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This edition of the Sustainable Cities Report is dedicated to the memory of ***Craig Haskins*** *(1968-2009). Craig was a member of the SACN's Indicators Reference Group, and represented the City of Cape Town in the SA-Denmark UEMP.*

contents

foreword

South African Cities Network's (SACN) Sustainable Cities programme highlights the need for cities to develop strategies that carefully consider the sustainable use of finite resources in the creation and delivery of infrastructure. The programme looks beyond the green issues and also examines a number of areas that impact on the quality of life and cost of living in urban centres. In 2009, the priority themes included renewable energy and waste-to-energy strategies, biodiversity, green building standards, sustainable public transport and climate change.

This edition of the Sustainable Cities Report provides an overview and analysis of sustainable city learning outputs produced by SACN and its partners during 2009.

We are very grateful to the Danish government for funding this programme through the SA-Denmark Urban Environmental Management Programme (UEMP). This grant will end in December 2010, and we look forward to sharing the lessons and experience from this complex intergovernmental programme. One impact of the UEMP is that it has allowed us to develop a new city climate mitigation programme that will be funded by the Public Private Infrastructure Advisory Facility over the next two years. This programme brings a number of municipalities together to achieve collective climate action, and SACN will profile it in Copenhagen in the run-up to COP 15 in December 2009.

Our thanks also go to Annie Sugrue and Dorah Lebelo who have coordinated the Sustainable Cities programme for the last two-and-a-half years. Their broad knowledge of the themes and their strategic perspective on what cities can do to be more sustainable has added a lot of value to the work of the SACN.

This edition of the Sustainable Cities Report would not have been possible without the following contributions:

- The SACN's Sustainable Public Transport Overview Report (2009) written by the transport team at the Council for Scientific and Industrial Research's (CSIR) built environment division.
- Lutske Newton, Saliem Fakir and Sara-Jayne Willicot's patience in leading and informing the renewable energy study tour to the UK, Germany and Denmark in February 2009, and their record of what was learnt.
- The fine work done by the Green Building Council of SA in developing and launching the first few components of the Green Star Rating Tool for South Africa. We are pleased to have been associated with this valuable knowledge generation project.
- The very complicated technical modelling that went into

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producing SACN's toolkit on waste-to-energy through biogas, compiled by a team from Agama Biogas.
- Jim Dorhman's practice note on landfill gas capture contributed by the USAID-funded ISLGS programme.
- The profile on carbon-neutral residential developments from BioRegional.
- Inputs from Anthea Stephens and Budu Manaka from the South African National Biodiversity Institute (SANBI), and from Meggan Lewis and Debra Roberts from eThekwini municipality on urban biodiversity and reforestation.

The SACN member cities are poised to play a significant role in achieving more sustainable development outcomes. Collective climate action, more assertive regulation of what we build and the way we build it, and massive investments in public transport infrastructure should result in cities that work quite differently in the future.

Sithole Mbanga, CEO

sustainable public transport in the cities

Cities all over the world struggle to develop and maintain sustainable public transport systems. In South Africa, public transport is a priority service commitment for the 2010 FIFA World Cup, with significantly more public funding being directed towards this sector. It is therefore regarded by all nine member cities of SACN as a key challenge for local government, and a priority theme for knowledge exchange between member cities. In order to achieve urban integration policy objectives, public transport has been identified as a key sector (along with human settlements and land use management) in the built environment suite of functions that should be assigned to city administrations.

In collaboration with the Transformation Towards Sustainable and Integrated Transport for the Urban Environment (TranSIT) programme of Sustainable Energy Africa, SACN put together a learning theme titled Sustainable Public Transport. The key output of this learning focus took the form of a two-day seminar that allowed public transport and environmental officials from the member cities to analyse international leading practices in community-led transport solutions and public transport mega-projects.

The seminar allowed member cities as well as local and international transport industry stakeholders to share experiences in planning, implementing and managing public transport projects and programmes. Representatives from the political leadership in cities, city officials, commuter organisations, labour unions, academia, research councils, public transport operators and non-governmental bodies were also present at the seminar.

An overview report on sustainable public transport in the SACN member cities was compiled by the CSIR built environment division. What follows is a summary of that report. (The full report can be downloaded from SACN's website: www.sacities.net.)

Public transport is seen as a developmental signature of cities. The state of public transport in a city, in terms of its accessibility, affordability, acceptability and availability, is a good indicator of the commitment of the city towards sustainable development.

In South African cities, public transport also forms part of a broader basic service delivery agenda given the large proportion of households without a car, the large proportion of the population without driving licences, and the need to minimise the ever increasing household expenditure on transport. Population growth and its diverse needs

demand that the innovative design and delivery of public transport services receive priority.

A sustainable public transport system is usually characterised by high levels of access, affordability, acceptability and availability. Accessibility levels are improved, for example, when the distance travelled between a journey origin and a public transport route is minimised, with the norm being a maximum of 500 metres (or 5 minutes) walking distance. From a user perspective, the South African transport policy promotes a maximum of ten per cent of disposable household income on public transport (RSA, 1996). Authorities should therefore invest in a basket of public transport infrastructure and service solutions that are affordable to the user. Additionally, an administration system that ensures financial sustainability of the public transport system is crucial. An acceptable public transport system is compatible with the values held by society, in terms of service quality and impact on the environment.

Availability of a public transport service refers to its capacity in relation to travel demand, for example headways, vehicle capacity and network capacity. Successful public transport services attempt to functionally integrate with other modes of transport in order to maximise patronage. In order to achieve this, dedicated institutional planning and management of the system are required.

In South Africa, much of the public transport planning and management responsibilities are shared between all three spheres of government – national, provincial and local. In line with legislation, local government is responsible for formulating and implementing the integrated transport plan. The plan should essentially provide an overall local government transport service delivery agenda. Cities, as part of the local government sphere, are especially required to formulate comprehensive integrated transport plans.

The shared responsibility of functions between the three spheres of government is often a source of conflict, especially between cities and the other spheres. Whereas cities are directly accountable to their political constituencies and rate payers, there is less pressure on provincial and national government. Consequently, cities are sometimes held responsible for decisions taken by provincial and national government within the city's area of jurisdiction. For example, subsidised public transport services, the provincial road network, national passenger rail, and national roads. As a result, the ability of cities to deliver sustainable public transport is inherently limited.

Although there have been legislative attempts to devolve full public transport responsibilities to the cities, successful implementation remains to be seen. In order for South African cities to deliver on their sustainable

An acceptable public transport system is compatible with the values held by society, in terms of service quality and impact on the environment

public transport mandates they need to lobby for greater autonomy over the control of public transport. Speaking at the seminar, SACN CEO, Sithole Mbanga said that the expenditure of funds for public transport should be the domain of local government. He argued that the state should allow local government to have greater autonomy in order to harness creativity, with a view to improving service delivery. He also outlined a critical need for integrated planning and service delivery, especially with regard to the linkages between housing provision and transportation.

Greater autonomy over public transport service delivery has seen many cities around the world become innovative and effective agents. Cervero (1998) identifies examples of four city archetypes that, through proper and dedicated transport planning and management, have been able to deliver sustainable public transport:

- **Adaptive cities:** These are public transport oriented cities that have invested in high capacity public transport systems i.e. rail, to guide urban growth. Examples are Copenhagen, Tokyo, and Stockholm.
- **Adaptive public transport cities:** These are cities that have managed to successfully adapt their public transport to serve somewhat dysfunctional urban sprawls. Examples are Karlsruhe, Adelaide and Mexico City.
- **Strong core cities:** These are cities that have successfully integrated public transport with the built environment within a more confined central city context. Examples are Zurich and Melbourne.
- **Hybrids combining adaptive cities and adaptive public transport archetypes:** These are cities that have managed to concentrate their development around main public transport corridors and at the same time adapting the public transport system to serve outlying areas. Examples are Curitiba, Ottawa and Munich.

Vasconcellos (2001) makes a strong argument that sustainable transport (including public transport), cannot be delivered within a traditional planning framework founded solely on technical treatise, and proposes a social and political approach, referred to as 'sociology of transport'. This proposed new approach would not take trips as a given, but ask why and how trips are made, using an analytical framework that incorporates societal, economic and political contexts. The approach further ties with the notion that travel is in many respects a derived demand. This implies that when people travel, they do so in order to fulfil specific goals other than travel itself. Transport is used as a means to an end. This statement is very important for setting the scene for transport planning and management in cities. In fact, it challenges some of the assumptions embedded in transport policies and implementation projects, and demands that practitioners understand the underlying reasons for travel in order to provide more sustainable developmental solutions.

Ultimately public transport is a service, and in order to provide a sustainable public transport service, it is imperative that the customer is thoroughly understood in order to improve service delivery. Public transport solutions that are centred on the customer, rather than technologies and vested commercial interests, are characteristically sustainable.

Numerous approaches to public participation have found wide application in the design and operation of public transport systems. In many cities around the world, authorities enter into some form of contractual arrangements with operators for the provision of public transport services. Such contracts allow authorities to hold operators accountable for the quality of the service. In such cases, public inputs in the form of customer satisfaction surveys are used to assess the performance of the operator.

Recently, performance-based contracts have gained popularity over tendered public transport service contracts. Survey techniques such as focus groups and in-depth one-on-one sample surveys are essential for gaining insights into the experiences of public transport customers.

Contracts between authorities and operators are often concluded within the ambit of a regulated public transport system. However, in fully deregulated public transport systems, as is the case in many developing countries, authorities have no control over the service quality specifications. The service quality of fully deregulated services is improved if operators voluntarily make a collective effort to formulate service quality standards and enforce such standards through a self-regulation process. In fact, experience around the world shows that by organising themselves into route associations, these operators can lower their per-seat operating costs and become more competitive (Cervero and Golub, 2007).

State of public transport in SACN cities

Transport legislation and strategies introduced immediately after 1994, was intentionally formulated to address the transition of transport planning and management from a strong apartheid-led policy to a system aligned with the values of the new Constitution. During the initial phases of the transition, some bold policy targets were set, such as the modal split between public and private transport and household expenditure on public transport.

At the same time, a number of policy blunders were made that have seen the country unable to transcend the transition to the extent that the process produced its own problems:

- Failure to anticipate the impact of increased energy costs on travel patterns.
- The view that low cost public transport is more important to the poor and service quality is more important to the wealthy - the underlying assumption being that the poor do not deserve a good quality service. This is being rectified by cities such as Johannesburg which recently formulated public transport plans to deliberately enable the delivery of premium services to the poor.
- Assumption of a surplus of skills in the country to address issues relating to transport service delivery. This has created enormous planning and implementation backlogs, and an inability to spend allocated capital and operation budgets for improved public transport services.
- The assumption that intersphere government coordination would work seamlessly. This has proven to be particularly problematic in respect of regulatory functions shared between the provinces and cities, and in the interface between housing provision and public transport services, which resulted in poorly located settlements.
- Underestimation of the role of labour unions in the transformation of the public transport system. As a result, little planning was made to accommodate the impact of public transport reforms on the labour force, which was met with much resistance from the unions.
- Failure to anticipate and plan for the growth of the middle class with increased disposable incomes, and their subsequent ability to completely shift to private transport use.
- State ownership and operation of public transport infrastructure and services.
- The long trip distances still undertaken by the poor, including those who live in previous homelands. This is associated with a failure to create substantially increased employment opportunities in townships.
- Land ownership reform.

As a result of these failures, the generalised costs of transport, especially public transport, have been on the increase. The 2005/06 income and expenditure survey (Statistics South Africa, 2008) found that transport is the household expenditure item that increased substantially over recent years. Even for 20 per cent of households with the lowest income, transport expenditure as a proportion of total household expenditure increased from 4 per cent in 1995 to 10.6 per cent in 2005/06. In terms of travel time, many commuters have changed their time of departure to work to either earlier or later than the traditional peak time, as a result of road congestion. (Lombard, Cameron, Mokonyama and Shaw, 2007)

SACN member cities are all required by law to prepare comprehensive integrated transport plans, but some still

have no such plans. While each city has a unique set of issues to contend with, the following emerged as common obstacles:

- The challenge of managing an integrated public transport network.
- Deteriorating road traffic safety.
- Poor infrastructure planning, provision and management for non-motorised transport modes.
- Deteriorating public transport service quality.
- Attempts to revitalise the public transport system through the introduction of bus rapid transit networks.
- The use of the 2010 FIFA Soccer World Cup as a catalyst for improved public transport investments.

The current state of transport in South African cities is not adequately monitored. Many of the sample surveys available are more representative of provincial rather than local government level. The design and implementation of appropriate survey instruments aimed at monitoring the state of transport in South African cities should receive priority. This is achievable through the use of satellite technology, various forms of transactional data, and the use of information and communications technology.

The pressures created by the forthcoming 2010 FIFA Soccer World Cup, the taxi industry reforms, oil depletion and rising fuel costs, rapid decline in the availability and supply of parking space, and an increase in traffic congestion and its impact on the environment, together provide a perfect storm to tackle the headline issues regarding sustainable public transport in South Africa.

Indications are that cities are increasingly becoming pressure points. For example, the average household size in a city is declining, but the number of households is increasing. This presents particular challenges in that the per capita household journeys are on the increase, and this in turn has implications for the physical capacity of the transport system.

Despite concerted efforts to invest in public transport infrastructure, indications are that many of the public transport systems in large cities around the world have declining ridership levels, and public transport continues to lose to private transport. It is therefore important to find solutions that work for South African cities and this requires an intimate understanding of city systems and environments.

Public transport trends in South Africa that specifically require responses include the following:

- Trip distances are generally higher than world averages. For example, in Tokyo the public transport commuter trip distance is 8km, compared to the City of Tshwane where it is over 25km and still on the increase.
- Between 1995 and 2003, the City of Cape Town had

the largest increase in the number of new household owned cars. Cape Town has the highest proportion of car owning households (about 50 per cent) compared to Johannesburg (estimated at 32 per cent) (Lombard, Cameron, Mokonyama and Shaw (2007).

- In the same period, the City of Johannesburg had the highest average development density (about 21 persons per hectare) of all South African cities, yet in world standards it is considered too low to sustain public transport. In terms of inner city densities, the Nelson Mandela metro has the largest density of all the cities (about 56 people per hectare) but the lowest in term of the whole metropolitan area (about 5 people per hectare) (Van Den Berg, Krynauw and Cameron, 2005).
- Bus services are losing their market share, with minibus taxis taking a large proportion of this demand. Given this trend, cities have to seek the right mode for the right circumstances.
- The nature of trips are changing. Work trips used to be the main purpose for travel. That has changed, and the importance of trip purpose, in descending order is: education, shopping, visiting and then work. On a typical day there are more people who do not travel than those who travel to work (DoT, 2003).
- The safety and security levels of the public transport system are inadequate. For example, an epidemiology study of railway injuries and deaths reveal a large number of incidents stemming from falls from trains and being struck by trains (Lerer and Matzopoulos, 1996).

This paints a picture of a public transport system facing critical challenges. Solutions that could be adopted to address the challenges were discussed at the seminar.

Prioritising the users of space

South African cities have traditionally prioritised the private car and there is still a strong roads lobby group that influences the transport agenda in the country. There is widespread agreement that the focus needs to shift; the design of space to properly accommodate pedestrian activity should be prioritised. The size of walking space is not a technical decision but is indicative of whether or not authorities take into account the needs of the public. A good example is the City of Cape Town's bicycle network master plan with stringent design standards. While the design of non-motorised transport is seen as important, there is no clear indication of the direction cities should adopt as the way forward.

Commuter-led planning

Vibrant civil societies make governments more accountable. Some of the most revolutionary changes in cities around the world are as a result of communities challenging the authorities and claiming their right to ownership of their cities. It is imperative that communities are involved in transport planning and management. This can be achieved through proper consultation with, for example, organisations such as the South African Commuter Organisation (SACO).

Cities are in fact required to consult with communities when preparing integrated transport plans. However, the turnouts at such meetings are usually poor. A possible reason for this could be that city officials resort to technical jargon when engaging members of the public. In the City of Cape Town, before plans were drawn, the city conducted a focus group survey to better understand the needs of the public. This is one way in which cities can consult and receive input rather than presenting communities with a decision.

Commuter-led planning in local government is fundamentally supported by Section 152 of the Constitution. It identifies one of the objectives of local government as that of encouraging the involvement of communities and community organisations in matters of local government.

This is further reflected in the 1996 National Transport Policy white paper which states that "the needs of the community and customers will be determined and provided for by a transparent, consultative, coordinated and accountable process, based on comprehensive information. Public participation in decision making on important transport issues, including the formulation of policy and the planning of major projects will be encouraged."

The National Land Transport Transition Act and the soon to be enacted National Land Transport Bill both state that planning authorities must "encourage, promote and facilitate public consultation, participation or involvement through hearings, seminars and workshops and any other means that are appropriate to ensure effective communication with customers, communities, organised labour and transport operators." It is therefore imperative that cities find improved ways of ensuring that this legislative mandate is achieved.

The planning, provision, maintenance and sustainability of public transport systems must take into account the real needs of the customer. City officials need to place emphasis on capturing the voice of the user, and genuinely endeavour to plan, implement, maintain and evaluate projects in partnership with users. Adopting innovative approaches that place the users' voices at the centre of the process is critical. It is important that public transport infrastructure and services should be demystified as a technocratic activity that is planned by experts and professionals who do not use the system.

It has been illustrated in various parts of the world that communities can transform city road space to be compatible with its use by the community. When children were being killed by cars in a community in Accra, Ghana, the community erected 'road humps' with locally available soils and rubble. In 1968, in Delft in the Netherlands, the community constructed the first woonerf (traffic calmed street) before the municipality later replicated this initiative throughout the municipal boundary. Another form of community protest is space hi-jacking. In cities such as London and San Francisco, community members grouped together to turn parking space into family and leisure space.

In attempting to resolve commuter led planning struggles it is important to keep abreast of the dialogue and sentiment. Certainly, the best response is not to wait for commuter public transport challenges to explode before remedial actions and plans are tabled. A proactive and inclusive sustainable public transport agenda will help to prevent undesirable results.

The active involvement of local communities in the urban design framework in Melville, Johannesburg is a good example of how positive change takes place when communities are involved.

Mega-projects

Mega-transport projects as discussed at the seminar refer to large scale and multi-part transportation projects that are often characterised by the following attributes:

- Multi-billion Rand capital expenditures
- Long life time of 20 years and more
- Consumption of large area or tracts of land (size, shape and volume)
- Massive infrastructure components
- Considerable uncertainty with respect to demand forecasts and cost estimations.

Examples of mega-projects in South Africa are the Gautrain, Bus Rapid Transit networks and railway networks. These present a number of challenges for cities. Investment in large capital projects means that the demand for maintenance funding will increase. With funding already stretched as it is, cities will have to find new ways of generating extra funds for such maintenance programmes. Involvement of the private sector in investment for transport infrastructure and operations must be explored

and exploited. Cities need to engage with the National Department of Transport on the newly proposed National Transport Fund to find out how to tap and access funds for sustainable public transport initiatives. Such a fund, if properly managed, could prove to be useful.

Mega-projects are huge money spinners and there are bound to be vested interests in any large transport project. Apart from the potential for corruption, manipulation of the system to indirectly serve the business interests of some groupings is a problem. Statistics that show the potential for job creation and economic growth can be used to manipulate decision makers. The solution is to ensure that transparency is maintained in all the transactions for maximum public input. The City of Johannesburg appointed a probity advisor to provide an independent audit of all the transactions entered into with contractors, to ensure minimal corruption.

A shared vision

In order to provide and measure up to the standards of sustainable public transport, South African cities need to have a shared vision. Such a shared vision can be generated and developed through a strategic transport approach which entrenches long-term transport thinking. A shared sustainable public transport vision should strategically position cities to deliver effectively and efficiently on their mandate. This may entail undertaking the following activities:

- **Assessing the state of the city transport system:** Each city should identify and analyse its own public transport opportunities and problems; the sustainable public transport values and preferences of its residents; sustainable public transport change drivers, and its assets and resources.
- **Developing a long-term vision for a city transport system:** There needs to be a shared strategic understanding among all stakeholders. Thinking citywide provides a mechanism for stakeholders to assess the linkages between their respective priorities for health, security, jobs, housing, education, transport and the environment, and developing a shared vision for these priorities.
- **Engaging networks of cities:** Learning from peers through city-to-city public transport knowledge sharing networks is the most effective and sustainable way of transferring knowledge. The involvement of organised civil society bodies and other non-governmental bodies is crucial for the institutionalisation and replication of a sustainable transport development strategy.
- **Adoption of standards:** Cities need to use a common language and the same metrics to communicate their vision.

Cape Town train. Picture: mallix (www.flickr.com/photos/mallix)

The main challenge for South African cities is how to tackle public transport challenges head on. The first step may involve realising and accepting that the sustainable public transport challenge is indeed a collective challenge for all cities. This also highlights the underlying issue of public transport governance - keeping abreast of community and stakeholders needs via dialogue and transparent processes, and reassuring constituencies that their cities are indeed committed to improving public transport. Central to this debate is improving commuter service delivery. The government's response to improving commuter needs and governance issues should be clear.

Sustainable public transport is a global challenge. Cities worldwide have experimented with a variety of public transport intervention measures with mixed results. South African cities must avoid recycling transport measures that do nothing to relieve their public transport pressure points. While there is much to learn from other cities, solutions should be adapted and modified to the local context.

Going forward

These are some of the key building blocks of a sustainable urban transport public policy agenda that emerged from the seminar:

- Public transport systems should be built around the happiness of children as well as access by disabled people and first-time users. The concept of universal access and universal design should form the core of public transport plans.
- Transit orientated development philosophies should be incorporated in city wide plans.
- Communities should be used as an invaluable planning resource and further empowered to take ownership of public transport infrastructure.
- As much as cities have roads master plans, the time is opportune for cities to develop and implement non-motorised transport master plans.
- Given the confluence of opportunities such as increased energy costs and road traffic congestion, car users are increasingly becoming vulnerable and cities have an opportunity to attract such users to public transport.
- The age of cheap oil is permanently over and mass public transport solutions are the only viable option.
- Major international events such as the FIFA Soccer World Cup should be exploited as rallying points to generate momentum for a critical mass of public transport projects to carry us into the foreseeable future. However, such events should not be used as a deadline for implementing sustainable public transport projects but rather seen as a significant milestone.
- While there is a need for mass public transport capital projects, cities need to invest in appropriate technologies. Such technologies need to adequately cater for transport workers and public transport customers, and also improve authority accountability.
- Increased autonomy for local governments is crucial for enhanced public transport service delivery and operations of mega public transport projects. Increased autonomy is also likely to improve the innovative capacity of local government to transcend bureaucracy and technological challenges.
- The levels of trust between public transport operators and city authorities need to be improved. Operators need to embrace change and become change agents.
- Cities should not be despondent about the challenges brought about by the implementation of mega public transport projects.
- Cities should have specific measurable standards for monitoring public transport performance within the context of sustainable development.
- Cities must invest in generating public transport datasets to facilitate service delivery, improve decision-making and enhance accountability.
- The capacity to implement and manage mega public transport projects in local government is currently in very short supply. Under these circumstances cities should seek to use the available resources in the network of South African and world cities more optimally. The long-term solution is continuous capacity building.
- The sustainable public transport reference group should be strengthened so that it fully addresses all public transport issues.
- The seminar report should be used by cities as a reference for framing future learning events.

For further information on sustainable public transport in South African cities visit:
The TranSIT programme http://sustainable.org.za/transit/
Infrastructure Dialogues session on public transport (October 2009) http://infrastructuredialogues.co.za/?page_id=36
Download the SACN's overview report on sustainable public transport 2009 www.sacities.net

Lion's Head, Cape Town. Picture: Karien van der Westhuizen.

national climate change response policy

what it means for local government

In 2006, Cabinet started the process of developing a national climate change framework for South Africa. A substantial body of scientific and political analysis has since been accumulated, outlining various scenarios for government to consider in the development of a climate change response policy. The Long Term Mitigation Strategy, the Climate Change Research and Development Strategy, the Technology Needs Assessment, the 2000 Greenhouse Gas Inventory, and the 2nd National Communication has been integrated with other local and international research (including amongst others, the IPCC's 4th Assessment Report) to shape the climate change response policy.

In July 2008, government drafted a Cabinet memorandum outlining its response to the climate change challenge. The memorandum stated government's intent to balance mitigation and adaptation responses in designing a policy for the transition to a climate resilient and low carbon economy and society.

At the Climate Change Summit held in March this year, government formally launched a policy formation process that will culminate in the drafting of a white paper on the national climate change response policy. Then-President Kgalema Motlanthe signed the national strategic policy framework, which allows for emissions to peak until 2025, then stabilise for 10 years, before declining in absolute terms towards mid-century.

One of the key resolutions adopted at the summit focuses on building and strengthening existing initiatives for energy efficiency, renewable energy, and the development of green industries. Government and the private sector were urged to prioritise investment in research and technology that would make a significant impact on greenhouse emissions.

The climate change response policy will cover six themes, based on what government calls 'required by science' – to limit the increase in global temperature to below 2°C.

The six themes are:

1. Greenhouse gas emission reductions and limits
2. Build on, strengthen and/or scale up current initiatives
3. Implementing the 'business unusual' call for action
4. Preparing for the future
5. Vulnerability and adaption
6. Alignment, coordination and cooperation

A document entitled *Towards an Effective South African Climate Change Response Policy* consists of stakeholder inputs gathered at the summit, as well as inputs from the Cabinet memorandum. It outlines a number of suggested goals, programmes and activities that can be undertaken by government, the private sector and civil society in order to give effect to the vision. The Department of Water and Environmental Affairs has invited written comments and it is expected that version zero of the climate change response policy will be completed by August 2009, followed by a green paper in April 2010. The South African Local Government Association (SALGA) will assist local governments to prepare comments, and some metropolitan municipalities have offered to coordinate responses for the provinces in which they are located. The City of Cape Town, working closely with local NGO Sustainable Energy Africa, has completed a citywide consultation process and will soon carry out one for the entire province. Both Johannesburg and eThekweni intend to convene consultations. South African Cities Network (SACN) and ICLEI (Local Governments for Sustainability) jointly hosted an African Local Government Summit on climate change in Tshwane at the end of July 2008 as part of the global local government climate roadmap process. The declaration from this summit is published in full at the end of this article.

The Climate Change Summit declaration states that local government will be responsible for 'national disaster management, the use of the development planning regime to guide the mitigation of greenhouse gas emissions, and adaptations to manage or minimise the impacts of climate change, including climate proofing of infrastructural development'. Given that local governments approve and implement development frameworks across the country, this is a critical role and could provide the necessary stimulus for change. Spatial development, which prioritises energy efficiency, the development of activity routes, densification, the enforcement of urban edges, and the priority of public transport over private, would impact significantly on a modal shift towards public transport - a key area in the reduction of greenhouse emissions. Local governments can also play a key role in

The vision is to start now through energy efficiency and conservation, reach for the goal by setting ambitious research and development targets and scale up by using market instruments such as taxes and incentives

Moving beyond the use of solar power, eThekwini municipality has developed a landfill gas to electricity project which will utilise landfill gas from three municipal sites

adopting and promoting more efficient waste disposal and sanitation methods that provide alternative energy sources, through, for instance biogas generation and promotion of wind and solar energy.

Local governments are strategically positioned to be the front line in tackling climate change and are expected to respond to, and implement the objectives of the national climate change response policy. Both mitigation and adaptation strategies are needed.

There are a number of mitigation strategies that local governments could pursue. These include:

- Actively sourcing local energy supplies from renewable sources and increasing municipal targets for renewable energy consumption.
- The use of renewable energy technologies in the building industry, through town planning and building plan approval processes.
- Providing or requiring the use of solar water heaters (SWH), and providing support for the emerging local SWH manufacturing industry.
- Setting mandatory standards for energy efficiency, including standards for commercial, residential and government buildings.
- Implementing a green purchasing strategy that considers sustainability and environmental impact when municipal purchasing decisions are made.
- Investing in sustainable public transport services, and encouraging passenger modal shifts towards public transport.
- Implementing waste reduction and recycling programmes at source to ensure that recyclable waste does not go to landfills.

The adaptation strategies that local governments could pursue include:

- Accelerating the development of the Risk and Vulnerability Atlas to inform adaptation responses and planning.
- Increasing public awareness of climate change.
- Making amendments to spatial development plans to take climate change impacts into account.
- Pooling the buying power of municipalities to procure green technologies in a cost-effective way.

There are many other strategies that local governments can use to reduce greenhouse gas emissions, and increase their capacity to adapt to the impact of climate change. Larger metros have already made strides in developing credible mitigation and adaptation strategies. The scaling up of renewable energy use is a focus area for local governments. In a bid to popularise the use of SWHs, the City of Johannesburg developed a solar-water system project in Cosmo City whereby solar water heaters were installed in low-income households. Similarly, the City of Cape Town plans to scale up renewable energy use by having 10 per cent of all city-owned housing and public households equipped with SWHs by 2010. To further its goal to source 10 per cent of its energy from renewable sources by 2020, the city plans to purchase 'clean' electricity produced by the Darling Wind Farm.

Moving beyond the use of solar power, eThekwini municipality has developed a landfill gas to electricity project which will utilise landfill gas from three municipal sites. The sites are expected to yield 10 megawatts of power annually. eThekwini also plans to amend its spatial development plans to account for climate change impacts, and respond accordingly to improve the resilience of the city's natural and built environment to climate change.

The public transport system, which is heavily dependent on petroleum, is a key focus area for cities. Reducing cities' carbon footprints requires changing the mode of transportation from private vehicles to public transportation, such as buses and rail. The introduction of the Bus Rapid Transit system is an opportunity for local governments to mitigate climate change by providing a more efficient bus transportation system that will result in a modal shift from private vehicles to public transportation.

The climate change response policy is set to become an overarching policy that impacts on the activities of every sphere of government. The development of a national climate change response policy means that local governments have national support in undertaking local climate change strategies. The options are endless, and every facet of local government's work can be transformed to prepare for and mitigate the impact of climate change. In order to do this successfully, local governments have to integrate the climate change response policy into their normal planning and implementation practices. The policy must guide all areas of development and local government is in a unique position to do this, through development planning and approval processes, and large scale implementation activities.

In his recently released book, *Cleaner Energy, Cooler Climate*, Harold Winkler summed it up well when he said 'the starting point for both energy and mitigation policy is sustainable development. Climate change mitigation policy, specifically, should start with local sustainable development rather than with goals set in climate terms.' Winkler argues that developing nations like South Africa can see the greatest benefits if they focus their attention on changing development paths. He states that although the residential sector may not deliver the largest absolute

energy savings, it is critical for social development. This is the arena in which local government operates; it sets the development pathways of cities and of the residential sector. It can redirect public spending into activities that ensure thermally efficient buildings are built, that SWHs become the norm, and that cities are densified, thus making public transport a reality. Winkler suggests that this is where the real gains will be found – the integration of climate change strategies into social development goals, thus providing the means to achieve goals set by the climate change response policy.

While there was a great deal of consensus among stakeholders at the Climate Change Summit, there were key areas where participants did not agree. There was little agreement on the 'energy mix' that would be used in order to achieve the climate mitigation goals. Participants did not agree with the use of coal-based electricity or the roll out of the nuclear programme. Some felt that renewable energy technologies could not address base load requirements. There was much heated debate about the energy planning process, which underpins the climate change response policy process. Stakeholders argued strongly for a more participatory process, and for openness and transparency. They felt that, in order to be effective participants in the climate mitigation process, they needed to be able to inform the policies, strategies and processes that feed directly into how this mitigation is done. There was a strong call for a total review of Eskom's new build programme, as stakeholders felt it was committing the country to a carbon intensive pathway, even as government announced its shift in focus to a low-carbon economy. The proposed incentive and tax mechanisms proposed by the Long Term Mitigation Strategy process also came under fire, with some believing that these would help shift the trend towards a low-carbon economy, and others cautioning about the impacts in the current economic climate.

What is clear is that this is the start of a long process that will require strenuous negotiation. The competing interests of growth and development with challenges like climate change are immense, and it will take a great deal of political will to deal with it comprehensively. National government would be wise to engage intensively with local government, as it is the sphere of government that has demonstrated the clearest will to deal with the issues. It is important to remember that local government is closest to the people, and is the first to feel the heat when natural disasters such as floods destroy homes and infrastructure. Engaging with local government as an equal partner with other national government departments should be a top priority.

African local government declaration on climate change

Emerging from the African local government Climate Roadmap Summit held 29-31 July 2009 in Tshwane, South Africa

Preamble

- We, the undersigned African local governments, came together in the City of Tshwane, in July 2009, at a Climate Change Roadmap Summit for African local governments convened by ICLEI Africa, UCLG Africa and other partners.
- We endorse the ICLEI and UCLG international declaration to the parties and the conference of the parties; and issue the following additional declaration to prioritise key concerns of African local governments.

Statements

- We acknowledge the vulnerability of the African continent, including coastal and inland urban and rural areas, to the impacts of climate change, as per the outcomes of the IPCC assessment reports, local and international research, and on-the-ground experience.
- We recognise that African vulnerability is exacerbated by high levels of poverty and limited adaptive ability.
- We recognise that vulnerability is experienced differently within geographical regions and social groups, particularly by marginalised groups.
- We affirm that the African continent has the fastest growing urban population and that our urban centres are sites of substantial development pressure, and are at the frontline of response to climate change.
- We assert the critical need for key local government competencies with regard to climate response, particularly with regards to long-term spatial planning.
- We recognise that local government is a key partner in achieving the Millennium Development Goals, which need to be delivered within a climate change context.
- We acknowledge Africa's substantial current and future energy requirements for poverty alleviation and economic development.
- We recognise, as detailed in the IPCC Fourth Assessment, that a 2 degree Celsius rise in temperature is likely to be exceptionally damaging for the African continent, with scientists anticipating a decrease in crop yields of up to 50 per cent by 2020.
- We acknowledge that as a continent, Africa has to date contributed very little to the problems associated with human induced climate change, and is therefore only accountable for a marginal proportion of the consumption of 'carbon space'.
- We recognise that science increasingly shows that even aggressive mitigation measures are not going to eliminate the need for the world to adapt to climate change impacts and that the longer the delay in mitigating climate change, the greater will be the demand for adaptation.
- We acknowledge that to date the African continent has not benefited proportionally from the existing carbon financing mechanisms established.

We call on the United Nations Framework Convention on Climate Change parties to:

- Recognise Africa's local governments as key partners in implementing climate change action.
- Build and develop a pro-poor framing of the global response to climate change.

- Realise a visible commitment (substantial resources) towards adaptation commensurate with the anticipated impacts and associated costs.
- Establish an adaptation framework that is flexible, accessible, supportive of long-term sustainable development, and responsive to the African local government reality and its diverse regional characteristics.
- Commit to ambitious emission reduction targets for developed countries.
- Initiate a process of emissions targets for developing countries that are cautious and reflect local levels of development and future growth needs.
- Support Africa's enormous potential for low-carbon economic growth, especially in relation to local job creation opportunities.
- Establish a framework for technology transfer flows (in all directions) that provides access for African local governments to the scientific and technological advances of the industrialised countries.
- Elevate and support indigenous knowledge systems and approaches in support of climate response action.
- Support the empowerment and capacity development of African local governments as the main platform for climate response implementation.
- Support the inclusion of ecosystems service approaches within the global climate adaptation framework.
- Emphasise the value of ecosystems services in climate stability and include actions to ensure healthy ecosystems as key components of the global mitigation framework.
- Affirm the need for both total and residual risk compensation.

Commitments

- In meeting the challenges of climate change, we avail ourselves to supportive partnerships and commit ourselves to the following:
- To mainstream climate change response into local government through high level political commitment.
- To utilise, draw on and share indigenous knowledge in finding solutions to the global climate crisis.
- The empowerment, participation, involvement and contribution of local communities, specifically marginalised groups, in addressing climate change.
- The development of localised medium- and long-term adaptation strategies and low-carbon development plans that address the issue of poverty and African development potential.
- The inclusion of climate change in all local decision-making, day-to-day operations, planning and development, financial systems and human resource allocations.
- The establishment of locally grounded long-term baseline data related to emissions and climate change impacts.
- To recognise and value ecosystem services for their local and global contribution to climate stability.
- To continuously engage local, national and international governments, and other role players on the issue of climate change towards integrated climate solutions and sustainable development in Africa.

Local governments and local government associations at the summit:

- City of Saint Louis government, Senegal
- City of Lusaka, Zambia
- Kasese district local government, Uganda
- Kampala city council, Uganda
- Oshodi/Isolo local government, Nigeria
- North East district, Botswana
- Arusha municipality, Tanzania
- Bobo Dioulasso, Burkina Faso
- Maputo city council, Mozambique
- Walvis Bay municipality, Namibia
- Douala 4 municipality, Cameroon
- Mombasa city council, Kenya
- City of Matlosana, South Africa
- Motheo district municipality, South Africa
- Mangaung district municipality, South Africa
- City of Tshwane, South Africa
- Lekwa-Teemane local municipality, South Africa
- City of Cape Town, South Africa
- EThekwini metropolitan municipality, South Africa
- City of Johannesburg, South Africa
- Sedibeng district municipality, South Africa
- City of Tlokwe, South Africa
- Sol Plaatje municipality, South Africa
- Cape Winelands district municipality, South Africa
- Bergriver municipality, South Africa
- Ekurhuleni metropolitan municipality, South Africa
- Waterberg district municipality, South Africa
- Nelson Mandela Bay metropolitan municipality, South Africa
- Modimolle local municipality, South Africa
- Capricorn district municipality, South Africa
- Mopani district municipality, South Africa
- Lesedi local municipality, South Africa
- Maruleng local municipality, South Africa
- Thabazimbi local municipality, South Africa
- Amathole district municipality, South Africa
- Ehlanzeni district municipality, South Africa
- Ba-Phalaborwa local municipality, South Africa
- Tswelopele local municipality, South Africa
- South African Local Government Association
- United Cities and Local Governments of Africa
- Rwandan Association of Local governments
- Association for Local Governments of Tanzania
- Mozambique Association of Local Governments
- Botswana Association of Local Authorities
- Association of Local Governments of Kenya
- Lake Victoria Regional Local Authorities

renewable energy study tour

There is growing awareness of the role that cities play in contributing to South Africa's carbon emissions through the supply of coal-powered electricity, location and form of buildings, and transportation systems. At the same time, cities have a duty to ensure that their residents receive basic services, including the provision of electricity.

It is predicted that over the next 20 years, energy consumption in South African cities is set to double. Cities are virtually totally dependent on fossil fuels and currently use 40 per cent of national energy, even though they occupy only 3 per cent of the land area. Buildings throughout South Africa are typically energy inefficient, and poor public transport systems result in most South Africans driving private vehicles or using taxis. The production of hot water is the biggest electricity user in the residential sector, using about 17 per cent of electricity consumption.

The South African Cities Network (SACN) identified renewable energy as a priority theme in the Sustainable Cities programme in 2008 and 2009. The theme kicked off with a Renewable Energy City Summit in May 2008, followed by a Wind Energy Summit in January 2009, and culminated in a Renewable Energy Study Tour to the United Kingdom, Germany and Denmark in February 2009. These countries were identified for their success in establishing and achieving renewable energy targets. The purpose of the tour was to develop awareness of the planning and implementation of renewable energy initiatives at a local level, and to investigate the policy processes that underpinned such initiatives, as well as the obstacles that were overcome in the design and implementation of these policies.

The Renewable Energy Study Tour was assembled and coordinated by Reid Management Consulting Services. This article is a summary of the full report on the tour that was prepared by Lutske Newton and Sara-Jayne Willicot with technical inputs from Saliem Fakir.

United Kingdom

The UK leg of the study tour took place in the city of London. The development of a renewable energy policy, strategies and targets for London started ten years ago when the erstwhile mayor sought an energy strategy that would address the dependence on fossil fuels for energy.

The achievement of a renewable energy target in the

UK is officially set at 10 per cent by 2010 and 15 per cent by 2020. However, the government is aspiring to reach 20 per cent by 2020, in line with the target set by the European Union in 2007.

From an institutional perspective, the starting point was the establishment of a Sustainable Development Commission. The business sector was engaged in the process of setting targets as it consumes the most energy. The scope of business interventions was identified as: reducing energy use through energy-efficient buildings, reducing transmission losses, and focusing on energy security. Targets were set to reduce carbon emissions and improve energy efficiency. Approximate energy savings could be as high as 50 to 60 per cent at no cost at all.

The implementation of renewable energy targets in the city of London involved an array of interventions. These included persuading central government to incorporate the renewable energy target into the planning regulations, and establishing a massive capacity-building programme to up skill planners, developers, councillors and politicians. Capacity building included training artisans to install renewable energy systems, funded by the London Development Agency. Local government planners were placed on courses to learn about the technology and techniques so that they could engage directly with developers. Supporting tools and instruments such as an extensive guide on how to measure energy consumption, were developed.

The London study demonstrated the multi-faceted nature of the implementation process; its reliance on individual champions to drive the process and partnerships with the non-governmental sector. It also highlighted the fact that renewable energy is part of a broader approach to development, based on the principles of sustainability. There is an ongoing need for awareness raising and educational initiatives that target every sector of the development process. For the successful implementation of targets, strategic partnerships must be established and sufficient financing provided for capacity building programmes. Furthermore, targets must be incorporated into building regulations so that new building projects incorporate these in the design phase.

Participants of the study visited a sustainable housing project to see first hand how energy efficiency had been incorporated into the planning and building of housing units. The Bedzed ecovillage was developed by the Bioregional Development Group. The village has its own biomass plant, parking bay for electric cars that are car pooled (or will be when electric cars are widely available), and rooftop gardens.

Renewable energy is part of a broader approach to development, based on the principles of sustainability

Study tour participants about to embark on a tour of the Bedzed ecovillage.

Germany has increased its renewable energy target from 20 per cent to 30 per cent by 2020, as renewable energy production has increased far more rapidly than was anticipated

Germany

Government intervention and support from local authorities has been key to the development of the renewable energy industry in Germany. The country is heavily dependent on coal but is rapidly increasing the percentage of contributions from renewable energy sources, especially wind, solar and biomass initiatives.

In 2002, Germany was the world's fifth largest consumer of energy, and two thirds of its primary energy was imported. The country has since turned around its massive consumption of fossil fuels to become a major exporter of renewable energy technology. German production now accounts for half of the world's wind turbines and a third of all solar PV cells. Solar technology in Germany has grown exponentially since 2000 and has become a 4.9 billion Euro industry.

Germany has increased its renewable energy target from 20 per cent to 30 per cent by 2020, as renewable energy production has increased far more rapidly than was anticipated. The government has initiated wide ranging emission reduction activities and the country's overall emissions are falling. Germany has been so successful, that it has set its reduction targets to 40 per cent by 2020 – double that of the European target of 20 percent.

In areas of low employment, the government has introduced tax credits and feed-in tariffs, which guarantee an above-market price for the installation of renewable energy generators. These measures therefore address employment issues as well as renewable energy targets.

The feed-in tariff has also played a significant role in making micro renewable schemes affordable and attractive for individual households and small institutions such as schools. Compared to the UK which has not yet managed to introduce the correct financial incentives, Germany's feed-in tariff has been highly effective. A plan for reducing tariffs is being debated because the cost of renewable energy in Germany has been reduced almost to the point of grid parity. It is an equal competitor with other forms of energy and negates the need for financial incentives.

The city of Bonn has set targets to reduce CO2 emissions, to increase energy efficiency, and to enhance climate awareness. It was one of the first cities in Germany to introduce cost-related supply payment for electricity from regenerative energies. The city has put in place a number of measures and incentives to achieve the energy efficiency standard set by central government thirty years ago. Photovoltaic panels have been installed in schools and nursery schools. This generates money for these institutions as they create more electricity than they use. Vouchers are distributed to households to replace existing appliances with energy efficient appliances – the higher the rating, the greater the value of the voucher. Public buildings are being retrofitted and private homes built on municipal land must go beyond the energy efficiency legal standards.

The city established separate waste collection (packaging, glass, paper, bio-waste) for recycling. Bio-waste is composted and used as fertiliser, or to produce energy. The rest of the waste is used to generate heat for approximately 10 000 homes. Bonn has had no land filling for the last ten years.

There are also programmes to protect the city's biodiversity and one of these is the inclusion of sustainable development and biodiversity in the school curriculum. Learners are taken on regular excursions into protected areas. Incentives are given to individual households to create gardens that promote the local biodiversity, and a green garden award recognises efforts in this regard.

A key driver behind the take-up of renewable energy is climate protection. Germans are very conscious about environmental protection, and there is broad consensus among poli tical parties with respect to the green agenda. Since there often tends to be a gap between consciousness and demand, the user pays principle has been effective in bridging that gap (less waste, less cost; less energy, less cost; less water, less cost). As resources decrease, so prices will increase. People therefore have a strong financial motivation to keep costs down. Achieving targets is reliant on a combination of awareness and price.

The city of Cologne aligns its targets to the national Kyoto commitments for Germany and has undertaken several projects, especially around solar powered housing, in order to contribute towards the achievement of these targets.

Transport, heating and electricity are the three main sources of energy-related CO2 emissions in Cologne. District heating has rapidly expanded over the last thirty years and there has been a shift in dependence from oil and coal to gas as a dominant source of energy. Since 1986, Cologne has managed to reduce energy related CO2 emissions by 19 per cent.

The Energy and Climate 2020 Initiative was established by RheinEnergie, an infrastructure service provider for the Rhine region, responsible for providing energy and water

South African CitiesNetwork

to about 2.5 million people, industry, business and service enterprises. This initiative intends to reduce energy-related CO2 emissions even further by expanding the use of renewable energy and district heating using gas and steam co-generation plants. It has also established a regional network to support mitigation initiatives and projects.

The visit to Germany highlighted the potential for both on- and off-grid solutions, and the technology available for rural electrification through the establishment of battery banks. It was discovered that a feed-in tariff provides considerable scope for individual households to benefit. The tour participants also gained valuable insight into how German municipalities organise themselves, the role local government associations play in influencing policy and legislation, and the support they offer their members in the implementation of policies.

Denmark

The participants of the study tour held meetings with the municipalities of Copenhagen, RingkØbing-Skjern, Lolland and Kolding. The idea of alternative energy solutions is ingrained in the culture of local authorities. Public consciousness is also a key factor. The public demands alternative solutions, and politicians are obliged to meet the demand of their constituencies. The effect of bottom up pressure is that it forces the municipality to think in advance about what needs to be changed. The municipalities of these cities are far more advanced than South African municipalities in terms of ensuring their citizens are ready for the coming low-carbon era. Their motto is self-sustenance.

The city of Copenhagen will host the United Nations Climate Summit (COP15) in December 2009, and has launched a number of climate projects in the lead up to this event. The Copenhagen Climate Council aims to create global awareness of the importance of the COP15. The council will promote constructive dialogue between government and business, so that when the world's political leaders and negotiators meet in Copenhagen, they will do so equipped with the very best arguments for establishing a treaty that can be supported by global business. By promoting and demonstrating innovative, positive, and meaningful business leadership and ideas, the council aims to demonstrate that achieving an effective global climate treaty is not only possible, but necessary.

Municipalities have a major role to play in the uptake of renewable energy at a local level

The city of Lolland experienced an economic turn-around 20 years ago and used that as an opportunity to make the green sector the key driver of economic change and growth. Thus, the entire city was converted into a green city. Having managed to generate sufficient green energy from wind, solar and wind technology, it is able to both sustain its own energy needs and sell excess energy. There is now considerable focus on marine biomass for the creation of heat, electricity and fertiliser. They recently established an offshore wind farm, and conducted research into the use of hydrogen for heat and electricity - to be deployed during the day when the electricity grid is normally stressed. Thirty-five thousand homes are already receiving hydrogen in this way.

The Ringkøbing-Skjern municipality reported on how they had used planning tools to stimulate developments in wind power generation. They identified different thresholds and zones for wind energy, and offered rights of development to the private sector. To ensure maximum buy-in, they also stipulated that all wind projects must have local resident ownership of up to 20 per cent.

The sustainability successes in the city of Kolding is attributed in part to the partnerships it has formed with local organisations - many of the initiatives implemented by the municipality have come about as a result of dialogue with these organisations as well as citizens, institutions and companies. The municipality ensures involvement of children and young people through a Nature School which offers a wide range of activities to schools in the area.

Kolding's role as a frontrunner in environmentally friendly solutions to normal development problems is strongly attributed to the political will required to ensure that environmental concerns are prioritised.

In October 2008, Kolding was named an 'energy town' by the Ministry of Climate and Energy as a result of its dedicated commitment to the environment, climate and energy. Energy towns will be showcased during the run-up to the United Nations Climate Summit. They are seen as models for both Denmark and the rest of the world.

The way forward for South African cities

The imperatives driving renewable energy in the countries visited are very different from South Africa. In these countries, the backdrop to renewable energy is environmental consciousness and sustainable development. Furthermore, awareness of climate change and the impact that fossil fuel has on the climate has consolidated efforts to extend the use of renewable energy.

Whilst this consciousness does exist in South Africa, the greater concern is lack of energy security and energy poverty, which is prevalent in both rural areas and informal areas of urban municipalities. The energy crisis has meant that renewable energy is being weighed up against other forms of energy such as nuclear and further coal power stations, as there is an immediate need to ensure that supply can meet demand. The threat to economic development has resulted in the sidelining of environmental considerations as the implications of stunted economic growth outweigh any other concerns. Furthermore, renewable energy is not necessarily being seen in the context of a broader sustainable development agenda.

The chances are that renewable energy will remain a fairly marginal source of energy in South Africa until the longer-term picture is factored in, whereby renewable energy is treated as both a sustainable source of energy, as well as an important mitigation measure that will greatly assist the country in reducing its carbon emissions. The application of renewable energy has to be done in a holistic way, as part of an approach to energy efficiency that achieves energy savings and results in less energy required by residential and commercial buildings.

The greatest lesson emerging from the study tour is that municipalities have a major role to play in the uptake of renewable energy at a local level. This role can range from very practical measures such as ensuring that bylaws address the inclusion of energy efficiency standards and that a percentage of energy supply to buildings is from renewable energy sources, to a highly strategic one whereby local economic development plans factor in the stimulation of the renewable energy sector.

Cities will have to adopt a dual focus of energy security and carbon emissions reductions. They should focus on solar heated water systems and biomass (waste/sewerage). A concrete plan is required to establish renewable energy in municipalities, and it would rely on public and private sector support. A subsidy for solar heated water is required, and wind turbines along the coastline should be established.

Cities need to lobby national government , through established structures such as SACN and SALGA, to ensure support for their plans to intensify the use of renewable energy. Barriers to growth in the implementation of renewable energy due to insufficient national support must be addressed. Local government must have a voice in energy debates. The SALGA strategic framework for engagement through lobbying and advocacy (2007) is relevant here. Part of the lobbying process should include the review of the Energy white paper. A possible policy thrust may be to locate the national planning commission within the Presidency, and include

Picture: Fernando Tomás

energy security (including renewable energy) as part of its brief.

Cities and their associations can play an important role in ensuring that other municipalities are informed about the potential for renewable energy to address energy poverty, whilst containing carbon emissions. These issues need to be understood and widely communicated within organisations. It entails institutionalising the debate, and establishing which key internal stakeholders need to be brought on board.

During the course of the study tour, it became apparent that some of the municipalities had taken bold steps towards the achievement of renewable energy and energy efficient targets. There is scope for greater knowledge exchange in respect to bylaws, regulations and planning tools.

The SACN study tour saw the need to establish an effective reference group that would be able to, among other things, lobby national government for the support required to speed up the rate of implementation of renewable energy solutions. On a more immediate note, a SALGA/SACN delegation will be mandated to participate in the National Climate Change Response Policy Development Summit 2009. The SACN Board will reflect on how to anchor climate change in its programmes, and a delegation will be sent to a meeting of municipalities in Copenhagen, in preparation for the UN Climate Change Summit in December 2009.

Key lessons from the trip

- All these countries built an alternative energy strategy on the back of a clear carbon reduction strategy.
- National government has an important role to set the framework, but delivery must happen at the local level.
- In Denmark and Germany, energy generation is becoming more democratic with greater participation by local authorities and citizens in the energy debate, who are also given the right to produce the energy rather than simply relying on a centralised national utility.
- Alternative energy generation requires national government intervention through feed-in tariffs, tax breaks, depreciation allowances, etc.
- While one cannot change the whole of the country, one can change one's neighbourhood and build the future bit-by-bit.
- No idea will see its time without public momentum and awareness – the effort in all three countries to continue educating the public was impressive.
- Alternatives are expensive but it is a spurious argument to only use financial considerations as a way of measuring the trade-off. All these countries are reducing their dependency on imported energy and building a new economy on the basis of sustainability principles.
- Healthy competition between local authorities to be the best ensures high standards and innovation.

The full report of the renewable energy study tour can be found on SACN's website: www.sacities.net

green building standards

The promotion of green building standards is a priority learning area for SACN member cities. Cities have to balance the need for urban development which provides access to water, housing, health, education, etc., with the need to promote sustainable building practices in the building industry. The built environment is the link between the natural environment and economic and social systems.

There is a direct link between buildings and climate change due to the high rate of carbon emissions from the construction and ongoing use of buildings. Building resources take up to 40 per cent of energy use and 17 per cent of fresh water use. Twenty-five per cent of wood harvested and 40 per cent of material produced are attributed to the built environment (US Green Building Council, 2008). The promotion of energy efficiency and resource sustainability in the building industry is crucial for mitigating climate change.

The Green Building Council of South Africa (GBCSA), in partnership with SACN, has developed a green building rating system and tool to evaluate and rate buildings in terms of their environmental performance. The Green Star Rating Tool was unveiled at SACN's Sustainable Cities seminar in 2008. One of the important aims of the seminar was to gather input from local governments, and to look at ways of mainstreaming the rating tool and other green building issues in order to transform the building industry.

A green building is defined as an energy efficient, resource efficient, environmentally responsible building that reduces negative impacts. High Human Development Index (HHDI) features of sustainable buildings include diversity of the local economy, access to facilities, access to education, access to health services, and inclusion.

Some of the benefits of green and sustainable buildings are:

- positive social and economic impacts, and reduced negative environmental impacts
- quality of life – improved internal and external environments
- reduced consumption of water, energy, and non-renewable materials
- reduced waste production
- insurance against costs associated with tightening legislation
- improved ability to accommodate change
- a positive marketing and corporate image.

A rating system is key to motivating a national green building trend. The main objectives of a rating system are:

- to serve as a reference tool for developers
- to set benchmarks and standards to measure green building initiatives
- to facilitate integrated design
- to reduce the environmental impact of development.

There are a number of leverage points and mechanisms that cities could use to introduce sustainable building practices. These include sustainable development conditions on environmental impact assessment (EIA) applications; development control and land use, building by-laws, incentive schemes, guidelines, and by implementing green building standards in their own buildings. Spatial development frameworks and integrated development plans can be used by cities for sustainability road testing to assess the implications of different options for public transport, housing, education facilities, health facilities, sport, and communications. It may also be used to gauge transport trends, and energy and water consumption trends.

It is important for cities to ensure that their approach to supporting sustainability in buildings is context-responsive and takes into account environmental, social, and economic priorities, as well as local limitations and opportunities. City objectives have to be communicated clearly to ensure a shared understanding. Cities also have to ensure that strategies are always modelled and tested, that there is planning of detailed specific incremental initiatives that can be built, and that initiatives are always coordinated and integrated to be implemented in a collaborative way.

A rating system is key to motivating a national green building trend

Green building is an important issue and the *Green Star Rating Tool* is a powerful weapon to start addressing the impact of the built environment on our natural resources

The *Green Star Rating Tool* is one of a range of tools and mechanisms that can be used to encourage green building in South Africa. Local governments will benefit enormously by adopting green building standards. It does however, require a lateral shift in thinking about the built environment. Other initiatives that contribute to the greening of the built environment and that can be driven by local governments include bicycle lanes, car pooling, local material sourcing, and food production.

Some cities have initiated measures to promote sustainable building practices. The City of Johannesburg has developed three strategies that will address climate change, energy efficiency and resource sustainability in the built environment:

- Self regulation by the property industry, and the application of the city's Design Guidelines for Energy Efficient Buildings. This means promoting the Green Star Rating Tool as a development paradigm that can be adopted as the norm. However, the challenge is to ensure that it not only becomes part of blue-chip development by corporates, but that it also filters down to smaller property developers to encourage a different way of designing buildings.
- The enforcement of legislation, in particular the National Building Regulations and the National Codes (SANS 204). Building codes are aimed at ensuring compliance with minimum technical standards but they do not promote the levels of innovation desired for this development paradigm. As a result, cities have to anticipate the technical and administrative implications of implementing the building legislation.
- The application of the City of Johannesburg's criteria for the promotion of energy efficiency in land use development. These criteria will be used to assess new land use development applications, so as to mitigate the effects of climate change due to carbon emissions from the built environment. These will also be integrated into the city's Spatial Development Framework and the town planning scheme.

Green building is an important issue and the *Green Star Rating Tool* is a powerful weapon to start addressing the impact of the built environment on our natural resources. Some practitioners have tried to implement green building standards, but there are a number of barriers such as local by-laws and lack of political will. It is possible to

address these challenges through a powerful lobby group, but it requires commitment and determination. Stakeholders need a platform for green building issues, and local government is at the coalface of this. What is needed is a high profile workshop or conference where cities, the South African Bureau of Standards (SABS) and the GBCSA can thrash out issues of implementation, training, and practical ways of sharing knowledge and helping smaller municipalities through some institutional arrangements.

In order to ensure that the rating tool doesn't simply remain an office system for specialists in big companies, but that it can used by small developers and those involved in low-cost housing developments, the GBCSA will roll out the rating tool to the residential sector. They also plan to run workshops for developers.

In October 2009, GBCSA hosted their second annual Green Buildings Conference in Cape Town. More than 700 practitioners from the building sector, manufacturing, and government attended the event to hear speakers from South Africa, Australia, the UK and the US present best practices and principles.

The first Green Star rating was awarded to Nedbank. The second phase of Nedbank's head office in Sandton, Johannesburg was certified as South Africa's first Green Star building under the GBCSA's Office v1 rating tool. Based on its tender documents, the building received a four-star rating, which signifies 'best practice' in green building. The building will be completed in 2010.

GBCSA have released a pilot version of their second rating tool for retail. The Green Star SA-Retail Centre pilot rating tool assesses the environmental attributes of new commercial retail centres as well as major refurbishments of existing retail centre facilities across South Africa. GBCSA will elicit feedback during the pilot phase which will run until 19 February 2010, after which version 1 of the tool will be released.

In the last year, more than 1 000 people have completed the GBCSA training course and over 100 people have taken the exam and become Green Star Certified. The number of conference attendees, the designation of the first Green Star building, and the increasing number of Green Star certified practitioners, demonstrates a step towards a greener South Africa.

Read more about the *Green Star Rating Tool* in the fact sheet on the next pages.

Green Star SA - Office v1
RATING TOOL FACT SHEET:

ABOUT THE RATING TOOL

The Green Star SA – Office PILOT rating tool assesses the environmental attributes of new commercial office buildings as well as major base building refurbishments of existing office facilities across South Africa.

The tool assigns a Green Star SA rating to the base building and its services on the basis of design potential and does not examine in-use data or operational management. Tenant fitouts are not rated under this tool.

The tool can be used to rate the environmental merits of an office facility at the design phase (Design rating) as well as post-construction phase (As Built rating).

The tool is designed to be used by owners, developers and consultants (architects, engineers,quantity surveyors, project managers,building contractors etc.) to influence the design of office facilities. The tool enables these stakeholders to minimise the environmental impacts of their developments and to capitalise on, and receive recognition for, their design initiatives.

TOOL DEVELOPMENT PROCESS

The Green Star SA – Office rating tool is based upon the Green Building Council of Australia's Green Star – Office Design v3 and Green Star – Office As Built v3. The Green Building Council of South Africa (GBCSA) staff, along with an international rating tool consultant, local technical consultant Arup and a voluntary Technical Working Group made up of local industry professionals,evaluated all credits for adaptation to the South African market. In addition, several new credits were added to the rating tool.

The Green Star SA – Office tool was made available in PILOT form to allow for feedback from users and for testing of the tool. The PILOT phase ran until 1 September, 2008. During this time, significant feedback was received.

The GBCSA collated and incorporated all the feedback received, and the rating tool was released as Version 1 (v1) at the GBCSA Convention & Exhibition '08 on 2-4 November, 2008.

CERTIFICATION

Green Star SA – Office will award certified ratings for the following levels of achievement:

* 4 Star Green Star SA Certified Rating
Weighted score of 45-59
Signifies 'Best Practice'

* 5 Star Green Star SA Certified Rating
Weighted score of 60-74
Signifies 'South African Excellence'

* 6 Star Green Star SA Certified Rating
Weighted score of 75-100
Signifies 'World Leadership'

The Green Star SA rating tools are developed to be equitable across building sectors. In other words, a 5 Star Green Star SA – Office project will exhibit a degree of industry leadership comparable to that of any other 5 Star Green Star SA project under another tool.

ENVIRONMENTAL IMPACT CATEGORIES

Green Star SA rating tools consist of eight environmental impact categories and an innovation category (see page 2). Points are awarded within each of the categories based on the building's potential to minimise its environmental impact in a range of key areas.

Please note that the Green Star SA – Office tool takes into consideration the unique development requirements and impacts of the office sector. As such, the number of credits within categories and the category weightings will vary from other Green Star SA rating tools.

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GREEN BUILDING COUNCIL OF SOUTH AFRICA

green star SA Office v1
Green Building Council of South Africa

The table below outlines each category and credit within the Green Star SA – Office rating tool.

MANAGEMENT

- Green Star SA Accredited Professional
- Commissioning Clauses
- Building Tuning
- Independent Commissioning Agent
- Building Users' Guide
- Environmental Management
- Waste Management
- Airtightness Testing

INDOOR ENVIRONMENT QUALITY

- Ventilation Rates
- Air Change Effectiveness
- Carbon Dioxide Monitoring and Control
- Daylight
- Daylight Glare Control
- High Frequency Ballasts
- Electric Lighting Levels
- External Views
- Thermal Comfort
- Individual Comfort Control
- Hazardous Materials
- Internal Noise Levels
- Volatile Organic Compounds
- Formaldehyde Minimisation
- Mould Prevention
- Tenant Exhaust Riser
- Environmental Tobacco Smoke (ETS) Avoidance Energy

ENERGY

- Energy - Conditional Requirement
- Greenhouse Gas Emissions
- Energy Sub-metering
- Lighting Power Density
- Lighting Zoning
- Peak Energy Demand Reduction

TRANSPORT

- Provision of Car Parking
- Fuel Efficient Transport
- Cyclist Facilities
- Commuting Mass Transport
- Local Connectivity

WATER

- Occupant Amenity Water
- Water Meters
- Landscape Irrigation
- Heat Rejection Water
- Fire System Water Consumption

MATERIALS

- Recycling Waste Storage
- Building Reuse
- Reused Materials
- Shell & Core or Integrated Fit-out
- Concrete
- Steel
- PVC Minimisation
- Sustainable Timber
- Design for Disassembly
- Dematerialisation
- Local Sourcing

LAND USE & ECOLOGY

- Ecology – Conditional Requirement
- Topsoil
- Reuse of Land
- Reclaimed Contaminated Land
- Change of Ecological Value

EMISSIONS

- Refrigerant/Gaseous ODP
- Refrigerant GWP
- Refrigerant Leaks
- Insulant ODP
- Watercourse Pollution
- Discharge to Sewer
- Light Pollution
- Legionella
- Boiler and Generator Emissions

INNOVATION

- Innovative Strategies & Technologies
- Exceeding Green Star SA Benchmarks
- Environmental Design Initiatives

CATEGORY WEIGHTINGS

Management	9%
IEQ	15%
Energy	25%
Transport	9%
Water	14%
Materials	13%
Land Use & Ecology	7%
Emissions	8%
TOTAL:	100%

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growing a green economy

A green economy provides for both current and future generations. The expansion of green industries can assist South African cities to reinforce a weakening economy by creating new jobs, while also protecting the planet from the impending climate crisis.

Any job that helps protect the ecosystem and biodiversity; reduces water, energy and material consumption; reduces carbon emissions, and minimises waste generation, can be considered a green job. Jobs in key economic sectors like agriculture and forestry, building and construction, energy generation and distribution, transportation, research and development, and basic service delivery are all considered green jobs. Examples of green jobs include the manufacture of solar panels, retrofitting existing buildings to meet green building standards, and removing waste from municipal parks.

While programmes and principles promoting green jobs have become commonplace throughout more developed countries, it remains an unfamiliar idea in developing countries. As a leader in Africa, it is essential that South African cities promote sustainability principles. Cities should encourage job growth in the following sectors: agriculture, building and construction, energy, industry and manufacturing, transport, waste management and recycling.

The agriculture and farming sector remains one of the largest employers in the world. Food insecurity throughout Africa and the rest of the world can serve as a catalyst for farmers to continue farming and increase their yields. For South African cities, this means promoting agriculture in rural areas and creating urban agriculture programmes.

Construction of green buildings and the retrofitting of existing buildings to green standards will create new jobs within relevant sectors. These include architects, auditors, engineers, estimators, green designers, project managers, planners, and a variety of construction jobs. Estimates suggest that implementing green building standards will create as many as two million jobs in the European Union (EU), one million in America, and 150 000 in India.

Energy efficiency is a major component of green job development. Compared to fossil fuel production, renewable energy is more labour intensive, creating more jobs per unit of power generated, and is a better return on money invested. Globally, there are about 2.3 million workers employed in the renewable energy sector; 300 000 workers employed in wind power; 800 000 in solar; 1.2 million generating biomass; 39 000 in hydropower; and 25 000 in geothermal.

Brazil, China, Germany, Japan, and the US support the majority of renewable energy development worldwide but as demand grows, the EU and India are becoming important producers in the industry. Kenya also has a dynamic solar market. In Nairobi, the Kibera Community Youth Program initiated a solar project to provide young people with employment and promote an environmental agenda. In Bangladesh, Grameen Shakti, a manufacturer of renewable technology, has offered micro loans to help people install 100 000 solar home systems in rural communities. Grameen is also training 100 000 youth and women as certified solar technicians and repair and maintenance specialists. By 2030, global employment estimates in the renewable energy sector are expected to soar to as high as 2.1 million in wind, 6.3 million in solar, and 12 million in biofuels. Expanding green jobs in the energy industry in South Africa would provide energy security, ease the economic recession, enhance job creation, and reduce carbon emissions.

Industries producing iron, steel, cement, aluminium, paper, pulp and related chemicals are the most energy-intensive industries. Boosting renewable energy production, curtailing pollution, and responsible waste management is key to reducing the environmental footprint of these industries.

Transportation is responsible for 23 per cent of energy-related greenhouse gas emissions, and continues to increase annually. The production of more fuel-efficient vehicles and the development of public transportation alternatives can curb these environmental impacts, and they are ideal green jobs. A shift away from private vehicles towards public transportation can generate considerable employment gains, while at the same time reducing carbon emissions and improving air quality. The expansion of rail networks and bus lines will create substantially more green jobs. The EU already employs 150 000 people to manufacture green vehicles; Japan employs 62 000, the US employs 13 000, and South Korea 10 000.

Informal recycling and waste collection accounts for an immeasurable number of jobs worldwide. In China for example, more than 10 million people are involved in the formal and informal recycling sector. Municipal recycling programmes can harness existing individual initiatives within cities.[1]

1. Numerical facts were extracted from the United Nations Environmental Programme. (September 2008). Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World. Nairobi, Kenya: United Nations Environmental Programme.

Expanding green jobs in the energy industry in South Africa would provide energy security, ease the economic recession, enhance job creation, and reduce carbon emissions

Government support

Government support through incentives and investment programmes is essential to the creation of green jobs and green industries. Green jobs are already an important aspect of national government policy in the US and the EU. In South Africa, these types of programmes have recently become integral to the national agenda for job growth. In the months preceding the 2009 national elections, the need to create green jobs to meet global economic and environmental challenges became an important national issue.

The Framework for South Africa's Response to the International Economic Crisis, released in February 2009 promotes the creation of green jobs, demonstrating support from business, labour, government, and community representatives. The document recognises the opportunities for green technologies and industries "to create a large number of green jobs" and "build on current initiatives of greening existing manufacturing and service activities."[2] The framework articulates South Africa's economic interventions to offset the effects of the global economic crisis. The scale and importance of South Africa's initiatives is mirrored across the globe, in particular in the 2009 US Economic Stimulus Package which promised to create 1.5 million new green jobs or roughly 40 per cent of the total number of expected new jobs.

At the National Climate Change Summit in March 2009, the Deputy General Secretary of the Congress of South African Trade Unions (Cosatu), Bheki Ntshalintshali, supported the development of green jobs as part of government action against climate change and poverty alleviation. Cosatu envisages the creation of green jobs as "a major contribution to clean economic growth, development, and poverty alleviation." Ntshalintshali asserted that initiatives to create green jobs provide an opportunity to build a "more socially, economically, and environmentally sustainable society."[3]

Key priorities for South African cities

National government has traditionally been responsible for the development of new environmental policy, but cities are ultimately responsible for implementing such policies. Therefore, cities should be the primary entities

2. National Treasury. (19 February 2009). Framework for South Africa's Response to the International Economic Crisis. Pretoria.
3. Ntshalintshali, B. (3 March 2009). Climate Change Summit. Midrand.

creating these environmental policies. Throughout the world, cities have been the primary incubators for the most important green economic development legislation. American and European cities have proven adept at designing and executing environmental policies that best suit the needs of the city.

Whereas national government tends to respond to the environmental crisis by enacting reactionary policies, cities are best placed to prevent crisis by administering proactive legislation. Cities should therefore take a more active role in outlining the specifics for environmental economic legislation. Several American cities – Boston, Chicago, New York, Portland, San Francisco – have created incentive programmes to develop green enterprises, including renewable energy component manufacturing, green retail, and green housing. German cities such as Freiburg have restructured their regional economies by investing in and incentivising renewable energy industries. Local green economic legislation and programmes will make South African cities more competitive within Africa and the world by providing jobs and enabling economic, social, and physical city growth. The growth of a green economy can be encouraged through a variety of government initiatives. Cities throughout the world have encouraged green industries through subsidies. Typically, cities phase out subsidies for unsustainable industries and shift those incentives to subsidise green industries.

The Renewable Energy Feed-in Tariff, which encourages the adoption of renewable energy by obliging Eskom to purchase energy from renewable producers at regulated rates, has proved successful. Such incentives remove the affordability barriers and revenue uncertainties associated with renewable energy generation. Additional jobs are created as these green industries develop. Eco-branding has also been successful in promoting green industries and green job growth throughout the developed world. South African cities are uniquely positioned to expand on these incentive programmes by greening municipal services, integrating green policies into municipal bylaws, and through green branding and tourism.

A study by the Centre for Development and Enterprise, *South Africa's 'Door Knockers': Young People and Unemployment in Metropolitan South Africa* highlighted the challenge of high unemployment amongst youth between 18 and 24. The study determined that while cities expend considerable energy and resources to create jobs, to prepare people for the labour market, and to support aspirant entrepreneurs, these resources are spread across hundreds of fragmented interventions, making it difficult to tackle the endemic challenges of unemployment. Broad-based, cross-cutting programmes like the Expanded Public Works Programme pervade all aspects of the public and private sectors, and have

Cities can encourage the growth of green jobs by integrating green policies into municipal by-laws

the highest incidence of success.[4] Cities must therefore launch comprehensive programmes to reduce barriers to unemployment. Developing a green economy is one such programme.

Municipalities can encourage job growth by assimilating green industries into existing services. Employing people to remove refuse from public parks and to paint all city-owned roofs white to reduce the heat island effect, are simple initiatives with enormous potential. A formalised, citywide recycling programme will create green jobs while also encouraging principles of sustainability. In this instance, jobs will be shifted from waste management toward resource preservation with additional jobs created to manage these new green forward-thinking programmes.

Cities can encourage the growth of green jobs by integrating green policies into municipal bylaws. This can be done by altering municipal planning and building by-laws to include a sustainable development requirement. New structures should be required to meet sustainable building regulations (exceeding the national building regulations) as a precondition for planning or building plan approval. Requiring new industries to meet environmentally-friendly production methods through air and water quality, and environmental health monitoring and enforcement would promote green jobs and long-term sustainability and efficiency. Municipalities can also create green zones or precincts that encourage green industries to move to specific areas, encouraging infill development in key development nodes as well as local job growth.

Increased recognition for green industries and jobs will encourage future growth by growing the market for these products and services. Showcasing the greenest industries and municipal departments will encourage future expansion and investment. Greening programmes that highlight municipal environmental efforts will make cities more competitive. Showcasing the green aspects of cities will also encourage tourism. Studies reveal that the greenest cities attract larger numbers of tourists. Many cities have used greening and green jobs as a revitalisation tool by encouraging the reuse of abandoned spaces. Several US cities have redeveloped themselves as green cities, attracting economic investment, privately developed housing and retail, as well as increased tourism. In Chicago, the creation of a new public park spurred a tremendous downtown revitalisation. Jobs and housing soon followed, with private developers building more than 10 000 housing units within two kilometres of the park. San Francisco has drawn both people and industry because of its reputation as a green city, and New York has used greening as a means for redeveloping previously blighted urban areas. Highlighting and branding key green aspects of South African cities will encourage further growth.

Skills and business development must play a more critical role in preparing employees for the green labour market. Cities should facilitate links between individuals and the budding green economy. The Department of Labour could increase awareness of the availability of green jobs through school programmes or career fairs hosted by cities' economic development units. Forming partnerships between green businesses and potential labourers is essential to reducing unemployment and enabling the development of a green economy.

A critical component of skills development is the provision of sustainability training. Cities should partner with the private sector to provide sector-specific job training in green technologies. Providing people with information will empower them towards independent entrepreneurial activities. Training individuals and encouraging the growth of small businesses will make South African cities and their inhabitants more competitive in the global economy. Cities should involve schools and educational centers to provide learners with ample green training to be competitive in the green workforce.

A green economy can lift people out of poverty through job creation and skills development. Millions of people are already employed in green industries worldwide. German-based Roland Berger Strategy Consultants estimates the global market for environmental products and services at $1.4 billion, with a projected $2.7 billion by 2020. Green industries could provide millions of jobs in South Africa. Cities must develop innovative drivers for green industries; retaining existing jobs while creating new ones. Those cities best able to expand their labour market to include green industries will be more competitive in the future. With looming carbon taxes and regulation, energy insecurity, and declining environmental quality, the opportunities for a green economy in South Africa are enormous.

This report was written for SACN by Astrid Wood.

4. Centre for Development and Enterprise. (September 2008). South Africa's 'Door Knockers': Young People and Unemployment in Metropolitan South Africa. Johannesburg.

waste-to-energy through biogas

Waste management and pollution are key urban environmental management challenges for cities. Space for landfill sites has become scarce, and communities object to the establishment of new sites. Incineration is not popular as a waste management strategy due to its potential for introducing airborne pollution and additional toxins. As more households become connected to the main sewage systems in cities, the capacity of existing sewage treatment works are being placed under strain; many townships have poorly designed systems that result in sewage spills. Cities need to find a way to deal with waste in an integrated and sustainable way.

Another problem facing cities is the vulnerability of their economies, and of their poorest residents, to increases in energy prices. With developing countries now increasingly required to play a part in mitigating the risk of climate change, it is difficult to promote increased energisation without including strategies to reduce greenhouse gases. Many poor people are forced to use the most polluting sources of energy: coal, paraffin and firewood. The South African government has formulated renewable energy and climate change responses, and implementation actions are now required. One option used extensively in China, Nepal, Bangladesh and Pakistan, is energy generation through biogas.

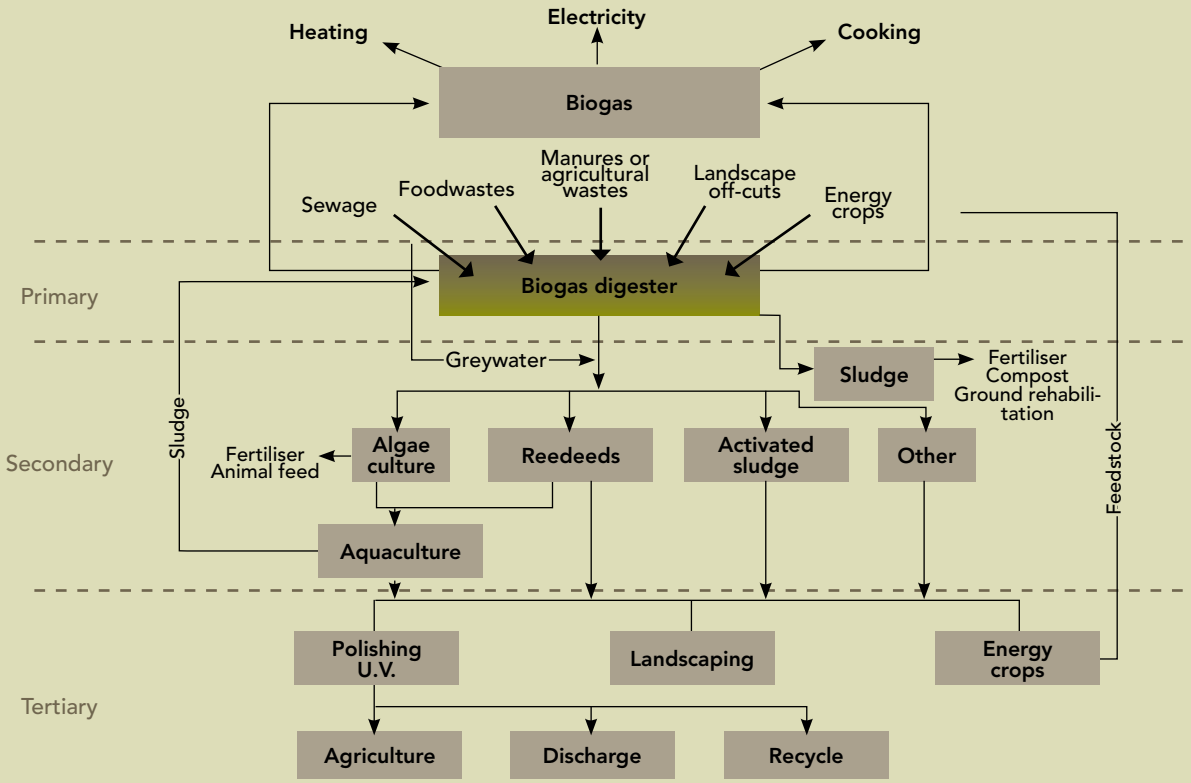
In 2009 SACN contracted AGAMA Biogas to develop a toolkit to guide member cities in planning, designing and assessing the feasibility of biogas generation as a municipal service that promotes sustainability. In developing the toolkit, AGAMA Biogas explored the creation of biogas energy from waste as a solution to address both liquid sewage and solid waste management problems in municipalities. The toolkit links waste-to-energy strategies with integrated waste management, sanitation planning, energy crisis resilience and climate change mitigation responsibilities. This article provides a summary of technical and feasibility reports in SACN's Waste-to-energy through biogas toolkit.

Waste-to-energy opportunities

In South Africa, the flow rates to centralised waste water treatment works (WWTW) and the generation of municipal solid waste (MSW) are increasing due to urbanisation and population growth. There is also a lack of proper landfill and WWTW management. The results are a shorter landfill life, increased methane emissions from landfills and WWTW, and increased pollution of water and ground. This is not sustainable.

An alternative to centralised services provision of waste management is to rather deal with these wastes further

Figure 1: Options for integrated bio-energy and waste management solutions



upstream, and even on-site, at the point of generation. This could include on-site composting of the organic fraction of municipal solid waste (OFMSW), and installation of an on-site sewage treatment system. Combining the two waste flows into one stream for co-treatment is a further option.

The most direct and simple use of biogas is for household cooking or heating. Scrubbed and purified biogas could feed directly into a natural gas network. Industries or industrial areas that have organic waste but also require heat for drying, steam production or cooling (in conjunction with an absorption chiller) could achieve integrated resource management with energy from waste.

The nutrient rich effluent from a biogas digester is well suited to algaculture and aquaculture. Algae are fast growing and can be used as animal feed or fish food (and a possible future food source for humans). The algae can also be seen as an additional feedstock to put back into the digester, or for biofuel production.

The figure above shows the options for integrated bio-energy and waste management solutions

Biogas technology applications

Anaerobic digestion is a process of decay of non-lignocellulosic biomass through the activity of anaerobic bacteria in the absence of oxygen. There are three micro-organisms (hydrolytic, acetogenic and methanogenic) which break the complex chains to short-chain fatty acids and gases. It is then converted to acetic acid, and finally becomes biogas.

The energy output varies and is dictated by the volume of the biogas produced and the percentage methane in that volume. Carbohydrate-rich feedstock results in about half methane, half carbon dioxide, whereas feedstock with high nitrogen (such as sewage sludge) produces nearly two-thirds methane. While the volume of biogas gained from a unit of various feedstock is fixed, the rate of production (thus the digester size) is affected by the temperature and mixing within the digester.

Fermentation reactors are used in the production of biogas. These can be either wet (up to 15 per cent dry) or dry (between 25 and 50 per cent dry). Wet fermentation technology is generally a reactor tank which is continuously mixed by impellers, re-circulating pumps or re-circulated biogas injection. The reactors are sometimes heated.

Covered lagoon digesters are also used for wet fermentation and are typically non-heated. Dry fermentation has been successfully demonstrated in a floor heated concrete chamber that seals the biogas in and keeps the air out. Other types of dry fermentation are 'bag type' or 'immersion liquid storage vat'. The dry feedstock is introduced into the chamber in batches by means of a front-end loader or similar. The low sulphur output of dry fermentation means that less gas scrubbing is required for electrical generation.

The biogas characteristics of wet and dry fermentation are shown below:

Component	Average Wet Percentage	Range Dry Percentage
Methane (CH4)	60%	40 - 75%
Carbon Dioxide (CO2)	35%	25 - 55%
Water Vapour (H2O)	1.67%	0 - 10%
Ammonia (NH4)	1.67%	0 - 1%
Hydrogen Sulphide (H2S)	1.67%	0 - 1%

It is possible that dry biomass from OFMSW can be added to a wet fermentation process, or dry sludge from the drying beds or dewatering plant at a wastewater treatment plant could be added to the dry fermentation process.

Biogas needs to be filtered, scrubbed and purified for electricity generation. This process extracts water vapour and sulphur as well as CO_2 (which has no energy content) from the biogas. The resulting biomethane could be used as a fuel for gas engines or a turbine powering an electrical generator. Another emerging electricity generator from biogas is a fuel cell. In this case the biogas needs to undergo intensive upgrading because H_2S and ammonia (NH_4) are toxic to the catalysis and have to be completely removed.

Emerging technologies such as fuel cells and micro-turbines can be considered when assessing waste-to-energy facilities, but in developing countries it may be wiser to choose reciprocating engine technology that is well known, locally maintainable, easily available and proven to be effective.

Plug-flow (wet) fermentation reactor.

500 kW biogas engine, Austria.

Municipal waste data

The current national wastewater treatment plants process an estimated 7 600 ML/day. Theoretically, the potential electricity generation from all the national plants, if AD was utilised, is about 850 MWth or 255 MWe (UCT study). AGAMA Energy conducted an assessment of the wastewater to energy potential of the six largest metros, arriving at 31 MW capacity or 263 GWh per annum. A study by PDG investigated the plants in South Africa that are currently utilising AD, that are considered large enough, and calculated the electricity potential from these plants as about 12 MW and 105 GWh/annum.

The AGAMA study projected that the quantity of solid waste disposed by the six largest municipalities[1] in 2004 is about 8 million tonnes with a projected increase to 10 million tonnes in 2010. A total amount of 71 000 TJ/annum of net energy content is disposed of at landfills in South Africa's metros. This is equivalent to a total electricity generation of 6 000 GWh/annum from a capacity of 693 MW of net energy being discarded. This is a theoretical number of all the embedded energy and it does not take into account any energy losses occurring in energy transformation and supply systems, nor infrastructural constraints, and assumes conversion of all of the energy content. If only the organic fraction is considered for the generation of biogas, then the six largest metros can potentially generate about 1 500 GWh/annum from about 176 MW of capacity. If a 25 per cent organic waste capture factor were taken into account, this would result in 375 GWh/annum from 44 MW of capacity.

Summary of energy potential in South Africa

Waste	Electrical capacity	Electrical generation
Theoretical		
AD of wastewater	31 MW	263 GWh/annum
AD of organic solid waste	176 MW	1 500 GWh/annum
TOTAL	**207 MW**	**1 763 GWh/annum**
Realistic		
AD of wastewater	12 MW	105 GWh/annum
AD of organic solid waste	44 MW	375 GWh/annum
TOTAL	**56 MW**	**480 GWh/annum**

It should be noted that these figures are for large electricity generating plants. There is also an energy from waste potential for smaller plants where the gas is used directly and locally as an LPG (liquid petroleum gas) replacement for cooking and heating.

1. City of Johannesburg, Ekhurhuleni, eThekwini, Tshwane, Nelson Mandela Bay, City of Cape Town

Clockwise from above left: Reinforcing of the digester in progress at Cato Manor, South Africa; The biogas power building and 1.416 MW Jenbacher gas gensets at Petro SA; Dry fermentation energy recovery plant in Moosdorf, Germany; Bran Sands Waste Water Treatment, UK.

Case studies

The toolkit describes a number of existing projects in South Africa, Europe and Asia. These are summarised in the table below.

Country/ Continent	South Africa		Europe		Asia
Plant	Cato Manor	PetroSA	Bran Sands	Moosdorf	Rayong
Type	Hydraulic fixed slab digester with aquaculture	Gas engine electricity generators	Advanced anaerobic digestion	Dry fermentation	Mech treatment and anaerobic digester
Feedstock	Sewage (70 m3), OFMSW & Chicken litter (~3t max)	Refinery process waste	Sewage	OFMSW and yard waste (12 700 t/a)	OFMSW (25 550 t/a)
Size	Small (280 m3 digester)	Large	Large (2.1 ha)	Medium (7 chambers – 4 000 m^2)	Medium
CAPEX	R1.2 million (min 4 y breakeven)	R30 million	R429 million	R21 million (estimated)	R31 million
Output & benefits	13 t/a LPGe (min) Max: 67 t/a LPGe	34 GWh/a elec (3 x 1.4 MWe), 33,000 t/a CO2	37 GWh/a elec (4.7 MWe), 2 MWh heat, R21 mil ROCs	5 GWh/a elec (710 kW), 7 GWh/a heat, 3 500 t/a water	5 GWh/a elect (625 kWe), 43 513 t/a CO2
Cost per output	R92k/t/a LPGe (min) Max: R18k/t/a	R882k/GWh/a, R7mil/MWe (elec plant only)	R11mil/GWh/a, R91mil/MWe	R4.2mil/GWh/a, R29mil/MWe	R6.2mil/GWh/a, R50mil/MWe
Maintenance	Low	High	High	Medium	High

Planning a biogas project

1. The project concept is outlined at a basic level, so that the ultimate end point is well defined.
2. Project feasibility to assess technical, financial and legal factors.
3. If the project appears feasible, the project preparation steps can be undertaken.
4. Implementation, or project realisation.
5. After implementation, the biogas energy system is ready for commissioning.
6. The project moves into the operation and maintenance stage.

Feasibility tools

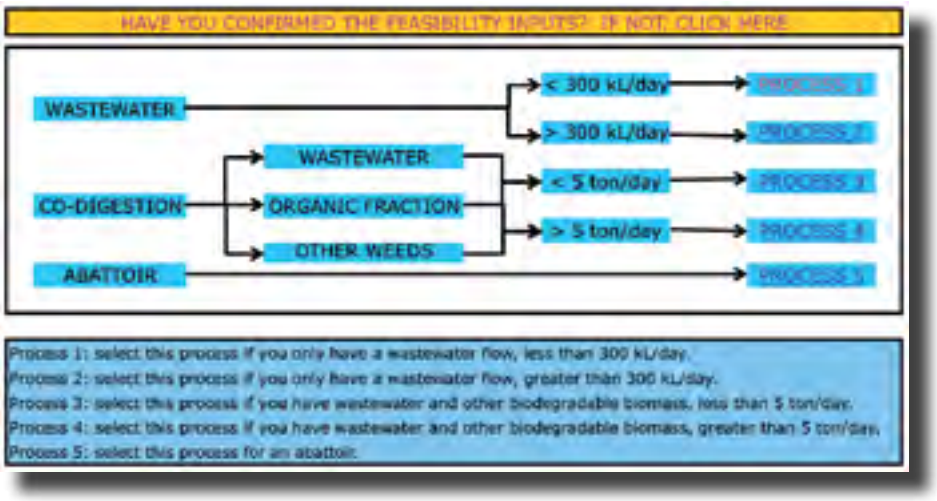
The toolkit includes a feasibility model in the form of a Workbook containing eight spreadsheets and five process sheets with options (eg. input for waste, post digester, land cost, revenue and site specifics). The output summary includes:

- plant footprint
- capital and operating cost
- cost
- revenue and interest charges
- IRR, NPV and payback
- electricity capacity and generation, or LPG equivalent.

The feasibility inputs provide financial options (eg. equity levels, inflation, sale prices, etc), technical options (eg. generator efficiency, electricity required, runtime, etc), and carbon options (eg. price, emission factors, CDM costs, etc). An overview of the model is illustrated by the flowchart shown below. In the model, the flowchart directs the user to the correct process sheet.

What policy-makers should consider

- Carbon revenue can make large anaerobic digestion (AD) projects feasible.
- Biogas benefits include heat, electricity and fertiliser.
- Integration of effective sanitation goals and free basic alternative energy policy.
- A standard implementation agency, as well as skills development and capacity building in energy from waste projects.
- Demonstration projects to help pave the way.
- Better waste data collection is required.
- Cumbersome regulatory issues have led to a lack of successful projects.
- The Municipal Finance Act imposes constraints on public-private partnerships.
- Special feed-in tariffs may boost the viability of projects.



Copies of the technical and feasibility reports and the feasibility model (MS Excel workbook) in the waste-to-energy through biogas toolkit can be downloaded off the SACN website: www.sacities.net.
For more information on biogas visit www.agama.co.za

landfill gas recovery

The Increasing Sustainable Local Government Services (ISGLS) programme, a partnership between the South African government and the United States Agency for International Development (USAID), and implemented by the Louis Berger Group, Inc., aims to improve local government service delivery. This practice note on landfill gas recovery was written by Jim Dohrman, an advisor on alternative service delivery for the ISLGS team. Landfill gas capture and recovery is an important sustainable city strategy because it can provide a clean source of renewable energy while reducing greenhouse gas emissions. It also provides significant opportunities for public private partnerships that transform waste into a revenue generating resource.

Before considering a landfill gas recovery system as a public private partnership, municipalities need to understand the processes by which landfill gas (LFG) is generated and extracted from the landfill. LFG is generated by the anaerobic decomposition of organic waste placed in a landfill. This decomposition process also produces leachate which is the biggest environmental impact of landfilling organic waste. The factors that effect waste decomposition include:

- waste type
- size and depth of the landfill
- moisture content
- landfill PH
- temperature
- waste density

One of the most important and misunderstood of the above factors is moisture content. The anaerobic decomposition or organic waste in a landfill is a maximum at moisture content in the 60 per cent range, but decreases significantly as moisture is reduced, and decomposition as well as LFG generation is minimal below 25 per cent moisture. General domestic waste in South Africa is highly variable but in general has a relatively high organic percentage and moisture content of between 25 and 50 per cent. Much of this moisture in the initially landfilled waste is released during the early phases of decomposition and by the time the methanogenic phase (the anaerobic phase that produces LFG) begins, the moisture content is generally below 25 per cent, unless additional water is added to the waste. This additional water originates from rainfall on the landfill during its operational life.

Since the same decomposition process that produces LFG also contributes to leachate generation, a properly designed and operated landfill limits the introduction of rainwater into the waste. The use of daily, intermediate and final cover soil, compaction of waste and diversion of rainfall run-off are all designed to reduce the amount of rainwater entering the landfill. These efforts to control rainwater infiltration into the landfill are intended to reduce leachate generation by slowing the decomposition of the waste, but they also reduce LFG generation.

For most unlined landfills in South Africa the control of rainwater infiltration is a key issue in terms of the landfill's long term environmental impacts from leachate. For newer, lined landfills that collect and treat leachate, there

are more management tools available for leachate and LFG management. In a lined landfill it is possible to accelerate decomposition, leachate and LFG production by artificially adding moisture and nutrients without increasing environmental impacts. This is often done by collecting and recirculating leachate back into the landfill. This maximises LFG production without leachate contamination impacts. It does however alter the baseline scenario and renders the landfill ineligible for carbon credits.

The South African minimum requirements for landfills recognise the impact of rainfall infiltration on the generation of leachate by requiring a water balance during the permitting stage of the landfill design. If a proposed landfill receives a B- water balance rating, it means that the landfill will not produce significant amounts of leachate and it also indicates a much lower potential for LFG generation.

There are many computer models that estimate the amount of LFG production in a landfill, based on several variables. Most of the models include a rainfall factor. A geographic region that receives less than 25 inches (62.5 cm) of rainfall per year is generally considered arid or semi-arid and will use a much lower LFG generation factor than an area receiving more the 25 inches of rainfall. A landfill located in an arid or semi-arid area is not likely to produce sufficient LFG to justify a recovery project. In terms of contracting issues, a B-landfill presents a high risk that a LFG recovery system will be successful

Permit conditions

Carbon credits are available to LFG projects but only if the baseline does not include flaring of LFG as a permit condition. The minimum requirements for landfills do not include a requirement for flaring of landfill gas, but some individual permits may include such a provision. If the permit is for a large landfill and LFG odours are identified as an issue, the permit often includes such a provision. For example, the new regional landfill in Cape Town recently received its environmental Record of Decision (ROD) from the Department of Environmental Affairs and Tourism (DEAT). One of the provisions includes a requirement to collect and flare the LFG. This provision establishes the baseline as flaring, making any LFG management system ineligible for carbon credits. Without carbon credits, many LFG projects will not be economically feasible.

In addition to general cover soil requirements, an individual landfill operating permit may have specific closure requirements relative to the application of final cover soil or management of landfill gas. Since these issues are also relevant to LFG recovery systems, any lease or gas rights agreement must clearly define the equipment and operations required under the closure conditions of the permit, and those required for the extraction and recovery of the LFG. For example, a landfill permit may require an active system of gas extraction wells to control gas migration. The LFG recovery contractor will want to incorporate these wells into the gas extraction system. These wells and connecting pipelines are often damaged by settlement as the landfill decomposes. The agreement must clearly define who maintains and repairs these components.

Another significant closure issue is the placement of low permeability final cover soil. Final cover soil is intended to reduce or eliminate the infiltration of rainwater into the landfill. Although this will reduce the generation of leachate, it will also reduce the generation of landfill gas. This may not be in the best interests of the LFG system operator.

Operating conditions

Many LFG agreements are negotiated and signed while the landfill is still operating or even before operations begin. The potential for a landfill to support an effective LFG recovery project may in part depend on how that landfill was operated. One of the more problematic operating conditions that can affect future LFG recovery is cover soil. Daily cover soil is intended to control blowing debris, flies and vermin, and limit potential impacts from fires. There are generally no permeability requirements for daily cover and operators use whatever is available including demolition and builders rubble. Intermediate cover is applied when a section of the landfill is completed and the active cell of the landfill is moved elsewhere. In addition to fulfilling the objectives of daily cover, intermediate cover must have a low permeability to act as a barrier to rainfall infiltration. If a subsequent layer of waste cells is placed on top of this intermediate area, the low permeability intermediate cover soil should be removed to allow for moisture and gas to move through the waste body. In practice this is seldom done.

An effective LFG recovery project relies on the ability of the generated LFG to migrate through the waste body to LFG collection wells drilled in the waste to recover the gas. If too much daily cover has been used or it is a low permeability material, the daily cover soil may impede the movement of gas through the waste body and reduce the capture capacity of the gas well. Similarly if low permeability intermediate cover soil is not removed, it too will impede the movement of gas through the waste body. In this case the LFG operator may have to place the collection wells closer together at significantly greater cost. A fine grained cover soil may also clog the openings of the gas collection well screens, further reducing its efficiency.

LFG quality

The decomposition of waste produces some strong organic acids found in landfill leachate. It is these organic acids that mobilise heavy metals found in some waste materials like batteries and e-waste. Unfortunately, small amounts of these organic acids are also found in LFG as contaminants. These contaminants can be a significant issue depending on how the LFG is utilised. If the LFG is used in a larger boiler as a small supplement to other fuels, the trace contaminants will not cause significant problems. However, if the LFG is used to fuel internal combustion engines in a generator set, the contaminants can cause increased corrosion of engine parts and exhaust systems. If LFG is utilised, these engines must include higher quality alloy cylinder heads and valves to resist the higher corrosive nature of the fuel. These engines will require more frequent maintenance and repairs than a similar engine run on natural gas.

Will recycling help or hinder the recovery of LFG?

This is a catch 22 question. The removal of inorganic materials such as glass, plastic and tins will concentrate the organic matter and theoretically increase the gas yield per ton of waste. But as stated above, the effective recovery of LFG relies on the waste body remaining permeable to allow the generated gas to migrate to the gas collection wells. As organic waste decomposes, its volume decreases. Landfills will settle as much as 20 per cent after closure. This settling tends to close the voids left in the waste body. As waste decomposes it is the inert materials such as glass, plastic and metals that keep these voids open, allowing LFG to move through it; also allowing water, either infiltration or the product of decomposition, to drain away. In high rainfall areas the reduction in void spaces can result in saturated conditions, which also restricts the collection of LFG. Recycling may hinder the recovery of LFG in the future by reducing the permeability of the waste body.

South African CitiesNetwork

The impact of green energy on LFG projects

Green energy is generated from clean renewable fuels that are considered environmentally friendly. Wind and solar energy are typical examples of green energy. Electricity produced from LFG would certainly qualify as green energy. The current problem with green energy is that it is expensive compared to commercially available energy produced by Eskom. Under current regulations, Eskom is required to purchase energy produced by small power produces but it is restricted to paying a percentage of its wholesale electricity price for that power. That price is usually well below the cost to produce green power. The energy regulator will not permit Eskom or any distribution utility to buy power at the true cost of green power production and then spread that cost throughout its rate base. Although there is discussion focused on establishing a higher 'buy-in' tariff for renewable green power, there has been little progress in that regard. Until a higher renewable buy-in tariff policy is implemented, the distribution utility is responsible for locating specific customers who are willing to buy 'green power'. The LFG project developers usually assist the utility in locating these green customers and it often becomes a joint project responsibility. The sales price for green energy from a LFG project must be clearly defined in the agreement along with the responsibilities of each party in locating green power customers.

Conclusion

Many municipalities are rushing to sign agreements for LFG projects. These agreements include attractive provisions for profit sharing but there are some basic technical issues that need to be considered before municipalities dedicate resources to these projects. They may not be the win-win projects that everyone seems to think they are. The Gas Rights and Lease Agreement must clearly define the roles of all parties and account for technical variables that can affect both the quality and quantity of LFG produced.

USAID FROM THE AMERICAN PEOPLE

sustainable living

Figures produced by the Global Footprint Network show that we are consuming the earth's resources at a faster rate than the earth can replenish them. This causes problems such as disappearing forests, declining fisheries, air pollution, and climate change. One of the main challenges facing society is how to enjoy a decent quality of life whilst keeping our ecological footprint to a minimum.

BioRegional have created the One Planet Communities Programme to coordinate the construction of sustainable residential developments in partnership with developers and municipal authorities across the world. They provide a model, which can be adapted for local contexts, that shows how to design, build and manage genuinely sustainable communities that are attractive and affordable.

Beddington Zero Energy Development (BedZED) in the UK is one of the first developments in the One Planet Communities Programme. It consists of 100 homes as well as office and community space. Although some aspects have not worked, the project represents a major step forward in sustainable living practices.

The energy efficient design of the units and appliances, coupled with a renewable energy strategy has led to major carbon savings –residents at BedZED have achieved a 45 per cent reduction in electricity consumption and an 81 per cent reduction in heating and hot water, compared to homes in the surrounding area.

The largest single carbon savings is due to the introduction of a car club, and a reduction in car parking. Surveys show that the overall rate of car ownership at BedZED is 0.6 cars per household, which is dramatically lower than the 1.6 cars per household for the wider area. Private car mileage is estimated as 64 per cent lower than the UK national average. With fewer cars, there is more space for children to play and for neighbours to meet – fostering a strong sense of place and community.

BioRegional used the gathered data and lessons learned from the BedZed project to create the One Planet Living concept, a practical framework based on ten guiding principles of sustainability. (See far right.)

One planet communities around the world

Communities across the world, in the USA, Europe, Middle East and South Africa, have adopted the ten One Planet Living principles. Other projects are in earlier phases of planning in Australia and China.

One Brighton in the UK consists of 172 apartments as well as office and community space. The development generates approximately 50 per cent of its energy requirements, with the remainder purchased as guaranteed green electricity through One Brighton Energy Services. Green lifestyle features include rooftop allotments, communal sky gardens, a car club, and a green caretaker. Construction started in September 2007 and first residents will move in during summer 2009.

Masdar City is a zero-carbon, zero-waste, and car-free community in Abu Dhabi. Designed along the principles of a traditional Arabic walled city, this high density mixed-use development will house approximately 50 000 people and up to 1 500 businesses focusing on

Construction at Ivory Park.

Locally recruited coach Sithembiso Ndzimbomvu, facilitating a session at the nef coach training workshop in Waterloo, June 2009.

Brighton One Planet Living community, UK.

In South Africa, the One Planet Communities Programme is suitable for new builds as well as retrofitting and regeneration projects in urban and rural locations

sustainable products and services. Energy will be supplied from a concentrated solar power plant and photovoltaic panels. No more than 1 per cent of waste will be sent to landfill; the vast majority will be recycled, with residual waste being converted to clean energy through a plasma gasification process. Water consumption will be reduced by 50 per cent, with almost all non-potable water supplied from recycled water. Treated waste water will be returned to replenish ground water. The quantity of fresh water needed will be greatly reduced, and will be supplied by a solar desalination plant.

Currently under construction in California in the USA, the Sonoma Mountain Village development aims to reduce carbon emissions in building use by 100 per cent by 2020. Sonoma's zero waste plan will limit the total amount of solid waste sent to landfill to 2 per cent by 2020, ensuring at least 70 per cent of waste by weight is reclaimed, recycled or composted. The combined impact of green transportation strategies will see an 82 per cent reduction in GHG emissions arising from travel to, from, and within the community. Cycling and walking will be the primary modes of transport, with pedestrian promenades, narrow tree-lined streets, paths and convenient bicycle parking everywhere. Neighborhood electric vehicles charged by solar arrays will be inter-connected with the grid to allow the local utility to extract energy from the cars' batteries during peak periods.

One Planet communities in South Africa

In South Africa, the One Planet Communities Programme is suitable for new builds as well as retrofitting and regeneration projects in urban and rural locations. The programme demonstrates cutting edge sustainable urban growth and regeneration, and provides a replicable model for development and poverty alleviation.

At the World Summit on Sustainable Development in 2002, BioRegional assisted Johannesburg EcoCity Trust to create a demonstration of eco-houses and a community centre in Ivory Park. In 2005, BioRegional held its first One Planet workshop in Johannesburg, hosted by the DBSA. A number of subsequent workshops were held for the City of Cape Town, Tongaat Hulett Developments in Durban, The Natural Step, SACN, and Joburg Property Company.

BioRegional has been working with Tongaat Hulett Developments and eThekwini municipality to apply the ten one planet principles to the proposed Sibaya development north of Umhlanga in Durban. They are in the process of creating an overarching strategy for the development of the 850 hectare site, which will accommodate 6 000 residential units, commercial space and six hotels by 2027.

A three year partnership programme between eThekwini municipality and UK-based new economics foundation (nef) will align the nearby township of Waterloo with the economic development opportunity provided by Tongaat's developments. The aim is to develop the local economy in a sustainable way through enterprise. A local coach has been recruited and employed by BioRegional South Africa to support Waterloo residents' entrepreunerial ideas and take them forward as business entities.

Mbongi Dhlomo, Development Manager for Sibaya says, "While green building may be in its infancy in South Africa, Tongaat Hulett aims to be one of the leading developers in creating truly sustainable developments. Tongaat Hulett's R13.7 billion mixed-use residential, leisure and commercial property development at Sibaya will be built using One Planet principles, as we see them to be a most holistic approach to sustainable development, highlighting that sustainability is as much about lifestyles as it is about building."

For more information about BioRegional's work on One Planet Communities contact:
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urban biodiversity

The ecological footprints of cities around the world are increasing at alarming rates due to rapid growth and urbanisation. Urban ecosystems are important for the survival and sustainability of human habitats, but urban pressures threaten the biodiversity of these ecosystems, and the services they provide. Urban dwellers are becoming alienated from the natural world, and tomorrow's leaders could be making important environmental decisions without the necessary knowledge.

The South African Biodiversity Institute's (SANBI) Urban Nature Programme aims to coordinate urban environmental management initiatives and identify channels through which to develop and promote good practice. The aim is to provide institutional knowledge, expertise and skills to municipalities and other local authorities who are responsible for managing and protecting urban ecosystems, especially those with high ecological and heritage value.

Working with ecological scientists, local governance agencies and civil society, the programme aims to build public understanding of the biodiversity value in threatened urban environments. It facilitates community involvement in biodiversity related action, engages in actions for the protection and restoration of ecosystems threatened by urban activities, and contributes to processes and partnerships that improve urban environmental management practice.

SANBI have built links and ongoing working relationships with a number of international agencies that work towards understanding and enhancing the protection and sustainable management of urban nature globally. These include cities that are part of the International Union for Conservation of Nature (IUCN), Protected Areas Task Force, the ICLEI LAB project, and the Stockholm Resilience Centre.

Three key projects are currently being implemented through the programme:

- Cape Flats Nature, which works with the City of Cape Town to engage communities in the care, use and management of biodiversity assets in their neighbourhoods.
- Working for Wetlands, a poverty alleviation and skills development project within the Expanded Public Works Programme (EPWP) poverty alleviation programme.
- Green Futures, a horticultural skills development project.

Cape Flats Nature

The Cape Flats Nature project works at conservation sites that are part of the City of Cape Town's biodiversity network of public open spaces. Its activities are focused on conservation, education, recreation, health, job creation, and building local leadership. It promotes good practice in sustainable management of nature sites in a people-centred way that develops local leadership for conservation action. It approaches the challenge of conserving biodiversity in urban settings where poverty is widespread, by building bridges between people and nature, and demonstrating the benefits of conservation to the surrounding communities.

Working for Wetlands

Working for Wetlands (WfWet) uses wetland rehabilitation as a vehicle for both the wise use of wetlands and poverty alleviation. It follows a cooperative government approach by creating partnerships between landowners, communities, civil society and the private sector.

Wetlands are natural infrastructure for gathering, managing and delivering water for human use. They purify water, control floods, and contribute to the maintenance of flow in rivers. Many wetlands also have significant worth as warehouses of biodiversity and as sites of spiritual, recreational, educational and scientific value. With climate change predicted to increase rainfall variability and intensity, wetlands will play a more important role than ever in mitigating extreme episodes of floods and droughts.

Working for Wetlands helps to restore degraded rivers and wetlands to a more natural state. The Peninsula Project on the Cape Flats provides work and training for previously unemployed people. They remove invasive alien plants, reshape the banks of rivers and wetlands, and plant indigenous wetland plants.

Wetlands along the Soutpansberg River in Tswhane are being rehabilitated by draining the Tswaing Crater on its northern edge. The project is located within the Tswaing Crater Reserve, a notable tourist destination. About 80 people have been temporarily employed in the construction of concrete and gabion structures to reduce water flow speed and protect the river banks from eroding.

Another project in Tswhane spans two quaternary catchments linked to the Jukskei and Crocodile rivers. Rehabilitation intervention includes construction of concrete and gabion structures, and clearing of invasive alien plant species. The project provides temporary employment and skills development for 62 people.

The Rietvlei wetland lies upstream of the Rietvlei Dam within the 4 000hectareRietvlei Nature Reserve just outside Pretoria. The dam produces about 41 million litres of water per day, which is 3 per cent of Tshwane's drinking water requirements. By early 2007, rehabilitation intervention at Rietvlei had shown great success. Reeds were re-established throughout the wetland and there is even distribution of water, with no channelling. The wetland is considered to be nearly fully recovered.

Increased urbanisation in the municipality of Ekurhuleni has resulted in a range of development-related impacts on its wetlands. These include concentrated storm water outflows, roads, pipeline and railway line crossings, infrastructure encroachment, invasive alien plant infestations, channelisation, channel incision, headcut erosion, mining and dumping. These impacts reduce the ability of

Working for Wetlands helps to restore degraded rivers and wetlands to a more natural state

the wetlands to provide ecosystem services such as water purification and flood attenuation. Water pollution is a major concern, and wetland rehabilitation is considered highly important for improving water quality. Rehabilitation projects are active in several quaternary catchments situated at wetlands draining into the Klip, Kaalspruit, Rietspruit and Swartspruit rivers.

Wetlands suitable for rehabilitation were identified at Van Riebeeck Park, Kempton Park; near Thembisa, north of Ivory Park; north of Carnival City near Kwathema in Brakpan; and near Palm Ridge, south of Thokoza. The projects provide temporary employment and skills development for 45 people. Rehabilitation interventions include gabion and concrete structures to de-activate erosion headcuts within the system

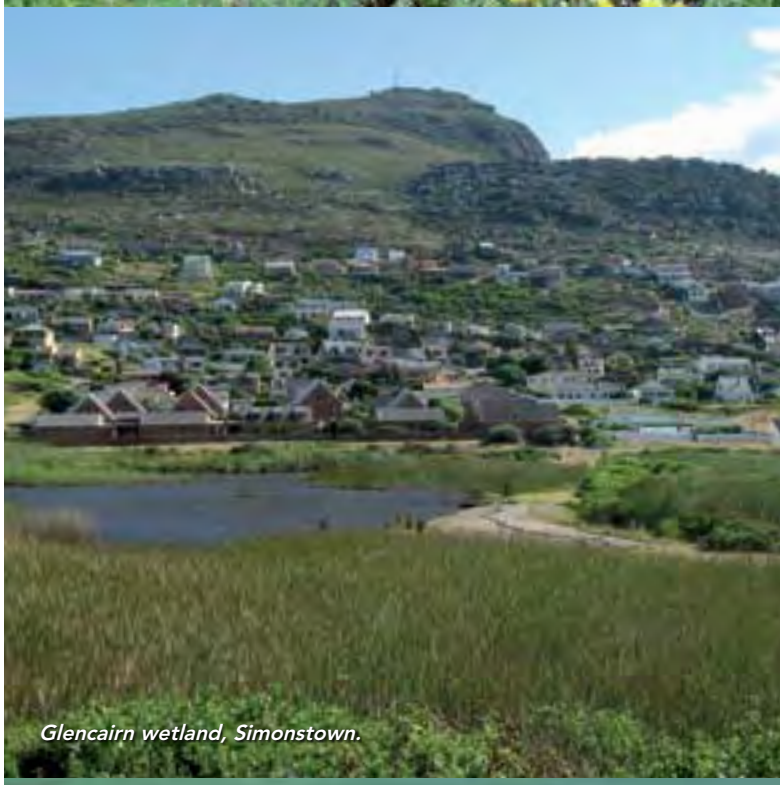
Wetlands in the City of Johannesburg play an exceptionally important role in the purification of water flowing through the city. They also maintain patches of primary granite grassland vegetation; provide suitable habitat for the African Grass Owl, an IUCN red list species; and support large stands of rice grass, a breeding and foraging habitat for the marsh sylph butterfly, also an IUCN red list species. The wetlands are also important for flood attenuation, stream flow regulation, erosion control and toxicant assimilation.

The wetlands receive a significant amount of urban water pollutants, and are under increasing pressure from urbanisation. They have also been severely eroded. Vegetation remains close to a natural condition, but erosion features have resulted in encroachment of invasive alien plants. Twenty-three wetlands in the 183 900 hectare quaternary catchment were identified for rehabilitation. Previous rehabilitation efforts were focused on the Klip River, but has now expanded to include the catchments of the Crocodile, Jukskei and Kaalspruit rivers. The project is implemented in partnership with the City of Johannesburg metropolitan municipality. About 70 people have benefited from temporary employment and capacity building. All team members receive training in health and safety, fire awareness, and introductory courses on wetland health and functionality. They are also trained to build rehabilitation structures.

Green Futures

This unique project plans to establish indigenous landscaping and life skills colleges that will place previously unemployed youth into jobs through an annual integrated learnership. The courses will include practical internships at an income-generating nursery and landscaping business linked to each college. The project will be piloted at two priority biodiversity sites on the Cape Flats and another in Nelson Mandela Bay, with a view to expanding nationally. The project is designed to develop nature-based sustainable livelihoods for people from the local community, and so engender a conservation ethic in surrounding areas.

Green Futures nursery.



Glencairn wetland, Simonstown.

Buffelsdraai landfill site, Durban.

Local Action for Biodiversity (LAB)

Local Action for Biodiversity (LAB) is an ICLEI-Africa pilot project that plans to work with approximately 15 cities from across the globe to investigate how local governments can engage in effective biodiversity protection, management and utilisation. The project aims to develop biodiversity toolkits and create a global network for biodiversity. It also aims to promote greater understanding about urban biodiversity issues and implementing actions, as well as increased awareness of the need for local action in this regard

The Second International LAB Workshop

The purpose of this workshop, held in 2008, was to further discussions about key local government biodiversity issues, with an emphasis on improving and informing political will, in order to create an enabling environment for biodiversity management. The workshop focused on planning, implementation, political commitment, and the future of LAB. The key themes of the workshop were balancing conservation and development; political and public buy-in; public awareness-raising and participation; mainstreaming of biodiversity across line functions of local government; the importance and utility of partnerships; and hands-on concepts such as maintaining connectivity for biodiversity across the cityscape. Political will was demonstrated very strongly through the signing of the Durban Commitment – a formal commitment to biodiversity conservation at the level of local government, signed by political representatives.

The Grasslands Programme

This is a SANBI bioregional programme for the development of a 20-year conservation strategy to secure and sustain the biodiversity and ecosystem services of the grasslands biome. The programme aims to protect and conserve grasslands for current and future generations, and to fulfil conservation targets by working with government departments, conservation agencies, private-sector groups, civil society organisations, and tertiary and research institutions. It aims to influence policies and decision-making by engaging with partners in sectors that utilise the biome. These sectors include agriculture, forestry, urban development and coal mining. Market level initiatives to direct the development footprint away from high priority biodiversity areas, and to incentivise greener production practices are being developed with partners in the Grasslands Programme.

Buffelsdraai community reforestation project in eThekwini

This project is located in the buffer zone around the Buffelsdraai regional landfill site. The objective is to replace the existing sugarcane with indigenous forest - similar to that originally cleared to make way for cane cultivation. The project is part of Durban's Greening 2010 programme, which aims to ensure that Durban's hosting of the 2010 FIFA World Cup (FWC) contributes to the overall sustainable development of the city. This restored forest area will have to be maintained for a period of at least 20 years in order to act as an effective carbon sink for some of the CO^2 that will be produced during the 2010 FWC activities hosted in Durban. Sponsorship has been obtained for an initial planting of 62 500 trees and the intention is that eThekwini Municipality will continue with the project in order to ensure that the 650 hectare buffer area is fully restored and managed.

The environmental benefits of this project are clear. Climate change will be mitigated through the removal of CO^2 from the atmosphere, and important ecosystem services such as water provision and flood attenuation will be restored in an important river catchment area. There are also socio-economic benefits. The Wildlands Conservation Trust works with local communities to establish 'treepreneurs' – community members who collect seed and grow seedlings which are then traded for goods (groceries, bicycles, school fees etc.) at local 'treestores'. Nine local community members are employed permanently on site to oversee the holding nursery and to plant the seedlings. The project develops income-generating skills and encourages community members to help manage the environment. It is a pioneering example of how the creation of green jobs can address the twin challenges of poverty reduction and climate change.

For more information, go to: [SL to find URL] www.capeflatsnature.org | www.iclei.org/lab | www.greenfutures.co.za)
For more information on the Grasslands Programme contact Anthea Stephens, Grasslands Programme Manager, stephens@sanbi.org OR Budu Manaka, Grasslands Urban Coordinator, budu.manaka@gauteng.gov.za

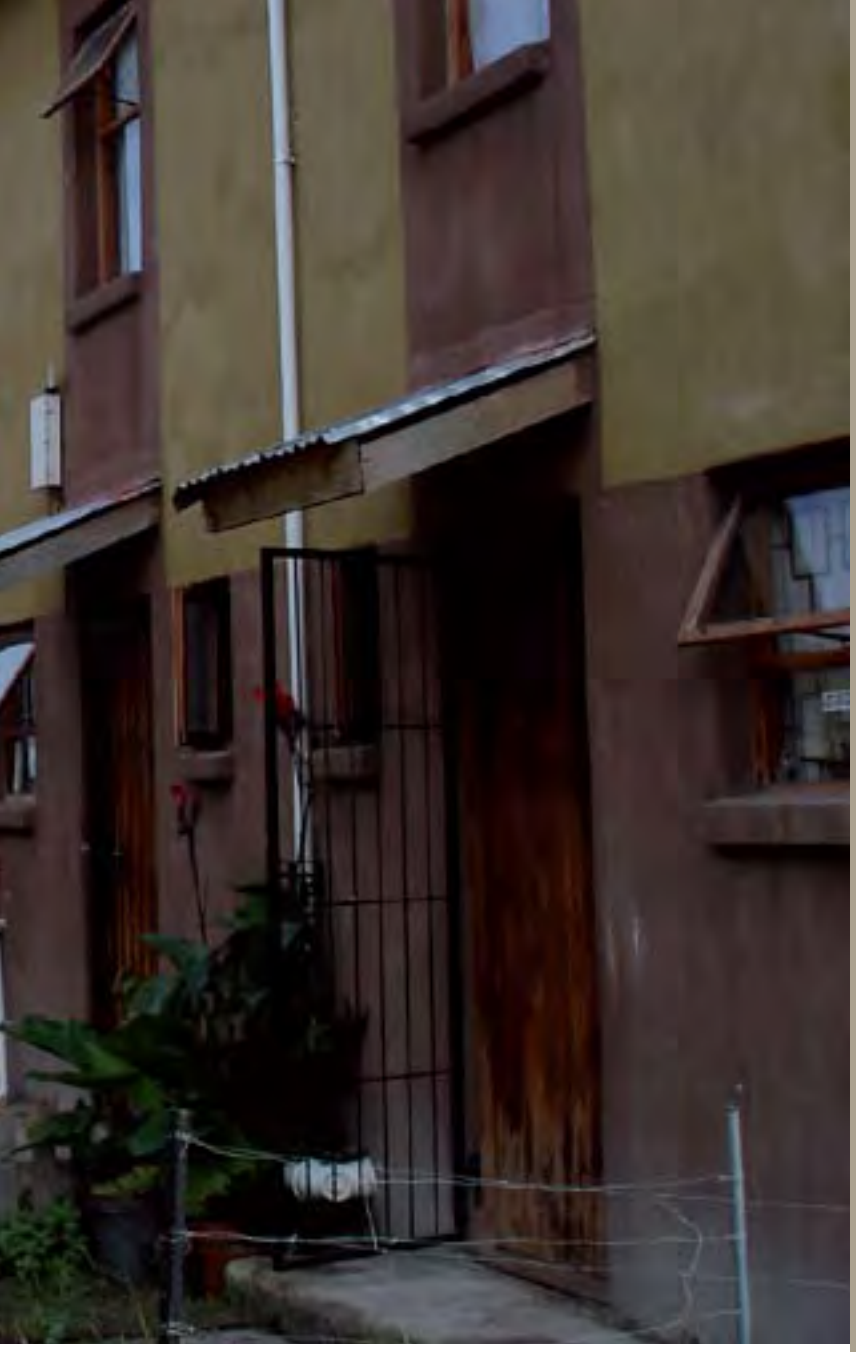
indicators of sustainability

A sustainable city examines the extent to which sustainability strategies are integrated into city strategies, the alignment between sustainability and urban services, and how cities are addressing both local and global sustainability concerns. The objective of SACN's sustainable city programme is to ensure that social and economic development responds appropriately to natural and other resources, and promotes equity and efficiency.

Indicators are invaluable for describing and monitoring the sustainability of the urban environment, to help assess the available management options, and to evaluate the outcomes of actions taken.

In 2008, SACN commissioned a study to review and update the existing sustainable city indicators. This is an extract from the report prepared by Dr Brett Cohen, Dr Yvonne Hansen, and Dr Philippa Notten from The Greenhouse. Through a process of stakeholder engagement with the SACN's Indicators Reference Group and workshops with representatives from member cities, the following themes were selected for the updated sustainable city indicator set:

- Energy
- Climate Change
- Air Quality and Noise



- Human Settlements
- Transport
- Waste Management
- Land Use and Planning
- Water and Wastewater
- Biodiversity / Conservation
- Culture and Heritage
- Overall Sustainability

These themes were populated with indicators collated from an extensive review of international and local best practice. The objective was to develop an indicator set that was comprehensive (covering all the identified themes) and compact (a small number of core indicators) while taking into account the availability of data. The recommended core set of indicators are summarised in the following table.

Theme	Rationale
ENERGY	The South African economy is heavily dependent on energy use and availability. And while the majority of our energy is generated from coal – a situation that is unlikely to change in the foreseeable future – there is growing awareness about the need to increase energy efficiency and accelerate the development and application of renewable energy alternatives. Quantifying existing energy use is the first step towards realising the goal of sustainable energy use across all sectors of the city. The suggested energy indicators therefore focus on quantifying and disaggregating energy consumption. Energy generation by renewable and non-renewable technologies also needs to be quantified. Once energy supply and consumption are known for the city per sector, hotspots of energy consumption can be identified and targets set for sustainable use of energy.
Indicator	**Measure/definition**
Electricity generation	kWh/year or GJ/year • Breakdown of electricity generation by type. • Include trend data if available. • Energy generated by the city (as opposed to Eskom, whose electricity mix is known) • Renewables in separate section (but can be included here).
Energy/fuel type	kWh/year or GJ/year • Breakdown of energy usage across all sectors by source or type. Include trend data if available • Renewables in separate section (but can be included here).
Renewable energy	kWh/year or GJ/year • Breakdown of renewable energy generated/used. Include trend data if available.
Energy consumption	• Sectoral breakdown of energy consumption by activity. Include trend data if available. • If data is available, residential energy consumption can be considered for different income levels. • Residential energy consumption: kWh/year or GJ/year • Transport energy consumption: GJ/year • Industrial energy consumption: kWh/year or GJ/year Industrial sub-sectors will be specific to individual cities. Examples: pulp and paper, textiles, food and beverage, manufacturing, etc. • City council energy consumption: kWh/year or GJ/year
Energy intensity	• Energy intensity by activity: • public and private transport: GJ/passenger-km • freight: GJ/tonne-km • residential activities: GJ/capita • industrial subsectors: units specific to output or R-value of products • commercial activities: units specific to output or R-value of products • city council activities: GJ/capita
Energy cost	• Cost of electricity: R/kWh • Cost of solar energy: R/kWh • Cost of wind energy; R/kWh
Energy efficiency	• Energy savings due to conservation and efficiency improvements: kWh/year or GJ/year • Number of new developments meeting energy efficient criteria.
Renewable energy	• Number of households: uptake of renewable/ecological technologies (e.g. solar heating).
Theme	**Rationale**
CLIMATE CHANGE	Climate change and greenhouse gas emissions are strongly linked to energy use, but have been purposefully put into a separate theme. This is because climate change is still largely perceived as an environmental issue and therefore outside of the direct responsibility of many local government departments. However, much of the data collected to support the energy indicators will be used here.
Indicator	**Measure/definition**
Climate change	• Breakdown of greenhouse gas emissions (CO^2, nitrous oxide, methane per sector/activity. Include trend data if available. • Can be derived from energy data using conversion factors. Greenhouse gas intensities can be calculated similarly. • Greenhouse gas emissions per sector: • residential: tonnes CO^2-e/capita • transport: tonnes CO^2-e/passenger-km; tonnes CO^2-e/tonne-km • industrial sub sectors: specific to each city • commercial: specific to each city • city council: specific to each city • Carbon footprint: tonnes CO^2-e/capita (total city greenhouse gas emissions converted to CO^2 equivalents divided by the total population) • Mean annual temperature: degrees celsius
CDM and carbon trading	Tonnes CO^2-e/year: • Total annual tonnages of CO^2 'saved' as a result of Clean Development Mechanism (CDM) and/or other trading scheme projects.

Theme	Rationale
AIR QUALITY AND NOISE	Improving air quality by reducing pollution from urban development, industry and transport is a key requirement of sustainable development. This theme is linked to the energy and climate change themes as improving air quality is often linked to minimising energy use from fuels that give rise to pollutants (wood fuel, coal, petrol, diesel etc.) as well as preventing and reducing waste releases and noise. An essential aspect of any air quality strategy is monitoring to determine whether actions taken at local and national level are effective in meeting sustainability objectives.
Indicator	**Measure/definition**

Air quality	• Concentrations of:
	  • sulphur dioxide: ppm
	  • nitrogen dioxide: ppm
	  • particulate (PM10): ppm
	  • lead: ppm
	• Annual number of air pollution events
	• Number and proportion of population affected by air pollution events. Some definition of 'affected' population required. Trends in respiratory diseases may also be useful here.

Stratospheric ozone depletion	• Consumption of ozone depleting substances by sector • Stratospheric ozone levels
Air toxics	• Concentrations of air toxics if considered necessary
Noise	• Number of complaints
Odour	• Number of complaints
Theme	**Rationale**
HUMAN SETTLEMENTS	Inadequate housing in overcrowded neighbourhoods without access to green space, transport and opportunities has negative consequences in terms of health, sanitation, education, employment and other issues. Providing decent affordable housing can therefore form the basis for beginning to address some of these wider issues. Thus, the governance question under this theme is whether or not the city has a unit dedicated to the management of the delivery of housing; and further, how does this unit interface and align with the provincial housing department.
Indicator	**Measure/definition**

Human settlements	• Housing density per zone/suburb: dwelling units/ha
	• Zones/suburbs to be defined as specific to each city. An alternative is fraction of zones exceeding high density (expressed in persons per household).
	• Overall population density: population/km2 (per zone/suburb if applicable)
	• Incidence of TB: number of cases
	• Incidence of TB and/or other communicable diseases is seen as a proxy indicator of density.
	• Percentage dwelling types per settlement category/zone:
	  • formal backyard dwelling
	  • informal backyard dwellings
	  • 1 room dwellings not in backyards
	  • other types (e.g. homes built with traditional materials, rental housing vs. owned housing
	• Total delivery of new subsidised (e.g. RDP) housing
	• Number of new subsidised households on greenfield
	• Percentage reduction in the housing backlog (requires definition of adequate/inadequate housing)

Urban green space	• Area of urban green space: km2 (urban green space is defined as good quality, well maintained public green space) • Percentage of population with access to urban green space (access is defined as within 300 metres or 5 minutes walk from their homes)

Additional indicators
These indicators are either more "tricky" to quantify or they provide additional information/insights into the core set of indicators
	• Area of urban agriculture area (reported under land use): km2
	• Number of new and existing trees planted by species:
	  • indigenous
	  • fruit-bearing
	• Unit cost of street trees (including maintenance)

Theme	**Rationale**

TRANSPORT	Impacts associated with transport include congestion, noise and air pollution, global warming, and health effects. A sustainable transport system provides access to facilities, services, goods and employment while minimising these adverse impacts of transport on human health and the environment. In particular, people from vulnerable groups are placed at a disadvantage without access to key services including clinics and employment opportunities. Providing an efficient and reliable transport service should be at the forefront of sustainable city planning. The governance questions under this theme aim to determine how far along the city is in terms of providing sustainable transport alternatives: Is there an Integrated Transport Plan for the city? How does the city guide development along transit corridors? Does your city have authority for public transport? And are you performing this function? Are pedestrian and cycle paths planned in conjunction with new roads?
Indicator	**Measure/definition**

Transport	• Average travel time to work: minutes
	• Breakdown (no. and %) of transport mode to work and public vs. private transport:
	  • public transport: bus
	  • public transport: train
	  • public/private transport users: taxi
	  • private transport users: car
	  • private transport users: motorcycle
	  • non-motorised transport: walking
	  • non-motorised transport: cycling
	• This will give the split between public and private transport, and can be used to derive the proportion of the population using public transport
	• Number of private cars/1000 population
	• Capacity and availability of public transport:
	  • number of municipal buses per capita
	  • number of taxis per capita
	  • number of train seats per capita (during peak travel times)

Transport infrastructure	• Availability of pedestrian and bicycle paths:
	  • length of dedicated cycle routes per km^2
	  • length of dedicated pedestrian routes per km^2
	• Length of road by type per km^2 (road types and quality to be specified if possible e.g. paved, unpaved, dirt roads, etc.)
	• Length of road dedicated to public transport (i.e. bus/taxi lanes): km^2
	• Length of rail per km^2

Additional indicators	• Rand cost of transport per km:
	  • bus
	  • train
	  • taxi
	  • car
	  • motorcycle
	• Number of traffic signal outages per year

Theme	**Rationale**
WASTE MANAGEMENT	Increased waste generation, brought about by unsustainable consumption and inefficient use of resources, can, if inappropriately managed, lead to air and land pollution, pollution of fresh and marine waters, disruption of ecosystem services, destruction of habitats, and species loss. It also increases pressure on scarce landfill space. Integrated waste management aims to avoid and reduce waste generation where possible by using energy, materials and resources more efficiently, increase re-use and recycling activities, and manage residual waste appropriately. Whether the city has an Integrated Solid Waste Management Plan is therefore one of the governance questions under this theme, as well as qualifying what waste minimisation and recycling initiatives, strategies and/or policies are in place.
Indicator	**Measure/definition**

Waste generation	• Tonnes/year and % of solid waste generated by type:
	  • household waste
	  • industrial waste
	  • hazardous waste
	  • commercial waste
	  • medical waste
	  • construction and demolition waste
	  • radioactive waste
	• Household waste composition (tonnes/year, tonnes/capita and/or %):
	  • kitchen waste
	  • garden waste
	  • paper
	  • plastic
	  • metal
	  • glass
	By region or income level if data exists

Indicator	**Measure/definition**

Waste reduction and recycling	• Tonnes and % of solid waste recycled per year:
	  • household waste
	  • industrial waste
	  • commercial waste
	  • construction and demolition waste
	• Household waste recycled or composted per year (tonnes/year; tonnes/capita and/or %):
	  • kitchen waste
	  • garden waste
	  • paper
	  • plastic
	  • metal
	  • glass
	• Value of waste recycled: R/year
	• Number and locality of waste to energy projects
	• Tonnes/year of waste utilised in waste to energy projects

Waste management	• Tonnes of waste disposed by method (tonnes/year and/or %):
	  • sanitary landfill
	  • incinerated
	  • open dump
	  • composted
	  • burned openly
	  • other

Additional indicators	• Waste reduction and recycling
	• Tonnes/year of waste avoided as a result of waste minimisation activities and initiatives
	  • industrial
	  • commercial
	  • city council
	  • household
	• Waste disposal
	• Areas of illegal dumping plus amounts illegally dumped (or number of times cleared)

Theme	**Rationale**
LAND USE AND PLANNING	Land use is a key theme for sustainable development as it influences resource and energy use, transportation requirements, access to services and employment, air quality, water supply and quality, biodiversity and the natural environment, as well as the built environment. While Integrated Development Plans are now commonplace in South African cities, the governance questions under this theme probe a bit more deeply to determine whether or not they have been updated; if there is a Spatial Development Framework; how many precinct level development plans are currently in place, and how the city enforces land use restrictions.
Indicator	**Measure/definition**
Land use	• Area of greenfield developments: km^2 • Area of brownfield developments: km^2 • Area of developed green space: km^2 • Area of undeveloped green space: km^2 • Area of urban green cover: km^2 • Loss of agricultural land and metropolitan open space to urban and peri-urban development: km^2

Planning	• Land use ratios (total km^2 and %):
	  • industrial
	  • residential
	  • commercial
	• New developments:
	  • number of new industrial and commercial development
	  • extent of new industrial and commercial developments: km^2
	  • number of new mixed use developments
	  • extent of new mixed use developments: km^2
	• Area of land set aside for conservation or as natural and cultural heritage sites: km^2

Additional indicators	These indicators are either more 'tricky' to quantify or they provide additional information/insights into the core set of indicators
	• Land condition:
	  • desertification
	  • soil loss
	  • soil acidification
	  • soil salinisation
	  • land degradation
	  • persistent organic pollutants

Theme	Rationale
WATER AND WASTEWATER	After energy, water is probably the next most pressured resource. Ensuring water availability and supply is a key concern in our cities. A water management plan at the city level is therefore necessary and is the first governance question under this theme. The indicators under this theme cover water quantity in terms of consumption demands and availability, and water quality. Wastewater management considers the volume of wastewater generated, the fate of wastewater, wastewater treatment capacity and performance, and the status of wastewater infrastructure. Additional indicators include indicators to measure freshwater, marine, coastal and estuarine ecosystem integrity.
Indicator	**Measure/definition**

Wastewater management	• Volume of wastewater generated (Ml/year):
	  • industrial
	  • domestic
	  • commercial
	  • other
	• Fate of wastewater (Ml/year and/or %):
	  • treated
	  • not treated
	  • recycled/reclaimed
	  • unaccounted for
	• Wastewater treatment works:
	  • total capacity: Ml/day
	  • number and type
	• Sludge and effluent compliance:
	  • percentage wastewater discharge that meets discharge standards
	  • percentage sludge that meets discharge standards

Wastewater infrastructure	• Age of network: years • Sewer blockages per 100km of pipe per year: no/100km.year • Leaks per km of pipe per year: Ml/km.year • Current investment: % of asset value spent in maintenance per year: R/year

Water quantity	• Breakdown of water consumption (surface water and groundwater):
	  • residential water consumption per activity: Ml/year
	  • industrial water consumption: Ml/year
	  • commercial water consumption: Ml/year
	  • council water consumption (per activity): Ml/year
	• Locality and capacity of reservoirs: Ml total, % full
	• Intensity of use (groundwater and surface water): Ml/capita
	• In terms of salinity, nutrients, microbiology, toxics etc:
	  • surface water quality
	  • groundwater quality
	  • drinking water quality
	• Proportion (%) of population affected by violation of drinking water quality criteria (definition required for 'affected' population
	• Number of pollution events in water bodies
	• Number and locality of algal blooms

Additional indicators	• Wastewater infrastructure • Network density in terms of metres of pipe per connection: m/connection • Length of pipe per km^2 • Backlog in maintenance
	• Water quantity • Ml/year: Reduction in drinking quality water demand as a result of educational initiatives, technological interventions (e.g. low flow showerheads, low flush toilets)
	• Freshwater ecosystem integrity • Riparian vegetation • Number of new developments near wetlands • Pollutant loading entering freshwater systems from land based sources • SASS biological index (disaggregated) • Number of households in 50 year and 100 year flood zone (or number of households affected by flooding)
	• Marine, coastal and estuarine ecosystem integrity • Concentrations of heavy metals in sediments or biological tissues • Number of new developments in the coastal zone • Pollutant loading entering freshwater systems from land based sources • Number and locality of oil pollution accidents along the coast

Theme	Rationale
BIODIVERSITY / CONSERVATION	The natural environment provides us with ecosystem services, ensuring clean air, water, food and raw materials. While these services and resources have historically been treated as unlimited, ever increasing impacts from unsustainable activities has raised awareness of the need to conserve and protect our natural environment and resources.
Indicator	**Measure/definition**
Species diversity	• Biodiversity rating/index • Lists of threatened and extinct species, populations and ecological communities • List of endemic species, populations and ecological communities • List of alien (non-indigenous) species

Habitat change	• Extent of conserved area:
	  • total area: km2
	  • percentage lost or gained on previous years
	• Extent of natural areas:
	  • total area: km2
	  • percentage lost or gained on previous years
	• Disturbance regimes: fire frequency:
	  • number of fires
	  • area affected: km2
	• Disturbance regimes: flood and drought:
	  • number of events
	  • area affected: km2

Resource value	• List of commercially utilised natural resources (list and Rand value generated):
	  • indigenous species
	  • freshwater species
	  • marine, coastal and estuarine species
	  • terrestrial species

Theme	**Rationale**
CULTURE AND HERITAGE	Preserving our culture and heritage for future generations is an integral part of sustainable development, but does not get the same attention as more pressing environmental concerns. The governance question here is a self-evaluation of how actively the city is protecting and developing cultural and heritage sites.
Indicator	**Measure/definition**
Culture	• Number, status and locality of cultural sites • Investment into developing new and maintaining existing cultural • heritage resources (budget allocation) • Number of local and international visitors to cultural heritage sites
Natural heritage	• Number, status and locality of natural heritage sites • Investment into maintaining and developing natural heritage resources • (budget allocation) • Number of (local and international) visitors to natural heritage sites • Number of blue flag beaches • Number of listed buildings
Theme	**Rationale**
OVERALL SUSTAINABILITY	The governance question posed under overall sustainability is: Does the city produce a sustainability report? Such a report should cover most if not all of the themes listed above, although it may follow a different framework. The primary aim of ecological footprint studies to date has been the promotion of public awareness and education, although its use to support policy-making is increasing. Calculation of a city's ecological footprint requires the collection and collation of data on resource availability and consumption, and thus provides an established and consistent framework for gathering and organising data, setting targets and monitoring progress. It is also a good visualisation tool and can help to highlight the problem areas if calculated in sufficient detail.
Indicator	**Measure/definition**
Ecological footprint	• Global hectares/capita: • Ecological footprint calculated using the footprint network's methodology. Disaggregated consumption data used in the calculation is useful for informing policy and should be recorded.

The next step will be to populate the revised sustainable city indicator set with available data collected from the cities. As it is unlikely that the necessary data will be available to fully populate the indicator set, the study recommends that a data collection/ environmental monitoring strategy be developed and implemented, to accompany this proposed set of indicators. This draft indicator set represents a starting point for what is considered an iterative, participative process of measuring and analysing the sustainability of our urban environment.

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