THE LOW-CARBON CENTRAL CITY STRATEGY

2014

Sustainability in Cape Town's Central City

881 000
Tonnes of CO_2 per year

The carbon footprint of the central city in 2012

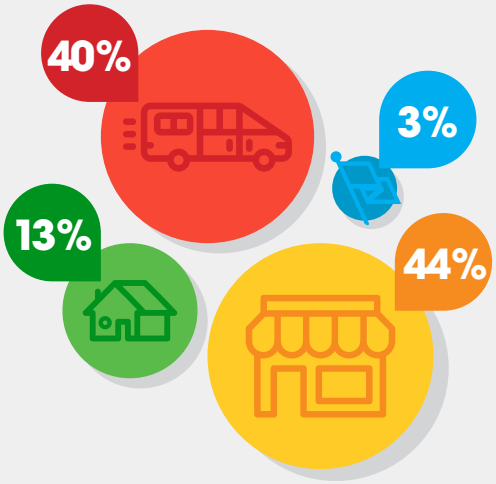
7 100 TERA JOULES

Energy consumed annually in the central city

12 600 TERAJOULES

The energy needed by the central city to power itself in 2030 if we do nothing to change our use

Where do the central city's carbon emissions come from?



Commercial buildings (retail, office & lodging)

Transportation

Residential buildings

Government buildings

300 000

The number of commuters who come in and go out of the central city daily across all forms of transport

40%

Economic contribution of the greater central city area to the economy of Cape Town metro-region

7.8 tonnes

Average annual emission of CO_2 per capita in the Cape Town metro-region

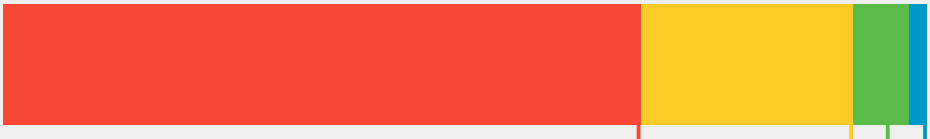
WHAT'S A GIGA JOULE?

One million joules, or enough energy to keep a 60-watt light bulb lit non-stop for six months

WHAT'S A TERA JOULE?

One trillion joules, or enough electricity to power your entire home for about thirty years

Which sectors consume the most energy in the central city?



69% Transportion
23% Commercial
6% Residential
2% Government

Preface

“Climate change poses one of the toughest challenges facing us today. It’s an economic issue that has the potential to put prosperity out of the reach of millions of people. Cities offer a unique opportunity to tackle climate change.”

– WORLD BANK PRESIDENT, JIM YONG KIM, AT THE LAUNCH OF THE LOW CARBON LIVEABLE CITIES INITIATIVE (2013)

Cities are some of the most dynamic places on our planet today. It is in cities that people come together to seek out new opportunities, make new livelihoods, and bring together the past and the present to create hope for a better future. They are the engines of change on our planet, creating unprecedented new developments in the ways that humans interact, connect and create. Through concentration of people, ideas, and opportunity, cities are some of the most efficient and effective spaces for fulfilling the needs of growing populations, like jobs, education and community growth. The pace at which our cities are growing, however, threatens to outstrip the capacity of our planet to handle this urban expansion. Environmental degradation, particularly as a result of carbon emissions,

C40: Cities as Tools for Climate Change

Cities generate amazing amounts of development, talent, creation and opportunity. But they also generate a lot of carbon emissions, placing a heavy burden on our natural environment. To explore more about how carbon emissions relate to cities, finances, economic growth, and general health, check out this interactive infographic that guides you through the potential benefits of low-carbon cities, produced by the C40 Network: **http://c40.org/ending-climate-change-begins-in-the-city**

The C40 Cities Project is a global network of the world's megacities which are taking action to reduce greenhouse gas emissions. South Africa will take centre stage from 4-6 February 2014, as Johannesburg, one of the C40 Cities, hosts the fifth biennial C40 Cities Climate Leadership Group Mayors Summit. This summit will bring together mayors and top officials from all C40 cities to meet to discuss future actions and opportunities to fight climate change.

threatens to transform cities from engines of growth into cesspools of environmental decay that entrench pre-existing social and economic divides: Stronger winds, heavier rains, floods, and droughts – serious effects of global warming and climate change – are all much harder to cope with in poorer and under-resourced areas of cities. This puts even greater pressure on the urban poor to cope with these environmental shocks, detracting from their ability to access the very opportunities that make cities such promising areas of growth.[1]

People look to urban centres for greater economic and social opportunities, and the number of people living in cities around the world is growing. How these cities are built and rebuilt, and how they change, will have dramatic implications for their Greenhouse Gas (GHG) footprints. In order to guarantee the future prosperity of cities around the planet, and of the people who live in them, we must ensure that cities become drivers of resilient growth, where people-centred change built on environmental sustainability guarantees the future of the city itself. Each new person in a city should not be seen as an

[1] For a better understanding of the different ways that pro-poor measures can be adopted by cities in the developing world, and how partnerships are at the heart of this change, see Caroline Moser and David Satterthwaite's paper *"Towards Pro-poor Adaptation to Climate Change in the Urban Centres of Low- and Middle-income Countries,"* 2008.

environmental threat, but instead as a new opportunity to activate economic and social connections in a way that enhances the environment, not destroys it.

Cape Town, at the southern tip of the African continent, is at a tipping point of sustainable urban development. People are seriously questioning the ability of our local economy to expand in a way that creates meaningful new opportunities for a growing population. The social and spatial inequalities throughout the city, which stem from South Africa's colonial and Apartheid past, could lay the path towards a worryingly unsustainable future. While some people in our city enjoy a good quality of life, others continue to live below the poverty line, often without the most basic of urban services. This inequality is compounded by Cape Town's divided spatial form, which feeds sprawl, separation and exclusion through the built environment. Underpinning all of this are increasing pressures on the city's natural environment. The economic production and urban growth happening at the moment in Cape Town could put unsustainably high demands on our natural environment that put future longevity at risk for the sake of the present mode of production. Undoing these deeply rooted problems will take a new approach towards *resilient* urban growth based on people-driven change at a people-friendly scale.

Guaranteeing Cape Town's long-term urban resilience will require building on existing strategies and developing new strategies that bring together citizens, the environment and the economy in a way that mobilises all three as engines of resilient change. New partnerships that bring together knowledge, innovation, data and strategy will help to expand the opportunities for citizens to play a bigger role in making their urban space more resilient. Looking to the future, Cape Town cannot afford to maintain the "business-as-usual" scenario of carbon emissions.

The beginnings of a new approach toward a more environmentally-friendly growth are already taking shape in Cape Town. An expanding public transport network, new government initiatives in environmental sustainability and a greater focus on a greener built environment are all encouraging more people to take a greater role in enhancing the city's environmental and social future. But what do these shifts look like at a local scale, and what can be done to help more people access them? By activating Cape Town's central city as an urban laboratory on carbon emissions, we can start to better understand the actions that people are taking each day to promote greater environmental resilience, and support them with new strategies and initiatives that help grow this change.

Visualising Resilience

Want to know more about some of the different themes that make up resilience? Take a look online at these four infographics from the Siemens "Toolkit for Resilient Cities" report, which show how the electricity, transportation, building and water management systems in cities are critical to ensuring urban staying power. If you like the graphics, the report is also there to download for free!
http://w3.siemens.com/topics/global/en/sustainable-cities/resilience/Pages/home.aspx

Table of Contents

Acronyms

AMI	Advanced Metering Infrastructure
CBD	Central Business District
CCDS	Central City Development Strategy
CCID	Central City Improvement District
CCT	City of Cape Town
CO_2/ CO_2e	Carbon dioxide/ carbon dioxide equivalent
CTP	Cape Town Partnership
DoE	Department of Energy
ECAP	Energy and Climate Action Plan
EE	Energy Efficiency
ESC	Electricity Savings Campaign
ESCO	Energy Service Company
FEDHASA	Federated Hospitality Association of Southern Africa
GBCSA	Green Building Council South Africa
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GVA	Gross Value Added
HVAC	Heating, Ventilation and Cooling
IDM	Integrated Demand Management
IEMP	Internal Energy Management Protocol
IMEP	Integrated Metropolitan Environmental Policy
IPCC	Intergovernmental Panel on Climate Change
LEAP	Long-range Energy Alternatives Planning
LPG	Liquefied Petroleum Gas
LTMS	Long-Term Mitigation Scenarios
NMT	Non-Motorised Transport
OEF	Optimum Energy Future
RTMC	Road Traffic Management Corporation
SAEEA	South African Energy Efficiency Agency
SALGA	South African Local Government Association
SEA	Sustainable Energy Africa
SWH	Solar Water Heater

Glossary

Business As Usual	A term that indicates no change in current trends/patterns
Cape Town	Generally refers to the area encompassed by the City of Cape Town local municipal boundaries – also referred to as the metro area.
Cape Town central city	In this report, this is the area locally referred to as the "City bowl", including the Central Business District and surrounding nearby suburbs such as Tamboerskloof, Gardens and Vredehoek. This area is slightly larger than the Central Business District and includes key inner-city residential areas.
Central Business District	Also known as the CBD, this is typically the central area, or areas, of a city with the greatest concentration of retail and business activities. Cape Town's primary CBD is located within the central city and is connected to the rest of the metro-region by train, bus and highway.
Central City Improvement District	The Central City Improvement District, or CCID, is a public-private partnership formed by the property owners of a defined geographical area to provide top-up or complementary services over and above what the City of Cape Town provides.[1] The geographic area of the CCID's working mandate is smaller than the central city and covers the heart of the Central Business District. The CCID is one of 27 City Improvement Districts across the Cape Town metro-region.
Resilience	The term "resilience" relates to cities that have developed capacities to help absorb and respond to future shocks and stresses to social, economic and technical systems. Resilient cities are those that have empowered people through enhanced infrastructure so that, in the presence of an unforeseen change in the economic, social or natural environment, society will still be able to maintain ongoing functionality.[2]
Non-Motorised Transport	Any travel that does not require the use of a motor or combustion engine.
"Own Steam" Transport	This study makes use of the term "Own Steam" transport to refer to any mode of movement that is powered by *humans* alone, as opposed to fuels and motors. "Own Steam" includes: Young, old, able-bodied, less able-bodied, male, female, walkers, cyclists, skateboarders, trolley-users, small-freighters, and wheelchair and frame users. It is more all-embracing than "active transport" (which excludes the slow), "slow modes" (which excludes fast people) or "non-motorised transport" (which normalises the use of a motor).
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[3]

[1] Source: http://www.capetownpartnership.co.za/ccid/

[2] Source: http://www.resilientcity.org/

[3] Our Common Future, also known as the Brundtland Report

Executive Summary

In order to promote a partnership-driven approach towards environmental and economic urban resilience, the Cape Town Partnership and Sustainable Energy Africa spent 2013 working with the City of Cape Town, the Stockholm Environment Institute and other key stakeholders to transform the central city into a leading urban hub of low-carbon emissions. New research and modelling enabled us to create working carbon emissions scenarios for this small yet crucial area of our city – an area that will make or break Cape Town's environmental and economic future. Status-quo models helped us better understand current energy usage and carbon footprint patterns in the central city; future-scenario models enabled us to gauge just how effective new interventions will be in reducing our overall carbon emissions levels.

The outcomes of this year-long strategy development initiative include new approaches in policy and action that encourage stakeholders to work in synergy with one another

to reduce overall carbon emissions in the central city. A fundamental aspect of the Low-Carbon Central City Strategy is the sharing of outcomes and information with people and organisations from the private, residential, public and government sectors. New communications initiatives produced in conjunction with this strategy will help to connect more people and organisations through knowledge and experience-sharing that will help to collectively reduce the carbon footprint of the central city area.

This policy document serves as a policy insight into the Low-Carbon Central City Strategy. It begins by detailing the case for the Low-Carbon Central City Strategy and the socio-political context in which it operates. It then focuses on where the specific data came from, what it illustrated and how the information can be used to spur onward action in various groups of the central city's population – all through an emphasis on electricity, transportation, waste management and urban greening.

In terms of results, the data within this strategy indicates that reductions in individual motor vehicle use, along with a sharp decline in the amount of electricity consumed, are going to be the biggest levers for low-carbon change in the central city. Accomplishing this will require a continued enhancement and expansion of solutions like carpooling, energy-efficient building retrofits, and a more walkable and "bike-able" urban environment.

Finally, this document makes suggestions for the different ways that this work can continue in order to maintain the momentum created by this initial year of research, data collection, policy creation and communications engagement. Because effective communications are so important for any forward movement in making our city less carbon-intensive, this policy document also contains an emphasis on how to transmit this knowledge creatively and effectively in order to get people to work together for a lower-carbon future in the central city.

Looking to the future, Cape Town cannot afford to maintain the "business-as-usual" scenario of carbon emissions. By activating the central city as an urban laboratory, we can help equip people with the tools they need to make changes that reduce carbon emissions and promote Cape Town's urban resilience.

Introduction:
The Case for the Low-Carbon Central City Strategy

Cities have a vital role to play in mitigating global climate change, which is why they have been a strong focus for studies on environmental sustainability. There is no shortage of information about the behaviours that contribute to climate change or the consequences of the actions that are continuously putting greater pressure on our ecosystems. Various systems of measurement, from tonnes of carbon emissions to temperature increases, all indicate that we are heading for a large-scale climate disaster, and rapidly. Inherent in this sense of warning is recognition that all is not lost. If planned for, cities can become engines of resilient and people-centred change, impacting positively on the environment instead of harming it through unchecked economic growth. An important emphasis in policy addresses this through the ways that cities work in terms of economic and environmental collaborations. In South Africa, the newly released Integrated Urban Development Framework discussion document[5], along with the National Development

[5] "Towards an Integrated Urban Development Framework: A Discussion Document". 2013. Department of Cooperative Governance, Republic of South Africa. Available at: http://www.cogta.gov.za/index.php/documents/doc_view/1036-discussion-document-for-integrated-urban-development-framework.raw?tmpl=component

Plan[6], both underscore the vital need to examine the roles that cities can play in enhancing environmental protection while continuing to boost economic growth and reduce poverty and inequality.

What is missed at the macro-level, however, is the connection between the strategies and the people who act upon them–the way that information interacts with the urban form and the people, companies, governments and organisations who use it. Large-scale data and long-term policies, while revealing and informative, often lack clear and achievable actions that can be undertaken by individuals, companies and government. City-wide carbon footprints are useful for world rankings and policy approaches, but make it hard to see results of actions. To make changes that are truly effective, people need information that shows them the reality of the status quo, proactive steps to take to change it, and a structured platform that promotes increased collaboration and engagement.

Cities have a strong influence over the spatial patterns of urban development that can make or break their carbon footprints; much more influence, in most cases, than national governments have. Cities can also have significant influence over the energy and emissions intensity of buildings, whether that energy is used for heating and cooling or for lighting, appliances and equipment. Pairing strategy and information that promotes these changes in a way that inspires individual action is key to unlocking a new approach towards reducing carbon emissions.

Doing away with larger policy documents or big collections of data is not the way forward. Quite the contrary. For most cities – Cape Town included–the greatest opportunities lie in policies and actions that help to reduce the GHG emissions associated with transportation and building energy. What must be asked, then, is how can a neighbourhood-scale understanding of carbon footprints better equip citizens with the knowledge they need to make the changes that our environment demands? How can data trends predict the impact that individual decisions will make on a city space to better show people how their actions will help reduce their carbon footprints? And most importantly, how can real-time data be incorporated in policies, communications strategies and plans that help the residents, companies, developers, employees and politicians in the central city develop their own solutions for their own lives? And to do this in a way that creates increasing returns-to-scale of personal choices that reduce environmental impact on a people-based scale?

These questions, and others, are what prompted the Cape Town Partnership and Sustainable Energy Africa to form a working partnership around climate change at the neighbourhood level. As a group of urbanists and energy experts, we wanted to find out more about the carbon emissions that come from Cape Town's central city, and work together with a range of different people to come up with new strategies to help people reduce their impact on the environment while simultaneously continuing to grow the city and its economy in a more resilient way. We wanted to synthesize existing policies and

---

[6] "The National Development Plan: 2030". 2011. National Planning Commission, Republic of South Africa. Available at: http://www.npconline.co.za/pebble.asp?relid=25

collect localised data to create and communicate forecasts that people can understand.

With funding from the Swedish International Development Agency (SIDA) and further support from the Stockholm Environment Institute (SEI), the team set out to map the current carbon footprint of Cape Town's central city and model how different interventions at the local level would change it. With funding from the Swedish International Development Agency (SIDA), the team set out to map the current carbon footprint of Cape Town's central city and model how different interventions at the local level would change it. The Long-range Energy Alternatives Planning (LEAP) model (see p. 43 for more information) was used to chart the various ways that different strategies could change our carbon footprint into the future. As far as possible, the strategies drew on existing local policies.

As part of the effort to further support communications, the low-carbon team consulted with many different stakeholders, from government officials to local business owners, and came up with different ways that the people who live, work and visit in the central city can play key roles in changing our emissions for the better. Bringing all of this information together has resulted in the formulation of a strategy that roots local action at the heart of place-driven climate change, taken up by people throughout the city.

The Low-Carbon Central City Strategy is designed to expand the sustainability component of the Cape Town Partnership's Central City Development Strategy (CCDS) so that the results can be easily incorporated into topics like economic growth, urban planning guidelines, communications tools for use by collaborative working groups, such as building forums, district working groups and other possibilities. This design, informed by partners in both local and provincial governments, takes great steps to ensure that the Strategy is positioned in line with and in support of the City of Cape Town's Energy and Climate Change Action Plan and other urban development policies related to environmental efficiency and improvement. Ultimately, we wanted to make sure that we created a strategy that helped to put the central city on a positive trajectory towards resilient urban growth in

a way that could have even greater payoffs for the larger metro-region over time. By shifting the central city onto a low-carbon development path, we hope to contribute towards a more sustainable development pattern for the metro-region as a whole.

As a team, we created this document in order to share more of why we did this project, what we learned and the many ways that we see this project continuing in the future. In short, this is the home of our project, in written form. Everything you want to know about our project should be here, for easy reference and usability. Specifically, this document includes:

- A carbon profile of the central city area. This profile serves as a functional base that can be used to show long-term changes in energy demand over time.
- Key areas of intervention that, if activated, will help catalyse new opportunities for people to change their environment through on-the-ground actions.
- Our suggestions for the feasible long-term continuation of the project that includes future funding sources, potential project leaders and the different ways that people can get involved across different themes, like transport and electricity. These recommendations also show how low-carbon interventions contribute to larger urban development goals like economic development, improved access to social and economic opportunity, poverty alleviation and increased sustainable densification.
- Important lessons on our experiences in partnerships and their critical role in implementing localised environmental strategies.

Why Cape Town?

Focusing on Cape Town's central city area, a relatively compact but economically and socially vital area at the heart of the larger metro-region, enabled us to look at climate change from a very localised level; an exciting new approach towards analysis and intervention in environmental and urban policy. It has also allowed us to gather localised data for a greater understanding of one of the most important economic spaces in the wider metro. Cape Town's greater central city area, while small in landmass, is at the heart of Cape Town's larger economy. Each day more than 300,000 commuter trips bring people into and out of the central city from across the metro by bus, train, car and more. Over and above that, there are more than 5,000 residents living in the core of the Central Business District alone. If we expand our scope to include surrounding suburbs such as Oranjezicht, Gardens, Zonnebloem, Woodstock and the V&A Waterfront, the number of people who call the central city home increases to 47,060.[7] The central city also has a growing economy made up of some of the region's top companies and commercial headquarters. Together, they make up an estimated 40% of the metro-region's total business turnover. Local, provincial and national governments all have offices here as well, meaning that the central city plays a crucial role in connecting government services and activity with citizens from across the metro-region.

Across a 24-hour time horizon, the central city is a hive of activity, attracting and connecting people from across the metro for many different reasons. This high level of activity translates directly into high levels of carbon emissions and environmental impacts. Understanding the environmental impacts of the economic and social production that happens

Floods in Cape Town

In November of 2013, the Cape Town metro-region was hit with unprecedented floods, leaving many residents temporarily homeless and many businesses with a large mess to clean up. The City's infrastructure was also badly damaged, mainly in terms of roads and train lines. As the realities of climate change become more apparent, the question must be asked: how much more can Cape Town take?

Chapman's Peak Drive

For more photos of the floods and the damage they caused, please see this collection of images compiled by News24: **http://www.news24.com/Multimedia/South-Africa/10-of-the-best-Cape-flooding-pictures-20131118**

[7] Data taken from the 2011 South African National Census

in the central city each day will reveal the best ways that people can start to reduce their environmental impact. Crucially, it will also empower local businesses, residents, commuters and visitors to take a more active role in carbon mitigation through real-time changes that will begin to filter through to other areas of the metro-region through the immense connections that people have with the central city as a place to live and work.

But what is it about Cape Town that makes it such a unique urban environment for a localised carbon emissions analysis? The metro-region itself is one of the more fragile urban spaces in South Africa from an environmental point of view. The Cape Floral Biosphere, the smallest in the world, is also the most diverse in terms of unique plants that grow nowhere else in the world. Cape Town's coastal location also makes it extremely susceptible to the environmental changes caused by global warming, such as rising sea levels and increased intensity of storms. It is, however, the people of the city who make the opportunity to examine localised carbon emissions here so great. Cape Town faces some of the same challenges that cities across the developing world face every day: growing levels of urban migrants, poverty, lack of employment, urban sprawl and an increased need to re-evaluate the future of the city's economy. All of these factors directly influence the people who call Cape Town home, and are thus at the heart of the need to ensure the city's resilient future through a more sustainable environment.

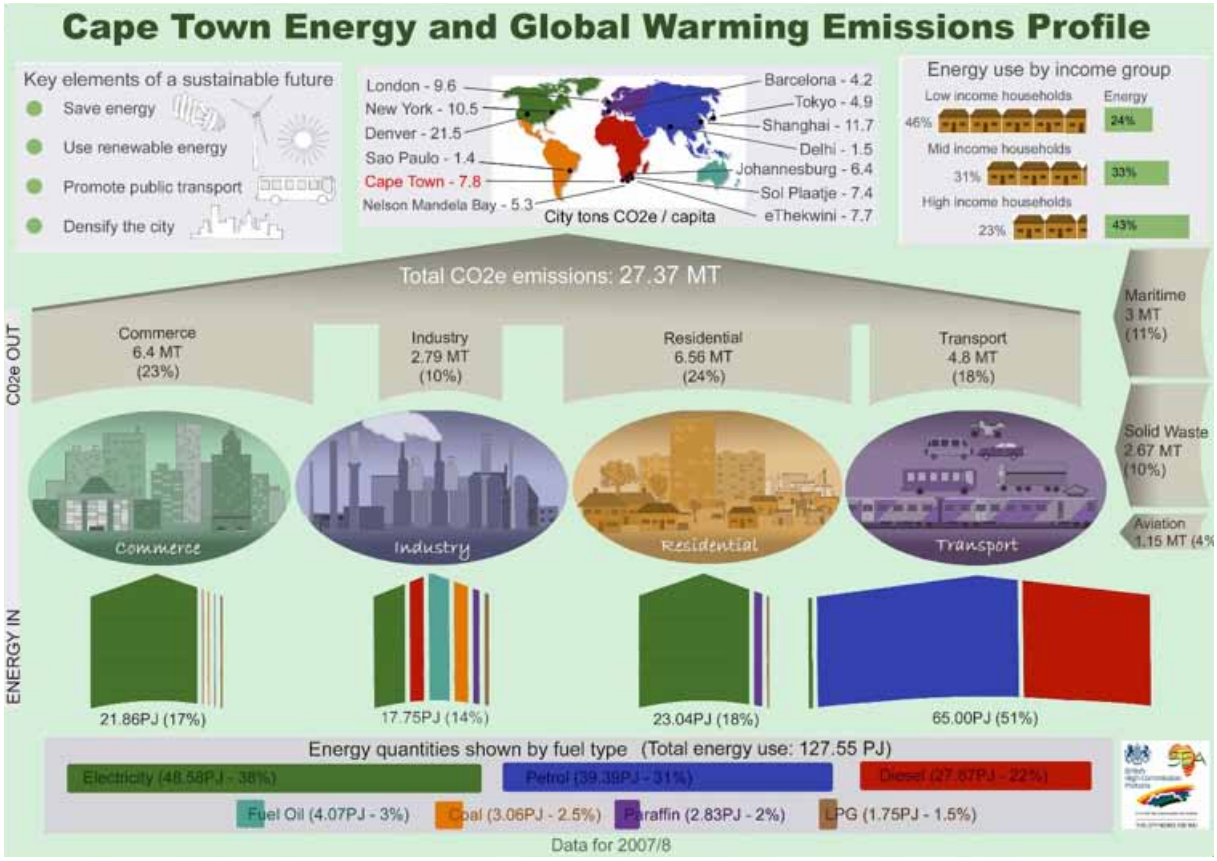
A History of Cheap Energy and Segregated Planning

A look at final energy consumption in South Africa per sector in 2000 shows that 45% was consumed by industry, 20% by transport and 10% by residential sector, of which most is urban and falls in the mid- to high-income group (Winkler, 2008). South Africa is ranked among the world's top 15 largest carbon dioxide (CO_2) emitters[8], largely due to our heavy dependence on coal which supplies 90% of our electricity (DME, 2005; Eberhard, 2011; CDIAC, 2012). This plentiful cheap coal is what led to our developing an energy-intensive industry sector, which includes producing liquid fuels from coal.

Thus like South Africa's other cities, Cape Town's present energy challenges are rooted in a national history of cheap, domestically produced energy sources; primarily coal. Historically, the cheap energy of abundant domestic coal production encouraged low levels of energy efficiency in transport, households and production processes across the country. International sanctions put in place during the Apartheid era further entrenched this reliance on the abundant resource of domestically-mined coal, creating a culture that prioritised high energy consumption at relatively low prices. Cape Town today, like many other South African cities, is incredibly resource inefficient relative to similar-sized international cities. The average South African metro has a carbon footprint of 6.5 tonnes/capita/annum of carbon dioxide equivalent (CO_2e), equivalent to cities such as Paris and

[8] 14th biggest carbon dioxide emitter in the world as a result of energy-sector emissions

Berlin, which have significantly higher levels of development. In 2007, Cape Town's metro-wide carbon footprint (including landfill gas) was 7.82 tonnes CO_2e.[9]



Source: Sustainable Energy Africa

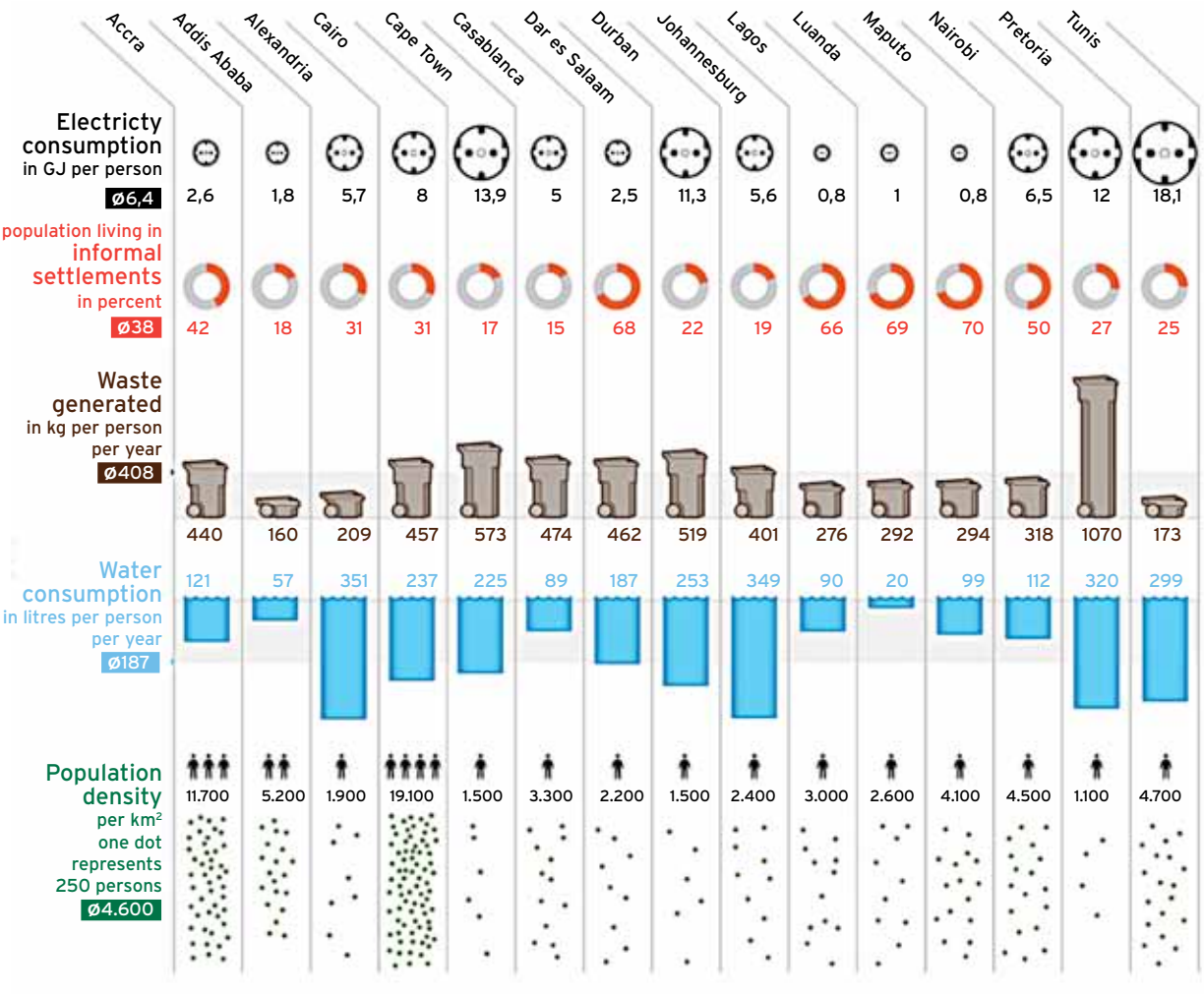
This resource inefficiency is perpetuated by a spatial form rooted in the Apartheid legacy of urban sprawl, inequality and social divides. Cape Town, typical of South African cities, must work with an inherited pattern of low-density metro-region development.

The issue of space use in the city plays a crucial role in the productivity of Cape Town's economy and the long-term financial viability of the City government itself. It significantly influences the welfare of city residents, patterns of human interaction, social inclusion and the efficiency of resource use in a city, particularly energy for mobility and distribution of services and people. Cape Town's inherited settlement patterns, along with its history of modernist planning, has further encouraged low-density suburban development which prioritises immediate technical efficiency and short-term political preferences over longer-term social and environmental imperatives and urban resilience. The city's poor frequently find that the only available opportunities for affordable housing are on the outskirts of the city – a reality that is underscored by increasing property prices and past patterns

[9] *Energy Scenarios for Cape Town*, SEA 2011

of separation based on Apartheid's race policies. There, the challenges of an improving but still limited infrastructure system only add to the disproportionately high cost that people must pay to access reliable public transportation along with the city's social and employment resources.

Combined with Cape Town's history of energy inefficiency, the city's divided and sprawled spatial form means that more than half of the energy used in the Cape Town metro area is consumed by the transport sector (SEA, 2006; SEA, 2011); moving people from one place to another, often at great expense and time. Transport routes are unsustainably long. People remain dependent on private vehicles, and only recently have the first steps been taken to replace a weak and under-resourced public transport system. Furthermore, the importing of basic products, including basic foodstuffs,



Source: "African Green City Index", compiled by Siemens.[10]

[10] Available online at http://www.siemens.com/press/pool/de/events/2011/corporate/2011-11-african/african-gci-report-e.pdf

not only increases the external carbon footprint of the Cape Town metro area but renders citizens vulnerable to shocks in fuel prices and economic fluctuations in supplier regions.

The infographic above comes from a report compiled by Siemens, which explores the "green" features of various cities across the African continent. Cape Town, along with Durban, Johannesburg and Pretoria, all stand out amongst the selected cities of analysis as some of the most inefficient when it comes to electricity consumption, population density and waste generation.

Urban sprawl, together with the anticipated growth in household numbers in the metro area from 1.1 million in 2011 to 1.7 million in 2035,[11] will only compound these challenges and further entrench social inequities. According to the Western Cape Government, the City of Cape Town's GINI Coefficient[12] stood at 0.57 in 2010, indicating that our metro-region is one of the most unequal in the world, ranking with other developing-world cities like Johannesburg, Addis Ababa, Bogota and Mexico City.[13] [14] As a growing city, it is imperative that more thought be given to the way in which we grow, and the way that environmental change impacts upon the future of the city and its people.

Sprawl also has some serious health consequences for urban populations. Weight gain, stress, chronic disease, risk to pedestrians and poor air quality are just some of the many factors associated with low densities and high sprawl that make citizens sicker and more unfit for a resilient lifestyle.

The Cost of Suburban Sprawl

The allure of sprawl is clear for developers: Lots of unused land to build with relatively few restrictions. But sprawl has serious consequences for our cities. This interactive infographic produced by Sustainable Prosperity shows the knock-on effects of sprawl, and why it should be avoided: **http://thecostofsprawl.com/#**

Cape Town's energy status quo demands an innovative and forward-thinking approach that finds more sustainable energy solutions in a way that connects people with more opportunities for growth and inclusion. Reversing these trends will require a new perspective on highly localised interventions that prioritise people-scaled changes for real-time results. The challenges faced in Cape Town have encouraged people throughout the city, both within and outside of government, to think afresh about how to promote a better growth path: one that encourages economic

[11] Source: Presentation to the City of Cape Town by Bärbel Haldenwang from Institute for Futures Research, University of Stellenbosch, October 2013.

[12] A statistical measure of income inequality across a specific population. A GINI coefficient is a number between 0 and 1, with the higher numbers corresponding to greater levels of inequality.

[13] "Regional Development Profile: City of Cape Town". Western Cape Government, Provincial Treasury. Working paper, 2011. Paper available online at www.westerncape.gov.za.

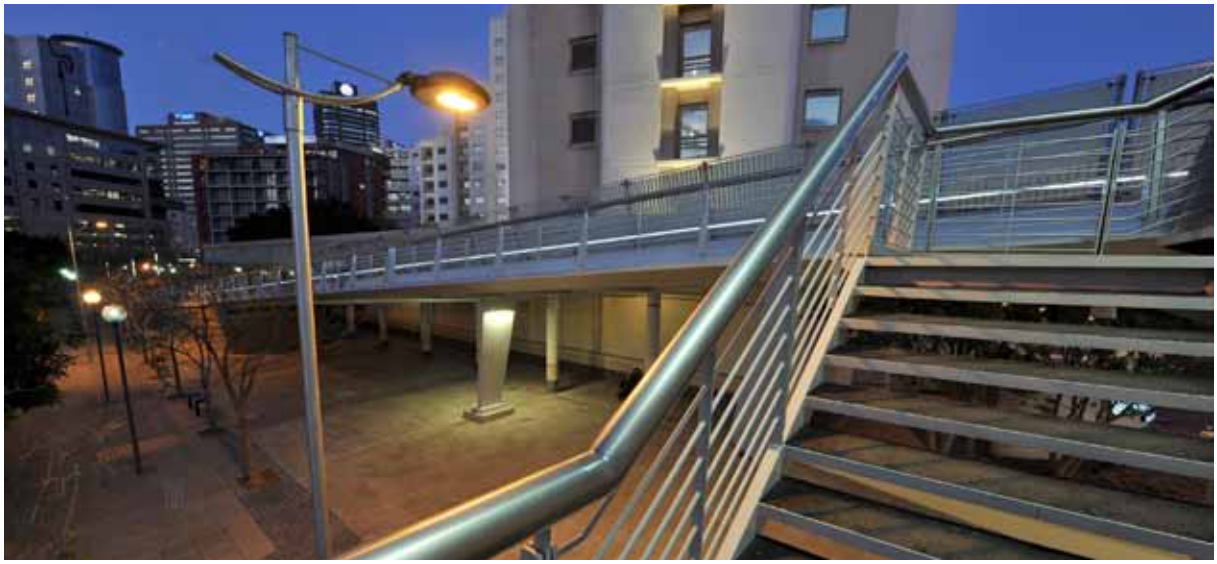
[14] "State of the World's Cities 2010/2011: Bridging the Urban Divide". UN-Habitat, 2010.

Source: PEW Reasearch, Measuring the Health Effects of Sprawl: a National Analysis

You can find this infographic online, compiled with data from the United States, at:
http://www.archdaily.com/389183/how-our-cities-are-shaping-us-infographic/

development while simultaneously reducing our impact on the environment. Future planning needs to make room for an economy that opens up more opportunities, a space that re-connects people, and an environment that ensures urban *resilience*: Cape Town's ability to remain competitive and strong in many years' time. By expanding environmental data and opening up practical new solutions for people to adopt, it is our hope that we can transform the heart of our city's economy into an engine of carbon-reducing opportunity growth.

Policies, Strategies and Plans Afoot in South Africa



South Africa's many developmental challenges continue to persist following the introduction of an inclusive democracy in 1994. As the country sets out to reconfigure its economic linkages in an ever-changing global supply and demand network, the social and cultural inequalities that are a legacy of colonialism and Apartheid continue to impede truly inclusive development. Poverty remains ever-present throughout the country, as its alleviation is wrapped up in governmental approaches that span focus areas from housing and infrastructure all the way to economic growth and cultural reintegration.

It is within this milieu of developmental challenges that the country's focus on climate change falls. In response to the many climate challenges that face South Africa, the City of Cape Town local government, the Western Cape Government, and the South African National Government have all enacted new policies over the past decade that show a shift in the ways in which government officials, policymakers and politicians are tackling the issues of climate change. These developments are hugely important for the Low-Carbon Central City Strategy – our work must be able to link up to these changes and respond with information that helps strengthen the argument for low-carbon progress across all spheres of government.

At a Local Level: Policies and Programmes in Cape Town

Tackling these challenges head on, the City of Cape Town municipal government has been one of South Africa's leading local governments in developing energy and climate change work that seeks to address climate change in a growth-oriented manner. New policies and planning tools have been put into place that now set the stage for truly game-changing actions to be taken on climate change.

The City adopted the first Integrated Metropolitan Environmental Policy (IMEP) in Africa in 2001. This policy formed the foundation for an environmental management strategy; outlining how the City intended to implement its commitment to the principles and underlying approaches to sustainable development and giving direction to local government's activities and programmes.

Encouraged by the IMEP, the City of Cape Town published its initial Cape Town State of Energy Report in 2003 and updated it again in 2007 and 2011. These State of Energy reports provide valuable information on where, how and why energy is consumed across the metro-region, along with the associated carbon emissions produced.

The 2003 energy baseline data and the 2001 IMEP became key ingredients in the City's pivotal *Energy and Climate Change Strategy*,[15] which was adopted in 2006 (see below for more information). The Strategy set out concrete sustainable energy objectives, targets and measures, and activated supportive institutional reforms. Further augmenting this Strategy, the City revised the 2001 IMEP to transform it into the City's larger Environmental Agenda, setting out key measurable environmental commitments by the City of Cape Town for the five-year period from 2009 until 2014.

In response to the Energy and Climate Change Strategy, the City developed an *Energy and Climate Action Plan* (ECAP), which was adopted by Council in May 2010. The ECAP is, in essence, an implementation plan for the energy and climate objectives set in the

[15] Available at: http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/PoliciesandStrategies.aspx

City's Energy and Climate Change Strategy. ECAP lists all energy- and climate-related programmes and projects currently underway or planned within the next three years in the City.

The Current Energy and Climate Action Plan (ECAP)

The ECAP forms the basis on which the City of Cape Town prioritises, budgets for, implements, monitors and evaluates its energy and climate change programme. The overarching goal of energy security and the criteria used in the ECAP for selecting and undertaking an initial prioritisation process is outlined below in Figure 1.

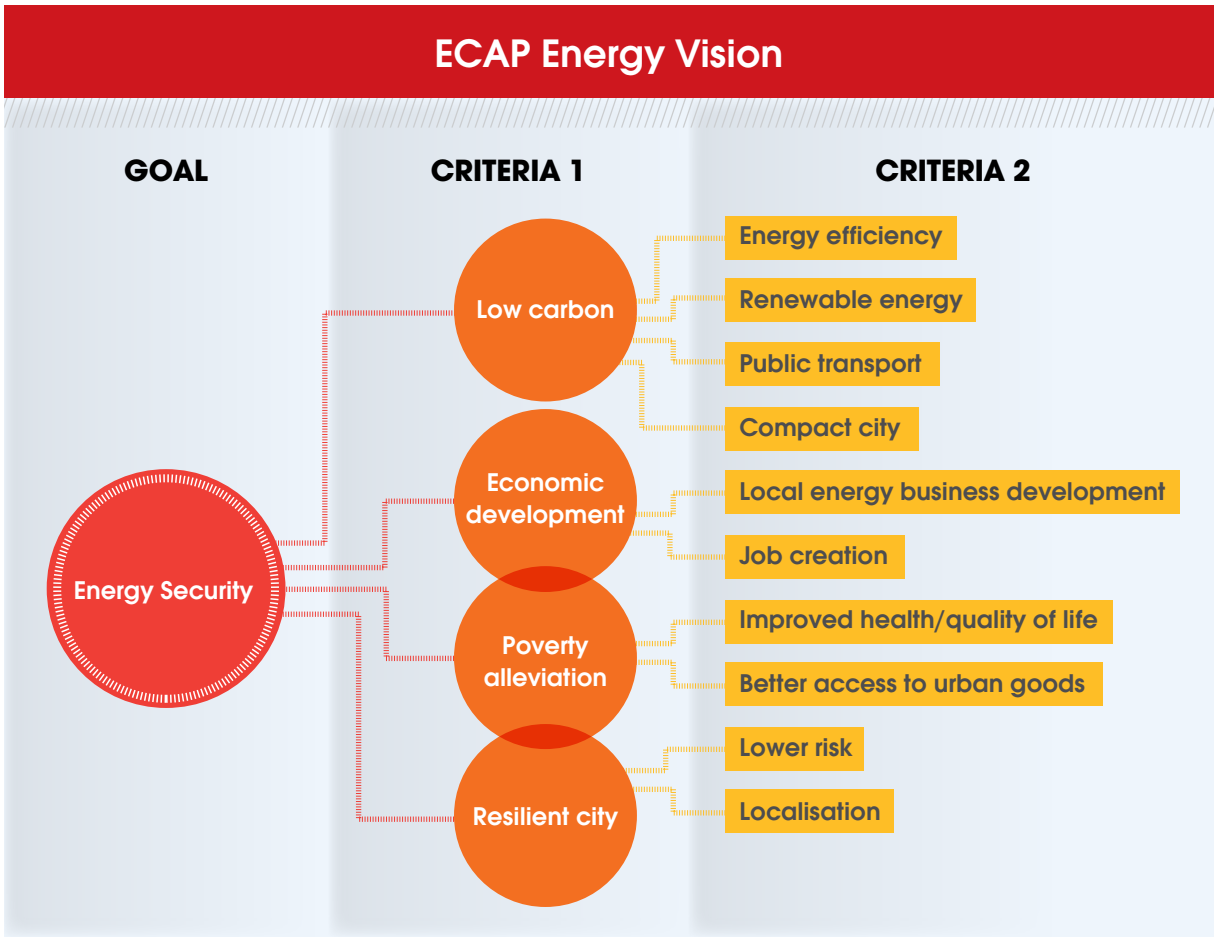


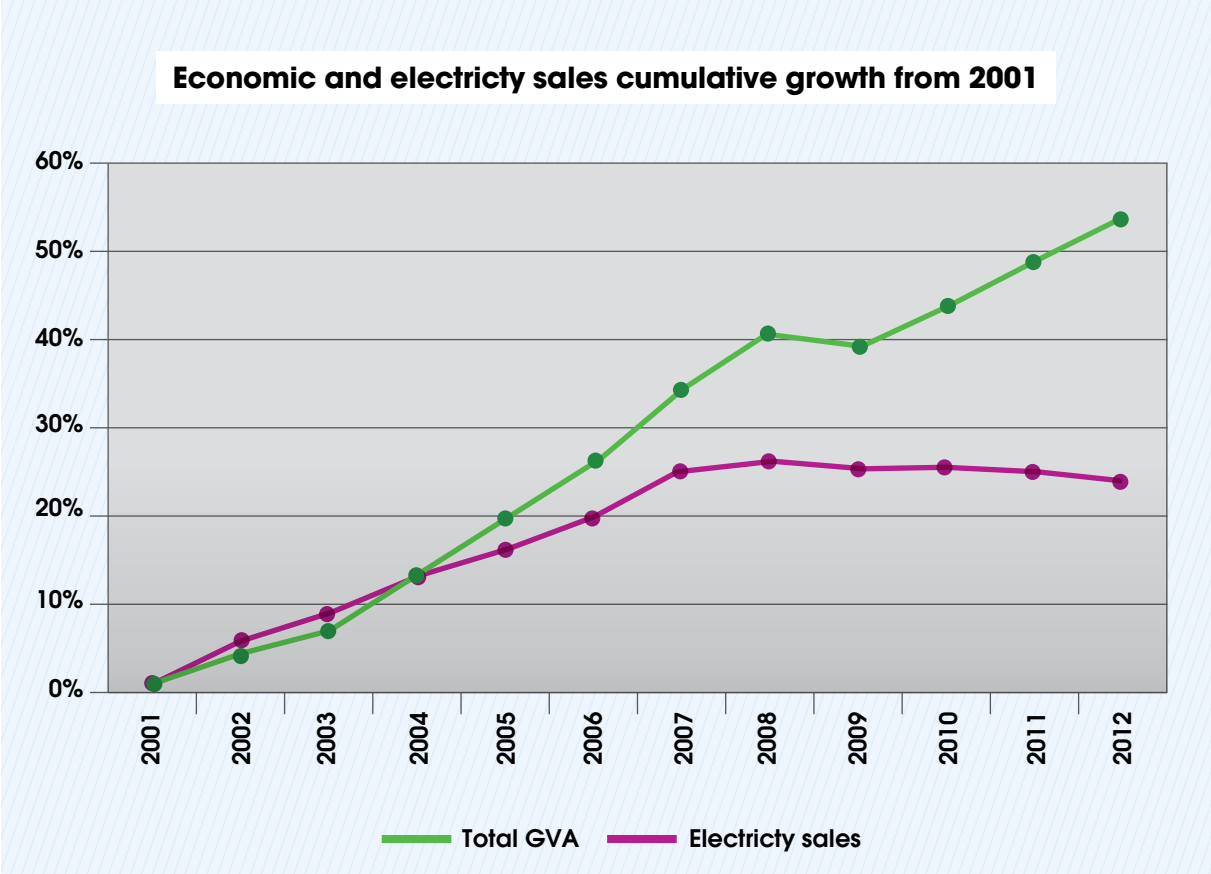
Figure 1: Overall goal and prioritiSation criteria for the energy and climate change action plan (ECAP)

Based on the criteria in Figure 1, ECAP identifies key energy and climate change objectives of the City of Cape Town, and details associated activities. These were based on, and are in line with, the City's energy and climate change strategies, as well as taking national policies into account:

Table 1: Energy and Climate Change Objectives of ECAP	
Objective 1	City-wide: 10% reduction in electricity consumption on unconstrained growth by 2012
Objective 2	10% Renewable and cleaner energy supply by 2020; all growth in electricity demand to be met by cleaner / renewable supply
Objective 3	Council operations: 10% reduction in energy consumption on unconstrained growth by 2012; all growth in demand to be met by cleaner / renewable supply
Objective 4	Compact resource efficient city development
Objective 5	Sustainable transport system
Objective 6	Adapting to and building resilience to climate change impacts (city wide)
Objective 7	More resilient low income / vulnerable communities
Objective 8	Development of carbon sales potential
Objective 9	Local economic development in energy sector
Objective 10	Awareness: energy and climate change communications and education programmes (driven by Objectives 1 – 9)
Overall	Energy and climate change research and development; monitoring and evaluation

These objectives contain 43 programme areas and over 100 projects that help to reinforce the overall message conveyed in the policy itself. These projects are currently either underway or, through the initial prioritisation process, have been identified for implementation in the short term.

As an early indication of success through implementation, Cape Town's consistent population growth within the city area has been met with a corresponding reduction of electricity consumption to below 2007 levels (see the graph below). This result suggests that the energy efficiency incentives provided in the ECAP are producing the desired effects as more people shift to energy-saving behaviours. Other factors, such as the shifting of Cape Town's economy from a manufacturing-rooted economy towards one more focused on services and the financial industries, also contribute toward this decoupling of energy use and population growth. In order to better encourage the growth of more targeted policy initiatives, it will be vital to develop a more thorough understanding of the ways that behaviour, technological, and economic changes all affect energy savings.



Source: City of Cape Town electricity sales data and Global Insight electricity data.

The ECAP electricity efficiency target of 10% by 2012 has been exceeded. Going forward, the intention is to keep electricity consumption levels declining or at the very least below 2007 levels while still growing our economic production. At this stage no new targets have been set.

Extending the ECAP: The 'Energy Futures for Cape Town' Project

In order to augment the ECAP with an assessment of different future development paths for the local and national energy sectors, the City of Cape Town undertook a strategic energy modelling initiative, called the *Cape Town Energy Futures* project, from 2009 to mid-2011. This work, known as the Energy Scenarios for Cape Town[16] project, presented a comprehensive analysis of current and projected metro-wide energy use based on an extended and up to date dataset of energy consumption, supply mix options, costing data and energy use trends.

The Energy Futures project was primarily intended to inform and extend the ECAP energy vision. It drew on the approach used in the National LTMS project (2007), to model the carbon future for the country and to define the carbon trajectory required by science to align with international climate change targets.

The Energy Futures modelling identified specific energy-efficiency interventions and a cleaner and more renewable electricity supply as the optimum way forward for a secure energy future for Cape Town. It also identified key interventions that would: encourage employment creation and a more efficient economy within a carbon-constrained future; lower the cost of energy across the city without compromising energy service provision; and promote a greener city overall. The three major areas of intervention required to alter the city's carbon profile were: (1) electricity efficiency (2) transport efficiency and (3) renewable electricity supply. It was clear from these findings that a focus on all three, and ambitious implementation within each, would be necessary to fundamentally shift the city's carbon profile. This suggested combination of strategy and implementation became known as the Optimum Energy Future (OEF), and it included many sub-interventions in each sector, all of which were perceived to be realistic and implementable despite being ambitious. The baseline energy picture, along with scenarios and OEF strategy were presented in the City's *Cape Town 2011 State of Energy and Energy Futures* report.[17]

The Central City Development Strategy

To better enable planning policy to take into account new data, political ambition and private investment, a partnership of private and public sector interests came together in 2008 to formulate a strategy for the development of the Central City area that prioritised the synergies between the urban environment and the people who use it. The end result

[16] Work undertaken by Sustainable Energy Africa and the Energy Research Centre, University of Cape Town for the City of Cape Town

[17] Available at: http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/Reportsand.aspx

of a year-long planning collaboration between the Cape Town Partnership, the City of Cape Town and the Western Cape Government was the creation of the **Central City Development Strategy.** The intention of this 10-year strategy is to pave the way for large-scale changes in Cape Town's Central City area with the vision that, by 2018, the Cape Town central city will have greatly enhanced its reputation as a dynamic business and people centre. The aim is for development to occur across many sectors that ultimately connect people with opportunity, growth and one another. The Central City Development Strategy structures people-centred change on five key pillars:

- Making Cape Town central city a more competitive **business location**
- Transforming the central city into a **quality sustainable urban environment**
- Keeping the central city a **popular destination** for Capetonians and visitors alike
- Building the city's role as a **leading centre of knowledge, creativity and innovation**
- Supporting its role as a **crossroads that connects people to one another, and to the rest of the city**.

While this Strategy creates the starting point for connections between planning, economic growth and environmental change, more work is needed to bridge the divide between planning policy and action. For more information about the Central City Development Strategy, please see Annexure 6.

Transport Policies for a Low-Carbon Future

Cape Town's infrastructure is rooted in a pattern of sprawling growth and increasing private motor vehicle transportation. Although our trains are some of the busiest in the country, our overall public transportation sector has yet to bring about a behavioural shift that encourages motorists to make the change from private cars to public transport. It is thus the goal of new policies being implemented at the City of Cape Town to facilitate this change through more integrated and better quality services, improved security, and extended and improved route offerings.

Cape Town's latest **Integrated Transport Plan** (ITP) was published in September 2013. This

plan covers the entire metro-region, and encourages a greater connection – in planning and in practice – between the various different forms of public transportation, like rail, bus, and minibus (van taxis). The City of Cape Town's draft **Inner City Transport Plan** (ICTP), building on the Central City Development Strategy of 2008, was also published in draft form in 2013, and seeks to encourage newer and more efficient movement patterns in the Central Business District through pedestrian corridors, prioritised bus services and strategic parking suggestions.

Although the focus of these pieces of work has not been carbon reduction, they reflect a strongly emerging paradigm which orientates transport planning away from its historical emphasis on prioritising the movement of vehicles towards prioritising the movement of people; and in a way that also promotes the wellbeing of the City environmentally, socially and in terms of business. There is also a renewed emphasis on planning the use of urban land in a way that manages motorised movement where feasible, as well as on street and public space design. For more information about aspects of these transport policies, please see Annexure 7.

Connecting Cape Town to Policy at the Provincial and National Scales

Building on the City's leadership role in climate change policy, the Western Cape Government has established itself as a leader among regional governments, having developed and adopted a Climate Change Strategy and Action Plan and a White Paper on Sustainable Energy that was approved by Provincial Cabinet. More recently, the Western Cape Government has launched its 110% Green Campaign, which seeks to motivate private and public sector organisations around the Western Cape province to connect environmental preservation with economic growth. Launched in 2012, the programme continues to catalyse new opportunities for our local industries to expand their operations in an environmentally friendly way.

Backing up the environmental policies put into place at the local and provincial levels is a variety of policies at the national level that link what is happening in Cape Town with strategies and efforts in other South African cities. To read more about a selection of these policies that support and influence the implementation of the Low-Carbon Central City Strategy, please see Annexure 5.

Global Precedent:

How cities around the world are dealing with climate change

Our local challenges mean that there is a lot of hard work ahead. But they also open up the opportunity for Cape Town to be a key player in the global discussions on climate change. Thousands of world cities, large and small, have developed goals and plans to catalyse new localised climate change action. Coordinated and encouraged by a number of global networks, including ICLEI–Local Governments for Sustainability as well as others, including C40 Cities and regional or country-specific networks–these cities have planned and implemented countless policies and actions to reduce CO_2 and other greenhouse gas emissions.[18] Collectively, the impact of these policies and actions has been estimated to be in the order of 250 million tonnes CO_2e relative to business-as-usual in 2020.[19]

As Cape Town looks towards more sustainable development policies that emphasise the need for low-carbon and more environmentally friendly development, it is important to learn from what other cities around the world have done.

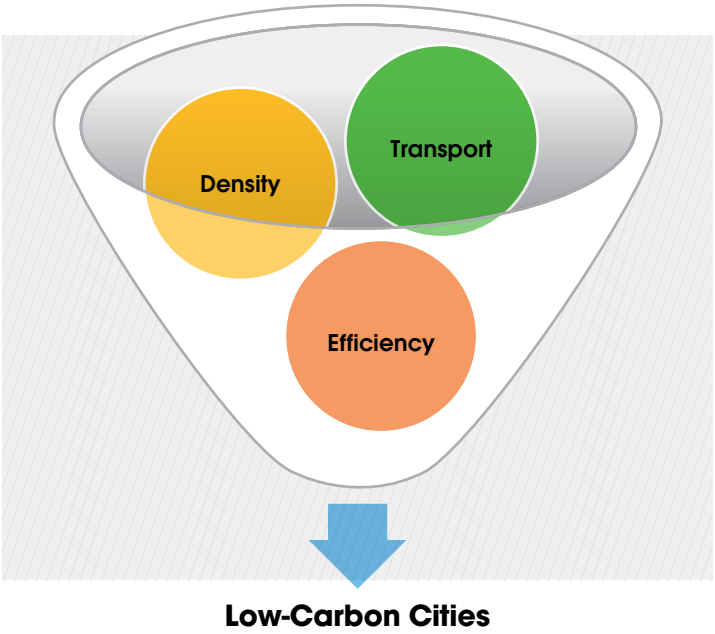
[18 & 19] **Kennedy, Christopher, Julia Steinberger, et al. 2009. "Greenhouse Gas Emissions from Global Cities."** *Environmental Science & Technology* **43 (19) (October 1): 7297–7302. doi:10.1021/es900213p.**

Role of cities in reducing global GHG emissions

The shape and density of cities can strongly determine how people move around their cities, directly affecting the CO_2 emissions of transportation methods. Cities that provide residents ready access to goods and services through proximity rather than extensive networks of cars, roads, and parking lots lead to lower carbon emissions. When home, shopping, work, school and entertainment are all near to one another, car trips are fewer and shorter. As population density – the amount of people living closer together – goes up, car traffic and associated greenhouse gas emissions usually go down on a per-person basis.

To show what a difference density can make, look at a case study of two cities, Denver in the US and Barcelona in Spain: In Denver, a city with tremendous urban sprawl, the average CO_2 emissions per person rests at over 6 tonnes. Barcelona, on the other hand, with a more compact spatial form, has reached a point where their average CO_2 emissions are below 1 tonne per person. While other factors such as heating and climate differences also have an impact, the pattern of population density helps to encourage that difference of up to 5 tonnes CO_2e per person between Denver and Barcelona.[20] By building up and filling in, cities help create the conditions in which walking, biking and public transport can take the place of car trips.

Because of the key role that density plays in reducing carbon emissions, a key emerging policy focus areas for cities to reduce GHG emissions is through urban planning: Specifically, to use comprehensive plans, zoning regulations, and other land-use and transport policies to plan for expanding urban density and transportation in tandem. By creating denser, people-focused neighbourhoods with a high prevalence of services and connected to transit, personal vehicle use can be dramatically reduced. Such an approach can be especially appealing to central cities as they typically already



[20] Source: Kennedy, Christopher, Julia Steinberger, et al. 2009. "Greenhouse Gas Emissions from Global Cities." *Environmental Science & Technology* 43 (19) (October 1): 7297–7302. doi:10.1021/es900213p.

have (or are approaching) critical levels of services and transit accessibility. In these cases, increasing residential development can help reduce overall per-person travel, relative to those residents living in more outlying areas.

Land Use Planning in Singapore

One of the more remarkable examples of combined land use and transport planning in a developing country over the past couple of decades is Singapore, a city-state with a current population of more than 5.3 million people (living in an area of 714 km^2). In the 1950s and 1960s, Singapore was plagued with poverty and pollution, and was growing very quickly with limited public transport and relatively little consideration of development patterns. In 1971, Singapore introduced a "Concept Plan", which charted future residential town developments, including linkages with rapid transit. A key part was the inclusion of high-density, public-sector social housing that allowed for the scale of density to be protected in perpetuity. Since then (and in regular updates to the Concept Plan and Master Plan), Singapore has expanded transit infrastructure systematically with land development and travel demand, and they point to the 1971 Concept Plan as the turning point. They also report that per-person vehicle travel is now lower than it otherwise would have been had they not taken this approach to land use and transport planning, though little analysis exists (as yet) to quantify the effect.[21]

Stockholm's Sustainability Journey

Another example of combined transport and land use planning is Stockholm, a city that is developing new districts, near the city centre, which it hopes will reduce energy and transport demands while improving quality of life. The city believes that developing new districts closer to the city centre, as opposed to development at the city periphery, will lead to shorter travel distances suitable for walking and biking, facilitate connection to public transportation (which it is expanding) and energy infrastructure, and locate residents closer to private and public services. To provide a framework for this process, Stockholm has created a long-term vision ("Vision 2030"), a master plan for urban development and land use ("Stockholm City Plan"), an "Accessibility Strategy" for public transportation, and a city-wide Bike Plan. Stockholm is supplementing these city-wide plans with detailed, district-level plans (which it calls "the middle level") that it develops in close consultation with stakeholders and that have been critical in its large redevelopment projects, such as the Stockholm Royal Seaport mixed-use project.

---

[21] For more on Singapore and Stockholm's efforts on combined land use and transport planning, see the upcoming report from the World Bank, titled "Climate Change Action Planning in C40 Cities in East Asia".

Programmes to retrofit buildings for increased energy efficiency

Once the scale of density is improved, one of the most effective ways to further reduce urban carbon emissions is by making strategic changes to the built environment. Because of South Africa's highly carbon-intensive electricity generation, CO_2 emissions associated with building energy represent one of the more cost-effective and efficient GHG abatement options. In general, two broad strategies exist for increasing building energy efficiency: Building energy codes, which generally apply most readily to new buildings, and building energy retrofits, which apply to buildings already in existence. Except in areas that are growing extremely rapidly, efforts to address the energy intensity of existing buildings often have greater energy-savings and GHG abatement potential.

There are other ways that cities can reduce GHG emissions, whether associated with waste

Learning by Doing: Making Data a Public Project

A key part of using data to change cities involves making it accessible. An organisation called Public Lab (@PublicLab on Twitter) offers an open-source virtual community space that gives users Do-It-Yourself experiments to explore environmental challenges. Their data is deliberately kept open and available to the public in order to "change how people see the world in environmental, social, and political terms," particularly in under-served communities. Their work focuses squarely on the human capacity behind change, and how to match the potential of a person with the right data. For more information, visit them online at: **www.publiclab.org**.

management (e.g. through capture of landfill gas and increasing recycling) or increasing the efficiency of local industry. Other emissions sources–whether due to the sources of electricity generation, or industrial energy use, or the GHG intensity of agriculture and food production–are generally influenced more by national than by city-scale policy.[22]

[22] For a global assessment of the GHG abatement potential and local influence of different urban-scale technologies and practices, see Erickson, Peter A., Michael Lazarus, Chelsea Chandler, and Seth Schultz. 2013. "Technologies, Practices, and Measures for GHG Abatement at the Urban Scale." *Greenhouse Gas Measurement and Management*. doi:10.1080/20430779.2013.806866.

Plotting Greenhouse Gas Emissions down to the Building and Street Level

Researchers at Arizona State University in the US have created a new software system that can estimate the intensity of greenhouse gas emissions across the urban landscape, down to the building-scale. The "Hestia" Project used the city of Indianapolis as a test-case in order to demonstrate the benefits of localised data for policymakers and citizens alike. Their models come equipped with computer simulations across a map of the urban landscape to visually represent the constantly-changing levels of carbon dioxide produced by "hot-spots" in the city. Find out more about the Hestia Project here: **https://asunews.asu.edu/20121009_Hestia**

The Low-Carbon Central City Development Strategy

Introduction To Strategy

In order to put carbon emissions at the forefront of the evolution of Cape Town's urban environment, the Low-Carbon Central City Strategy brings together data, communications and policy in a collaborative effort to assist people to understand how their urban space contributes towards the changing of the environment. This work draws from the policies and strategies listed above, and many more. Geographically, our work takes direction from the Central City Development Strategy. Programmatically, we rely substantially on the work done thus far with the City of Cape Town's climate work and policies, particularly ECAP. Directionally, we look to national policy for a better understanding of the ways in which our work can help inform future progress. Importantly, our work must be able to be understood and actioned in a way that supports a socially, politically and environmentally resilient pattern of economic development.

The main goal of the Low-Carbon Strategy, promoting a lower-carbon development pattern for Cape Town, will be reached through two main workstreams. The first combines new and existing data to synthesize quantitative information so that people, companies and government can better understand our environmental status quo at a very specific local level. This data will also help encourage a greater take-up of monitoring and evaluation going forward, so that people and organisations can observe how their actions impact on the central city's carbon footprint through changes in the built environment. While data and information on the metro-wide environmental and development scenario supports action on a broader scale, the smaller-scaled community focus on information, data and strategies captured in order to formulate this strategy will link environmental effects and changes with people's home communities and workplaces. Localised data is able to show people what the power of change can do in their own backyard.

The second workstream focuses on the development of a low-carbon strategy that builds on existing policies and strategies, rather than inventing something new. A key component of this approach will be related to communication, outreach and public activation through various strategic interventions. The strategy itself will be grounded in clear actions that can be implemented in shorter time spans.

Both of these workstreams are rooted in partnership, relationship building and community enhancement in key topics related to carbon reduction. By working together, everyone involved, whether an employee, a resident or a government official, can collaborate to build a better environment and a more resilient future for Cape Town.

Many people have asked us why this strategy focuses on Cape Town's central city, and not another area of the Cape Town metro-region. As a percentage of the wider city, the central city is a concentrated hive of activity and people where positive environmental change, brought about through people-centred strategies, could be deployed not only to reduce the carbon emissions of an area, but also to spread the strategies further afield; to pave the way for other city centres to adopt new strategies and individuals to change

their behaviours, thus creating a hoped-for domino effect. For example, by working with employees of companies that are adopting low-carbon strategies, we can help them to take those lessons home and translate them into their own residential environment. By putting companies and property owners in the driver's seat of environmental change, we can help empower them to empower others.

Above all, this strategy sets out to link people's actions with visible outcomes from government, residents, businesses, commuters and others. Reducing actions to the local level allows the impact of interventions to be much more personal and comprehensible as well as achievable. For example, by looking only at the central city, commuters can see the massive impact that carpooling will have on the emissions of the central city through easily understood graphics. By working together, multiple building owners will be able to discuss, strategize and implement new infrastructural enhancements that lessen the impact of the built environment far more than a floor-by-floor approach would do.

The Low-Carbon Central City Strategy focuses on six key strategic areas which are underpinned by extensive modelling, data collection and methodology. Combined, these elements lead to a series of recommended decisions and future actions. The six areas including methodology are:

Broad Strategy Support

This section provides the governance and institutional support needed to ensure that the strategy remains relevant and is implemented. It is our intention that this does not become a document that is shelved but rather is continuously updated and developed in such a way that change takes place, however small.

Methods and Data Constraints

This strategy used the LEAP (Long-range Energy Alternatives Planning) model to investigate the impacts of various future energy scenarios for electricity and transport use in the central city. A summary of the methodology is outlined below and detailed notes can be found in the methodology Annexure. It was abundantly clear from the modelling undertaken that a "business as usual" trajectory would be unsustainable. As a result, clear interventions have been indicated.

Electricity

The modelling undertaken covered four sectors: residential, commercial, government and renewable electricity options. It was clear that the focus should be on electricity efficiency, with particular emphasis on sector-specific interventions. Modelling results indicate that, while highly visible, renewable energy options will not contribute significantly to carbon reductions in a central city environment.

Transport

This strategy makes use of transport emissions data to suggest various interventions to address the emissions challenges that Cape Town faces. Our modelling work reinforces the need for strategies that support a strong low-carbon perspective, based on the following

thematic breakdowns: Encouraging "own steam" transport; Supporting public transport; Avoiding transport; and the TravelSMART programme (which includes an emphasis on carpooling).

Waste

In order to reduce the impact that waste production and processing has on Cape Town's urban environment, intensive waste-minimisation strategies need to be developed and implemented. Within the central city area, new developments or renovations need to take into consideration space for recycling, particularly in office and apartment blocks.

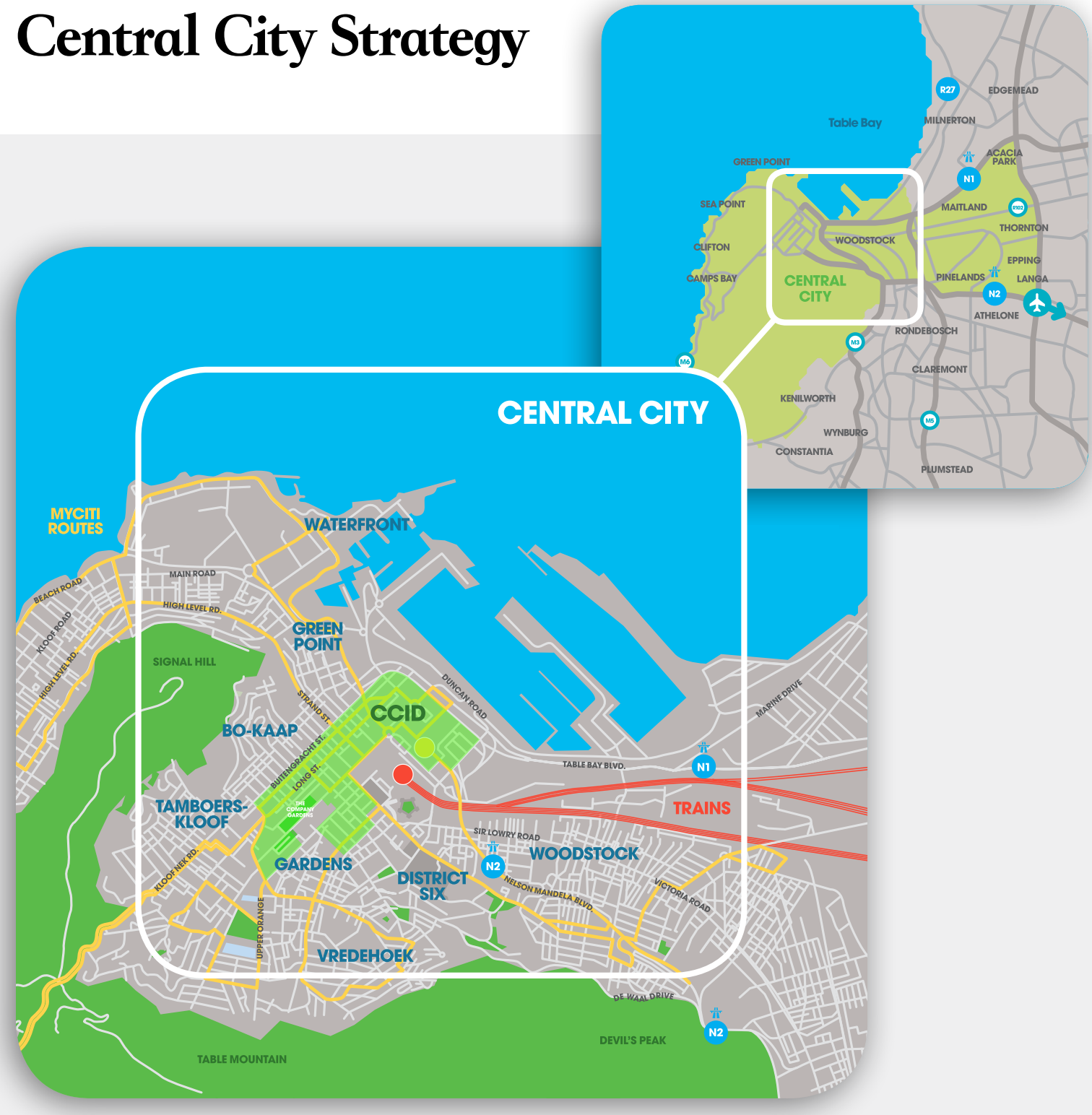
Urban Greening

Urban greening has a high potential to catalyse new opportunities in public education aimed at a greater understanding of the relationship between humans and the natural environment. If targeted correctly, rooftop gardens, streetside planting and other green patches in the central city can rally support for environmental protection. Urban greening can also enhance pedestrian corridors and streetscapes, which further encourage people to walk instead of using motorised transportation.

Innovation and Communication

Synthesizing results from data analysis is greatly beneficial for underscoring the rationale behind a focus on reducing carbon emissions. But activating this requires a great deal of public-facing communications that explains the ins-and-outs of the results in a way that is understandable for everyone. Innovation will also encourage a new way of connecting results with action, particularly in the design of new low-carbon solutions for the built environment and transportation.

The Low-Carbon Central City Strategy



Data and input for the Low Carbon Central City Strategy came from businesses, governments, residents and commuters in and around Cape Town's central city.

The Central City Improvement District (CCID) was particularly instrumental in providing real-time data on the different kinds of businesses in Cape Town's Central Business District.

Similarly, the City of Cape Town provided valuable data and information on transport and energy use in the central city.

This map indicates the primary area of data collection, as well as wider influencing areas, from which some assumptions and data sets were drawn. This strategy is founded on the idea of partnership: By working together with more people, we can help take the information and action of the work in the central city and connect it to other low-carbon activities throughout the metro-region.

Doing this will help new ideas, sustainable practices and stronger working relationships to develop and spread across the city over train lines, bus routes, highways, bike paths, and community connections.

Broad Strategy Support

This strategy structurally includes institutional and governance support in order to ensure effective implementation. It is through this level of support that the strategy will be reviewed and the associated work undertaken, evaluated and monitored to ensure that it is in line with current thinking, new information, and changes within the economic and political arena. The intention is to set up a longer-term steering committee made up of key Central City stakeholders within the sector, such as government officials, representatives of business, civil society and resident associations. We believe that it is through working together and partnership that real change can happen. It is essential that this strategy remains in alignment with the City of Cape Town's various plans, policies and strategies: To this end, this policy recommends that the steering committee set up an annual workshop with key government officials from the City of Cape Town in order to engage with their high-level decision-making committees. Through this structure, this strategy will be flexible and able to adapt to the changes in Cape Town's socio-economic and political contexts as need be.

A key element in developing the strategy has been the gathering of data that explain and illustrate the impacts of various low-carbon interventions. Having interactive data means being able to monitor and evaluate what difference energy efficiency or transport efficiency strategies will make to the level of carbon emissions in the Central City over a longer time frame. Having data that clearly indicates successful interventions will also help encourage new job opportunities related to the creation, design, manufacturing, installation and maintenance of new green technologies.

One of the most significant points to come out of this strategy is the need for more data on localised carbon emissions: A model is only as good as the information that goes into it. Looking forward, the culture of open and accessible data is growing, both in Cape Town and in South Africa. New steps are being taken to unlock data sets that can be incorporated into this Strategy which, while not specifically related to carbon, will help to give a better indication of how people are using the city space, and what environmental impact this use produces. This strategy has therefore been designed to take on new data as it becomes available, and to actively search for new information, in order to expand the robustness of the models themselves.

Finally, the long-term success of this strategy will require the securing of sufficient financial and human resources in order to continue to activate the recommendations made by the data. Fundraising, relationship-building and network expansion are thus key elements in ensuring the success of the strategy.

Objective: Institutional support for a low-carbon central city strategy		
Strategy Goal	**Action Plan**	**Who**
Oversee and drive the strategy	■ Establish a steering committee composed of key players in the Central City to work in partnership to achieve the goals of the strategy ■ Nominate a strategy coordinator to oversee the entire strategy implementation. Identify champions and partnerships for each element of the strategy that would support implementation of low-carbon projects. ■ Set up steering sub-committees for the individual strategic areas in order to drive specific actions. ■ Conduct an annual workshop with City government officials around key strategic actions and ensure alignment with their policies and strategies, and attend high-level decision making of relevant committee meetings. ■ Avoid duplication of existing structures, working groups or forums by enhancing those already in existence with a focus on the Central City.	CTP, City of Cape Town, WCG, SAPS, CCID, hospitality industry, Growthpoint and other property developers, financial institutions, V&A Waterfront, CTICC
Facilitate adequate data collection for modelling, and monitoring	■ Work with partners to develop a data collection, data publication and data processing system. Include this data in the State of the Central City Report, or similar. ■ Focus on priority gaps in electricity and transport data	SEA, City of Cape Town, WCG, CTP
Monitor and evaluate strategy	■ Secure a strategy coordinator to monitor on an ongoing basis what is being implemented in each strategic area and to what extent targets are being met. ■ Set up an annual workshop/meeting with key stakeholders engaged in the implementation of the strategy to evaluate what has been undertaken and achieved during the preceding year. ■ Produce an annual report on work achieved, including challenges, and identifying focus areas for the forthcoming year.	Steering committee and strategy co-ordinator
Ensure strategy is adequately resourced to maintain effectiveness	■ Secure multi-year funding and staffing for broad strategy implementation and support	CCT, CTP, SEA, steering committee

Methods and Data Constraints

This strategy represents an exciting new way of looking at localised data as building blocks for a better understanding of city-scale climate change and a better way forward in terms of policy development and implementation. As shown on the Strategy's map, most of the data that informed our models comes directly from the Cape Town Central City area.

For this strategy we used the LEAP (Long-range Energy Alternatives Planning) model, which is a widely used software tool for medium- to long-term energy policy analysis and climate change-mitigation assessment. It is a flexible model that has the ability to present complex energy analysis concepts in a transparent and intuitive way. However, some challenges emerged during the course of the modelling undertaken for this project and they included the following:

1. The modelling of the transport sector is relatively simplistic in LEAP and draws primarily from several key data inputs: modal split, cost per passenger-km per mode, energy use per passenger-km per mode, and overall growth in the transport sector. LEAP is best used to show the broad implications of modal shifts and energy intensity (efficiency) changes. Detailed transport sector analysis requires the use of a transport-specific modelling tool; an initiative that can be taken up in the extended life of this Strategy.

2. LEAP is based heavily on user-defined energy inputs. This is what makes the tool so transparent to use, but it also means that the output is driven largely by input data quality. LEAP results should therefore be used to indicate the broad implications and the relative scale of the impact of a particular energy future, rather than to focus on specific data point outputs.

The geographic boundaries for the modelling were set as closely as possible to the city bowl area (CBD and surrounding residential areas) – a localised and geographically small area – to help identify key areas for local sustainable energy interventions. Our geographic scale was also largely guided by data availability; discussed in detail further below. The more data that becomes available, the more robust our localised studies will become, which is why robust data collection is essential into the future.

In terms of the Strategy's modelling and future projections, priority focus areas include the **residential, commercial (retail, office, and accommodation) and government built environment** and the **passenger transport sector**. At this initial stage, we chose to exclude the industrial and freight sectors and street and traffic lighting from this analysis for the following reasons:

- The industrial and freight sectors, while important, have only sparse data available.
- The City of Cape Town and the Cape Town Partnership, who are seen as the main drivers for the implementation of the Low-Carbon Central City Strategy, have greater influence over the commercial and residential sectors through strategic partnerships, regulations and

planning. As an example, the port falls under national, rather than local, jurisdiction, and is thus subject to national government control.

- The city bowl area is largely comprised of commercial and residential built environment stock. Most industrial activity is situated further afield in areas such as Paarden Eiland and Epping.

Data on street and traffic lighting was also excluded from the project at this stage due to data unavailability for street/traffic lighting electricity use specifically in the central city area. At present, this data is available at the metro level only.

The main indicator for the **residential sector** (number of households) was drawn from the StatsSA National Census of 2011. Data was available on the StatsSA website down to the ward level, one of the basic forms of geographical demarcation for census data. Ward 77 was chosen as the ward most closely aligning with the Central City area (see below map). This ward includes Cape Town's Central Business District along with the suburbs of Gardens, Oranjezicht, Tamboerskloof, Schotsche Kloof (the Bo-Kaap), De Waterkant and Vredehoek, but excludes the suburbs of Woodstock, Zonnebloem, District Six and the V&A Waterfront. In order to supplement the data with information from the V&A Waterfront, the number of residential units in the V&A Waterfront was extrapolated from a report by Growthpoint property managers. For more detailed information on this information, please see the detailed Methodology Annexure 1.

The most detailed data for the **commercial sector** (e.g. floor area by sub-sector such as office, retail) was available for the Central City Improvement District (CCID) area (see diagram below) and the V&A Waterfront (from a Growthpoint report). Most of the city bowl area outside of the CCID area is predominantly residential, interspersed with pockets of commercial activity, which means that a lack of commercial data for these areas is not too great a concern. The main exception is the suburb of Woodstock, which does contain sizeable commercial activity. Gathering more conclusive data on Woodstock, along with other commercial areas surrounding the CCID area, will be a crucial next-step in this Strategy for understanding the way in which commercial energy uses contribute to carbon emissions on a local scale.

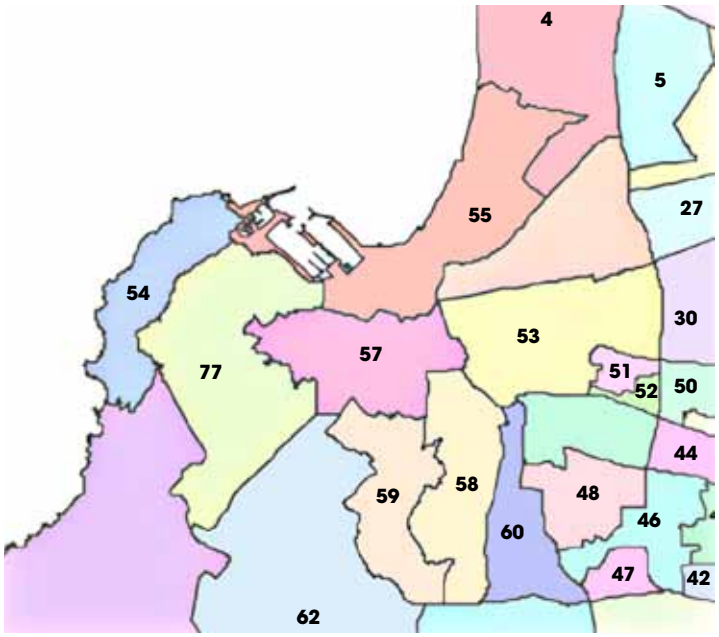


Figure: Census ward map

In the **transport sector**, cordon counts provided a picture of the number and types of vehicles and the number of passengers moving in and out of the city centre along major entry and exit points (shown in below diagram). This was used to determine the impact of motor vehicle traffic on the central city's carbon emissions. Data from recent planning and research being undertaken by the City of Cape Town further added to the quality of this project's analysis.

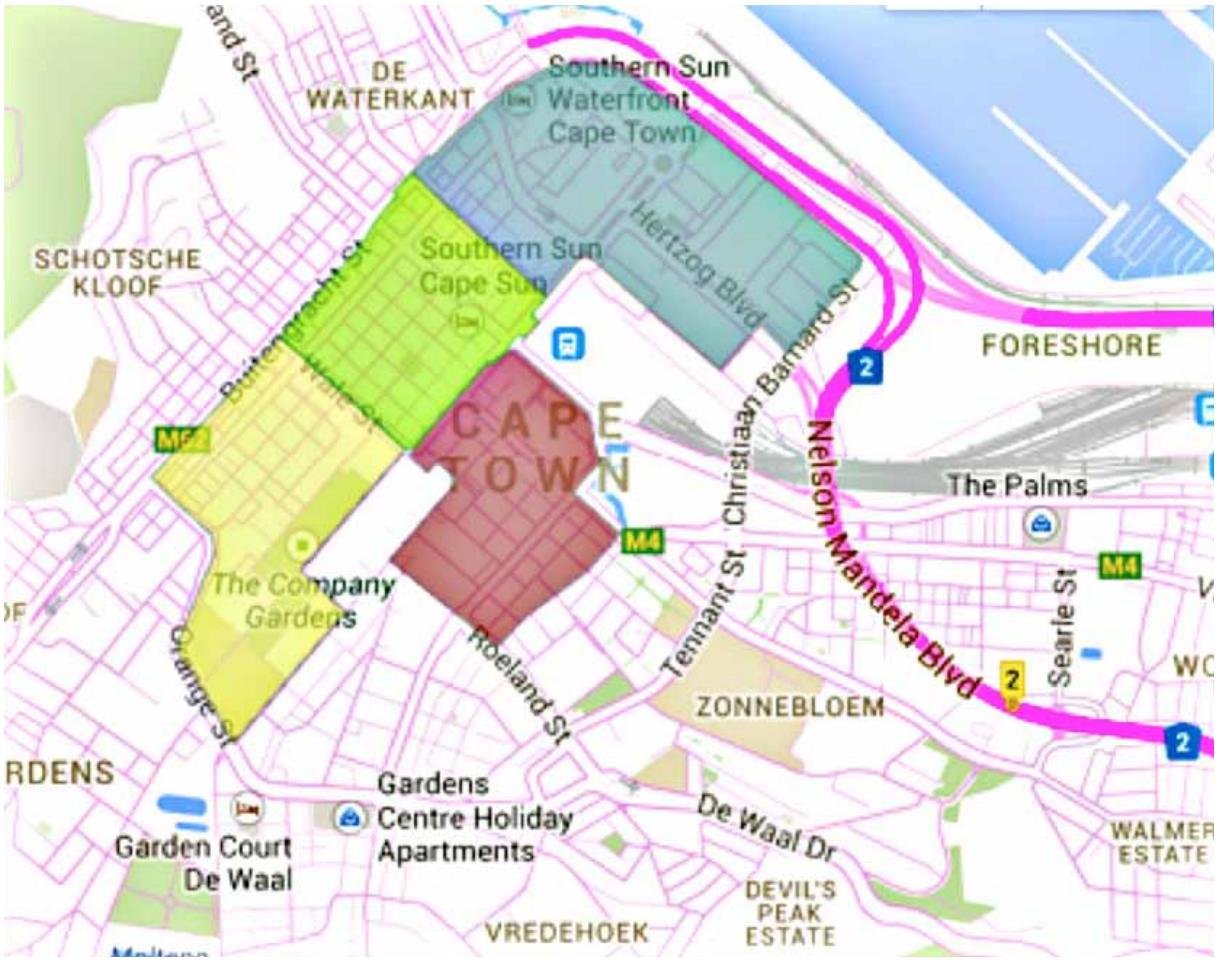


Figure: CCID area

The energy fuel focus was to a large extent on electricity consumption in the commercial, residential and government sectors, and on liquid fuel (petrol, diesel and other forms) consumption in the passenger transport sector. Liquid Petroleum Gas (LPG) use was not accounted for due to time constraints and the difficulty in sourcing data on LPG supply and/or energy intensity values for LPG use (e.g. amount used for cooking in restaurants).

The Strategy's data runs on a baseline year of 2012. Various future energy trajectories were modelled up to 2030 in order to assess the implications of different future energy development paths for the central city. A "Business as Usual" (BAU) scenario modelled the central city's current trends and projected them into the future in order to highlight future energy consumption and emissions should no further climate intervention action be taken

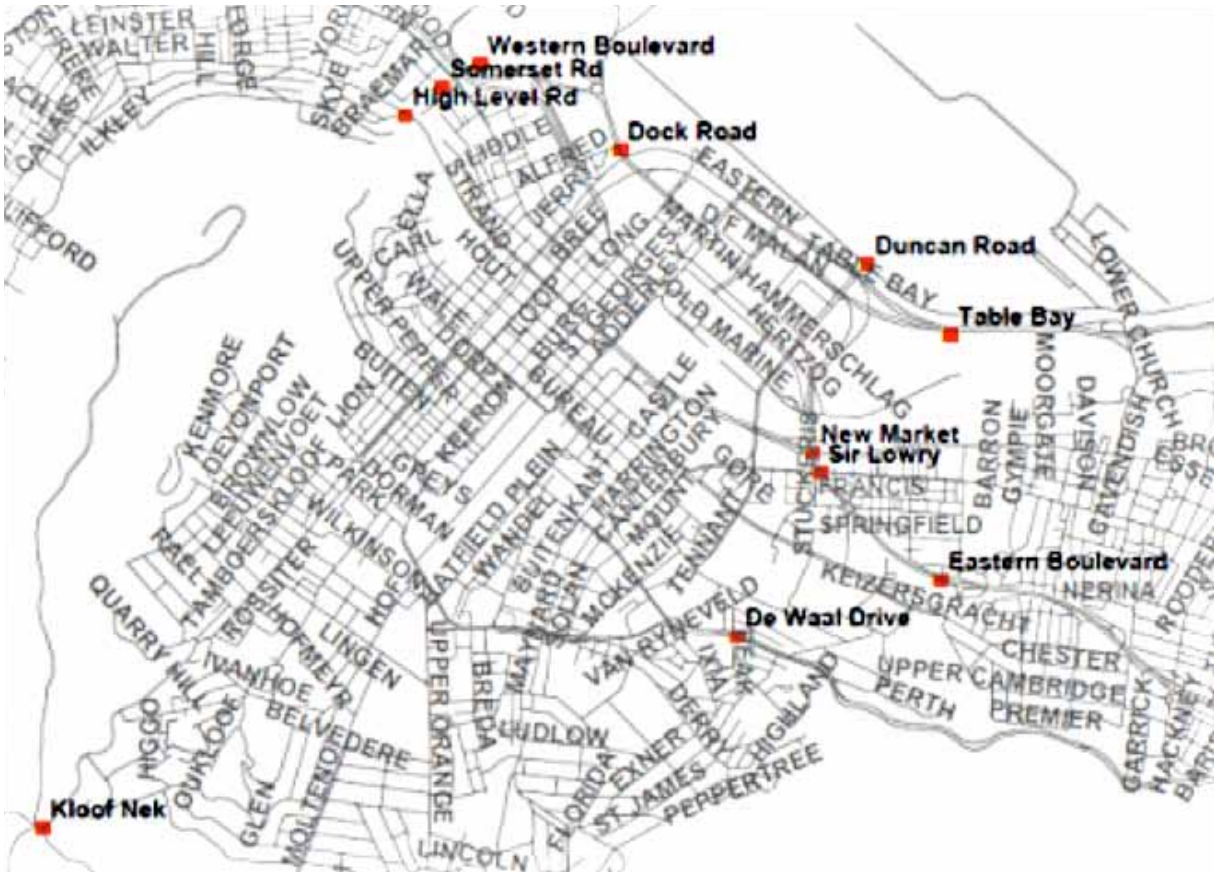


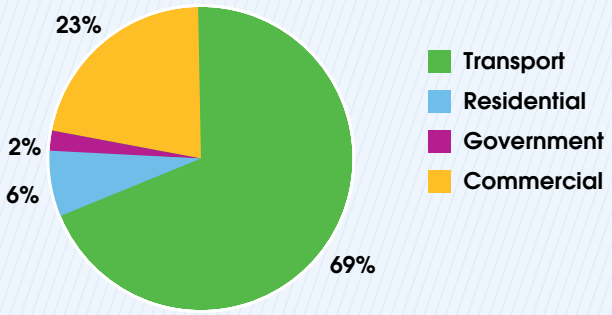
Figure: Cordon count 2011 count points

by business and residential partners of the central city. This scenario was used as a baseline, modelling all other energy efficient scenarios against this to show the cumulative effects of different climate interventions.

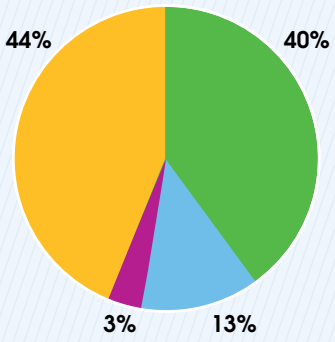
The Central City's Energy Status Quo: What does our baseline look like?

The baseline 2012 energy and greenhouse gas emissions profile for the central city is shown in the figures below. Transport features as the largest user of energy at 69%. This is consistent with the energy picture for several other metros and municipalities across the country, and is largely attributed to the sprawling nature of our urban spaces. While the transport sector dominates the energy picture, it is the commercial sector that is responsible for the largest share of greenhouse gas emissions, at 44%. This is due to the very carbon-intensive nature of our electricity, which is produced mainly using coal-fired power stations. Coal-fired power stations supply South Africa with 90% of its total electricity. The remaining 10% is made up of 5% hydro power and 5% nuclear power. This will change, with the Integrated Resource Plan (IRP)–South Africa's national electricity build plan–setting a goal of 9% of electricity supply to come from renewable energy sources.[23] This has been factored into the BAU modelling scenario.

Energy use by sector in Cape Town central city (2012)

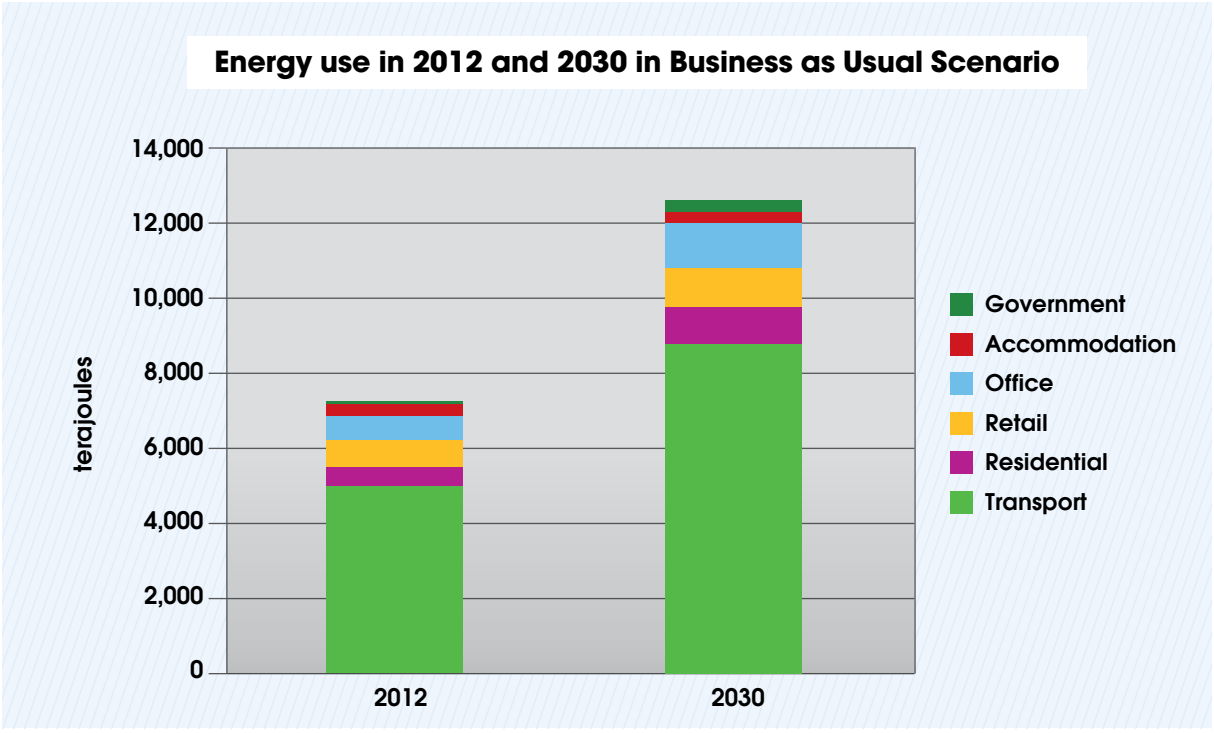


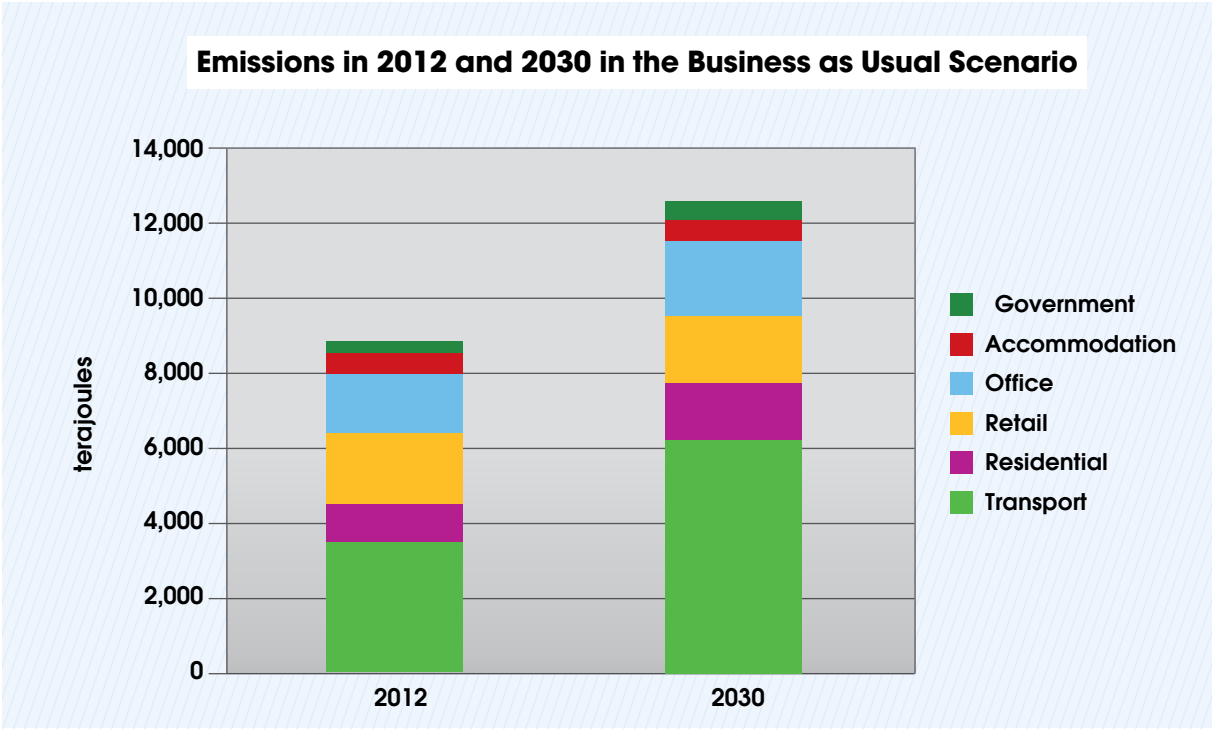
Emissions by sector in Cape Town central city (2012)



[23] IRP 2010 Policy-Adjusted Scenario

The projected energy use and emissions in 2030 for the BAU Scenario is shown in the graphs below.





It is clear that continuing on a "Business as Usual" (BAU) trajectory is not sustainable for the central city or for South Africa. The transport sector will remain the largest bulk energy-user, while the built environment (commercial, residential, government sectors) contributes proportionally more to the central city's carbon footprint due to the higher amount of emissions per unit of energy. Electricity-using sectors consume 31% of the energy, but produced 60% of the emissions in 2012. In 2030 the BAU picture will be slightly different (31% energy, 50% emissions) due to the inclusion of renewable energy and nuclear power in the country's national electricity build plan.

Future Scenarios modelled in LEAP

The data used in this strategy has been used to make valuable projections of future scenarios for the central city's carbon emissions. These future energy scenarios for the central city allow this strategy to show what our current carbon emissions will grow to by 2030 if we do nothing to stop them, along with the future impact of various energy efficiency and renewable energy-implementation strategies aimed at reducing the central city's future carbon emissions. Further detail on model assumptions can be found in the methodology Annexure.

Business as Usual Scenario

Current energy use and growth trends are unchanged into the future. The national electricity supply follows the IRP 2010 build path.

Electricity Efficiency Scenario

Residential

Includes the following interventions:

In all (low & mid-high) residential household:

- All lighting efficient by 2018
- 50% of all water heating is efficient by 2030
- All refrigeration efficient by 2030

In mid- to high-income residential:

- All efficient lighting LED (vs. CFL) by 2030

Commercial and Government

In Retail/Office/Hotels/Government sectors:

- All lighting efficient by 2018
- All HVAC efficient by 2030
- All water heating efficient by 2030

In Retail/Office/Hotels sectors:

- All refrigeration efficient by 2030
- The above interventions could be grouped or split into different scenarios, e.g. a "commercial sector" scenario will include all the efficiency interventions listed above for the retail, office and accommodation sectors.

Renewable Energy Scenario: Solar PV

Embedded solar PV included, with the amount (48 MW) based on estimated available roof space in central city.[24] The results on energy use and emissions by 2030 when compared to a Business as Usual (BAU) scenario are shown in the graphs below.

Transport Scenarios

"Own Steam"

A central city that is easily and safely accessed by one's "own steam", meaning mostly on foot and, especially from inner suburbs, by bicycle.

Interventions:

- Improve city accessibility
- Improve city legibility: pedestrian way-finding maps, signs, apps, etc
- Lower average traffic speeds: reduce local pedestrian-vehicle conflict, increase pedestrian safety through traffic calming
- Right-size existing streets and improve pedestrian and cycle infrastructure: area-wide improved street environment for public and non-motorised transport
- Increase street connectivity: reduce the block size and increase pedestrian accesses through large blocks

Modelled in LEAP as follows:

- A 5% modal shift to public transport
- Increase in "own-steam" transport, i.e. cycling and walking

Public Transport

A central city that enables a low-carbon "last leg" of journeys, and supports the use of public transport.

Interventions:

- Further improved inner-city infrastructure for public transport
- Supportive strategies for 'last leg' of public transport journeys
- Parking demand management strategy and implementation

Modelled in LEAP as follows:

- 10% shift to public transport
- Increase in "own steam" transport

"Own Steam" vs. Non-Motorised Transport

This strategy's "Own Steam" transport model refers to any mode of movement that is powered by humans alone, as opposed to fuels and motors. It includes: Young, old, able-bodied, less able-bodied, male, female, walkers, cyclists, skateboarders, trolley-users, small-freighters, and wheelchair and frame users. It is more all-embracing than "active transport" (which excludes the slow), "slow modes" (which excludes fast people) or "non-motorised transport" (which normalises the use of a motor).

In order to be inclusive to all forms of human-powered transportation, we use the term "own steam" transportation throughout this document.

[24] Sustainable Energy Africa 2013

Avoid Transport

A central city that reduces the need for motorised travel through higher density central city living.

Interventions:

- Promote the development of high-density residential units, including the release of state-owned land for developments that support lower carbon transport

Modelled in LEAP as follows:

- Density changes leads to 5% mode shift from car to public transport
- 10% reduction in vehicle-kilometres

Travel Smart

A central city that promotes private transport efficiency.

Interventions:

- Promote low-carbon driving behaviour ("eco" driving)
- Shift from petrol to diesel, from inefficient petrol/diesel to efficient petrol/diesel, and from conventional to electric/hybrid
- Optimise vehicle maintenance
- Increase vehicle occupancy and carpooling

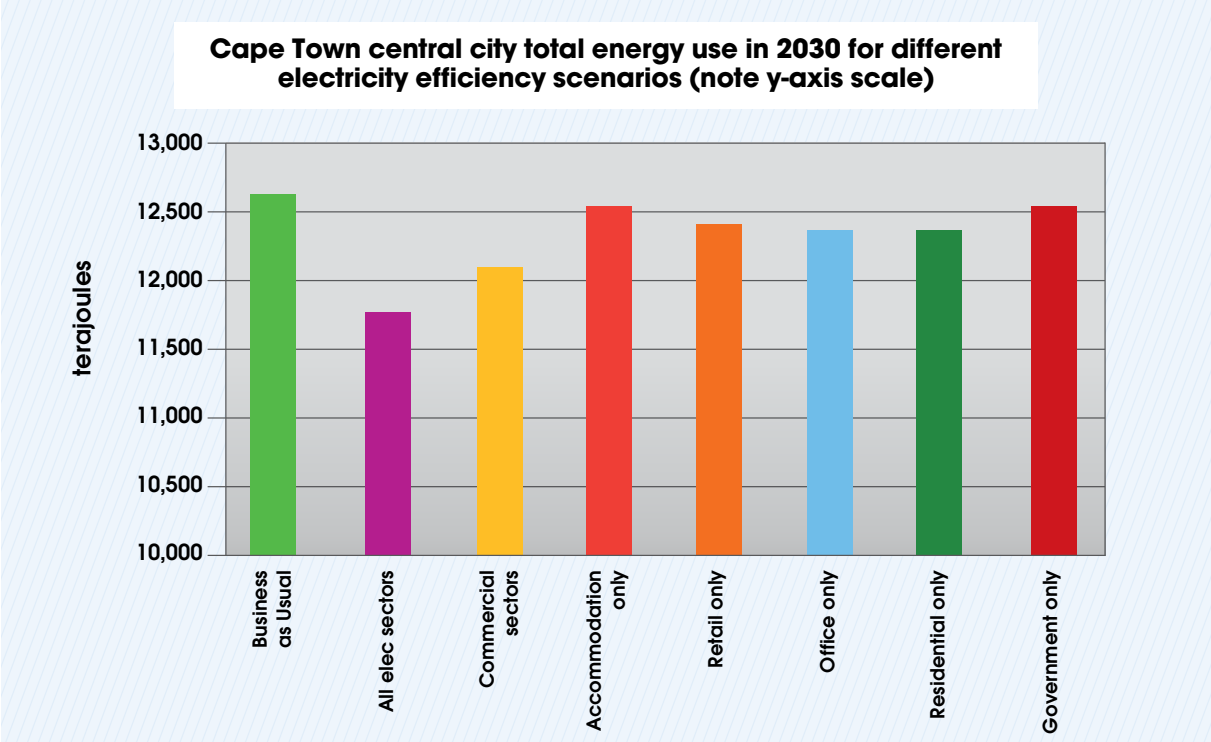
Modelled in LEAP as follows:

- Car occupancy shift from 1.4 (2012) to 1.75 (2030)
- Shifting private vehicle activity from less to more efficient options

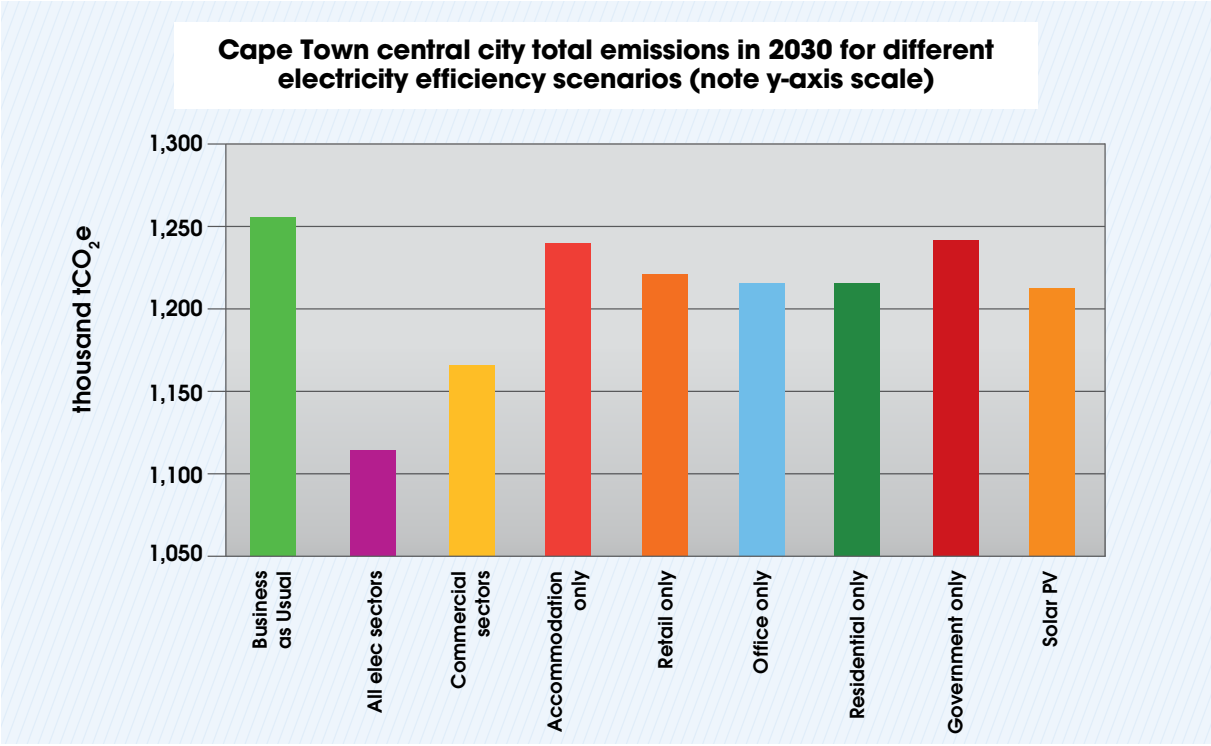
Private mode	2012	2030
Petrol	91%	59%
Efficient petrol	0%	6%
Diesel	9%	27%
Efficient diesel	0%	3%
Electric	0%	2%
Hybrid	0%	3%

LEAP model results

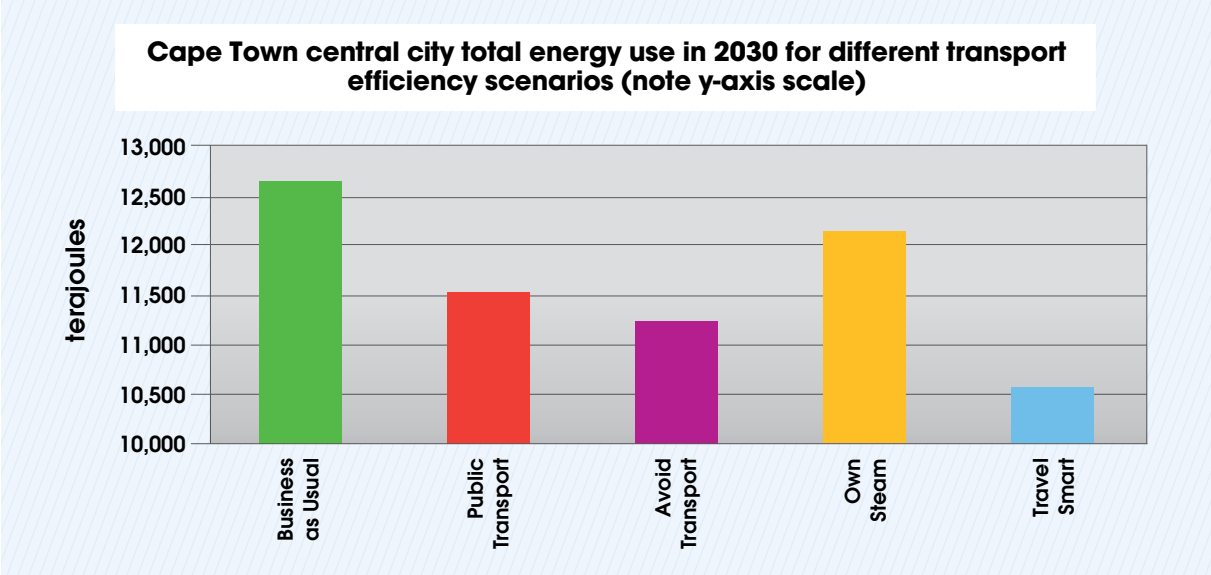
The results of the scenarios described in the previous section are shown below.



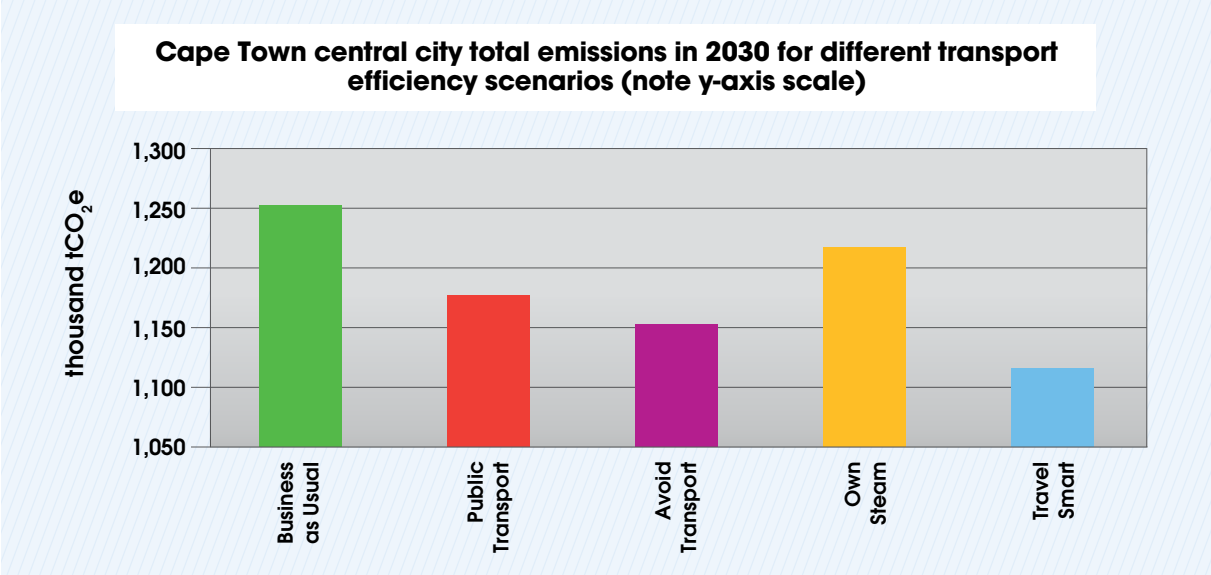
The effect of electricity efficiency interventions in different sectors on 2030 total central city energy use when compared to Business as Usual (BAU)



The effect of electricity efficiency and renewable energy interventions in different sectors on 2030 total central city energy-related emissions when compared to BAU



The effect of transport efficiency interventions on 2030 total central city energy use when compared to BAU

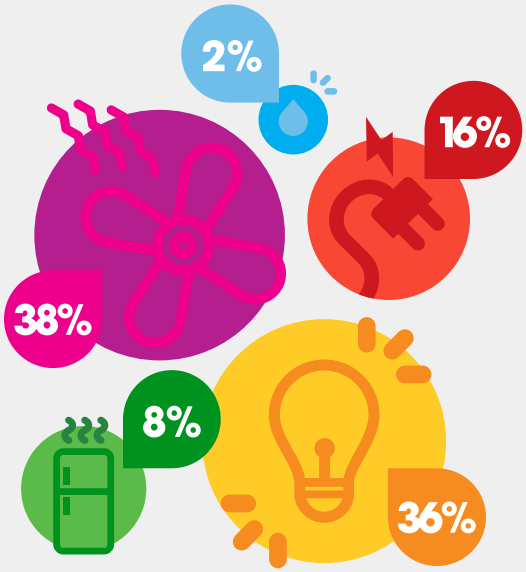


The effect of transport efficiency interventions on 2030 total central city energy-related emissions when compared to BAU

In the built environment (commercial, government and residential), lighting and HVAC (air conditioning) efficiency has the largest impact in the commercial and government sectors, while efficient water heating (such as solar water heaters and heat pumps) and lighting have the largest impact in the residential sector.

Interestingly, implementation of renewable energy, in the form of embedded local solar PV generation, has a minimal impact on the overall emissions pathway of the CBD (when compared with, say, electricity efficiency measures implemented across all non-transport sectors), due to the relatively small space available for large rooftop roll-out of PV. The required returns-to-scale are more realisable in industrial areas with large warehouse roof

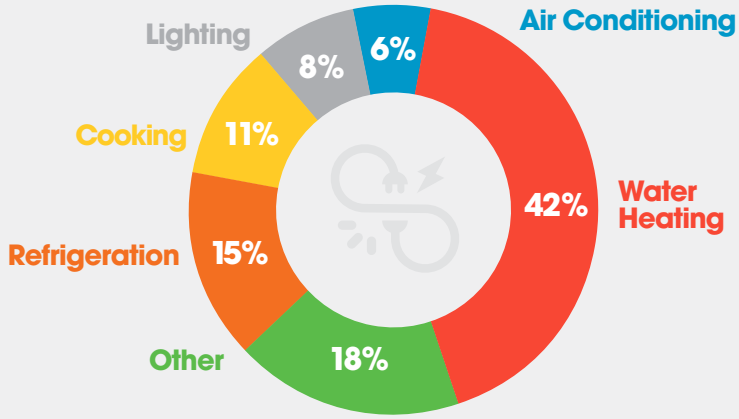
Electricity and Sustainability in the Central City



Commercial Electricity Demand in the Central City:

- Air Conditioning
- Lighting
- Other
- Refrigeration
- Water Heating

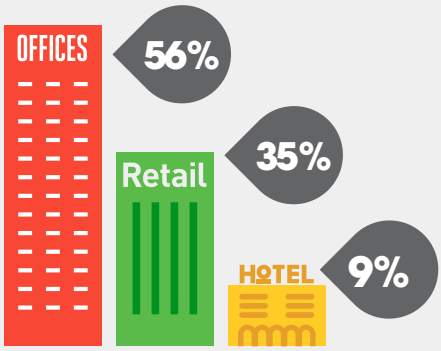
Residential Electricity Demand in the Central City:



Carbon tonnes

Releasing a tonne of CO_2 is the same as consuming 40 braai gas canisters

Commercial Use of Electricity in the Central City:



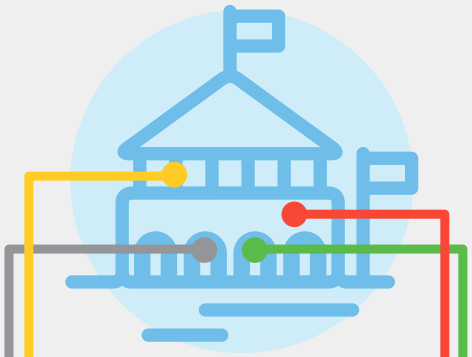
Leading by example, government buildings can save big amounts of electricity.

By retrofitting now, government buildings could SAVE big energy in the year 2030:

55 000
Gigajoules by using more efficient lighting

13 000
Gigajoules by installing more efficient air conditioning

7 000
Gigajoules by using more efficient water heating



Government buildings in the central city use electricity for:

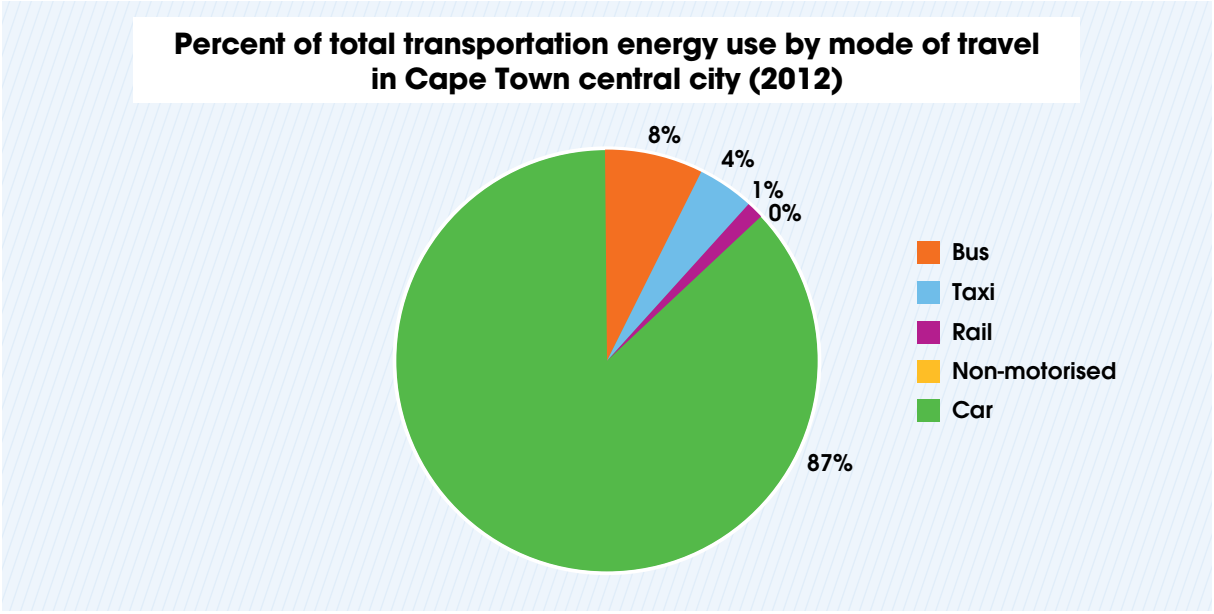
- 55% Lighting
- 26% Air Conditioning
- 15% Other
- 4% Water Heating

What government can do:

- Lead by example
- Spread the message on energy efficiency
- Use their purchasing power to procure greener suppliers, contractors and service providers
- Create policies, forums and programmes to encourage energy saving enhancements across the central city

space. The implementation of small-scale wind energy was not modelled, as there was difficulty in acquiring data on the potential scope of wind power roll-out.

The results of the transport scenarios are clear: high occupancy in private vehicles and the use of more efficient private vehicles (both included in the TravelSMART Scenario) will result in the largest energy use reduction; even greater than what would be realised (a) through the rolling out of electricity efficiency interventions across all non-transport sectors or (b) through an aggressive 10% modal shift to public transport. This highlights the fact that behaviour change is absolutely essential for ensuring a low-carbon future. The key to the effectiveness of this measure is the improved efficiency of the use of road space by reducing the number of vacant seats. This also improves the efficiency of transport energy use, as fewer vehicles are needed to move the same number of people. Since cars consume a disproportionately large amount of energy compared with other vehicle types (see pie chart below), any efficiency gains in private vehicle use has a large impact.



Electricity:

The Low-Carbon Central City Strategy seeks to promote the development of a central city that uses less electricity and cleaner power for a more sustainable future

Introduction

South Africa has set a national target for energy efficiency improvement of 12% by 2015. Cape Town's Energy and Climate Change Strategy set an electricity efficiency target of 10% by 2012. Commendably, this target has been exceeded through the City's electricity savings campaign and other strategies. This has occurred in spite of economic expansion and population growth. The intention behind this strategy is thus to maintain such savings

while encouraging further gains.

One of the challenges relating to reducing electricity consumption relates to an unexpected technicality in the sale of electricity itself. In South Africa, municipalities are often redistributors of electricity, buying power directly from Eskom and on-selling it to municipal customers. The profits from electricity sales are typically used to maintain the electricity system operations as well as to cross-subsidise electricity delivery for the urban poor. Other non-electricity-related services also stand to benefit, depending on the structure of the municipality in question. A direct result of this structure is that any reduction in electricity use within the boundaries of a municipality will have an impact on overall municipal revenue; and the big question is how municipalities deal with this impact. There is therefore a tension in electricity departments around electricity savings.

Better Budgeting for Open Cities

Budget transparency is a crucial part of active civic engagement. Open budgets help citizens better understand how their taxes are being spent and where the City gets its revenue from. In Cape Town, the organisation Ndifuna Ukwazi is leading the way in translating municipal budgets into tools of citizen engagement. To find out where electricity fits into the City of Cape Town's revenue stream, see Ndifuna's 2013/14 draft City of Cape Town budget analysis here: **http://nu.org.za/analysis-city-of-cape-town-201314-draft-budget/**

Cape Town is no different. Due to the reduction in electricity consumption in part through various energy-saving programmes, the City of Cape Town is currently facing revenue losses, which limits its ability to cross-subsidise other services. In order to address this, the City of Cape Town is currently investigating new ways to restructure revenue that will help to de-couple overall revenue from energy consumption. This will allow for a greater emphasis on energy-saving measures while promoting a more secure balance sheet and overall municipal financial standing.

While this Low-Carbon Strategy continues to advocate for reduced electricity use as a vital part of any low-carbon strategy, it is essential that we raise awareness of the challenge without compromising the drive for electricity efficiency. In order for a more partnership-driven approach to electricity efficiency, there needs to be a greater understanding of the financial impact of energy reduction. The subsequent roll-out of the strategy will thus entail extended engagement with the City electricity and treasury departments as it helps to develop strategies to manage the losses. In this area, larger partnerships with other municipalities, non-government organisations, and other supporting bodies, like the South African Local Government Association (SALGA), will be critical for a long-term engagement on the restructuring of municipal revenue streams for the purposes of environmental protection.

A key part of effectively implementing any energy efficiency strategies related to electricity and the efficiency of the built environment is the relationship between the

investing and benefiting parties. The fact that the landlord might not realise any financial benefit from the energy-saving measures installed in buildings is often a disincentive for green investment. The tenant is equally disincentivised to install energy-saving measures, as they do not get to realise rewards beyond the point of tenancy – it is relatively difficult to take an entire HVAC system out of a building should you decide to move offices. A key part of our analysis points to the greater need for green leases in both the corporate and the residential sectors. These leases help to promote a collaborative approach between landlord and tenant towards green technology and building retrofits, and ensure that the financial rewards for going green are shared between both parties.

The interventions considered in the electricity section of the Low-Carbon Strategy are efficiency implementations in the residential, commercial and government sectors along with an analysis of renewable energy potential. The key interventions with the highest impact as per the modelling are efficient lighting, solar water heaters and HVAC. Whilst the impact of each looks to be quite small, grouped together they substantially reduce

Australia's Strategy to Bridge the Gap between Owner and Beneficiary

Several challenges exist in pursuing energy retrofits of building stock, most notably the "split incentive" problem, where the people who make the investment in energy efficiency measures and the people who reap the financial benefits of energy savings are not the same. For example, tenants typically pay their own energy bills, leaving building owners little or no incentive to make capital investments that would decrease energy intensity. Even if the split incentive can be addressed (or where it does not exist), building owners can still be reluctant to invest due to the perception (or reality) of long pay-back times that can threaten project finance.

Several cities globally have approached the issue of split costs and benefits on energy retrofits by creating innovative new financing mechanisms. For example, the City of Melbourne (Australia) and the regional government of Victoria have created a new financial mechanism, the Sustainable Melbourne Fund (SMF) that provides building owners with the upfront costs of building energy retrofits. These costs are then repaid via a surcharge on the building's property tax payable to the Melbourne City Council, which in turn forwards the payment on to the lending institution. One of the key innovations of this program is that the loans stay with the property even if the building is sold, helping to open the door to investments with longer payback periods than might otherwise be readily undertaken. The split incentive problem can be addressed, in part, if tenants agree to finance part of the surcharge through their lowered utility bills. Melbourne has similar cooling needs to Cape Town, and has identified that increased efficiency of cooling, including using ground-source heat pumps for heat sinks in the summer, as one of the most cost-effective GHG abatement options available.

For more information on green leases in South Africa, please read this press release by the Green Building Council: **http://www.gbcsa.org.za/news_post/the-green-lease-positive-step-to-efficient-operation-of-buildings/**

the emissions for the central city area. It would seem that some of the challenges centre on cost and returns on investment, but critical to this is behaviour change. Therefore communication and information are significant in bringing transformation.

Energy Efficiency in the Residential sector

The immediate central city area comprises mainly mid- to high-income households living in medium-density apartment blocks and single-family dwellings. This strategy draws its modelling data from the South African National Censuses conducted in 2001 and 2011 in order to gather the most accurate information available on the population that calls the central city home. The residential building stock is made up of approximately 64% apartment-style structures; 29% freestanding homes; and 7% "other" (a category that includes dwellings like semi-detached homes, townhouses, granny flats, and cluster houses).

The growth figures applied in the LEAP modeling were -6.95% for low-income households and 4.31% for mid- to high-income households. The reason for the decrease in low-income housing growth is due to a regular escalation of property prices and rates that prevent lower-income families from living or moving into the CBD area. The figure of 4.31% growth for the mid- to high-income households was taken as a more realistic estimated growth rate due to land availability limitations in the central city into the future. Using the growth rate of 10.9%, which is in line with the high growth rates of this

A Spotlight on Inclusive Density

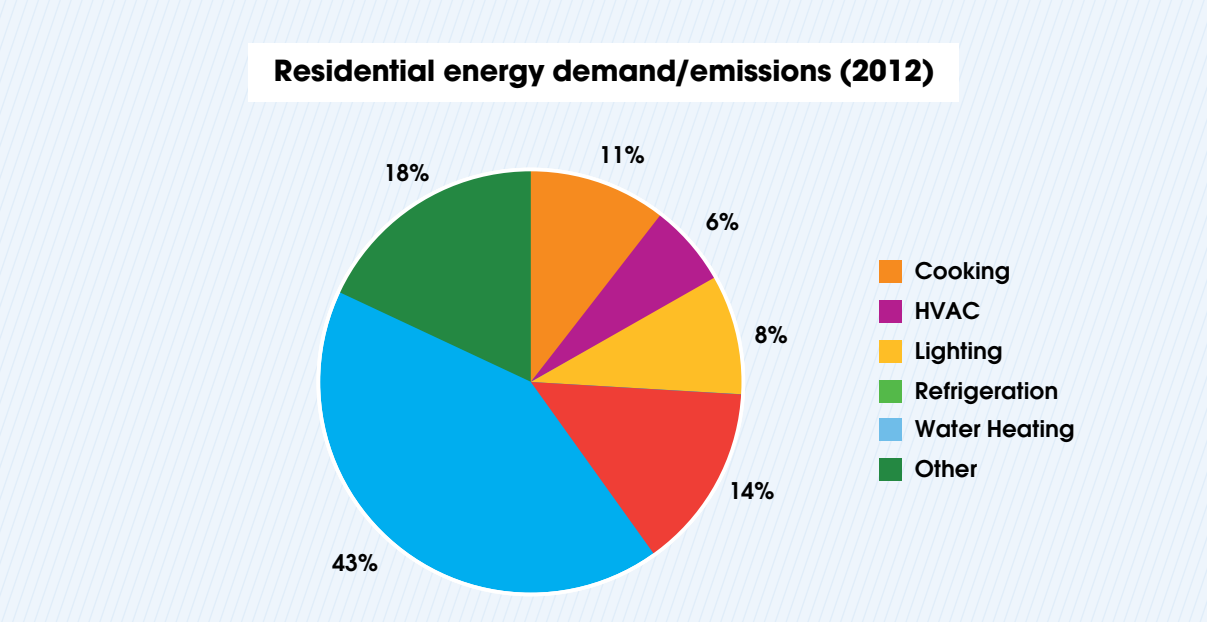
The drop in the number of lower-income households in Cape Town's CBD points to a bright possibility of resilient low-carbon growth for the wider metro. Taking on board the idea of densification, bringing more people into the central city would help alleviate the carbon emissions that are created by people commuting each day into and out of the city centre from distant residential locations. Increasing the availability of affordable housing in the central city is one sure-fire way to do this. In addition, a greater residential population would help grow the local economy, provide more opportunities for greater social connections, and pave the way for more sustainable movement patterns like walking and public transport along corridors that connect spaces of higher density within a more compact and populated central city.

Increasing the residential population of Cape Town's central city would increase the carbon emissions of the area due to the rise in per-capita users. For the metro-region as a whole, however, the carbon emissions rates would drop due to a reduced amount of transportation and individual electricity use. If built in a forward-thinking and green way, greener and more affordable housing could be a key factor in transforming the central city into a green catalyst for the wider metro-region.

sector seen over the past decade, would result in a quadrupling of mid- to high-income households by 2030. Given limited land space this would not be feasible.[25]

Income	2001	2011	Growth p.a. (%)
Low	4,057	1,974	-6.95
Mid- to high	3,256	9,179	10.92
Total	7,313	11,153	4.31

Going forward it will be important for this strategy to include the Woodstock and Zonnebloem areas, in particular District 6, as these areas hold great potential for the development of lower-income housing opportunities. In addition there is potential to work with the City and Province to showcase new District 6 developments as low-carbon and energy efficient housing developments incorporating interventions such as efficient lighting, SWHs, ceilings and orientation. This work would need to be integrated into land use management and spatial development policies and could potentially lead to including guidelines that can be used across the City.



Energy demand or emissions by end-use in the residential sector.

In terms of electrification, 99% of households in the city bowl use electricity for lighting (StatsSA 2011). Therefore it was assumed that all households in the area are electrified.

Note: The reason that the energy demand and emissions graphs are exactly the same (i.e. same proportions of emissions or energy demand by end-use) is due to the fact that only electricity (one fuel) was analysed. Therefore if 8% of electricity is used by lighting, 8% of emissions would be from lighting.

[25] For more information on how growth figures were determined, please see the detailed Methodology appendix.

Impact of electricity efficiency interventions on residential sector energy demand

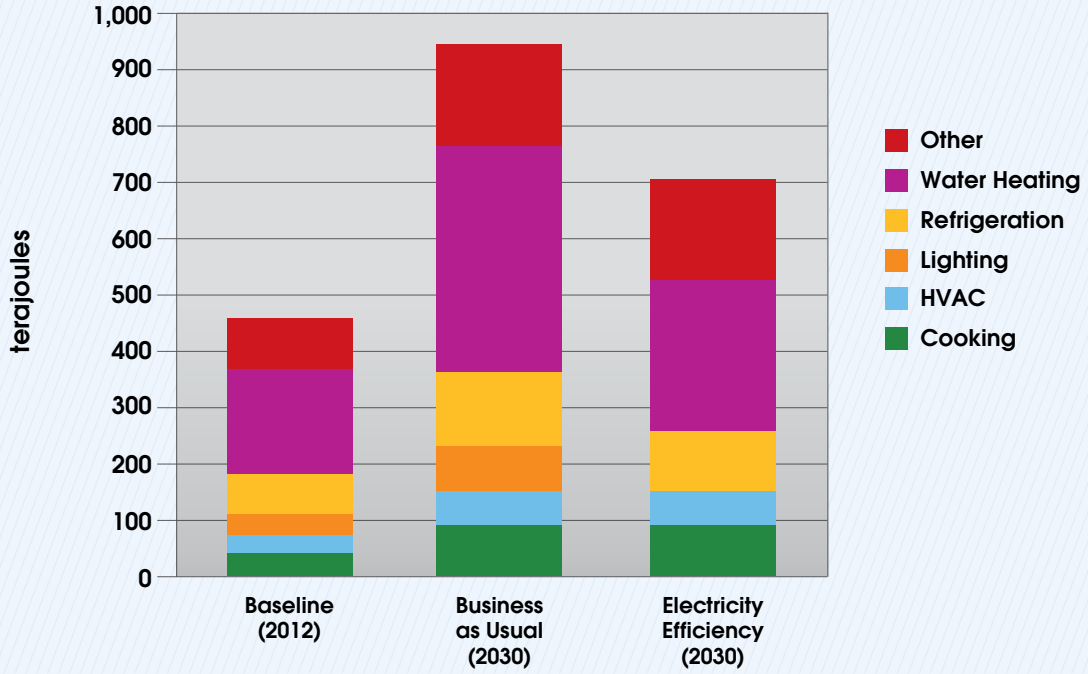
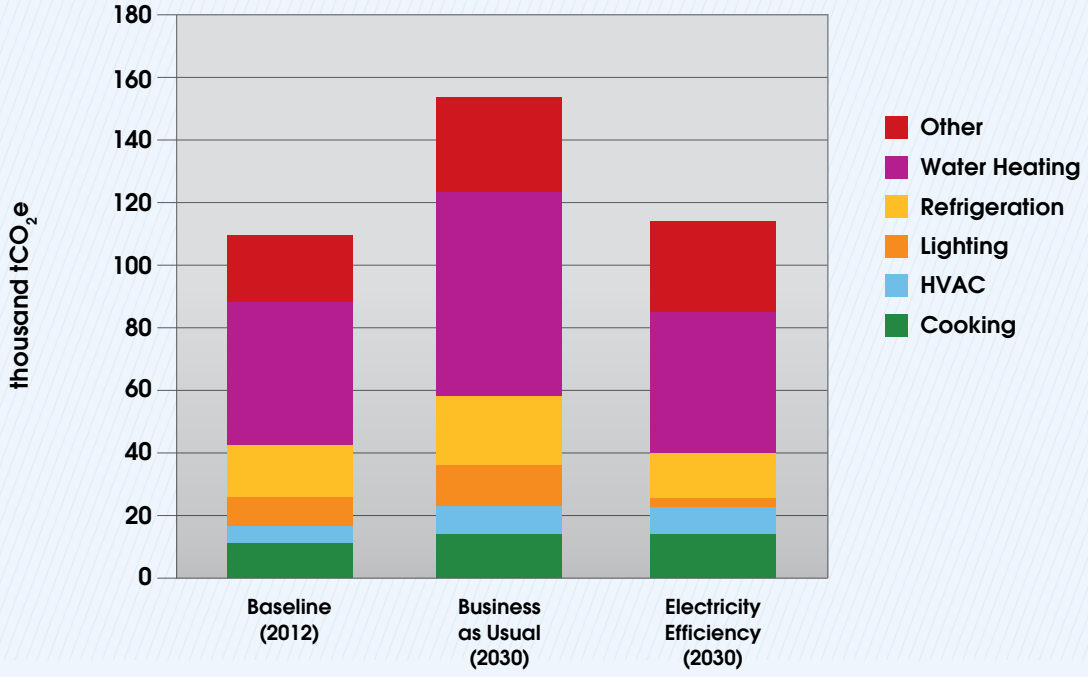


Figure: Impact of electricity efficiency interventions on residential sector emissions



The two main interventions identified as making a significant impact on energy and greenhouse gas emissions in the residential sector were reductions and efficiency increases in **lighting** and **water heating** activities. Refrigeration, although showing a substantial energy saving, is not as significant as lighting and water heating in terms of reducing electricity consumption.

The City of Cape Town began its Electricity Savings Campaign (ESC) a year ago, which has continued to build on existing electricity savings programmes already in place within the City. This specific campaign aims to reduce residential electricity use across the entire Cape Town metro area for mid- to high-income households by between 26% and 40%. Results of this nature would very substantially contribute to further energy savings, but could have implications for the city's revenue base from reduced electricity sales. Our work intends to build on and complement the electricity saving campaign in striving for greater energy efficiency within the central city environment.

What is the Electricity Savings Campaign Busy With?

A 2013 survey undertaken by the Electricity Savings Campaign across the Cape Town metro highlighted that Cape Town residents are eager to reduce their electricity costs. In order to expand public awareness about ways to save electricity, the ESC is currently developing a mobile exhibit of electricity efficient measures for the residential sector. Their intention is to take this to shopping centres and large scale building supply stores such as Builders Warehouse – places people visit when they are considering home renovations or moving houses. This exhibition is planned to provide advice and information on various efficiency measures including information on solar water heaters, infrastructure suppliers, installation and equipment options, potential energy savings, information on lighting, the energy consumption of appliances, green building developers and suggested builders to use if renovating. For more information on the ESC and their other activities, please visit their website here: **http://www.capetown.gov.za/en/electricitysaving/Pages/default.aspx**

Green Building Tools for Greener Homes

The Green Building Council of South Africa (GBCSA) has recently launched a new toolkit that helps multi-unit residential structures improve their own energy efficiency. By assessing the "green factor" in new and refurbished multi-use residential properties, this toolkit is helping to empower a greener high-density residential form for a less carbon-intensive urban fabric. Find out more about the Multi-Unit Residential Tool on the GBCSA website here: **http://www.gbcsa.org.za/green-star-rating-tools/multi-unit-residential-tool/**

Objective: Greater energy efficiency in the Central City's residential sector		
Strategy goal	Action plan	Who
To provide information on, and promote awareness of, energy efficiency measures for the residential sector	■ Promote information and awareness programmes among local ratepayers through the inclusion of an energy efficiency information leaflet in rates bills that inform residents of saving campaigns such as benefits of installing solar water heaters ■ Engage ratepayers associations about energy efficiency opportunities and work with them to involve local residents ■ Disseminate energy efficiency information to neighbourhood watch databases ■ Work with ESC and hold an energy efficiency forum meeting specifically for CBD area. This would include residential, commercial and government sectors	■ CCT ■ SEA ■ ESC ■ EE forum ■ Rate payers associations ■ Body corporates ■ Neighbourhood watch organisations
To build efficient water heating awareness and facilitation	■ Develop a media campaign about a SWH accredited supplier scheme and financial and environmental benefits of installing a SWH. ■ Link with work of the ESC. They have a list of accredited suppliers.	■ ESC ■ CTP
To promote energy efficiency awareness in residential flats (45% of all residents in the area reside in rented flats)	■ Develop suitable information to support energy efficiency programmes ■ Identify and work with interested body corporates to help disseminate information to residents ■ Hold meetings to explore possible partnerships with the Western Cape Government and the Sustainability Institute's demonstration facility at Oude Molen ■ Disseminate information to existing groups, such as neighbourhood watch databases, particularly in neighbourhoods like Devils Peak and Oranjezicht, which have large numbers of apartment blocks. ■ Link with the City of Cape Town's potential SMART living demonstration exhibition.	■ CCT ■ Body corporates ■ Neighbourhood watch

To promote low carbon approaches in new residential developments (e.g. District 6)	■ Develop broad guidelines for low carbon developments ■ Incorporate low carbon development into discussions and planning around District 6 development ■ Incorporate low-carbon initiatives in the *Development Guidelines for Land Use Management*, which encourage collaborative planning and zoning of new developments ■ Keep abreast of the progress of the City's Resource Efficiency Development Policy (this policy will be opened up to public participation shortly) ■ Examine City by-laws and relevant regulations that encourage low-carbon approaches towards new development, notably SANS 10400 Part XA.[27]	■ CCT ■ CTP ■ property developers for CBD ■ Architects ■ SAPOA
To promote efficient appliance purchases amongst consumers and residents	■ Determine the status of the national Department of Energy's appliance labelling programme ■ Promote this programme in the Central City	■ CT ■ CTP ■ ESC
To promote existing awareness tools that encourage energy efficiency in general	■ Explore existing tools such as the GBCSA has developed and assess the most appropriate for the residential sector. ■ Link with the ESC to expand the reach of the energy savings tips they have developed.	■ GBCSA, CTP, ESC

[27] SANS 10400-XA provides the 'deemed-to-satisfy' requirements for compliance with the National Building Regulations with regards energy usage

Energy Efficiency in the Commercial Sector

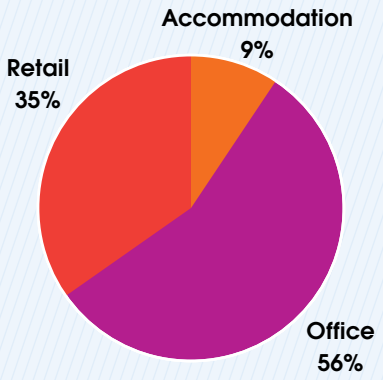
The commercial sector in this strategy includes the retail, office and accommodation (hospitality) sub-sectors. The graphs below illustrate that commercial office spaces have the greatest energy demand followed by retail and then accommodation. Due to data constraints, the accommodation sub-sector in the study did not include guesthouses outside of the core of the CBD. In future, the wider inclusion of hotels, bed and breakfasts, and other accommodation outlets in the low-carbon modelling will help to provide a more robust picture on the impact that the sector has on energy emissions. This will inform future mitigation actions for the strategy.

Pinning the Profit in Sustainability

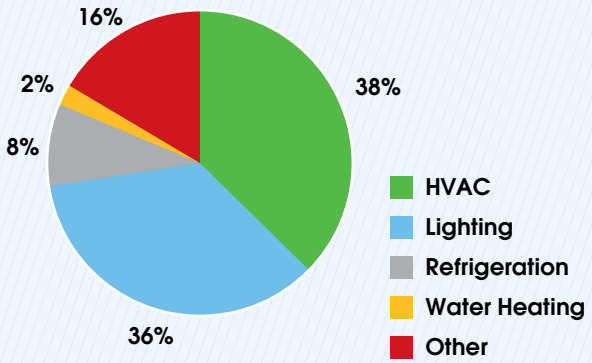
Going green sounds great for your company, but where's the profit in it? These two infographics, which come courtesy of publicly available Pinterest, show in graphical form exactly what businesses stand to gain from becoming more sustainable in policy and practice:

- The Triple Bottom Line for Business **http://www.pinterest.com/pin/523543525401841233/**
- The Business Case for Sustainability **http://www.pinterest.com/pin/523543525401654749/**

Energy demand by sub-sector in the commercial sector (2012)

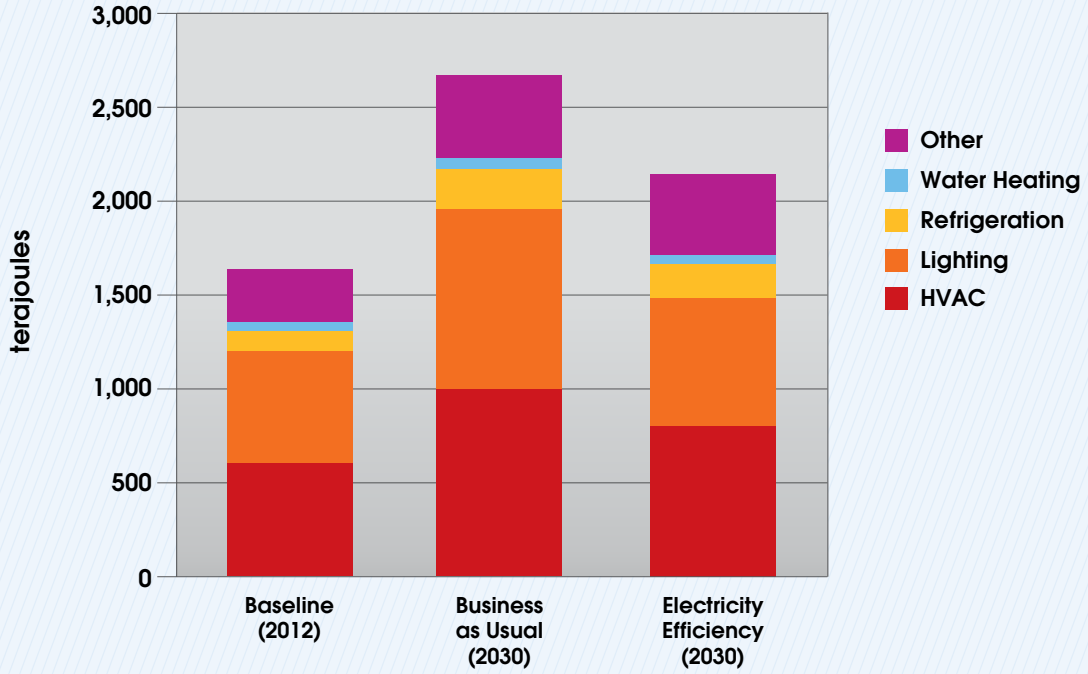


Energy demand by end-use devices in commercial sector (2012)

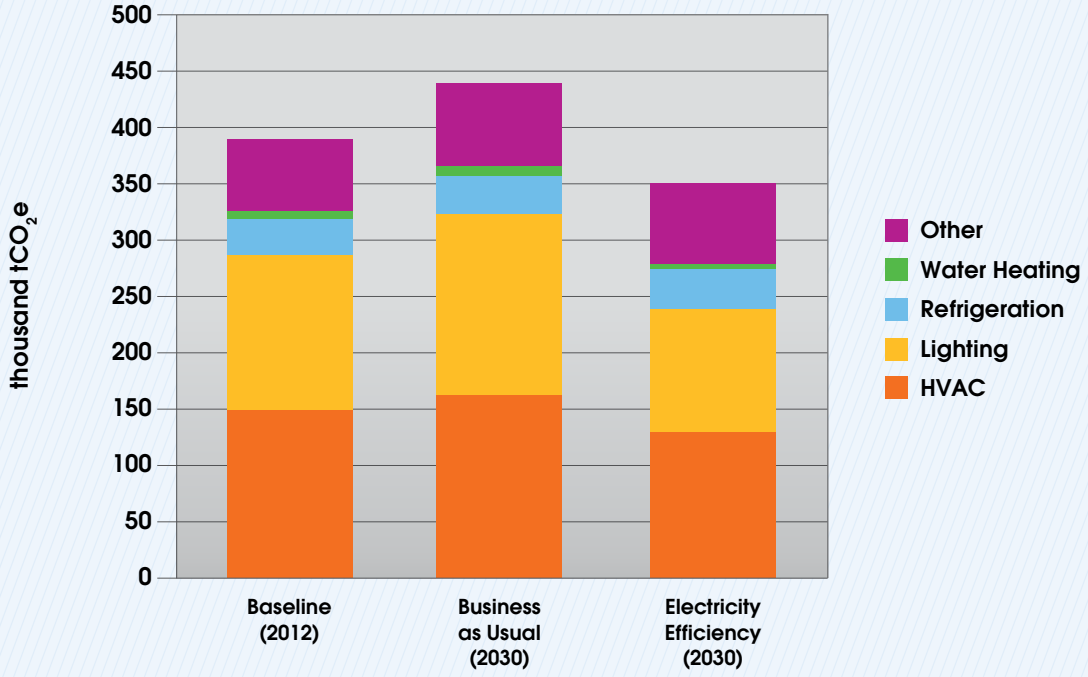


Note: The reason that the energy demand and emissions graphs are exactly the same (i.e. same proportions of emissions or energy demand by end-use) is due to the fact that only electricity (one fuel) was analysed. Therefore if 36% of electricity were used by lighting, 36% of emissions would be from lighting.

Impact of electricity efficiency interventions on commercial sector energy demand



Impact of electricity efficiency interventions on residential sector emissions



Realising Greater Value in Greener Buildings

Profit is often one of the biggest incentives for change. So how valuable is it for building owners to "go green" and retro-fit their buildings? In Australia, work has been done to show the increase in investment returns on green office buildings so that this question can be answered for property owners. The higher rents that can be secured from green offices are starting to make a significant impact in the cost/benefit equation for green retro-fits, which has driven many owners to pursue more resilient building remodels. In Australia, the sheer profitability of green retrofits has shifted the question from "Why would you go green?" to "Why would you NOT go green?"

For more information about how landlords are realising greater returns by going green in Australia, and the general performance of the green office market, see their report called "Building Better Returns" here: **http://www.api.org.au/assets/media_library/000/000/219/original.pdf**

It is evident from the graphs above that lighting and HVAC use hold the greatest potential for energy and emissions savings within the commercial sector. The strategy therefore focuses primarily on these two areas for implementation.

Similar to energy-saving strategies in the residential sector, the challenge of ownership, tenancy and incentives holds back both landlords and tenants from investing in more efficient building products and systems. Building owners do not feel that they reap the financial rewards from new building technology, often realised through lower utility bills. Tenants do not see the rationale behind financing more efficient operating systems if they do not reap the financial benefits over time, making the investment worthwhile in the end. The relationship between property owner and tenant is complex and in some cases the property owner is buying electricity in bulk from the City of Cape Town and selling on to the tenant. In other cases tenants may be buying directly from the City.

Prioritizing a Greener Private Sector

In order to catalyse large-scale change in companies across South Africa, the National Business Initiative (NBI) has recently launched the Private Sector Energy Efficiency Initiative. Funded in excess of R100 million by the UK Government, this tool will work with around 60 large companies and just over 1,000 medium companies to encourage a greater uptake in energy efficiency. The initiative involves working through advice, face-to-face support, and long-term energy management support to help companies gain a better footing for greener operations. Read more about this exciting new development here: **http://www.esi-africa.com/private-sector-energy-efficiency-initiative-launched-in-sa/**

New Instruments for Financing Retrofits

Cities around the world are grappling with how to make retrofits financially viable for building owners. Several cities, like New York, Melbourne and Berlin, are looking at new financing instruments created by the city governments themselves that help to make it easier and more cost-effective for building owners to go green. Read more about these instruments on the Global Urbanist website here: **http://globalurbanist.com/2014/01/14/financing-energy-efficiency?utm_source=The+Global+Urbanist+All+Subscribers&utm_campaign=5dfecd0154-Mailchimp+weekly+RSS+email&utm_medium=email&utm_term=0_8e67c2efd8-5dfecd0154-284283593**

In addition to their work on green leases (discussed in the section on residential efficiency above), the Green Building Council of South Africa has developed new tools to address commercial energy efficiency head-on. By creating new rating systems for both new and existing buildings, the Council is hoping that it will be able to show the financial rewards of investment in green technology not only through utility savings costs, but also through increased tenant demand and rent prices.

Growthpoint, a major South African commercial property developer, has embarked on a nationwide programme to retrofit its office rental stock with energy-efficient lighting. Although the capital costs are estimated to be quite high, Growthpoint has worked directly with tenants to ensure that the energy and financial savings will be shared equally between the tenant and Growthpoint. The developer has arranged for the signing of a Green Addendum with its clients to enter into this programme: So far, 75% of tenants have signed on. Programmes like this could be replicated and rolled out between other tenants and owners in the commercial sector to realise greater energy savings through dedicated and continued partnerships. Further supporting these efforts are programmes based on

effective communication, behaviour change and education that help employees and owners alike better understand how their actions inside buildings impact overall energy savings.

Much work will need to be done in terms of building awareness, building relationships and highlighting the benefits of behaviour change. Not all companies have been willing to either actively engage in assisting with the development of this strategy, or to look at ways in which the corporate sector can be involved in energy efficiency. Communication will be critical to reverse this trend. In addition, information on the financial implications of building retrofits, such as the capital and maintenance costs per square metre under BAU compared to the savings per square metre accrued when energy efficient interventions are implemented, needs to be made more available to both developers and tenants. This will help underscore the financial sense of greener buildings and retrofits. This strategy aims to develop campaigns and other support tools to assist property owners and tenants to develop business cases for "going green," thus facilitating the transition from the current state of our built environment towards a new way of looking at buildings as engines of green change.

Some actions require working very closely with the electricity department, which needs to be engaged with at every step in the implementation of those action areas: For instance, load shedding-avoidance incentives and smart meters. Smart meters are recognised as a tool for the consumer to assess how much electricity they are using and so help incentivise behaviour changes

This strategy helps to expand on how behaviour and efficient technological interventions could bring about greater savings. Pilot projects in the central city could go a long way towards creating real-time examples of the new ways that people can be at the heart of built-environment change. By using examples to demonstrate savings, two to three buildings can serve as case studies that let the public see change over time through open data, smart meters and behavioural shifts.

Objective: Commercial sector to become Energy Efficient		
Strategy Goal	Action Plan	Who
To engage with large property owners on energy-efficiency potential, leasing models, financing options	■ Assist the City of Cape Town in rolling out and publicising their Energy Efficiency guides ■ Investigate and promote suitable leasing models in partnership with the Green Building Council and SAPOA ■ Identify suitable property owners and engage with these stakeholders ■ Engage SAPOA around energy efficiency and the identification of influential property owners who would be amendable to testing new energy-efficiency technology, leasing models and financing options	■ CT ■ CTP ■ GBCSA ■ Growthpoint ■ SAPOA
To promote the distribution and activation of Green Building Council of South Africa (GBCSA) **toolkits**	■ Facilitate workshops with building owners, tenants and the GBCSA to activate toolkits ■ Publicise GBCSA toolkits including the new existing building performance tool which will assess the environmental performance of existing buildings ■ Encourage the use of the new Green Star Interiors rating tool that assesses the environmental attributes of interiors of individual tenant spaces within buildings. This is particularly useful for office, retail and hospitality as it lets tenants monitor their individual workspace, even if it is part of a larger building.	■ CTP ■ GBCSA
To promote information and awareness for tenants and small property owners regarding energy-efficiency interventions	■ Facilitate **building tenant and property owner energy efficiency forums for the CBD area** ■ Link with the City of Cape Town ESC and energy efficiency forums ■ Consider an energy efficiency forum that focuses on the CBD area but is also open for participation by all members	■ CTP ■ ESC ■ CCT

Strategy Goal	Action Plan	Who
To develop a **support facility** for building owners and tenants To promote information and awareness for tenants and small property owners regarding energy efficiency interventions	■ **Develop supportive information** to (1) encourage tenants to lobby for energy efficiency upgrades, and (2) encourage owners to implement energy efficiency changes in their buildings ■ Develop the following data indicators: □ Possible savings achievable via EE (cost-benefit) □ Case studies of good practice (e.g. Waterfront, Growthpoint buildings) with costs and savings clearly demonstrated □ Energy efficiency retrofit guides (e.g. SEA's HVAC guide) □ Profiles of property owners that are proactive in installing EE measures ■ Work with smaller tenants such as call centres that operate 24/7 due to their great potential for significant savings within this sector ■ Target small business owners as most of the large owners are already engaged in green initiatives	■ CTP ■ CCT ■ SEA ■ Growthpoint ■ GBCSA
	■ Establish a support facility for those requiring advice, audits, information around energy efficiency and carbon-footprint reduction through possible options such as: □ A City of Cape Town walk-in centre at a City building, with 44 Wale Street being a notable possibility □ An Energy Service Company (ESCO) website □ More information on the financial costs of green retrofits, per square metre (capital and maintenance inclusive) and cost savings per square metre, in order to inform better decision-making processes. ■ Develop an Energy Roadmap – a basic "how-to" guide on adopting an energy-efficient approach to developments, business and general living ■ Provide case studies or success stories of energy efficiency implementation ■ Provide an understanding of technology, products, processes and service providers	■ CCT ■ CTP ■ ESC

Strategy Goal	Action Plan	Who
To create incentives that encourage energy efficiency in buildings	■ Facilitate working partnerships between building owners and ESCOs in order to encourage more efficient electricity usage ■ Upgrade and publicise current ESCO website	■ CCT ■ (ESC, SEA)
To implement a high-profile media and website campaign that promotes the benefits of energy efficiency along with ways to activate energy efficiency measures	■ Ensure **Eskom Integrated Demand Management (IDM)**[28] programme is used to a maximum, and develop awareness and clear understanding of the funding options within IDM programme ■ Explore the possibility of a focused workshop with Eskom on their rebate incentives ■ Disseminate energy efficiency information via media outlets and workshops	■ CTP ■ SEA
	■ Develop awards programme for the most energy efficiency buildings at various geographical levels, such as quadrants of the CBD, the entire central city and Cape Town as a metro-region	■ CCT ■ CTP ■ ESC
	■ Design a specific communications programme ■ Secure high-level buy-in at various political and corporate levels ■ Link with the City of Cape Town's Energy Savings Campaign ■ Develop a user-friendly website ■ Build awareness and demonstrate behaviour change programmes using *The Terraces*, a Growthpoint building in the CBD, as a demonstration project ■ Investigate installing smart meters for each tenant and monitor electricity use and identify where behaviour could change; measure impacts as a case study to illustrate return on investment ■ Arrange tours of green buildings for current and prospective building owners and tenants ■ Create a competitive spirit amongst buildings in pursuing targets of optimal energy efficiency in their daily operations and functioning ■ Develop an accreditation map of green initiatives in the central city	■ CTP ■ Growthpoint ■ Electricity Department

[28] Through this programme, Eskom assists in the funding of the retrofit of commercial buildings

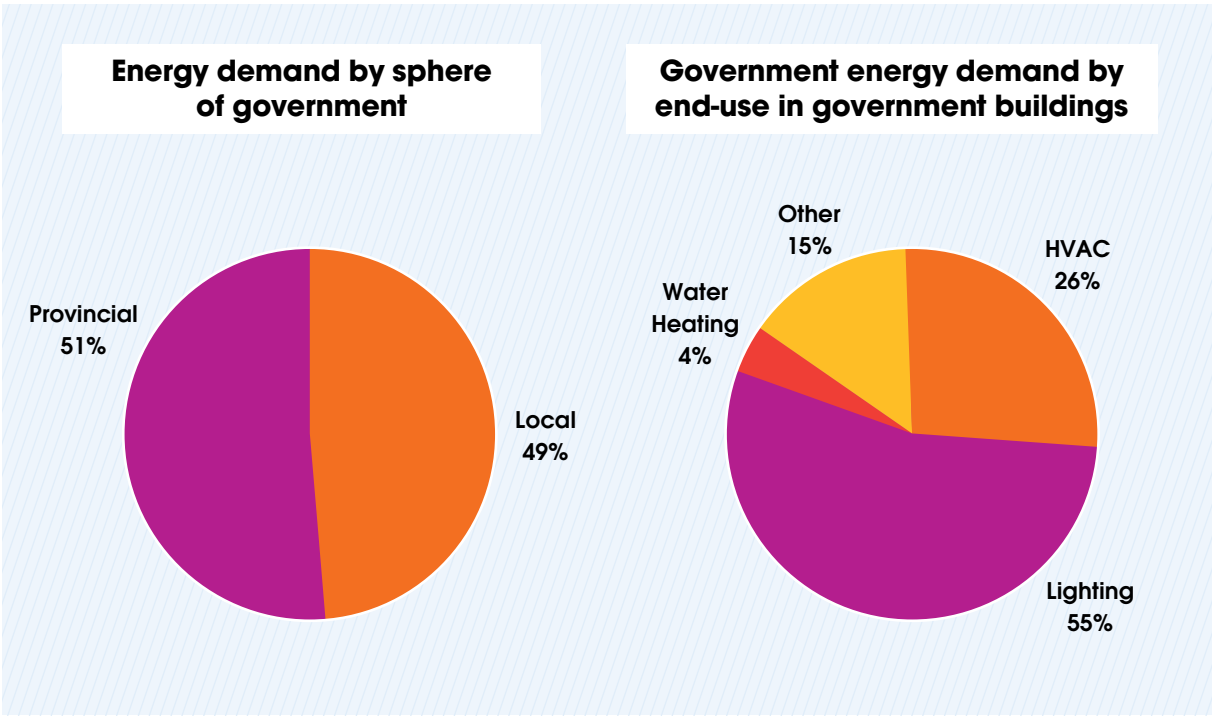
Strategy Goal	Action Plan	Who
To establish feasible and functional energyefficiency training programmes	■ Develop training programmes for CBD building managers and draw on City of Cape Town course materials for additional reference ■ Contact SAEE[29] for resource support ■ Partner with the Green Building Council of South Africa on their training programmes ■ Facilitate running of training programmes ■ Include property owners who have implemented low-carbon actions and invite them to share information about their experiences in going green	■ CTP ■ ESC ■ SEA ■ GBCSA ■ Property owners ■ SAPOA
To establish a specific energy efficiency promotion programme for hotels and accom-modation facilities in the central city	■ Facilitate the training of architects & interior designers regarding green building regulations	■ CTP, academic departments
To promote awareness of energy-efficient technology options that are currently available for procurement	■ Develop and collate new and existing energy-efficiency information, manuals, and guides for the accommodation industry ■ Discuss & plan broad-reaching energy-efficiency interventions with specific organisations such as Cape Town Tourism & the Federated Hospitality Association of South Africa (FEDHASA) ■ Develop an energy efficiency forum for the accommodation sector	■ CTP ■ FEDHASA
	■ Conduct field trips and roadshows that demonstrate efficient technologies and behaviours along certain activity corridors within the central city	■ CTP
To encourage load-shedding avoidance incentives	■ Preferential treatment by the City of Cape Town municipal government to buildings that demonstrate energy efficiency interventions – this needs to be explored with electricity department and decide if feasible (consider substation zones linked to CTP broadband groups as an option)	■ CCT ■ CTP

[29] Southern African Association for Energy Efficiency

Energy Efficiency in the Government Sector

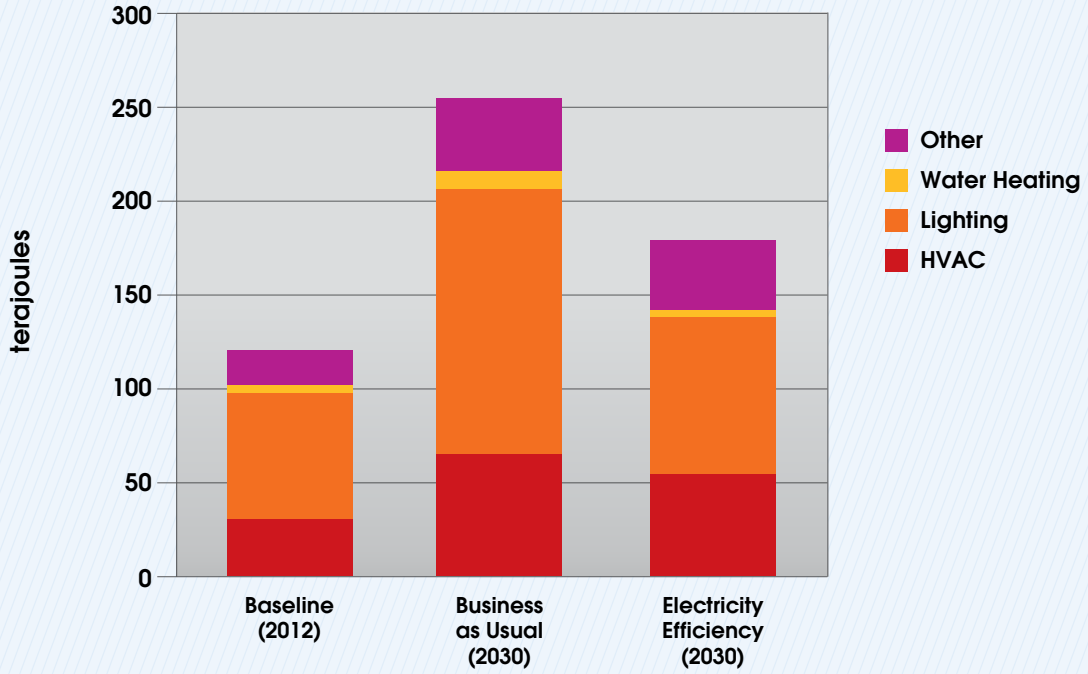
The City of Cape Town offices, Western Cape Provincial Government offices, National Government offices and Parliament are all located within the heart of the CBD, making government one of the most important stakeholders in the pursuit of a low-carbon central city. Within Cape Town's CBD alone, more than 21,000 government employees work in 109 individual government offices and serve more than 27,000 members of the public on a daily basis.[30] Given government's prominent physical presence in the central city, the potential to introduce and build on existing efficiency strategies and for government to lead by example from within all three spheres is significant.

The data available provides a breakdown of energy demand only for local and provincial government *buildings* within the central city area. For the future it would be useful to access data on energy demand of national government buildings and Parliament within the CBD as well, should the data become available. Data on electricity use for street and traffic lighting was not available at the central city level. This data is only available at the metro level. For similar reasons, data on the vehicle fleet is not included. The focus in this report is on energy efficiency in government buildings.

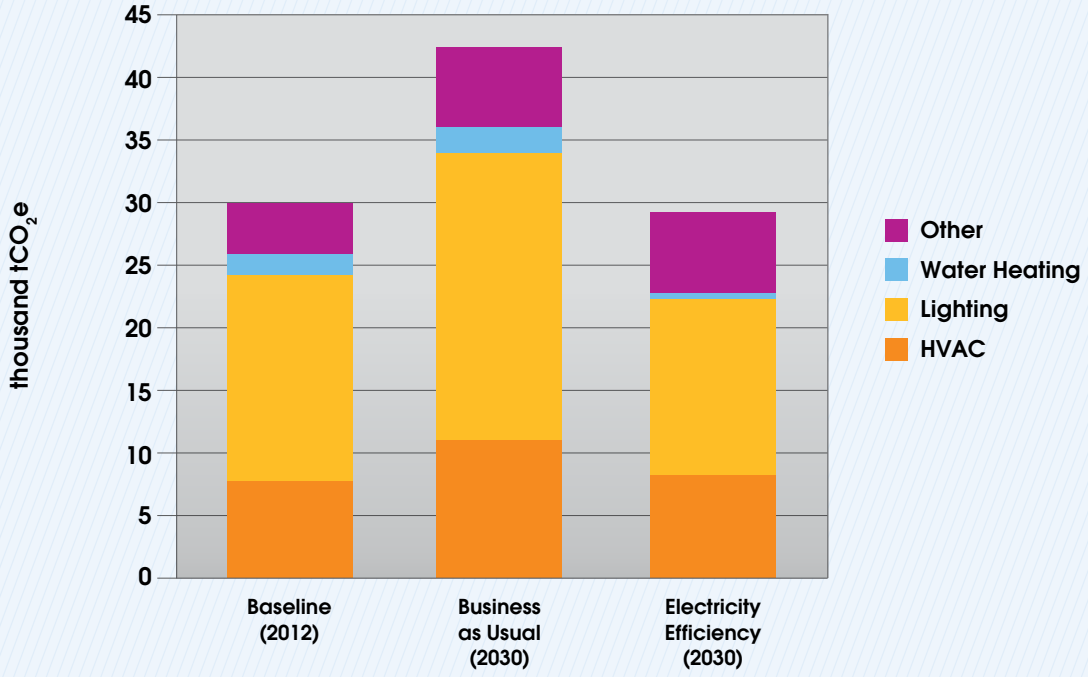


[28] "State of Cape Town Central City Report", 2012. Cape Town Central City Improvement District.

Impact of electricity efficiency interventions on government sector energy demand



Impact of electricity efficiency interventions on government sector emissions



In government buildings, lighting accounts for the largest share of electricity use, and it is here that the potential and focus on efficiency lies. Although overall government as a sector is the smallest contributor to greenhouse gas emissions in the central city (3%), it should be leading by example and showing other sectors what is possible. This means they need to be implementing changes as well as informing the public of what they are doing. Both the Western Cape Government and the City of Cape Town have impressive policies, plans and strategies in place, including, amongst others, the Energy Strategy and the Energy and Climate Change Action Plan (ECAP) of the City of Cape Town, and the Green Economy Strategy Framework and the White Paper on the Promotion of Renewable Energy and Clean Energy Development of the Western Cape Government.

Government sector to be energy efficient		
Strategy Goal	Action Plan	Who
To ensure strategy alignment with current City of Cape Town energy saving strategies	■ Review IEMP and ECAP and other strategies as they are updated or developed at the City of Cape Town ■ Maintain a close link with the City of Cape Town's environmental, transport and electricity departments to ensure that new data and policies are readily implemented and activated.	■ CCT ■ SEA ■ Steering committee ■ CTP
To ensure strategy alignment with current Western Cape Government energy saving strategies	■ Establish a close link with WCG to ensure alignment of plans and strategies	■ CCT ■ Steering committee ■ Province
To raise awareness and understanding of energy use within government buildings for government employees	■ Set up a training programme for all City of Cape Town and Western Cape Government building managers (part of IEMP) that focus on practical infrastructural implementation, such as the reading of smart electricity metres (AMI) ■ Link with ESC electricity saving tips	■ CTP ■ CCT ■ ESC
To promote the idea that the City of Cape Town requires energy efficiency measures be in place in all buildings considered for leasing and occupation	■ Explore legal issues with Supply Chain management at the City of Cape Town	■ CCT

Government sector to be energy efficient		
Strategy Goal	Action Plan	Who
To reduce the energy consumption of existing government buildings	■ Conduct an audit of government buildings already retrofitted with energy efficiency measures ■ Develop targets for remaining buildings to be retrofitted ■ Source funding and undertake energy efficient retrofit of remaining buildings	■ CCT ■ CTP ■ SEA
To promote energy efficiency in historic building stock whilst maintaining heritage status	■ Development of guidelines for solar water heaters and renewable energy installations on sensitive heritage buildings and streetscapes	■ CCT
To encourage the reuse of existing historical buildings rather than demolishing and rebuilding or building new buildings	■ Integrate into City Policy such as Resource Efficient Policy and IEMP	■ CCT
To motivate for, where appropriate, the removal of unsightly air-conditioning systems	■ Create guidelines for retrofitting buildings within relevant policy documents	■ CCT
To encourage the recycling of used building materials	■ Development of a building material bank and development and implementation of policy	■ CCT

Renewable Energy

In recent years, there has been a huge uptake of solar photovoltaic (PV) systems internationally, primarily due to the declining cost of PV systems and set against the backdrop of increasing electricity prices and the trajectory towards low-carbon development.

In South Africa, the recent price escalations announced by Eskom and the National Energy Regulator of South Africa (NERSA) have further encouraged the usage of small-scale embedded generation such as solar PV installations among commercial and residential energy consumers alike. Currently, however, there are few measures provided

Photovoltaics (PV)

Photovoltaics (PV) generate electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels composed of solar cells containing a photovoltaic material. Embedded generation, also called distributed, on-site, dispersed, or decentralized generation, refers to electricity generation from many small energy sources, e.g. solar panels on a roof building, as opposed to large, central solar PV plants.

by government to incentivise the use of renewable energy, primarily due to the ability of municipal governments to on-sell electricity to consumers at a profit, providing an increase in overall municipal budgets.

Embedded generation, generally secured through rooftop-mounted solar panels, is included as an important area in the Integrated Resource Plan (IRP)[31] and is seen as an important demand-side measure from the perspective of government, particularly the National Department of Energy (DoE). Policies have been set up to enable the use of PV in the national energy mix, although there is ongoing debate around the legality of connecting and feeding back energy generated from PV into the national grid. These concerns from Eskom and the National Energy Regulator (NERSA) are based largely on the associated cost implications, and the fact that national power infrastructure has not yet been enabled and set up to take on externally-generated energy inputs. Municipalities across South Africa have interpreted the legislation around this differently, resulting in a variety of policy approaches towards PV and renewable energy.

Project developers wishing to connect their renewable energy projects to the electrical grid are currently unable to legally do so in the City of Cape Town. The City will allow renewable energy projects provided that the energy is for the specific use of the building generating the power, and not fed back into the grid. At present the City of Cape Town's electricity department is in the process of exploring the possibility of allowing feedback to the grid, but no date has been set for approval and implementation of this action. Small-scale embedded generation tariffs have also been tentatively devised but have not yet been implemented.

Within the CBD area, the amount of roof space available could potentially allow for 48MW of electricity to be generated through embedded solar PV. In the light of the costs of implementing small-scale solar PV, the amount of available roof space and the fact that the City of Cape Town has not yet finalised guidelines and regulations governing PV implementation, nor a strategy on how feeding renewable energy into the grid would operate, renewable energy via PV is significantly less viable in the immediate future. However, this strategy considers renewable energy via PV as a long-term option for the central city.

[31] The national electricity build programme of the Department of Energy.

Transport and Sustainability in the Central City

By totalling all the passenger-kilometres travelled into, around and out of the central city, we get an excellent snapshot of people's regular way of travelling:

- 54% Cars
- 24% Trains
- 12% Buses
- 9% Taxis
- 1% Non Motorised

HOWEVER Different forms of transport use different amounts of energy:

This means that while they account for 54% of passenger-kilometres, cars use 87% of all transport energy

Occupancy matters

The energy used by cars drops significantly when more people ride in one car (Megajoules per passenger-kilometre):

Transport Energy Efficiency: The Lower, the Better (Megajoules per passenger-kilometre):

1.8	PETROL CAR
1.2	HYBRID CAR
0.9	BUS (Golden Arrow)
0.5	BUS (MyCiTi)
0.5	MINIBUS TAXIS
0.1	TRAINS

7 500 kJ
Single occupancy petrol car

20 percent
The increased percentage of CO_2 released during shorter trips

250 kJ
Total energy found in 1 egg

500 kJ
Walking

250 kJ
Cycling

To travel 2.5 kilometres by bicycle only uses 250 kJ of energy... while a car uses 30 times more energy to do the same

8 779 TERA JOULES

The estimated amount of energy required for transportation in 2030 to keep up our current use

We can reduce our future transport energy demand to the following levels:

8 263 TJ
If we use Own Steam transport like walking and cycling

7 655 TJ
If we use more public transport like trains as well as buses

7 338 TJ
If we avoid transport by living closer to work or working from home

6 670 TJ
If we Travel Smart by ride sharing and carpooling

Solar PV embedded generation and Renewable Energy Promotion		
Strategy Goal	Action Plan	Who
To facilitate more informed decision-making by residential and commercial users around the implementation of Photovoltaic Renewable Energy	■ Develop general information guides for commercial and residential sectors that detail the financial implications, technology standards, tariffs, billing and other factors associated with installing and using PV ■ Keep the strategy up-to-date with national processes and policies that influence and support small-scale embedded renewable energy generation ■ Support the efforts of external organisations, such as the South African Local Government Association (SALGA), that are working to find solutions towards the challenge of electricity tariffs and municipal budget structure	■ CTP ■ SEA ■ SALGA ■ City of Cape Town
To support the City of Cape Town's electricity department with information and research as and when necessary	■ Hold regular meetings with the City of Cape Town's Electricity Department to monitor the progress of discussions regarding renewable energy and PV implementation ■ Support the restructuring of municipal budget flows at the City of Cape Town where relevant and beneficial ■ Provide the City of Cape Town's electricity department with information that supports the case for renewable energy implementation	

Transport:

The Low-Carbon Central City Strategy seeks to promote the development of a transportation infrastructure and public education campaign to encourage a low-carbon movement pattern into and throughout Cape Town's central city.

Introduction

Cape Town's local transportation sector is currently undergoing a transition, both in policy and in practice. The newly created Transport for Cape Town (TCT) authority has the potential to strengthen and extend the fragmented offerings of public transport in the city to help Cape Town move towards a low-carbon transport future. In addition, the City's

Integrated Transport Plan (ITP) outlines over R900m of public transport investment planned and budgeted for the 2014-2015 financial year showing the City of Cape Town's commitment to an expansion of public transportation. Meanwhile, the Cape Town Partnership, its business partners and the City of Cape Town more generally continue to promote more people-centred, high-quality and sustainable urban environments around the central city, all of which encourage greater amounts of "own steam" and public transportation.

One of Cape Town's biggest challenges at present with regards to low-carbon transport involves the collection of data, its public presentation and the way people understand what it shows. It is not easy for people to see the critical link between the way they move around the city and the effects that it has on the environment.

Other challenges to a low-carbon future for Cape Town's transportation network exist, notably:

Transport for Cape Town

The new Transport for Cape Town authority has set out to revolutionise the way that transportation is planned, constructed and maintained in Cape Town. For more information on TCT read this article by Future Cape Town: **http://futurecapetown.com/2012/10/transport-for-cape-town-a-new-era-for-south-africa/#.Uqak8tISaSo**

1. Apart from a strong local public transport focus, the elements that could form a low-carbon central city transport strategy, such as support for walking, cycling, improved parking management, and other strategies to avoid or reduce travel, are relatively underdeveloped, and do not have strong financial mandates to support their expansion.

2. The non-motorised transport sector has been increasingly supported by the City government, but given that 30-40% of all peak hour Cape Town trips are on foot[32] and that walking is (after cycling) the most energy efficient mode it remains a relatively poorly funded sector when compared to other transport investments. Worryingly, statistics point out that, on average, one pedestrian each week will require hospitalisation due to a serious traffic incident in the central city.[33] This only further emphasises how badly the non-motorised transport sector needs support.

3. Managing transport demand and behavioural change in the transport sector are also relatively undeveloped activities to date. Efforts so far have tended to be demonstration-type or pilot projects rather than well-supported, institutionalised long-term campaigns.

The Inner City Transport Plan (ICTP) calls attention to these matters in some detail, but it does not yet have a mandate or funding streams.

---

[32] Page 17, ITP, August 2013

[33] From SAPS data for 2008-2011 for Seapoint, Cape Town and Woodstock areas. Actual figures may be much higher due to discrepancies between SAPS and FPS data.

This strategy makes use of the data that we have collected on transport emissions to suggest interventions to address the challenges that Cape Town faces. The modelling work related to transport reinforces the need for strategies that support a strong low-carbon perspective. Importantly, any action taken to activate transport as a catalyst for carbon reduction should continue to build on the good work and action plans already underway across the sector by government, private individuals and other interest groups.

In order to divide the collected data and policy recommendations into working categories, this strategy created four focus areas that brought together different aspects of central city transport for further evaluation. Each focus area, or scenario, is matched with its own modelling, showing how its adoption would change the carbon intensity of transportation within the central city over time.

Below is a short description of each focus area:

- **Travel Smart** – This strategy underscores the value of carpooling and collective movements by getting people out of individual cars and into shared vehicles. In this way carbon emissions can start dropping on a per-person basis as vehicle efficiency and energy are maximised.

- **"Own Steam" Transport** – This strategy envisions a central city which is easily and safely accessed by one's "own steam", meaning mostly on foot and, especially from inner suburbs, by bicycle. This prioritises "own steam" transportation in the central city area, and relies primarily on public transportation for everything else. In this focus area, movement by private car is actively discouraged.

- **Support Public Transport** – This strategy prioritises public transport for commuters and provide new ways of taking the "last leg" of your trip – i.e. localised services to connect people to their destinations as well as parking management, and other walk/cycle interventions.

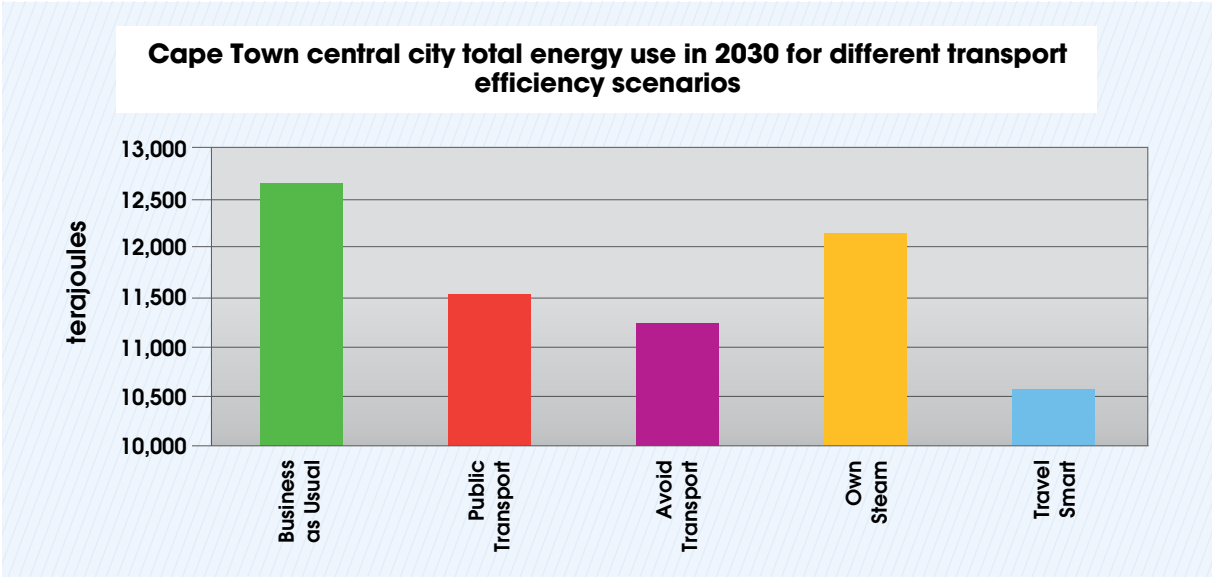
- **Avoid Transport** – This strategy actively encourages higher residential densities in order to reduce the need for short-distance motorised transportation in and around the central city, along with the need to commute into and out of the central city each day for work and social activities.

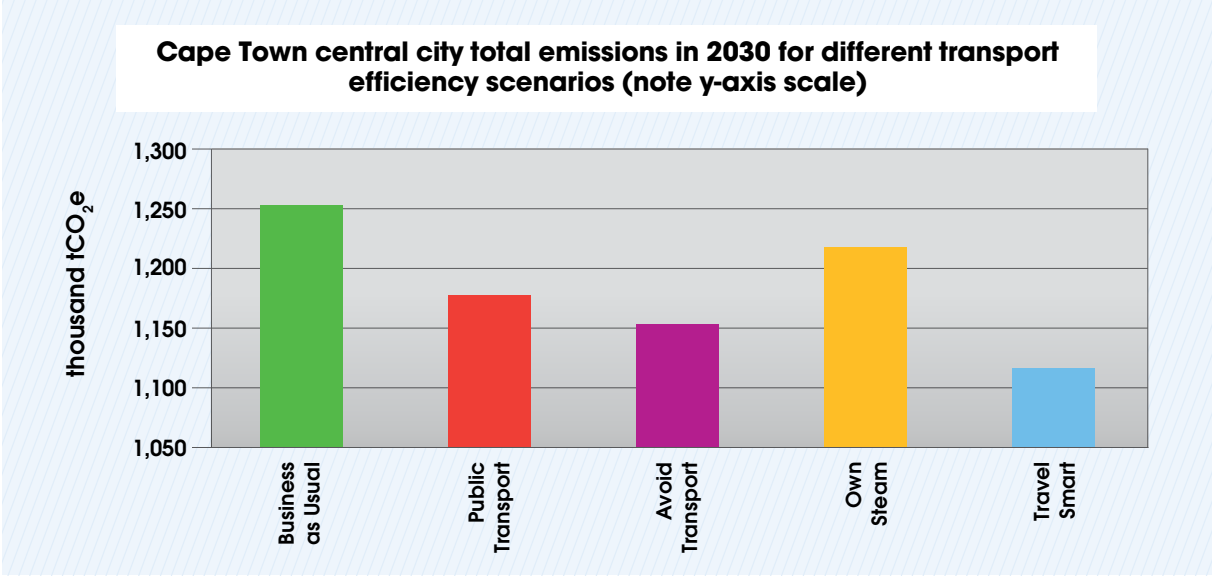
Planning for a More Connected Inner City

The Inner City Transport Plan, currently in draft form, is a local area planning document which draws on earlier planning work done in 2008 as preparation for the 2010 FIFA World Cup, and the Central City Development Strategy.

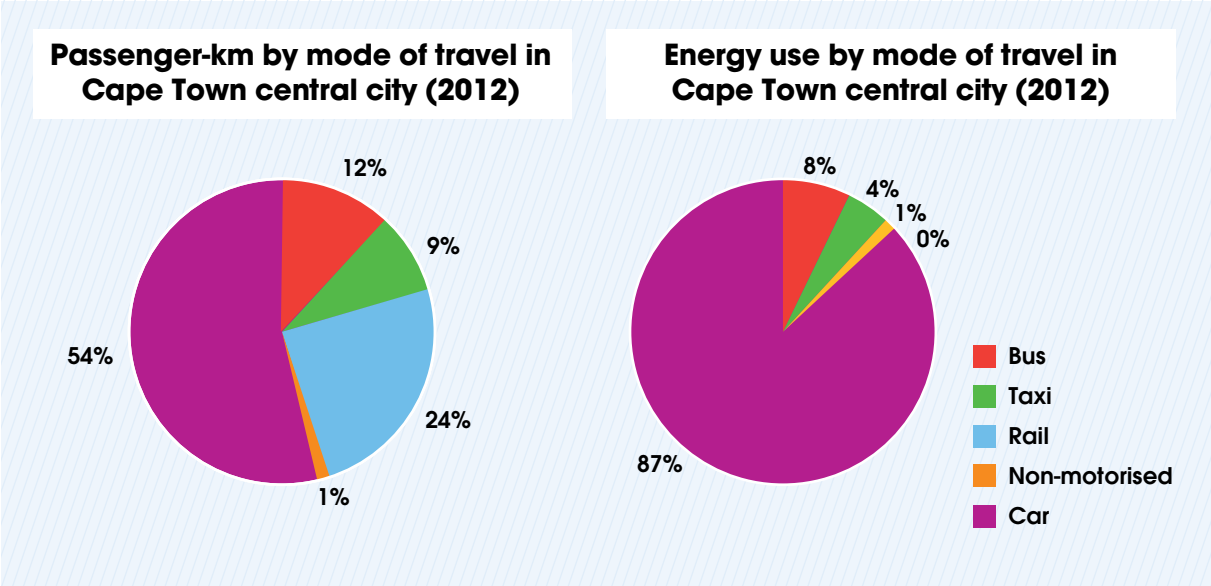
It presents a detailed status-quo review of transport in the inner City, proposes a decision-making framework, and outlines action steps for the shorter term.

Although the baseline case for transport was challenging to establish due to a lack of robust data and the limitations of the LEAP model in reflecting the complexities of land-use-transport and economy-transport interactions, the models give important *indications* of broad-level energy and emission impacts for each of the strategy areas.





Overall, this strategy shows that each focus area has low-carbon emissions benefits. Measures which target the single occupancy vehicle have the largest impact. This is simply because the single occupancy vehicle is by far the biggest contributor to central city transport energy use – even seemingly modest behavioural changes and reductions in private motor vehicle use can have disproportionately large carbon savings for the central city.



THE STRATEGIES

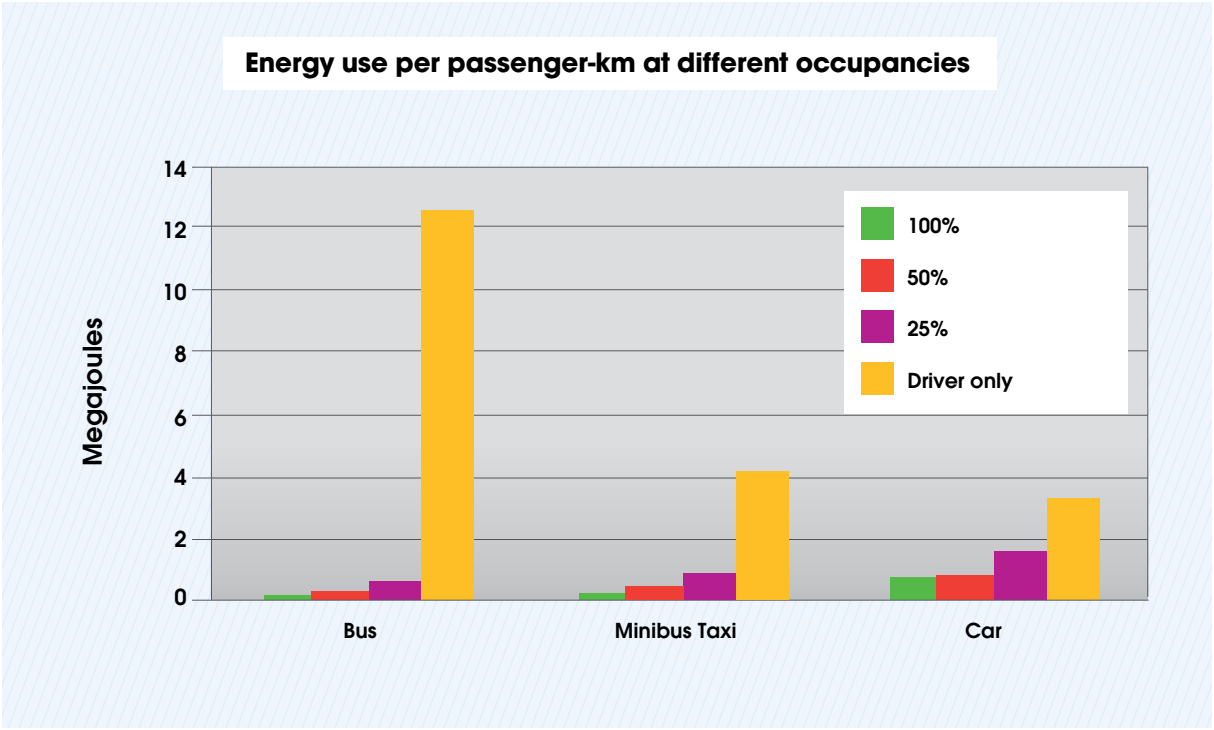
Travel Smart

The Travel Smart focus area of the Low-Carbon Central City Strategy is based on the existing *TravelSMART* behavioural change project run by the City of Cape Town, which collaborates with businesses, organisations and individuals at a micro scale to promote practical transport changes, like carpooling, which can help to reduce transport-related energy use and emissions. The City's *TravelSMART* programme optimises the use of Cape Town's "fleet" of private cars by reorganising their use as a collective resource. Currently, thousands of empty vehicle seats are moving around in private vehicles. If more of these seats can be used to move people, overall emissions per head will decrease as fewer cars will be moving around; road space will free up as vehicles are removed from the road; and companies will save money on the costs of providing parking bays and infrastructure. Above all, carpooling produces individual benefits and incentives such as a significant reduction in money spent on fuel, vehicle maintenance and parking.

Increasing car occupancy through carpooling, lifts clubs and lift shares was shown by the LEAP modelling to be a very influential tool in reducing the central city's carbon emissions. This is backed up by extensive international research that shows the success of other carpooling programmes similar to that of *TravelSMART* in reducing urban carbon

emissions at relatively low public investment. A recent *TravelSMART* pilot programme conducted by the City of Cape Town demonstrated these tangible benefits and indicated that *TravelSMART* is a programme worthy of support and expansion.

Two frequently cited disadvantages of lift-share schemes are decreased flexibility for business travel and concerns about getting home in the case of unexpected domestic issues. These problems can be overcome, and have been overcome elsewhere, through policies such as work-place vehicle sharing and subsidised taxi arrangements for emergency situations. As well as carpooling and lift-shares, *TravelSMART* encourages other methods of transportation such as walking, cycling, public transport and "eco-driving" when car journeys are still necessary.



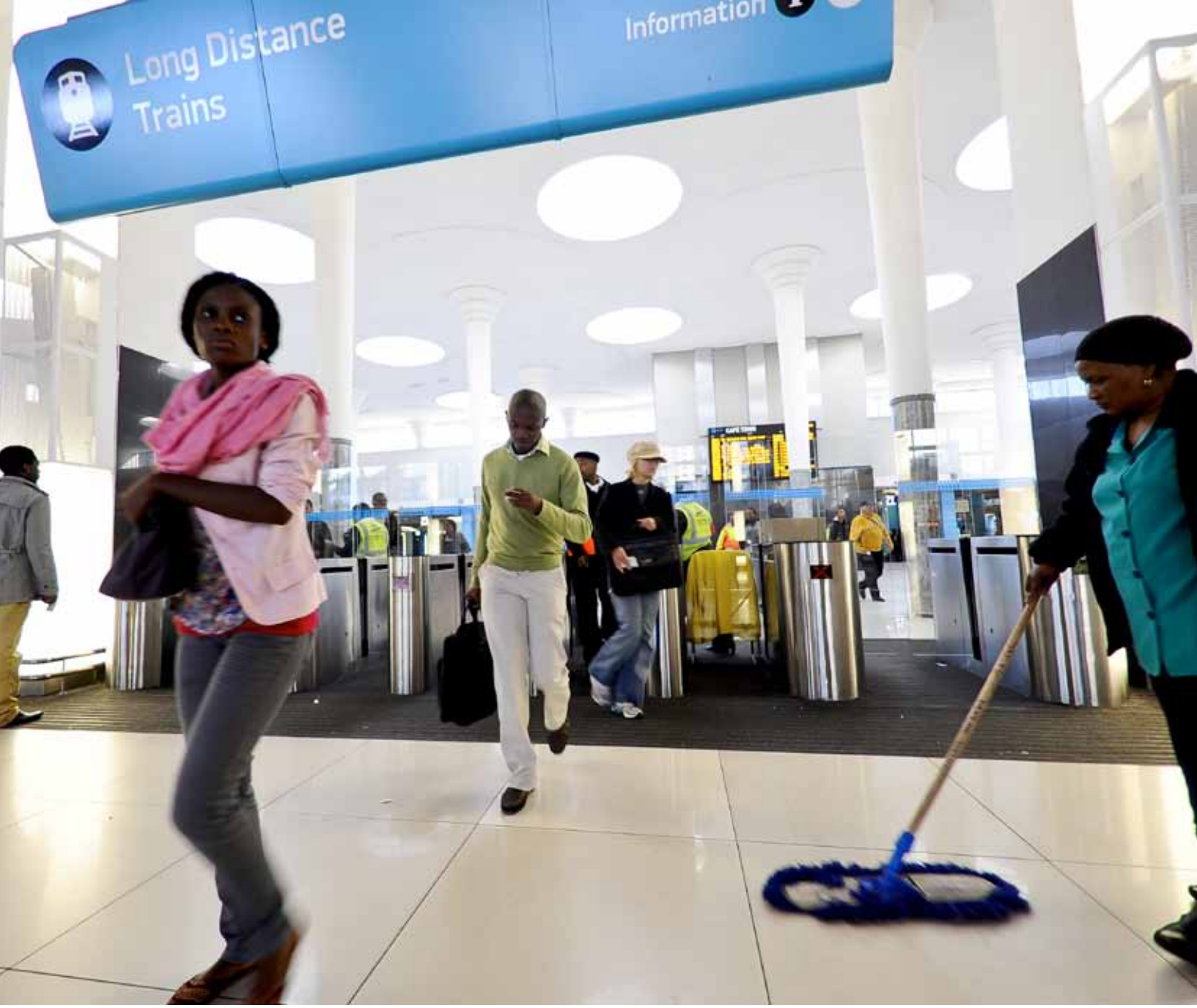
A comparison of bus, minibus, rail with driver only, driver plus 25% occupancy, driver plus 50% occupancy, and driver plus 100% occupancy. Note: 100% occupancy assumed to be 4, 16 and 90 for car, minibus taxi and bus respectively

Creating a Better Way to Carpool

The Green Building Council of South Africa, Adidas, Dimension Data and a large number of well-known national and international companies are among the 100+ companies that will soon have access to the new "FindaLift" scheme at the Black River Office Park in Mowbray, Cape Town. FindaLift will match people, via an online platform, who use similar routes in order to make carpooling quick and easy to arrange. Says Lauren Le Roux, tenant liaison manager at the Black River Park: "The FindaLift movement ... encourages fewer cars on the road which not only reduces pollution and saves on the cost of motoring, but also creates a culture of sharing and social cohesion."

"We can talk about the power of technology to change travel behaviour until we are blue in the face, but what we truly need is a positive human response," says Daniel Claassen, creator of FindaLift.

FindaLift is a programme that can be rolled out at any large office building in South Africa. It easily integrates with the web infrastructure of companies and office buildings, requiring little to no branding change. For more information on this low-carbon carpooling tool, please visit the website at: **http://www.findalift.co.za.**



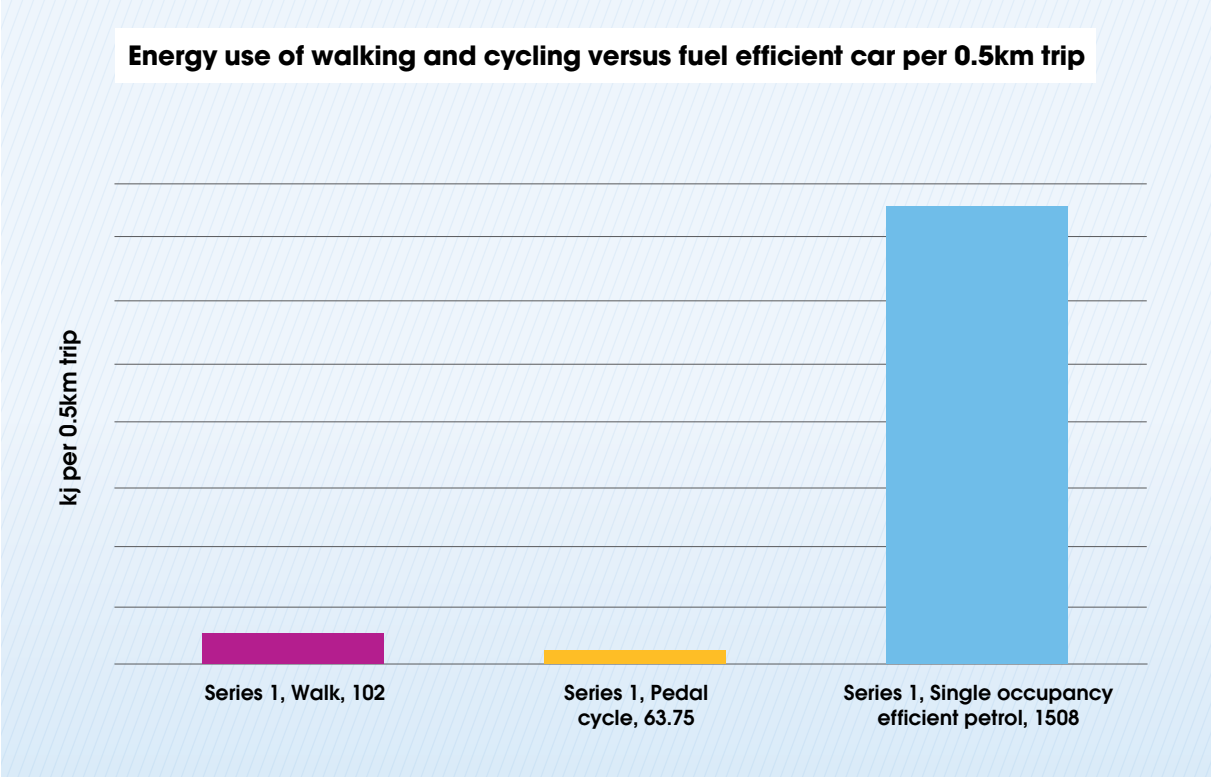
This strategy's Travel Smart plan builds on the success of the City's *TravelSMART* programme by promoting a similar shift in behaviour, activity, and planning. Travelling in a more carbon-friendly way is not only about individual choices. The infrastructure that all forms of transport use has a large influence on the efficiency of operations, and can make a significant difference in the length of time and intensity at which motorised vehicles operate. Optimising existing traffic operations is a great place to start: Prioritising sustainable transport and *overall* energy economy would require a review of existing traffic signal operations and street design plans.

There is also a strong business case for encouraging the adoption of a more fuel-efficient approach towards the regular operations of bus and taxi companies. Optimising public transport operations in these sectors requires little infrastructural investment and can be enabled through better monitoring, education and sharing of best practices among vehicle owners and operators. The uptake of these practices is highly likely, given the strong business case and the potential savings that can accrue to owners and operators through fuel savings and maintenance cost reductions.

Objective: Encourage a Central City which promotes a more low-carbon and energy efficient transport future		
Strategy Goal	Action Plan	Who
To promote energy-efficient transport systems	■ Work with RTMC to establish "energy efficiency" over the whole transport system as the norm for traffic operations ■ Work to reduce motor vehicle speeding in order to improve safety ■ Improve experience for pedestrians and "own steam" users in order to help encourage the shift from short vehicle trips to "own steam" trips ■ Reduce vehicle idling	■ RTMC ■ TCT
To explore the possibility of additional fuel levies and road taxes in order to promote efficient motor vehicle fuel consumption	■ Maintain a watching brief on the impact of e-tolling in Johannesburg (and other developing cities) on business, travel behaviour, energy use and emissions ■ Monitor the effect of fuel price increases on the number of daily commuters and the number of people using public transport options	■ CCT ■ CTP
To promote more economical driving practices for motor vehicle users	■ Develop materials that can be inserted into annual vehicle licensing documents containing information on steps to take to improve eco-driving ■ Find sponsorship for eco-driving leaflet drive at car spares shops, vehicle showrooms, garages in the central city and inserts in motoring magazines ■ Promote eco-driving in motoring media	■ CCT ■ CTP ■ SEA
To expand and refine "TravelSMART"	■ Establish additional human resources for TravelSMART ■ Establish user forum for peer support, sharing international and local lessons, local case studies and best practice ■ Review existing communications materials in light of recent knowledge about behaviour change ■ Consider issues of transport carbon monitoring; and publishing ongoing progress against metrics ■ Provide positive media press for participants; and develop campaign for "social norming" of TravelSMART practices into the central area ■ Develop an annual awards programme	■ CCT ■ CTP

Strategy Goal	Action Plan	Who
To upscale the City of Cape Town's "TravelSMART" programme for businesses	■ Identify highest car-using businesses and partner with these businesses for initial interventions so as to realise maximum effect quickly. ■ Explore whether and how property owners can receive GBCSA "green points" for lower-carbon travel associated with their buildings ■ Quantify the financial benefits to employers and property owners of a TravelSMART programme, such as savings from parking space rentals	■ GBCSA ■ CCT ■ CTP
To establish TravelSMART as the "business as usual" scenario in government buildings and departments	■ Build on existing work to move forward TravelSMART roll-out in government operations ■ Identify the existing obstacles to programme roll-out and interrogate problem areas ■ Establish incentives for TravelSMART behaviour, including limited free taxi-rides home per annum, and incentivised parking for shared vehicles ■ Support lift-share schemes such as "FindaLift". ■ Continue to support the work of greening the City of Cape Town's motor vehicle fleet and further introduction of their eco-driving programmes	■ CCT
Establish TravelSMART in education establishments	■ Benchmark the travel patterns and associated energy use of schools, colleges and campuses ■ Specifically focus on private schools and universities where car usage by students, faculty and families is at high levels	■ CCT ■ WCG Education Dept
To promote GBCSA building rating and accreditation systems which include sustainable transport credits	■ Engage with GBSA regarding the benefit of TravelSMART ■ Link the GBCSA rating tools to TravelSMART as a way of incentivising building developer, owner and tenant involvement ■ Target existing high-star GBCSA building owners and tenants for TravelSMART programme	■ CTP ■ GBCSA ■ CCT

"Own Steam" Transport



Source: Various, Lisa Kane, Sustainable Energy Africa

Increasing movement by your "own steam" and reducing short-distance vehicle trips is a key component of any strategy that promotes a low-carbon central city. The arguments for supporting "own steam" movement – by walking, cycling, skateboarding, prams and wheelchairs – all extend well beyond the idea of carbon emissions. Prioritising "own steam" transport also enhances business, tourist, safety, community and economic development, since most of what makes Cape Town distinctive and attractive as a place to live, work and do business can only be fully experienced at a street level, on foot. Cape Town's cosmopolitan character, rich historical heritage, diverse mix

of people, festivals, carnival, parades, markets, businesses, schools, colleges, worship and street life –are all best experienced at a slower pace.

Although "own steam" interventions cut across many different ways of moving around a city-space, this strategy focuses primarily on an analysis of walking and cycling, as these methods of "own steam" transport have the greatest potential for behavioural shifts which will positively impact on transport energy consumption.

Own Steam: Walking

At the heart of our "Own steam" approach is a strong focus on walking, the most basic yet effective of natural human mobilities, as a low-carbon access strategy for the heart of the central city. The City of Cape Town's Inner City Transport Plan agrees on the need for the central city to become a prioritised area for short distanced and "human-scaled" travel by becoming a more pedestrian-friendly city that links transport modes and final destinations through "own steam" transport.

The Central City Development Strategy emphasises that walking in the city is not simply about getting from A to B. Promoting walking in the city implicitly promotes experiences of the city, transforming the city from being a place to pass through, into

Visualising a Walkable City

What does a walkable city look like? Making sure people know how far various places in cities are, and how long it takes to walk there, is a key part of encouraging more people to walk instead of drive. The City of Pontevedra in Spain has come up with a new map to help connect people to places through colourful and practical route plans: **http://www.thepolisblog.org/2013/02/metrominuto-walking-map.html**

"Pedestrians in Cape Town are a hunted race, moving about the city on the premises of vehicular traffic, often at the risk of one's life."

– PROFESSOR JAN GEHL, 2004, QUOTED IN CCDS

a place for living in. A challenge to the idea of a walkable Cape Town Central City is the common misperception of how long it takes to walk or cycle between two places: In 15 minutes a healthy adult can walk 1.25km, and a less able person 800m[34]. In 15 minutes a gentle cycle ride will cover 2.5km. Despite these quick time frames, a recent survey of central city residents showed that even though 65% of respondents lived within three kilometres of their work, 69% reported driving as one of their main modes of commuting – only 45% reported walking, and a fewer 10% mentioned that they cycled. Increasing these numbers is vital for a more resilient Central City in which walking becomes a catalyst for environmentally-friendly growth while also encouraging greater economic growth and social connections.[35]

> **"Pedestrians: This is perhaps the biggest challenge and the biggest opportunity for improving the transport system (in the Inner City) as a whole..."**
>
> CAPE TOWN INNER CITY TRANSPORT PLAN DRAFT, 12 JUNE 2013

Despite the potential ease with which the relatively small central city can be covered on

Pedestrian Ping-Pong

Street crossings in Germany have taken the next step towards being more fun and safer at the same time. In order to get pedestrians to adhere to green and red crossing signs, new games are being installed on the lampposts of pedestrian crossing areas, letting people play a game of ping-pong with the person on the other side of the street while they wait for the light to turn green. See a video of this here: **https://www.youtube.com/watch?v=C3Ozz6_pdMI**

[34] Based on 5.0km/hr typical walk speed for healthy adult and 3.2km/hour for 80 year old (Irish study).

[35] "Life in the Heart of the Cape Town Central City" Residential Survey, Central City Improvement District, August 2013. Total respondents: 220. You can find the survey and its results online here: http://www.capetowncid.co.za/news/staying-in-the-central-city/CCID-residential-survey-Cape-Town-CBD/ [36] From SAPS data for 2008-2011 for Seapoint, Cape Town and Woodstock areas. Actual figures may be much higher due to discrepancies between SAPS and FPS data.

Pedestrian infrastructure, from bump-outs to bike racks, can help create a safer environment for own-steam transportation that encourages more sustainable forms of movement throughout the central city.

foot or by bicycle, photographic surveys show numerous places where pedestrians could struggle to cross streets and thoroughfares: unseen obstructions in the path, fast-moving vehicles and poorly functioning road-crossing points. These problems are exacerbated for more vulnerable users such as the elderly, those using wheelchairs and assistance frames, and those moving trolleys, prams and other wheeled devices. Data for the central city shows that on average one pedestrian, and two drivers or passengers, will require hospitalisation ***each week*** due to a serious traffic incident in the central city[36]. A further 17 will receive slight injuries each week. Data on fatal incidents is currently unreliable, but suggests ***at least*** one traffic death per month in the central city. Each incident recorded reflects many near-misses, or places where people simply choose not move about on foot due to perceived (and real) dangers.

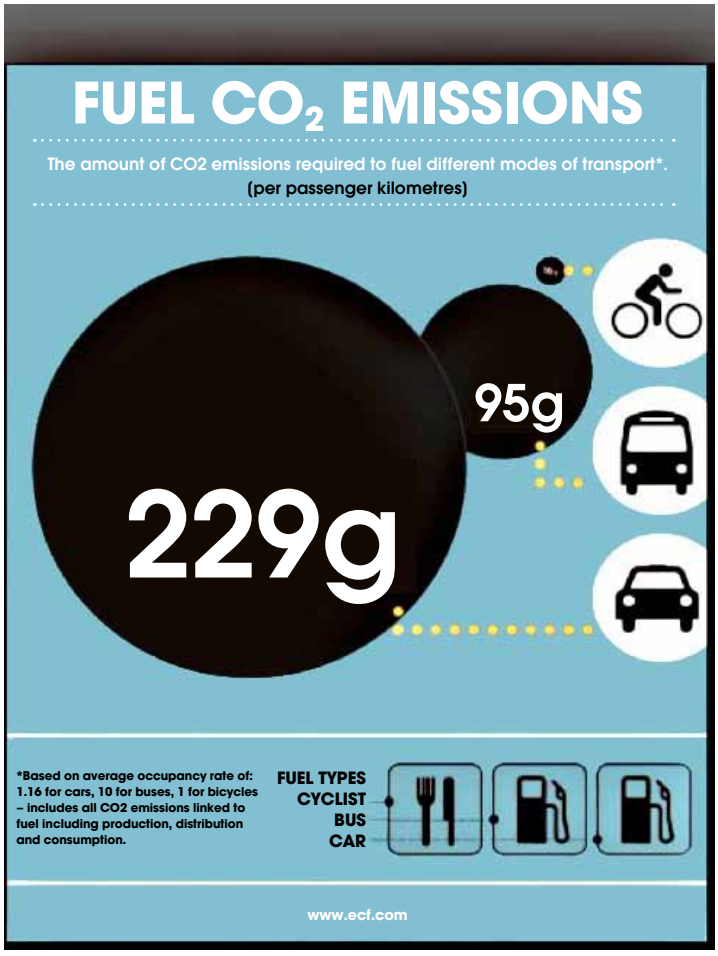
It is in this area that creative design of streetscapes can make a substantial difference to the safety of pedestrians while helping to encourage more people to take up "own steam" options of moving around the city. "Bulb-outs" and "refuges" are simple measures that can help those on foot, but a comprehensive approach is needed to make Cape Town city easily and safely navigated on foot.

As an example, think about what a core network of night-time walking routes could do to promote mobility – pathways that are dedicated safety zones to help people get from

one neighbourhood to another at night. Augmented by better lighting, these safety walks would be supplemented with more security officers, better walking paths and improved public transportation connectivity – like the MyCiTi Bus – to encourage the extended use of public transportation instead of driving. A strategy like this encourages low-carbon movement while also expanding public safety, security and economic development through safe walking routes.

Own Steam: Cycling

A key part of promoting "Own Steam" transport as a low-carbon option is ensuring that people can still move across longer distances in a safe, feasible, and enjoyable way – an inner-city commuting strategy. Cycling is therefore a key



This graphic, from the European Cyclists' Federation, shows just how different each mode of transportation is in terms of the emissions produced.

Mapping your Bicycle Trip

The Cape Town metro-region is getting more and more bicycle friendly. Cyclists now have an interactive way to find safe cycling routes, bicycle racks, safe storage, and bicycle-friendly venues with the Cape Town Bicycle Map, available online at: **http://capetownbicyclemap.co.za/**

component of "Own Steam" transport, particularly for Cape Town's central city. Enhancing the urban environment for more cycling will go a long way towards activating carbon-free transport options for more people throughout the central city.

The relatively compact size of Cape Town's central city makes it very suitable for cycling. In 30 minutes, a bicycle ride can cover over five urban kilometres, making the bicycle an incredibly efficient way of moving across short city distances, particularly in peak traffic. Encouraging bicycle use over relatively short stretches also makes a significant impact on reducing carbon emissions: Short vehicle trips are significantly more carbon intensive than longer vehicle trips, due in part to the energy costs of warming a cold engine and the start-stop of quick acceleration. Saving this fuel by encouraging cycling also saves money – after the initial purchase price, bicycles are one of the most affordable options for moving around cities. Promoting commutes into the central city by bicycle and electric-assisted bicycles is thus an essential part of this low-carbon transport strategy.

The areas surrounding the Cape Town's central city hold great potential for increased amounts of cycle trips. Neighbourhoods further afield on mid-distance cycle routes such as the Two Rivers Urban Park route also have the potential to appeal to the thousands of keen leisure cyclists, especially if safe routes and locker-room facilities at final destinations can be assured. A critical mass of cyclists has been shown overseas to improve overall rates of traffic safety for all users. There is also plenty of social good that can come from cycling:

Each year on Parking Day, you can look around and see people using "parklets" to transform what is normally a street-side parking spot into a space for more people. Some of the parklets have now become permanent in Cape Town.

Increasing Retail Sales with Bike Lanes

New York City has been at the forefront of rolling out new pedestrian and bike lanes on some of its busiest thoroughfares. Although shop owners and operators were nervous at first that the reduction in cars would cause a reduction in traffic through their stores, the opposite has been shown to be true: retailers on 9th Avenue between 23rd and 31st streets saw up to a 49% increase in retail sales following the installation of bike lanes. More on this economic growth can be found here: **http://www.americabikes.org/nyc_study_finds_protected_bicycle_lanes_boost_local_business**

Promoting cycle use for lower income groups through subsidised bicycle schemes economically benefits the recipients, improves the critical mass of cyclists on the road and promotes lower carbon transport use. Bike Share programmes currently under discussion, and linked to public transport, could do the same for Cape Town's central city. The active cycle advocacy groups in Cape Town, such as the **Bicycle Empowerment Network** (BEN), are key allies in this strategy, and are also able to highlight other benefits of cycling, such as health, poverty alleviation and wellbeing.

Promoting "Own Steam" transport like walking and cycling would also go a long way towards enhancing the economy of the central city area. An extended-hour city, founded on people moving about the streets, makes better use of the existing transport infrastructure and has the potential to improve the viability of extended public transportation networks through extended use. More people walking and cycling on the streets would also help to improve the overall perceptions of safety and security in the city by putting more

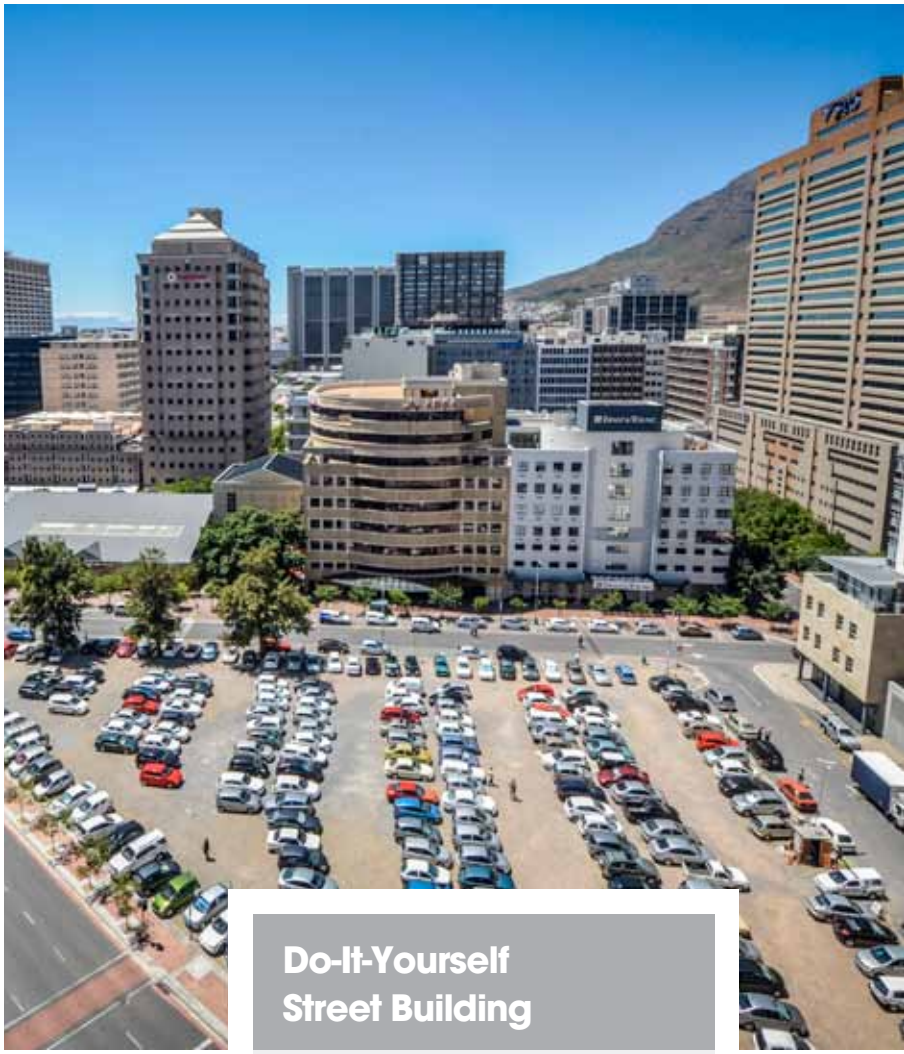
Atlanta's Parking Tax Possibilities

Cape Town is not the only city around the world with parking problems. In the US, the city of Atlanta is grappling with ways to encourage a more permanent shift towards public transportation by looking at various tools and incentives for commuters. One such proposed tool is a new parking tax that would create revenue for the local government to build more public transportation. Want to know more about this suggested solution? Read about it in Georgia Institute of Technology's virtual library here: **https://smartech.gatech.edu/handle/1853/40796**

"eyes on the street". Improving street lighting, new road design features which optimise pedestrian visibility, visible on-street security and more integrated management of city improvement districts will only further enhance own stream transport.

Another leg of the strategy for encouraging more energy-efficient transportation in the central city focuses on parking, and the use of streetscapes for alternative uses to vehicle storage. The availability and cost of street and on-site parking plays a key role in the patterns of movement within the inner city. This is a complex and potentially contentious area, but simply speaking, the use of central city street space for parking is increasingly seen as wasteful when potential alternative uses are explored.

There are strong arguments for limiting on-street parking in the central city in order to enable the street space to be allocated to business and leisure uses, walking, cycling and other "own steam" activities.



Do-It-Yourself Street Building

Want to make your own streetscape in which public transportation comes together with motorised and "own steam" transportation? Go to **www.streetmix.net** and get started with an online toolbox of road building.

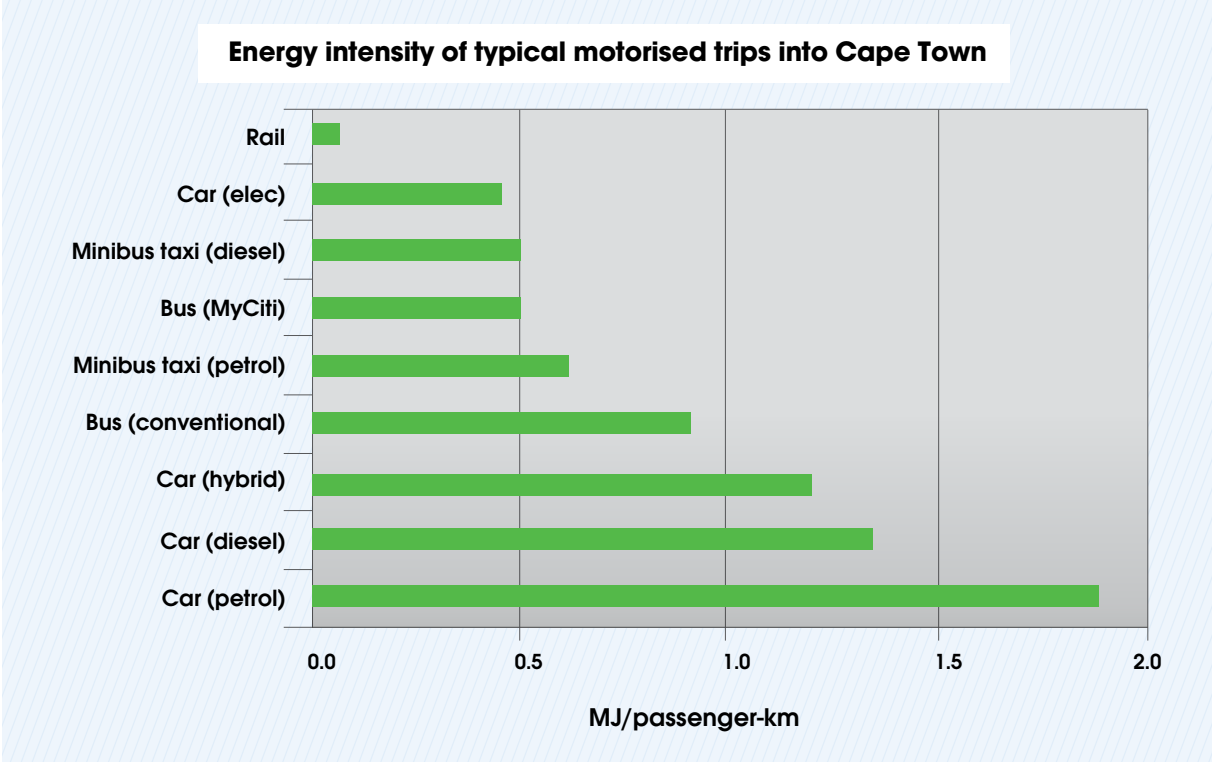
Objective: A central city which is easily and safely accessed using "own steam" transport		
Strategy Goal	Action Plan	Who
To benchmark bicycle safety levels throughout the Central City	■ Map cycle incident "hot-spots" through SAPS data ■ Liaise with active groups of cyclists to determine the day-to-day problem spots in the central city ■ Relay the gathered information to local and provincial governments, police forces, Central City Improvement District security, and other organisations that can help encourage a safer cycling environment	■ SAPS ■ CCT ■ WCG ■ FPS
To audit commuter cycle lane use	■ Draw on existing work done for DGLUM and the ICTP, along with the knowledge and experience of cycle groups in the city, to identify problematic and successful commuter cycle routes into the central city from inner suburbs ■ Identify a priority plan for roll-out of new bike lanes and street redesign ■ Encourage extended budget lines, financing mechanisms and sponsorship strategies for the roll-out of bike lanes that promote connected central city cycling	■ CCT ■ Bicycle Cape Town ■ CCT (maintenance and roads)
To support bicycle advocacy groups	■ Partner with advocacy groups so that they can continue to promote cycling and lobby for infrastructural and safety improvements	■ CTP
To promote bicycle use amongst lower-income users	■ Work with the Bicycle Empowerment Network (BEN) and similar cycle promotion groups to identify suitable inner-city areas for bicycle education, advocacy and promotion	■ BEN ■ CTP
To audit "walkable" streets and spaces within the central city	■ Draw on international participatory audit best practice for "walkable" cities along with existing work done for the Development Guidelines for Land Use Management (DGLUM) and ICTP to identify problem, and successful, street and public space areas ■ Consider the micro-engineering of streets: poorly located signage; lacking or poorly constructed drop kerbs; potholes; obstructions; legibility; and way-finding	■ CCT ■ CTP

Strategy Goal	Action Plan	Who
To identify priority areas for traffic safety infrastructural investment	■ Work with user groups to identify problem areas for pedestrian safety.	■ SAPS ■ CCT ■ FPS ■ CTP
To identify a "core" connected cycle and pedestrian network	■ Draw on existing data for traffic, cycle and pedestrian counts throughout the day/week, and new data as necessary; and on audit and safety analysis outputs to identify where the highest usage routes are, with a particular focus on vulnerable users (children, the elderly, mothers with youngsters, less abled, disabled). ■ Use this data, and other existing qualitative analyses to engage with user groups and identify a "core" cycle and pedestrian network. Include consideration of the "Laneways" ■ Encourage and promote the increasing connection between components of the pedestrian and cycle network so that "own steam" movement activity is not disrupted by lack of available streets, lanes, and pathways	■ CTP ■ CCT ■ user groups
To identify a "night" pedestrian and cycle network	■ Draw on existing work and surveys to identify routes and movement corridors which are most important and accessible for pedestrians in the evening, night and weekend economy. These corridors will link residential areas with parking, public transport, leisure and nightlife activity to encourage safe walking throughout the central city at all times of the day and night ■ Work with partners to ensure that these movement corridors are lit, secure, and active	■ CCID ■ business owners ■ residents ■ user groups
To quantify the benefits of a walkable central city	■ Develop the financial and social case for investment in a walking city in terms of carbon, health, business, tourism, and job creation	■ CTP
To improve the general user experience of walking and cycling in the central city	■ Create more comprehensive way-finding strategies and signage to assist in "own steam" movement ■ Work with Cape Town Tourism to promote mountain and sea linkages, and heritage-themed routes, for "own steam" users that help to connect the natural beauty of the central city with daily movement corridors	■ CCT ■ CTP ■ Heritage ■ Tourism

Support Public Transport

After walking and cycling, an efficient public transport system offers the lowest-carbon alternative to single occupancy vehicles. The main purpose of the "support public transport" strategy is to monitor and encourage investments in the public transport sector by demonstrating their future value in terms of energy savings. The low-carbon credentials of public transport are not, generally, sufficient reasons for most people to choose public transport over a car. However, when these credentials are paired with the personal financial savings accrued by switching to public transportation, a strong personal case for "the shift" can be made. Another strand of this strategy is making explicit the hidden costs of private car use and making them relevant to Cape Town commuters through local comparisons.

Although the concept of "low carbon" is not a strong policy driver at present within local and provincial governments, this strategy emphasises the immense value held in public transport for reducing urban carbon emissions.



This "support public transport" option encourages existing efforts to promote the roll-out of Integrated Rapid Transport (IRT) within the central city in conjunction with demonstrating the important role played by taxi, rail and other bus services in transporting thousands of commuters into Cape Town each day. As indicated above, the various forms of public transport demonstrate that a shift from independently driven cars to public transport would greatly reduce the energy intensity of Cape Town's overall transport pattern each day.

A walkable central city, described in the "Own Steam" section above, will also support increased investments in, and use of, public transport, since every public transport trip is also a part-walking trip. "Last leg" transport options, or trips that connect people between a public transport terminus – like a bus station – to their final destination, can take the form of a cycle trip, a taxi ride or a walk through the central city. People and companies in the central city can play a key role in focusing on the improvement of these "last leg" journeys by coming together to enhance the environment in which these trips take place. Whether it involves short-trip shuttles between the office and station for off-peak transport needs; improvements to building frontages; or working with the CCID to encourage safer walking pathways for employees, an increased awareness of the "last leg" needs will go far towards informing more forward-thinking policies. This approach is required for public transport trips that integrate with other land-use management measures to support public transport connectivity, use and viability. Parking strategy will be a key issue here going forward.

Objective: A Central City which supports the use of public transport		
Strategy Goal	Action Plan	Who
To promote safety and security on public transportation and on "last leg" journeys	■ Support and promote the existing safety and security work by the CCID on the central city streets ■ Ensure increasing safety at public transport terminuses	■ CTP ■ CCID ■ City of Cape Town ■ SAPS
To encourage a range of affordable, accessible and low-carbon options for short trips and "last leg" of journeys	■ Review institutional and policy frameworks for taxi cabs, pedi-cabs, tuk-tuks and potential bike share systems ■ Assess research and data blockages that prohibit the continued roll-out and uptake of above transport options ■ Research the relative cost rates of taxi cabs and other "last leg" transport options to assess whether these options are fulfilling their full potential niche for short-hop business, tourist and off-peak travel	■ CCT ■ CTP
To encourage the uptake of transport points in the various GBCSA developer toolkits and rating systems	■ Lobby for low-carbon transport points to be included as part of the GBCSA toolkits and rating systems in order to encourage greater take-up by developers and professionals ■ Highlight successful integration of public transport as a form of green development by establishing site visits and walking tours to completed projects that prioritise low-carbon transport	■ GBCSA ■ CTP ■ CCT

Avoid Transport

The strategy's third transport focus area involves avoiding the use of motorised transport through strategic urban design, higher residential and commercial population densities, and forward-thinking parking policies that encourage "own steam" transport over individual motorised transport when possible. Minimising the need for movement, particularly long-distance trips, more people can help encourage a cleaner way of living, working and playing in the central city. This strategy acknowledges the complexity and long lead-in timeframes associated with shifting spatial form.

At the core of this strategy is making sure people live closer to the spaces that they travel to every day. Densification, at the heart of many of the City of Cape Town's most important

spatial planning policies, calls for a significant increase in the residential density figures for the central city. Bringing more people into a smaller area can bring about tremendously positive social change: More economic development, less kilometres driven each day, and a growth of jobs as increased business for retail and trade sectors. Although increased densification will naturally cause a localised increase in carbon emissions from the increased use of buildings in the central city, the benefits of densification here must be seen on a larger metro-wide scale: Reduced long-distance commutes, increased walking, better safety at street level and more people-based connections to opportunities. As the City's policies continue to promote densification, indicators and interventions along the same lines as our work will help to make sure that any higher-density growth happens in a way that supports a stronger environment as well. The core of the central city's goal should be: More people with a smaller carbon footprint, particularly as new initiatives to roll out affordable housing in the central city begin to be implemented.

Another set of interventions that would help reduce the need for commuting would be to reduce private vehicle use at scale, to increase occupancy of private vehicles and to increase public transport use in one go. To do this, new financial mechanisms such as road taxes and congestion charges are being used in cities around the world such as London, Stockholm and Milan. Although models differ depending on the political will and financial needs of each city, the general idea is basically the same: Charge motorists for the use of the road in order to incentivise a switch to public transportation or non-transportation.

Despite technical and political challenges, international research shows that an increase in the price of single-occupancy vehicle travel must be

A Policy for Higher Density

In 2012, the City of Cape Town Council approved a new Densification Policy which prioritises a new model of urban development based on the benefits of density to the wider metro-region. For more information on this policy, feel free to download it for free here: **http://www.capetown.gov.za/en/Planningportal/Documents/DensificationPolicy%20web.pdf**

seriously considered as a long-term strategy for increasing the resilience of cities against future increases in fuel costs and carbon emissions. Charging more for motoring can create flexibility in our transport systems, which are currently heavily reliant on single-occupancy private vehicles, particularly if the funds collected are channelled into public transport enhancements. Existing urban transport systems are chronically underprepared for future fuel price shocks. Although the congestion charge is difficult to model without better local research, and is currently politically difficult in light of e-tolling protests in Gauteng, it is a point that Cape Town, along with other South African cities, must start considering.

advocated for the central city as a whole, although it's worth researching some form of *differentiated* parking prices, which would promote off-street parking, free up valuable core city-street space for other uses and promote a walking culture in the central city.

Objective: A central city which enables central city living and reduces the need for motorised travel		
Strategy Goal	Action Plan	Who
To promote high density central city living	■ Explore with property economists and others in the City the remaining blocks to providing high density residential housing at scale in the Central City. ■ Identify a specific site for focus, and a demonstration project. ■ Explore blockages to the use of heritage buildings largely unsuitable for businesses uses, for residential development	■ CCT Econ Devt ■ SPUD ■ WCG
To develop underutilised land and property for high density residential housing	■ Identify blockages to use of empty/low density government land parcels and partner to secure their release	■ CCT Econ Devt ■ SPUD ■ WCG
To showcase urban living as a new norm	■ Showcase and promote the benefits and attraction of urban living in the Central City by profiling existing residents, and what is saved by the City and themselves by their choice to live urban	■ CTP

Future Sustainability in the Central City

Recycling could change this. By using less, and recycling more, we can reduce the impact that waste has on Cape Town's environment.

850 000

The number of waste bins emptied every week by the City of Cape Town

30 kms

The distance that waste travels in individual trucks from the central city to the landfill

2020

The year that the Urban Development Zone tax incentive for the upgrading of CBD buildings ends

The UDZ provides big tax incentives to buildnew buildings and renovate existing ones. Developers can use this tax tool to save money and make buildings low-carbon at the same time

16 000

Tonnes of domestic and trade waste collected in the central city by the City of Cape Town each month

2 700

Tonnes of additional waste dropped off by the public (large, garden waste, etc.) in the central city each month

R900 million

The amount set aside by the city for the expansion of the public transportation system across the central city, which will better serve the people residing in Cape Town's greater central city - making for more sustainable transport options in the future

47 060

12%

The nationally-set target for energy efficiency improvement by 2015

Although they only make up 3% of the total carbon footprint in the central city, government offices can be huge engines of change:

21 000

Number of employees working at 109 offices in the central city

27 000

Members of the public served at government offices in the central city on an average day

Waste

While this strategy does not include specific numerical indicators for the contribution that waste makes to the carbon emissions in the Central City, the removal of physical waste from the city has a substantial environmental impact in the forms of water use, landfill space consumption, transportation of waste, and energy to dispose of waste. The concentrated urban space of Cape Town's central city further exacerbates the waste footprint of the area. The bulk of central city consumer waste is routinely collected directly by the City of Cape Town collection department and is augmented in specific geographic areas by private waste removal companies.

The central city area includes businesses, government buildings, residential areas and streets, all of which produce a great deal of waste. Although residential, small commercial enterprises and government buildings are serviced by the City of Cape Town waste collection services directly, businesses have a choice between municipal and private collection agencies, and can employ private companies as an alternative. Many businesses take this route as it ensures that their refuse is collected more than once a week–a particular benefit for the hospitality industry such as hotels and restaurants. In certain cases where waste generation is unusually high, businesses use two or more service providers: One for general waste and the other for recycling. The City, other than in pilot areas, only collects general waste and does not provide recycling services.

In order to fast-track environmental changes in the waste department, the City of Cape Town is currently developing the pilot of an extended strategy around recycling which would complement its integrated waste management policy. Although waste minimisation is a municipal mandate, it remains

Waste Removal by Numbers:

850,000
Number of bins emptied every week by the City of Cape Town

30
The number of kilometres that waste must travel in individual trucks from the central city to the landfill

16,000
Tonnes of domestic and trade waste collected by the City each month in the central city

2,700
Tonnes of additional waste dropped off by the public each month (large waste, garden waste, and more)

unfunded to date, and, coupled with the complexity of the Municipal Finance Management Act, makes rolling out more strategic recycling options highly problematic. In order to implement a recycling policy, the City of Cape Town will need to find a way to cover the costs associated with recycling through new business and operational models. As recycling costs are higher than normal waste processing costs, normal rates revenue will not cover the additional amount needed for a holistic recycling solution.

In terms of waste removal, the primary ability of this strategy to encourage results is to help raise awareness and facilitate a pilot recycling project in the central city area to help win greater public support.

Objective: A central city which supports waste minimisation and recycling		
Strategy Goal	Action Plan	Who
To develop a pilot recycling project in the central city	■ Work with the City of Cape Town waste department to develop a CBD pilot project on recycling ■ Link with private waste disposal companies	■ CCT ■ CTP
To promote a greater awareness of waste minimisation and recycling in the central city	■ Establish a Resource Efficiency forum similar to the Energy Efficiency forum, which considers some of the challenges and issues of recycling in the CBD ■ Partner with the CCID to encourage businesses to undertake waste minimisation and recycling initiatives ■ Encourage stronger collaboration on the re-use of waste materials between the CBD and other areas of the metro-region. This could facilitate the use of wasted construction materials for design students at the Cape Peninsula University of Technology (CPUT) or more use of recycled paper from the CBD in industrial factories around the rest of the city. ■ Work with property developers regarding new developments to make space for recycle bins	■ Steering committee CCT ■ EE Forum ■ CCID

Urban Greening

When thinking about big buildings, commuter trips and power savings, the idea of agriculture and forestry is usually not at the top of the list of implementation strategies for cities. For Cape Town, however, urban agriculture could play a leading role in getting

Greening for Wellbeing

Green spaces are great for the environment, but they also have a tremendous impact on the mental wellbeing of people in urban spaces. A new study in the UK shows that greener spaces can make people happier for a longer period of time when compared to the more temporary levels of happiness that come from things like raises, bonuses, and other financial perks.

The BBC article can be found here (**http://www.bbc.co.uk/news/science-environment-25682368).** If you want to read the full academic report, you can find it here **(http://www.ncbi.nlm.nih.gov/pubmed/23613211).**

people involved in environmental sustainability on a much more personal scale. More green spaces and trees can also provide welcome shade to "own steam" travellers. In its consideration as a land use, urban agriculture brings about many benefits for a city, such as food production, income generation, job creation, city greening, flood reduction and social cohesion. Like parks and other public green spaces, its "profitability" cannot be determined solely fiscally.

One of the primary ways that urban greening can improve the sustainability of the central city environment and contribute to a low-carbon approach towards development is through enhancements to the environment that pedestrians use on a daily basis. As the transportation section above demonstrates, encouraging "own steam" transport is one of the best ways to reduce the carbon impact in the central city. Enhancing pedestrian corridors, public spaces and other outdoor areas with more numerous trees, plants, flowers and other green elements will not only make the environment better for those already using "own steam" transport, but will also help to encourage more people to take up walking, cycling and other forms of "own steam" as primary methods of moving around the central city.

Urban agriculture also provides the City with an opportunity to create a more sustainable and ecological urban environment for all. Strategically placed food gardens could increase the functionality of underutilised land in public facilities like parks, zoned public open spaces and vacant industrial lots. Similarly, road and rail reserves can be used for agricultural purposes, further increasing the productive use factor of these government investment sites.[37]

The development of land into urban agriculture provides socio-economic benefits to the surrounding communities as well: Benefits identified in a Cape Town urban agricultural study were community connection and increased entrepreneurial spirit among participants.[38] This also helps the City of Cape Town make better use of its underutilised infrastructural assets, and could potentially be a source of additional revenue for schools and

[37] SA Food Lab Public Dialogue; Stanley Visser presentation; June 2012.

[38] 'Growing Communities: Integrating the social and economic benefits of urban agriculture in Cape Town' Jane Battersby; UCT.

other facilities that use portions of their property for food production to generate revenue, or to provide feeding schemes to their learners. Schools that have foreseen the asset of local food production and are beginning to incorporate agricultural sections in their curricula and present it as a career opportunity are beginning to open a new labour market in areas that have been negatively affected by unemployment.

Taking a wider approach towards the role of urban greening and agriculture in resilience, a thriving urban agriculture sector can expand the economic offering of a city space through the production, processing, packaging, and marketing of specific consumable products like mushrooms, herbs, and other leafy greens. This activity can help bring about an increase in entrepreneurial activities, the creation of job opportunities, and a reduction in food costs through the removal of additional cost layers such as extended transport of food crops, re-seller fees, and other economic outputs. Urban greening can also better utilise existing natural resources, such as storm-water runoff and the naturally-flowing Camissa river systems for irrigation purposes.

Within the central city, green spaces and food gardens can be used strategically as skills-development centres to teach people about the benefits of a lower-carbon urban environment. Sustainability-oriented education initiatives can help demonstrate to young people the value of resilient thinking, the process of food production, and the nutritional benefits of food grown locally and organically: These can unlock new ways of understanding the process of consuming food, the role of plants in the environment and the need to reduce the impact that we have on our larger ecological environment.

Oranjezicht City Farm, pictured left, is one of Cape Town's newest examples of how urban greening through strategic partnerships can bring more people closer to fresher and locally-grown produce.

Objective: A central city which supports urban green spaces and urban agriculture		
Strategy Goal	Action Plan	Who
To develop and maintain a multi-stakeholder strategic planning forum aimed at enhancing urban green spaces in the central city	■ Expand participation of this planning forum to companies, government officials, residents, and other members of the central city public ■ Identify strategic places where urban greening can enhance the overall environment: Activity corridors, pedestrian zones and other areas of importance ■ Work with strategic partners to ensure that planting and maintenance happens in a way that encourages greater amounts of "own steam" transportation ■ Seek out sponsors for specific spaces in the central city in order to get companies in the area involved	■ CTP ■ City of Cape Town ■ CCID ■ Planning Forum
To integrate urban planting into street maintenance and reconstruction	■ Work with street designers and road engineers to better understand the benefits and costs of street planting in the central city ■ Ensure these considerations are included in design guidelines ■ Promote their uptake through urban professional discussion and education	
To promote a greater awareness of low-carbon initiatives by using urban greening and urban agriculture as a learning example	■ Establish an urban agriculture "learning zone" where people of all ages and backgrounds can visit and experience a "green pocket" that shows the life cycle of plants, the impact that air pollution has on plants and the ways they can improve the environment ■ Develop a specific "green spaces" walking tour that can showcase the growing number of green spaces in the central city ■ Encourage the participation of the general public in planting and maintaining green spaces in order to create a stronger sense of ownership	■ CTP ■ CCID ■ City of Cape Town ■ Local Businesses ■ Local Schools

Innovation and Communication

This low-carbon strategy is premised on progressive policy and investment decisions which will be substantially implemented only if underpinned by a fundamental paradigm shift, individual will and behaviour changes. In order to support these changes, a dynamic and far-reaching communications strategy will be needed to ensure that the information generated by this strategy is utilised and understood in a friendly, accessible and enjoyable way – one that makes a real impact on people and organisations and encourages active change.

Given the many challenges to greater savings in transport and electricity energy, game-changing action will need to draw from Cape Town's growing creative networks of innovation, design and systems thinking. To be creative is a contemporary necessity in the face of development and climate change concerns. Creativity in the field of climate change and carbon emissions represents a great opportunity for Cape Town to build examples of best practice that can be used across South Africa and around the world. Cape Town's central city is an important innovation hub, with more than 1,000 creative and cultural industries in the area – connecting to the wider metro, the central city could be activated as a sustainable transportation and electricity-efficient node, coming up with solutions that help people reduce their environmental impact in new and exciting ways.

More effective communications on the whole can begin to rally people around the idea of low-carbon living in different ways. Local people-led initiatives have already started to show just what is possible when transportation and creativity are combined. The Bicycle Cape Town advocacy group, the Moonlight Mass bike ride, the National Sk8 Collective and Open Streets Cape Town have each, in different ways, started to profile some of our most pressing transport issues that, as Janette Sadik-Khan says in her **September 2013 TED Talk**, are "hiding in full view", and to re-imagine urban street space for creative expression and "own steam" movement. Each of these initiatives is a creative response to wide-ranging concerns about vehicle traffic, including the negative impacts that transportation has on the environment.

The electricity savings campaign has already had a huge impact on substantially reducing electricity consumption across the Cape Town metro-region. As the results from this strategy continue to be expanded with greater amounts of data inputs, the creative uptake of this information by different employees, companies, building groups and city precincts will be encouraged: Innovative ways to reduce the consumption of electricity in the home and office will be highlighted. There is also considerable scope for

Live Design. Transform Life.

2014 represents a spotlight year for Cape Town as it serves as the World Design Capital under the theme "Live Design. Transform Life." More than 400 initiatives will come under the international design spotlight, giving further credibility and attention to the role that design can play in rethinking processes and reconfiguring systems. Many of these relate to the sustainability of Cape Town's urban environment. To see what is planned, visit the World Design Capital website at **http://www.wdccapetown2014.com/**

showcasing individual success stories and encouraging others by publicising achievements.

Further backing innovation, the Western Cape Government has called for dynamism, openness and flexibility in its Green Economy Strategy and sees the idea of "going green" as an idea that is full of economic opportunity. The Green Economy strategy reimagines the Western Cape as the leading green economic hub on the African continent. "Innovation," it says, "lies at the heart of any green economy strategy."

Telling the Story of Climate Change in Africa

In order to empower journalists across Africa to communicate more relevant, accurate and local information about climate change in Africa, UNESCO has created a new guidebook for journalists that focuses on the specifics of climate change. Key to this tool is the idea of story-telling: How can personal stories better translate the message of climate change to the diverse audiences across the African continent? Find out more here: **http://www.unesco.org/new/en/communication-and-information/resources/publications-and-communication-materials/publications/full-list/climate-change-in-africa-a-guidebook-for-journalists/**

There is real potential synergy between the low-carbon vision of Cape Town's central city, the ongoing people-led creative initiatives suggested in this strategy and the Western Cape Government's own goals for an innovative Province. The central city is the perfect place for this synergy to begin, acting as a platform for creativity and innovation. By encouraging greater connections between these groups of people and programmes, we can help transform the city into a living laboratory: a space for creative urban experimentation, where people can think "out of the box" about what strategies could better promote more environmentally friendly and people-centred solutions. New solutions will be able to cut across activities such as cultural industries, nightlife operations, independent retail outlets, restaurants, markets, public events, music performances, crafters, and more, especially highlighted on the eve of 2014 – Cape Town's World Design Capital Year.

We have also worked to develop a strong base of communications interventions that will better help the public access the outcomes of our study in ways that they can understand. While great in the present moment, these communications strategies – all thought through by industry leaders who gave their time freely to our project – count on a long-term future engagement for their success. Many of the communications suggestions that have come through over the past year involve strategies such as: Using humour and light-hearted messaging; using understandable language; making the data from this strategy open-source; and putting low carbon into context to make sure people *care* about change, beyond just *knowing* about changing.

Capturing people's attention for a moment may raise awareness about a problem, but it will do little to move people to action. In order to motivate people to change, a strong and regularly updated store of information needs to be produced that accords with people's needs. This communication strategy will be at the heart of this community engagement: promoting practical, useful and meaningful information on ways in which people can be at the heart of a reduction in the central city's carbon footprint.

Objective: A central city which is innovative in its approaches to energy use		
Strategy Goal	Action Plan	Who
To transform the central city into a place of learning about responses to energy saving	■ Use the central city as a laboratory to open up new ways of engaging with old habits in street and public space and building design. ■ Reimagine the central city in detail, starting with streets currently high in the public imagination: Long Street and Adderley Street. Do this from a position of improved knowledge and be guided by existing research and data. ■ Use the central city as a place to take bold steps and learn from mistakes, in the pursuit of energy-use reduction through innovation and creativity	■ CTP ■ CCT ■ interest groups
To hold a low-carbon fun day for the CBD	■ Use street drama, art, music to demonstrate low-carbon and energy-efficient practices ■ Bring together key stakeholders and public officials to build a collective enthusiasm for low-carbon transitions	■ CTP ■ ESC ■ CCT ■ SEA
To promote competition and transparency	■ Install barometers in prominent offices and buildings in the central city to show progress to date in behaviour and practice across various professional sectors and geographic areas. ■ Recognise and promote the month's best practice individual and company	■ CCT
To establish city walks that promote low-carbon interventions	■ To establish walks through the city which showcase and talk about the Low-Carbon Central City Strategy ■ Demonstrate walking as a transport option, point out heritage sites where retrofits have been undertaken, and identify commercial buildings that are energy efficient ■ Highlight the new initiatives that are being undertaken by the City of Cape Town to improve the urban form in a low-carbon way. These can be enhanced links to public transportation, recycling bin placement, walking-friendly streets, and more.	■ CCT ■ CTP

Strategy Goal	Action Plan	Who
To enhance the overall communication on Low-Carbon benefits	■ Regularly engage stakeholders through written, oral and other forms of communication ■ Partner with organisations such as the Green Building Council in order to optimally distribute knowledge, best practice and information about the ways to "go green" ■ Support the establishment of working groups of building owners, tenants, and others to share experiences with retrofits or new-build technology ■ Focus on storytelling as a means of relating to people and conveying successes and challenges that have been seen by developers who have already made advancements towards low-carbon goals	

The Future of the Low-Carbon Working Group

We have worked directly with people who are at the heart of change – business leaders, government officials, advocacy groups and others. As a result, we have been able to identify the key areas of intervention that could collectively drop overall urban carbon emissions in the central city through real-time and on-the-ground actions carried out by everyone who uses the space. But part of guaranteeing the success achieved from this initial study is in guaranteeing the longevity of the study itself. The enthusiasm for this project has grown throughout the past year, and the applicability of its work has grown even more. To keep this momentum going, we want to devise a plan for the continuation of this strategy that lets it grow as the central city's economy grows, allowing the strategy to be an ongoing tool for decision makers to use as a reference as they ensure the long-term resilience of the city through environmental interventions.

The data used in our modelling illustrates one of the most exciting areas for growth embodied in a long-term continuation of the Low-Carbon Central City Strategy. At the increased rates at which it is being released, new data from sources at the City of Cape Town, the Western Cape Government, private developers and other businesses in the area could all help to build on the initial models in the strategy, making them immensely more informative, robust and interactive over the coming years. Allowing new data to plug into the models will let us analyse the effects of our recommendations and update the carbon footprint at regular intervals. New data will also help us better understand the intricate nuances of the sources of carbon emissions in the central city. We want to make sure that our work goes a long way towards encouraging the development of an open-data culture in Cape Town, where people not only feel comfortable in sharing data in a safe way, but actively want to do so in order to better understand their own city.

As more cities around the world begin to explore the value of localised data on carbon footprints and emissions, the work of this strategy can help to contribute more examples of which low-carbon interventions worked, and which didn't. By giving the data and communications elements of this work the time they need to develop further, we can help ensure that Cape Town becomes a leading city in terms of localised strategies for environmental change. The learnings embedded in this study can help transmit lessons and examples to cities throughout South Africa and around the developing world as cities continue to grapple with the enormous challenge of climate-related behaviour change.

A framework for moving this initiative forward takes shape through a multi-pronged strategy of intervention across various stakeholder groups and participation levels. From within government, the information from our initial study along with continued updates can start to form a voice for local government officials to support more environmentally friendly policies. Planning instruments, like the Development Guidelines for Land Use Management – a partnership-driven reference guide for development in the central city – and the Central City Development Strategy, will gain strength through information as low-carbon initiatives begin to support a new form of physical development. These policies can support the work of other local government policies, such as the Inner-City Transport Plan, which aims to create a more efficient network of public and non-motorised transportation options for people within Cape Town's inner city.

A localised approach to national policy will also be vital. As the Carbon Tax is further debated, and implemented, businesses will no doubt be looking for new ways to reduce their overall carbon profile to remain competitive locally and globally. The information in our strategy, updated at regular future intervals, will not only offer up examples of other companies who have taken big steps in reducing emissions through structural change, but also provide the tools to actually make the shift. A long-term continuation of this strategy will help people make the transition from *knowing* to *doing*; from thought to action.

This low-carbon CCDS takes an overarching approach to address climate change impacts in the city. Perhaps the most powerful driver of change to come out of a long-term engagement of this strategy will be the growth of strategic partnerships around the need for a reduced carbon footprint. Throughout the initial year of the study, we have built partnerships with a wide array of individuals, groups, and officials. It is perhaps here that the project has succeeded the most: By working together, people can help to advance their common goals of environmental resilience. Ensuring the continuation of the Low-Carbon Central City Strategy means ensuring the enhancement of these partnerships and the immense value to on-the-ground change that they bring.

In order to activate these partnerships, one of the most potent solutions to come out of the strategy would be the development of a Resilient Cape Town community – a working group of like-minded individuals across different sectors that come together regularly to champion new approaches towards holistic low-carbon urban development. The Resilient Cape Town community would include people from the transport, commercial, residential and government building sectors. It would consider waste, economic growth and sustainable livelihoods for all as well as energy use and emissions on a building-specific basis. To facilitate this, it is proposed that an initial steering committee or partnership group be established. The stakeholders of this group would include the Cape Town Partnership, the City of Cape Town, property developers such as Growthpoint, local businesses, large-scale property developments like the V&A Waterfront, various resident associations, tenant groups, the Green Building Council of South Africa, and others that have a direct interest in a more resilient and low-carbon urban development agenda in our city.

A Note of Gratitude

We have made some really big strides in our work over the past year. By making use of data, we have launched a new way of looking at climate change at a local level. By exploring new ways of communicating, we have begun to promote new ways of working together to promote more sustainable practices in areas like construction, building maintenance, employee commuting patterns, and more.

While we did a lot in-house to make this happen, there have been many extremely motivated and giving people who have helped us along the way out of sheer passion for the topic. Many people from across the private and public sectors alike attended our workshops, came to our events, and contributed their ideas, all at no cost. Contributions like this not only helped us create a truly dynamic strategy, but also supported us with encouragement, critical thought, and excitement for a lower-carbon future. We would like to take the opportunity to thank the many people and organisations who came on board to make this strategy a success.

We hope that, through participating, the many people who gave their time and thought to this project are able to realise value from it, both in functionality and in future gain.

We would also like to take this moment to thank the Swedish International Development Organisation (SIDA) for funding the research and creation of this strategy. By generously making available their resources, SIDA has enabled this team create a new tool with which to look at Cape Town's climate indicators and a new model for building sustainability-related partnerships throughout the metro-region and across the country. Without their support, this project would not have been possible.

Our work was also supported through the strategic input of the Stockholm Environment Institute. Their perspectives on current global trends in urban carbon emissions informed our own work and indicated various areas of global relevancy that this strategy could plug into for future use. We hope that, through this strategic international partnership, we can continue to expand the dialogue between South African cities and others around the world regarding challenges to environmental sustainability and the tools that can help create more resilient cities.

We know that, as this project continues, there will be more people who come on board in their own capacities to make it an even better strategy. We are looking forward to this with excitement: The power of collaboration has put this project ahead of initial expectations, and it is set to take this project very far into the future.

Production credits

The **contents, contributions and editing** of this document were created and executed through a collaboration between the Cape Town Partnership, Sustainable Energy Africa, the City of Cape Town and the Stockholm Environment Institute. This document was **designed** by Sean Robertson. The **photos** included in this document come from many sources all over the city. We would like to give special thanks to Lisa Burnell, Bruce Sutherland (courtesy of the City of Cape Town), Justin Patrick, Jacques Marais, and Johan Dempers (Aerial Image) for their photographic skills in depicting some of the challenges, opportunities, examples, and case studies of sustainability and resilience in Cape Town's central city. The **infographics**, along with the **map** on page 40, were produced by Ivan Colic. **Proofreading** was carried out by Deborah Louw.

References

Arup, CNdV Africa, Viruly Consulting. (2013). *City of cape town inner city transport plan draft report 2013-06-12*

Australian Property Institute. *Building Better Returns*. Available at: **http://www.api.org.au/assets/media_library/000/000/219/original.pdf**

C40 Cities. *Climate Action in Megacities*, 2011.

C40 Cities Leadership Group. *Why Cities? Ending Climate Change Begins in the City*. Available at: **http://c40.org/ending-climate-change-begins-in-the-city**

C40 Cities News Team. *Dispatch from Rio: C40 Mayors Demonstrate Progress in Greenhouse Gas Reductions and Announce New Actions to Take on Climate Change*, 27 June 2012. Available at: **http://newswatch.nationalgeographic.com/2012/06/27/dispatch-from-rio-c40-mayors-demonstrate-progress-in-greenhouse-gas-reductions-and-announce-new-actions-to-take-on-climate-change/**

CCDS DGLUM

Cape Town Central City Improvement District. Website: **http://www.capetownpartnership.co.za/ccid/**

Cape Town Partnership. Central City Development Strategy, 2008.

Central City Improvement District. *State of Cape Town Central City Report*, 2012.

City of Cape Town. (2012). *TravelSMART employee trip reduction plan. December 2012*

City of Cape Town. (2013). *Comprehensive integrated transport plan 2013-2018. October 2013*

City of Cape Town. (2013). *Draft parking policy for the city of cape town. September 2013*

City of Cape Town, Transport Department. *Cordon count,* 2010, 2011, 2012.

City of Cape Town. Electricity Savings Campaign. Website: **http://www.capetown.gov.za/en/electricitysaving/Pages/default.aspx**

City of Cape Town. *Energy and Climate Change Action Plan,* 2010. Available at: **http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/PoliciesandStrategies.aspx**

City of Cape Town. *Energy and Climate Change Strategy*, 2007. Available at: **http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/PoliciesandStrategies.aspx**

City of Cape Town. *Integrated Metropolitan Environmental Policy*, 2001. Available at: **http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/PoliciesandStrategies.aspx**

City of Cape Town. *State of Energy*, 2003.

City of Cape Town. *State of Energy*, 2007.

City of Cape Town. *State of Energy and Energy Futures Report*, 2011. Available at: **http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/Reportsand.aspx**

City of Cape Town. TravelSMART programme. Website: **http://www.capetown.gov.za/en/TravelSMART/Pages/default.aspx**

Department of Cooperative Governance, Republic of South Africa. *Towards an Integrated Urban Development Framework: A Discussion Document*, 2013. Available at: **http://www.cogta.gov.za/index.php/documents/doc_view/1036-discussion-document-for-integrated-urban-development-framework.raw?tmpl=component**

Department of Energy, Republic of South Africa. *Integrated Resource Plan Policy-Adjusted Scenario*, 2010.

Energy Research Centre, University of Cape Town. *Long-Term Mitigation Scenarios*, 2007. Documents available at: **http://www.erc.uct.ac.za/Research/LTMS/LTMS-intro.htm**

Erickson, P. A., Lazarus, M., Chandler C., and Schultz, S., 2013. *Technologies, Practices, and Measures for GHG Abatement at the Urban Scale. Greenhouse Gas Measurement and Management*. doi:10.1080/20430779.2013.806866.

Green Building Council of South Africa. *The Green Lease – positive step to efficient operation of buildings,* 2012. Available at: **http://www.gbcsa.org.za/news_post/the-green-lease-positive-step-to-efficient-operation-of-buildings/**

Green Building Council of South Africa. *Multi-Unit Residential Tool*. Available at: **http://www.gbcsa.org.za/green-star-rating-tools/multi-unit-residential-tool/**

Green Cape. (2013). *Developing a business case for sustainable biofuels in south africa: A focus on waste-based bioethanol for fleet transport in the western cape. november 2013* No. Draft). Cape Town

Grren is Smart: Western Cape Green Economy Strategy Framework

Institute for Futures Research, University of Stellenbosch. *South African demographic trends to 2035*, 2013.

Kennedy, C., Steinberger, J., et al. *Greenhouse Gas Emissions from Global Cities*, 2009. *Environmental Science & Technology* 43 (19) (October 1): 7297–7302. doi:10.1021/es900213p.

McGaffin, R., Viruly, F., Massyn, M., & Hopkins, N. (2013). The economics of providing high density, affordable housing in the inner city of cape town – the value versus cost challenge. *Draft in Preparation,*

Moser, C. Satterthwaite, D., *Towards Pro-poor Adaptation to Climate Change in the Urban Centres of Low- and Middle-income Countries,* 2008.

Moving Mountains

National Development Plan 2030. Our Future National Planning Commission, Republic of South Africa. *The National Development Plan: 2030*, 2011. Available at: **http://www.npconline.co.za/pebble.asp?relid=25**

Newman, P., & Kenworthy, J. (2011). Evaluating the transport sector's contribution to greenhouse gas emissions and energy consumption. In R. Salter, S. Dhar & P. Newman (Eds.), *Technologies for climate change mitigation – transport sector* (pp. 7-23). Denmark: UNEP Riso Centre on Energy, Climate and Sustainable Development.

OECD International Road Traffic Safety Data and Analysis Group. (2013). *International transport forum road safety annual report*

Pew Research. *Measuring the Health Effects of Sprawl: A National Analysis*. Available at: **http://www.archdaily.com/389183/how-our-cities-are-shaping-us-infographic/**

Provincial Government of the Western Cape. Department of Transport and Public Works. (2011). *Integrated infrastructure capacity assessment of the central city. prepared by gibb. august 2011*

Public Lab. Website: **www.publiclab.org**

ResilientCity.org. Website: **http://www.resilientcity.org/**

SABS. *SANS 10400 part XA: Energy Usage*, 2011. Available at: **https://www.sabs.co.za/**

Siemens. *African GCI Report*. Available at: **http://www.siemens.com/press/pool/de/events/2011/corporate/2011-11-african/african-gci-report-e.pdf**

Siemens. *Toolkit for Resilient Cities*. Available at: **http://w3.siemens.com/topics/global/en/sustainable-cities/resilience/Pages/home.aspx**

Smart Living Handbook

State of Energy and Energy Futures

Statistics South Africa, *Census*, 2001, 2011

Sustainable Energy Africa. *Energy Scenarios for Cape Town: exploring the implications of different energy futures for the City up to 2050,* 2011. Available at: **http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Pages/Reportsand.aspx**

Sustainable Prosperity. *Suburban Sprawl* info-graphic. Available at: **http://thecostofsprawl.com/#**

UN-Habitat. *State of the World's Cities 2010/2011: Bridging the Urban Divide*, 2010.

Urban and Regional Carbon Management. *City Based Climate Change Action Plans*. Available at: **http://www.gcp-urcm.org/Resources/CityActionPlans**.

Vasconcellos, E. (2001). *Urban transport, environment and equity: The case for developing countries*. London: Earthscan.

Venter, C. J., & Mohammed, S. O. (2013). Estimating car ownership and transport energy consumption: A disaggregate study in nelson mandela bay. *Journal of the South African Institution of Civil Engineering, 55*(1), 2-10.

Walters, J. (2013). Overview of public transport policy developments in south africa. *Research in Transportation Economics, 39*(1), 34-45.

Western Cape Government. *110% Green Campaign*, launched 2012. Website: **http://www.westerncape.gov.za/110green/**

Western Cape Government, Provincial Treasury. *Regional Development Profile: City of Cape Town*, 2011. Available at: **www.westerncape.gov.za**

World Bank. *Climate Change Action Planning in C40 Cities in East Asia*.

Western Cape Government 2013 Green is Smart: Western Cape Green Economy Strategy Framework

Annexures

Annexure 1: LEAP Modelling Methodology

Overview:

The data that informed the Low-Carbon Central City Strategy came from many sources throughout the Cape Town metro-region. This Appendix details the data sources and the assumptions made in order to create the future models held within this Strategy.

Summary of key data

Data is for the base year of 2012, unless otherwise stated.

Data	Value	Source/Notes
General		
City of Cape Town GDP (2011)	R428.84 bill	*City of Cape Town District Fact Sheet*, Wesgro
GDP growth for City of Cape Town	4.3%	Quantec standardised regional data (average annual growth for 2000-2010)
Residential Sector		
No. of low-income households (2011)	1,974	StatsSA Census 2011
No. of mid- to high-income households (2011)	9,939	StatsSA Census 2011; *V&A Waterfront Sectoral & Operational Reviews*, Growthpoint
Growth of low-income households	-6.95%	StatsSA Census 2001 and 2011

Data	Value	Source/Notes
Growth of mid- to high-income households	4.31%	StatsSA Census 2001 and 2011
Cost of electricity (low-income households)	R1.18/kWh	City of Cape Town: Average of Blocks 1-4 Domestic Lifeline (<450 kWh received per month) tariffs
Cost of electricity (mid- to high-income households)	R1.40/kWh	City of Cape Town: Average of Block 1-4 Domestic (>450 kWh received per month) tariffs
Commercial Sector		
Cost of electricity	R1.51/kWh	City of Cape Town: Average of Small Power User 1 and Small Power User 2 tariffs
Cost of efficiency	50c/kWh	Eskom Standard Offer Programme
Retail floor area	468,923m^2	*The State of Cape Town Central City report 2012*, Cape Town Partnership; *V&A Waterfront Sectoral & Operational Reviews*, Growthpoint
Office floor area	873,943m^2	*The State of Cape Town Central City report 2012*, Cape Town Partnership; *V&A Waterfront Sectoral & Operational Reviews*, Growthpoint
Number of beds (accommodation) in CBD	6,850	*The State of Cape Town Central City report 2012*, Cape Town Partnership; *V&A Waterfront Sectoral & Operational Reviews*, Growthpoint
Electricity intensity (retail)	471 kWh/m^2	Average of large and small shopping centre energy usage (*Energy savings through HVAC retrofits in the commercial sector in SA*, M. Moorlach, A. Hughes, UCT)
Electricity intensity (office)	223 kWh/m^2	Green Building Council SA
Electricity intensity (accommodation)	9,000 kWh/bed p.a.	*Establishing energy benchmarks for commercial buildings in the City of Cape Town*, Caroline Martin
Growth of Accommodation sub-sector	2.57%	StatsSA average annual growth from 2000-2010 in *Wholesale and retail trade, catering and accommodation* category
Growth of Offices sub-sector	3.6%	Calculated by considering the relationship between national GDP and office floor area growth projections by the National LTMS.
Growth of Retail sub-sector	2.08%	Based on ground floor availability for development (Cape Town Partnership)
Government Sector		
Cost of electricity	R1.51/kWh	City of Cape Town: Assume same as commercial tariff
Cost of efficiency	50c/kWh	Eskom Standard Offer Programme

Data	Value	Source/Notes
Local government floor area (2009)	140,881 m^2	City of Cape Town
Provincial government floor area (2011)	89,674 m^2	Western Cape Government
Growth in floor area	4.3%	Assumed to track GDP
Local government energy intensity	115 kWh/m^2 p.a.	City of Cape Town
Provincial government energy intensity	188 kWh/m^2 p.a.	Western Cape Government
Transport Sector		
Cost of diesel	R10.51/litre	Department of Energy
Cost of petrol	R11.23/litre	Department of Energy
Liquid fuel cost *nominal* growth p.a. (2005-2012)	11.3%	Personal petrol use/ cost records[38]
Average CPI (Consumer Price Index) growth (2005-2012)	6.5%	StatsSA
Liquid fuel cost *real* growth p.a. (2005-2012)	4.8%	Growth excluding inflation
Annual passenger-km	3,436,606,822	City of Cape Town Cordon Count, 2012; ACET Household Travel Survey 2010
Growth in passenger-km	4.3%	Assumed to track GDP growth

Study boundaries and scope

The geographic boundaries were set as closely as possible to the city bowl area (CBD and surrounding residential areas), but were driven by the information that was available. The various datasets boundaries did not match exactly, but were chosen to match as closely as possible. It was decided to focus largely on the residential, commercial and passenger transport sectors, for the following reasons:

- Data for the industrial and freight sectors was sparse.
- The city bowl area is largely commercial and residential. Industrial activity is mainly situated further afield in areas such as Paarden Eiland.
- The City of Cape Town and the Cape Town Partnership, who are seen as the main drivers for the implementation of the Low-Carbon Central City Strategy, have greater

[38] Zanie Cilliers, Sustainable Energy Africa

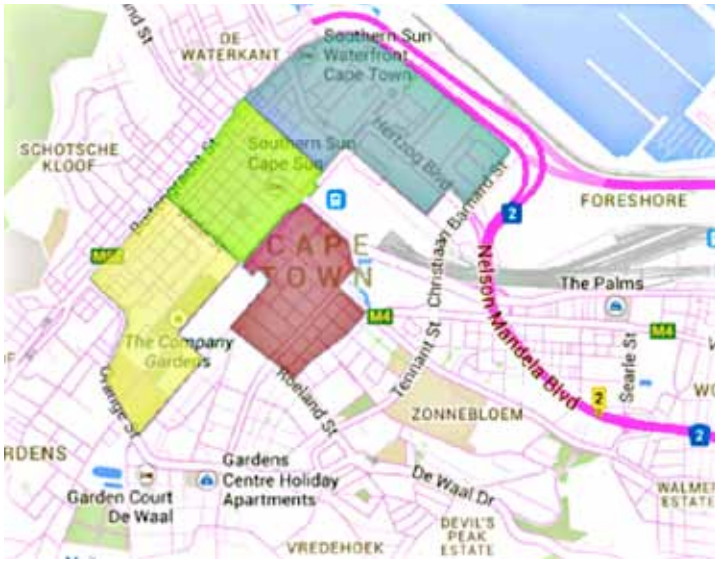
influence over these sectors, through partnerships, regulations and planning. As an example, the port falls under national, rather than local, jurisdiction.

The focus for fuels was on electricity use in the commercial, government and residential sectors, and liquid fuel use in the passenger transport sector. LPG use was not covered due to time constraints and the difficulty in sourcing data on LPG supply and/or energy intensity values for LPG use (e.g. amount used for cooking in restaurants). Regarding LPG, a possible intervention for future analysis is the shift from cooking with electric stoves to gas stoves in the residential sector (the commercial sector already uses LPG as the main fuel source for cooking).

Regarding the transport sector, cordon counts were available, containing the number and type of vehicles and the number of passengers moving in and out of the city centre along major entry and exit points (see below diagram).

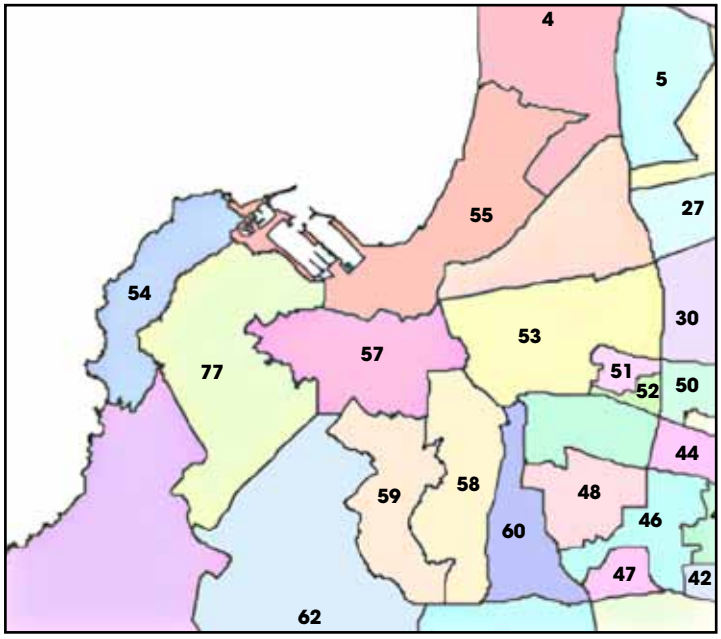
Cordon count 2011 count points

The most detailed data for the commercial sector (e.g. floor area by sub-sector such as office, retail) was available for the Central City Improvement District (CCID) area (see diagram below). Most of the city bowl area outside of the CCID is residential. The exception is the Woodstock area. This area represents a data gap.



CCID area

The main indicator for the residential sector (number of households) was drawn from the StatsSA Census 2011. Data was available on the StatsSA website down to the ward level. Ward 77 was chosen (see below map). This ward includes Cape Town Central, Gardens, Oranjezicht, Tamboerskloof, Schotsche Kloof, De Waterkant and Vredehoek, but excludes Woodstock, Zonnebloem and the V&A Waterfront. The ward covering the V&A Waterfront extended into Paarden Eiland and Milnerton, which were seen to be outside the central city study area. Census 2011 data by sub-place was obtained at a later stage from Cape Town Partnership to ascertain the number of households at the V&A Waterfront, but it was shown as zero, which is not the case. The number of residential units in the V&A Waterfront was obtained from a report by Growthpoint property managers.



Census ward map

Residential Sector

StatsSA provides household data broken down into 12 income bands. These were amalgamated into low- and mid- to high-income categories as follows:

- **Low-income:** R0-R38 400 pa
- **Mid- to high-income:** >R38 401

Household numbers and current growth rates were obtained from StatsSA Census 2001 and 2011 data for ward 77 (Cape Town city bowl area). The number of households by income band is shown below. 2012 figures were extrapolated from current growth rates.

Income	2001	2011	Growth p.a. (%)	2012
Low	4,057	1,974	-6.95	1,837
Mid- to high	3,256	9,179	10.92	10,181
Total	7,313	11,153	4.31	11,634

The number of residential units at the V&A Waterfront were added to the above mid- to high-income households numbers. A Growthpoint report states that 518 residential units were built in the V&A Waterfront between 2001 and 2009, with an average of 80 units built per year after adjusting for delay in residential development experienced in 2005 and 2006. Assuming a baseline of zero and a continuation of the current build rate, the number of residential units in 2012 in the V&A Waterfront is 758. This was added to the StatsSA city bowl figures to get the following:

Income	2012
Low	1,837
Mid- to high	10,939
Total	12,776

The growth figures applied in the LEAP modeling were -6.95% for low-income households and 4.31% for mid- to high-income households. The reason the lower/average growth figure was used for mid- to high-income households is that the limitations of land availability in the CBD would in all likelihood dampen growth rates. Using the growth rate of 10.9% would result in a quadrupling of mid- to high-income households by 2030. This was seen as unfeasible. Further research is required as to the potential future growth rates of mid- to high-income households in the CBD.

99% of households in the city bowl use electricity for lighting (StatsSA 2011). Therefore it was assumed that all households in the area are electrified.

The energy intensity figures (kWh per household) used for various technologies are listed below.[40]

End-use (kWh/household p.a.)	Low-income	Mid- to high-income
Lighting (incandescent)	405	753
Lighting (CFL)	101	188
Lighting (halogen downlight)	N/A	584
Lighting (LED)	N/A	58
HVAC	286	679
Cooking	791	1,115
Water heating (conventional)	767	4,722
Water heating (SWH)	0	1,464
Refrigeration (inefficient)	596	1,583
Refrigeration (efficient)	477	1,267
Other	319	2,073

Note: Solar water heaters in low-income households do not have electric back-up.

Technology costs and lifetime included in the LEAP modeling:

Technology	Cost (ZAR)	Lifetime (years)
Electric conventional geyser (150 lit)	3,000	10
Electric conventional geyser (200 lit)	4,000	10
Solar water heater (low-pressure)	5,000	10
Solar water heater (high-pressure with electric back-up)	16,000	10
Fridge (small)	3500	15
Fridge (large)	10,000	15
Lighting – incandescent	15	1
Lighting – CFL	30	5
Lighting – halogen downlight	20	2
Lighting – LED	100	6

Note: Electric geyser and solar water heater technology costs do not include installation.

Savings assumed:

Technologies compared	Savings
LED vs. halogen downlight	90%
CFL vs. incandescent	75%
Efficient vs. inefficient fridge	20%
Low-pressure solar water heater vs. conventional electric geyser	100%
High-pressure solar water heater with electric back-up vs. conventional electric geyser	69%

[40] **Source:** *Energy Scenarios for Cape Town: Exploring the implications of different energy futures for the City of Cape Town up to 2050* (technical report) by SEA for the City of Cape Town

Commercial Sector

The key indicators for the commercial sub-sectors are shown below.

Sector	Sub-sector size	Energy intensity	Growth
Retail	468,923 m^2	471 kWh/m^2 pa	2.08%
Office	873,943 m^2	223 kWh/m^2 pa	3.6%
Accommodation	6,850 beds	9,000 kWh/bed pa	2.57%

Retail area growth is limited largely by ground floor availability. Without a station precinct redevelopment this would equate to no more than 210,000m^2. With a station redevelopment (indications were that this may be unlikely), that can go as high as 450,000m^2.[41] The growth rate applied in LEAP was one that would result in 210,000m^2 (growth if there was no station precinct development) by 2030, which was 2.08%.

The growth in the accommodation sub-sector was assumed to match the average 2000-2010 growth in GVA in the Cape Town area for the *wholesale and retail trade, catering and accommodation* category.[42] The accommodation market is largely saturated in Cape Town central, so this growth figure may be too high.[43] Due to the relatively small contribution in energy use and emissions generation by the accommodation sector, this was not seen as having a major impact to the energy modelling, though further research is recommended in future studies.

The National LTMS study estimates that national floor area of office blocks and shopping centres is estimated to increase by roughly 4.5% per year until 2030. This projection assumes that GDP will increase at an average of 5.4% between 2010 and 2030 and that the commercial sector will play a larger role in the economy and will therefore contribute to a higher percentage of GDP over this time period. The office floor area growth in the Cape Town CBD was calculated by applying the percentage difference between the national GDP (5.4%) and national office floor area growth (4.5%) to the Cape Town metro GDP growth (4.3%). This resulted in a growth rate of 3.6%.

Growth (residential and commercial) in the CBD is limited by bulk rights available. About 3.7million m^2 additional bulk is already known of and in some degree of planning by developers. If all of this were developed there would be serious traffic and infrastructure issues (e.g. waste water). Growth rates used in LEAP in the office and retail sectors equate to about 1 mill additional m^2. This doesn't include household growth (which is measured in households, not m^2 in the LEAP model) or growth in the accommodation sector (measured by number of beds in LEAP).

Electricity by end-use:

[41] Personal communication with Jodi Allemeier, Cape Town Partnership

[42] Quantec Data

[43] Personal communication with Jodi Allemeier, Cape Town Partnership

End-Use	Retail and offices (%)[44]	Hotels (%)[45]
Lighting	40	37
Water heating	2	3.5
HVAC	36	30.5
Refrigeration	7	11
Cooking	0	0.5
Other	15	17.5

The water heating figure may seem low, but this is due to the use of LPG (not electricity) as the main fuel for water heating in the commercial sector. Likewise, LPG rather than electricity is used for cooking. The above percentage figures were applied to the total energy use figure by floor area to get energy use by end-use (see below table).

End-use p.a.	Retail kWh/m²	Offices kWh/m²	Hotels kWh/bed
TOTAL	471	223	10,825
Lighting	188	89	4,005
Water heating	10	4	379
HVAC	169	80	3,302
Refrigeration	33	16	1,191
Other	71	33	1,894
Cooking	0	0	54

Unlike the residential sector, the commercial and government sectors were modelled using a top-down, rather than bottom-up approach. As an example, modelling the cost of an intervention in the residential sector would include the costing of the electricity use, lifespan and cost of the inefficient vs. the efficient technology (e.g. incandescent bulb vs. CFL). This costing is more complicated in the commercial sector, due to the wide range in size and costs of technologies such as HVAC. Data on the average electricity usage and technology costs per m² for differing HVAC systems was not readily available.

The cost of efficiency interventions was approximated based on the value Eskom places on savings in the commercial sector. Therefore a cost of 50c/kWh saved was used, based on Eskom's Standard Offer Programme. Note that this cost is currently modelled until 2030. It could not be decreased to zero after 3 years (the duration of Eskom's payments in their

[44] "Trends in commercial and residential building demand in South Africa" presentation by Alison Hughes from ERC/CESAR

[45] "Establishing energy benchmarks for commercial buildings in the City of Cape Town" masters dissertation by Caroline Martin. Note: this was for the category "other non-residential spaces."

Standard Offer Programme), as some interventions may only be implemented at a later stage after the first three years. This is a limitation in the modelling software in conjunction with the baseline data set-up.

Savings potential assumptions:

End-use	Savings potential
HVAC	20%
Lighting	40%
Water heating	69%
Refrigeration	5%

Government Sector

This sector includes government buildings only, i.e. it excludes government waste water treatment works and other bulk services such as street and traffic lighting. These areas are generally tackled in metro-level energy strategies. Floor area and energy intensity in government buildings was obtained from the City of Cape Town and the Western Cape Government. It was assumed that growth in building floor area tracks GDP growth for the Cape Town metro.

Government sphere	Floor Area (m^2)	Energy Intensity (kWh/m^2 p.a.)
Local government	140,881	115
Provincial government	89,674	188

Average electricity use by end-use was based on energy audits of 4 City of Cape Town buildings; namely the Plumstead, Durbanville, Ottery and Fezeka offices. Energy end-use data for CBD-based government buildings was not available. These percentage figures were applied to the overall energy intensity figure to get energy intensity by end-use values.

End-use	%	Local kWh/m^2	Provincial kWh/m^2
HVAC	26	30	49
Lighting	55	63	103
Water heating	4	5	8
Other	15	17	28
TOTAL	100	115	188

The following savings potential figures were used:

End-use	Savings Potential
HVAC	20%
Lighting	40%
Water heating	69%

Transport Sector

Transport data was represented in passenger-km (pass-km) in the LEAP model. The numbers of vehicles and passengers moving in and out of the central city between 06:00 and 19:00 was obtained from cordon counts for the years 2010, 2011 and 2012. The average trip lengths from the ACET households travel survey was used to calculate the number of pass-km for motorized transport modes, e.g. 100 passengers travelling by car at an average trip length of 14km would equal 100 x 14 = 1400 pass-km. Assumptions were made in the case of non-motorised modes. The total 2012 annual passenger-km was calculated as 3,436,606,822 pass-km. The trip lengths used were as follows:

Mode	Trip length
Rail	14
Bus	16
Minibus	10
Car	10
Cyclist	13
Pedestrian	5

It must be noted that the cordon count only captures vehicles moving in and out of the central city. It does not capture inner-city movement or whether a car may be moving straight through the central city (e.g. a vehicle heading from the Northern suburbs through the central city to Sea Point).

In South Africa, the number of registered vehicles has tracked GDP more closely than it has tracked population growth. Nationally, growth in registered vehicles and GDP has been around 3-4%, whilst population growth has been around 1.2-1.5%.[46] Therefore it was assumed that pass-km growth tracks GDP growth.

The cordon counts were used to determine the modal split of passenger transport through the calculation of pass-km per vehicle type using the methodology described above. The modal split data are not consistent across the 2010, 2011 and 2012 cordon

[46] "Quantifying the energy needs of the transport sector for South Africa: A bottom-up model" by Bruno Merven, Adrian Stone, Alison Hughes and Brett Cohen from ERC, Jun 2012

counts, but appears to show a relatively dramatic shift from car to buses and minibus taxis. Due to uncertainty over whether this was a real trend or a data error, the average modal split across all three years was used. This split is as follows:

Mode	Pass-km
Private	54%
Public	46%

Public mode	Pass-km
Total	46%
Bus (Golden Arrow)	6%
Bus (MyCiti)	1%
Bus (private)	5%
Taxi (metered)	1%
Taxi (minibus)	8%
Non-motorised	1%

The demand cost per mode was obtained from previous LEAP-modelling work for the Cape Town metro area,[47] increased at inflation levels until 2012. The financed cost of a vehicle is included in all modes except that of rail. Infrastructure cost is included in BRT (Bus Rapid Transit). It must be noted that infrastructure costs (e.g. road maintenance, parking, etc) would need to be included in the other modes for fair cost representation. Unfortunately data in the format required for the LEAP model set-up (e.g. cost of road maintenance per pass-km per annum) is not available.

Mode	R/pass-km pa
Bus/Minibus (diesel/petrol)	0.03
BRT (diesel)	3.28
Car (diesel/petrol)	0.28
Car (elec)	1.01
Car (hybrid)	0.86

The average occupancy figures for the 2010, 2011 and 2012 cordon counts were used to calculate the energy intensity of different transport modes. The exception is MyCiTi, where only the 2012 occupancy data was complete.

[47] Source: *Energy Scenarios for Cape Town: Exploring the implications of different energy futures for the City of Cape Town up to 2050* (technical report) by SEA for the City of Cape Town

Mode	Capacity	Occupancy	People per vehicle	Km/lit	Lit/pass-km
Bus (GABS)[48]	90	16%	14.0	3	0.0238
Bus (MyCiti)	90	28%	24.9	3	0.0134
Bus (private)	90	14%	12.9	3	0.0258
MBT[49] (petrol)	16	42%	6.7	8	0.0187
MBT (diesel)	16	42%	6.7	11.5	0.0130
Car (petrol)			1.4	10	0.0714
Car (efficient petrol)			1.4	11	0.0649
Car (diesel)			1.4	16	0.0446
Car (efficient diesel)			1.4	17.6	0.0406
Taxi[50] (petrol)			1.4	10	0.0714
Taxi (diesel)			1.4	16	0.0446

Efficient petrol/diesel km/lit = inefficient mode x 0.91
Hybrid = diesel car km/lit x 0.89
The energy intensity of an electric car was taken to be that of the Nissan Leaf[51] at 0.212 kWh/km (0.1514 kWh/pass-km at 1.4 occupancy). Rail was set at 0.017 kWh/pass-km.[52]

The conversion factors used in the above table, were drawn from LEAP:

Fuel	GJ/lit
Diesel	0.03770
Petrol	0.03315
Fuel	**GJ/kWh**
Electricity	0.0036

Energy intensity was assumed to decrease at 1% per annum as newer vehicles are made to be more efficient.[53]

[48] Golden Arrow Bus Services
[49] Minibus Taxi
[50] Metered taxi
[51] Source: http://en.wikipedia.org/wiki/Nissan_Leaf
[52] Source: *Energy Scenarios for Cape Town: Exploring the implications of different energy futures for the City of Cape Town up to 2050* (technical report) by SEA for the City of Cape Town

The split between diesel and petrol vehicles were set as follows[54]:

Mode	Diesel	Petrol
Car	9%	91%
Metered taxi	9%	91%
Minibus taxi	5%	95%

Electricity Supply

Electricity capacity (MW) and supply (MWh) mix figures were based on the IRP 2010 Policy-Adjusted Scenario:

Fuel	MW 2010	MW 2030	MWh 2010	MWh 2030
Coal	85%	45.9%	90%	65%
OCGT	6%	8.2%	0%	0%
CCGT	0%	2.6%	0%	1%
Hydro	5%	5.3%	5%	5%
Wind	0%	10.3%	0%	5%
CSP	0%	1.3%	0%	1%
Solar PV	0%	9.4%	0%	3%
Other	0%	1%	0%	0%
Pumped storage	0%	3.3%	0%	0%
Nuclear	4%	12.7%	5%	20%

Electricity generation plant availability, efficiency, costs (capital and operations/ maintenance) and lifetime were drawn from the *SNAPP 2.0 IRP 2010 Base and Policy-Adjusted Tool* by the Energy Research Centre, UCT.

The growth factor in electricity tariffs was obtained using an iterative calculation:

- Update the demand-side data and run the LEAP model to ascertain the overall electricity demand in MWh for each scenario until 2030.
- Enter the electricity demand for each scenario into an external spreadsheet (*Electricity Supply Tool*) and set the desired percentage supply fix from each generation technology.

[53] Source: "Quantifying the energy needs of the transport sector for South Africa: A bottom-up model" by Bruno Merven, Adrian Stone, Alison Hughes and Brett Cohen from ERC, Jun 2012

[54] "Quantifying the energy needs of the transport sector for South Africa: A bottom-up model" by Bruno Merven, Adrian Stone, Alison Hughes and Brett Cohen from ERC, Jun 2012

Using these inputs, the spreadsheet calculated the MW supply needed from each electricity supply type (wind, coal-fired, nuclear, etc.).

- Enter the MW output figures from the spreadsheet into LEAP's supply side branch.
- Run the LEAP model again.
- Copy the cost results from the LEAP supply-side branch into the *Electricity Supply Tool*, which calculates percentage tariff growth.
- Copy tariff growth formula from *Electricity Supply Tool* into LEAP

LEAP Scenarios

Business as Usual

Current energy use and growth trends are unchanged into the future. Key assumptions:

- Liquid fuel cost: 4.8% growth
- GDP: 4.3% growth
- Growth in retail: 2.08%
- Growth in office: 3.6%
- Growth in pass-km: same as GDP growth
- Growth in accommodation sector: 2.57%
- Low-income household growth: -6.95%
- Mid-to high-income household growth: 4.31%

Electricity Efficiency

Includes the following interventions:

In all (low & mid-high) residential household:

- All lighting efficient by 2018
- 50% efficient water heating by 2030
- All refrigeration efficient by 2030

In mid- to high-income residential:

- All efficient lighting LED (vs. CFL) by 2030

In Retail/Office/Hotels/Government sectors:

- All lighting efficient by 2018
- All HVAC efficient by 2030
- All water heating efficient by 2030

In Retail/Office/Hotels sectors:

- All refrigeration efficient by 2030

Business as Usual with Peak Oil

Same BAU scenario, except liquid fuel price increase 5% above current rate, i.e.9.8% vs. 4.8%

Solar PV

Embedded solar PV included in supply-side. Amount based on estimated available roof space in central city, which is 48 MW.[55]

Own Steam

A central city that is easily and safely accessed by one's "own steam," meaning mostly on foot and, especially from inner suburbs, by bicycle.

Interventions:

- Improve city accessibility: street audits, small scale improvements
- Improve city legibility: pedestrian way-finding maps, signs, apps
- Lower average traffic speeds: reduce local pedestrian-vehicle conflict; increase pedestrian safety through traffic calming
- Right-size existing streets/ improved pedestrian and cycle infrastructure: area-wide improved street environment for public transport; walk/cycle accessibility
- Increase street connectivity: reduce the block size/ increase pedestrian accesses through large blocks

Modelled in LEAP as follows:

- 5% shift to public transport (46-51%)
- Public transport modal split

Public Transport Mode	2012	2030
Bus	26%	26.5%
Rail	52.5%	48.5%
Taxi	19%	21.5%
NMT	2.5%	3.5%

Public Transport

A central city that monitors and evaluates trends in transport energy use, enables a low-carbon "last leg" of journeys, and supports the use of public transport and "own steam" modes, though parking management.

Interventions:

- Further improved inner City infrastructure for public transport
- Supportive strategies for 'last leg' of public transport journeys
- Parking demand management strategy and implementation

[55] Sustainable Energy Africa 2013

Modelled in LEAP as follows:

- 10% shift to public transport (from 46-56%)
- Public transport modal split

Public Transport Mode	2012	2030
Bus	26%	26%
Rail	52.5%	46%
Taxi	19%	21%
NMT	2.5%	7%

Avoid Transport

A central city that reduces the need for motorised travel through higher density central city living.

Interventions:

- Promote release of state-owned land for developments that support lower carbon transport

Modelled in LEAP as follows:

- Density changes leads to 5% mode shift from car to public transport
- 10% reduction in vehicle kms. Pass-km by 2030 (BAU): 7,332,421,118. 10% less = 6,599,179,006. Therefore annual growth in pass-km 3.7%.

Travel Smart

A central city that promotes the efficient use of private and public vehicle energy.

Interventions:

- Promote low carbon driving behaviour ("eco" driving). Can reduce fuel consumption by 10%.
- Shift from petrol to diesel, from inefficient petrol/diesel to efficient petrol/diesel, from conventional to electric/hybrid
- Optimise vehicle maintenance
- Increase vehicle occupancy/ carpooling/ Travel SMART

Modelled in LEAP as follows:

- Car occupancy shift from 1.4 (2012) to 1.75 (2030). Looked at energy intensity growth pa between 2012 with 1.4 occupancy and 2013 with 1.75 occupancy figure. Also factored in 1% per annum increase in energy efficiency in new vehicles. Came to overall 2.2% decrease in energy intensity per annum.
- Private vehicle modal shift

Type	2012	2030
Petrol	91%	59%
Efficient petrol	0%	6%
Diesel	9%	27%
Efficient diesel	0%	3%
Electric	0%	2%
Hybrid	0%	3%

Annexure 2: Road Pricing as a Model for Reducing Vehicle Use

Road pricing is the practice of charging drivers for road use. This appendix describes how researchers have analysed the impacts of road pricing and describes several systems in place or under consideration around the world.

Road pricing, also known as congestion pricing, charges drivers directly for road use and can take many different forms, including:

- **congestion metering** – pricing by area and time designed to reflect congestion caused by each driver,
- **time based pricing** – similar to congestion metering with charges based on length of time within area,
- **distance based charging** – pricing based on distance travelled within metered area,
- **point based pricing** – drivers charged when they pass a specific point (e.g. toll station) where the system of pay points are used to separate congestion area, and
- **supplementary licenses** – fee system for licenses or entry permits to drive within a specific area, which can also have restrictions for time of day (Ison 2004; Hasan et al. 2012).

Primarily the objectives of road pricing are to produce a shift in travel routes, to change the time of travel, to generate revenue, to mitigate negative environmental impacts, and to improve quality of life for urban inhabitants (Breithaupt 2002). Recent technology advances have facilitated the introduction of road pricing options and eliminated the need for physical tolling booths.

Road pricing is considered a 'fragile' initiative, often met with opposition from interest groups over concerns regarding cost, fairness, and inconvenience (Ison 2004). Public acceptance is key to successful implementation of large-scale transportation planning decision in urban centres (Banister 2011) as economies have become more globalised and as the new communications infrastructure allows international networking and travel at a low cost. There has been a true internationalisation of all activities, and travel forms an essential part of that process. However, this mobility is fuelled by carbon, and there is clear scientific agreement that carbon emissions are affecting the global climate with irreversible long term consequences. Transport is the one sector where a reduction in energy use and emissions is proving to be extraordinarily difficult to achieve despite some success in urban areas. This paper focuses on cities, mobility and climate change, highlighting recent trends in both developed and developing countries. It is argued that the current situation is unsustainable, and that transport

must contribute fully to achieving carbon reduction targets. An alternative is presented, based on the sustainable mobility paradigm (Banister, 2008. Implementation has been most successful where a clear rationale for the project has been communicated and advantages are apparent to all system users (Breithaupt 2002). The rationale for implementing road pricing schemes has varied across regions. Most often a desire to reduce congestion and improve travel times/reliability has been the primary driver for adoption (Buchanan and Buchanan 2007). Other factors that have been used to support initiatives include local air pollution (especially in Santiago, Chile) and GHG emissions (London, Melbourne, Stockholm and Trondheim, Norway) (Ueckermann and Venter 2008)South Africa. Critics of pricing have raised equity concerns for low-income drivers dependent on car travel, especially in relation to proposed projects in the U.S. However, equity concerns are somewhat different in the developing country context where car ownership is predominantly a privilege of high-income and some middle-income residents (Rivasplata 2012). In Latin America, for example, car ownership is out of reach for low-income residents, who are predominantly dependent on transit and non-motorized transport (Rivasplata 2012), and for which road pricing could potentially improve travel times.

The primary impact of road pricing is sometimes anticipated to be a reduction in vehicle miles travelled (VMT) (Litman 2012)identifies existing transport market distortions, and describes reforms that can correct these distortions. This analysis indicates that many common transport policies and planning practices result in economically excessive motor vehicle travel, which is particularly harmful to lower income people and economies. Mobility management strategies include improvements to alternative modes, more efficient transport pricing, and more neutral planning practices. These strategies tend to increase transport system efficiency, and help achieve social equity objectives by improving affordable transport options. Mobility management can provide multiple economic, social and environmental benefits, and so helps create truly sustainable transport systems. This has important implications for developing countries which are still establishing their planning policies and practices. However, studies examining road pricing have tended to focus on quantifying the impact on transport mode and traffic volume rather than VMT, which can be more complicated to measure and is not always the primary aim of policies adopted (Salon et al. 2012). Approaches for quantifying the impact of road pricing on VMT are similar to those for urban densification (see Appendix 3 below). They include econometric studies using a combination of travel diary survey data and algorithms to calculate travel distances based on route taken and travel demand forecasting models (Salon et al. 2012). While many studies are limited by data and modelling capabilities, Salon et al. (2012) suggests the ideal research design to examine the implications of a travel demand measure, such as road pricing, would include the following structure:

- Baseline measurement of VMT for a randomized sample of the target population
- Implementation of the action for an experimental sub-sample of the population without impacting the control group
- Measurement of VMT for the experimental sample and control group
- Comparison of before-and-after VMT for experimental and control groups.

In their review of studies examining road pricing, Salon et al. (2012) found most studies report impacts in terms of traffic volumes, with estimates of the elasticities of traffic volume ranging from -0.1 to -0.45 depending on local conditions such as alternative non-tolled routes, availability of non-car alternatives, trip purpose and congestion levels on alternative routes. Traffic volumes may not always be well correlated with VMT, if road pricing diverts travel to outside the tolled area.

Transport demand models, including four-step transport models and activity-based models, as described in the urban densification (see Appendix 3 below), have also been used to examine the implications of road pricing on VMT. Khademi and Timmermans (2011) suggest that the following characteristics of activity-based models make them better suited to reflect the implications of road pricing rather than the traditional four-step models: the tour-based structure and time-of-day choice, the micro-simulation scale, and ability to incorporate additional choice dimensions (e.g. possession of road pricing pass).

Evidence and Examples from Cities

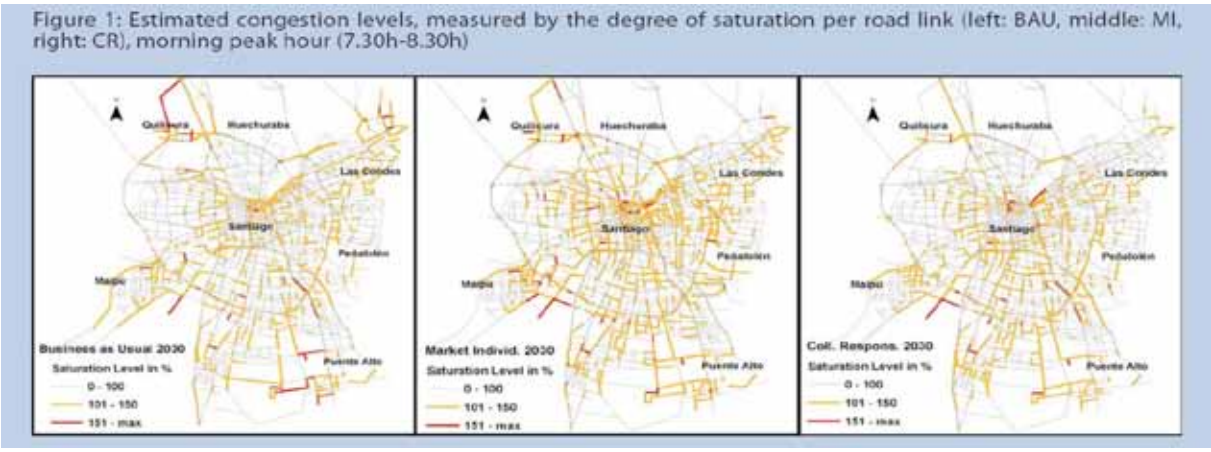
Congestion pricing programs in place in central London, the Singapore metropolitan area and Oslo are well documented. In Singapore, congestion pricing increases of 10% were estimated to reduce traffic volumes by 2-3% (Olszewski 2007). Road pricing programs have also been rejected in several cities in the UK (Manchester, Birmingham and Edinburgh) and in New York. Examples from cities in developing countries are more limited: We present examples of plans that have been considered here.

Several cities in Latin America (Santiago, Bogota, Sao Paulo, and Mexico City) have restrictions on vehicle use on a given day of the week based on license plate numbers, a form of supplementary license road pricing (Rivasplata 2012). While it is believed this has reduced vehicle use, many high-income households, which are the predominant car owners, have gotten around this restriction by purchasing another car (Rivasplata 2012). As a result, many cities are looking toward other approaches to reduce congestion (Rivasplata 2012; Mahendra 2011).

In Sao Paulo, with a population of over 18 million and car ownership of 230 cars per 1,000 residents, private car transport makes up 32% of all trips (Rivasplata 2012). One of the options proposed by a task force established to examine travel demand management is congestion pricing using a three-ring pricing scheme for central Sao Paulo (Rivasplata 2012). Drivers would be charged for driving in one or more of the two outer rings; no fee would be imposed for driving in the economically-depressed inner city centre (Rivasplata 2012). Initiatives which encourage the use of revenues for investments in public transit and non-motorized travel have been supported by recent federal legislation in Brazil in 2012 that authorize cities to implement congestion pricing (Presidencia de Republica 2012). In 2004, the Institute for Transportation & Development Policy (ITDP) initiated work developing a plan for a congestion pricing scheme in Sao Paulo, bringing together expertise from the London system to work with city officials (Hook and Ferreira 2004). Proposed plans are currently under consideration by the city council, but have not yet been implemented.

Private vehicle use in Santiago, Chile has been rapidly on the rise, with a 40% increase in vehicle ownership between 2001 and 2009 (Helmholtz Association 2011). A 2030 scenario

analysis was conducted, including investigation of the implications of congestion pricing for Santiago, as part of the *Risk Habitat Megacity* initiative, a collaborative effort of five German research centres partnered with Chilean organizations, including the United Nations Economic Commission for Latin America (ECLAC) (Helmholtz Association 2011). The scenario analysis includes 2030 projections for transport, as well as other sustainability indicators, under a business as usual (BAU), as well as "collective responsibility" and "market individualism" scenarios. Under the collective responsibility scenario, a congestion charge in the historic city centre and eastern commercial area is included, along with enhancements to public transit (Helmholtz Association 2011). As compared to the BAU and market individualism scenarios, "collective responsibility" results showed car ownership rates were the lowest, while the percent of public transport usage was maintained (as compared to decreases in other scenarios) and congestion in the inner city was reduced (Helmholtz Association 2011). Congestion pricing is currently used on highways entering Santiago, making use of technology to allow for free flowing tolling with car tags. Added tolling fees are applied for travel during rush hour and busy weekend times (Ministerio de Obras Publicas 2014).



Estimated levels of congestion in terms of degree of saturation per road link for Santiago de Chile in 2030 under Business as Usual (BAU), market individualism (MI) and collective responsibility (CR) scenarios. The CR scenario includes congestion pricing for the city center and eastern commercial area. Source: Helmholtz Association (2011)

The concept of congestion pricing has also been explored in the context of Chinese cities by Wang (2010), though his review suggests that approaches adopted in cities such as London and Singapore may have limited applicability in Chinese cities which have a more mixed land-use pattern, higher percentage of government operated vehicles, rapid change in car ownership rates, and lack of funding to cover high transaction costs. Road pricing has been explored in other developing country cities, but specific proposals plans have not been analysed, including Buenos Aires, Argentina (Anon 2012); Dhaka, Bangladesh (Hasan et al. 2012), Kuala Lumpur, Malaysia (Ensor 2004); Johannesburg, South Africa (Ueckermann and Venter 2008).

While the road pricing programs and proposals discussed above involve congestion or time-based metering aimed at imposing fees for driving within a certain area during specific time periods, the option of distance-based pricing has been given less attention. In the US, the Dept. of Transportation for the state of Oregon tested a vehicle-based mileage fee as an alternative to the gas tax (Rufolo and Kimpel 2008). The test involved installation of GPS-based systems in samples of cars that collected information on mileage by location and time of day. Drivers were assigned to one of three groups: control (no fees charged), VMT (flat fee per VMT applied) and peak hour (higher VMT fee at peak travel periods) (Rufolo and Kimpel 2008). Results found the most significant reduction in VMT for the peak hour group, a 20% reduction in travel during peak periods relative to the VMT group (Rufolo and Kimpel 2008).

Our review here suggests road and congestion pricing is a policy approach actively under consideration in many cities in developing countries. Studies examining the implications of road pricing on VMT are limited, especially in the developing country context. Applying the available quantification approaches to examine the implications of road pricing on VMT is a clear knowledge gap that could help inform urban planning moving forward.

References

Anon (2012) 'Peajes con barreras cada vez mas pesadas'. *Pagina 12*, 31 July. Buenos Aires, Argentina.

Banister, D. (2011) 'Cities, mobility and climate change'. *Journal of Transport Geography*, 19(6). 1538–46. doi:10.1016/j.jtrangeo.2011.03.009.

Breithaupt, M. (2002) *Economic Instruments*. Deutsche Gesellschaft fur (ed.). Sustainable Transport: A Sourcebook for Policymakers in Developing Cities. GTZ, Eschborn, Germany.

Buchanan, M. and Buchanan, C. (2007) 'Road pricing lessons - the experience to date'. *TEC - Traffic Engineering and Control*(A worldwide review). http://www.sparamics.cn/upload/file/Road_Pricing_English.pdf.

Ensor, J. D. (2004) *Malaysia Transport Pricing Strategies, Measures, and Policies Inception Report*. Malyasia Transport Research Group, Cambridge, MA, US. http://web.mit.edu/mtransgroup/reports/reports%20pdf%203-25-04/Ensor%20_2004_%20Malaysia%20Transport%20Pricing%20Strategies.pdf.

Hasan, T., Ison, S. and Quddus, M. A. (2012) 'Traffic Congestion in Dhaka, Bangladesh: Role of Transport Demand Management Measures'. Presented at the Transportation Research Board 91st Annual Meeting. http://trid.trb.org/view.aspx?id=1129533.

Helmholtz Association (2011) *How Sustainable Is Santiago de Chile?: Synthesis Report of the Risk Habitat Megacity Research Initiative (2007 - 2011)*. http://www.dlr.de/dlr/Portaldata/1/Resources/documents/2011_1/Synthesis_Report_Megacities_english.pdf.

Hook, W. and Ferreira, E. (2004) 'Congestion Charging: Can it Work in Sao Paulo?' *Sustainable Transport*, (16).

Ison, S. (2004) *Road User Charging: Issues and Policies*. Ashgate Publishing, Ltd.

Khademi, E. and Timmermans, H. (2011) 'Incorporating Traveler Response to Pricing Policies in Comprehensive Activity-Based Models of Transport Demand: Literature

Review and Conceptualisation'. *Procedia - Social and Behavioral Sciences*, 20. 594–603. doi:10.1016/j.sbspro.2011.08.066.

Litman, T. (2012) 'Mobility Management Solutions to Transport Problems Around the World'. *Cars and Carbon*, T. I. Zachariadis (ed.). Springer Netherlands. 327–54.

Mahendra, A. (2011) 'Options for Travel Demand Management: Traffic Bans versus Pricing'. http://trid.trb.org/view.aspx?id=1116826.

Ministerio de Obras Publicas (2014) *Costanera Norte - Tarifas 2014*. Costanera Norte. http://www.costaneranorte.cl/descargas/tarifas-2014.pdf.

Olszewski, P. S. (2007) 'Singapore motorisation restraint and its implications on travel behaviour and urban sustainability'. *Transportation*, 34(3). 319–35. doi:10.1007/s11116-007-9115-y.

Presidencia de Republica (2012) 'Law N. 12.587 of January 3rd, 2012'. http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12587.htm.

Rivasplata, C. (2012) 'Urban Vehicle Restriction and the Prospects for Congestion Pricing in Latin America'. Presented at the CODATU XV: The role of urban mobility in (re) shaping cities. http://trid.trb.org/view.aspx?id=1250421.

Rufolo, A. and Kimpel, T. (2008) 'Responses to Oregon's Experiment in Road Pricing'. *Transportation Research Record: Journal of the Transportation Research Board*, 2079(-1). 1–7. doi:10.3141/2079-01.

Salon, D., Boarnet, M. G., Handy, S., Spears, S. and Tal, G. (2012) 'How do local actions affect VMT? A critical review of the empirical evidence'. *Transportation Research Part D: Transport and Environment*, 17(7). 495–508. doi:10.1016/j.trd.2012.05.006.

Ueckermann, T. M. and Venter, C. (2008) 'International Experience with Road and Congestion Pricing and Options for Johannesburg'. *Proceedings of the 27th Southern African Transport Conference* Proceedings of the Southern African Transport Conference, Pretoria, South Africa. http://137.215.9.22/bitstream/handle/2263/6508/Ueckermann_International%282008%29.pdf?sequence=1.

Wang, R. (2010) 'Shaping urban transport policies in China: Will copying foreign policies work?' *Transport Policy*, 17(3). 147–52. doi:10.1016/j.tranpol.2010.01.001.

Annexure 3: Impacts of Urban Densification on Vehicle Travel and Greenhouse Gas Emissions

Reducing emissions from the transport sector is a key component of low-carbon planning, including in Cape Town. This appendix describes how researchers have analysed the relationship between density, urban form, and vehicle travel around the world, including some preliminary results. This information may help support further research on these types of strategies in Cape Town.

Compact development, also referred to as urban densification, walkable communities, transit-oriented developments, or smart growth – can reduce transportation emissions by having people live close to the places they visit each day, including work, school, stores, and transit. The aim of compact development and densification of urban centres is to intensify the range of activities within a given area reducing individuals need to travel as far and reducing their need to use a car by making other modes of transit more accessible (UN Habitat 2012). Despite continued population growth in urban centres worldwide, cities have actually become less dense in recent decades (Angel 2011). This type of urban land expansion has contributed to sprawl, congestion and segregation and may reduce quality of life for city inhabitants and increase greenhouse gas emissions from transportation.

Evaluating the role of urban densification on transport emissions is focused on understanding how characteristics of urban densification known as the 5 D's: density, diversity, design, destination, and distance to transit can reduce vehicle miles travelled (VMT) or vehicle kilometres travelled (VKT). Quantifying the impact of urban densification on travel patterns is an active area of research with results that can help inform planning decisions in urban areas. Research methods fall into three general categories – simple geographic comparisons of per capita VMT, more complicated elasticity-based methods that look at a number of factors, and integrated land use and transport demand modelling. Here each of these approaches is presented along with examples of results generated from each. Examples from cities in the developing world that have adopted policies and programs to promote urban densification are discussed.

Simple geographic comparisons: comparing per-capita VMT across geographic areas with varied density

The simplest, and perhaps most common, way to estimate the effect of density on vehicle travel is to compare per-person travel distance in less and more dense areas and assume that increasing density could achieve corresponding levels (reductions) of vehicle travel. Though highly simplistic, this approach can give rough, order-of-magnitude estimates. The earliest work examining urban densification and VMT, focused on density of population, residential units, employees, building floor area, or characteristic per unit area (Ewing and Cervero 2010).

One common approach is to compare neighbourhoods within a metropolitan area (e.g. city centre vs. outlying areas) or different urban centres. For example, VandeWeghe and Kennedy (2007) compared per capita VMT for zones in the central city and low-density outskirts for the greater Toronto area in Canada. Quantification relied on a combination of survey data on origin-destination travel patterns for each zone combined with an urban transport planning software tool to simulate travel times and speeds in order to calculate total trip distance and trip counts by transport type and zone. Results found per capita VMT increased from 5875 VKT in the central city core to 11875 VKT in low-density surrounding city zones (VandeWeghe and Kennedy 2007) emissions from private auto use are on par with those from fuel use for building heating. Once beyond the transit-intensive central core, private auto emissions surpass the emissions from building operations. Variation in total auto- and building-related emissions is quite significant between census tracts, ranging from 3.1 to 13.1 tonnes of carbon dioxide equivalents per year. Of all tracts, the top ten in terms of GHG emission are located in the lower-density suburbs, and their high emissions were largely due to private auto use. Taking a similar approach but comparing among global cities, Kennedy et al. (2009) found an even greater variation – from over 6 t CO_2e in Denver (density <2,500 people/km2) to less than 1 t CO_2e per capita in Barcelona (density >19,000 people/km2) (Kennedy et al. 2009). Though straightforward, simple geographic comparisons such as these do have their limitations. As Ewing and Cervero (2010) note, dense areas may lead to congestion that slows travel and actually increases VMT. Travel distances may still be far if locations of school, work and residences are separated even if each area is dense (Ewing and Cervero 2010). And, aggregating analysis at the scale of neighbourhoods and urban areas can miss household level differences (Ewing and Cervero 2010).

Elasticity-based, multi-factor analysis of the relationship between urban form and VMT

To overcome some of the limitations of the simple geographic comparison, this approach looks at a wider group of variables. In this method, density is one of several variables considered, along with diversity of land uses, design of street network characteristics, destination accessibility to trip attractions and distance to transit among others (Ewing and Cervero 2010). Quantitative relationships are often expressed as elasticities: unitless measures of the relationship between a pair of variables calculated as the ratio of the percentage change in one variable associated with the percentage change in another variable (Ewing and Cervero 2010).

Many individual studies have calculated elasticities for built environment variables on VMT. Ewing and Cervero (2010) conducted a meta-analysis calculating elasticities based on 50+ individual studies. Results found VMT most strongly correlated with accessibility to destinations, as well as street network design (Ewing and Cervero 2010). Planners can make use of elasticities from individual and averaged results as proxies to estimate VMT reductions that can be achieved via policy measures (Ewing and Cervero 2010). While a majority of the studies examined are from North America or Europe, research in Santiago, Chile found a significant effect of distance of the household from the city centre on household vehicle use (Zegras 2010). Results found for each kilometre a household was further from the city

centre household vehicle use increased by 530 meters (Zegras 2010). Elasticities calculated suggest that a range of built environment characteristics – density, as well as land use mix, four-way intersections density and plaza density – are strongly correlated with vehicle travel (Zegras 2010).

One of the primary criticisms of this type of analysis is with self-selection bias. This is the possibility that it may be the travel preferences of residents who choose to live in more dense neighbourhoods rather than the built environment itself that influences activity despite the fact that some studies attempt to correct for traveller attitudes and residential self-selection (Ewing and Cervero 2010).

Transport modelling of densification scenarios

Travel demand models are used to develop dynamic forecasts of the impact of proposed plans and policies on travel behaviour and demand. They are the most complex of the three types of approaches reviewed here. There are several different types of transport modelling, we describe them here and provide examples of specific models in use.

Traditional travel demand models operate by quantifying each individual trip in a region. In general, such models follow four sequential steps:

- **Trip generation** (the number of trips made). Trip generation rates are modelled based on factors such as number and size of households, density, activities in the zone, transit connectivity, and car ownership.

- **Trip distribution** (the destination of those trips). This step involves a process of weighting the attractiveness of different destination zones based on what is located in the zone (shopping, work, residences) and determining the travel times between zones. Trip distribution quantifies how many trips are taking place between each pair of zones.

- **Mode choice** (how trips are divided among modes of travel). Mode choice quantifies how people travel between their origin and destination (e.g. transit, personal car, bike, or walk). Often mode choice is quantified using a sub-model that is based on data surveys and assumptions regarding the relationships between mode choice and activities.

- **Trip assignment** (prediction of the route used for travel). Last, the trip assignment step determines the route people will take to travel for each trip from the origin to the destination. Most often it is assumed the quickest route is taken, route selection quantification incorporates factors regarding congestion levels, road conditions, transit schedules among others.

Models once developed are tested, or validated, to see how well they can reproduce current surveyed travel patterns. Then they are used to investigate how patterns may change based on proposed changes, such as increasing development in a certain area. The limitations of the trip-based method are that they focus on the demand for trips rather than activities,

which may not reflect actual individual's behaviour.

By contrast, activity-based transport models have been considered the next generation of modelling capacity. In contrast to trip-based models, which look at individual trip segments as unrelated events, activity-based models look at an individual's overall travel behaviour by travel mode, destination, time-of-day and activity. These models use a "tour-based" instead of a "trip-based" framework, this approach explicitly chains trips in together in tours (e.g. home – day-care – work – shopping – home vs. home-work, home-shopping, work-shopping). These models focus on an individual's daily activity pattern and examine the relationships between the transportation system, including factors such as access to transit, congestion, and activity choices made. The models predict where and when individuals conduct specific activities. This approach is focused on demand for activities, the interdependence of tours, activity and travel decisions made in context of other decisions. These models are well suited to look at shift in tour mode with added tolling or transport change. These models focus on an individual's travel behaviour, and can avoid averaging by zones, which is used in the trip distribution step in trip-based modelling, which is less representative of actual behaviour patterns.

Many models use a scale that is too large to evaluate small-scale design features. More recently, models with spatial resolution at the micro-level have been developed that can better capture effects of land use features on transport (Litman and Steele 2013). An example is the parcel-based land use model developed by the Puget Sound Regional Council (PSRC) for the Seattle (USA) metropolitan area. The PSRC land use model forecasts land use development based on inputs from regional economic forecasts. While previous models used by PSRC and others considered land use change for zones within the metro region, this model can predict and capture land use changes at the parcel level, based on inputs on the development that is permitted for each parcel (e.g. housing units or square feet of building space) under comprehensive plans or development scenarios. The model is tailored to interact with PSRC's travel models so impacts of land use development on transportation can be examined. The model produces forecasts of yearly simulations of the location decisions for each household and job in the region (Puget Sound Regional Council 2013). The limitations of these types of integrated land use and transport models is that they require extensive local data inputs-- meaning they are not transferable across geographic regions-- and advanced statistical and software programming expertise for operation and implementation (Puget Sound Regional Council 2013; Litman and Steele 2013).

Conclusions from analysis of the impact of urban densification on VMT

Generalized results suggest vehicle miles travelled (VMT) in compact developments are 30% less than in sprawling suburban areas (Ewing, R. et al 2008). Increasing densification by 10% has been shown to reduce VMT by 0.5-1%. When densification is associated with other factors like the diversity of land use and distance to transit, larger reductions of 1-4% are found (Ewing, R. et al 2008). In the US, densification of development is projected to lead to a 20-40% reduction in VMT, and can be achieved with limited or reduced cost, while also providing economic and health benefits (Ewing, R. et al 2008). Similar results

were found for urban centres in Mexico, where a country-wide urban densification scenario including policies to promote development and preservation of urban centres with mixed land use (access to work, schools and shopping), revitalized urban landscape, improved equitable access to city services, maintenance of environment, and limitations on sprawl and car use through urban growth boundaries could lead to GHG reductions of 14.3 Mt CO_2e/year relative to baseline GHG emissions. Analysis found that these emission reductions could be achieved for a net benefit of mitigation of 66.4 $/t CO_2e, when the infrastructure investment required is compared with reduced operating costs and distances travelled in higher density areas (Johnson et al. 2010).

Exponential growth rate in urban areas of developing countries is anticipated in coming years, as rural populations move to urban centres (UN Habitat 2012). Despite recognition that rapid growth rates may provide a great opportunity to provide guidance for planning decisions, there are limited studies of the impact of built environment on travel behaviour in developing country cities (Zegras 2010). A recent UN Habitat report entitled *Urban Patterns for a Green Economy: Leveraging Density* provides a guide for action steps that can be implemented to support urban densification by exampling case studies from global cities on how application of these principles has worked in different regions. Guiding principles presented to support planning for urban densification are:

- promote, preserve and open up natural spaces
- integrate and retrofit infrastructure to support higher densities in appropriate locations
- develop a sustainable urban transport strategy that focuses on non-motorized and public transport options
- identify and intensify urban nodes
- increase build area and residential densities to support notes and public transit corridors
- enhance the role of the street as a multi-function urban space that accommodates a range of activities and uses
- promote mixed-use develop and intensification of activities
- practice good governance, knowledge sharing and cooperative approaches

Source: UN Habitat (2012)

The city of Curitiba in Brazil has applied a transit-oriented plan to encourage high-density, mixed-use linear urban development radiating out from the city centre. Key to the success of the urban planning effort has been the integration of land use and transportation planning (U.S. Dept. of Transportation n.d.). Since the implementation of this plan close to 30 years ago, the city has successfully supported densification – 30% of the city's population now lives in the city centre, 30% along high density arterials and 40% elsewhere. Success of city design has been supported by extensive bus rapid transit, with very high transit accessibility. Since implementation of the bus system in the early 1970s, the system has maintained 70% transit usage rates by commuters even with population growth over the same time period (UN Habitat 2012; U.S. Dept. of Transportation n.d.). A 1991 case study, found 28% of bus riders had previously travelled by personal car and overall reduced

personal car trips by 27 million per year and overall per capita fuel usage by 30% as a result of transit usage (U.S. Dept. of Transportation n.d.).

An urban redevelopment project in Australia's 6th largest city – Newcastle – with close proximity to Sydney, invested in revitalizing the waterfront area in the inner city that had suffered from urban decay. The Honeysuckle Urban Renewal Project used brownfield land in the inner city for affordable and high-density housing aimed at minimizing urban sprawl (UN Habitat 2012). The development includes a shared bike and pedestrian path with connections to the regional rail system, and has reported to have helped generate positive economic impact (Hunter Development Corporation 2009), though no effects on vehicle travel were reported.

References

Angel, S. (2011) *Making Room for a Planet of Cities*. Lincoln Institute of Land Policy, Cambridge, MA. http://www.lincolninst.edu/pubs/1880_Making-Room-for-a-Planet-of-Cities-urban-expansion.

Ewing, R. and Cervero, R. (2010) 'Travel and the Built Environment: A Meta-Analysis'. *Journal of the American Planning Association*, 76(3). 265–94.

Ewing, R. et al (2008) *Growing Cooler: The Evidence on Urban Development and Climate Change*. Urban Land Institute.

Hunter Development Corporation (2009) *Building Better Cities/Newcastle: A Case Study in Renewal*. Hunter Development Corporation, NSW Land and Property Management Authority, NSW Government. http://www.hunterdevelopmentcorporation.com.au/documents/publications/Building_Better_Cities_Newcastle_A_Case_Study_in_Renewal.pdf.

Johnson, T., Alatorre, C., Romo, Z. and Liu, F. (2010) *Low-Carbon Development for Mexico*. World Bank, Washington, DC.

Kennedy, C., Steinberger, J., Gasson, B., Hansen, Y., Hillman, T., et al. (2009) 'Greenhouse Gas Emissions from Global Cities'. *Environmental Science & Technology*, 43(19). 7297–7302. doi:10.1021/es900213p.

Litman, T. and Steele, R. (2013) *Land Use Impacts on Transport: How Land Use Factors Affect Travel Behavior*. Victoria Transport Policy Institute.

Puget Sound Regional Council (2013) *2013 Land Use Baseline Validation Report*. Analysis and Forecasting at PSRC. Seattle, WA. http://www.psrc.org/assets/9876/ForecastProdBaselineValidation.pdf.

U.S. Dept. of Transportation (n.d.) 'Chapter 3: Curitiba Experience'. *Federal Transit Administration*. http://www.fta.dot.gov/12351_4391.html.

UN Habitat (2012) *Urban Patterns For A Green Economy: Leveraging Density*. United Nations, Nairobi, Kenya.

VandeWeghe, J. R. and Kennedy, C. (2007) 'A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area'. *Journal of Industrial Ecology*, 11(2). 133–44. doi:10.1162/jie.2007.1220.

Zegras, C. (2010) 'The Built Environment and Motor Vehicle Ownership and Use: Evidence from Santiago de Chile'. *Urban Studies*, 47(8). 1793–1817. doi:10.1177/0042098009356125.

Annexure 4: Where Cape Town Gets Its Energy From

Cape Town draws its energy from South Africa's national power grid. It is thus subject to the distribution challenges of getting electricity and fuel from various parts of the country to the city, and the environmental implications thereof.

Cape Town's fuel supply lines are in many instances exceptionally long. Crude oil is shipped mainly from the Middle East, some 10 000 kilometres away. It is pumped ashore at Saldanha Bay, a port 120 km north of Cape Town, and then piped to the local Caltex refinery situated 15 km from the city centre, in Milnerton. From the refinery, the various liquid fuels (petrol, diesel, paraffin and gas) are distributed to bulk depots and smaller distributors. The vast resources that go into transporting this fuel from start to finish greatly exacerbate the carbon impact of fuel use in Cape Town.

Electrical energy is drawn from the national grid, 90% of which is generated near the coalfields of Mpumalanga (in the northeast part of South Africa), 5% from the Koeberg Nuclear Power Station situated on the West Coast (45 km north of Cape Town's city centre), and 5% from large hydro projects on various rivers throughout the country. Electricity is transmitted to Cape Town from these sites along Eskom's transmission grids and distributed to industry, businesses and households either directly by Eskom or via the City of Cape Town, which is a licensed distributor. Significant energy losses (up to 15-20%) occur in this transmission process due to line leakages. The heavy reliance on coal-powered electricity generation means that South Africa's electricity usage is extremely carbon-intensive.

Annexure 5: National and Provincial Policies

Local policy can make a tremendous impact in the way that change happens at a local level. But for policy work to be truly effective, the work of cities around the country must be tied together through national-level policy that drives and directs change at a greater scale, taking into account macro-factors that are above the ability of cities to affect.

The work of this strategy builds on several key national directives that call urgently for a low-carbon and more socially equitable future. We have summarised some of South Africa's key national energy strategies below to show the way that they have impacted our strategy.

The National Planning Commission's Diagnostic Report of 2011 warned that the South African economy is unsustainably resource intensive. The ensuing National Development Plan (NDP) (2012), while seeking to eliminate poverty and reduce inequality by 2030, makes a clarion call for urgent action to be taken to ensure environmental sustainability through its chapter on Sustainable Development. This is further articulated in the National Climate Change Response Strategy, the newly released draft of the Integrated Energy Plan for the country and numerous other policies at national, provincial and local government levels.

This strategy and White Paper have a strong impetus on addressing climate change and development of the Province. Both support each other in promoting renewable energy and energy efficiency practices in the Western Cape. The aim of which is to institutionalise their objectives around a cleaner energy path for the province to combat climate change and address poverty issues.

National Energy Efficiency Strategy (NEES) (2005)

The vision of this strategy is to strive for affordable energy for all and to minimise the negative effects of energy usage on human health and the environment through sustainable energy development and efficient practices. The latest NEES prioritises energy efficiency and programmes and has an overall target of 12% of energy efficiency for the country, 10% for residential and 15% for other sectors by 2015. The NEES also includes photovoltaics as a fuel switching option (only if the substitution allows for de facto improvement in energy efficiency). Key points in this policy include 1) a strong call for energy efficiency in all economic sectors with ambitious targets and 2) renewable energy is compartmentalised as 'fuel switching', mostly focussed on poor communities with poor energy access.

The Electricity Regulation Act (2006, amended 2008)

This Act makes provision for energy efficiency measures with respect to lighting, water heating and space heating/cooling and smart metering to be promulgated. It also ensures that incentives and penalties are legislated. These energy efficiency applications included in the Act are largely the responsibility of municipalities to enforce and/or implement. Key points in this piece legislation include: 1) allows for budget to be allocated for energy efficiency specifically and 2) strong municipal focus for implementation.

Mitigation Scenarios (2008)

The Long Term Mitigation Scenarios (LTMS) is a Cabinet approved document developed by the

Department of Environmental Affairs & Tourism. It outlined three key scenarios – *growth without constraint*, i.e. business as usual which they clearly state is unacceptable, *current development paths*, which will not be sufficient to create change, and *required by science* which would provide the shift needed to arrest the catastrophic effects of climate change. They noted that by 2050 there would be a huge gap of 1300Mt CO_2 between *growth without constraint* and *required by science* scenarios. The document argues that GHG emissions should plateau by 2020 and decline by 2030. They identified possible solutions which included extensive energy efficiency measures, and a split between nuclear and renewable energy production by 2050 as well as the introduction of carbon tax.

Key points from this document include: 1) Cabinet buy in for accepting that measures must be taken to arrest climate change into the future. This would include photovoltaic generation and 2) mention of a carbon tax which could cross subsidise cleaner generation and more efficient technologies

National Solar Water Heating Framework

The DoE has developed a solar water heating framework, which consolidates all solar water heating programmes currently run by various municipalities, public entities and the private sector. This framework also proposes a viable funding mechanism that will allow for the accelerated installation of one million solar water heaters by 2014/15. The Solar Water Heater (SWH) programme, in terms of which a commitment has been made to progressively deploy the solar water heaters in all residential dwellings which do not have a geyser (this is approximately six million households). The outcome of this programme includes electricity demand reduction (3 600MW). A subsidy and insurance linked programme is planned for increasing uptake in middle to high income households. As of 2012, 160 000 solar water heaters have been installed (of which 40 000 are high pressure systems in middle to high income homes).

Reducing Greenhouse Gas Emissions: The Carbon Tax Option (2010)

The South African government intends introducing a carbon tax by 2015 as a means of meeting the country's national and international obligations to reducing greenhouse gas emissions by 34% by 2020 and 42% by 2025 against a business as usual curve.

A carbon tax is a market based instrument designed to introduce incentives for companies, businesses and individuals to change their behaviours and consumption patterns to reduce the reliance on fossil fuels and lower greenhouse gas emissions.. Emissions arise from various sources, the most common being transportation and electricity usage. A kilogram of CO_2 is emitted for every kilowatt hour of energy produced and consumed in South Africa. Therefore being energy efficient and reducing energy consumption becomes increasingly important. Government has proposed a carbon tax of R120 per tonne of CO_2e (carbon dioxide equivalent) on scope 1 emissions.[56]

[56] Scope 1 emissions are direct greenhouse gas emissions arising from activities taking place within a certain geopolitical boundary such as municipality etc.

Western Cape Climate Change Response Strategy and Action Plan & White Paper on Sustainable Energy for the Western Cape.

This strategy and White Paper have a strong impetus on addressing climate change and development of the Province. Both support each other in promoting renewable energy and energy efficiency practices in the Western Cape. The aim of which is to institutionalise their objectives around a cleaner energy path for the province to combat climate change and address poverty issues.

Annexure 6: Cape Town Central City Development Strategy

"Though typically small in size and population, and under-represented in the political system, Central City areas are fundamental drivers of city-wide and provincial development. Because the health of the Central City is so tightly linked with wider city-region success; municipalities across the world are increasingly recognizing the Central City as the most strategically significant node in the urban system."[57]

The Low-Carbon Central City Strategy is founded on many of the principles held within the Central City Development Strategy, a document launched in 2008 by the Cape Town Partnership, the City of Cape Town, and other organisations who are dedicated to using the central city as a catalyst of inclusive economic and social growth. This document underscores the rich value of partnerships for creating inclusive changes in urban developments, and outlines a series of changes that need to be made in order to create a more productive central city – one of which is a stronger focus on environmental sustainability.

In the next ten years, the Cape Town Central City will grow and greatly enhance its reputation as a dynamic business and people centre

Cape Town's greater Central City is the commercial hub of the city, accounting for around 40% of total business turnover. It is the single most important concentration of employment and the location of many of the region's top companies and commercial headquarters. It is a key transport hub, a major generator of tax surpluses, a visitor gateway, the heart of city, the location of Metro, Provincial and National government offices, and a cultural focus for residents and visitors alike. Because of the high level of activity that takes place in the Central City, the geographical space has an important influence on the region's economic trends and is a vital component of the City of Cape Town's spatial and transport development. The Central City is also a significant energy and natural resource consumer and is thus a primary generator of global warming emissions.

[57] Central City Development Strategy for Cape Town, p7

The United Nations Environment Programme Finance Initiative

The United Nations Environment Programme Finance Initiative (UNEP FI), which, In January 2011, convened the first ever *Sustainable Infrastructure Financing Summit*, motivates that:

- It is necessary to both mitigate and adapt to climate change
- Developing countries must follow a path of "low-carbon infrastructure development"
- There are challenges and costs involved in the above, as well as opportunities for job creation and "long-term prosperity".

Balancing mitigation, adaptation and social and economic development requires collaborative innovation. As a relatively small City with established policy support and real environmental, social and economic challenges, Cape Town is well positioned to act as a testing ground for innovative solutions to sustainable city development that might be shared across larger cities in the African content and developing world in general

In 2008, a partnership of private and public sector interests came together to formulate a strategy for the development of the Central City area. This ten year Central City Development Strategy (CCDS) shares a vision that:

The strategy is broken down into five inter-related pillars, namely:

- Making Cape Town's Central City a more competitive **business location**
- Transforming the Central City into a **quality sustainable urban environment**
- Keeping the Central City a **popular destination** for Capetonians and visitors
- Building the city's role as a **leading centre of knowledge, creativity and innovation**
- Supporting the role of the Central City as **crossroads that connects people to one another, and to the rest of the city**.

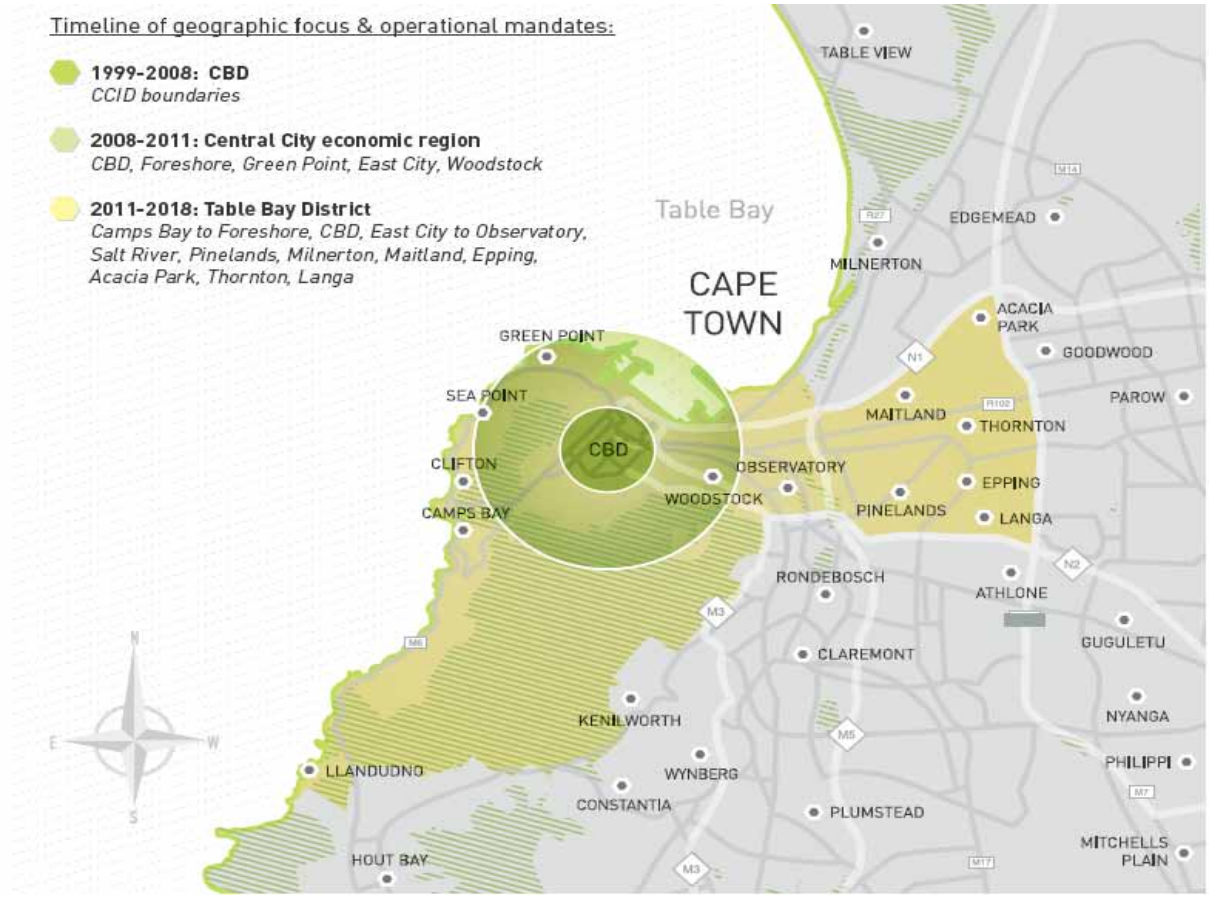
A threat to the above aims would be the Central City moving into a period of decline due to environmental, infrastructural or congestion related constraints. A Bulk infrastructure survey of 2010 showed that bulk infrastructure in the Central City is a key constraint to further densification of the area. Similarly, the draft Inner-City Transport Plan (2013) shows that continued commercial densification without residential densification and/or a significant and rapid shift to public transport modes, will result in congestion that can drive investment away from the centre. If these spatial investment trends are managed, there is a risk of continued urban sprawl with associated costs for transport and overall metropolitan sustainability. A shift to a low-carbon development path can help to mitigate this risk.

Furthermore, in a global context, it is important that the Central City Development Strategy considers the impact of city development on climate change carefully and joins other cities in working to mitigate and adapt to climate change.

The CCDS does not, however, go into enough detail to develop a strategy to reduce

carbon and carbon-equivalent (CO_2e) emissions. This Low-Carbon Development Strategy thus augments the existing CCDS strategies and policies by providing the detail and research-based direction needed to implement projects in the central city that can shift us onto a low-carbon development path/

The CCDS speaks to the Central City of Cape Town, which is currently defined as the Table Bay Planning District, depicted below.



Annexure 7: The Inner City Transport Plan

Encouraging and facilitating more sustainable forms of transportation around the central city requires a streamlined approach towards all modes of transportation. The City of Cape Town has taken great steps towards pursuing this through key planning and policy approaches.

Both the Integrated Transport Plan (ITP) and the Inner-City Transport Policy (ICTP) build on other existing policies and legislation. The ITP references a host of related policy documents, but puts special emphasis on the Integrated Development Plan and its five pillars of Opportunity City; Safe City; Caring City; Inclusive City; Well Run City. The ICTP highlights the National Spatial Development Perspective, the Development Facilitation Act, the Western Cape Provincial Spatial Development Framework and various local planning frameworks as important and guiding, including the Central City Development Strategy (CCDS). The recently published "Green is Smart" green economy document of the Western Cape Government also includes "Smart Mobility" as one of its five pillars.

The ICTP is most relevant to the work of the Low-Carbon Central City Strategy. The key arguments of the ICTP are summarized in the following table:

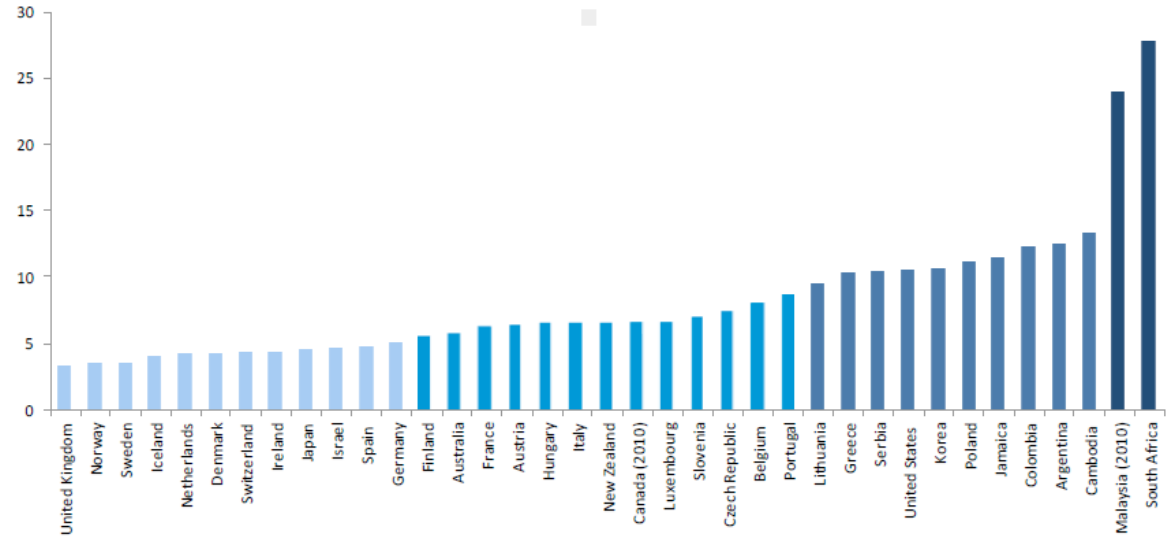
Role of the Inner City	Detail
Inclusive	Integrated – physically accessible
	Affordable – financially accessible
Powerfully attractive	Excellently managed
	Rich vitality, historic, revealing heritage
Driver of growth	Diverse mix of activities
	Tourism

Under each of these headings detailed strategies are proposed and the implications for transport highlighted. The ICTP report goes on to describe limitations and uncertainties, and to identify land-use development scenarios, and also high-level spatial plans for six zones of the City. More specific projects around walking, cycling, parking, public transport are identified. The ICTP is a comprehensive and rigorous analysis of land-use and transport planning matters in the Central City. It could form a valuable resource for future detailed transport planning work. As it stands, however, its very comprehensiveness makes it difficult to engage with, and a more distilled version would add value for its dissemination. Also, the matter of carbon is not addressed directly in the report, although they are implicitly present and quantifying potential carbon scenarios and targeted action plans for carbon are also not addressed. As a benchmarking tool for action, then, it requires supplementing. This report aims to complement the ICTP, building an energy lens onto it; making some initial estimates of carbon impacts; and setting some detailed action steps in place.

Annexure 8: Pedestrian Safety in the Central City

Encouraging non-motorised and "own steam" transport is a key part of the Low-Carbon Central City Strategy's approach towards reducing carbon emissions in Cape Town. Although the "walkability" of the central city is increasing with time, there are still serious challenges around the safety of pedestrians on the streets with relation to motorists. Improving the below information will be a crucial part of ensuring greater levels of "own steam" movement in the future.

Figure 6. **Road fatalities per 100 000 population in 2011**



Transport figure 6: Road fatalities per 100 000 population in 2011
Source: IRTAD, OECD Road safety Annual Report 2013

Data for the central city shows that on average one pedestrian, and two drivers or passengers, will require hospitalisation *each week* due to a serious traffic incident in the central city[58]. A further 17 will receive slight injuries each week. Data on fatal incidents is currently unrealiable, but suggests *at least* one traffic death per month in the central city. Each incident recorded reflects many near-misses, or places where people simply choose not move about on foot due to perceived (and real) dangers.

[58] From SAPS data for 2008-2011 for Seapoint, Cape Town and Woodstock areas. Actual figures may be much higher due to discrepancies between SAPS and FPS data.

Given accurate location data, incident analyses can identify problem areas needing to be fixed, but experts in the field have identified under-resourced police and traffic services as a block to accurate location, and severity data. This is a severe constraint on traffic safety analysis work, and intervention. Until better traffic incident data is available, local knowledge and creative information gathering will be needed in the identification and targeting of problem areas.

The current design speed of the road network as a whole is high, and fear-inducing to those on foot. This is particularly problematic outside of the peaks when there is less congestion to slow vehicles down, but even during the peaks the main arterial network and much of the Foreshore is high speed. Internationally there is widespread acceptance of the need to lower road design speeds through calming and redesign measures and 20mph (32kph) are now commonplace in areas with high "own steam" traffic. The simple reason for this is that at higher speeds the vehicle driver's cone of good vision is reduced, and so danger is less able to be seen; the braking speed is longer, and so danger is less easy to avoid; and the force on impact is higher, and so collisions are more injurious. Getting serious about city which supports, and makes safe "own steam" modes means getting serious about street re-design.

Annexure 9: Heritage, Sustainability and the Central City

Cape Town's central city area has numerous buildings of heritage value, a legacy of the city's rich architectural past. The City of Cape Town government has undertaken an inventory of all buildings older than 60 years which is continually being updated on the City's heritage database. There are over 10,000 heritage buildings in the metro-region, of which 2,500 buildings are owned by the City.

In accordance with local laws, any alteration to a building over 60 years old requires a heritage permit under the National Heritage Resources Act; if the building is in a Heritage Protection Overlay Zone under the Cape Town Integrated Zoning Scheme, heritage consent from the City is required prior to undertaking any structural changes to the building.

The City is developing an incentive scheme to encourage heritage upgrades. However, as noted above, there are strict regulations in terms of refurbishment, which frequently pose great challenges for developers looking to refurbish existing buildings, particularly from a sustainability perspective. Overcoming these challenges, and working in coordination with the City of Cape Town, will open up many new opportunities to make use of existing buildings for new uses – a much more strategy in terms of resources, land use, urban zoning, and other factors when compared to greenfields development in outlying areas of the metro-region.

In order to facilitate the productive engagement between heritage and a more sustainable built environment, it is important to ensure that any new solar water heaters or domestic or commercial renewable energy installations do not detract from the heritage or aesthetic value of a building or streetscape, and that it is compliant with any heritage legislation and requirements. In many cases the refurbishment of existing buildings and removal of unsightly and energy inefficient air-conditioning units and the use of natural means of ventilation are in line with heritage objectives as well as energy efficiency objectives.

In view of the important role of heritage buildings in the CBD area and the regulations for refurbishment, energy efficiency in heritage buildings is highlighted by this strategy as a future tool to promote a more sustainable central city area.

cape town partnership

SEA

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

THIS CITY WORKS FOR YOU