

# Land-use management system as a tool towards achieving low-carbon cities in South Africa

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## Abstract

The scientific community has to a large extent accepted that climate change is no longer a vague threat but a growing reality attributed to the build-up of greenhouse gas emissions. As urban areas are responsible for a substantial component, these emissions, reducing carbon emissions from cities, can make a significant difference in reducing global emissions. This article examines the nature and extent of greenhouse gas emissions in South Africa, and explores the contribution that spatial planning, land development and regulatory aspects of the land-use management system can make towards achieving lower carbon cities.

## GRONDGEBRUIKBESTUURSTELSELS AS 'N WERKTUIG OM LAE KOOLSTOFSTEDE IN SUID-AFRIKA TE SKEP

Die wetenskap het grootliks aanvaar dat klimaatverandering nie meer 'n vae dreigement is nie, maar 'n werklikheid as gevolg van die vrystelling van kweekhuisgasse. Aangesien stedelike gebiede die oorsprong van baie van hierdie uitlatings is, behoort stede dus die fokus van bekampingsaksies teen die wêreldwye kweekhuisgasvrystellings te wees. Hierdie artikel bespreek die aard en omvang van kweekhuisgasvrystellings in Suid-Afrika en die rol van ruimtelike beplanning, grondontwikkeling en regulatiewe aspekte van die grondgebruikbestuurstelsel in die skep van lae koolstofstede.

## MOKGWA WA TSAMAISO YA TSHEBETSO YA LEFATSHE JWALO KA SESEBEDISWA SA HO FIHLELLA METSE YA DITOROPO E NANG LE MOYA O SILAFETSENG HO LA AFRIKA BORWA

Baahi ba tsa mahlalehale ba amohetse ka ho otloleha hore phetoho ya boemo ba lehodimo ha e sa hlole e le tshosonyana feela empa ke nnete e holang e hokelwang ho ho dutleng ha kgaswe ya grenhouse. Ka ha dibaka tsa metsemeholo ya ditloropo e le tsona tse bakang ho dutla hona ha dikgase tsena, ho fokotsa ho dutla ha dikgase tsa moya o silafetseng (carbon emissions) metseng ya ditloropo ho ka tliša phapano ya bohlokwa ho fokotsa ho dutla ha dikgase tsena lefatsheng lohle. Pampiri ena e tla hlahloba mokgwa esitana le ho tswela pele ho dutla ha dikgase tsena tsa greenhouse mona ho la Afrika Borwa, e ntano batlišisa thuso eo moralo wa sebaka, temo ya lefatsheng esitana le dintlha tsa taolo ya mokgwa wa tsamaiso wa tshebediso ya lefatsheng di ka o etsang ho fihlella metsemeholo ya ditloropo e dutlang moya o silafetseng o sa hlwekang o tlase ha ho bapiswa.

## 1. INTRODUCTION

The scientific community has to a large extent accepted that climate change is no longer a vague threat but a frightening reality (Raubenheimer, 2008; The Royal Society, 2010), evidenced in the frequency and extent of natural disasters. Such change has largely been attributed to the increase in greenhouse gas emissions over the past 250 years (IPCC, 2007: 5), much of it derived from the use of fossil fuels for energy and manufacturing: "There is strong evidence that the warming of the Earth over the last half-century has been caused largely by human activity, such as the burning of fossil fuels and changes in land use, including agriculture and deforestation" (The Royal Society, 2010: 1).

Urban areas, now home to half the world's population, have contributed disproportionately to the build-up of these emissions (Hoornweg, Sugar & Gómez, 2011). Although cities have a small physical footprint, they extract an excessive proportion

of the world's resources (Reader, 2005: 301). Consequently, reducing carbon emissions from towns and cities can make a significant difference in reducing global emissions.

As a signatory to international agreements and accords, South Africa has accepted the responsibility to reduce its carbon emissions. This article examines the nature and extent of greenhouse gas emissions in South Africa, and explores the role of the land-use management system in reducing carbon emissions.

## 2. SOUTH AFRICA AND CARBON EMISSIONS

South Africa has participated in international summits, conferences and agreements on sustainable development and is a signatory to the Kyoto Protocol and the Copenhagen Accord. However, this country has major challenges regarding greenhouse emissions. It ranks among the worst offenders regarding greenhouse gasses: in 2009, the International Energy Agency listed South Africa as the thirteenth highest emitter of carbon dioxide in the world (South Africa. Department of Environmental Affairs, 2010). Its carbon emissions, when expressed as emissions per capita of between 9.5 and 9.9 tonnes of CO<sub>2</sub> per capita,<sup>1</sup> may be lower than those of the United States or Australia, but are roughly equivalent to those of Greater London or New York City, and considerably higher than those of Sweden, Switzerland or Mexico (Winkler & Zipplies, 2008: 112; Hoornweg *et al.*, 2011: 211-212). South Africa constitutes some 1.2% of global emissions and six times the African average (Winkler, 2009: 60). It also exceeds the world average of 5.6 tonnes per capita. This high carbon profile can be attributed to an economy that has been based on energy-intensive mining and manufacturing industries (Winkler, 2009: 39-43).

The majority of South Africa's emissions (45%) are derived from the energy supply sector, (predominantly electricity generation from coal-fired generating

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1 CO<sub>2</sub>e refers to carbon dioxide (CO<sub>2</sub>) equivalents, reflecting the potency and contribution of other greenhouse gasses (Winkler & Zipplies, 2008).

plans or synthetic petroleum), followed by industrial energy (14%) and transport (11%) (Winkler & Zipplies, 2008: 116).

Industry is the greatest consumer of energy (45%), with transport using 20% and residential some 10% (Winkler, 2009: 40-43). However, as part of its drive to improve the quality of life of millions of South Africans, the government is actively promoting the provision of electricity to households as part of the package of basic services. This is increasing the demand for electricity and, consequently, carbon emissions, given the profile of South Africa's electricity generation profile (Winkler, 2009). Thus, for South Africa to reduce its carbon footprint, it needs to restrict the emissions from energy generation, industry and transport, and ensure that the latter and households are more energy-efficient.

While energy demand and use in the energy-intensive mining and manufacturing sectors are generally beyond the scope of urban and regional planners, reducing energy demand in buildings and transport emissions are certainly within the scope of a land-use management system.

### 3. SOUTH AFRICA'S RESPONSE TO CLIMATE CHANGE

The Department of Environmental Affairs and Tourism (DEAT) has led the way in addressing the issue of climate change and greenhouse gas emissions, both internationally and locally. It has commissioned a set of long-term mitigation strategies that were accepted by cabinet in July 2008 and discussed at the 2009 Climate Summit held in March 2009 where key stakeholders met to discuss climate policy (Chesterman, 2009: online). Among the resolutions adopted require government to reduce greenhouse gas emissions from land-use change and housing developments and include mitigation actions in integrated development plans (IDPs) (South Africa, Department of Environmental Affairs and Tourism, 2009).

Mitigation and energy efficiency were also addressed in the 2009 budget speech by Finance Minister, Trevor Manuel (Manuel, 2009: online):

We propose taking further steps to encourage energy efficiency

and reduce harmful emissions, some of which have tax implications.

- An incentive for investments by companies in energy-efficient equipment will be introduced, in the form of a supplementary depreciation allowance.
- An increase is proposed in the international air passenger departure tax.
- The existing excise duties on motor vehicles will be adjusted to take into account carbon emissions.

It is important, furthermore, that we should encourage South African companies to take advantage of the clean development mechanism established in the Kyoto Protocol. A favourable tax treatment will therefore be introduced for the recognition of income derived from the sale of emission reductions, as certified through this mechanism.

The South African national government is clearly committed to addressing carbon emissions and is actively seeking means to achieve this. One focus is on energy efficiency<sup>2</sup> and renewable energy sources, carbon capture and storage, and reduction of transport emissions (South Africa, Department of Environmental Affairs and Tourism, 2009) which will address the primary sources of carbon emissions in South Africa.

Among the objectives of the *White Paper on Energy Policy* (South Africa, 1998a) are: improving governance in the energy sector; increasing access to affordable energy; stimulating economic development; managing energy-related environmental impacts, and securing supply through diversity. *The White Paper on Renewable Energy* (South Africa, 2003) states that its prime objective is to ensure that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy-supply options. These policies have been translated into policy to provide subsidised electricity connections to newly constructed or upgraded state-subsidised housing as well as pilot projects to provide informal settlements that cannot be upgraded with alternative energy sources such as liquid petroleum gas (LPG) or solar

power (Winkler, 2009).

More recently *the National Climate Change Response Green Paper* (South Africa, 2010) has identified the three sectors that are responsible for over 80% of South Africa's greenhouse gas emissions, namely energy, industry and transport. Noting the impact of climate change already evidenced in the country, the Green Paper also addresses issues of adaptation and disaster risk management (South Africa, 2010: 9, 10). These responses are to be guided by a set of principles, derived from legislation and international agreements, namely:

- The principle of common but differentiated responsibility that acknowledges the different contributions to climate change and varying capacity to act;
- The precautionary principle that adopts a careful, risk-averse stance;
- The polluter-pays principle that insists on those responsible for environmental damage and negative health impacts should bear the costs of remedial or mitigating action;
- A people-centred approach that acknowledges human dignity and the vulnerability of especially the poor to disasters, while accepting stewardship and the responsibility to ensure environmental sustainability which links to the principle of intergenerational rights, and
- Informed participation which deals both with the science of climate change and adaptation or mitigation as well as informing and educating citizens on these issues and building capacity for appropriate action.

These principles should be taken into account when formulating a land-use management policy to reduce carbon emissions and manage the effects of climate change.

### 4. LAND-USE MANAGEMENT SYSTEM IN SOUTH AFRICA

*The White Paper on Spatial Planning and Land Use Management* (South Africa, Department of Land Affairs, 2001a) adopted a holistic approach to land-use management. For many planners land-use management, or development control as it was best

2 Due to the lack of investment in power-generation facilities coupled with sustained economic growth the South African power-generation entity, ESKOM could not meet demand and large-scale blackouts were experienced. All cities had to reduce their consumption by 10% or face rolling blackouts which severely impacted on business and the mining industry.

known in the past, is mainly associated with control. The new approach is to link spatial planning and development facilitation with development control to create a system of land-use management. This broader perspective is reflected in the *White Paper on Local Government* (South Africa, 1998b) and subsequent legislation, such as the *Municipal Systems Act 32 of 2000* (South Africa, 2000) and the *Municipal Planning and Performance Management Regulations* (South Africa. Department of Provincial and Local Government, 2001b) where the spatial plan that is a mandatory component of the Integrated Development Plan (IDP) must contain guidelines for land-use management.

Thus spatial planning and land-use control, which comprise the processing and evaluation of land-development applications as well as the enforcement of the controls and legislation, form the core of the land-use management system. The spatial development framework informs the evaluation of applications (including building plans) and the existing legislation, including a zoning scheme, form the basis of the law enforcement or control function. These functions are supported by the land-information system that contains cadastral, land-use rights data as well as topographical and geological data (e.g. unsafe land due to mining or dolomite, etc.).

The principles and norms contained in planning policy and legislation (South Africa, 1995; South Africa. Department of Land Affairs, 2001a; South Africa. Ministry of Agriculture and Land Affairs, 2008) inform the system, demanding that it operates transparently, includes the community in decision-making, and promotes sustainable development.

## 5. HOW THE LAND-USE MANAGEMENT SYSTEM CAN CONTRIBUTE TO REDUCING EMISSIONS

Each of the elements of the South African land-use management system, including the spatial development framework, the regulatory element and enforcement can make a contribution to lower carbon emissions. As the enforcement element supports the spatial planning and regulatory components, it is crucial, for without a strong enforcement arm and stiff penalties, compliance will be voluntary and limited.

### 5.1 Spatial planning and development

Spatial planning, linked to land-use management, can make a major contribution by creating a more efficient urban form that enables sustainable transport, through the use of more sustainable energy and through carbon sequestration (Crawford & French, 2008; Swilling, de Wit & Thompson-Smeddle, 2008).

The majority of South African cities are built at such low densities that they cannot support effective public transport systems. Newer areas of higher density are often on the fringes of the urban area with a swathe of low-density, detached housing between the inner city and the fringe. This pattern gives rise to a dependence on private transport, and for the poor, on micro-bus taxis.

It is essential to reduce dependence on private transport densification as well as defining and enforcing a hard urban edge beyond which no further subdivisions should be permitted. In addition, higher densities must be encouraged along (potential) public transport routes which can become 'high streets' where retail and social facilities are located. This will both reduce the need for private vehicles and encourage cycling and walking for local trips and public transport for longer trips. Simultaneously, large freestanding, car-centres shopping malls must be rejected (Swilling *et al.*, 2008).

Integrated public-transport systems can be enabled through spatial planning. The metropolitan areas of South Africa have initiated bus rapid transit (BRT) systems as a first step towards more integrated public transport that will link outlying areas with the inner core and other major nodes. The primary objective of the Gautrain linking Tshwane, Johannesburg and OR Tambo Airport is to reduce the traffic on the main highways between these destinations and consequently, associated carbon emissions.

These modes of transport can be encouraged by providing safe pedestrian walkways and cycle paths.

Spatial planning can also contribute to carbon sequestration by ensuring that natural areas, particularly along rivers and ridges, remain unspoiled and that indigenous vegetation is retained. Besides absorbing carbon, these areas provide biodiversity corridors for the movement of flora and fauna (Swilling

*et al.*, 2008). Street trees appropriate to the climatic conditions of the city not only improve the appearance of the city, but also act as carbon sinks. Where possible, alternative forms of energy, such as wind or solar power, should be planned for and implemented, even at the level of the individual home.

In emphasising these issues in the integrated development plan, the primary strategic and operational planning tool of local government, that spatial planning can make its largest contribution. Besides the actions mentioned above, other related issues can be mooted such as the reduction and recycling of waste, the extraction of energy from landfills, the use of alternative energy sources in homes and industries, and the promotion of economic development towards efficient resource use (Zipplies & Du Plooy, 2008; Thabrew, Wiek & Ries, 2009; Cape Town, 2006). Stressing these concerns as part of a more comprehensive debate on sustainability can raise the priority and associated funding.

### 5.2 Regulatory environment

The regulatory environment comprising the zoning schemes and building regulations can contribute significantly to lower carbon emissions as buildings, in both construction and operation, are large contributors to greenhouse gases (Van Wyk, 2009; Horn & Miller, 2008).

As the *Land Use Management Bill* (South Africa, 2008) has not yet been passed, there is an opportunity to strengthen the sustainability component. In addition, the regulations are still to be compiled, and thus this creates the opportunity to ensure that new developments are more sustainable, and that cities are more compact and promote public transport.

Performance zoning can be introduced where (re)developments must meet certain minimum criteria regarding greenhouse gas emissions. These could be calculated on the basis of distance from public transport, use of renewable energy and carbon sequestration. It may be possible to include carbon taxes on new developments not adjacent to public transport routes.

The role of Strategic Environmental Assessments and Environmental Impact Assessments in evaluating development applications can be strengthened to ensure that ecological and carbon footprints are evaluated, and that negotiations regarding alternative uses, methods and materials can commence

(Thabrew *et al.*, 2009; Stoeglehner & Narodslawsky, 2008).

As part of the development process, local governments must approve the engineering services associated with new townships (subdivisions). There is an opportunity to insist on more sustainable services, from solar-powered traffic lights to more efficient use of water.

The *National Building Regulations* (South Africa, 1977) are being reviewed and this creates an opportunity to ensure that green building methods and materials are enforced. A holistic approach such as that espoused in Horn & Miller (2008) and Van Wyk (2009) could be the foundation for new construction under a revised building code. Various cities, such as Cape Town and Tshwane, are engaged in developing green building by-laws. While these could not be applied retrospectively, they could be enforced for all new construction (Winkler, 2009). Some aspects, for example solar water heating, could be made mandatory for existing housing.<sup>3</sup>

Given that the main contributor to greenhouse gas emissions in South Africa is energy production and use, the greatest savings will be in reducing energy consumption, and green building technologies that reduce energy demand must therefore play a major role.

## 6. CONSTRAINTS

While there is clearly potential to reduce carbon emissions through the land-use management system, there are also a number of constraints.

Although the South African government is committed to reducing emissions and creating a lower carbon society, the rate of implementation is slow. An analysis by Winkler (2009) indicates that while much work has been done, a high level of sustainability is still to be reached, while Swilling (2004: 229) is concerned that the government's renewable energy targets are "highly inadequate given the challenges ahead".

Other urgent and immediate needs such as the delivery of basic services promised in election campaigns, job creation and poverty alleviation in a country with nearly one quarter of the

population living on less than R174 per month (about \$1 per day) (South Africa. The Presidency, 2008) must be prioritised, particularly in local governments where these needs are most acutely felt. Investments in long-term solutions to climate change may be forfeited for short-term political gains.

Although the Department of Minerals and Energy played a role in the development of policies and strategies to reduce carbon emissions, the majority of CO<sub>2e</sub> emissions result from activities which it controls. Traditionally a powerful department, it may not curb mining-related emissions to the desired extent, possibly due to vested interests from powerful mining companies.

Public attitudes and ignorance are another cause for concern. Upper income South Africans are mainly conspicuous spenders with environmental issues not yet driving local political agendas. For the many South Africans living in poverty survival from day to day is paramount, while reducing carbon emissions appears to be irrelevant. Education can play a key role in creating awareness and informing on actions that South Africans can take to mitigate the effect of climate change.

Besides demands for private transport (a necessity in low-density cities as well as a status symbol), South Africans of all races have traditionally preferred lower density detached housing with a private garden. Only in the past fifteen years or so has there been a significant move to higher density forms of housing by the upper income groups, and by some low-income groups moving to inner-city apartments.

As there are initial capital costs to moving to alternative energy sources such as solar heating, the public will be unwilling, or unable, to invest in these technologies without government subsidies (Winkler, 2009).

The market that drives consumerism will probably not change of its own accord. Government will require a carrot-and-stick approach with incentives for investment in renewable energy sources, cleaner fuels and energy-efficient production and transport methods, alongside penalties for high emissions and excessive energy uses. Both surcharges and tax benefits such

as those mentioned in the 2009 budget speech (Manuel, 2009: online) will have to be employed to encourage the market to contribute its share to lower carbon cities. Consistent application of the policies and regulations, in the face of probable opposition by developers and other businesses, will be necessary by both officials and politicians.

## 7. CONCLUSION

There is unquestionably scope for the South African land-use management system to make a meaningful contribution to low(er) carbon cities. In the broad conceptualisation of land-use management adopted by South Africa (Enemark, 2007; South Africa. Department of Land Affairs, 2001a), both the spatial planning and the regulatory components can contribute, but must be reinforced with consistent enforcement to ensure compliance.

More compact cities, with higher densities that support energy-efficient transport systems, can reduce emissions related to transportation. This can be supplemented by retaining natural areas and planting street trees, even in arid areas. The land-use management regulatory component can support spatial planning policies and ensure low emission design and construction of new developments or refurbishments.

While compact cities have for a long time been a goal of urban planning, revised land-use management legislation with a revised building code, in conjunction with existing environmental legislation, provides an opportunity to ensure that it occurs in practice.

Control measures must be complemented with greater awareness and education as well as appropriate incentives, at least for a transition period until the new concepts, processes and technologies are firmly established.

Above all, for the land-use management system to succeed as an effective tool in creating lower carbon cities there must be the political will at all levels of government to ensure that the measures described above are approved and implemented.

<sup>3</sup> Raubenheimer (2008) estimates that solar water heaters could save between two and five tonnes of CO<sub>2</sub> per home.

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