for the future, awareness programmes, based on 'knowledge about environmental issues', are then rolled out. This assumes that this will lead to a change in attitudes and subsequently a shift towards more environmentally responsible behaviour. Paterson and Stripple (2010: 342) echo this critique that the displacement of the state's responsibilities onto the individual is a diversion of attention from the "broader political questions of power and collective responsibility".

Rutland and Aylett (2008) maintain that a helpful way to understand the way in which governments set out to achieve certain goals is to use the concept of governmentality. Governments achieve their goals "by insinuating specific ways of thinking (political rationalities) in their citizenry" through programmes which they term "technologies of government" (after Foucault) (Rutland and Aylett, 2008: 629). In this way, the values and beliefs of an individual can be moulded by government without the application of force. With this approach, subjects are being formed and identity created by 'governmentality' through which individuals become self-regulating (Rutland and Aylett, 2008).

It is clear that government plays an important role in framing the climate change debate. As a response to the issue of climate change, poli-

cies are then produced which state the need for all stakeholders to get involved in its management by reducing carbon emissions, whether it is business, industry or citizens. Paterson and Stripple (2010) propose that there is an emerging 'governmentality' that creates the 'conduct of carbon conduct' where the state creates a particular subjectivity of the individual as a responsible citizen who will do his/her share.

BARRIERS AND CHALLENGES TO LOW CARBON CITIZENSHIP IN SOUTH AFRICA

The barriers and challenges in South Africa, a developing country, to achieving low carbon citizenship are discussed below.

• Unequal society

South African society is one of the most unequal societies in the world due to the historical legacy of apartheid and colonial segregation. The majority of the population in Durban and South Africa is poor, which poses a number of challenges. Aspirations of the poor can act as barriers to a low carbon lifestyle. For example, having grown up being poor, an individual often wants to show that he/she has made it in society by engaging in conspicuous consumption (Van den Bergh and Steinemann, 2007). In South Africa, in particular, since the commencement of social and political transformation in 1994, the majority of the population has developed expectations of improved levels of living and with that increased levels of consumption.

The inequality in South Africa also poses a challenge to the design and delivery of relevant information to diverse income and cultural groups in the country.

Gibson *et al.* (2010) note that economic class is an important variable when targeting low carbon awareness-raising programmes. Affluent educated households, while being the strongest supporters of 'green practices', are also the highest consumers of products that produce high carbon emissions. In this way low carbon citizenship becomes equated with upper and middle classes, which in South Africa reveals a race dimension.

Scott and Oelofse (2009) point to a growing dis-

course in South African environmental management, where pro-environmental discourses are increasingly being interpreted in racial terms. Black officials and politicians refer to these environmental discourses as 'white, racist anti-development' discourses (Barnett and Scott, 2007; Scott and Oelofse, 2009).

• Lack of information about climate change

One of the biggest challenges to stimulating low carbon behaviour is the lack of information, or recipients not being able to understand the information provided. Information needs to be relevant to the citizens' life worlds and at a level and language that is understood (Van den Bergh and Steinemann, 2007).

• Cost of transport infrastructure

Transport is one of the highest emitters of GHGs and the use of public transport is generally recommended as a means to lower emissions of GHGs. However, the enormous cost of the infrastructure is a barrier to providing public transport in many cities in the developing world. Exhorting people to use public transport when there is no safe and efficient transport infrastructure in place is not a feasible option.

• Lack of financial resources

Poverty may preclude individuals and families from adopting some aspects of a low carbon lifestyle, e.g. they may be unable to afford the purchase of energy efficient appliances and energy systems. Gibson *et al.* (2009) have noted that the best way to reduce carbon consumption is to be poor. One of the top priorities of the South African government is the reduction of poverty levels. In this respect, the need to achieve this goal, while simultaneously addressing the need for a low carbon future, must be borne in mind.

• Implementation deficit

The large-scale legislative, policy and institutional reforms that have taken place in South Africa since 1994 have led to what can be termed an institutional vacuum or an implementation deficit (Hajer, 2005; Oelofse *et al.*, 2009). The lack of skilled people to fill positions in government at all levels, and the lack of capacity of many officials, acts as a barrier to the establishment of appropriate government institutions and aware-

ness-raising programmes for carbon reduction by individuals (Scott and Oelofse, 2009).

- **Inadequacy of the behavioural approach**

Carbon reduction awareness-raising programmes based on the 'information deficit model' lead to the adoption of a behavioural approach, which assumes that upon receipt of information, an individual will act to reduce carbon emissions. This simple model is inadequate for addressing awareness-raising in a multi-cultural society where the majority of the population has low levels of education and high levels of poverty.

- **Confusing information sources**

The vast amount of information about carbon reduction practices that is available through the Internet from sources ranging from government to bloggers causes confusion as it often offers conflicting advice. In the absence of an official Internet site, users have little experience of how to judge which sources are reliable and provide authentic and relevant advice.

- **Awareness-raising is aimed at the individual**

The individual is assumed to live in a household and awareness-raising is mainly aimed at the individual in the domestic context. There is little reference to awareness-raising for collective carbon reduction practices. An exception to this is the 'Imagine Durban' outreach programme for the greening of schools. This programme has revealed how schools can become centres of sustainability, impacting on children, their families and the communities in which they live (Oelofse *et al.*, 2009).

- **Managerial, technicist approach to carbon reduction**

The dominant approach to reducing carbon consumption is embedded in the neoliberal framework where there exists a managerial, technicist approach to environmental issues and carbon reduction (Randalls, 2010). This approach assumes that carbon reduction can be managed through technical innovations, with little focus on values and the 'ethics of care' or on appropriate locally-derived solutions that are not driven by science or technology.

- **Absence of a low carbon citizenship social norm**

There are no prevailing social norms in South Africa that encourage low carbon citizenship. The current social norm regarding pro-environmental behaviour is that it is elitist and anti-development. A great deal of work needs to be undertaken to shift this norm through the provision of information regarding the urgency of taking climate change into account in development decisions.

- **Polarisation of environment and development**

Economic growth and the creation of jobs are top priorities of government. These imperatives are at this point viewed as far more important than long-term climate protection. In a developing country context, environment and development need to be integrated into a knowledge system in order to prevent these spheres from becoming polarised agendas in the political realm (Scott and Oelofse, 2009).

- **Differential energy pricing that favours large consumers**

In the current political economy context, there has been intense criticism of the energy pricing structure adopted by Eskom, in which the largest industries and consumers pay the lowest prices. In this context, it is difficult to persuade individual consumers to reduce their energy consumption in an effort to reduce carbon emissions.

- **The dominance of scientific knowledge in climate change information**

It is important to recognise that there is a plurality of knowledges around the issue of climate change, including local and indigenous knowledges, which challenge scientific knowledge. Wynne (1992) notes the mistrust of science by the public and that the public's uptake of knowledge from science depends on the trust and credibility that the public ascribes to government institutions which are disseminating the scientific information.

Wynne (1996) proposes that a new form of public knowledge must be sought which is more legitimate and less alienating, and which includes the substantive knowledge of science and the cultural knowledge of values. This analysis is par-

ticularly relevant in developing countries where substantial bodies of indigenous knowledge and value systems exist which inform individual practices in relation to the environment.

Magistro and Roncoli (2001: 93), in their paper on anthropological perspectives on climate change, emphasise “the importance of cultural meanings, collective myths, and social memory in shaping public and private responses” to climate change. They assert that cultural perspectives shape how ordinary citizens receive new information about climate change and also how they trust the information and the experts producing the information (Magistro and Roncoli, 2001). They propose that objective scientific accounts of climate change need to be complemented with interpretive frames of knowledge which include local knowledge and indigenous knowledge.

- **High crime rates**

High crime rates in Durban, and other cities in South Africa, hamper the advocacy of walking and cycling options, as part of a shift to low carbon behaviour.

- **Neoliberal individualisation**

Cultural shifts in the neoliberal landscape have been towards more ‘individualisation’, meaning, amongst other things, fewer persons per household, more private ownership and use of cars, more extended mobility patterns and higher expectations concerning fulfillment of individual lifestyle aspirations, all of which have frequently involved greater overall energy consumption. The resulting increased affluence and consumption have nullified the effect of efficiency improvements.

ACHIEVEMENT OF LOW CARBON CITIZENSHIP: BEST PRACTICE IN A DEVELOPING CITY CONTEXT

Some best practice suggestions are given below.

CARBON REDUCTION AWARENESS-RAISING PROGRAMMES

Although it was acknowledged in the earlier critique of the behavioural approach that individuals will not necessarily take up the advice offered

by awareness-raising programmes, the content of the messages that go out to form a knowledge base for low carbon citizenship needs to be carefully crafted and appropriately framed. In a society where the majority of the population has a relatively low level of education and poor access to the media, city-wide carbon reduction awareness-raising programmes and projects should be initiated in neighbourhoods and schools. By focusing on schools it is possible to build new social norms regarding low carbon consumption from the ‘bottom-up’ through school programmes. The programmes should incorporate the following principles:

- **Integration of technical and values approaches**

Low carbon awareness-raising should be developed through the integration of technicist approaches and a values approach which focuses on the ‘ethics of care’. It is acknowledged that the mainstream approach is technicist, however, Clark and Stevenson (2003, in Randalls 2010) propose that in addition, there should be the development of an ‘ethic of care’.

- **Tailoring the messages to appeal to different sections of society**

Relevant and appropriate classifications of sectors of society could be developed for awareness-raising in the context of South Africa as a developing country.

- **Integration of green and brown issues**

Awareness-raising programmes for low carbon behaviour should be designed to integrate the green issues (climate change) with the brown issues (development) in a developing country context. Skea and Nishioka (2008) contend that linking low carbon behaviour into a sustainable development framework is more appropriate in this context because of the importance of development priorities for human well-being. The ‘Imagine Durban’ Schools programme is an example of best practice as brown and green aspects of climate change are integrated in practical applications (Imagine Durban, 2010).

ENABLING ROLE OF GOVERNMENT

There needs to be a united campaign by national, provincial and local government to

create a consistent body of information and branding so that all messages that go out to the public are related and co-ordinated. This campaign needs to be conceptualised as a long-term campaign. This serves to build trust. The public's trust in the institutions developing and providing information is strongly linked to the extent to which they will take action to reduce carbon consumption.

GREEN CITIES

In the developed world there are many examples of cities that have opted to become model green cities and as part of their climate change programmes, have introduced best practice awareness-raising programmes and techniques, in which citizens are encouraged to participate. Examples include Freiburg in Europe and Portland in the US. Freiburg has established ecological living in two neighbourhoods and is a leader in Europe in the implementation of solar energy (Beatley, 2000; Purvis, 28/3/2008). The city of Portland in the United States has developed the Portland Carbon Dioxide Reduction Strategy to change the carbon consumption behaviour of residents. Effectively what this programme did was to translate the objectives of the state into individual goals and is an example of a municipal programme in which the local state can exercise power over individuals to self-regulate (Rutland and Aylett, 2008).

In a developing country context, it may be more appropriate for the greening focus to be neighbourhood-based for the reasons outlined previously.

ETHEKWINI'S 'IMAGINE DURBAN' PROJECT

EThekwini's 'Imagine Durban' Project (Imagine Durban, 2010), is an example of a best practice municipal project. It has produced a Long-term Plan (Imagine Durban, 2010) targeted at individuals, civil society, business and government and incorporates a number of elements that meet the criteria for best practice.

It has been successful in enrolling citizens into innovative projects (e.g. City Veggie Gardening). The Green Roofs Pilot Project undertaken by the Environmental Planning and Climate Protection

Department (eThekwini Municipality, 2010b) is an example of an initiative by local government that stimulates interest.

It is noted that the majority of the goals stipulated in the plan are highly relevant to encouraging low carbon citizenship.

Similarly, there are recommended actions for individuals and civil society for transport, food, waste, safety and other issues related to climate change. Awareness-raising programmes should build onto these action plans and use them as a basis for developing further specific programmes.

The 'Imagine Durban' Long-term Plan also provides guidelines for civil society organisations, i.e. collective groups that wish to take action. Bearing in mind that much of the literature criticises the individual approach of many awareness-raising programmes (Oelofse *et al.*, 2009) the guidelines provided can form the basis of specific programmes that should be developed for collectives that wish to advance environmental goals, including carbon reduction. Existing social movements and civil society organisations should be targeted with the goal of adding the reduction of carbon consumption to their development mandates (Scott and Barnett, 2009).

CONCLUSIONS AND RECOMMENDATIONS

Low carbon citizenship cannot be achieved through individual action only. Government must play an enabling role to incentivise and facilitate individuals making low carbon choices in their consumption, travel and lifestyle behaviour.

The city of Durban has a strong record of promoting environmental, and more specifically climate change, matters. Since the early 1990s, when city officials responded to the call for sustainable development (Hindson *et al.*, 1996), and over the ensuing almost twenty years, sustainable development has been integrated into the city's development agenda through its IDP, as well through a wide range of environmental policies and programmes (e.g. Roberts and Diederichs, 2002). Other relevant work includes activities to build resilience and adaptation

policies for the city (Roberts, 2008; 2010b) and the formulation of the Municipal Climate Protection Plan (Roberts, 2008). A set of guidelines for citizens to reduce their carbon consumption has also been developed (eThekweni Municipality, 2007). Furthermore, the recent 'Imagine Durban' Project includes many elements of best practice low carbon citizenry.

There is also evidence that this record goes beyond the creation of policies. The creation of the new Energy Office in the eThekweni Municipality is confirmation of this commitment. Thus, stimulating and promoting of carbon control by government is now part of government's mainstream approach to manage the environment.

Part of this management is to enroll citizens to carry out the government's mandate to control carbon.

Governments will have to develop policies and programmes for changing the current patterns of consumption and behaviour among citizens. This will need both encouragement and compulsion. Encouragement will involve imbuing citizens with a set of moral values such that they will carry out government policies. The concept of governmentality is a useful framework for understanding how the state-society relationship with regard to inducing low carbon behaviour operates.

Key Lessons:

Recommendations for achieving low carbon citizenship are as follows:

1. Carbon reduction awareness-raising programmes should have the following characteristics:
 - They should integrate a technicist approach (i.e. one that is managed through technical solutions) with a values approach that focuses on the ethics of care.
 - They should link green (climate change) and brown (development) issues, which is particularly important in a developing country context.
 - They should target groups or collectives (e.g. neighbourhoods or schools) rather than individuals.
 - They should be tailored to appeal to different sectors of society.
2. There must be a long-term, united campaign across all spheres of government that creates a consistent body of knowledge and branding so that all messages to the public are related and co-ordinated. The framing of the education programme is particularly important and in this respect the 'smart living' concept is particularly suitable.
3. The 'Imagine Durban' Project identifies a number of action plans which provide a useful basis for developing further specific carbon reduction programmes. The advantage of this approach is that the plan already has some traction and imbues many of the elements of low carbon citizenship.



A **green economy** provides a macro-framework for the transition to a **low carbon** city





green economy for ethekwini municipality

WORLDWIDE GROWTH OF THE GREEN ECONOMY

Local economic development is increasingly vulnerable to global and regional scale changes in the economy, climate and the natural support systems that ensure growth. The changes that have occurred in the global economic order over the past two decades have involved a shift, towards greater short-term unpredictability and non-linearity (Lubchenco, 1998; Malhotra, 1999; Folke *et al.*, 2002; Folke *et al.*, 2005). In addition, there is the problem of resource scarcity, which pushes up the prices of energy, water and food (Krugman, 2010).

In many developed and developing countries, growth has been constrained by such price rises in energy and water, and household budgets of the poor have been severely impacted. Especially since the global financial crisis of 2008, a global movement towards green technological and economic change has emerged. This is evidenced by the high percentage spend of economic recovery packages in the United States, China, South Korea and the European Union on green technologies (Swilling, 2010). Green economic development is finding acceptance in developed and developing countries alike.

While African governments have been generally slow to respond to this global trend, there is increasing evidence in public statements by the South African president and other ministers that the concept of a green economy is becoming a central part of policy discourse in South Africa (Zuma, 2011³⁰; Pandor, 2010³¹; Patel, 2010³² and Sonjica, 2010³³). The concept has not yet taken root in the eThekweni Municipality, although it is

strongly recommended in the city's Industrial Strategy (Urban-Econ, 2010). The city with its high unemployment rates and large numbers of people living in extreme poverty, is vulnerable to changes in the global economy and environmental support systems, and has much to gain from following a path of green economic development.

According to a recent report by the United Nations Environment Programme (UNEP) (UNEP, 2011), the time to transition to a green economy is now. General arguments in support of a green economy, and particular benefits for eThekweni Municipality are presented in the following section.

THE CASE FOR A GREEN ECONOMY

A green economy is low carbon, resource efficient and socially inclusive. According to UNEP (2011:1), a green economy is one that:

"results in improved human well-being and social equity, while significantly reducing environmental risks and ecology scarcities".

A working definition for a green economy as conceptualised in this report is as follows:

A green economy is one that is decoupled from resource exploitation and environmental impacts, while still ensuring socio-economic growth and quality of life for present and future generations. It is also one in which significant behavioural change has occurred towards lower ecological footprint lifestyles, state-led development and business practices, ensuring at the

³⁰ President Jacob Zuma's State of the Nation Address 2011 - <http://www.peherald.com/news/article/706>

³¹ SA moves for slice of green economy http://www.sagoodnews.co.za/economy/sa_moves_for_slice_of_green_economy.html

³² Address by the Minister of Economic Development, at the Green Economy Summit, Johannesburg; <http://www.polity.org.za/article/sa-patel-address-by-the-minister-of-economic-development-at-the-green-economy-summit-johannesburg-20052010-2010-05-20>

³³ Zuma backs green economy - <http://allafrica.com/stories/201005190111.html>

ultimate level a sustainable social-ecological system.

The notion of a green economy as outlined above dispels the myth that there has to be a trade-off between economic growth and environmental sustainability. Economic growth and environmental sustainability can co-exist and indeed, economic growth can be enhanced by transitioning to a green economy. Second, it dispels the myth that it is a luxury that only developed economies can afford. On the contrary, "It [green economy] is the new engine of growth and the eliminator of poverty" (UNEP, 2011: 2). In a green economy, growth is driven by a reduction in GHGs and pollution, enhanced energy and resource efficiency and the prevention of the loss of biodiversity and ecosystem services (UNEP, 2011). Further the green economy is viewed as a means to achieve sustainable development.

Green economic development is founded on two core concepts, viz. economic decoupling and behavioural change (Stern, 2000). Economic decoupling argues for economic growth that is relatively or strongly decoupled from environmental impacts and resource exploitation (Fischer-Kowalski and Swilling, 2010). Behavioural change requires both normative changes (in terms of values, beliefs and norms that underlie behaviours – Stern, 2000), and leapfrogging the infrastructure and technologies (Muller, 2007) that underlie day-to-day behaviours of the public, businesses and the state (e.g. in respect of transportation, energy-use, water use, etc.).

In the case of eThekweni Municipality, the green economy or green economic development presents a significant and sizeable opportunity to:

- Shift the current growth path away from one that depends on cheap water and electricity. A growth path that depends on cheap energy and water will be critically challenged in the future, as price rises in both water (Muller, 2007) and energy (Tyler and Winkler, 2009) are projected to rise above 40% in the medium term.
- Address the inequalities of development in the municipality, where the lack of employment is located mainly in the skilled and

semi-skilled levels of the economy. The new national political leadership that took office in May 2009, has stressed, even before the New Growth Path (EDD, 2010) was released, that the new economic growth plan will be focused on creating jobs, thus acknowledging the severity of the crisis of unemployment in South Africa (Paton, October 2010).

Despite the recent rhetoric from national government ministers about the green economy as noted above, the growth of the South African economy is still resource and energy intensive.

The barriers and constraints to implementing green economic development strategies in South Africa, and also in the eThekweni Municipality are:

- The growth of the South African economy is resource and energy intensive (Burns and Weaver, 2008; Swilling, 2010; Mahomed, 1997; Fine and Rustomjee, 1996). Fine and Rustomjee (1996) make the argument that growth in the South African economy has been dictated effectively by the power base held by the minerals-energy-complex that financed the type of growth that the manufacturing sector has undergone since the 1980s (i.e. by the large mining finance houses). Swilling (2010) critiques the national economic policy for economic growth on the basis that it "... effectively disconnects South Africa from the \$100 to \$200 billion worth of investments in low carbon development and contradicted South Africa's negotiating position at the Copenhagen Climate Change Conference in December 2009."
- Strategy-making and the coordination of implementation level programmes that are geared towards green sector development are fragmented as a result of state and business sector institutions operating within sector-specific silos.
- There is a shortage of the skills that are required for introducing green economic development strategies and technologies, both within institutions and amongst the employment pool available in eThekweni Municipality, and South Africa more generally. In order to realise the transition to a green economy, a variety of new skills is required

at different levels of implementation. These include:

- Governance and institutional skills for effective implementation of greening strategies.
- Technical skills for the implementation of green technologies. In some quarters, these new low carbon skills are termed 'green collar jobs', which are essentially blue collar jobs or manual labour jobs in green businesses (Pinderhughes, 2007). Examples of 'green collar jobs' are waste recycling, SWH installation, bicycle hire and repair. The advantage of this category of jobs is that they require low levels of skills and on-the-job training can be provided (Local Government Association, 2009).

While the obstacles to embarking upon a green economic trajectory are significant, there are also key opportunities that exist. These are as follows:

- The New Growth Path (EDD, 2010) for South Africa emphasises the need to create employment in the South African economy, especially at the skilled and semi-skilled levels, and to adopt renewable and green technologies in moving towards more sustainable economic growth in the medium and long term.
- Significant opportunities exist for state-led intervention in partnership with the business and commercial sectors for leap frogging key infrastructure in respect of waste, energy, water and transport, some of which are already incentivised (e.g. Eskom's support of renewable energies).

- Green sector development is widely thought to create significantly more job opportunities and opportunities for stimulated small and medium-scale business and industry than non-green development. The recent report by UNEP (UNEP, 2011) paints a slightly more conservative picture, stating that the green economy will create at least as many jobs as the business-as-usual scenario and notes that there will be a shift in the nature of employment. It is acknowledged in the report, however, that there is considerable potential for creating employment in the transport sector by shifting to public transport, in the waste sector and in the renewable energy sector. A full investigation will need to be undertaken to quantify this anticipated benefit of green economic development in eThekweni Municipality.
- Stimulating the 'green collar job' sector brings social as well as environmental benefits as the target market is the poorer sectors of society, or the unemployed and the unskilled and/or semi-skilled workforce.
- At an international level, the growth rates of markets in low carbon goods and services are far exceeding growth in other sectors and offer a path out of the recession (Local Government Association, 2009).
- Again at an international level, consumers are engaging in green purchasing and there is also evidence that positive political action on climate change is informing voting behaviour (Local Government Association, 2009).
- Cities that engage with a low carbon economy early could develop a competitive advantage and enhance their reputation.

Key Messages:

- The green economy is low carbon, resource efficient and socially inclusive.
- Green economic development is founded on two core concepts:
 - Economic decoupling, in which economic growth is decoupled from environmental impacts and resource exploitation.
 - Behavioural change, which requires changes in values and beliefs, as well as changes that require leap frogging infrastructure and technologies.
- National government has committed to green economic development in a number of policy statements.
- Green economic development has the potential to create more job opportunities, particularly in skilled and semi-skilled levels, as well as more small and medium-scale business opportunities than non-green development. Further investigation is needed.

TRANSITION TO A GREEN ECONOMY

The nature and pace of transition to a green economy is also important. According to Swilling (2010), there is already evidence of minor decoupling in the South African economy, but speeding up this transition is required in order for a more sustainable future to be realised. However, care must be taken in order for effective and lasting interventions that are well phased and do not create wide-scale disruption to services and to economic growth, to be made. Grand social-engineering projects that are insensitive to the citizenry must be avoided.

A strong argument is made by Smith *et al.* (2010) and Grin *et al.* (2010) for a multi-dimensional strategy that goes beyond one that focuses on price signals in the market as a strategy for bringing about transition to a green economy. They argue against 'greenwash' and 'end of pipe' greening as solutions and favour fundamental change that is aimed at the entire production-consumption chain and the behaviour of consumers.

Green economic development should be a broad, holistic and far-reaching coordination strategy, rather than existing in piecemeal, sector-based programmes. To this end, acknowledging that green sector development requires dedicated institutional and governance arrangements in order to be realised successfully, can take eThekweni Municipality a long way towards more successful, co-ordinated action, some of which has already been established.

The report by UNEP (UNEP, 2011) identifies key drivers for successful transition to a green economy. Although they were identified at a global level, some are applicable at a local level. They are as follows:

- **Establish sound regulatory frameworks**

The city can regulate through by-laws which can be used to prohibit certain activities, establish minimum standards for activities and remove unsustainable behaviour. Self-regulation in certain sectors (e.g. industry) and public-private partnerships can be valuable complements to regulation.

- **Prioritise investment and spending in areas that stimulate greening of economic sectors**

Government spend represents a fairly large fraction of GDP. In South Africa as a whole, this figure is 35% for the financial year 2009/10 (Verwey *et al.*, 2009) and in eThekweni Municipality, local government spend is 3.8% of the city's GDP in 2009 (IHS Global Insight, 2010). The introduction of sustainable public procurement policies can stimulate demand for green goods and services and provides a good example for the private sector to follow.

- **Invest in capacity building and training**

Local government needs the capacity to implement and administer activities required to transition to a green economy.

OPPORTUNITIES FOR TRANSITIONING TO A GREEN ECONOMY

Chapter 2 identified relevant trends and challenges in key social, economic and ecological sectors and gave an overview of local government responses, which includes a variety of projects and programmes. From this baseline, key mitigation opportunities for transitioning to a low carbon city (Chapter 5), opportunities for increasing the city's resilience (Chapter 6) and opportunities for increasing carbon sinks (Chapter 7) were identified.

At the core, however, some themes emerge as key opportunities for transitioning to a green economy (UNEP, 2011).

Many of these themes have existing initiatives that are making a valuable contribution, however, they constitute a relatively piecemeal, fragmented response to climate change. There is a need for stronger, more coordinated policy and action between institutions and arms of government in order to bring about more profound and fundamental change in the economic basis and behavioural landscape of eThekweni Municipality. The concept of a green economy provides this overarching framework.

In order to realise a transition across a broad front, attention is required on the following themes (UNEP, 2011):

- **Invest in natural capital**

A green economy places value in natural capital and invests in it. Environmental goods and services in eThekweni Municipality have been valued at R 3.1 billion (Roberts, 2003) creating a foundation for bringing environmental accounting more explicitly into economic strategy-making and planning (Sinner and Scherzer, 2007). Conservation-oriented programmes such as Working for Water and Working for Wetlands, alien clearance programmes and other conservation programmes that have already enjoyed widespread success in South Africa should be promoted, as they provide green jobs and ensure that ecosystem services and aesthetics are protected for other sectors such as agriculture and tourism. International negotiations around a REDD (Reducing Emissions from Deforestation and Degradation) scheme may present an opportunity to invest in afforestation schemes.

- **Invest in urban agriculture**

On a large scale, greening of the agricultural sector requires efficient use of water, the use of organic or natural nutrients, etc. In an urban context, there should be an overriding focus which is to promote investment in urban agriculture by putting in place mechanisms to support investment. Local food production mitigates GHG emissions by minimising distances over which food is transported and improves household resilience to external shocks in water and energy prices that impact upon food prices. Such activities constitute an important area of focus for climate change programmes.

According to the Economic Development Strategy for the municipality (Economic Development Unit, 2008), the municipality is 36% rural, 29% peri-urban and 35% urban. The large rural base and suitable climate of eThekweni Municipality presents an opportunity to invest in urban agriculture and contribute towards alleviating poverty. Market gardening should be particularly encouraged.

- **Green the water sector**

One of the biggest opportunities to speed up the transition to a green economy is to invest

in provision of clean water and sanitation to the poor. Simultaneously, efforts to reduce consumer demand and improve efficiency of use are pertinent, and to a large extent are underway in eThekweni Municipality.

- **Green the energy sector**

Greening requires a greater reliance on renewable energy as a substitute for fossil fuels and the promotion of energy efficiency. Initiatives in and opportunities for eThekweni Municipality were presented in Chapters 2 and 5 respectively. Improving access to clean energy for the poor is also a key factor in the transition to a green economy and, in addition, realises substantial health co-benefits.

- **Green the tourism sector**

Growth in tourism leads to an increased use of water and energy and increased generation of wastewater, all of which result in an increase in GHG emissions; potential damage to local biodiversity is also relevant. Not only should the whole sector be greened (reduced consumption of water and energy; local hiring and sourcing, etc.) but ecotourism should be encouraged. Targeting the tourism sector for greening will require partnerships and participatory processes to be set up between state, business and civil society sectors. The tourism industry is human-resource intensive with the potential for job creation.

- **Green the waste sector**

The waste sector presents considerable opportunities for greening. There is large potential for the creation of employment in eThekweni Municipality at the lower end of the skills spectrum but in order to satisfy the criteria for a green economy, the jobs created must ensure safe working conditions, especially for recyclers. There tends to be a global problem with the employment standards in this sector. There are many waste sector initiatives underway in eThekweni Municipality (see Chapter 2), with further opportunities identified in Chapter 5. The key imperative is to decouple waste from economic growth and higher living standards. This requires an emphasis on resource efficiency and resource recovery. Green transitioning in this sector requires critical infrastructure to be in place, as

well as large-scale behavioural change. For example, in a drive towards 100% recycling, the municipality should make provision for infrastructure that will allow for separation of waste at source at both household level and in the commercial and industrial sectors.

- **Green the industrial sector**

The industrial sector is the largest producer of GHGs in eThekweni Municipality and opportunities for mitigating GHGs were identified in Chapter 5. This sector also tends to use considerable amounts of water. Greening of the sector can involve a number of interventions, starting with improving energy and water efficiency. In the case of manufacturing industries, greening involves extending the life of manufactured goods by placing a greater emphasis on the design (to make products easier to repair and/or recycle), re-manufacture (to save energy) and recycling (to save energy) of products. Other options are to promote eco-industrial parks, characterised by industrial symbiosis, in which industries are connected through exchanges of waste and energy (Gibbs and Deutz, 2007). For example, the recycling of waste heat from manufacturing processes (e.g. from coke ovens, blast furnaces, electric furnaces and cement kilns) to generate electricity using combined heat and power (CHP) systems. The latest trend is to develop industrial symbiosis projects rather than full-scale eco-industrial parks (Gibbs and Deutz, 2007) and certainly, it is worth exploring opportunities for industrial symbiosis. The classic example is at Kalundborg in Denmark where there is a Centre for Symbiosis to provide advice³⁴. Another source of advice would be the UK's National Industrial Symbiosis Programme³⁵. Cleaner production, essentially the introduction of clean processes and technologies that reduce demand for water and energy, and in turn reduce GHG emissions, is also something that can be promoted.

- **Green the building sector**

The building sector is central to the greening of a city. The most recent IPCC report (IPCC, 2007) drew attention to the potential for reducing GHGs in this sector. Most of this can be achieved at low cost and by using exist-

ing technologies. New buildings should be constructed using green principles and existing buildings that are energy and resource intensive should be retrofitted. Green building codes are needed to promote greening of the sector. Substantial co-benefits accrue from greening buildings through reduced energy consumption, improved health and reduced risk of exposure to hazardous waste.

- **Green the transport sector**

The heavy reliance of the transportation sector in Durban on the private motor vehicle has high environmental and social costs, specifically air pollution, traffic congestion and risk of accidents. The thrust to green this sector should be on the co-benefits that accrue. The recent UNEP report (UNEP, 2011) identified three principles that must be followed to green the transport sector. They are as follows:

- Reduce or avoid vehicle trips. There are many examples of green transport policies around the world aimed at reducing trips e.g. congestion charges, low emissions zones and car-pooling (see Appendices 4 to 7). Chapter 5 also noted that the reduction in vehicle kilometres travelled had a greater impact on mitigating GHG emissions than changes in fuel. There are also opportunities through land-use planning to integrate residential areas and employment opportunities, with the aim of reducing mobility and avoiding vehicle trips (see Chapter 5).
- Large-scale shift from private to public transport. There are many examples of relatively recently introduced bus rapid transit (BRT) systems in developing country cities (e.g. Bogota and Johannesburg) and under-ground rail systems (e.g. Beijing). Other cities have invested in above-ground tram systems as opposed to expensive under-ground systems (e.g. Zurich). Also included here is a need to change from road to rail for freight transport.
- Improve vehicle and fuel technology. Fuel-switching of municipal fleets and minibus taxis could reduce GHG emissions.

³⁴ www.symbiosis.dk
³⁵ www.nisp.org.uk

- **Target green investment**

This involves setting aside a fixed percentage of GDP on an annual basis and allocating it to green investment in different sectors, for example waste, buildings and natural capital. By way of example, the global modeling exercise undertaken by UNEP (UNEP, 2011) allocated 2% of GDP to greening and showed that the green investment scenario yielded higher annual economic growth rates than the business-as-usual scenario within five to ten years.

- **Promote sustainable human settlements**

The sustainability of human settlements is key to the prosperity of the city and by extension the province and country. Mitigation and adaptation efforts should play a critical role in the planning, construction and management of human settlements. However, cast against the backdrop of poverty and poor education levels, achieving sustainable living conditions is no easy task. The drive towards building sustainable human settlements being championed by national government (e.g. speech by Minister for Human Settlements to the Development Bank of South Africa Knowledge Week, October, 2010)³⁶ presents significant opportunities for green economic development. It requires a mindset shift from one aimed at delivering houses to one of building and actualising sustainable human settlements. Processes and technologies that target waste streams, water and energy demand-side management, local food pro-

duction and conservation programmes and projects (e.g. river and wetland protection and alien clearance programmes) can be introduced under the umbrella of integrated planning programmes that are required for the development of sustainable human settlements. The focus on the introduction of SWHs (a target of 34 000 by 2011 in the case of the Solar Water Heating Program (low cost)) is commendable but as suggested above, the sustainable human settlements theme is far broader and presents a sizeable opportunity to develop sustainable and viable neighbourhoods and communities. Such a strategy will involve coordination between different sectors and institutions of governance, and has the potential to bring about significant impact at ward level. To this end, forming and formalising the partnerships and mechanisms for cooperation that is required amongst institutions of governance is the highest requirement.

- **Promote green procurement**

Local governments can play a role in facilitating the development of markets for green products and services and lead by example. Some training may be needed for procurement professionals in the municipality but there are opportunities to learn from other cities through the ICLEI Local Governments for Sustainability programmes and projects on sustainable procurement, as well as other sources (DIUS/OGC, 2009).

Key Messages:

- There are many existing initiatives in the city of Durban that are making a valuable contribution. However, they constitute a relatively piecemeal, fragmented response to climate change. There is a need for stronger, more co-ordinated policy and action between various departments to bring about more profound and fundamental change in the economic basis and behavioural landscape of eThekweni Municipality. The concept of a green economy provides this overarching framework.
- Attention is required on the following themes:
 - Invest in natural capital and urban agriculture.
 - Green the waste, water, energy, transport, tourism, industrial and building sectors.
 - Target green investment.
 - Promote sustainable human settlements.

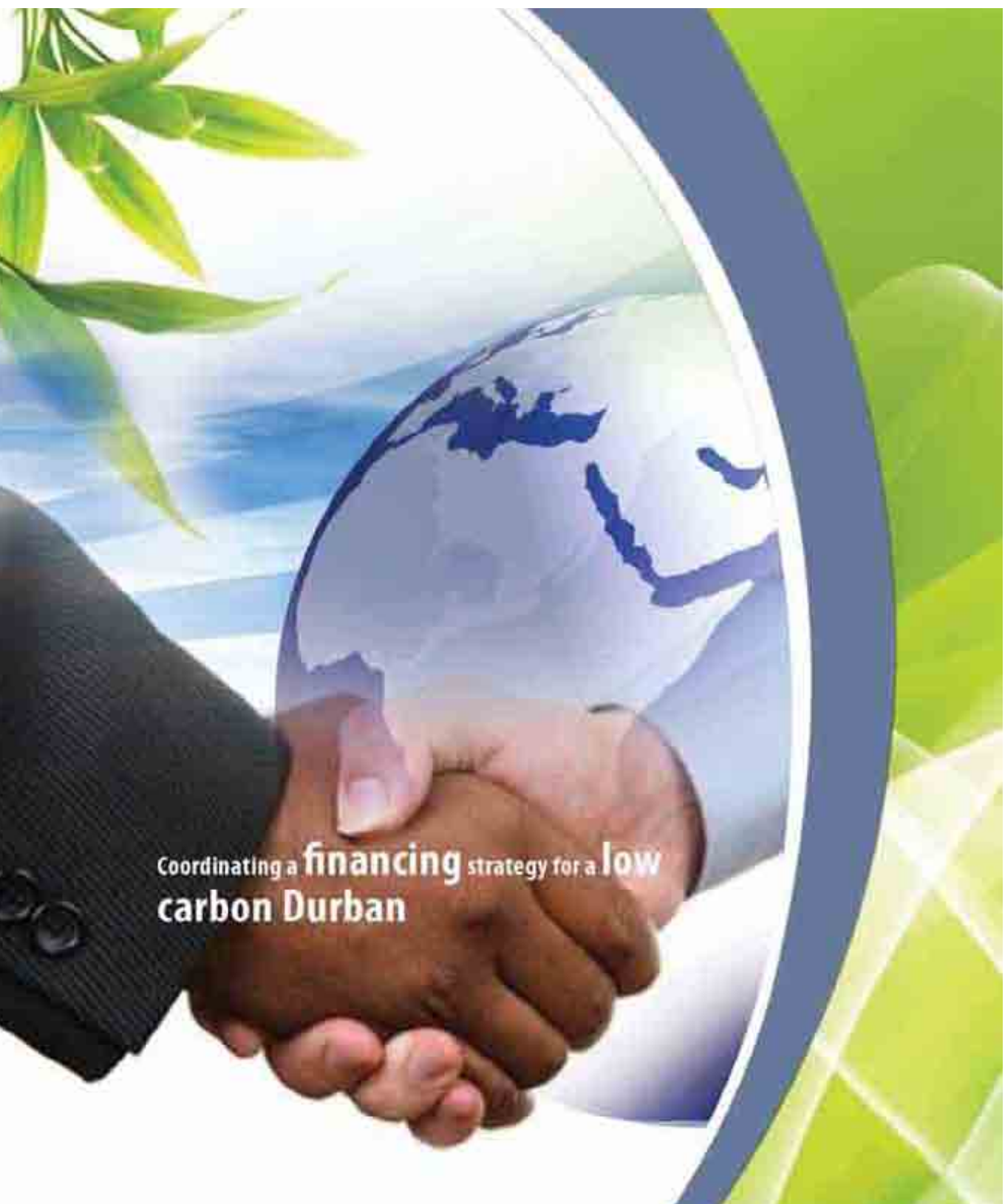
³⁶ <http://www.polity.org.za/article/sa-sexwale-speech-by-the-minister-of-human-settlements-at-the-development-bank-of-south-africa-and-department-of-human-settlements-knowledge-week-johannesburg-20102010-2010-10-20>

CONCLUDING REMARKS

There are compelling reasons for eThekweni Municipality to embark upon a trajectory of green economic development that brings about system-wide sustainability benefits and employment opportunities. There are key requirements for negotiating the transition to a green economy that are not currently present within the municipality and which will require state interven-

tion to develop. These include, *inter alia*:

- Skills transfer and development programmes.
- Investment incentives and development programmes.
- Research and innovation programmes that can be developed and catalysed through, for example, innovation centres or hubs that support and promote the development of sector specific or multi-sector initiatives.
- Participatory governance.



Coordinating a **financing** strategy for a **low carbon Durban**



financing opportunities for a low carbon city

INTRODUCTION

The first step in addressing cost-effective and efficient financial mechanisms to support low carbon initiatives in eThekweni Municipality is to fully understand the drivers of the city's carbon emissions. An accurate and up-to-date GHG emissions inventory yields information on the highest-emitting activities and hence, in which sectors of the economy to focus policies and strategies. The city has compiled a number of GHG emissions inventories, with the most recent having been undertaken in 2007 (see Chapter 5). Setting goals is important to meeting carbon reduction targets, and in this respect, the Energy Strategy (Mercer, 2008) has identified CO₂ reduction targets by 2020 for various sectors (see Chapter 2) and the Imagine Durban project (Imagine Durban, 2009) has established a long-term vision for the municipality. EThekweni Municipality is thus well positioned to take advantage of opportunities that exist for financing low carbon initiatives.

OPPORTUNITIES FOR FINANCING LOW CARBON INITIATIVES

CLEAN DEVELOPMENT MECHANISM

The Clean Development Mechanism (CDM) provides an opportunity for projects in South Africa that lower GHG emissions to access financing from industrialised nations which have binding emission reduction requirements under the Kyoto Protocol in return for verified Certified Emission Reductions (CERs). Hence, eThekweni Municipality is able to access additional financing to support carbon mitigation projects and sustainable development objectives.

It is important to understand fully the steps required to access this international incentive mechanism. The purchase of CERs is often done at issuance of credits, usually many years after the project was initiated. The financing of CDM is further complicated because it is extremely expensive to get a project registered by the CDM Executive Board. The process is lengthy and complex, requiring many steps. It requires specialised consultants to assess the feasibility of a project and to develop a Project Design Document (PDD). Thereafter, the project must be independently validated at the outset and subsequently verified which can cost approximately \$US 20 000 to \$60 000, depending on project type and location. The CDM also has stringent eligibility requirements, and may exclude project types that could be beneficial to South Africa. Finally, the complex process causes significant confusion which results in a lack of understanding of the CDM potential by those who can benefit most from it, viz. the project owners.

The CDM was established with the dual objective of helping developing countries achieve sustainable development while lowering their 'business as usual' emissions, and assisting industrialised countries to meet emission reduction commitments. Under the CDM, projects that reduce GHG emissions and contribute to sustainable development, as defined by each participating country, can generate CERs, which is a tradable commodity in the international carbon market.

When discussing the market potential of CDM for developing countries, it is important to recognise that a significant percentage of the overall carbon market value often referenced is

allowance and secondary market transactions within industrialised countries, while only a small percentage of the overall carbon market is invested in developing countries through project-based offsets. The total value of the 2009 carbon market increased 6% over 2008 to US\$144 billion, while the primary CDM market contracted by 59% to US\$2.7 billion over 2008, representing only 1.9% of the overall 2009 carbon market value (World Bank, 2010c).

The 2009 decline in primary CDM was due to numerous issues including, amongst others, a 32% year over year decline in average CER price to US\$16.6, a substantial decrease in origination activity and a CER issuance decline of 10% (World Bank, 2010c).

In terms of CDM engagement and beneficiaries, China, India and Brazil have captured the majority of the market in terms of projects in the CDM pipeline (China 40.1%, India 25.6%, Brazil 6.5%) and the volume of 2012 CERs anticipated from the first commitment (China 53.7%, India 16.9%, Brazil 5.9%) (UNEP Risoe, 2010). By comparison, Africa has been slow to reap the benefits of the CDM, with only 2.6% of the CDM pipeline and 3.5% of the 2012 CERs (UNEP Risoe, 2010). This is often attributed to factors such as lack of capacity to develop projects, limited number of attractive large-scale projects and a poor investment climate. Despite the limited number of projects to date, demand for African CERs is high, prompting many European utilities and buyers to pay more compared to units sourced from other regions (Sethuraman, 2010).

Key Lessons:

- The total value of the carbon market in 2009 was US\$144 billion.
- The Clean Development Mechanism market contracted by 59% between 2008 and 2009, and represented less than 2% of the 2009 carbon market.
- Africa has been very slow to reap the benefits of the Clean Development Mechanism.
- South Africa has 35 of 141 African Clean Development Mechanism pipeline projects but compares poorly with China, India and Brazil.

South African Experience with CDM

As a non-Annex I party to the UNFCCC, South Africa ratified the Kyoto Protocol in 2002 and in 2004, established the Designated National Authority (DNA) within the Department of Energy to oversee the CDM process. The main task of the DNA³⁷ has been to assess potential CDM projects, to determine whether they contribute towards South Africa's sustainable development goals and to issue approval of projects, where applicable. The DNA is also mandated to promote the establishment of CDM projects in South Africa in cooperation with other government agencies, such as the Department of Environmental Affairs.

South Africa is the leading African country with regard to the number of CDM projects, hosting 35 of the 141 African CDM pipeline projects (UNEP Risoe, 2010). However, when viewed in the global context, South Africa hosts only 0.65%

of the overall CDM pipeline projects, and features poorly when compared to other emergent economies, such as China, India and Brazil.

As of January 2011, 192 CDM projects had been submitted to the South African DNA, consisting of 137 Project Idea Notes (PIN) and 35 PDDs (RSA DNA, 2011). Of the 18 registered projects, two are landfill gas to electricity projects in Durban (UN Risoe, 2010). The trend of project submission to the DNA has remained steady over the past 3 years, with 39 submitted in 2008, 37 in 2009 (UN Risoe, 2010) and 62 in 2010 (RSA DNA, 2011). The number of projects by type is listed in Table 11.1, indicating a high percentage of renewable energy, energy efficiency, cogeneration, fuel switch, waste management and methane recovery and flaring projects.

Even though there are few registered projects in South Africa, a solid base exists for future CDM

³⁷ Republic of South Africa Designated National Authority. Guidance for Applicants of CDM in South Africa. http://www.energy.gov.za/files/esources/kyoto/DNA_Guide_line%20doc_1.pdf

Table 11.1: South African project type statistics (RSA DNA, 2011)

Project Type	Number of Projects	Percentage of Total (%)
Renewable Energy	62	32.3
Energy Efficiency	29	15.1
Fuel Switch	23	12.0
Cogeneration	22	11.5
Waste Management	20	10.5
Methane Recovery and Flaring	14	7.3
Biofuel Production	5	2.6
Industrial Process	6	3.1
Nitrous Oxide	4	2.1
Biomass	4	2.1
Transport	3	1.6

growth. The South African DNA is well organised and highly regarded, both domestically and internationally. The South African DNA has been effective in administering the limited CDM pipeline. In addition, the South African economy is based on electricity produced with an extremely high average Grid Emissions Factor (GEF) of an estimated 1.0481 (IGES, 2010). This creates an opportunity for renewable energy projects connecting to the national grid to produce more CERs per kWh generated than any other CDM eligible location in the world (IGES, 2010). This high dependency on coal-based power generation and an increasing demand for electricity provides an ideal baseline scenario for en-

ergy efficiency and renewable energy projects, creating significant potential for CDM projects to generate significant CDM returns (du Toit, 2009).

There is also a strong base of local project developers with the technical expertise to develop projects in South Africa. While other countries in sub-Saharan Africa have few if any local groups with the expertise to successfully develop a CDM project, South Africa has a core group of CDM service providers, both local consultancies and international organisations with offices in South Africa.

Key Lessons:

- A solid base exists for future Clean Development Mechanism growth in South Africa.
- The Designated National Authority is well organised and highly regarded.
- The city of Durban has experience in Clean Development Mechanism projects.
- South Africa has an extremely high Grid Emissions Factor creating an opportunity for grid-connected renewable energy projects to generate more Certified Emissions Reductions than any other Clean Development Mechanism eligible location in the world.
- Technical expertise exists.

VOLUNTARY CARBON MARKET

In addition to the rise of the regulated CDM market has been the development of a voluntary carbon market, in which Voluntary Emission Reductions (VERs) are traded. This also provides an opportunity for eThekweni Municipality to access finance for carbon reducing or sequestering projects that are either not eligible for or not interested in undergoing the rigour of the CDM process. The voluntary market allows companies and individuals to offset their emissions by purchasing carbon credits outside of the CDM. The primary difference between the two mechanisms is that of their respective governance structures; compliance markets belong to a legally binding framework whereas voluntary markets do not, relying on the influence of supranational and non-state actors to package offsets according to their needs (Bumpus and Liverman, 2008).

While the CDM has established strict standards for the design, monitoring and certification process of its projects, the voluntary market is regarded as less rigorous and allows project types excluded from CDM (i.e. land-based projects such as avoided deforestation, etc.). The voluntary market has also been effective in that it often places emphasis on secondary objectives over and above emissions reductions, such as promoting sustainable development, conserving biodiversity and community development (Hamilton *et al.*, 2010).

Buyers in the voluntary market are drawn from both developed and developing countries and can be organisations, governments, individuals, companies, or other entities such as one-off events. In such cases the motivation to purchase credits is not to ensure compliance with any regulatory obligation, but is usually for personal, or corporate social responsibility reasons, or in anticipation of future compliance. Within the voluntary carbon market there is a growing demand for credits, especially from African projects, that have strong community benefits associated with them, and which can demonstrate significant environmental features. However, the voluntary market is much smaller than the CDM compliance market, but for an emerging

supplier of credits, this is not a significant issue.

The volumes transacted in the voluntary markets approximately doubled from 2007 to 2008, to 126.6 MtCO₂e, then decreased to 93.7 MtCO₂e in 2009 in large part because of the global economic recession (Hamilton *et al.*, 2010). In 2007, the voluntary carbon market was valued at \$335.3 million, increasing to \$728.1 million in 2008, then decreasing by 47% in 2009 to \$387.4 (Hamilton *et al.*, 2009).

The quality of the VERs is an important issue. In response to concerns about the earlier quality of credits being sold, and the lack of independent verification, project developers have now embraced a range of tools and standards to prove the legitimacy of their credits. In addition, other standards have been developed to objectively measure the biodiversity and community co-benefits that are often associated with projects developed for the voluntary market (Chapple, 2008).

INCENTIVES AND SUBSIDY OPPORTUNITIES

Financing incentives often take the form of low-interest loans, subsidies, and rebates/grants. The funding is commonly sourced from the public sector such as national, state or local government budget. Such incentives can promote energy efficiency or conservation efforts that reduce carbon emissions through low interest loans, direct subsidies or rebates. Supported activities include, amongst others, installation of energy or water efficient technologies and/or provision of clean energy.

An example of a government-backed (municipal and state) loan scheme is the City of Melbourne's Sustainable Melbourne Fund (City of Melbourne, 2008b) and an example of a subsidy-based mechanism is the solar feed-in tariff scheme introduced by the state government of Victoria in Australia (Victoria Government, 2009). The City of San Francisco has adopted a solar rebate programme called GoSolar SF that was introduced in 2008³⁸. During its first year of implementation, the number of solar panel installations in San Francisco increased four-fold (Baker, 2009).

³⁸ San Francisco Solar Energy Incentive Programme Information. 2008. GoSolarSF: Bringing Solar Power to San Francisco Residents and Business. <http://www.sfsolarsubsidy.com/wp-content/uploads/2008/06/solar-incentive-description.pdf>

OTHER CARBON FINANCING OPPORTUNITIES

In addition to implementing publicly-funded low-interest loans, subsidies and rebates to drive low carbon initiatives, innovative market-based financing mechanisms can also be explored by eThekweni Municipality to meet its long-term low carbon goals. Opportunities to consider include Energy Service Companies (ESCOs), economies of scale buying and financial sector lending programmes.

Energy Service Companies

An ESCO model is implemented through a long term Energy Performance Contract based on specific terms and conditions. This is established between the customer and the energy efficiency contractor or ESCO. The key feature of this model is that energy efficiency is reasonably assured because payment of services is linked to the level of savings made, the contractor assists financially in the installation of the energy project and plays an operational role in terms of measuring and verifying energy performance. Under this model, the ESCO procures the technology and provides a package of energy services and equipment to end-users. ESCOs pay for the upfront costs and are then paid back by end-users incrementally through arranged payment schemes based on savings.

An excellent example of a successful city-wide ESCO is the Berlin 'Energy Savings Partnership'. Working in partnership with the Berlin Energy Agency, Berlin is using energy performance contracting models with private companies to increase energy efficiency in public buildings. This is enabled through ESCOs that finance and implement energy and cost reduction initiatives. By 2009, 1 300 buildings had been upgraded and carbon emissions had reduced by 600 000 tons (Economist Intelligence Unit, 2009). These savings were achieved through retrofitting in: automatic control engineering systems, heating control systems, lighting systems, and ventilation and air-conditioning systems. The Berlin Energy Agency also supports building owners and the ESCO to develop repayment schemes. On average, the payback period is 8 to 12 years. A key element to successful implementation has been positive interaction between key players and clear understanding of roles, responsibility

and accountability (Clinton Climate Foundation, 2010).

Economies of Scale

This model establishes an organisation responsible for bulk-buying technologies and then provides low-cost products or services to end-users (Stephens, 2010). It is based on the objective of stimulating demand and benefiting from economies of scale. A key example is the Clinton Climate Initiative and C40 Cities Programme, a partnership that brings together some of the world's largest energy service companies, five of the world's largest banks and 40 of the world's biggest cities (including Johannesburg) in a programme to reduce energy consumption and increase energy efficiency in existing buildings (Clinton Climate Initiative, 2010). The programme provides both cities and private buildings with access to financing products and services to help retrofit buildings for energy efficiency.

Financial Sector Lending Programmes

Municipal governments, in collaboration with financial institutions and community organisations have created financing products tailored for clean energy and make energy efficiency improvements investment in homes or businesses. An example is the KfW New Building Modernisation Programme in Germany. The programme finances CO₂ reduction measures and retrofits in buildings on the basis of a model that sets interest rates according to the degree and number of measures taken (Stephens, 2010). A lower interest rate is provided for a higher number of energy efficiency measures. The federal government of Germany initiated the KfW incentive programme to overcome market failures preventing the uptake of energy efficiency in buildings. The KfW is a bank group, 80% owned by the federal government (Korytarova, 2006).

The success of this model is best exemplified by the GESOBAU Märkisches Viertel redevelopment project. The residential area is connected to district heating networks and almost 13 000 flats have undergone energy retrofitting since 2008, at almost no cost for tenants, saving an estimated 20 000 tons of carbon emissions per year (Stephens, 2010).

FUNDING SOURCES

Implementing any incentive or subsidy programme requires finance to do so. Potential opportunities for consideration by eThekweni Municipality include municipal bonds, multilateral funds and private investment capital. The purpose of each investment differs, where some funds are set up to finance a series of initiatives, while others are suited to finance specific projects. Therefore, understanding the structure, investment flows and expected returns of a low carbon initiative are essential to determining where to source the underlying finance, which is in addition to carbon finance accessed from the international markets.

Municipal Bonds

Municipal bonds have also been used because they are a relatively low-cost option and have long-term repayment periods. An example of a successful green bond offering is the Moscone Civic Centre in San Francisco. The city sought a \$US100 million municipal bond to finance the installation of solar photovoltaic systems and energy efficient lighting. Energy savings paid for the loan over a ten-year term (ISCLC, 2009).

Economic and Infrastructure Development Funding Alignment

Aligning economic and infrastructure development funding to low carbon objectives can serve as a source of funding for low carbon initiatives. Significant opportunity exists to develop economic stimulus activities, infrastructure building and energy programmes in line with a lower carbon pathway. This could include cov-

ering transportation capital projects, energy efficiency and renewable energy technologies, state energy programmes and alternative energy grants.

International Funding

In addition to internationally financed carbon markets, financing opportunities are emerging for multi-lateral and bi-lateral funding for developing countries, including South Africa, to address climate change, with specific emphasis on adaptation. The process to access pledged funding and provision of actual pledged amounts is yet to be finalised. However, mechanisms are underway within the World Bank's Global Environmental Fund (GEF), CDM Adaptation Fund (sourced from a 2% tax on issued CDM credits) and the United Nations system to make climate finance available to developing countries.

Private Sector Financing

Investors are willing to fund state and locally-based energy efficiency programmes if there is a satisfactory return on their investment. Evidence that repayments can be made out of the energy savings or production must be possible. An example is the Venture Capital Fund and Seed Capital Fund, administered by Carbon Trust Investment Ltd. These funds invest in the United Kingdom's (UK) clean energy technology industry. The fund will invest in approved proposals from UK companies that are willing to develop alternative energy technologies, including wind power, solar power, tidal power, fuel cells, biofuels, new materials and process improvement.

Key Lessons:

Opportunities for financing low carbon initiatives include:

- clean development mechanism;
- voluntary carbon market;
- incentives and subsidies;
- energy service companies;
- municipal bonds.

KEY RECOMMENDATIONS FOR FINANCE OPPORTUNITIES FOR LOW CARBON INITIATIVES IN ETHEKWINI MUNICIPALITY

Low carbon initiatives in Durban should be aligned closely with the drivers of the city's emissions (i.e. carbon footprint) and developmental priorities. All municipal funding initiatives supporting economic growth or infrastructure development should be examined whenever possible for synergies to push forward the green economy and a low carbon city. In addition, financing can be accessed through the supply of carbon offsets for the international carbon markets. While this is an additional source of funding for low carbon development, in most cases it does not provide sufficient underlying project finance to make a project bankable. Furthermore, cash flows from carbon finance are delayed, which causes a problem for project finance, which is in most cases required up-front. As a result, carbon finance should be included in the long-term financial feasibility of low carbon initiatives by the municipality but caution is advised regarding the difficulties associated with and the true opportunities of the CDM. Carbon financing should be encouraged for its catalytic role in promoting suitable low carbon development.

In addition, opportunities exist to explore other innovative financing instruments and sources of funding. Precedent from cities around the globe demonstrates well-designed and imple-

mented financial incentives, such as low interest loans, subsidies and rebates or grants can generate energy/water savings that reduce GHG emissions.

In addition, private sector or public private partnerships can effectively reduce emissions through ESCOs, partnership of bulk purchase and innovative financial sector programmes. Other opportunities include lobbying for preferential transfers from national government based on 'greening' programmes and exploring local taxation activities that are differentiated by sustainability aspects. While all these opportunities have significant potential, a key constraint regarding access to finance often hinders or limits widespread deployment. To overcome, a long-term perspective is required and all possible funding sources within the public and private sector, and at the local, national and international levels should be explored.

Notwithstanding these cautionary notes, eThekweni Municipality must exploit every opportunity that exists to finance low carbon development initiatives. The Energy Office of eThekweni Municipality should be tasked with coordinating a financing strategy for a low carbon Durban, with the prime objective of identifying innovative financing schemes that derive funds from both public and private sectors, and at local, national and international levels.

Key Recommendation:

- The Energy Office of eThekweni Municipality should be tasked with coordinating a financing strategy for a low carbon Durban, with the prime objective of identifying innovative financing schemes that derive funds from both public and private sectors, and at local, national and international levels.

A large, modern stadium with a translucent, leaf-like roof structure. The stadium is filled with spectators, and the field is visible. The image is framed by a large, stylized green leaf graphic on the right side.

There are **12 core strategic** recommendations,
of which the shift towards a **green economy**
is foremost.



conclusion and recommendations

SUMMARY

The objectives of this study were highlighted in Box 1.1 in Chapter 1. The extent to which these objectives have been addressed in this report and the key findings are summarised as follows:

Objective 1:

- **Review carbon reduction strategies in key cities around the world to identify lessons learned. This would include an examination of the actual strategies that influence carbon mitigation, the trade-offs and synergies of carbon management, the roles of institutions and carbon governance structures.**

An international comparison provides actions and experiences of other cities and allows the city of Durban to benchmark its climate change activities. Cities can learn from examining and modifying strategies adopted in other cities. Chapter 4 provided a comprehensive overview of climate change activities in major cities around the world. Attention focused not only on mitigation actions as was implied in the objective above, but also on adaptation measures. Appendices 4 to 7 provided full details of the varied and innovative, individual city responses to the threat of climate change, with a view towards providing information on actions that could potentially strike a chord with officials in eThekweni Municipality and offer potential for replication or modification. Climate change action plans in cities around the world generally focus on clean and renewable energy sources; energy efficient buildings; an increased shift towards public transport; and, reduced waste and industrial pollution. While the emphasis in cities in most developed countries is on mitigation, adaptation measures do feature high on the agenda of some climate change action

plans, particularly those in Europe, including the UK. Cities in Japan focus their activities primarily on the built environment and Tokyo's experience has demonstrated the effectiveness of mandatory climate change action planning. Most cities in Europe have responded to the climate change challenge and have ambitious policies and targets for reducing GHGs. In the UK, climate change indicators are embedded in the municipal performance reporting which provides a means of promoting action in a consistent way. The UK and European approaches have also placed a strong emphasis on networks of cities as a means to foster climate change action. Networks and partnerships among the major metropolises in South Africa have the potential to advance the climate change agenda in a similar manner.

Objective 2:

- **Review mitigation and adaptation policies that are already in place in the city of Durban.**

Existing mitigation and adaptation policies provide a baseline, against which further interventions can be recommended. EThekweni Municipality has a long history of climate change activities, mostly driven by the Environmental Planning and Climate Protection Department (EPCPD). These were described briefly in Chapter 1, and more fully on a sector-by-sector basis in Chapter 2. Adaptation activities tend to be driven by the EPCPD, whereas mitigation activities fall largely under the newly established Energy Office. The various sector initiatives reveal that the water and sanitation, and the waste departments, are leaders in terms of activities and innovation, and that there has been relatively little response in some key sectors, notably transport. Durban is widely regarded as a leader

and at the forefront of climate change action within South Africa. It is noted that the climate change efforts are scattered across local government departments. In some respects this is a strength as it shows awareness in each of the involved departments and allows for innovation and broader support and uptake. However, the recommendations that follow address the need to provide greater multi-level co-ordination of all climate change actions and responses to ensure greater synergy.

Objective 3:

- **Identify key areas of intervention in terms of reduction in energy-use and implementing energy efficiency measures. This would include, *inter alia*, an examination of options to improve energy efficiency in existing and new buildings; and a consideration of transport and land-use planning.**

Energy efficiency is clearly a key factor in mitigating GHG emissions and is widely regarded as the 'low-hanging fruit'. Current activities under this banner in eThekweni Municipality were identified in Chapter 2 and further opportunities to improve energy efficiency were given in Chapter 5.

Inclusion of key low carbon principles into land-use planning hinges largely on controlling variables that can influence energy-use. These were identified as: combating urban sprawl; compacting city form; decentralising urban opportunities; promoting urban corridors; promoting sustainable neighbourhood planning; and developing a shared vision of spatial growth amongst key sectors, senior city management and politicians, and major landowners and civil society groups. It was noted that whilst many of these low carbon principles were present in the city's planning policy documents, they had not been fully integrated and/or successfully implemented. Recommendations to ensure greater success in implementation were given in Chapter 5.

In the transport sector, results of a scenario modeling study were used to prioritise interventions. The top priority was identified as the need to reduce the vehicle kilometres travelled in the road freight sector as this provided the greatest

opportunity to simultaneously reduce emissions of GHGs and traditional air pollutants, thus maximising co-benefits. In the long term a shift to rail is the solution and in the short to medium term, attention should focus on a road freight traffic management system. The proposed shift to rail underlines the need for multi-level governance, as the city of Durban alone, cannot achieve this. The second priority is to focus on the reduction in vehicle kilometres travelled in the passenger fleet. This can be achieved through education awareness programmes, offering incentives for car-pooling, introducing penalties for single-driver vehicles and forming strategic partnerships with business to assist in reducing vehicle kilometres travelled. However, at a broader level, this relates to the need to reduce passenger mobility through planning considerations and the need for a shift in modes of transport (i.e. from private to public).

Many energy efficiency initiatives in municipal buildings have been implemented. These have included retrofitting buildings with energy saving devices; introducing energy efficiency standards for new public buildings; energy audits; capacity development in energy efficiency, etc. However, it is important not to lose sight of the relatively small contribution of the municipal building sector to overall energy consumption and to ensure that energy efficiency measures in buildings are implemented across the industrial, commercial and residential sectors. The key to successful implementation hinges on behavioural change, emphasising the importance of education. Behavioural change, under the banner of low carbon citizenship, was addressed in Chapter 9. Awareness-raising programmes must be carefully crafted and tailored to appeal to different groups, e.g. neighbourhoods and schools, rather than individuals. The framing of the education programme in terms of the 'smart living' concept is appropriate. Notwithstanding the strong emphasis on behavioural change, the role of regulation through building codes for energy performance and other incentive systems, also have an important role to play as was outlined in Chapter 5.

In addition, efforts to address energy efficiency in industries in the industrial sector of South Durban were documented. Attention was drawn to the need to integrate climate change and

air quality considerations in air quality management planning. With the current focus on trying to improve air quality in South Durban, many of the interventions introduced have increased emissions of greenhouse gases, underscoring the need for an integrated approach that maximises co-benefits.

Objective 4:

- **Identify opportunities for renewable energy applications and/or cleaner fossil fuel technology.**

Renewable energy is a key aspect of low carbon development. In eThekweni Municipality, relatively little progress has been made in switching from over-reliance on grid electricity supplied by Eskom to independent generation of electricity from renewable energy sources, as was noted in Chapter 2. Various investigations have been conducted and there are supportive policy documents in place, but thus far there has been little progress in this regard. Further opportunities were reviewed briefly in Chapter 5, with the option of generating electricity from sugar cane residue (bagasse) explored in greater detail. The chapter on Financing Opportunities (Chapter 11) drew attention to the high Grid Emissions Factor in South Africa, creating an opportunity for renewable energy projects connecting to the national grid to produce more Certified Emission Reductions per kWh generated than any other Clean Development Mechanism eligible location in the world.

Objective 5:

- **Identify opportunities to reduce the city's carbon footprint in areas of infrastructure provision, waste management, wastewater management, water provision, food production, biodiversity management and protection.**

Considerable progress has been made in eThekweni Municipality in terms of innovative carbon reduction schemes, particularly in the water and sanitation sector and the solid waste sector. Other projects, such as the Green Roof Pilot Project and the City Hall vegetable gardening, serve as useful demonstration projects. These were described in Chapter 2.

Further opportunities in each of the sectors were identified in Chapter 5.

In the solid waste sector, there are opportunities in terms of waste recovery and recycling; mechanical biological treatment of waste, particularly dry anaerobic biological digestion; CO₂ fertilisers, biofuels and composting.

In the water and sanitation sector, key recommendations were to address water losses, address consumer demand, promote safe, onsite sanitation where appropriate as an alternative to expanding activated sludge treatment plants, revert to anaerobic digestion technology and to treat all water supplied to households to drinking water standards.

Chapter 7 was devoted to opportunities for enhancing carbon sinks and drew attention to the carbon mitigation role of urban vegetated areas, which although small in comparison to the city's GHG emissions, has significant co-benefits in terms of ecosystem services. The value of natural capital was highlighted further in Chapter 10 on the green economy.

The importance of local food production was underscored particularly in the chapter on the Green Economy (Chapter 10), as well as Chapters 5 and 7, where the opportunities presented in eThekweni Municipality (suitable climate and large peri-urban and rural spaces) were highlighted.

Objective 6:

- **Identify opportunities to reduce the city's carbon footprint that also have adaptation advantages.**

While the purpose of adaptation is different (reduces harm) from mitigation strategies (reduces emissions), there are many strategies that have benefits for both. A strong argument for an integrated approach was made in Chapter 6 on Building Resilience. By focusing on urban development and the improvement of services, the ability of cities to adapt to climate change and mitigate greenhouse gases is enhanced. Examples include adaptation strategies to minimise the impact of flooding and heavy rains by increasing vegetated cover, which in turn

mitigates carbon emissions; and strategies to improve energy and water efficiencies, which in turn enhance energy and water security and improve resilience. One of the key messages of Chapter 6 on Building Resilience was the need to capitalise on co-benefits and to link climate change adaptation efforts to existing risk and hazard management strategies.

Objective 7:

- **Identify opportunities for neutralising unavoidable emissions through carbon offsetting schemes.**

The focus in the report was not on how the city of Durban could offset its carbon emissions by purchasing carbon credits, but rather on how it could maximise opportunities for enhancing carbon sinks and thus possibly identify opportunities for selling carbon offsets (Chapter 7). The section on Afforestation, Reforestation and Deforestation (ARD) activities noted that the effort to initiate ARD activities was high compared with the benefits that could be claimed and the price of carbon that could be realised, and argued that only large-scale ARD projects were likely to be profitable. However, the full set of ecosystem services benefits of a greener, better-managed natural area system is often the main reason for undertaking these activities, with carbon sinks as a co-benefit. Attention was drawn to an initiative called REDD (Reduction of Emissions from Deforestation and Degradation), which has much political support and the potential to gain traction in the future. Essentially the initiative aims to slow the rate of forest loss rather than try to restore the forest after it is gone.

Objective 8:

- **Consider carbon storage options.**

The topic of carbon storage was addressed in Chapter 7 on Enhancing Carbon Sinks. The key message that emerged was that net carbon storage is several orders of magnitude smaller than net primary production (i.e. plant growth), and that the only way to avoid this inefficiency was to divert biomass flows to permanent or long-term storage. In essence, in order to maintain carbon benefits over time, a resource has to be in a productive state, which means it must

be taken out periodically by harvest, rather than strictly protecting it. The harvested material must then be diverted into a secure long-term storage e.g. timber houses, furniture or biofuels.

The related matter of carbon capture and storage (CCS) was not addressed in this report. An examination of the literature concluded that CCS is still in its early development phase and has not yet reached the commercialisation phase. It would be premature for the city to devote attention to CCS at the current time. However, it is important to keep abreast of developments, particularly at a national level. In this regard, CCS at Eskom coal-fired power stations is a possibility that the city should advocate, whilst simultaneously pushing for a multi-level governance approach that would facilitate them having an influence at a national level.

Objective 9:

- **Make recommendations on the transition to a low carbon city with a particular emphasis on low carbon technologies.**

Chapter 5 covered mitigation opportunities in detail. Throughout the chapter there are references to actions that can be taken. These are further consolidated in Chapter 10 on the Green Economy, where the green economy is promoted as a useful framework for the transition to a low carbon city. It provides an overarching, co-ordinated approach that offers potential to provide a common vision and link to what may be perceived as unsynchronised and unrelated actions under a common theme. This approach is explored further as a recommendation in the following section of this chapter.

An important component of the transition process is behavioural change. This topic was captured under a broader theme of Achieving Low Carbon Citizenry in Chapter 9. Strategies to persuade citizens to change to a low carbon lifestyle were identified. Key pointers for carbon reduction awareness-raising programmes were given as follows: integrating technical and values approaches to focus on 'ethics of care'; tailoring the messages to appeal to different sectors of society; and integrating green and brown issues. The Imagine Durban Schools project was cited as an example of best practice.

Other drivers for change include pricing, available choices, and information about the carbon footprint of goods and services. Recommendations for introducing the notion of the carbon footprint of goods and services into public vocabulary as a way of getting citizens to think about their consumptive behavior were made in Chapter 9.

A chapter in the report that indirectly addressed the matter of the transition to a low carbon city, but which was considered sufficiently important to have as a separate chapter was Chapter 11 on Financing Opportunities. Financing climate change initiatives is potentially a major constraint for the city, hence opportunities that are available were summarised. These include, *inter alia*, the Clean Development Mechanism, the voluntary carbon market in which Voluntary Emission Reductions (VERs) are traded, incentives and subsidies, Energy Service Companies (ESCOs) and municipal bonds. It was recommended that the Energy Office be tasked with coordinating a financing strategy for a low carbon Durban, with the prime objective of identifying innovative financing schemes that derive funds from both public and private sectors, and at local, national and international levels.

Objective 10:

- **Make recommendations regarding appropriate institutional and governance structures in a low carbon city.**

Chapter 8 focused on Achieving Low Carbon Governance in eThekweni Municipality. It was noted that a global shift in climate change responses has taken place, from an early focus on mitigation to one focused on adaptation as the local risks from climate change become more of a reality. The central role of local government is thus reinforced. The importance of multi-level governance (including both horizontal and vertical co-ordination) was stressed to strengthen the ability of local government to manage adaptation and improve resilience. Some of the recommendations contained in this chapter included: raising the profile of climate change matters on Council agendas; institutionalising coordination around climate change matters; working to build a knowledge base to enhance adaptability; establishing

demonstration projects in highly visible locations; and partnering with business/industry and citizens.

Objective 11:

- **Consider the broader application of the recommendations to other cities in South Africa.**

This topic was not explicitly covered in the body of the report. All South African cities face similar challenges in respect of economic development, poverty alleviation and the creation of employment opportunities. These overriding imperatives will shape the climate change agenda in each of the cities. Larger metropolitan areas such as Cape Town and Johannesburg may not have the same long track-record in climate change activities as the city of Durban, but they are fast establishing their reputations and have implemented some innovative activities, for example the 'smart city' approach adopted in Cape Town. Certainly, the initiatives taken by eThekweni Municipality (described in Chapter 2) provide many useful lessons for other cities in South Africa, particularly in the solid waste and water and sanitation sectors. The chapters on achieving low carbon governance and low carbon citizenship (Chapters 8 and 9 respectively) are broadly applicable to cities across South Africa. Similarly, the principles covered in Chapters 6 and 7 on improving resilience and enhancing carbon sinks respectively, provide many common pointers for other cities. The key opportunities for transitioning to a green economy as described in Chapter 10 are generic and are broadly applicable. Most of the recommendations that follow will resonate with other cities in South Africa, especially as Durban is regarded as a role model for other cities and a trend-setter for city action.

RECOMMENDATIONS

Throughout the report, key findings were summarised and sector-specific recommendations made. These were generally highlighted as key lessons in each chapter. The following section consolidates these findings and sector-specific recommendations into the core strategic recommendations of this study.

1 ENSURE A SHIFT TOWARDS A GREEN ECONOMY

eThekweni Municipality must promote the transition to a green economy by ensuring that every action, investment, regulation or decision contributes towards nurturing and building a strong green economy that is low carbon, resource efficient and socially inclusive.

The need to move to a green economy is critical in establishing a macro-framework in which all activities in eThekweni Municipality can be steered in a co-ordinated way in a low carbon and sustainable direction. There are compelling reasons for the municipality to embark upon a trajectory of green economic development. A green economy has potential to bring about employment opportunities and system-wide sustainability benefits, including all three pillars of sustainable development, viz. environmental, social and economic. The green economy is viewed as a means of achieving sustainable development, and therefore strongly supports the sustainability principles already embedded in many of the city's activities.

To foster the change will require a careful balance between strong governance, and empowerment of the citizenry. There are no fully developed or universal models to follow, and what will work for eThekweni Municipality will likely be different from other places, but that does not mean that there is not a great deal that can be learnt from the practice of others (good and bad).

The move towards a green economy will require significant effort and co-ordination of actions to change an economy that is currently developing on a fundamentally unsustainable path, into one that fully contributes to sustainable development. This is a task that will require serious commitment and one that needs to be commenced as soon as possible: every step taken in an unsustainable direction is one that embeds these practices more deeply and makes the necessary changes all the more difficult.

The first steps to take are not about doing anything 'new', but to ensure that the actions of the municipality encourage shifts in the right direction. Every action, investment, regulation

or decision made by the municipality needs to nurture this shift. To do this, frameworks need to be put in place to assess these activities both in terms of their three-fold sustainability (economic, social and environmental) and to ensure that judgements are appropriately made on a long-term balance of all three, not simply on short-term economic gains. By ensuring a move to a position where municipality actions take account of sustainability principles, the natural functions of the municipality in both the delivery and procurement of services can begin to lay the foundations for a change of direction across a wide spread of areas.

Specific action recommendations are:

- Develop a sustainability assessment framework for the municipality.
- Ensure that all municipality operations are undertaken in a sustainable manner.
- Implement a set of sustainable procurement policies to promote sustainability throughout the municipality's supply chain.
- Steer investment towards supporting sustainable activities.
- Put in place planning regulations and policies to guide sustainable development.

2 EMPHASISE CLIMATE CHANGE CO-BENEFITS

To ensure that climate change policies and actions can be developed and implemented effectively and efficiently, with the full support of the political leadership of the city and local citizens, it is essential for co-benefits to be emphasised.

By adopting a co-benefits framework, there is likely to be greater support for some of the proposed climate change initiatives. Where resources are scarce, public awareness relatively poor and political will, sub-optimal, an emphasis on co-benefits can elevate the issue of climate change to a higher level.

Within conventional frameworks for determining the costs and benefits of policies and/or activities, it is often difficult to make those with an environmental focus appear to provide 'value'. This is especially true in the case of climate change, where many of the benefits may only be felt some way in the future. By ensuring that

co-benefits of policies and actions are identified and emphasised across a full range of domains, measures begin to appear far more efficient and beneficial than when considered in terms of climate change alone.

It is important to identify 'win-wins' and 'trade-offs' across the municipality. Benefits can be broadly defined and could include, for example, environmental, financial, health and others. Climate change adaptation actions, in particular, can have co-benefits in the broader sustainability and development space. For example, the removal of infrastructure and housing from a floodplain may facilitate the reallocation of the land to agriculture, thus enhancing food security. Other examples of co-benefits discussed in the report are the mitigation of greenhouse gases and the simultaneous improvement in air quality; and the enhancement of carbon sinks which improves ecosystem services, regulates the microclimate, reduces pollution, provides flood control, and improves recreational and aesthetic landscapes.

By embedding consideration of co-benefits within a broader sustainability assessment framework, benefits can be achieved across a wide range of issues.

Specific action recommendations are:

- Develop cross-departmental networks to help identify the scope for developing 'win-win' policies and actions.
- Implement scrutiny procedures that identify and question policies and actions that are likely to lead to significant trade-offs between economic, social or environmental issues.
- Ensure that the sustainability assessment framework drives all activities.

3 ENSURE A MULTI-LEVEL GOVERNANCE APPROACH

A strong drive to ensure multi-level governance is necessary for low carbon development in the city of Durban. A partnership-based approach with national government and other stakeholders must be enhanced.

A city such as Durban cannot transition to a low carbon city on its own. Notwithstanding the

fact that local government is an autonomous sphere of government, there are many instances where the city is in a relatively weak position and unable to exert any influence. In such cases, multi-level governance and appropriate partnerships with national government and/or other stakeholders can assist in pushing a low carbon agenda forwards. Examples include partnerships with Eskom over renewable energy and partnerships with the national Department of Transport and Transnet over rail-based freight transport.

Partnerships with the private sector are beneficial as organisations may wish to use such platforms to promote and implement their Corporate Social Responsibility policies and image. EThekweni Municipality has recognised the importance of partnerships by establishing the Durban Industry Climate Change Partnership Project. Partnering with citizen groups is also valuable and may increase the effectiveness of local government. There are limitations to the regulatory and the provision role of government, which means that other actors must be enabled and supported to act. This should also be seen as part of a process to build wider consciousness around climate change issues so that this percolates into the agendas of political parties and a wide range of other institutions.

Specific action recommendations are:

- Identify and implement appropriate partnerships and fora that will assist in driving the low carbon agenda in the transport sector.

4 PROMOTE LOW CARBON CONSUMPTION

The city of Durban must promote low carbon lifestyles and play a leadership role in reducing upstream carbon emissions. An understanding of the carbon footprint of the city from a consumption perspective is important.

Increasingly, the notion of consumption is being emphasised within the context of a low carbon city. While it is important for a city to address reductions of greenhouse gases within its own jurisdictional area, it is also essential for a city to understand the impacts of its consumption on other geographical areas. Goods and services consumed in a city need to be produced

somewhere. Hence, promoting goods and services that have low life-cycle CO₂ emissions will contribute towards low carbon development globally. A better understanding of patterns of consumption and life-cycle CO₂ emissions of items such as food, construction materials, consumer goods and water is needed. By creating awareness about goods and services that have low life-cycle CO₂ emissions, the city is indirectly addressing the need for a behavioural shift in consumption.

Currently, none of the cities across the globe account for their carbon footprint from a consumption perspective. International debates about consumption and carbon accountability are ongoing. Regardless of the outcome of these debates, an understanding of the carbon footprint of Durban from a consumption viewpoint will be useful.

Cities differ vastly in terms of their functions. A commercial city, without a production base may appear low carbon compared with other cities with a strong production base, but in terms of consumption, the reverse may apply. Hence, alongside mitigation and adaptation activities, the city must promote low carbon consumption if it is to be genuinely low carbon.

Specific action recommendations are:

- Promote low carbon consumption behavior through education programmes.
- Influence consumer choice by making low carbon goods and services available.
- Promote the concept of a carbon footprint and the computation of individual, organisational and city carbon footprints.

5 ENSURE THE IMPLEMENTATION OF LOW CARBON LAND USE PLANNING

Land use planning plays a key role in low carbon development. Key principles include combating urban sprawl, compacting city form, decentralising urban opportunities, promoting sustainable neighbourhood planning, and a shared vision of spatial development in the city amongst all stakeholders.

Low carbon land use planning is central to the achievement of many of the recommendations made here. The promotion of a low car-

bon consumptive lifestyle hinges on appropriate planning; a modal shift from private to public transport rests on the planning of public transport corridors; and the layout of settlements/developments can contribute to energy efficiencies.

Specific recommendations are as follows:

- Build a shared vision of spatial development in the city by bringing together the powerful stakeholders in the private and public sectors, i.e. landowners, private developers, political and business leaders.
- Refuse development applications that do not comply with key planning documents of the city (e.g. Integrated Development Plan).

6 ENSURE THE INTEGRATION OF MITIGATION AND ADAPTATION ACTIVITIES

Traditionally, mitigation and adaptation activities have developed separately in cities, frequently residing in different municipal departments. There is a need to develop a strong drive to integrate mitigation and adaptation activities across the municipality.

In eThekweni Municipality, the development of mitigation and adaptation policies and activities has mirrored the international tendency towards separation of activities. However, recently, the global trend is towards integration of mitigation and adaptation within a development agenda. The argument for an approach that integrates mitigation, adaptation and urban development rests on the view that by focusing on urban development and the improvement of services, the ability of cities to adapt to climate change and mitigate greenhouse gases is enhanced. In essence, by pushing to improve services, and in the context of a city in a developing country specifically, striving to meet the Millennium Development Goals, there will emerge a better-served community that is more resilient, better able to adapt to climate change and more likely to be in a position to address climate change mitigation needs.

In addition to the need for simultaneously planning for adaptation and mitigation, it is increasingly being recognised that these two factors need to be integrated into the broader spheres of sustainability and development planning. A

number of reasons for this suggestion are offered. First, efforts to cope with the impacts of climate change and attempts to promote sustainable development share common goals and determinants including access to resources (including information and technology), equity in the distribution of resources, consideration of stocks of human and social capital, access to risk-sharing mechanisms and abilities of decision-support mechanisms to cope with uncertainty. Second, vulnerability to specific climate change impacts are most severe when considered along with other stresses, such as poverty, environmental degradation and food security, and the ability to adapt to them depends on the pace of development. Finally, climate change adaptation actions have co-benefits in the broader sustainability and development space.

The drive to integrate should not necessarily be seen as a push to establish a single 'Climate Change' department. Indeed, it could be argued that there is greater value in having climate change activities dispersed across different sectors and departments as it entrenches support across a broad front. What is required, however, is a multi-level, co-ordinated approach that through integration, raises the profile of the climate change agenda across all sectors and serves to build capacity within the municipality. The current informal, inter-departmental collaboration that is taking place provides a useful foundation for such a co-ordinated approach. However, it needs to transform into one that is likely to be more enduring and sustainable and less-heavily reliant on individual networks. In a fast-changing local government environment there is a need to formalise the institutional arrangements so that they are not entirely dependent on individuals working together.

Specific action recommendations are:

- Develop a formal, high-level, representative platform or structure within the municipality to ensure the integration of all climate change activities, encompassing both adaptation and mitigation.
- Ensure that sectors/departments currently inactive in climate change activities are explicitly included.
- Ensure that monitoring and evaluation of

progress is built into the structure.

- Give careful consideration to the positioning and reporting lines of such a 'structure' within the municipality in the light of the need to raise the profile of climate change activities on the Council agenda. Direct reporting to either the City Manager or Mayor is recommended.

7 ENSURE AND RECOGNISE VISIONARY LEADERSHIP

International experience demonstrates the role of leadership in advancing the climate change agenda. EThekwi Municipality must entrench its reputation as South Africa's leading city in terms of climate change actions and should strive to be South Africa's first 'zero-carbon' city. The city must also seek to identify and support individuals with the commitment, charisma and public image to act as a local champions or ambassadors for climate change action.

Leadership at the city level as a whole, as well at an individual level, is critical to success. From a climate change perspective, the city of Durban is widely regarded as the leading city in South Africa. The city must ensure that it maintains and enhances this profile as it can act as a powerful attractor of investment. The municipality's leadership role is to ensure the promotion of a clear message of low carbon development within all its communication, as well as through its actions. Evidence shows that the public is more likely to become active participants in a low carbon agenda if there is commitment from the city in terms of its own activities. In this respect, energy efficiency efforts in municipal buildings and demonstration projects in the city have a valuable role to play.

Everywhere that good, strong climate change strategies have been implemented, it has been due to one (or more) 'champions' who have had the personal profile and commitment to engage with a wide range of stakeholders in arguing strongly and coherently for the necessary changes. Leadership must exist amongst the politicians, municipal officials and the community at large. When leadership comes from the top, as demonstrated by the visionary leadership provided by a former mayor of London in advancing the climate change agenda in Lon-

don, it then cascades through the Council and the municipality and society in general.

The essential qualities for climate change leadership are not necessarily technical expertise, but a passion and commitment to the issue, matched with a broad understanding of the full implications and an ability to reach out and communicate with a wide spectrum of stakeholders. Rarely do such leaders miraculously appear, but they can be nurtured in a deliberate and proactive way.

The recent steps to establish an Advisory Forum under the Durban Climate Change Partnership that will provide guidance on the establishment of a Steering Committee for the partnership may provide an opportunity to realise such a goal.

Specific actions recommendations are:

- Promote the municipality's own climate change activities across all sectors in the municipality in order to demonstrate leadership by action.
- Encourage climate change leaders or ambassadors to come forward.

8 GIVE URGENT ATTENTION TO THE TRANSPORT SECTOR IN THE TRANSITION TO A LOW CARBON DURBAN

The transport sector is central to the transition to a low carbon city and requires urgent attention in eThekweni Municipality. The main overarching efforts of the municipality must be on reducing the need to travel by focusing on accessibility rather than mobility. The mobility demand then needs to be assessed and addressed in the most efficient and sustainable manner.

There is a need for a paradigm shift in thinking around transport in the city. The role of transport in the city can be viewed at three levels:

- The need to reduce mobility, which relates to urban planning.
- The need to address the real mobility demand in the most efficient and sustainable manner, which means promoting a modal shift to public transport.
- The need to improve the energy efficiency of each mode and ensure the use of low carbon fuels.

In terms of addressing mobility, there is no inherent benefit to be gained from the expenditure of financial and environmental resources to simply move objects or people from one place to another, and yet the current social systems that have developed have led to transport playing a central role in our economies. In a carbon-constrained future and in a world in which population pressures rapidly lead to congested transport systems, the first and most important step to take is to reduce the need for mobility in a city. Economic principles, such as economies of scale, have often led to centralisation of resources (e.g. large 'out of town' shopping centres rather than local shops).

This has been encouraged by a transport discourse promoting 'mobility' that seeks to ensure that all in society have the ability to move around freely and affordably. All over the world this has led to huge increases in travel, resulting in high levels of congestion and the use of resources for building and fuelling transport systems, as well as the loss of land to roads, railways, car parks and airports. Slowly the international move is towards the promotion of 'accessibility' and ensuring that all people have equitable access to meet their needs by seeking, where possible, to provide them locally. This leads to a need to decentralise facilities, and whilst from one perspective this can be seen as 'inefficient' and potentially leading to some duplication of roles and tasks, from another it will lead to opportunities for greater and more meaningful employment, providing additional jobs in peoples' own localities.

In order to move towards a sustainable transport system, taking these first steps towards reducing the need to travel is crucial. In the developed world, the fundamental unsustainability of transport systems has been highlighted by the debate on using biofuels for transport use. The calculations for the amount of land needed to convert existing fleets and usage provided a clear indication of the literal 'footprint' of these systems. In order to fuel transport sustainably, travel demand needs to be effectively managed.

Once priorities have been set for what is regarded as essential travel, the real mobility demand can then be addressed. This will inevitably in-

volve promoting a modal shift, as well as promoting energy efficiency and clean fuels. Energy efficiency can be addressed through energy efficiency of vehicles, smaller size vehicles, congestion reduction and driver education. The identification of those essential transport needs of the city will then allow policies to be implemented to support the shift to clean, efficient modes of transport confident that investment in the improvements will make a specific contribution to wider efforts to build a green economy for the city.

Specific action recommendations are:

- Organise a 'transport summit' to bring together various stakeholders to develop a strategy for moving to a more sustainable transport system that duly reflects carbon concerns.
- Develop clear policies that will help reduce the need for travel, focusing on accessibility and not mobility.
- Ensure that where transport is necessary it is part of a sustainable, integrated system.
- Develop strategies that explicitly deal with freight, public and private transport.

9 ENSURE A STRONG MITIGATION FOCUS IN THE INDUSTRIAL SECTOR

The industrial sector is the major contributor to greenhouse gas emissions in the city, contrary to the pattern in many global cities. EThekweni Municipality should ensure that through regulation, investment and incentives, local industry plays a central role in mitigating greenhouse gas emissions and in the development of a green economy that fulfils the social and economic needs of the municipality.

The industrial sector is responsible for 45% of the greenhouse gas emissions in the city and must be a major focus of mitigation efforts. Local air quality management planning provides an ideal framework to address climate change considerations. The integration of climate change and air quality considerations will avoid situations where technological interventions aimed at improving air quality increase emissions of greenhouse gases. Local industry must play a major role in mitigation efforts to curb greenhouse gas emissions in the foreseeable future.

Local industry is also central to the development of the green economy and needs to fulfill its role in this respect. Industry must be encouraged to incorporate sustainability principles that minimise reliance on natural resources and minimise waste outputs – both solid wastes and pollutant emissions to air, land and water. Where possible, waste streams should be integrated so that one industry's waste becomes the raw material for another. The municipality can drive this forward by having forward-looking waste management policies that could direct investment into industries that might profitably (and sustainably) use current waste streams rather than investing in systems to manage its safe disposal. In order to provide funds to invest in and support the development of sustainable local industries, the municipality should consider the establishment of local rating and taxation structures for businesses that are directly related to key indicators of their sustainability (such as energy-use or carbon intensity of production). This will provide a driver for existing businesses to improve their environmental performance whilst clearly basing local revenue-raising on the widely accepted 'polluter pays' principle. Revenue raised from green taxes and other fiscal measures could then be ring-fenced specifically for further investment in the development of the green economy.

Specific action recommendations are:

- Draw up a strategic plan on how industry can contribute to the low carbon and climate resilient city and also identify the potential for developing and attracting new green businesses and improving and regulating existing ones.
- Ensure that all policies to regulate industry are backed up by the resources and ability to successfully enforce them.
- Prioritise public investment and support for industries that clearly favour low-carbon activities that provide strong local social benefits.
- Seek powers to develop local taxation frameworks that are based on the polluter pays principle and ring-fence revenue for investment into stimulating a green economy.

10 ENSURE A BROADER FOCUS ON THE BUILT ENVIRONMENT

Energy efficiency in buildings is often hailed as the 'low-hanging fruit' in the low carbon transition process, as actions can be implemented more easily than in other sectors such as transport. It is recommended that eThekweni Municipality extend their focus from energy efficiency in municipal buildings to the broader built environment in the city.

The built environment forms the physical framework in which all the activities of the city occur. The city is defined by them and without sustainable buildings there can be no low carbon or sustainable city.

Buildings, within the context of the broader built environment, need to be considered at three scales:

- Individual buildings, especially their energy efficiency and ability to remain habitable in future climate scenarios with minimal reliance on air conditioning.
- The layout of buildings within sustainable neighbourhoods that can provide for the needs of residents without excessive travel, and help foster strong, self-reliant communities.
- The strategic layout of the city and how it can be allowed to develop in a sustainable form.

The development of the built environment needs to embed both mitigation and adaptation at all levels. Buildings need to be designed to operate with minimal energy usage (with an aspiration to being zero-carbon, or even carbon-negative) and reduce the urban heat island, whilst also being designed to withstand more extreme climates (effective natural ventilation to cope with higher temperatures, green roofs and sustainable drainage systems to cope with and mitigate the impacts of heavier rainfall). The energy efficiency practices implemented in the municipal sector need to be spread broadly across the city, especially in the commercial and residential sectors. Building codes that address energy efficiency need to be introduced. Neighbourhoods need to be designed to meet the needs of the community, mitigating through

reducing the need to travel and being designed to incorporate safe, accessible outdoor space with plenty of shade.

At the city level, the urban form needs to be contained to prevent unsustainable urban sprawl that continually eliminates the peri-urban environment. Again, the need for travel can be significantly reduced through policies to ensure that business, commercial and residential areas do not each occur in large isolated zones.

Specific action recommendations are:

- Ensure that planning and development control policies at all scales properly incorporate adaptation and mitigation issues.
- Provide strong guidance on the incorporation of sustainability into development at an individual building and neighbourhood level.
- Use Council ownership of land as a strong driver for pushing forward sustainable developments.
- Make sure that city-level planning strategies are strong enough to direct and control what happens at the local scale.
- Introduce building codes at the individual building level.
- Ensure energy considerations are taken into account and implemented in large-scale developments.

11 MAXIMISE LOCAL OPPORTUNITIES IN THE LOW CARBON TRANSITION PROCESS

While the underlying principles of a low carbon city are universal, the transition process requires capitalising on local opportunities to achieve sustainability. It is recommended that eThekweni Municipality actively identify these local opportunities and exploit them to best advantage.

The local context of a city frames the low carbon transition process, both in terms of the opportunities that are presented and the risks posed. To achieve future sustainability, low carbon policies and actions implemented elsewhere cannot be deployed solely on a replication basis, but must pay due regard to the local context and within this framework, maximise local opportunities. There must be synergy between the low carbon development path that is charted and the local situation. Examples of particular local opportu-

nities in eThekweni Municipality that should be highlighted and exploited to best advantage are:

- The city's status as a convention destination, which presents opportunities to advance the low carbon agenda by 'greening' of events and using high-profile events such as the COP-17-CMP-7 meeting in November 2011 to secure greater local political support for climate change activities.
- The city's status as a tourism destination, which presents opportunities to 'green' the tourism industry.
- The potential of sugar cane residue (bagasse), which presents opportunities for electricity generation or the production of liquid fuels.
- The city's subtropical climate, which offers a favourable climate for growing plants thus presenting opportunities for renewable energy production from biomass.
- The city's open space network (D'MOSS), which presents opportunities to enhance carbon sinks and to provide a public education platform for climate change.
- The relatively large rural and peri-urban component of the metropolitan area, which presents opportunities to encourage local food production and thus reduce the carbon footprint of the food system.

Specific action recommendations are:

- Compile a comprehensive register of local opportunities pertinent to the low carbon transition process in eThekweni Municipality and ensure that these are communicated and integrated into the planning policies and procedures of all departments in the municipality.

12 ENCOURAGE INNOVATION THROUGH A PARTNERSHIP-BASED APPROACH

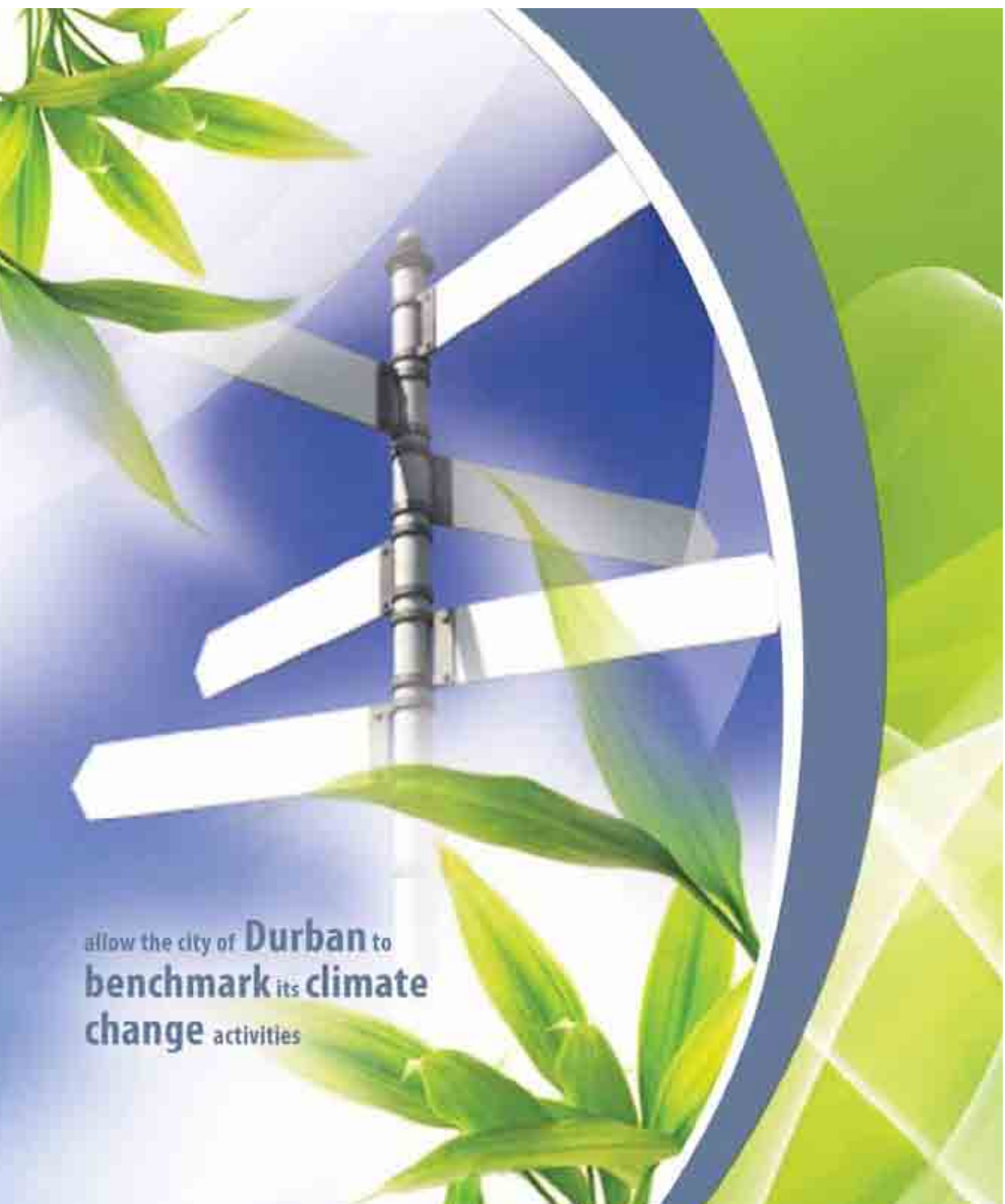
Innovation, both technological and social, is key to a low carbon transition. It is recommended that eThekweni Municipality fosters innovation by developing partnerships with local universities, businesses and communities.

The transition to a low carbon city presents many challenges, not all of them with ready-made solutions. Innovation needs to be promoted and supported. Pockets of innovation are evident in the city and these should be encouraged and supported. While new technologies will undoubtedly play a major role in the transition to a low carbon society, innovation should not be viewed only through a technological lens.

The term social innovation is becoming increasingly prevalent as the need to build the resilience of a future society assumes greater importance. It is recommended that eThekweni Municipality recognises the key role of innovation by establishing a forum, hub or 'think tank' that can stimulate innovation and strengthen and develop partnerships amongst key role players drawn from local government, local universities, businesses and communities. The role of the municipality is a co-ordinating one in which relevant role players are networked in a drive towards innovation.

Specific action recommendations are:

- Establish a climate change 'think tank' or 'innovation hub' comprising key individuals drawn from local government, local universities, industries and communities to stimulate innovation around low carbon development for the city.
- Mobilise resources (intellectual, financial, human) for innovative research in climate change.



allow the city of **Durban** to
benchmark its **climate**
change activities



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low carbon city in a **developing** country



appendices

appendix 1 - biographies of panel members

Dave Dewar

Professor Dewar held the BP Chair of City and Regional Planning at the University of Cape Town (UCT) until his retirement at the end of 2010. He is the author or co-author of nine books and over 200 monographs and articles on city and regional planning. In 1997 he was elected a Life Fellow of UCT. He was a member of the National Development and Planning Commission, charged, *inter alia*, with drawing up a Green Paper on planning in South Africa. He is a Member of ASSAf.

Shobhakar Dhakal

Dr Dhakal holds a PhD in Urban Environmental Management from The University of Tokyo. He is a Senior Policy Researcher at the Institute for Global Environmental Strategies (IGES) in Japan. Dhakal's core interests are in energy-use and carbon emissions in an urban context and related management strategies and policies. His particular focus is on urban transport. He is active in the global change research community, especially the International Human Dimensions Programme (IHDP), the Global System for Analyses, Research and Training and the Asia Pacific Network for Global Change Research. He was responsible for organising a recent conference in Japan on 'Low Carbon Cities'.

Roseanne Diab

Professor Diab has a PhD in Environmental Science from the University of Virginia, USA. She has published widely in the field of air quality and is currently engaged in a research project on the integration of climate change and air quality. She is a Member of ASSAf and is the major-time Executive Officer. She is Emeritus Professor in the School of Environmental Sciences at the University of KwaZulu-Natal. Diab is a member of a number of international bodies such as the

International Ozone Commission and the Commission on Atmospheric Chemistry and Global Pollution. She was one of the lead members of the team that drafted the National Framework for Air Quality Management in South Africa and served as the Vice-Chair of the InterAcademy Council (IAC) review panel of the IPCC.

Jim Longhurst

Professor Longhurst is a Professor of Environmental Science and Associate Dean in the Faculty of Environment and Technology at the University of the West of England in Bristol, UK. He is also Director of the University Centre for Research in Environmental Sciences, Co-director of the Institute for Sustainability, Health and Environment and Director of the Air Quality Management Resource Centre. He has a PhD from the University of Birmingham. Longhurst has extensive experience of international approaches to air quality management in Europe and Asia, and has a particular interest in the management challenges of megacities such as Beijing, São Paulo, and Mexico City. He is familiar with South African climate change and air quality policy through his participation in a team that drafted the National Framework for Air Quality Management and was the invited international speaker at the local National Association for Clean Air Association Conference in 2007.

Peter Lukey

Mr Lukey is the Chief Director: Air Quality Management and Climate Change in the Department of Environmental Affairs and Tourism. He was a key figure in the development of the new Air Quality Act in South Africa. His role is to ensure the development and implementation of legislative and other measures to protect and defend the right of all to air and atmospheric quality that is not harmful to health and wellbe-

ing. He has vast international experience in the climate change policy arena.

Mongameli Mehlwana

Dr Mehlwana graduated from the University of Cape Town. He is currently a member of the management team of the CSIR Alternative Energy Futures research theme. He is an energy policy specialist with expertise in areas such as sustainable development, energy efficiency and demand-side management, energy end-use analysis and integrated energy planning. He has worked on a range of projects varying from enhancing the efficiency of the electricity utility company, carrying out a feasibility study for the utilisation of wind energy, capacity-building of local authorities, non-governmental organisations and other implementation agencies, with regard to integrating sustainable energy options and environmental practices in rural urban development projects. He has vast experience in the southern Africa region, particularly in South Africa, Namibia, Zimbabwe and Lesotho.

Bob Scholes

Dr Scholes is a systems ecologist, employed by the CSIR since 1992. He has a PhD from the University of the Witwatersrand, is a Fellow of the CSIR and the Royal Society, and a Member of ASSAf. He studies the effects of human activities on the global ecosystem, and in particular on woodlands and savannas in Africa. He is or

has been a member of several steering committees of international research programmes, such as the International Geosphere-Biosphere Programme (IGBP) and the Global Climate Observing System (GCOS), and served as a convening lead author for the IPCC. He has published widely in the field of global change, has broad experience and has contributed to the formulation of national environmental policy.

Coleen Vogel

Professor Vogel is currently a professor at the School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand. She is a climatologist by training and has undertaken research in climate change, climate vulnerability and adaptation to climate, with a particular focus on disaster-risk reduction and climate variability, of both rural and urban communities in southern Africa. She is the immediate past-Chair of the International Scientific Committee of the IHDP and was previously Vice-Chair of the Land-use and Land Cover Change Programme (a joint international science programme of the IGBP and IHDP). She is a member of various editorial boards and was also a member of the International Council for Science (ICSU) SA board. She has also recently participated in the compilation of the Fourth Assessment of the IPCC on Impacts, Adaptation and Vulnerability and was part of the final overall synthesis process of all three working groups of the IPCC and the Summary for Policy-makers.

appendix 2 - list of commissioned studies

Lead authors

Name	Affiliation	Topic
Prof Dianne Scott	Research Associate, School of Development Studies, University of KwaZulu-Natal (UKZN)	Local context Achieving low carbon citizenry
Ms Catherine Sutherland	Lecturer, School of Development Studies, UKZN	Local context
Mr Glen Robbins	Part-time Researcher, School of Development Studies, UKZN	Achieving urban carbon governance
Mrs June Lombard	Environmental Consultant and Waste Management Specialist, Lombard and Associates	Waste management and recycling
Mr John Fay	Researcher, Graduate School of Business, University of Cape Town	Opportunities for financing low carbon initiatives
Dr Camaren Peter	School of Public Leadership and Associate of the Sustainability Institute, Stellenbosch University.	Green economic opportunities for Durban
Ms Sarah Stands, Mr Chris Bellingham and Craig Richards	Envirominds, Durban.	Green economic opportunities for Durban

Contributing authors

Name	Affiliation	Topic
Ms Vicky Sim	Planning and Environmental Consultant	Local context
Ms Lavinia Poruschi	Researcher, Global Carbon Project, National Institute for Environmental Studies	Low carbon city development experience and lessons from Asia
Ms Rose Bailey, Mr Simon Baldwin	Researchers, Institute for Sustainability, Health and Environment, University of the West of England, Bristol	Low carbon initiatives in British cities
Dr Dotun Olowoporoku	Researcher, Institute for Sustainability, Health and Environment, University of the West of England, Bristol	Low carbon initiatives in British cities Low carbon initiatives in selected European capital cities
Dr Yvonne Lewis	The Green House	Building Resilience and Risk Reduction
Dr Tim Chatterton and Ms Jo Barnes	Institute for Sustainability, Health and Environment, University of the West of England, Bristol	Conclusion and Recommendations

List of Interviewees in eThekweni Municipality

Name	eThekweni Municipal Department
Andrew Mather	Project Executive: Coastal Policy
Derek Morgan	Head: Energy Office
Faizal Seedat and Mark Byerley	eThekweni Housing Unit
Helene Epstein and Kajal Singh	Framework Planning Branch
Jacquie Subban	Head: Geographic Information Policy
John Parkin	Deputy Head: Durban Solid Waste
Ken Breetzke	Strategic Executive: Infrastructure Planning, eThekweni Engineering Department
Logan Moodley, Manoj Rampersad and Robin Chetty	Deputy Head: eThekweni Transport Authority Senior Manager: Transport Planning, eThekweni Transport Authority Senior Manager: Public Transport Planning, eThekweni Transport Authority
Neil Macleod	Head: eThekweni Water and Sanitation
Sandile Mapumulo	Head: eThekweni Electricity
Speedy Moodliar	Senior Manager: eThekweni Water and Sanitation
Themba Msomi	Deputy Head: Economic Development Unit
Vincent Ngubane and Billy Keeves	Disaster Management

List of Interviewees in the City of Johannesburg

Name	Affiliation
Mekgoe Mokomane	Director, Gauteng Energy Office
Rodgers Musiyarira	Technical Support Officer, Gauteng Energy Office
Ferrial Adam	Gauteng City-Region Observatory

List of Interviewees in the City of Cape Town

Name	Affiliation
Brian Jones	Head: Green Energy, Electricity Services, City of Cape Town

List of Expert Reviewers

Name	Affiliation
Prof David Gibbs	University of Hull, United Kingdom
Prof Harold Annegarn	University of Johannesburg, South Africa
Mr Daniel Hoornweg	World Bank, Washington DC, United States
Prof Anu Ramaswami	University of Colorado, United States

appendix 3 - 2007 anc polokwane climate change resolution

- Recognising that climate change is a new threat on a global scale and poses an enormous burden upon South Africans and Africans as a whole because we are the most vulnerable to the effects of climate change. The risks to the poor are the greatest.
- Recognising that the evidence for climate change is indisputable and that immediate action by all governments and the public as a whole is needed.
- Setting a target for the reduction of greenhouse gas emissions as part of our responsibility to protect the environment and promote sustainable development, and to participate in sharing the burden with the global community under a common framework of action.
- Supporting the meeting of the target through: a) energy efficiency improvements in industry, in households and by setting vehicle fuel efficiency standards; b) diversifying energy sources away from coal, including through nuclear energy and renewables - especially solar power; c) putting a price on the emission of carbon dioxide and other greenhouse gases; d) allocating significant additional resources for the research and development of innovative clean and low-carbon technologies, including by retrofitting existing technologies; e) further exploration and development of carbon capture and storage methods; f) the introduction of a tariff system that promotes the efficient use of electricity; and g) the promotion of affordable public transport, the expansion of rail logistics and the reversal of the apartheid spatial legacy.
- Escalating our national efforts towards the realisation of a greater contribution of renewable energy sources, including solar and wind power, as part of an ambitious renewable energy target. The hydroelectric potential of the SADC region should be included in our plans.
- Further ensuring that our economy benefits from the global growth potential of the renewable energy sector, including through the provision of incentives for investment in renewable energy infrastructure as well as human resources to ensure that institutions and companies are ready to take full advantage of renewable energy opportunities. Moreover to promote the realignment of institutional mechanisms which will fast-track the utilisation of renewable energy to mitigate the climate change effects, including the implementation of a feed-in tariff.
- Moving to an energy efficient economy should take due regard of the imperative to create jobs. Consideration should be given to launch a green jobs programme.
- Mobilising the public, business and other players to act responsibly and save energy both as collectives and in their individual capacity, including through a mandatory national energy efficiency programme. Industrial and commercial buildings have particular potential for efficiency improvements. The government, as a huge consumer of electricity, has a special responsibility in this regard. Government buildings and installations must be given mandatory targets to become energy efficient.
- Encouraging further and increased efforts to raise public awareness about energy saving. Energy saved reduces both greenhouse gases and the need to build new power plants.
- Escalating our efforts to encourage efficiency in the consumption of energy, including through the integration of energy-saving technologies into our social programmes and by leading campaigns to encourage environmental and energy-conscious consumer behaviour.
- Further integrating climate change considerations with sustainable development strategies, the science and technology agenda,

integrated energy planning, transport policy and the evolving industrial policy. In this context to maximise the integration of a full cost accounted economy in which the life-cycle of products is internalised and the goal of zero waste production is pursued.

- Continue to pro-actively build our capacity, and develop a comprehensive strategy, to adapt to the inevitable impacts of climate change, including in the roll-out of basic services, infrastructure planning, agriculture,

biodiversity, water resource management and in the health sector.

- Introducing environmental studies and the appreciation of nature in the school curriculum.
- Building partnerships between state institutions, business, trade unions, civil society and communities to address these challenges together.

appendix 4 - climate change initiatives in asian cities

Tokyo, Japan

The Tokyo Metropolitan Government aims to reduce GHG emissions from Tokyo by 25% below 2000 (or 19% below 1990) levels by 2020. Tokyo emitted 59.6 Mt CO₂e per annum in 2006, giving a figure of 4.8 tCO₂e emissions per person (TMG, 2010).

Tokyo's 2006 GHG emissions are higher by 3.2% than the 1990 level. Energy-related CO₂ comprises the majority, 95%. A total of 38% of energy-related CO₂ emissions are contributed by the commercial sector alone. In the past two decades (1990-2006), emissions from the industrial sector have declined by 45%, but commercial and residential sectors have increased by 37% and 16% respectively. The transport sector constitutes the second largest sector in terms of energy-related CO₂ emissions (26%), but the volume of emissions from this sector has stayed the same as that in 1990. Therefore, the commercial sector is the area of policy focus for GHG mitigation in Tokyo (TMG, 2008).

Tokyo has now become world's first city to implement a Cap and Trade Programme for reducing CO₂ emissions which has become Japan's first mandatory emissions trading scheme. The Cap and Trade programme started in April 2010 and covers only energy-related CO₂ emissions. It addresses mainly CO₂ emissions from energy-use in large-scale businesses and buildings of the commercial and industrial sectors. It includes factories, public buildings (including governmental ministries), commercial buildings and educational institutions. It includes point sources as well as heat and electricity use. Large facilities consuming over 1 500 kl per year (crude oil equivalent) fall under the cap and are obliged by law to set a target, submit a five-year reduction plan, and an annual progress report. About 1 400 such facilities or sites (about 1% of the total in Tokyo) come under the cap, accounting for about 20% of the total CO₂ emissions in Tokyo (or 13 million tons CO₂). This amount represents about 40% of the total CO₂ emitted by the commercial and industrial sectors. The commercial and industrial sectors together contribute about

45% of total GHG emissions or 47% of total energy-related CO₂ emissions in Tokyo. Small and medium-sized facilities are not subject to the cap but companies or businesses with multiple buildings, each of which are below 1 500 kl provision, but collectively exceed 3 000 kl, are required to submit an annual energy efficiency plan, which is made public.

The allocation of emissions for facilities follows the grandfather method. Accordingly, the total emission allowance is 94% of the base year emissions (implying a 6% reduction) multiplied by the compliance period (5 years). The base year emission is an average emission of any three desired years within the period 2002-2007. There are separate provisions for new entrants. Facilities in which energy consumption falls below the 1 500 kl threshold for three consecutive years are allowed to exit the scheme. The target of this scheme is final energy users, therefore, CO₂ emissions from electricity generators are attributed to the facilities. TMG aims to promote CO₂ reduction from power plants through a separate measure called the Energy and Environmental Plan. A fixed emission factor is used in the scheme in order to avoid complications such as the stoppage of nuclear power plants by TEPCO (Tokyo Electric Power Company) (similar to the British Government's Carbon Reduction Commitment (CRC) Scheme). Facilities are also required to verify emissions through licensed private audit firms. In July 2009, Tokyo established (a) Guidelines for calculating GHG emissions for facilities under the cap (b) Guidelines for verifying GHG emissions for registered verification agencies, and (c) Guidelines for applying procedures for acquiring the status of a verification agency.

According to the scheme, the first compliance period (Fiscal Year (FY) 2010-2014) aims to reduce emissions by 6% from base year values amongst the capped sectors, finally reaching 17% by the end of second compliance period (FY 2015-2020). Facilities are allowed to 'bank' the surplus within a given compliance period but are not allowed to 'borrow' in the current

compliance period from the following compliance period. In case of non-compliance, a fine of 500 000 yen, coupled with an additional reduction obligation beyond the shortfall is imposed and the facilities are publicly disclosed (WB, 2010b; TMG, 2010).

The scheme aims to trade within Tokyo but also offers three types of flexibility. First, the facilities are allowed to buy credits from small/medium facilities inside Tokyo which are not part of the cap but are carrying out voluntary emission reduction (to be verified by a third party). Second, the provisions for applying for credits from large facilities outside Tokyo are being developed with some purchase restrictions. Those large facilities having base year emissions less than 150 000 tCO₂ are covered in this flexibility and buyers can only buy up to one-third of the base year emissions. Third, the use of Renewable Energy Certificates of Japan is allowed. The scheme also provides measures to protect against a surge in trading price through Renewable Energy Certificates and other measures such as the banking of environmental benefits from TMG's subsidies to 40 000 households for solar applications in a Solar Bank and selling them in the form of Green Electricity (heat) Certificates (TMG, 2010).

The roots of Tokyo's Cap and Trade go back to early 2000 when it amended the ordinance for mandatory emissions reporting for large emitters. This allowed TMG to collect a large amount of information, to make evidence-based analyses and to argue reasonably to support the mechanism. Coverage of only CO₂, and simple fuel consumption-based calculation for CO₂ helped. TMG initiated Cap and Trade deliberations and the voluntary scheme in parallel in 2002. The inability to achieve the desired results in the voluntary scheme also convinced the Cap and Trade proponents to argue for mandatory emissions trading. Intensive public discussions, stakeholder consultations, appropriate legal frameworks and a focus on large scale emitters are major reasons that it was possible to implement the mechanism (WB, 2010c). Tokyo's initiative is likely to have enormous impact and influence. It houses 50% of listed companies on the Tokyo Stock Exchange; its activities account for 20% of Japan's GDP; and Tokyo is the seat of Japan's national government. The influence will extend beyond Japan because it is a first such

city-wide mechanism and is different from the European Union-Emission Trading System (EU-ETS) or Regional Greenhouse Gas Initiative in the United States for covering large-scale office buildings. The British Government introduced a Carbon Reduction Commitment (CRC) which is similar to that of Tokyo's in that it also covers the commercial sector.

While the recent Cap and Trade Programme has become the cornerstone of Tokyo's GHG policy, Tokyo's GHG policies have spanned over a decade. It launched a two-stage information campaign titled campaign entitled the "Stop Global Warming Campaign" in 2002. In late 2002, a number of key ideas for future climate policies were envisioned:

- Making CO₂ cuts mandatory for business operations, including their office facilities.
- Strengthening standards for energy efficiency for new buildings.
- Creating a system to fully inform consumers of information on energy efficiency.
- Strengthening measures to curb CO₂ emissions from road traffic.
- Promoting a shift to renewable energy.
- Promoting measures to tackle the heat island effect as part of urban planning.

Between 2002-2004, TMG launched Phase 1 of its three-year voluntary scheme. In this scheme, apart from the mandatory emission reporting, the facilities set emission-reductions voluntarily and implemented the three-year emissions reduction plan. In 2005-8, Phase 2 of the voluntary scheme made public announcements of reduction plans and their evaluation. The less-than desired outcomes from the voluntary scheme gave impetus to the mandatory Cap and Trade scheme.

For low carbon urban development, a range of policies are in place in Tokyo. The Tokyo Green Building Programme requires new buildings to be high performance. This programme was started in 2002 and further enhanced for standards and coverage in 2005 and 2008 respectively. It requires new buildings with a floor area of 10 000 m² or larger to submit an environmental performance-rating document. The rating elements are composed of energy, resources/materials use, natural environment and heat island miti-

gation. In addition, the building owners are required to pursue sustainable design according to TMG guidelines, and rated results and published on a public disclosure system. About 1 500 buildings were under this programme by early 2008 (TMG, 2008). In addition to the Green Building Programme, TMG has made low carbon a prerequisite for large urban development, with standards on insulation and energy efficiency in building equipment. A separate TMG Green Labeling Programme for Condominiums requires the developers of large condominiums to display environmental performance labeling (with three stars) for sales. A new District Energy Programme for efficient use has recently been established in Tokyo.

Japan's national plan for the introduction of renewable energy outlines a ten-fold increase in solar power capacity by 2020 (14 GW) and reaching a renewable energy-use share of 20% of total demand, and a 40 times capacity increase by 2030 (53 GW) (REN21, 2009). The national administration has not focused on other renewable energy industries as much as solar, making the photovoltaic (PV) industry the most advanced renewable energy sector in Japan. In this context, most of the large cities in Japan are taking action to reach that target³⁹. From 2009, TMG started a subsidy system for solar energy equipment. Between 2009-2010, 40 000 households installed solar energy facilities in Tokyo⁴⁰. The system provides a subsidy of 300 000 yen for a 3kW photovoltaic system, 200 000 yen for a 6m² solar heat system, and 30 000 yen for a 4m² solar hot water supplier. A marked distinction of the TMG programme from the national subsidy scheme (Implemented by the Japan Photovoltaic Energy Association at the Japan Photovoltaic Centre)⁴¹ are the prolonged application period for Tokyo city subsidies and the larger amount of funding available.

In order to reduce CO₂ emissions from transportation, the TMG programme includes the promotion of the use of low fuel consumption vehicles, reduced fuel consumption through improving average travelling speed, the promo-

tion of eco-driving, and vehicular traffic management.

Yokohama, Japan

Yokohama City was nominated as one of Japan's Eco-Model Cities in 2008. It has a reduction target for GHG emissions per person of over 30% by 2025 (4.02 t-CO₂/person) and over 60% by 2050 (2.30 t-CO₂/person) from 2004 levels (5.74 t-CO₂/person)⁴². The largest GHG emissions sources (2005 data) are the household and the transport sectors, each accounting for about 22.5% of the emissions, followed by the energy (19%), commercial (17%), industrial (15.2%) and waste (3%) sectors. While industrial sector GHG emissions have decreased, by comparison, emissions from households and commercial buildings have risen by about 40% and 80% respectively in the 1990-2005 period. This growth needs to be curtailed and GHG reductions in all sectors are essential. A detailed action plan has been devised which identifies 2000-2013 FY as an initial action period where reduction in CO₂ will be nominal but prepares the city for large future reductions in CO₂⁴³. Notwithstanding the fact that Yokohama's plan covers all major sectors (including transport and others), its climate policy hinges on households, about 11 000 offices from the commercial sector and the renewable energy sector. Energy efficiency improvements in commercial buildings and households are aimed to be achieved through support of energy-saving products (such as energy labels and campaigns), promoting energy-saving economic activities at all 110 000 companies⁴⁴, granting economic incentives, such as lower property taxes for Comprehensive Assessment System for Built Environment Efficiency (CASBEE) certified houses⁴⁵, implementing provisions for all buildings over 2 000 m² surface area to be designed as low carbon buildings. The transport sector aims to reduce emissions through encouraging the use and improvement of public and non-motorised transport systems, restricting automobiles entering specific areas and high charges for parking, eco-driving campaigns, and the promotion of fuel-efficient and electric vehicles (low-interest loans, lower property taxes

³⁹ <http://www.re-policy.jp>

⁴⁰ <http://www2.kankyo.metro.tokyo.jp/kikaku/renewables/index.html>

⁴¹ <http://www.j-pec.or.jp/>

⁴² http://www.city.yokohama.jp/me/kankyou/ondan/plan/codo30/leaf_english.pdf

⁴³ <http://www.city.yokohama.jp/me/kankyou/ondan/plan/codo30/pdf/honpen.pdf>

⁴⁴ This includes re-enforcement of the Climate Change Prevention Measure Planning System for all companies with large emissions and enabling voluntary participation by small and medium size companies (advisory services).

⁴⁵ CASBEE is a system that makes comprehensive environmental burden evaluations of buildings taking into consideration factors such as energy efficiency, recycling capacity or room qualities.

where property is used for charging electric vehicles, etc.). It aims to increase the consumption of renewable energy ten-fold by 2025 from the 2004 level, from 0.7% (1.7 PJ) in 2004 to 12% (17 PJ) by 2025. In the future renewable energy portfolio, solar power is expected to contribute 66% (44% for electricity and 17% for heating), biomass 11%, with other sources making up the remaining 23% in Yokohama's plan. These are to be achieved through a number of policy measures. Some of the notable ones are: demonstration and implementation at municipal buildings⁴⁶, expansion of the existing subsidy system on renewable energy for domestic and commercial building applications, fixed-price purchase system, mandatory regulatory system of information provision to housing customers, mandatory examination, and mandatory renewable energy integration in new houses. Yokohama's 2010 residential subsidy programme for rooftop solar power installations has offered subsidies to 2 000 houses at 40 000 yen/kW installed (approximately US\$ 458), with a maximum of 150 000 yen subsidy. This is in addition to a national subsidy if they fit into the national programme's criteria. Subsidies are also offered for solar heating systems and larger rooftop installations for public institutions.

Kyoto, Japan

Kyoto has 1.5 million inhabitants and 50 million visitors annually. It has set its GHG emissions mitigation targets at 40% reduction by 2030 and 60% by 2050 from 1990 levels. The GHG emissions of Kyoto in 1990 were 7.72 million tons CO₂e. They peaked in 1996 at just over 8 million tons and declined to 6.93 million tons in 2008. The city's 2010 GHG emissions' reduction target of 6.95 million tons CO₂e (10% reduction target), was achieved. Whether this is a sustainable reduction remains to be seen because the emissions profile of Kyoto shows that the 10% target was reached before in the 2002 – 2003 period, yet the lower levels were not sustained (Kyoto, 2009; Kyoto, 2010).

Kyoto's past emission profile shows that the industrial sector's contribution has declined in relative (27% to 16%) as well as in absolute terms (1.96 Mt to 1.07 Mt CO₂) in 1990-2006 but the commercial and household sectors have grown significantly (Kyoto, 2010). The household sector has grown from 21.4% to 29.7% (1.55 million

tCO₂ to 1.89 million tCO₂) and the commercial sector from 20.9% to 26.7% (1.52 million tCO₂ to 1.76 million tCO₂). Thus, the cornerstones of the new target aimed at 2030 and 2050 are low carbon buildings, pedestrian-centered urban planning, use of local materials, and changes to prevailing lifestyle. Kyoto's plan requires large businesses to submit their carbon emission inventories and plans for abating emissions every three years. At present, 148 businesses are categorised into one of the following categories: a) energy producers, using energy in terms of crude oil equivalents of more than 1 500 kl; b) transporters, owning more than 100 trucks, buses or railway cars, or more than 150 taxis; c) others, emitting more than 3 000 tons CO₂ annually. The GHG inventory, reports, and plans of each of these businesses are publicly disclosed on the city government's web-page.

Similarly to Yokohama and other Japanese cities, the building sector has been tackled by the CASBEE rating system. In this respect, one of the key criteria is the energy performance. In Kyoto's plan Local has been the catch phrase; CASBEE Kyoto building certification for Kyoto includes considerations related to the use of locally-produced material to aid energy-saving and create enduring structures (e.g. the use of locally-produced timber). For the household sector, Kyoto's plan envisions the expansion of renewable energy by encouraging solar PV installation for residential use. In 2010, subsidies of 80 000 yen per kW (approximately US\$ 917) were made available for Kyoto city residents, who could also benefit from a national grant up to a maximum of 70 000 yen per kW for installations less than 65kW. The subsidy scheme in Kyoto aims to reduce GHG emissions by 59 400 tons of CO₂ by 2030 through the expansion of solar PV. In Kyoto's plan, compact and public are two keywords. Its thrusts are on those urban planning policies that aim to reduce the number of cars in the street. Thus, eco-commuting of local government employees, wider sidewalks, special public transport lanes, restriction of vehicle access to narrow streets, biodiesel-operated city buses, infrastructure for recharging electric vehicle (EV) batteries and the use of fuel-efficient vehicles are the key components of GHG mitigation plan.

⁴⁶ The CO₂ emissions of municipal government is 4% of Yokohama's total as of now.

Kitakyushu, Japan

Kitakyushu is an industrial city and was recently selected for the model city programme of the national government. Kitakyushu's target is to reduce GHGs by the order of 30% by 2030 and 50% by 2050 from the 2005 baseline. In 2005, the city emitted about 15.6 Mt of GHGs. Unlike, Tokyo or Kyoto, Kitakyushu is an industrial city and thus 66% of the total GHG emissions originate from the industrial sector. The share of transport, commercial, household and waste sectors are 9%, 8%, 7% and 3% respectively.

The target of Kitakyushu is to reduce emissions from industrial activities by 27%, from transport by 47%, from the commercial sector by 42%, from households by 35%, and all other emissions by 26% from 2005 levels by 2050.

The Kitakyushu Action Plan focuses primarily on urban planning, energy, industry, and the community. Like other Japanese cities, it primarily uses the CASBEE system to address the building sector. In line with national promotion plans, greater use of solar PV in households and public facilities are envisaged through subsidy programmes and new energy sources such as waste heat from industrial plants will be utilised. To reduce emissions at a community level, the plan aims to promote efficient and durable housing to be developed together with public transportation. Kitakyushu aims to enable a greater use of fuel cells, electric cars and public electric bicycles in the city's transport system.

Seoul, South Korea

Seoul is a key city in terms of the climate change agenda. South Korea is an Organisation for Economic Co-operation and Development (OECD) member and is likely to come under an emissions reduction obligation in the post-Kyoto regime. The City of Seoul has developed an ambitious Master Plan to reduce GHGs to 40% by 2030 from the 1990 levels. Since buildings and transport account for 90% of total GHGs in Seoul and only 0.4% of the power consumed is self-generated, Seoul's low carbon policies focuses on energy efficiency, renewable energy (to increase the renewable portfolio in energy supply internally), and energy savings in the transport and building sectors. The plan mainly aims at in-

creasing renewable energy supply by 20%, an energy consumption reduction of 20% from 2000 levels and creating one million additional green jobs by promoting 10 major Green Technologies such as hydrogen fuel cells by 2030. The Plan of Seoul envisions transforming the existing 10 000 buildings larger than 2 000 m² into green buildings by 2030, making it mandatory for all new buildings to acquire green building certificates by 2030; transforming all public transportation into green vehicles, expanding public transportation ridership rate to 70% by 2020, and creating 207 km of bike-only lanes on main roads to increasing the bike ridership rate to 10% by 2020. In the Master Plan, Seoul plans to invest US\$ 45 billion, including private investment, by 2030. The ten major Green Technologies selected by the Seoul Metropolitan Government for promotion for carbon mitigation are: hydrogen fuel cells, solar cells, IT electricity, green buildings, LED lighting, green IT, green cars, urban environment recovery, recovering waste into resources, and climate change adaptation technology. Seoul plans to invest around US\$ 2 billion (an average of US\$ 100 million annually) and US\$ 200 million per technology in R&D by 2030⁴⁷. The city's climate adaptation plan aims to establish a system of vulnerability assessment, preventive adaptation, restoration of 13 streams, an intensive management of contagious diseases, heat waves, climate-related damages, water shortages and ecosystem disruptions.

Chinese cities

Climate change is not a priority on the policy agenda for Chinese cities. However, local priorities such as energy efficiency improvement and local pollution reduction are linked to the national and worldwide climate policy agendas. Consequently, Chinese cities often rationalise and address climate mitigation as a co-benefit as a result of these priority local agendas. The 12th National Plan is expected to be more proactive than the 11th Plan (1996-2010) in terms of its climate and energy efficiency agenda and it has the potential to stimulate a new wave, with Chinese cities tackling climate and energy-related issues. Whether cities merely follow the national government's plan and guidance or formulate additional ambitious agendas and plans is yet to be seen.

⁴⁷ <http://www.c40cities.org/docs/ccap-seoul-131109.pdf>.

In the past, a few cities, such as Shanghai, Beijing and Baoding have shown considerable interest in the World Wildlife Fund's (WWF's) Low Carbon City Initiative (LCCI) in China⁴⁸. Shanghai took part in the initiative to address energy efficiency issues in large commercial buildings, mainly through demonstration projects, research and public awareness. Baoding city, as a part of the WWF Initiative, aimed to promote its solar industries through better networking and information sharing, encouraging investment and other supporting activities. Separately, Beijing, Shanghai and other cities addressed or rationalised their actions on climate through activities related to pollution reduction, economic structure adjustment, clean coal technology or less coal reliance in urban areas and industries, improving public transportation, and other areas of energy management. Beijing initiated a massive subsidy system for efficient lighting, heating systems and public transport in the 10th and 11th Five-Year Plans. In the 11th Five-Year Plan, Shanghai envisioned a target of wind-driven energy generation of 200-300 MW and solar photovoltaic generation of 10 MW by 2010 making its renewable energy share 0.5% in its energy portfolio (Li *et al.*, 2010). If 20% energy intensity targets are achieved, Shanghai will decrease the energy intensity from 0.88 tCO₂-e/10 000 yuan in 2005 to 0.70 tCO₂-e/10 000 yuan in 2010 and the energy intensity of the industrial sector by 35% and that of the tertiary sector by 15%. Although such measures in Chinese cities are not primarily for climate change mitigation and, in reality, cities' CO₂ emissions are increasing dramatically given the high rate of economic growth, they are and will lead to a dampening of the CO₂ emission growth. In addition, encouraged by economic surpluses, the enthusiasm to build model cities does exist in China as reflected by ambitious plans for Dongtang city near Shanghai and a recent attempt to build an 8.8 sq km Turpan City in northwest China (in Xinjiang) as a national model for green city development by the National Development and Reform Commission and the National Energy Administration⁴⁹.

China made commitments during COP-15 to reduce the CO₂ intensity of its economy by

40-45% by 2020 from 2005 levels. Studies have shown that urban areas contribute to 85% of China's energy-related CO₂ emissions and its 35 key large cities with 18% of the population contribute to 41% of energy-related CO₂ emissions (Dhakal, 2009; IEA, 2008). China's national approach is built around dampening its carbon profile rather than absolute reduction, with its target focusing on the carbon intensity of the economy rather than GHG emissions. China already has a target of reducing energy intensity of the economy by 20% in the 11th Five-Year Plan (2006-2010). Cities are an integral part of this reduction. Big cities are setting their own similar targets to comply with the 11th Five-Year Plan as it has been passed-down from central government. Further, the ability of city and provincial heads to meet energy intensity targets is an indicator of their performance evaluation. To meet the climate target, China is likely to expand and consolidate the current approach in its 12th Five-Year Plan (2011-2015) with nationally binding targets. If that happens, it will serve as a key tool to make provinces and cities comply. Some cities in China, such as Baoding are already active in developing a low carbon city and a low carbon economy through massive promotion and use of solar energy industries and renewable energy. China's national climate change target, which includes downscaling of its implementation to lower tier governments such as cities, is motivated implicitly by a few key factors, *viz.* improving energy security, improving energy efficiency, making a leap in the renewable energy industry and curtailing local pollution.

Bangkok, Thailand

Bangkok (refers to the Bangkok Metropolitan Administration unless otherwise stated), has 9% of the country's population and emits 26% of the nation's CO₂ emissions from energy-use (Dhakal, 2010). The city has been enthusiastically involved with many international partners in debating low carbon city development. It unveiled the BMA Action Plan on Global Warming Mitigation 2007-2012 in 2007, outlined several initiatives and set a target of reducing business-as-usual GHGs in 2012 by 15%⁵⁰. The GHG inventory that the city presented in its action

⁴⁸ WWF's LCCI focus was on (a) supporting the research and the implementation of policies which contribute to low carbon development (b) supporting capacity building on energy efficiency and renewable energy, and supporting demonstration projects (c) promoting energy efficient technology transfer and cooperation between China and developed countries (d) exploring new finance and investment instruments and sustainable trade opportunities for energy efficiency and renewable energy industry, and (e) improving public awareness on climate change.

⁴⁹ http://news.xinhuanet.com/english2010/china/2010-05/11/c_13288735.htm.

⁵⁰ BMA Action Plan on Global Warming Mitigation 2007 – 2012, Bangkok Metropolitan Government, 2007.

plan is difficult to understand and perhaps not comprehensively prepared⁵¹ but it outlines five initiatives that are reported to have potential to reduce GHG emissions to 20% below the business-as-usual (BAU) scenario by 2012 (equates to 8.7% below 2005 by 2012). They are (a) expanding the mass transit rail system, improving the current bus system and bus rapid transit system, road network and traffic - about 5.53 million tCO₂e/year reductions from BAU in 2012 (b) promoting the use of gasohol and biodiesel - about 0.61 million tCO₂e/year reductions from BAU in 2012 (c) improving building energy efficiency in municipal, and commercial buildings and reducing electricity consumption through various conservation campaigns - 2.25 million tCO₂e/yr reduction from BAU in 2012 (c) waste and wastewater management - 0.46 million tCO₂e reduction, and (d) expanding park areas to increase carbon absorption - 1 million tCO₂e absorption.

Delhi, India

Delhi (Government of National Capital Territory of Delhi) became the first city in India to unveil a plan to tackle climate change in November 2009. The plan, officially known as Climate Change Agenda for Delhi 2009-12 outlines 65 agenda points for actions in various sectors⁵² that the local government intends to undertake in the coming years (SOE, 2010). The plan closely follows the Prime Minister's National Action Plan for Climate Change. The actions are largely organised under national missions (except Himalayan Ecosystem and Agriculture, namely (a) solar mission (b) energy efficiency mission (c) sustainable habitat including public transport (d) green India (e) water mission, and (f) strategic knowledge for climate change. The Delhi plan aims to increase the use of solar energy through subsidies and mandatory programmes⁵³ for solar thermal applications and employing photovoltaic applications in government areas and schools⁵⁴. A mandatory energy conservation building code is a cornerstone of the energy efficiency improvements in government buildings and all new construction projects applied for Environmental Clearance. The

utilisation of 2.5 million compact fluorescence lamps (CFLs) by 2012 is sought in the Plan and it aims to promote the Star-rating of all electrical equipments through a systematic campaign. In recent years, to improve public transport and to tackle air pollution, Delhi massively expanded the rail-based metro system as a back-bone of public transportation and it also introduced Compressed Natural Gas (CNG) vehicles into the public transport system on a massive scale. An expansion of the metro to 150 km and to have 12 000 buses by 2012 are targets of Delhi's plan (Delhi 2009). The ability of CNG vehicles to mitigate climate change, however, can be contested but other targets such as substantially increasing road tax on cars, promoting biofuels (10% in fossil fuel) and tax concessions for clean vehicles will be likely to have positive effects in Delhi if implemented. Currently, two coal plants of 200 MW in total provide electricity to Delhi (the rests is imported) and the plan aims to disband or switch to natural gas by 2014 or earlier.

In India, the national government committed to reduce the emissions intensity of the economy by 20 to 25 % by 2020 from the 2005 levels during COP-15 in Copenhagen. India formulated a National Climate Change Action Plan in June 2008. The plan identifies eight core National Missions running through to 2017 and formulates climate change actions in accordance with economic growth and developmental needs and maximises co-benefits of climate change and development. A number of these missions address urban areas for mitigating carbon. They include the promotion of solar technologies in urban areas (Solar Mission) and reducing energy consumption through demand-side management programmes in the municipality and buildings (Enhanced Energy Efficiency Mission). The National Mission on Sustainable Habitat aims to promote energy efficiency as a core component of urban planning and address key urban sectors such as Energy Conservation Building Codes, urban waste management and recycling, automotive fuel economy standards and using pricing measures to encourage the purchase of efficient vehicles, and incentives for the use of public transportation⁵⁵.

⁵¹ The Action Plan reports 42.75 Mt-CO₂e GHG emissions from Bangkok. The reporting disaggregates emissions (electricity 34%, transport 50%, waste 3% and others 13%) but it does not produce details based on well-established definitions (either IPCC inventory or traditionally used in energy analyses such as by sector and fuel type) prompting to some confusion whether accounting of emission is sound. The reported BAU emissions in 2012 are 48.7 MtCO₂e.

⁵² This includes water, waste, forestry, buildings, lighting, energy, renewable energy, and transport sectors.

⁵³ This includes, Rs 6000 (about 130 US\$) subsidy per consumer on 100 Litre Per Day (LPD) capacity for domestic applications and Rs 60,000 (about 1,300 US\$) subsidy for 1,000 LPD for non-commercial institutions; notification for mandatory use of solar water heating in hotels and hospitals was issued in 2008.04.21 (Vide no F.DTL/2010/F-13/2008/EO/EE&REM/77).

⁵⁴ Such as Civic Center, zonal offices, hospitals, staff quarters, etc.

⁵⁵ For details see web-site of Prime Minister of India at http://pmindia.nic.in/climate_change.htm.

Indonesia

Indonesia has recently announced a target to reduce GHG emissions by 26 % by 2020 from business-as-usual levels. It formulated a National Action Plan addressing Climate Change in November 2007 that affirms that the development

programme should firmly target the reduction of GHG emissions and energy intensity of economic growth; the plan does not address cities directly but a number of links to cities can be made⁵⁶.

⁵⁶ The plan on mitigation addresses industry sector and energy sector. The energy sector envisions increasing share of renewable into energy mix, promoting geothermal and employing CCS. For details see: <http://dna-cdm.menlh.go.id>

appendix 5 - climate change initiatives in european cities

Introduction

This report demonstrates various ways in which 18 selected European capital cities have utilised various opportunities, capacities and capabilities available to them in tackling the threats and risks posed by global climate change. This information was sourced in September 2010. In all cases, the official websites of the city councils were searched in order to identify information and policies that are reported by the authority. Some of the cities featured in this report are part of the C40 Cities Climate Leadership Group. A standard set of headings is used to present information on each city. This includes broad areas in which actions can be taken by the cities in tackling climate change. Where no information is presented under a heading, this indicates that the information is not available in English on the website.

Amsterdam, Netherlands

Amsterdam is the capital city of The Netherlands. With a population of approximately 751 000 people, it is the largest city in The Netherlands. The city is run by a City Council and a College of Aldermen. The Council comprises elected representatives with responsibility for setting the policy of the municipality and monitoring the Board of Mayor and Aldermen. It is the highest authority and is responsible for all important decisions, and setting the city's annual budget.

In February 2008, the city executive established the New Amsterdam Climate as a formal framework of cooperation between various stakeholders who will play leading roles in the city's climate policy. The New Amsterdam Climate is made up of citizens, businesses and institutions that understand the necessity of taking action and identifying opportunities created by these measures. It provides a platform where parties share knowledge, map out strategies and present annual CO₂ reports.

Information sources

- New Amsterdam Climate Report: <http://www.nieuwamsterdamsklimaat.nl/report>
- The Amsterdam Declaration on Global Change:

<http://www.essp.org/index.php?id=41>

- Business Green news article : <http://www.businessgreen.com/business-green/news/2258051/amsterdam-offers-loans-electric>

Baseline targets and dates

- Reducing the city's CO₂ emissions by 40% by 2025 (compared to 1990).

Institutional and regulatory capacity

- The Amsterdam Climate Office.

Mitigation actions

Building re-design and construction

- The municipality aims to set a good example by operating in a CO₂-neutral fashion by 2015
- The report 'Building Blocks for the Amsterdam CO₂ Reduction Programme' published in 2007, outlined what the emission levels will be in 2025, in the 'business-as-usual' scenario (without additional policy), and what measures are available to reduce this.
- The report also contains a proposal to measure the progress in reducing emissions.
- The energy performance norm for newly built houses has increased.
- A newly built house uses 70% less gas for heating than the average existing house.
- Beginning in 2010, Amsterdam will build 32 000 housing units at major locations; in 2010, 40% of newly built houses will be climate neutral and by 2015, 100% of newly built houses will be climate neutral.
- The increase in gas consumption would be cut in half and electricity consumption would decline by 30%.
- Housing associations are building climate-neutral houses and bringing existing houses to that level during renovation.

Energy

- Amsterdam City Executive has decided 20% of the energy requirements in the city will be from sustainable sources generated within the municipality.

- Reduced energy demand could increase the share of sustainable energy to 30%.
- Possibilities to make the roof area of Amsterdam available to solar power companies for commercial exploitation by solar power companies to install solar panels, thin-film PV, solar boilers and solar-oriented buildings are being considered.
- New Amsterdam Climate, in cooperation with the Ministry of Economic Affairs, financiers and the energy sector, wish to implement a large-scale roll-out of solar photovoltaic systems in the built environment.
- Installation of new wind turbines at various locations in the city.
- Amsterdam is already using biomass from municipal waste and sewage sludge to generate sustainable heat and electricity.
- The electricity generation for the trams and the metro takes place at the Waste and Energy Company, where slightly more than half of the incinerated waste from non-fossil origin can be considered to be biomass.
- 37% of the households are already using electricity from sustainable sources, compared with the national average of 33%.
- In February 2010, Amsterdam City Executives announced plans for a new €3m fund designed to offer grants to businesses that replace their conventional vehicles with electric ones.
- Grants of between €15 000 and €45 000 per vehicle will be made available to cover up to 50% of the additional costs of buying electric vehicles compared with conventional alternatives.
- Grants of up to €250 000 will be on offer to businesses that commit to buying fleets of 20 electric vehicles or more.
- Allocation of reserved parking spaces for electric vehicles and the installation of 45 charging stations, rising to 200 charge points by 2012.
- Drivers of electric vehicles will be able to subscribe to the network through a website and will receive a smart card that allows them to charge their car at any charging station.
- Reduced fee and priority for electric car owners when applying for residents' parking permits.

Transport planning

- Pilot studies, initiatives and projects that will lead to cleaner mobility such as electric scooters, tuktuks and tour boats operating on hydrogen.
- The Action Plan for Goods Transport and the Priority for a Healthy City programme have the objective of improving the air quality in Amsterdam.
- An environmental zone for heavy vehicles will restrict the most polluting ones with the aim of reducing the emissions of heavy commercial vehicles by 15%.
- Waternet recently began generating biogas from wastewater treatment plants to supply green fuel for the municipal vehicle fleet.
- The municipality is consulting with TCA about the possibilities of using cleaner taxis to reduce air pollution and CO₂ emissions.
- Municipal parking policy has become more stringent, and mobility more expensive, to encourage people to start sharing cars.
- The city Council has set a target of 200 000 battery-driven vehicles on Amsterdam's roads by 2040.

Local economic activities

- Establish a Climate Fund which offers financial support to highly promising initiatives in energy savings and sustainable energy by means of loans or surety bonds.
- In addition to start-up capital from the City of Amsterdam, this fund (which is partly revolving) could possibly be supplemented if participants in the climate programme invest their carbon offsets in the fund.
- A pilot study has been planned where selected shops will use an energy-efficient air curtain.
- Cooperation between the municipality and hotels, museums, cafés and restaurants and tour boat operators focusing on the transport of goods and the removal of waste using environmentally friendly vessels on the canals of the inner city.

Information and communication

- Yearly monitoring of the current situation by determining how much CO₂ the city has emitted.
- Collection of as much information as possible about CO₂ emissions that have been

avoided due to the various measures.

- Development of a model which will be supplied with information about energy-use in the following sectors: built environment, traffic and transport, businesses and the city organisation itself.
- Engagement and information dissemination to the public on the New Amsterdam Climate through the Climate Table, Climate Cafés and theatre, and education for schools.
- In 2009, a major campaign was launched in cooperation with energy suppliers to encourage private parties as well as companies to switch to green electricity.

Athens, Greece

The City of Athens is the capital of Greece with an approximate population of 3 million. The city is run by a Municipal Authority headed by a Mayor. Based on the information available on its website, the City of Athens does not have a specific strategy for tackling climate change. However, the authority considers the preservation of a healthy, sustainable environment as a key priority.

Information sources

- The City of Athens Website: <http://www.cityofathens.gr>

Baseline targets and dates

No identifiable data in English.

Institutional and regulatory capacity

- The Greenery Charter involves the codification of basic principles and policy directions which will change the Athens of today to an Athens which is more modern, functional and environmentally-friendly.
- It creates a base and an institutional framework for the creation of a new relationship between citizens of Athens and the city.

Mitigation actions

Building re-design and construction

- The Municipal Authority aims for new municipal buildings to be designed in accordance with bioclimatic planning principles and to incorporate photovoltaic systems.

Energy

- Participated in the international "Earth Hour" initiative by switching off the lights on Lycabettus Hill, at Athens City Hall on Kotzia Square and in tens of municipal buildings throughout the city.
- The City is investigating the use of natural gas to meet the energy demands of municipal buildings.

Land-use planning:

- Twin urban regeneration project, includes the reduction in total area of construction by 66 000 m² and an increase in the amount of greenery by 30 000 m².

Waste Management

- Residents are obliged, both collectively and individually, to make a conscious effort to keep the city clean and present a desirable image of Athens.

Information and communication

- Athens is participating in an international awareness-raising effort concerning climate change and energy efficiency, which has both a symbolic and substantive character.

Berlin, Germany

Berlin is the national capital of Germany and its largest city, with 3 416 255 inhabitants (as of December 2007). It is also one of the country's 16 federal states (Länder). Berlin is governed by the Senate, which consists of the Governing Mayor and no more than eight Senators. The House of Representatives elects the Governing Mayor, who appoints the other members of the Senate. The Governing Mayor determines the general guidelines of government policy, which must be approved by the House of Representatives, and monitors their observance by the Members of the Senate.

One focus of the environmental and energy policy of the Berlin Senate is climate change. Berlin's current climate protection programme 2006-2010 aims to contribute to the achievement of climate policy objectives by measures of sustainable energy, energy conservation and efficiency. It contains goals and measures for saving energy, for environmental protection and sustainable development of energy sources.

Information sources

- The National Energy Programme 2006-2010: the climate change programme in Berlin: <http://www.berlin.de/sen/umwelt/klimaschutz/landesenergieprogramm/>
- Energy Saving Partnership: http://www.c40cities.org/bestpractices/buildings/berlin_efficiency.jsp

Baseline targets and dates

- To reduce CO₂ emissions by more than 40 % by 2020 compared to 1990.
- As a member of the Climate Alliance, Berlin has also committed to a halving of *per capita* emissions by 2030.

Institutional and regulatory capacity

- The State Energy Programme (LEP) 2006-2010 was adopted by the Berlin Senate on 18 July 2006.

Mitigation actions

Building re-design and construction

- The City of Berlin in partnership with Berlin Energy Agency (BEA) developed the "Berlin Energy Saving Partnership" (ESP) which offers efficient refurbishment of public and private buildings with the advantage of relieving the owner of the building of any investment costs.
- 1 300 buildings have been upgraded, delivering CO₂-reductions of nearly 64 000 t/a (average saving of CO₂-emissions of 27.3% in relation to the baseline scenario).
- Total guaranteed cost savings of about € 10.5 m or 26% of usual energy costs (baseline) were realized.
- Public school renovation programmes.

Energy

- The reduction of final energy consumption in Berlin and further energy efficiency improvements.
- Doubling the share of renewable energies, particularly through the development of solar heating.
- Energy management and energy partnerships in the public service.
- Expansion of combined heat and power systems.

- Promoting solar energy-use.
- Climate change agreements with Berlin business enterprises.
- Target-specific campaigns and information services, such as the Berlin Impulse programme.

Land-use planning

- Promoting research and innovation for energy conservation and use of renewable energies for sustainable urban development.

Transport planning

- No increase in transport energy consumption.

Local economic activities

- Exploiting positive economic effects through investments in energy saving and rational use of energy, especially in the public and private building sectors and in manufacturing and commercial sectors, with the added benefit of maintaining and creating jobs.
- Economic development for the development and production of innovative environmental and energy technologies.

Information and communication

- The integration of social and economic actors, particularly through targeted marketing power.
- Establish and promote networks for business, education and research in support of knowledge and experience.

Bern, Switzerland

The city of Bern is the federal capital of Switzerland and also the capital of the Canton of Bern. The city has a population of approximately 120 000 people, while the metropolitan area has a population of up to 660 000 people. The city is run by a local Council which is responsible for governing, planning and acts as the executive body on behalf of the city.

The Council includes the Mayor, and five members who are elected every four years by the voters. The City of Bern published an Energy Strategy 2006-2015 as the policy framework for promoting effective use of energy, sustainable energy supply and renewable energy sources.

However, this document is not available in English, hence the measures outlined here were obtained only from the City of Bern official website.

Information sources

- The City of Bern website: http://www.bern.ch/leben_in_bern
- Energy Strategy 2006-2015, the City of Bern: http://www.bern.ch/leben_in_bern/sicherheit/umweltschutz/energie/bernlebenslage.2006-09-21.8260622339
- Canton Bern website: <http://www.bve.be.ch/bve/de/index/umwelt/umwelt/klima.html>

Baseline targets and dates

- Reduce consumption of fossil energy (oil, natural gas) and CO₂ emissions by 10%.

Institutional and regulatory capacity

- The Environmental Protection Agency is responsible for clean air, clean water, less noise and sustainable development in environmental and energy sectors in the city of Bern.
- The Energy Division is responsible for drawing up the targets for implementing the energy strategy.

Mitigation actions

- Increase in annual electricity production from renewable sources (excluding water) by 5 GWh.

Building re-design and construction

- Provide energy consulting services to owners of apartment buildings.
- Reduction in fossil fuel consumption in city-owned buildings.
- Stabilisation of the power consumption of the city-owned buildings at the level of 2004.

Energy

- Consumption of energy from renewable sources such as hydro, solar and biomass should be promoted.
- Increase in annual heat generation from renewable sources by 10 GWh.

Transport planning

- Reducing CO₂ emissions from city-owned vehicles.
- Reduction in private motor vehicles.

Information and communication

- Provides information through concrete projects and their contribution to reducing dependence on non-renewable energy sources.

Brussels, Belgium

The City of Brussels is the constitutional capital of Belgium and part of the Brussels-Capital Region which comprises 19 municipalities. The metropolitan area has a population of over 1.8 million, making it the largest metropolitan area in Belgium. The city is governed by an assembly of elected representatives, the city Council, and an executive, the College of Mayor and Aldermen. The city Council consists of elected representatives and is responsible for making all decisions of municipal interest. The College of Mayor and Aldermen ensures the execution of the decisions of the council and oversees the daily management of the municipality.

Information sources

- City of Brussels website: <http://www.brussels.be>
- Brussels-Capital Region website: <http://www.ibgebim.be/Templates/Home.aspx?langtype=2060>

Very little information is available in English.

Baseline targets and dates

- No information found.

Institutional and regulatory capacity

The environment is a subject managed by the Brussels Capital-Region, however the City of Brussels plays an active role in this domain through the Eco-Advice Unit.

Mitigation actions

Building re-design and construction

- New requirements for minimum energy efficiency and reducing the impact of these facilities on the environment.

Copenhagen, Denmark

Copenhagen is the capital of Denmark with over 1.1 million inhabitants. The City Council consists of 55 members elected for a period of four years. The Council is the city's supreme political body. It is divided into seven committees with various responsibilities, including energy and environment. In 2010, the municipality of Copenhagen published the Climate Plan which outlined ambitious targets along with 50 specific initiatives for reducing its carbon emissions in five years. The Climate Plan's goals are an extension of the municipality's other goals in transport, housing and construction, health, education, social activities and culture. It aims at making Copenhagen the first carbon neutral capital in the world.

Information sources

- The City of Copenhagen website: <http://www.kk.dk/english.aspx>
- Copenhagen Climate Plan: <http://www.c40cities.org/docs/ccap-copenhagen-030709.pdf>
- C40 Cities Climate Leadership Group website: http://www.c40cities.org/bestpractices/energy/copenhagen_heat.jsp

Baseline targets and dates

- 20% reduction from 2 500 000 tons to 2 000 000 tons CO₂ between 2005 and 2015.

Institutional and regulatory capacity

- The Municipality of Copenhagen.
- The Technical and Environmental Committee administers the city's activities within local planning, urban renewal, environmental and construction areas, as well as within other technical areas.

Mitigation actions

Building re-design and construction

- Aims to achieve 10% of its total CO₂ (equivalent to 50 000 tons) reduction by 2015 through construction and renovation projects.
- Placed a climate focus on all renovation, maintenance and management of municipal buildings.
- All buildings that the municipality rents must

meet energy conservation criteria.

- Established an energy fund so that savings from climate upgrading can finance upcoming projects.
- Building owners, renters, craft workers and consultants receive targeted training on CO₂ reduction opportunities.
- Inhabitants and businesses gain perspective on their building's heat losses via the "hotmapping" function on the municipality's homepage.
- Started a dialogue with businesses about energy conservation measures and the significant economic benefits these bring.
- Opened dialogue with the national and regional governments about undertaking energy upgrades of their buildings in Copenhagen.
- Contribute towards establishing and developing solar cell solutions through partnerships and a heightened information campaign.

Energy

- Aims to meet 75% (equivalent to 375 000 tons) of the combined CO₂ emissions reduction through the energy grid by 2015.
- 97% of Copenhagen city heating is already supplied by a system which captures waste heat from electricity production - normally released into the sea - and channels it back through pipes into peoples' homes, saving an equivalent of 665 000 tons CO₂.
- Renewable energy is also supplied by Horns Rev Off-shore Wind Farm, with 80 wind turbines and a total capacity of 160 MW
- Will work to build new windmills which deliver the equivalent of the entire municipal government's electricity use.
- Development of LED technologies and switching to more energy efficient for street lighting thereby cutting energy-use in half.

Land-use planning

- 1% of its total CO₂ (5 000 tons) reduction in 2015 through city development.
- Promoting an integrated city less dependent on transport.
- Climate change is integral to sustainability planning in all city development projects.
- All new city development areas are desig-

nated low energy areas with stringent low-energy standards.

- Enforce compliance with low energy requirements.

Waste Management

- Copenhagen's "Waste Plan 2008" is a detailed plan to reduce waste and improve management over the period of 2005-08.
- Only 3% of waste goes into landfill.
- Innovative and adaptive approaches to waste management - waste drop off points are local and have flexible hours of operation.
- The system has reduced CO₂ emissions by 40 000 tons CO₂ and generated 1 000 000 MWh of additional energy — enough to power 70 000 homes annually — by turning waste to energy.
- The Waste Plan is revised every four years and covers a twelve-year period to ensure flexibility, input from businesses and the community, and long-term solutions.

Transport planning

- Over 36% of the city's population cycle to work every day saving approximately 90 000 tons of CO₂ emissions per year.
- Will meet 10% of its total CO₂ reductions (50 000 tons) via the transport sector.
- Investment in public transport to ensure comfort, reliability, minimal travel times and smooth linkages between the different public transportation systems.
- Bus companies are required to reduce bus CO₂ emissions by 25%.
- Lobby the national government for the right to introduce road pricing and designation of environment zones in dense downtown areas where only environmentally friendly cars and trucks are allowed.
- Rerouting traffic away from shopping streets and parking restrictions to create the incentive for alternatives to automobile transport.
- Intelligent transport systems to optimise traffic signals to the benefit of bicyclists and busses. GPS-transmitted parking opportunities reduce congestion from drivers searching for a parking space.
- Provision of refuelling stations and free parking to users of electrical and hydrogen powered vehicles.

- The municipality's vehicle fleet is converted to hydrogen-powered and electrical cars.

Local economic activities

- Industries are encouraged and supported in reducing their CO₂ emissions.
- Business and academia combine forces to develop proposals for CO₂ reductions and economic development in an innovative think-tank.

Adaptation actions

- The municipality of Copenhagen will develop a climate adaptation plan to ensure that the city is ready for the weather expected from climate change.
- Develop various ways of draining water from big downpours – and applying these methods throughout the city.
- Additional green areas, pocket parks, green roofs and green walls which slow rainfall runoff, thus reducing the risk of flooding.
- More buildings using alternatives to air conditioning units, such as sunshades, improved ventilation and insulation.
- Safeguarding against flooding and rising sea-levels.
- Develop a comprehensive climate adaptation strategy.

Information and communication

- Aims to meet 4% of the total CO₂ (equivalent of 20 000 tons) reduction goal in 2015 by engaging residents of Copenhagen.
- Partnerships and publicity focus on more effective car-use – car-sharing, car-pooling and climate friendly driving techniques.
- Climate knowledge on the internet – debate, inspiration and specific actions for residents of Copenhagen.
- Climate consultants provide advice on domestic electricity and heat conservation, transport options and waste segregation.
- The new virtual climate science centre makes Copenhagen a leader in climate education of children and youth, and is helping to create a new generation of climate-wise Copenhageners.
- Climate partnerships, network solutions and scope for innovation in private enterprises link business development to climate action.

- The municipality sharpens focus on energy efficiency in all its procurement efforts.

Dublin, Ireland

Dublin is the capital of the Republic of Ireland. The city region had a population of 1 187 176 million people in 2006. This is projected to rise by up to 250 000 by 2013 and 440 000 by 2021. The city is governed by an elected city Council which is responsible for making decisions in key areas such as energy, planning, transport, waste management and biodiversity. The Climate Change Strategy for Dublin City 2008-2012, which was prepared by the Environment and Engineering Strategic Policy Committee in association with City of Dublin Energy Management Agency, was adopted by Dublin city council in May 2008. The Strategy builds on existing environmental policies, whilst recognising the potential implications of climate change as one of the key drivers of change within our community. It commits to implementing a range of measures across key areas.

Information sources

- Dublin City website: http://www.dublincity.ie/YourCouncil/CouncilPublications/Documents/climatechangeLOW_ENG.pdf

Baseline targets and dates

- Carry out an economic analysis of the cost of (a) stabilising Dublin's total CO₂ emissions at present levels and (b) reduction of CO₂ emissions by 3% per year, as part of the Action Plan on Energy for Dublin.
- Set an overall average target of minus 3% per year reduction in total energy end-use for the Council's own operations, giving a total reduction of 33% by 2020, in line with the national targets and exceeding the requirements of the EU Energy End-use and Energy Services Directive.

Institutional and regulatory capacity

The Climate Change Strategy for Dublin City is in accordance with the National Climate Change Strategy and with other agencies and State Departments. Close co-operation with all the local authorities in the Dublin Region is envisaged. The strategy will cover the years 2008-2012 in the short-term, but also takes into account a medium-term view to 2020 and beyond. Once

each year the strategy will be reviewed and updated.

Mitigation actions

Building re-design and construction

- Reduce the energy consumption across all Council-owned social housing and within its own facilities through education and refurbishment.
- As a part of the Energy Action Plan, detailed audits of Dublin City Council's buildings will be carried out. In the audits opportunities for energy efficiency and use of renewable energy will be delivered.
- Promote the use of solar thermal panels in both private and public housing.
- Carry out a pilot demonstration project for Passive House Standard Housing in one of the new Social Housing schemes.
- Target and promote a carbon neutral Sustainable Communities demonstration project in each of the five city areas.
- Promote overall sustainability in developments.

Energy

- Map areas that can be served by the proposed district-heating network to be used by planners and for inclusion in the next City Development Plan.
- Develop, publish and disseminate technical and operational guidelines for district heating in Dublin to inform both planners and developers to ensure compatibility between different schemes.
- Continue to pioneer and promote best practice in renewable energy through the Council's own projects and operations.
- Switch to renewable energy for municipality's own electricity supply as far as is practical within the established procurement process.
- Make sure that the development of a district heating system is not dependent on the planned waste incineration plant, but will take place with or without the plant.
- Install energy efficient outdoor and indoor lighting and convert all traffic lights to LEDs which are much more energy efficient than conventional light bulbs.

- Appoint an Energy Conservation Officer to drive forward energy conservation throughout the City Council through an 'Action at Work'-type programme.
- Nominate a staff member as an Energy Liaison Officer in each department to ensure that best practices in energy efficiency are adopted and that the 'Action at Work' programme is implemented.
- Influence private builders to improve the design standards of new buildings through the variation of the Dublin City Development Plan 2006-2011.
- Introduce requirements demanding highest energy saving standards in planning permissions for alterations of existing buildings.
- Meet the 59% recycling target by 2013 and make Dublin a leading recycling region in Europe.
- Monitor the development of new internal markets for recyclables and actively consider the use of recyclable products in line with the new green procurement guidelines.
- Implement the Commercial Waste By-Laws to ensure that business and industry source-separate specific recyclable and organic waste generated on-site.
- Progress the delivery of the centralised biological treatment facilities as swiftly as possible.
- Implement a phased roll-out of the brown bin across the city to be substantially completed by the end of 2008.
- Ensure that landfill gas capture rates of 70-75% are achieved at the existing and proposed landfill facilities to minimise the emissions.
- Optimise the routes travelled by the waste collection vehicles.

Land-use planning

- Promote overall sustainability in developments.
- Develop a more consolidated city as far as possible.
- Take sustainable transport aspects into consideration when planning new housing areas.
- Facilitate the location of park and ride sites in new areas adjacent to good public transport.
- Thoroughly evaluate the environmental aspects before giving planning permission for shopping centres, specifically examining carbon miles for goods sold and proximity of the centres to their customers.
- Walking routes within and between the centres on the north and south side of the Liffey, in order to enhance and strengthen the centre of Dublin and promote walking.

Waste Management

- Under its new green procurement guidelines, make demands regarding packaging and other waste related issues when procuring supplies, etc.
- Continue to expand the resources for awareness and educational staff and campaigns specifically targeted at waste prevention at the household, school and business level.
- Maintain the support of existing community reuse schemes through educational and financial support and support the development of new initiatives.
- Influence the improvement of the public transportation network.
- Extend and improve the cycling and walking network.
- 160 kilometres of bicycle lanes have been constructed in Dublin.
- Work actively to increase the number of trips made by public transport and to reduce the dependency on private car trips through implementation of the Quality Bus Corridors throughout Dublin.
- Start up the rental service Dublin City Bike.
- The use of the city centre by heavy goods vehicles (HGVs) has been restricted with the opening of the Dublin Port Tunnel and the introduction of the ban on 5+ axle vehicles, which has resulted in a reduction in HGVs of between 85 and 94% in the city.
- Investment in an Intelligent Transport System that manages the city traffic in different ways to increase the efficiency and safety, and reduce the GHG emissions.
- 3 000 lights changed to energy efficient LEDs, saving approximately 682 tons of CO₂ per year and by 2010 when the project is complete 2 000 tons will be saved per year.
- Dublin City Council Traffic Department also

uses solar power for all its 900 parking meters throughout the city.

- Set up a licensing system for cooking oil from food service establishments such as hotels and restaurants to be used as biodiesel.
- Promote more research into renewable fuels in Dublin City Council's fleet of vehicles.

Local economic activities

- Investigate new financial support mechanisms for delivering local advice, guidelines and information to building owners in order to encourage refurbishment of the existing building stock (commercial and residential), as these services cannot be delivered at local level at zero cost.
- Develop a programme for small businesses to help them be more energy efficient, as 96% of Dublin businesses are small and medium enterprises.

Adaptation actions

- Conduct an evaluation of the impacts and threats of climate change on ongoing planning and development projects both from the mitigation and adaptation perspectives.
- Maintain valuable mitigation habitats such as wetlands and forested areas.
- Ensure continued stringent protection of Natura 2 000 sites (currently 3 649 hectares), which, together with connectivity between them are essential to mitigate against the effects of climate change.
- Create a network of corridors linking Natura 2 000 sites to each other, to green areas and to Dublin City conservation areas. A cohesive network will allow the most resilient habitats and species to migrate and therefore it would provide the source for shifting ranges of habitats and species.
- Open up culverted streams and rivers. This is a mechanism of creating a corridor for species to move and adapt to changing climate.
- Use soft engineering options to reinforce coastal defences. These allow for natural and continued accretion of three Natura 2 000 sand dune habitats that occur in Dublin and also allows the coastline to continue augmenting its natural defences against rising sea-levels.
- Provide coastal defences to protect the community and reduce risk of flooding.

- Ensure that any reclamation of estuary land will be carried out in a sustainable manner.
- Ensure that there will be no removal of sand from beaches.
- Ensure that all coastal defence measures are assessed for environmental impacts.
- Track changes in phenology in the National Botanic Gardens, Glasnevin and link data with meteorological data and make the results available within Dublin City Council.
- Initiate a project to survey present distributions of indicator butterfly/ moth species and track changes in distribution over time.

Information and communication

- Include good information in all planning projects so that people are willing to live in new forms of housing, be more energy conscious, conserve water, recycle and be more litter conscious, and use public transport.
- Develop a marketing strategy to promote cycling.

Helsinki, Finland

The City of Helsinki is the capital of Finland. It had a total population of 576 632 in 2009. The city is governed by a City Council, which makes the most important financial decisions as well as those related to city administration. The Council further vests their powers in other organs such as the City Board, various committees and boards and individual officials. The threat of global climate change and emergence of European and national climate policies have in recent years introduced a significant new challenge to Helsinki's overall planning and policy formulation.

Helsinki Metropolitan Area Council approved a regional climate strategy in December 2007 which defines specific targets and guidelines for various municipal functions, including energy production and use, regional land use and transport system development, building construction and maintenance, waste management, recreational services, education and awareness-raising.

Information sources

- Environmental Sustainability Issues and Challenges in Helsinki 2010 Report: <http://www.hel>

fi/wps/wcm/connect/7d593d004298169a9779bf4b956b8a55/Environmental+Sustainability+esite_nettiin.pdf?MOD=AJPERES&CACHEID=7d593d004298169a9779bf4b956b8a55

- C40 Cities Climate Leadership Group website: http://www.c40cities.org/bestpractices/energy/helsinki_heating.jsp

Baseline targets and dates

- To reduce the CO₂-emissions/*per capita* in the whole Metropolitan Area by one-third by 2030, based on the 1990 level.
- In January 2008, the City Council of Helsinki adopted ambitious goals to reduce the city's total CO₂ emissions by 20 % by 2020, based on the 1990 level.
- The city also adopted the goal to increase the amount of renewable energy from 5% in 2007 to 20% by 2020 in the city's energy supply (heat and electricity production).
- In December 2007, Helsinki signed an energy conservation agreement with the Ministry of Trade and Industry, which aims to reduce energy-use by 9% between 2008–2016 in city-owned buildings.
- In 2009, the city adopted a Covenant of Mayors initiative to reduce the city's greenhouse gas emissions by more than 20 % by 2020 and to improve the energy efficiency of the city by 20 % by 2020. Helsinki is preparing a sustainable energy action plan (SEAP) to fulfil the commitment.
- In 2010 Helsinki signed EURO CITIES Green Digital Charter to decrease the ICT direct carbon footprint by 30% by 2020 and deploy five large-scale ICT pilots before 2015.

Institutional and regulatory capacity

- Environmental protection is a key aspect of all activities of the City of Helsinki. The City's environmental oversight and expert agency is the City of Helsinki Environment Centre.

Mitigation actions

Building re-design and construction

- A new challenge for Helsinki is to develop eco-efficient housing units in the eastern Östersundom district, which will also provide new possibilities to develop the utilisation of solar and geothermal energy.

- Low-energy construction in both new construction and the renovation of buildings.
- Building regulations are planned to be tightened for city-owned plots to A-class in dwelling houses (100 kWh/m² for heating, cooling and electricity in blocks of flats), which is similar to low-energy standards in Finland.
- For city-owned service buildings, low-energy renovation is being piloted and energy efficient renovation instructions have been assigned.
- Residential buildings in Finland can get 10–20% financial support for energy efficient renovation or for transferring the heating system of buildings into district heating or renewable energy.
- The first residential area with low-energy building codes, demand for renewable energy and for timber construction (carbon sink) has been planned for the Honkasuo district.
- For the new large residential planning area called Östersundom, low energy construction is being studied as well as the possibilities of using solar energy and local biomass to provide a major part of the required energy.
- The first 150 000 households are able to get their hourly electricity consumption from the Internet in 2010.

Energy

- Eco-efficient heating and cooling in Helsinki reduces emissions in the city by 40% a year - an average of 2.7 Mt CO₂ annually.
- The Helsinki-owned energy company, Helsingin Energia, which causes about 4/5 of the city's GHG emissions, has recently produced a long-term development plan to reduce its emissions.
- Include large offshore wind power plants in the Baltic Sea, and use wood-based biomass on a large scale to replace coal.
- Study the possibilities for carbon capture and storage technologies.
- Helsingin Energia is providing its customers a real-time electricity monitoring option through the installation of 'smart' meters in every household by 2013.

Land-use planning

- A major objective of the City Council's strategy programme for 2009–2012 is to mitigate climate

change with a compact city structure relying on a functional rail transport network.

- The municipalities of the Helsinki metropolitan region are now starting to prepare a combined master plan for the whole region with a target of preventing urban sprawl.
- Compaction and infill construction are primarily focused on under-utilised and brown-field areas where land use is changed to housing and services.
- A large part of the city's current harbour, industrial and storage areas in the inner city are being changed to new housing, office and service areas and seaside parks.
- All new residential areas will be functionally connected with the rail transport network. The network of bicycle lanes is being extended in all neighbourhoods.

Waste Management

- The top priority in the waste management sector is waste prevention.
- The waste treatment centre in Espoo receives unsorted waste and separately collected organic waste from over a million inhabitants and 50 000 firms in the Helsinki metropolitan area.
- About 55% of household waste is recycled or reused
- Compost made from organic waste is used in landscaping.
- Helsinki Region Environmental Services Authority (HSY) is planning to increase the efficiency of organic waste management by constructing a biogas digester to extract biogas from the collected organic waste before the composting process.
- Proposal for new incineration plant in 2014.

Transport planning

- The share of transport modes in Helsinki is such that about 30% of all trips are made by car, 32% by public transportation, 29% on foot and 7% by bicycle.
- In the centre of Helsinki, only 20% of all trips are made by car.
- The city strategy programme is committed to increase the share of sustainable transport modes by 3% by 2012.
- There are large ongoing railway projects, metro to the City of Espoo, metro/light rail

to the new residential area of Östersundom, railway to the Helsinki Airport and new light rails to the Kruunuvuorenranta residential area.

- A congestion fee study was carried out in 2008–2009 and follow-up studies are ongoing in 2010.
- In competitive tendering for bus services in the Helsinki metropolitan area, preference is given to environmentally friendly buses.
- Helsinki has committed to doubling the share of cyclists to 15% by 2020, and new cycle paths are planned and built.
- Pedestrian streets are also being extended in the city centre.

Local economic activities

- Special attention will be paid to the possibilities of reducing the carbon footprint of the city's procurement.
- Focused environmental education and awareness-raising services are also provided by Helsingin Energia, the Public Works Department, Helsinki Region Environmental Services (former YTV), the regional recycling centre, the national Motiva agency, which enhances energy saving and eco-efficiency as well as environmental NGO's, such as WWF, Finland's Nature Protection Association, the Youth Nature League and the Finnish Association for Environmental Education.

Adaptation actions

- Helsinki, together with the other cities in the metropolitan area and HSY, is preparing a climate change adaptation strategy for the metropolitan area to be completed in 2011.
- Helsinki already has a storm water strategy and a flood strategy.

Information and communication

- Efforts to raise environmental awareness of Helsinki's inhabitants by operating nature schools, organising environmental campaigns and seminars, arranging nature walks in the neighbourhoods and enhancing environmental education in schools and nurseries.
- Provide advice to citizens, firms and other organisations on preventing, sorting and recycling waste.

- According to a survey by HSY, domestic recycling has generally become more popular. Over 90% of the residents claimed that they recycle paper, nearly 80% recycle cardboard and approximately 70% recycle glass waste on a regular basis.
- Domestic recycling has been a steadily increasing trend during the first decade of the new millennium.
- Eco-support activity is to improve environmental management, eco-efficiency and environmental awareness in all workplaces of the city administration.

Madrid, Spain

Madrid is the capital and largest city in Spain. As of December 2009, the population of the city was approximately 3.3 million, while that of the metropolitan area is estimated to be nearly 6 million, making it the third most populous municipality in Europe. The city government is made up of a mayor and a 52-member City Council (known as the Pleno or plenary). The mayor and City Council members take responsibilities for key decisions in the city. The Act Regulating the Basis of Local Regimes provides that municipalities have jurisdiction to carry out activities complementary to those of other administrations regarding the general interest of the city, in particular protecting the environment. The City of Madrid proposes coordinated action among all municipal services to meet the abatement targets for GHG emissions. This is presented in the “*City of Madrid Plan for the Sustainable use of Energy and Climate Change Prevention*”.

Information sources

- City of Madrid Plan for the sustainable use of energy and climate change prevention: <http://www.c40cities.org/docs/ccap-madrid-110909.pdf>

Baseline targets and dates

- Proposes a 14% emission abatement by the year 2012, with respect to emissions in 2004, representing a total of 3 296.48 kt of CO₂ equivalent with respect to estimated emissions in the trend scenario for the same year.

Institutional and regulatory capacity

- A key feature for coordinating and managing actions on climate change and energy

in Madrid is the Local Energy Agency.

- This body will be backed by the Ordinance on sustainable energy-use, as a specific regulation governing integral, sustainable energy management.

Mitigation actions

Building re-design and construction

- Including a supplementary environmental report to Technical Building Inspection.
- Fostering Energy Certification for Buildings.
- Programming energy audits in the tertiary and services sector.
- Promoting collective systems for heating, domestic hot water (DHW) and air-conditioning.
- Programming subsidies for replacing diesel boilers.
- Fostering efficient lighting.
- Using LED lamps for traffic lights in the municipality.
- Plan for reducing consumption in the use of domestic appliances and air-conditioning equipment.
- Promoting bithermal domestic appliances and conventional ones that use DHW from thermal solar energy.
- Programming energy audits and certification in municipal buildings and facilities.
- Integrating solar energy systems in municipal buildings.
- Managing energy purchasing and clean quotas in all municipal facilities and buildings.
- Applying all criteria relating to energy consumption and GHG emissions in local contracting.
- Carbon neutral institutional events of the City Council.
- Revolving fund to invest in energy efficiency measures in municipal buildings.
- Energy efficiency and reduction plan for IT systems in municipal facilities and buildings.
- Fostering exemplary projects that integrate sustainable criteria in urban constructions and developments.

Energy

- Promote the optimisation of energy consumption at public municipal facilities and

offices, and monitor energy consumption in municipally-owned buildings.

- Reduce the external energy dependence of the city of Madrid while improving supply guarantee, quality and security.
- Considerable effort has been made through measures designed to address both objectives, such as the Local Air Quality Strategy, energy diversification of the City Council fleet or participation in European projects, among others.
- The Municipal Housing and Land Company of Madrid City Council plans to install photovoltaic panels in all the buildings it owns.
- The city of Madrid has some biogas production associated with material pruned from Madrid's 19 000 ha of forested surface area.

Land-use planning

- Madrid City Council has planned a series of actions to enlarge municipal green areas, with an increase of the city's capacity to absorb carbon.
- Madrid's green surface area occupies 43% of the city's total area (25 696.79 ha).
- According to recent figures from the urban forestry inventory, there are a total of 226 301 trees, meaning one tree planted for every 14 inhabitants (not including trees in parks and gardens), with a total of 4 146 tree-lined streets, representing 51.58% of all streets mapped in Madrid.
- Increasing the carbon sink capacity of city trees by 20%.
- Introducing green roofs in 10% of municipal buildings.
- Considering how necessary and important infrastructure works are for the city of Madrid, the City Council will foster the development of a Master Plan for Infrastructures, integrated within a Geographical Information System.
- Accordingly, the Master Plan for Energy Infrastructures will help coordinate actions by different stakeholders and public services, and achieve the maximum possible synergies in each action necessary in the city of Madrid's infrastructures.

Waste management

- The municipality currently has two energy recovery centres in operation: Las Lomas

incinerator and La Galiana degasification plant, powered with biogas generated in Valdemingómez landfill.

- Two plants for transforming organic matter into compost and biogas are planned to start operating in 2008.
- Measures in Madrid's Local Urban Waste Strategy include reducing the disposal of organic matter and biodegradable waste in landfills, due to the significant emission of GHG in its decomposition processes.
- Raise awareness, to minimise waste generation at source and increase separate collection.
- Introduce new green zones in the landfills.

Transport planning

- Promoting sustainable mobility.
- The city of Madrid will draw up and adopt an Urban Mobility Plan, with short, medium and long-term goals to reduce the use of private motor vehicles and increase the share of other, less pollutant modes of transport.
- Promote alternative fuel supply networks for transport.
- Raise awareness of drivers to consider environmental aspects when purchasing new vehicles.
- Campaigns to educate and inform and promote biofuels.
- Voluntary agreements with vehicle hire companies to promote clean vehicles.
- Setting up a car-sharing system.
- Limiting the number of parking bays in tertiary buildings.
- Annual campaigns to analyse energy consumption and GHG emissions by the vehicle fleet.
- Efficient driving programme for drivers in the municipal fleet.

Local economic activities

- Collaboration with public and private institutions and agencies.
- Awareness, communication and training in the industrial sector.
- Energy audits and certification. Training in biofuels and efficient driving (considered in the measure "Programme on Efficient Driving for Drivers in Municipal Fleets").
- Entering into agreements with supply com-

panies and the owners of distribution stations to introduce alternative fuel pumps. As part of these agreements, the option of tax allowances will be studied.

- Voluntary agreements with high-emitting companies, this includes encouraging companies to set reduction targets and monitor compliance.
- A Business Forum on Climate Change will be held, to kick off the network by means of a Voluntary Agreement Company/City Council, through Madrid Chamber of Commerce and the Business Association of Madrid.

Adaptation actions

- Study and evaluation of the risk from natural phenomena in the municipality of Madrid.
- Monitoring and protocol system for measures against the concentration of pollen, PM and other atmospheric pollutants.
- Raising awareness of food and water-borne diseases.
- System of indicators to enhance municipal tourism management models and policies.
- Conservation and protection programme for environmentally significant areas.
- Creating green zones and fostering biodiversity.

Information and communication

- Actions to divulge and inform on the Plan for the Rational Use of Energy and Climate Change Prevention.
- Awareness campaigns aimed at the public in general.
- Awareness and training for professional associations in the construction sector.
- Promoting an advisory body for climate change prevention and rational energy-use.
- Awareness and training programme aimed at municipal authorities.
- Promoting social research into the use of sustainable energies and climate change prevention.
- Draw up and centralise information and documentation regarding energy management and use.

Oslo, Norway

Oslo is the largest city in Norway. It has a population of 560 484 in its municipality. As Norway's

capital city, Oslo enjoys county status but is organised differently from the other county councils. Since 2004 the city has been divided into 15 boroughs (bydeler). Major administrative decisions are made by the Oslo City Council which is subordinated to an elected Oslo City Board.

Information sources

C40 Cities Climate Leadership Group website: http://www.c40cities.org/bestpractices/lighting/oslo_streetlight.jsp http://www.c40cities.org/bestpractices/waste/oslo_system.jsp

Baseline targets and date

- By the year 2030, Oslo's climate gas emissions will be reduced by 50 % compared to 1990.

Institutional and regulatory capacity

- In 1999, the City of Oslo began collaborating with its neighbouring counties, Akershus and Buskerud, in order to reduce greenhouse gas emissions. The main objective of this collaboration is to reduce emissions in the Oslo region according to the Kyoto Protocol target for Norway, without increasing the use of electricity beyond today's level.
- Oslo also collaborates with the Norwegian Public Roads Administration, to improve the local air quality in the city.

Mitigation actions

Building re-design and construction

- Improving energy efficiency in private and municipally owned buildings through the city's "ENØK" fund which gives financial grants and supports individual efforts to improve energy efficiency.
- The city will impose stricter energy efficiency requirements on new buildings.
- An assessment of tools which can best measure and control energy-use in buildings will be carried out.
- Improve current regulations for energy performance in new buildings, thus lowering the energy demand per m².
- The city will demand energy certificates for buildings and that a mechanism for energy accounting is established for real-estate transactions.

Energy

- 10 000 high-pressure sodium lights using an “intelligent lighting” system that adjusts light according to need save 1 440 t CO₂ and reduce energy consumption by 70%.
- Current economic incentive systems will be continued to encourage people to replace their old stoves with new, cleaner burning varieties.
- Other initiatives for reducing emissions from wood stoves will be considered.
- Doubling of the delivery of district heating to the Oslo region by 1000 GWh. Oslo already has Norway’s largest system of district heating and utilises a large proportion of renewable energy sources such as organic waste, heat pumps and hydropower.
- Increasing the share of renewable energy sources, and evaluating the establishment of a new bio energy plant.
- Converting 13 % of a total of 27 000 boilers in the Oslo region will reduce greenhouse gas emissions by approximately 300 000 tons CO₂ per year.
- Annual servicing and adjustments to the burners saves 10 % of the total energy consumption, with a similar reduction in greenhouse gas emissions.

Waste management

- In 2006, more than 200 000 tons household waste was collected and of this 1% was reused, 27% material recovered, 67% energy recovered and only 5% went to landfill.
- 58 000 tons of CO₂ were avoided through use of waste to generate energy for the city’s district heating system.
- From 2006-2009, the city has a Waste Management Strategy that, for example, sets ambitious targets for sorting of plastics and organic waste. This strategy aims to establish a “recycle and reuse” society.
- Waste will only be incinerated if there are no other more environmentally friendly ways to handle it.
- Improve management of landfills so that the greenhouse gas methane can be extracted.
- Construction of new waste handling plants for energy recovery and recycling, as well as the redesigning of old landfill sites to increase oxidation of methane.

Transport planning

- Facilitating the use of environmentally friendly transportation modes including regular public transit and car-sharing.
- The City of Oslo’s Agency for Road and Transport offers an advisory service for work places in the city in order to encourage mobility planning within the city’s business community.
- Increase the capacity and efficiency of freight transportation, in order to reduce the number of kilometres driven in the region.
- Encourage the use of cars that have low or zero emission of pollutants by imposing conditions on leasing agreements to ensure that Council vehicles meet high environmental standards.
- The use of environmentally friendly technology such as hydrogen, fuel cells will be stimulated.
- Increased use of biofuels through reduced taxes, encouraging filling stations to offer biofuels or a mix of diesel, gasoline and biofuel.
- Teaching drivers to adopt a more energy-efficient driving style.
- Offering courses in eco-driving for its employees and designing campaigns aimed at changing the driving behaviour of its citizens.
- Reducing the speed limits on parts of the highway network during winter periods with dry weather and during cold periods when the pollution levels are high.
- The city is considering the introduction of low-emission zones.
- A pilot project will try out alternatives to sand in the braking systems of the city trams.
- Assessing the feasibility of establishing land-based energy for the ferry terminal at Hjortnes, to reduce emissions from docked ferries.

Paris, France

Paris is the capital and largest city in France. According to January 2007 statistics, the city has an estimated population of 2 193 031, while its metropolitan area has a population of 11 836 970). Paris is one of the most populated metropolitan areas in Europe. The city is governed by an elected

Mayor along with other elected representatives. In October 2007, the City Council City unanimously voted a plan to combat greenhouse gas emissions generated by various activities in Paris. The Paris Climate Protection Plan provided cross-cutting low carbon initiatives with regards to key areas, such as transport and travel, urban planning and living conditions in the city.

Information sources

- Paris Climate Protection Plan: http://www.energy-cities.eu/IMG/pdf/Paris_climate_protection_plan_2007.pdf
- C40 Cities Climate Leadership Group website: http://www.c40cities.org/bestpractices/transport/paris_cycling.jsp

Baseline targets and dates

- 30% reduction in its 2004 emission levels by 2020.
- 30% reduction in the energy consumption of municipal services and street lighting.
- 30% share of renewable energies in its energy mix.

Institutional and regulatory capacity

A Parisian Climate Agency was founded as the City's expertise and development platform, with the role of working with all players in Paris and bringing together initiatives.

Mitigation actions

Building re-design and construction

- Thermal audit of the City's 3 000 public facilities within three years.
- Renovating existing building stock, including the thermal renovation of the buildings, the renewal of heating and ventilation equipment, lowering electricity consumption, improving the management of street lighting, increasing the share of renewable energy in consumption, and an extensive renovation plan for existing social housing. The City also strives to promote the renovation of the 100,000 buildings in Paris by 2050.
- Increasing the energy performance of new-build social housing.

Energy

- Requiring various concession holders to cut consumption and increase the share of renewable energy. Four energy sources have been targeted: electricity, gas, district heating and cooling networks.
- Proposes to create an energy management assistance fund to combat energy insecurity in addition to what is provided as part of the FSL (social housing fund).

Land-use planning

- Targets carbon neutrality for its major development operations.
- Incorporates the agreement on a 20% bonus on the *Coefficient d'Occupation des Sols* (land-use coefficient) as part of the PLU (local urban-planning plan) to construct very energy-efficient housing or buildings with renewable energy production facilities (solar or photovoltaic panels, heat pumps, etc.).

Waste management

- Prioritise the purchase of recycled or recyclable products, and the most efficient facilities or services as efficiently as possible to manage its supply stocks and equipment.
- Provides guidance to departments, users and elected representatives on the best "sustainable" practices.
- Developed waste screening at source in all districts.
- As part of the Climate Protection Plan, it is targeting a 15% reduction in Paris's waste production by 2020, by influencing consumer habits, developing culture of waste sorting, promoting a culture of re-use, improving professional practices and an improved recovery of waste.
- SYCTOM, the company in charge of processing waste from Paris and its outskirts, will also develop waste methanisation projects.

Transport planning

- On 15 July 2007, Paris launched *Vélib*, a 24/7 cycle hire scheme.
- *Vélib* is a public private partnership between the city of Paris and SOMUPI.

- A total of 20 600 cycles will be available for hire at 1 451 stations around the city, by the end of 2007;
- In the first three months of operation there were 100 000 users daily, travelling 300 000 km, translating to a 32 330 t CO₂ reduction of emissions annually.
- The City of Paris will generate €34 million through the scheme over the first 10 years of the project without investing a single cent. In exchange, the company which invested €80 million upfront will pay operating costs plus €3.4 million annually to Paris for rights to advertising space, and is expected to generate around €60 million annually in advertising revenues.

Local economic activities

- The City of Paris fosters economic activity and boosts job creation through a partnership agreement with the building sector, a business centre for companies in the sector with a view to displaying innovative construction and energy-management techniques, and the creation of a business incubator dedicated to the eco-industries.
- The City also proposes to work with tourism, transport, hotel and catering professionals to work towards sustainable tourism (with in particular the idea of a voluntary fund to finance sustainable development projects, aimed at offsetting greenhouse gas emissions related to air travel).

Adaptation actions

- heat-wave plan;
- adapting buildings;
- planting Paris (i.e. creating green areas, roof and wall gardens and community gardens);
- flood prevention plan;
- carbon off-setting.

Information and communication

- To bring about deep-rooted changes in habits and develop a genuine shared culture of the energy and eco-citizenship challenges, the entire City's communication media will be used internally, geared towards its 46 000 employees, and externally towards Parisians.

Rome, Italy

Rome is the capital of Italy and the country's largest and most populated city, with over 2.7 million residents. The population of its metropolitan area was estimated to be 3.46 million in 2004 and 3.7 million in 2006. The city is governed by a mayor and elected City Council with the responsibilities of making decisions about the city's environmental policies. Rome's climate change strategy emphasises the importance of working with large businesses in order to save energy and reduce greenhouse gas emissions.

Information sources

- C40 Cities Climate Leadership Group website: <http://www.c40cities.org/bestpractices/lighting/roma-lighting.jsp>

Baseline targets and dates

- 6.5% below 1990 baseline levels by 2012.

Institutional and regulatory capacity

- Not available in English.

Mitigation actions

Local economic activities

- 'Rome for Kyoto' is a strategy which involves monthly meetings with the city and other stakeholders, sharing data relating to key activities towards reducing emissions in the city
- Rome's 'Rome for Kyoto' climate change strategy emphasises the importance of working with large businesses in order to save energy and reduce greenhouse gas emissions.
- The partnership with the retailer IKEA is one example of this, demonstrating how a large company can reduce emissions and help other retailers in the community to improve their own practices.

Adaptation actions

- Not available in English.

Information and communication

- In cooperation with the municipality, external events, such as an 'eco-festival' have taken place.

Stockholm, Sweden

Stockholm is the capital of Sweden and also the centre for business and cultural life in Scandinavia. It has a population of 832 641 inhabitants (March 31 - 2010) occupying an area of 209 square km. The city has been named European Environmental Capital of the Year for 2010. The City Council is the supreme decision-making body of the City of Stockholm. The City provides Stockholm's inhabitants with a multitude of different municipal services. Most of the municipal activities in Stockholm are carried out in administrative or corporate form. In Stockholm, the emissions of greenhouse gases are estimated to have decreased by over 24 percent between 1990 and 2009. During the same period, the population of Stockholm has increased by 22 percent. Bearing in mind both the decrease in emissions and the increase in population, the reduction in greenhouse gas emissions is estimated to be 38 per cent per resident between 1990 and 2009. The City Council has adopted Stockholm Action Plan for Climate and Energy 2010–2020. The document demonstrates how the city can reduce greenhouse gas emissions by the year 2015 from transport, electricity, heating and district cooling within the City boundaries.

Information sources

- City of Stockholm website: <http://international.stockholm.se/http://international.stockholm.se/-/Search/?q=climate+change&uaid=09265472EB007A0DDB0904CD3FF4DE93:3137322E32302E3135312E313132:5245898951834107187>
- Stockholm Action Plan for Climate and Energy 2010–2020: <http://www.c40cities.org/docs/Stockholm%20SEAP%20English.pdf>
- C40 Cities Climate Leadership Group website: http://www.c40cities.org/bestpractices/transport/stockholm_vehicles.jsp

Baseline targets and dates

- Reduce greenhouse gas emissions to 3.0 tons *per capita* by the year 2015.

Institutional and regulatory capacity

- Stockholm City Council.

Mitigation actions

Building re-design and construction

- Energy-efficiency improvement in buildings involves improving building automation systems for ventilation and heating, and insulation of windows and conversions to more efficient lighting systems.
- General energy-efficiency improvements in the existing building stock are expected to result in a reduction of 1 per cent in greenhouse gas emissions between 2010 and 2015.
- The City has allocated SEK 10 billion up to 2015 in order to implement upgrading and energy-efficiency improvements in the municipally-owned property stock.

Energy

- The single largest reason for the decrease in emissions in Stockholm is because an increasing number of properties, oil and gas-fired boilers are being replaced by district heating and heat pumps. The district heating system covers over 80 percent of Stockholm's total heating needs.
- District heating is being produced with almost 80% renewable energy sources or energy from waste or residual waste heat.
- Major investments are being made to generate biogas and biofuel-fired combined heat and power plant which is expected to lead to reduced emissions equivalent to 37,800 tons in the city area.

Transport planning

- Since the mid-1990s, the city has been working to increase the proportion of clean vehicles on the market and the use of renewable fuels to power them.
- Just over 35% of all new vehicles sold in the region are clean vehicles.
- Stockholm has the highest percentage of clean vehicles in Europe; 30 000 vehicles or 5% of all vehicles now either hybrid or using biofuels.
- Stockholm's clean vehicles are slashing 200 000 tons CO₂ annually.
- The City is committed to:
 - 100% clean vehicles in the city by 2010
 - 85 % clean fuel in their tanks by 2010
 - 35 % of all vehicles sold in Stockholm should be clean by 2010.

- Market barriers have been removed by the City to help create a boom in the sales of ethanol, hybrid and biogas cars.
- Introduced congestion charge in August 2007 as a trial. Cut CO₂ by 14% and traffic by 25%.
- Traffic to and from the city centre has declined by an average of almost 20 % in one year.
- Investments in public transport have led to an average of 66% of all daily passenger transport being by public transport.
- Investments in cycle paths and cycle lanes.
- City's own vehicle fleet should consist of 100% clean vehicles by 2010.
- In the planning of the new city district Royal Seaport, measures were introduced to favour public transport, which are expected to reduce emissions.
- New City Line, which is planned to be operational by 2017, along with other railway investments are expected to reduce greenhouse gas emissions by a total of 18 300 tons by the year 2020.

Local economic activities

- Local initiatives have created supply and demand for biofuels
- Sales of ethanol have risen rapidly resulting in CO₂ reductions of over 440 000 tons in 2007.

Adaptation actions

- No information found.

Information and communication

- The City of Stockholm is conducting a number of communication projects to engage the residents and the business community on what can be done to reduce greenhouse gas emissions and overall energy-use.

Vienna, Austria

Vienna is one of Austria's federal provinces, as well as the federal capital city and the largest municipality of the Republic of Austria. It had a population of 1 680 266 in 2008. As a federal province Vienna has a right to its own legislation and provincial executive body. Legislation in Vienna is provided by the Vienna Provincial Parliament, while the Vienna Provincial Gov-

ernment, headed by the Governor, is responsible for its execution. The Provincial Parliament has 100 members. The Provincial Government which is formed by the Governor currently has 13-members called City Councilors. On the 18th December 2009 the City Council of Vienna enacted the update of the climate protection programme, the City of Vienna's Climate Protection Programme (KLiP II), which will be valid until 2020. This programme is the update of the so called KLiP I, which was enacted 1999 and consists of 37 sets of measures with a total of 385 individual measures.

Information sources

- City of Vienna website:<http://www.wien.gv.at/english/environment/klip/><http://www.wien.gv.at/english/environment/klip/pdf/klip2-short.pdf> <http://www.wien.gv.at/english/environment/klip/pdf/klip-brochure.pdf>

Baseline targets and dates

- City of Vienna's climate goal is a reduction in greenhouse gas emissions per capita of 21% when compared to 1990 by the year 2020.
- The current goals of KLiP II have been broadly discussed along these lines, have been agreed upon and will allow the city to reach the overall goal of a 21% reduction in greenhouse gas emissions per capita by 2020 when compared with 1990.

Institutional and regulatory capacity

- For the past 10 years, Vienna has had a broad climate protection programme known as KLiP Vienna. It was enacted in 1999 by the City Council and is valid until 2010.
- KLiP's goal of preventing an increase in annual emissions of CO₂ equivalents by 2.6 million tons by 2010 was already achieved in 2006.
- The city has thus far successfully avoided the annual emission of 3.1 million tons of CO₂ equivalent.
- Preparations for KLiP's successor began in 2007, long before KLiP was due to end. KLiP II, as it is called, will be valid until 2020.
- Numerous working groups all over the Vienna city administration, the municipal enterprises and funds, as well as the Vienna Ombuds Office for Environmental Protection, worked to elaborate the draft version.

- The process was coordinated by the Executive Office for the Coordination of Climate Protection Measures and accompanied by a steering committee, consisting of politicians of all four parties that have a seat in the City Council and experts of the administration.

Mitigation actions

Building re-design and construction

- The City of Vienna uses the subsidisation of new housing construction as a tool to promote ecologically beneficial projects.
- Higher thermal protection standards in new buildings for commercial use.

Energy

- Environment-friendly district heating.
- Reducing energy consumption and saving heating costs.
- Increasing the share of district heating to 50% via the expansion of the heating network, as well as by increasing energy efficiency and the use of renewable energy.
- Further promotion of thermal rehabilitation of residential buildings.
- Switching energy sources for heating and hot water: replacing carbon intensive energy sources (coal, oil, electricity) with less carbon intensive or carbon free energy sources (district heat, renewables, gas).
- Encouraging end consumers to use energy in the most efficient way, particularly with regard to measures taken for energy efficiency in buildings.
- Solar power, wind, hydropower, biomass and geothermal energy are used to supply part of Vienna's energy in environmentally benign forms such as electricity and heat.
- Cutting demand for heating through thermal rehabilitation measures to the existing stock of buildings for commercial use.
- Cutting the CO₂ emissions from production processes through measures to increase efficiency and switching energy sources.

Waste Management

- Reduce the greenhouse gas emissions generated by procurement operations of the City of Vienna, as well as by waste management operations for the entire city
- Introduce measures to tackle greenhouse gas emissions in the fields of agriculture, forestry and nature protection.

Transport planning

- Expansion of public transportation.
- Promotion of public transport.
- Reduction of passenger car traffic by promoting environmentally friendly modes of transportation like bicycling, walking, public transport, and car-sharing, bicycles and walking.
- Reduce, both directly and indirectly, greenhouse gas emissions generated by transport.

Local economic activities

- Businesses in Vienna are increasingly using district heating and other climate-friendly sources of energy.
- In 2003, some 50% of the heating requirements of enterprises in the city were already covered by district heating.
- Between 1993 and 2003, the share of energy from renewable energy sources (such as biomass, solar energy, ambient heat, etc.) climbed by 73%.
- Eco-Business Plan to help enterprises generate "green and clean" profits through ecological management.

Adaptation actions

- Aim to inform the Viennese population and other relevant stakeholders.
- Induce climate friendly behaviour by raising awareness.

appendix 6 - climate change initiatives in british cities

Bristol

In 2000, Bristol City Council's emissions were 54 708 tCO₂e, mainly from energy used in buildings (82%) and street lighting (14%). Community emissions were 3 860 500 tCO₂e from transport (36%), energy-use by commerce and industry (33%) and the residential sector (25%) (Bristol's CCP Emissions Inventory).

Bristol is involved in several initiatives aimed at reducing carbon emissions, some of which include:

- Green Capital Initiative: This is aimed at accelerating the pace of change in the economy and communities towards a low carbon future to make Bristol a more sustainable, healthier, greener city. It targets a 40% reduction in CO₂ by 2020 and 80% by 2050⁵⁷.
- Climate Change Action Plan⁵⁸.
- Peak Oil study⁵⁹. Given the City of Bristol's high dependence on oil as an energy source, the City of Bristol and the Bristol Partnership commissioned a study on the implications of 'peak oil', which concluded that peak oil could have severe impacts on the energy supply in Bristol. The study also highlighted options for moving away from oil and other fossil fuels to renewable energy.
- Local Area Agreement: The city has signed up to report on and set targets for National Indicator 186 in the Local Area Agreement.
- Low Carbon Cities Programme⁶⁰.
- Covenant of Mayors Signatory.
- Working with Carbon Descent on testing the VantagePoint software, which is designed for local authorities to model carbon reduction scenarios over time, to inform climate change strategies⁶¹.
- Inclusion of innovative low carbon building and renewable energy policies in the Local Development Framework.
- Established the Bristol Environmental Technologies Sector (BETS)⁶².

- Forum for the Future's 'Sustainable Bristol City-region': This is a 10-year project which is aimed at making "the Bristol city-region a model for the UK and for the world"⁶³. The project includes the 'West of England Carbon Challenge', to help organisations reduce their CO₂ by 10% by 2012⁶⁴.
- Host Bristol Festival of Nature⁶⁵.
- Engaging with several environmental organisations, businesses, charities, grass-roots movements.
- Establish low food and local food network.
- Implementation of sustainable development-based projects such as rapid transit system; greater Bristol bus network and the development of two more 3 MW wind turbines at Avonmouth.

As a result of these initiatives and projects, Bristol was recently shortlisted for the European Green Capital in 2009⁶⁶. Some of the achievements recorded by the city include:

UK's 1st 'Cycling City': £22m to invest in cycling across the Bristol urban area;. Recognised as the UK's most sustainable city in the Forum for the Future's 2008 Sustainable Cities Index (2nd in 2009).

- High recycling rate of 37%. *Per capita* waste sent to landfill has been reduced by 18% over the past five years.
- Good number of award winning sustainable restaurants and markets.

London

Climate change is a threat to London's future economic success. The capital is already feeling the effects of climate change in the form of increasing vulnerability to flooding, subsidence, excessive heat and water supply shortfalls. Currently, London generates around 44 000 000 tC per year. Initiatives in London towards mitigating these emissions include the following:

⁵⁷ Thi <http://www.bristolgreencapital.org/>.

⁵⁸ http://www.bristol.gov.uk/ccm/cms-service/download/asset/?asset_id=32697095.

⁵⁹ <http://www.bristolgreencapital.org/green-capital/energy/peak-oil>.

⁶⁰ <http://www.lowcarboncities.co.uk/cms/assets/Bristol-summaryv2.pdf>.

⁶¹ <http://www.carbondescent.org.uk/pages/vantage-point.html>.

⁶² <http://www.bristol-ets.co.uk/>.

⁶³ <http://www.forumforthefuture.org.uk/projects/sustainable-bristol-city-region>.

⁶⁴ <http://www.forumforthefuture.org.uk/projects/west-of-england-carbon-challenge>.

⁶⁵ <http://www.bnhc.org.uk/home/festival.html>.

⁶⁶ <http://video.google.co.uk/videoplay?docid=-8750946555917611243&hl=en-GB#>.

London Development Agency

The Agency works to “deliver the Mayor’s vision for London to be a sustainable world city with strong, long-term economic growth, social inclusion and active environmental improvement.”⁶⁷ It achieves this by planning and producing the Mayor’s Economic Development Strategy for London, which focuses on: places and infrastructure; supporting people; encouraging business; and promoting London. Some of the ongoing low carbon initiatives undertaken by the agency include:

- Investing in decentralised energy infrastructure which acts as a catalyst to improve the energy efficiency of London’s homes and other buildings.
- Investing in London’s waste and recycling infrastructure.
- Greening London’s public spaces.
- Opening up opportunities for a low carbon economy.
- Working with the Mayor of London to promote a greener London, from planting street trees - and helping reduce London’s heat island effect - to investing in open spaces and the East London Green Grid.

The Mayor of London

By setting a 60% reduction target for 2025, the Mayor aims at reducing London’s carbon emissions to 18 000 000 tons by that year. It also aimed at establishing London as a world leader in improving the environment locally and globally, by tackling climate change, reducing pollution, developing a low carbon economy, consuming fewer resources and using resources more effectively. This vision is set out in the publication - ‘Leading to a greener London: An environment programme for the capital’⁶⁸:

Examples of projects initiated by the Mayor include:

- Low Carbon Zones: In September 2009 the Mayor launched ten pilot Low Carbon Zones and pledged between £200 000 and £400 000 to each winning zone, as well as public support and programme management.
- Delivering low carbon energy for London: In October 2009 the Mayor launched ‘Powering ahead - delivering low carbon energy for London’, supporting the expansion of the decentralised energy market in London.

- Encouraging more hybrid buses: The Mayor believes London’s bus fleet should be converted to less carbon-intensive fuel, and will monitor technological developments in this area with the intention of deploying them within London’s bus fleet when possible.

London Climate Change Partnership

The Greater London Authority (GLA) leads the London Climate Change Partnership which is aimed at ensuring that London as a city is prepared for climate change. The objectives are collating and disseminating high-quality information to help stakeholders in London to be aware of the impacts of climate change. The partnership also assists in the development of London’s climate change adaptation strategy, the London Plan (the Mayor’s spatial development strategy) and other strategies and policies.

Manchester

The city of Manchester, with a population of around 2.5 million, is a large conurbation in the north-west region of England. It consists of a mix of high-density urban areas, suburbs, semi-rural and rural locations, but with an overwhelmingly urban pattern. Its major low carbon initiatives include:

- Green City objective: Manchester City Council’s low carbon objectives are driven by the performance of the economy of the city sub-region and healthier lives of its diverse communities. To achieve this, along with its vision of achieving a World Class City status, the authority set nine objectives, including the Green City objective, in the Manchester Sustainable Community Strategy. It projects that by 2015 Manchester “will be a ‘Green City’ proud of its rapidly improving local and global environmental performance and the contribution of the environmental sector, and with sustainable transport, to economic growth”⁶⁹.
- Manchester’s Climate Change Action Plan: “Manchester. A Certain Future”, was endorsed by the Council’s Executive Committee in November 2009. The plan sets out a strategic framework of actions that need to be taken by organisations and individuals throughout the city to address the challenges and opportunities of climate change

⁶⁷ <http://www.lda.gov.uk/about-the-lda/index.aspx>.

⁶⁸ <http://legacy.london.gov.uk/mayor/publications/2009/docs/leading-greener-london-300709.pdf>.

⁶⁹ http://www.manchester.gov.uk/info/500117/green_city/178/manchester_green_city_team/1.

between now and 2020. The actions aim collectively to substantially reduce the city's emissions of CO₂ and to achieve a change in culture that enables residents, businesses and other organisations to take steps to adopt and implement the principles of a low carbon economy⁷⁰.

- Neighbourhood regeneration: Manchester is host to the world-leading green neighborhood regeneration that will be internationally recognised for socially, economically and environmentally sustainable place-making.
- Retrofit Manchester's Town Hall to improve its energy efficiency.
- Establish a business alliance for climate change action.
- Introduce a low carbon energy infrastructure through working with the Association of Greater Manchester Authorities and the forthcoming Climate Change Agency.
- Establish Low Carbon Communities within each existing regeneration area to enable residents to cut energy costs.
- Ensure a climate-change ready Local Development Framework.
- Establish a Manchester Prize, attracting cutting edge designers and architects from across the world to turn the city into a living laboratory for climate change solutions.
- Green the city through working with the University of Manchester on the i-Trees project to create a green corridor along a particular street by planting more trees and installing green roofs and façades.
- Support Manchester airport to be a green airport and to achieve its aim for the site to be carbon neutral in terms of energy-use and vehicle fuel by 201.
- Climate Change Agency was established in 2009.
- Environmental Business Pledge: Over 1 300 businesses have signed up to the Environmental Business Pledge which had saved over 2 000 tons of CO₂ and realised over £500 000 of savings to business together with nearly £6 million in increased sales.
- 100 Months Club: The Club was established in early 2008 to enable businesses in Greater Manchester to share strategies for carbon reduction, encourage stronger and tougher tactics for reducing energy-use and to help

Manchester adapt and prepare for a leading role in tackling climate change.

- Tyndall Centre for Climate Research established at Manchester University.
- Manchester's 'Mini-Stern' report identified high economic costs of failing to take effective action – up to £21 billion in Greater Manchester by 2020⁷¹.
- Greater Manchester has been designated the UK's first Low Carbon Economic Area (LCEA) for the Built Environment.

Newcastle

The Newcastle City Council signed the Nottingham Declaration on Climate Change in September 2006, confirming the Council's commitment to evidence that the climate is changing and that this will have far reaching implications for the community of Newcastle.

Newcastle has a growing ambition to be the world's first carbon neutral city. Actions aimed at achieving this include:

- Newcastle City Council Climate Change Strategy and Action Plan⁷².
- North East Regional Climate Change Declaration: extension of the Nottingham Declaration⁷³.
- CarbonNeutral Newcastle has been established by the Council over the past four years to deliver elements of the city's Climate Change Strategy. CarbonNeutral offers the potential to engage with businesses in delivering the City's Climate Change Strategy. The principle of 'measure, reduce and offset' of CO₂ will be integrated into Council activities and promoted⁷⁴. Other elements of the CarbonNeutral initiatives include:
 - Raising the profile of climate change across all audiences.
 - Signing up businesses, organisations and events to carbon management programmes.
 - Helping people reduce their carbon emissions.
 - Raising funds for low carbon projects.
 - Influencing regional policy and strategic development to adopt low carbon principles.

⁷⁰ <http://cdn.faelix.net/creativeconcern/manchesterclimate/ManchesterClimateChangeActionPlan.pdf>.

⁷¹ http://www.deloitte.com/assets/Dcom-UnitedKingdom/Local%20Assets/Documents/UK_GPS_MiniStern.pdf.

⁷² <http://www.newcastle.gov.uk/wwwfileroot/ns/energy/CChangeStrategy1.pdf>.

⁷³ <http://www.strategyintegrationne.co.uk/page.asp?id=691>.

⁷⁴ <http://www.carbonneutralnewcastle.com/home/>.

- Newcastle Warm Zone: This is a not-for-profit partnership aiming to reduce fuel poverty and improve energy efficiency across all of the city's households by offering free or discounted insulation and heating measures together with an integrated package of benefits assistance and energy efficiency advice.

Belfast

Belfast City Council serves an area with a population of 300 000 people and has responsibility for about 200 buildings with an annual energy spend of more than £ 2 million. Some of its key low carbon policy initiatives include:

- Sustainable Development Action Plan: this embodies the priority actions identified in the Northern Ireland Sustainable Development Strategy.
- Range of measures to reduce carbon emissions in line with (but not tied to) a cut of 25% carbon emissions by 2025 and 80% by 2050
- Focus on reducing emissions from Council buildings and operations and reported through the primary performance indicator "% reduction in GHG emissions from Council premises"⁷⁵.
- Focus on the Waterfront Hall complex and achieved energy efficiency savings of £17 000 per annum.
- Part of the Carbon Trusts LACMP.

Glasgow

Glasgow City Council serves an area with a population of 580 690 people and has responsibility for about 1 000 buildings with an annual capital budget of £680 million net. The Council is developing a Climate Change Strategy and Action Plan, which will assess Glasgow City Council's contribution towards the causes of climate change and identify how climate has already changed and forecast change over the next 80 years. Its low carbon policy initiatives include:

- Signatory to Scotland's Climate Change Declaration in 2007.
- Review of progress on Scottish Climate Change Declaration targets;
- Identify the best way forward to reduce the GHG emissions arising from the Council's operations.
- Identify how the City should adapt to deal

with the predicted changes in climate.

- Provide a framework for an action programme to achieve the local and national GHG emissions targets and to adapt to the impacts of climate change⁷⁶.
- Glasgow Climate Change Partnership was set up in March 2009 involving communities, businesses, local stakeholder organisations and others in the community. It aims to bring together public, private and voluntary sector organisations to adapt to the challenges of climate change through education and by sharing good practice. The Climate Change Partnership for Glasgow is the only such union in Scotland to commit its members to specific carbon reduction targets.
- Setting carbon baseline and reduction targets.
- Involved in Carbon Trusts LACMP.
- Working with the Energy Savings Trust and others to inform small businesses and householders of the help that is available to them to reduce consumption.
- Implementing the Carbon Management Implementation Plan which was approved by the Council's Executive Committee in April 2008. The plan contains a five-year commitment to reduce GHG emissions by 20% by 2013. Progress in a number of projects detailed in the Council's Carbon Management Implementation Plan has resulted in a reduction of approximately 14 000 tons in the first year;
- Carbon Management Plan - the Council has set a target to reduce its CO₂ emissions from the 2005/2006 baseline figure of 196 600 tons by 20% over a five-year period.
- Sustainable Glasgow Project: this is a consortium led by the University of Strathclyde, including the Council and the private sector, to develop a project that aims to position Glasgow as one of Europe's most sustainable cities within 5 to 10 years. The project will provide the evidence to support investment in a range of projects that will contribute to its sustainability objectives through:
 - placing most homes, offices, and public buildings in Glasgow on a district heating network – delivering lower cost and cleaner heat;
 - delivering more sustainable homes and

⁷⁵ <http://www.belfastcity.gov.uk/sustainability/index.asp>.

⁷⁶ <http://www.glasgow.gov.uk/en/AboutGlasgow/Factsheets/Glasgow/Environment.htm>.

- offices for the people of Glasgow;
- developing low carbon public transport in Glasgow;
- significantly reducing Glasgow's carbon emissions; and
- providing Glasgow with a state of the art telecommunications infrastructure.

Cardiff

Cardiff, as the Welsh capital city, is its major commercial centre, with a population of over 300 000 and the seat of the National Assembly for Wales. In 2007, the Council set a 60% reduction target for CO₂ by 2018. Cardiff is involved in various low carbon initiatives, such as:

- Signatory to low carbon initiatives such as the Welsh Declaration on Climate Change and Energy Efficiency in 2006 and the 10:10 Campaign.
- Member of the Carbon Trusts LACMP.
- In 2007 a Carbon Lite working group was established to provide guidance for climate change work. The group has membership from the Council, Environment Agency Wales, Mandix Consultancy, Cardiff University, University of Wales Institute and Cardiff Transitions Project. This group reports back to the Community Strategy Vision Forum.
- In 2008, the Cardiff Council Authority was selected to participate, along with four other local authorities, in the three year Changing Climate, Changing Places project coordinated by the Welsh Local Government Association/UK Climate Impacts Programme (UKCIP). This project will focus mainly on adaptation measures along with some mitigation.
- A staff awareness campaign is being piloted within Cardiff Council, focusing on climate change mitigation issues, with the aim of replicating the campaign in partner organisations across Cardiff.
- In 2009, a Vision Forum Carbon Lite group was established with representatives from key Vision Forum organisations along with major energy users across the city. This group is working together to share best practice and identify projects in which collaboration will be beneficial.
- The Carbon Lite Cardiff Action Plan⁷⁷ was launched in June 2010, which highlights the

commitments of the Cardiff Council and its partners to combating climate change. Key partners for the success of becoming a Carbon Lite city are Community Strategy Partnerships and the local business community.

Birmingham

Birmingham is the most populous British city, with the exception of London, having a population of 1 016 800⁷⁸. As a significant city during the industrial revolution, Birmingham has since developed into an important national hub for commerce, education, high technology, research and development, and conferencing⁷⁹. According to the Council, the city has an important role in the UK transition to a low carbon future: "No place was more influential than Birmingham in sustaining the carbon based industrial revolution. The city should be just as much of a pioneer for the low carbon future"⁸⁰.

The Birmingham Sustainable Community Strategy set targets for a 60% reduction in carbon emissions by 2026, thereby saving 120 000 tons of CO₂ in 2009/10 and 130 000 in 2010/11. It is estimated that by 2026, at least 40% of household waste will be recycled, in addition to improved quality and standards for virtually all housing, with efficient heating systems. This will limit the city's 'ecological footprint' to its 2001 level.

Some of its low carbon initiatives include:

- Signatory to the Nottingham Declaration on Climate Change.
- Climate change strategic framework - Cutting CO₂ for a Smarter Birmingham Strategic Framework: This is a 3-year rolling climate change strategic framework developed under the Birmingham Sustainable Community Strategy.
- Be Birmingham: this is the Birmingham's Local Strategic Partnership (LSP) that brings together partners from the business, community, voluntary, faith and public sectors, including the Birmingham Environmental Partnership to deliver a better quality of life in the city. Birmingham was the first LSP to develop a partnership-based approach to both reducing emissions and helping the city prepare for a changed climate. The partner-

⁷⁷ http://www.cardiff.gov.uk/objview.asp?object_id=16964.

⁷⁸ <https://www.nomisweb.co.uk/reports/lmp/la/2038431965/report.aspx>.

⁷⁹ <http://www.birminghampost.net/news/newsaggregator/2009/10/06/birmingham-biggest-mover-in-european-league-table-second-to-london-for-uk-business-65233-24859371/>.

⁸⁰ <http://www.birmingham.gov.uk/>.

ship's four main areas of activity are:

- making Birmingham a cleaner city;
 - reducing waste and increasing reuse and recycling;
 - adapting to the inevitable impacts of climate change; and
 - working to reduce CO₂ emissions.
- The Climate Change Carbon Reduction Partnership is responsible for delivering part of Outcome 5 and NI 186. It supports the Birmingham Climate Change Strategy by delivering projects that help to reduce CO₂ emissions. Birmingham is set to host the first climate change festival in the UK, a festival that will explore how we plan, design and use our cities.

Nottingham

The Nottingham Council is committed to cutting carbon emissions by 10%. Apart from being a signatory to the Nottingham Declaration, the Council is also signatory to the 10:10 campaign which encourages all sectors in the UK to reduce their carbon emissions by 10% in 2010⁸¹.

Some of its other low carbon initiatives include:

- ZERO 2100 Climate Protection Strategy: this was produced in 2006 to build on the earlier Climate Change Action Plan. The aim of this

strategy is to put the city on a path towards a low carbon future with less dependence on fossil fuels and to ensure its adaptation to the inevitable impacts of climate change.

- Commencement of a new climate change plan for the city.
- Nottingham's local strategic partnership in 2008 adopted two National Performance indicators relating to climate change. NI 186 (*per capita* emissions) and 188 (planning to adapt to climate change).
- Nottingham Carbon Club: Nottingham is aiming to become one of the UK's first low-carbon cities through reducing emissions, raising environmental standards and capturing any economic benefits. In April 2007, the Nottingham Carbon Club was launched. Its main purpose is to assist Nottingham's major businesses help meet the cities commitments to lower carbon emissions⁸².
- Nottingham City Council is participating in the Carbon Trust LACMP.
- The Eco-Management and Audit Scheme (EMAS) throughout the City Council will strengthen actions taken to reduce the city's significant environmental impacts, by ensuring that the environmental impacts of all services are audited, monitored and actions taken to ensure continual improvement in this area.

⁸¹ <http://www.nottinghamcity.gov.uk/index.aspx?articleid=3821>.

⁸² <http://www.thisisnottingham.co.uk/news/Firms-turn-green-hit-targets/article-636821-detail/article.html>.

appendix 7 - climate change initiatives in latin american cities

Mexico City, Mexico

Mexico City was the first city in Latin America to publish a Climate Action Plan. This took place in 2008, with targets for reducing emissions by 12% (7 million metric tons) by 2012 (Mexico City Government, 2008). The city is classified as a megacity with over 20 million inhabitants. Climate change initiatives are also incorporated in the city's Plan Verde (Green Plan), which aims to illustrate environmental leadership that can be adapted by other megacities and to achieve its carbon reduction goal. In two years (from 2008 – 2010), the city recorded a reduction in GHG emissions of 1 397 942 metric tons of CO₂e, which represents 4% of Mexico City's GHG emissions (Mexico City Government, 2010).

Some key projects that Mexico City's Government (as outlined in Mexico City Government, 2010) have implemented and plan to implement to achieve this GHG reduction are:

- **Transport Corridors/Zero Emissions Transport Corridor:** This initiative aims to improve mobility in the city, by improving the public transport system, through a well functioning BRT system and the electric transport system.
- **ECOBICI Individual Transport System:** This is a public rental bicycle system that provides individuals with the option of using a bicycle for short and intermediate trips. It enables people to move from one public transport system to another. The system has been successful so far, with approximately 13 500 registered users, 1 200 bicycles and 86 docking stations.
- **Minibus and Taxis Replacement Programme:** this involves the replacement of minibuses and taxis with more efficient medium capacity buses.
- **Sustainable Housing Programme:** aims to incorporate sustainable and environmental concepts in the building of new homes.
- **Solar Energy Use Regulations:** The regulation will apply to all new companies that employ more than 51 people and use hot water to ensure that solar water heating is used.
- **Mexico City Government Environmental Management System:** The environmental

management system aims to find opportunities to reduce the usage of water, electricity and office supplies in public buildings.

- **Green Roofs Programme:** To promote the expansion of green roofs throughout the city, through various initiatives.
- **Restoration of Ecosystems and Compensation for Maintaining Environmental Services:** The 'Land of Conservation' comprises 59% of the total area of the city. The programme aims to compensate land-owners in the 'Land of Conservation' to protect and conserve their land and to prioritise the conservation of public land, for improved ecosystem services in the city.

In addition to the above initiatives the city also aims to 'To influence the behavioural patterns, habits, and attitudes of Mexico City's population so that it will contribute to the mitigation of climate change and enact adaptation measures'. (Mexico City Government, 2008: 9). The city is recognised for high levels of public participation in climate change action (Economist Intelligence Unit, 2010) which was achieved through a number of communication and educational initiatives (Mexico City Government, 2008).

Curitiba, Brazil

The city is recognised as one of the most sustainable cities in the world and is best known for its sustainable urban planning and sound environmental policies. Curitiba has a population of approximately 1.9 million within the city area and boasts green areas equivalent to 52m² per person, which is very high in comparison to a worldwide recommended average of 12m² per person (Sustainable Cities, 2008⁸³). The strategy that the city followed was that of a holistic, integrated approach to planning (Economist Intelligence Unit, 2010).

Some key reasons for Curitiba's internationally renowned success are (Sustainable Cities, 2008 and Economist Intelligence Unit, 2010):

- **Active participation:** The city ensured that there was active participation by all players,

⁸³ Sustainable Cities, 2008. Case: Curitiba: The Green Capital, <http://sustainablecities.dk/en/city-projects/cases/curitiba-the-green-capital>.

including the public and private sectors.

- Financial incentives: To get industry and private companies involved, financial incentives played a major role, for example local contractors get a tax break for planning developments with green areas.
- Green areas: Realising and emphasising the importance of green areas, which serve many purposes, for example the city developed more lakes in parks, which reduces the risks of flooding by holding back large quantities of water, while providing a recreational and aesthetic benefit and preventing illegal settlement.
- Visionary leadership: The success of the city can be attributed to architect and urban planner, Jamie Lerner, who was elected mayor for the city numerous times in the 1970s and 1980s. Mr Lerner led a team of planners, architects, engineers and sociologists to develop an integrated approach to the planning of the city.
- Sustainable transport: The city is dominated by an integrated Bus Rapid Transport (BRT) system that begun as early as the 1960s. The system is linked with urban-planning, with development occurring on BRT corridors. The network is therefore very easily accessible. Furthermore the city aims to ensure that all public buses run on biofuels instead of diesel.

São Paulo, Brazil

São Paulo is recognised as one of the first cities in a developing country to implement a climate change action plan. In 2009, the government of São Paulo passed the Municipal Act on Climate Change that aims to reduce GHG emissions by 30% from 2005 levels by 2012. By 2009 the city had already successfully reduced emissions by 20%, due to the development of two waste-to-energy plants at its two landfill sites and other environmental initiatives. The electricity generated from these sites is 350 000 MWh per year. In

addition to this, the rest of São Paulo's electricity is generated from hydropower plants, resulting in approximately net zero emissions from electricity use.

Other key initiatives the city has implemented or plans to reduce emissions further are (Devecchi⁸⁴; Robinson, 2009⁸⁵; Economist Intelligence Unit, 2010):

- Transport: the government introduced a range of initiatives to make the transport sector more sustainable. Since 2008 it has become mandatory for public bus companies to reduce fossil fuel use by 10% per year. Furthermore, the city has also introduced regulation limiting the number of cars entering the CBD, and have incentivised car-pooling, through a ride-sharing initiative and car-pool lanes.
- Waste management: São Paulo aims to introduce a mandatory recycling programme in the city and all new buildings will have to submit a recycling plan in order to be get a permit for the development.
- Construction: All new buildings will need to meet energy efficiency, sustainability and material quality standards. This law has already been implemented for new municipal buildings, while old buildings must be retrofitted with technologies to make it more efficient.
- Climate change adaption: adaption is also emphasised in the bill, focusing on disease control and education, research, early warning and emergency response initiatives. The city has also prioritised the need to preserve and increase its green spaces.
- São Paulo has adopted a framework based on sound policy through the establishment of the Municipal Act on Climate Change that allowed the city to enforce mandatory requirements in various sectors, related to climate change.

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⁸⁴ Devecchi, 2011. Tackling Climate Change in São Paulo, <http://www.lead.org/page/539>.

⁸⁵ Robinson, K., 2009. São Paulo Adopts Comprehensive Climate Change Policy, <http://www.wri.org/stories/2009/08/sao-paulo-adopts-comprehensive-climate-change-policy>.

appendix 8 - about assaf

History

The Academy of Science of South Africa (ASSAf) was inaugurated in May 1996 in the presence of then President Nelson Mandela, the patron of the launch of the Academy. The Academy was formed in response to the need for an academy of science consonant with the dawn of democracy in South Africa: activist in its mission of using science for the benefit of society, with a mandate encompassing all fields of scientific enquiry in a seamless way, and including in its ranks the full diversity of South Africa's distinguished scientists. The Parliament of South Africa subsequently passed the Academy of Science of South Africa Act (*Act 67 of 2001*), which came into operation on 15 May 2002. ASSAf is thus the official national Academy of Science of South Africa, recognised by government and representing South Africa in the international community of science academies.

Vision

The Academy of Science of South Africa (ASSAf) aspires to be the apex organisation for science and scholarship in South Africa, recognised and connected both nationally and internationally. Through its membership which represents the collective voice of the most active scholars in all fields of scholarly enquiry, ASSAf aims to generate evidence-based solutions to national problems.

Mission

The mission of the Academy is to:

- Recognise scholarly achievement and excellence in the application of scientific thinking for the benefit of society.
- Mobilise Members to ensure that they are available to contribute their expertise in the service of society.
- Conduct systematic and evidence-based studies on issues of national importance, producing authoritative reports that have significant impact on policy-making.
- Promote the development of an indigenous system of South African research publications, increasing their quality, visibility, accessibility and impact.
- Publish science focused periodicals that will showcase the best of southern African research to a wide national and international audience.
- Develop productive partnerships with national, regional and international organisations with a view to building our capacity in science and its application within the National System of Innovation (NSI).
- Create diversified sources of funding for sustainable functioning and growth of a national academy.
- Communicate effectively with relevant stakeholders through various media and fora.

Values

ASSAf's strength resides in the quality and diversity of its membership; internationally renowned scholars elected by their peers, who give of their time voluntarily in the service of society. The membership could be regarded as the 'brains trust' of the nation. ASSAf is able to use its membership as a collective resource for evidence-based solutions to national problems. Through the well-recognised convening power of academies, ASSAf is able to mobilise the best scientific minds from across the nation, as well as internationally, to provide authoritative advice to government and other stakeholders based on scientifically rigorous analysis of evidence and consensus of diverse experts.

As such, ASSAf is an independent, non-biased and credible source of policy advice. The diversity of its membership, embracing the full disciplinary spectrum, enables ASSAf to focus on issues of a multi-disciplinary, multi-sectoral nature and to bring the strengths of a fully inclusive approach to bear on the issues of national and international concern.

The further value of the Academy is its promotion of excellence through election to Academy membership and awards, and the fostering of scholarly activity through the provision of fora for scholarly activities and debate.

Key universal elements of Academy advice are that it is authoritative, independent, objective, free of vested interests, trusted, based on volunteerism, based on rigorous analysis of evidence and peer review, transparent, locally-based, multi-disciplinary and able to address complex issues that transcend disciplinary boundaries.

Mandate

The mandate of the Academy is to:

- Promote and inspire outstanding achievements in all fields of scientific enquiry and to grant recognition for excellence.
- Proactively or upon request undertake studies on matters of public interest with a view to providing evidence-based scientific advice to government and other stakeholders.

ASSAf's policy advisory role is informed by key national challenges and is executed in both a responsive and proactive manner. ASSAf strives to address cross-cutting and complex issues that suit the particular convening strength and niche of an Academy. ASSAf also seeks to implement projects in association with other science academies in Africa and abroad, in its efforts to influence regional and global policy. Linkages with other academies in the Southern African Development Community (SADC) and Africa are regarded as particularly important, as are the collaborations with key partners in the United Kingdom (UK), United States (US), Germany, India, China and Brazil.

As a membership-based organisation, the key intellectual resources of the Academy reside in its membership, which currently comprises 351 Members. Members are drawn from the full spectrum of disciplinary activities. Members, who volunteer their service, are supported in their policy-advisory role by the fulltime staff of the secretariat, which currently numbers 21.

ASSAf is governed by a Council, comprising 12 elected members and a thirteenth member appointed by the Minister as a representative of the National Advisory Council on Innovation. The activities of the Academy are structured into five programmes as follows: Governance and Administration; Scholarly Publishing Programme; Policy Advisory Programme; Liaison; and Communication.

Strategic Goals

The ASSAf Act provides the framework for identifying the Academy's overarching goals, defined as follows:

Recognition and reward of excellence

This includes the award of two Science-for-Society gold medals for outstanding achievement in scientific thinking for the benefit of society; the award of the Sydney Brenner post-doctoral fellowship; and young scientist awards.

Promotion of innovation and scholarly activity

Activities include the annual ASSAf Distinguished Visiting Scholar programme, the ASSAf regional scholarly lectures hosted at various universities, the publication of the South African Journal of Science, and evidence-based, policy advisory activities. The Scholarly Publishing Programme (SPP) is making a major contribution through enhancing the visibility and accessibility of South African scholarly journals.

Promotion of effective, evidence-based scientific advice

In order for ASSAf to fulfil its policy advisory role regarding key challenges facing the nation, a variety of consensus and forum studies are undertaken. Studies generally fall into broad categories related to health; environment; and social sciences and education.

Promotion of interest in and awareness of science education

ASSAf is engaged in a wide range of science education activities, including the publication of the highly acclaimed science magazine, *Quest*, which is widely disseminated to secondary schools in South Africa and other key stakeholders, and actively promoted at key national science events.

Promotion of national, regional and international linkages

ASSAf is currently an active member of a number of international networks including the Global Network of Science Academies (IAP), the InterAcademy Council (IAC), the InterAcademy Medical Panel (IAMP), the Academy of Sciences for the Developing World (TWAS), the G8+ grouping of academies, and the Network of African Science Academies (NASAC).

The President of ASSAf currently serves on the executive board of the IAC and has recently been elected President of NASAC. ASSAf also participates in the Science for Society Forum of Presidents of Academies, the Human Rights Network of Academics and Science Academies. ASSAf currently has bilateral agreements with the Uganda National Academy of Sciences,

the Russian Academy of Sciences, the Chinese Academy of Sciences and the Nigerian Academy of Science. ASSAf has also collaborated with NASAC to initiate and strengthen science academies in the SADC region and is actively engaged in joint initiatives with the science academies in Mozambique, Mauritius and Zimbabwe.

Academy of Science of South Africa (ASSAf)

ASSAf Research Repository

<http://research.assaf.org.za/>

A. Academy of Science of South Africa (ASSAf) Publications

A. ASSAf Consensus Study Reports

2011

Towards a Low Carbon City: Focus on Durban

Academy of Science of South Africa (ASSAf)

Academy of Science of South Africa

Academy of Science of South Africa (ASSAf), (2011). Towards a Low Carbon City: Focus on Durban. [Online] Available at: DOI <http://dx.doi.org/10.17159/assaf/0031>

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