TOOLKIT **EDITION 1** 2018

CITIES' **INFRASTRUCTURE DELIVERY** AND **MANAGEMENT** SYSTEM CIDMS

MODULE 5

Future demand

national treasury
Department:
National Treasury
REPUBLIC OF SOUTH AFRICA

CITIES SUPPORT PROGRAMME

IUDF
INTEGRATED URBAN DEVELOPMENT FRAMEWORK

2030 NDP

MODULE PURPOSE

This module focuses on estimating future demand and on managing demand in such a way that economic optimisation is achieved, that the city's spatial agenda is supported and services are delivered when required, that scarce natural resources are well-managed, and that the city's assets and services are configured to the adaptations required by climate change. This module strongly advocates the adoption of green infrastructure technologies where appropriate to support the transition to a low carbon environment, and to reduce the consumption of non-renewable resources.

WHY

1. Forecasting the need for future infrastructure and community services, and natural resource inputs, is a critical function of both urban planning and of infrastructure asset management planning. This is because growth is not assured, and the level of growth or decline is not constant. Demand will likely change over time, in terms of the nature, quantum or the spatial manifestation thereof.
2. Long lead times are often a key feature of infrastructure creation. It is therefore often necessary to project demand even before it manifests. Assuming that estimates point to the existence of sufficient demand, it may then take several years to identify, acquire and obtain the necessary approvals to develop land, undertake feasibility studies, obtain budget for construction and enter into construction contracts, for the construction process itself, and then asset handover and commissioning. The objectives of demand forecasting then are to:
   - quantify the demand for infrastructure services, in part to determine the quantum thereof, that points to the nature and scale of solutions to be implemented, and in part to the feasibility of the solution itself; and to
   - ensure that demand can be serviced or otherwise managed when it manifests at a material scale.
3. Future demand responses can include asset and non-asset solutions, the appropriate mix of which will likely ensure the future proofing of the city. In responding to demand, cities should consider the requirements of service delivery, climate change adaptation, optimising existing infrastructure capacities, and supporting spatial transformation objectives.

OUTPUTS OF MODULE 5:

1. The adoption of a corporate customer growth forecast, to be interpreted by sectoral planners in estimating future demand. The corporate customer growth forecast should:
   - Be based on the spatially-based, segmented corporate customer profile approved by city management.
   - Present a 30-year customer growth forecast for all customer categories adopted. The forecast should be presented in graphical and tabular formats, and should be supported by a narrative.
   - Consider all relevant factors that could lead to growth or decline in future customers.
   - State the confidence in future growth projections.
   - Highlight risks and opportunities evident in the customer growth forecast e.g. the risk of a decline in the number of medium to high income residential customers relative to low income residential customers, which poses a future financial sustainability risk, and also risks in providing subsidised services to the poor.
   - Future customer growth should be spatially apportioned to determine where demand will likely manifest or otherwise increase or decrease, taking into account factors such as committed low income housing projects, pending and approved development applications, bulk capacities, land availability, and spatial planning dictates.
   - The rationale and methodology, as well as key factors considered in the spatial apportionment of future growth should be documented.
   - The corporate customer growth forecast should be approved by city management, and interpreted by spatial and sector planners when preparing built environment plans, including SDFs, sectoral asset management plans and the city's built environment performance plan.

2. Sectoral customer growth forecasts and future demand quantified and presented in sectoral asset management plans, having interpreted the approved corporate customer growth forecast.
3. Demand management plans included in sectoral asset management plans that are responsive to city strategic outcome statements, resource constraints, the need for climate change adaptation and future city proofing, and spatial priorities.

KEY RELEVANT NATIONAL REGULATIONS, POLICIES AND STRATEGIES:

1. Spatial Planning and Land Use Management Act, No. 16 of 2013
2. National Environmental Management Act, No. 107 of 1998
3. Energy Efficiency Strategy of the Republic of South Africa. March 2005.
4. National Climate Change Response White Paper. October 2011.
5. Sectoral legislation, policies and strategies.

CONTENTS

Module 5 Future demand

LIST OF

Figures that appear in this toolkit

LIST OF

Tables that appear in this toolkit

5.1 ENGAGING WITH THE FUTURE

5.1.1 The future is pliable

It is often assumed that cities are large and that they will continue to grow in future. This is by no means a certainty. Many once thriving cities now find themselves in continual decline, often as a result of their past strengths and unwillingness or inability to adapt to changing conditions.

Detroit, automotive mecca of the world, was one of the five wealthiest cities in the United States during the early decades of the twentieth century. By 1960, Detroit was the wealthiest per capita city in the US. By 2013 the city had filed for bankruptcy. 33% of the city's built footprint is either in a vacant or derelict state, 60% of all children are living in poverty, 50% of the population is reported to be functionally illiterate and 18% of the population is unemployed (Matthews, 2013). Detroit is no isolated case. The Centre for Cities observed (2015) that the once powerful manufacturing metros of the North, Midlands and Wales in the United Kingdom have fallen behind, whilst the cities of the South achieve greater rates of growth. This is quite a common problem. Manufacturing's contribution to the economy is in decline, whilst the services' sector is increasing its share of the economy. Many manufacturing cities are struggling to convert to the knowledge economy in the post-industrial age. What can we learn from this?

There are a few important points:

Cities need not stay locked into mediocrity now, and neither is their current prosperity assured in the future.

Doing the same things tomorrow as were done yesterday will likely lead to stagnation and eventual decline.

The future is pliable to some extent. It is possible to influence the future to achieve better outcomes for cities. This provides the rationale for planning.

In short, cities should engage with the future, and attempt to shape it towards better outcomes. Several tools are available for engaging with the future, including:

01 VISIONING

Which in its final state articulates what communities see as the most desirable future. It is therefore a reflection of normative values that find expression in outcome statements to be achieved at some future point. Visioning is generally a participatory process, and should involve extensive consultation to agree a common desired future.

02 FORECASTS

In the built environment, forecasts generally are quantitative representations of future values or outcomes of specific variables under particular conditions (modelling assumptions). Forecasts can be used in a number of ways. The first is to adopt a vision and then to forecast that vision. This is called normative forecasting: actions are selected because it is believed that they will achieve the chosen vision. Another approach is to prepare forecasts with no particular future in mind. The resulting forecast then allows decision-makers to analyse results and to identify future opportunities and threats that will inform decisions about the future. Forecasts are normally prepared by experts, rather than by communities. Examples of forecasts include population forecasts, land take, demand for water and energy, infrastructure needs and costs.

03 SCENARIOS ARE DESCRIPTIONS OF POSSIBLE FUTURES

Since there is more than one possible future, there tends to be a set of scenarios that explain different yet conceivable ways on what the future may hold. Scenarios are often confused with visions, and even more so with forecasts. But they are distinctly different. A vision is a desired future state. A good set of scenarios will not present a series of desired future states, but rather various ways in which the future may unfold. Some of these scenarios will describe undesirable futures, such as the position that Detroit now finds itself in, whilst others hopefully describe desirable futures. And unlike forecasts that aim to project and quantify what is most likely to happen, the emphasis in scenario development is not on what's most likely to happen, but rather on the identification of different probabilities. It is also common practice to arrange scenarios from least to most desirable. Scenarios are very useful tools when contemplating uncertain futures, made even more uncertain by long planning periods and by the complex interrelationships typically found in cities. Scenarios are also extremely useful in considering changes or transition over time, whether as a result of changes in the external environment (e.g. changes in legislation or the technological environment), as a result of the implementation of city strategy, or in considering the interplay between changes in the external environment and the impacts of implementation of city strategy.

04 PROGRAMMES AND PROJECTS

These are specific city initiatives to shape or influence future outcomes towards attainment of the common vision agreed upon. Examples include initiatives such as urban renewal efforts to strengthen CBDs and primary nodes, invest in public transport along key corridors, establish and maintain urban edges, revitalise urban brownfield spaces, implement mixed-use zoning, upgrade bulk and distribution infrastructure to serve higher land use in urban spaces, all in an effort to establish compact cities with greater economic and social interaction. Programmes and projects often involve capital investment and infrastructure creation, but can also include interventions of a policy, educational or behavioural nature, such as promoting smarter travel or using water wisely.

The end result of the application of these instruments is a set of plans, including the city's growth and development strategy that is the long term strategy, its Integrated Development Plan (IDP) that focusses on needs in the medium term (five years), the Spatial Development Framework (SDF, that provides the spatial vision and interventions expressed spatially to effect the desired change), asset management plans and supporting master plans that indicate the required infrastructure, non-asset responses and financial implications to realise the required vision.

5.1.2 Planning horizon

Forecasting the future need for infrastructure services and social amenities is a critical function of both urban and infrastructure asset management planning. Increased demand may or may not be desirable, depending on its impact on the revenue position of the city, resource consumption and generation of wasteful products, including co^{2}. If desirable, cities will generally respond with asset solutions and when not desirable, it will likely respond with non-asset solutions to curb or substitute demand.

The creation of infrastructure assets on anything but the smallest scale generally have fairly long lead times. It is therefore often necessary to project demand even before it manifests. Assuming that estimates point to the existence of sufficient demand, it may then take several years to identify, acquire and obtain the necessary approvals to develop land, undertake feasibility studies, obtain budget for construction and enter into construction contracts, for the construction process itself, and then asset handover and commissioning. Expanding Eskom's electricity generation capacity is an excellent example: blackouts became a common phenomenon in 2007 and, despite Eskom embarking on a process to build new power stations at around that time, the country in 2015 still experienced capacity constraints.

The objectives of demand forecasting then are to:

- quantify the demand for infrastructure services, in part to determine the quantum thereof, that points to the nature and scale of solutions to be implemented, and in part to the feasibility of the solution itself; and to
- ensure that demand can be serviced or otherwise managed when it manifests at a material scale.

"Forecasting the future need for infrastructure services and social amenities is a critical function."

Get it right, and cities prosper. But there are risks. If demand has been overestimated, then an excess of infrastructure has been created – assets referred to as "white elephants". This places an unnecessary burden on a city's operating account in the form of increased capital repayments, finance charges, asset operation and maintenance expenses to be incurred on an ongoing basis, without a commensurate pay-off in benefits. And since infrastructure has lives typically measured in decades, these costs add up to very sizable amounts. Just a few large developments, say of the scale of an international convention center, where demand has been overestimated, can place tremendous pressure on a city's finances and threaten its financial viability. Of course, the accumulated effect of multiple projects of moderate size where excess infrastructure capacity is created can have exactly the same effect. Ratepayers, if it is known to them that they are paying higher rates and charges to finance surplus capacity due to poor planning, are likely to be resentful. Worse, since capital is always limited, and since unnecessary capital will have been locked into assets with excess capacity, there may not be sufficient capital available to invest in assets and activities with greater benefits.

On the other hand, if demand is underestimated either in terms of magnitude or in the timing of the manifestation thereof, then a services access backlog will emerge, possibly with devastating consequences. Communities may protest if they do not get timely access to services. A city may be forced to reject development applications by businesses where there is not sufficient bulk capacity in either its water or electricity systems. Much needed employment creation is foregone, along with the attendant benefits of decreased dependency on government support and increased social stability. The potential for increased municipal revenues is also impaired. Should the applicant be a well-known investor or company, or it becomes a pattern that business or industrial development applications are delayed or turned down for a period of a few years, the city may develop a reputation as a poor choice of investment. Capital is highly mobile, and there is fierce global competition for fixed capital investment. To appreciate the impact of infrastructure capacity constraints on economic growth, Eskom again serves as an excellent example. It has been estimated by multiple sources, including local economists and the World Bank, that constrained generation capacity by 2015 continues to impair GDP growth by some 2 per cent annually.

Forecasting involves engaging with the future. The single greatest defining property of the future is the uncertain nature thereof. Forecasters, analysts and planners often assume a single possible future, and will at most prepare forecasts doing sensitivity analyses on a few known key variables – in this sense their "planning" is deterministic in nature. Importantly, they by definition do not model for what they don't know. These tendencies and problems will be discussed in greater detail in later sections. But there is no one single future, rather multiple possible futures. Human beings are famous for wildly incorrect assumptions about the future, whether about trends, estimates on demand, the timing thereof or the costs involved. This applies to intellectuals, professionals such as economists, actuaries and statisticians tasked with engaging the future, captains of industry, government policy makers and built environment practitioners, not only in South Africa, but globally.

It is reasonable to ask whether forecasting is a worthwhile exercise when the future is so uncertain, when economists often fail to correctly predict economic growth for the next twelve months, and when so many assumptions about the future turn out wrong. Affecting changes in the built environment takes a very long time. This is in part due to the often long lead times for major infrastructure development. In greater part, though, it is due to the fact that existing city build footprints have been established over very long periods of time. Township lay-outs and transportation networks are resilient and resistant to change, often requiring vast investments over sustained periods to reconfigure. Furthermore, public sector infrastructure investment tends to be characterised by:

- High levels of capital outlay
- Long development lead times
- The creation of infrastructure with lives often measured in decades
- Fairly slow rates of uptake of capacity
- Long yield periods *(the time taken for the project to generate surplus revenue)*

Because infrastructure is generally build to last for several decades, and because it can often take twenty to thirty years for the project to become financially viable (where surpluses generated exceeds expenditure on the project), it is necessary to forecast the long term demand for the infrastructure, and to undertake investment appraisal over sufficiently long periods to determine financial viability. But demand generally does not stay constant over the planning period, nor does it follow conveniently neat linear trends. It is affected by multiple variables, including changes in population and the economy, social outlooks and trends, technological advances and the ability of the natural environment to sustainably support infrastructure services provision.

Accordingly this Toolkit recommends that cities prepare asset management plans and infrastructure investment plans contained in the city's strategic asset management plan by adopting a planning horizon of thirty years. This also means that future infrastructure needs and demand should be forecasted for thirty years.

5.1.3 Focus and content of this module

Customers generate demand, and this module first considers techniques for projecting customer growth and appropriating future customers (demand) spatially in the city space. It then considers how the growth of customers is translated into demand per sector (e.g. potable water or electricity).

The result at that point should be gross demand quantified by type of customer, spatially, over time. The next question is whether we are able and willing to serve gross demand. To answer this question, it is necessary to consider factors such as current supply arrangements and capacity, future supply constraints and opportunities, the financial needs and abilities of both the city and customers, and the timing of supply. In most cases it will be necessary to respond with both asset and non-asset solutions. By employing asset solutions a city typically responds to increased demand by building more infrastructure, upgrading capacity or reconfiguring systems to ensure more effective supply. Non-asset solutions generally aim to manage demand through a combination of hard and soft measures.

5.2 FROM CUSTOMER GROWTH TO ESTIMATED NET ADDITIONAL DEMAND

5.2.1 General

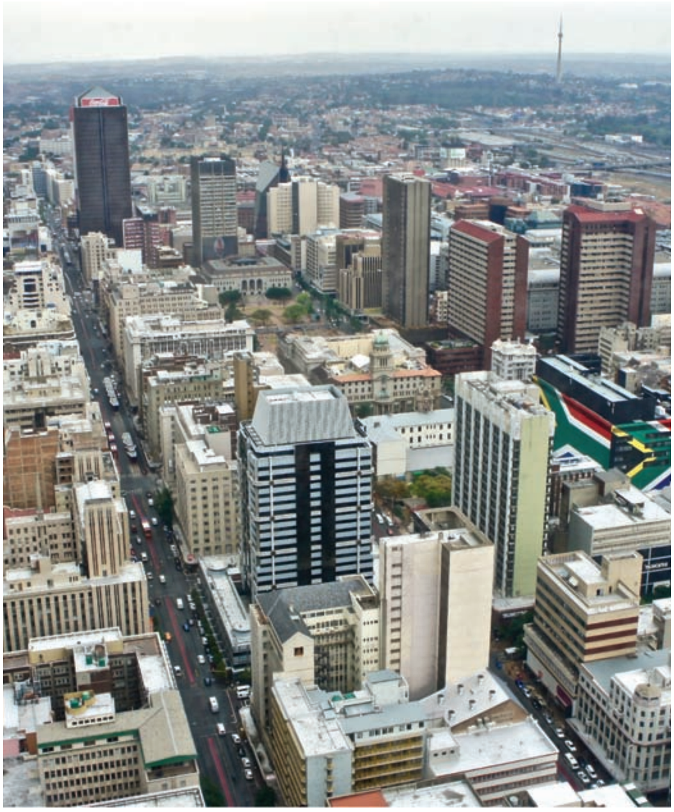
01 ONE CONSOLIDATED GROWTH FORECAST FOR THE CITY AS A WHOLE

The most important decision in forecasting customer growth is to prepare and agree one consolidated customer growth forecast for the city as a whole. This forecast then needs to be interpreted by various departments and sectors for the impact of growth in customers on demand, capacity and cash flow considerations. Why one consolidated forecast? If departments make different assumptions on the number of customers in the base year of the forecast and then further assume different rates of growth, then clearly some will end up projecting greater customer growth that will translate into a proportionally higher requirement for future capital funding to provide infrastructure to service growth. The end result is then likely to be a disproportional allocation of limited capital to various departments. It is also necessary to align the growth forecasts prepared with land use allocations in the SDF, requiring not just coordination between engineering departments (e.g. water, roads and electricity), but also between the planning and engineering departments.

02 PROJECT GROWTH FOR ALL CUSTOMER CATEGORIES

Module 4 showed that customers have different needs for infrastructure and social amenities, and that they often require different levels of service. Different types of customers at various levels of service also generate different volumes of demand. Many municipalities however limit growth forecasts to population growth. Limiting growth forecasts to residential customers will provide at best a partial view of future demand and infrastructure needs. Consider Box 5.1 for the importance and impact of non-residential customers on demand and revenue generation for cities. Large non-residential customers generally also employ a significant portion of the local community, that in turn are able to afford municipal services that increases municipal revenue and decreases dependency on municipal social welfare support. Furthermore, large non-residential customers provide critical mass around which associated and support industries develop, and if conditions are satisfactory, they attract further investment into the area.

This toolkit recommends that cities project growth for all customer categories proposed in **Module 4** (**see Table 4.9 for customer categories**).



03 ALLOCATE GROWTH SPATIALLY

Customers, housing and other forms of accommodation (e.g. office space, shops, factories and warehouses), and infrastructure capacity are not spread uniformly across the city space, and neither will future customers conveniently locate themselves evenly or even necessarily where spare bulk capacity exists. It is therefore necessary to anticipate where future customers will locate, to determine whether sufficient capacity exists in those areas, and if not, what the city's responses to demand should be. Techniques for allocating customer growth spatially are discussed in **Section 5.2.4.**

04 QUANTIFY THE DEMAND FOR ALL CUSTOMER CATEGORIES

Once growth in customers has been quantified and spatially located, the next step is to calculate the demand per infrastructure and community service. This is dealt with in more detail in **Section 5.2.5.**

5.2.2 *Projecting growth in residential customers*

FORECASTING POPULATION GROWTH AND INCREASE IN NUMBER OF HOUSEHOLDS

When forecasting growth in residential customers, cities should project not only population growth, but also expected growth in household formation in each of the residential customer categories presented in **Module 4. When planning for the future, and estimating demand, the following should be forecasted:**

- Expectations on future population size – this is indicative of facility capacity requirements and use, not only of municipal social amenities, but also those of other spheres of government and the private sector.

> *"Planning for municipal infrastructure services and municipal revenue is normally done on the basis of households."*

BOX 5.1:

The importance and impact of non-residential customers

CONSUMPTION COMPARISON:

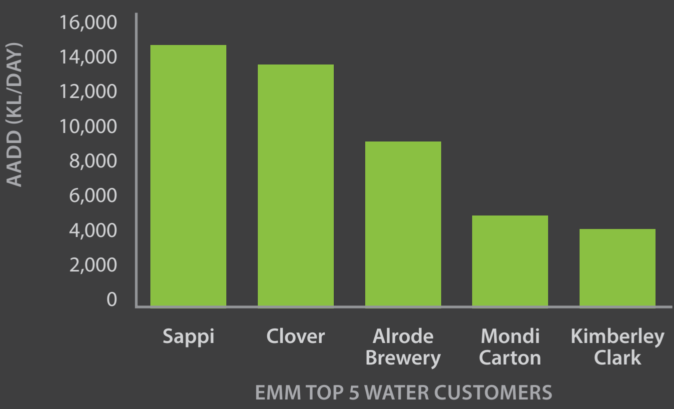
Both Steve Tshwete and Drakenstein are high capacity local municipalities situated in Mpumalanga and the Western Cape respectively. Each boasts a strong local economy: Middelburg is an important industrial zone in the Maputo Corridor and is considered the undisputed stainless steel capital of the southern hemisphere. The area is both rich in coal deposits and in close proximity to Eskom power stations, further benefiting the local economy. There are 50 449 households. Drakenstein comprises Paarl and Wellington and has 44 410 households. The local economy is highly diversified and boasts wine making, tourism, education and a host of tertiary economic activities.

But the scale of operations of the top companies in Ekurhuleni eclipses these large local economies. The top 5 water customers in Ekurhuleni consume an average of 46 266 kℓ per day, compared to the total daily consumption of 38 310 kℓ in Steve Tshwete and 44 253 kℓ in Drakenstein. Another way to look at the impact of the large customers is to equate their consumption to residential demand. Sappi consumes the equivalent daily water demand of about 14 000 medium income households. Similarly, the top 10 electricity customers in Ekurhuleni consume more than the combined demand for electricity in Steve Tshwete. The largest Ekurhuleni electricity customer, International Chemical Corp 2, consumes more electricity than the entire Elias Motsoaledi Municipality (Groblersdal and environments).

"...the top 10 electricity customers in Ekurhuleni consume more than the combined demand for electricity in Steve Tshwete."

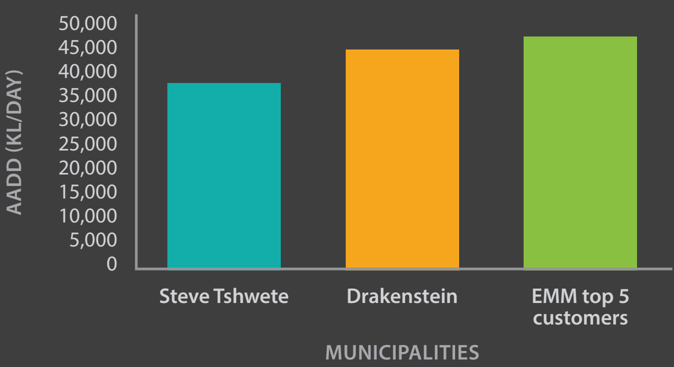
DAILY POTABLE WATER CONSUMPTION

by EMM's top 5 customers

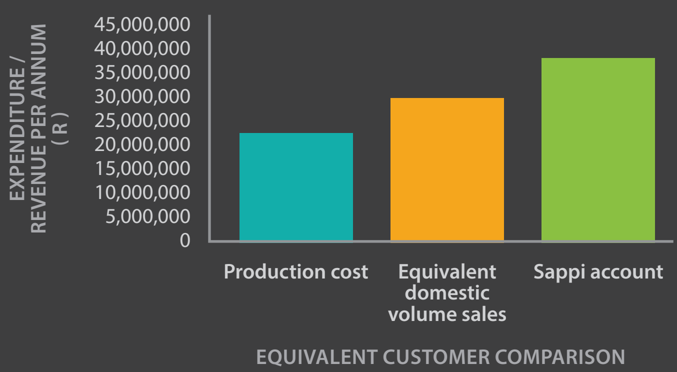


COMPARISON OF WATER CONSUMPTION

between EMM top 5 customers and other high capacity local municipalities



SURPLUS GENERATED FROM SALES TO SAPPI



REVENUE COMPARISON:

The municipality generates an annual surplus of about R 15.7 million from water sales to Sappi. The surplus generated from selling the same volume of water to domestic customers yield a surplus of only R 6.6 million. As a result the surplus margin on Sappi sales is 69% compared to the 29% margin for domestic sales. Put another way, if Sappi decides to disinvest from the area, Ekurhuleni would require growth of approximately 30 000 medium income paying customers to maintain current levels of surpluses. This surplus can in turn be used to provide land and a full suite of basic services to 625 poor households. And is this only on the water account!

- Shifts in the age composition of the population. Age profiles are normally good indicators of the type of amenities required. A young population will need crèches, schools, universities and sport and recreation facilities, and a variety of businesses will be geared to service the needs of young people. A large proportion of elderly people require old age homes, medical support, specialist medical suppliers (e.g. of walking and hearing aids), and perhaps home-based care systems.
- Household growth. Each household requires a physical structure and represents one unit of demand for housing. An household is normally also either a municipal customer that requires municipal engineering services and therefore receives a municipal bill, or is considered poor and is in need of financial support in the form of free basic services, or a combination of both. Planning for municipal infrastructure services and municipal revenue is normally done on the basis of households.
- Household income. It is necessary to project future household income to determine whether they are customers that will likely generate surplus revenues for the city, or poor households that require financial support.

StatsSA provides data to assist in both profiling and forecasting residential customers, as follows:

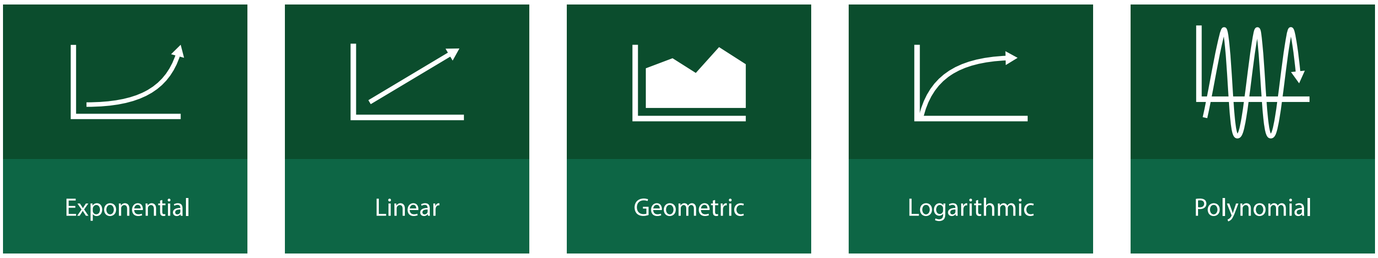
- **Sex and age distribution**
- **Highest education level (all ages)**
- **Average household income**
- **Employment for those aged 15-64**

Note that indicators such as births and deaths are not reported per municipality. Stats-SA does however report the population growth rate between the last two censuses (2001 and 2011).

A number of techniques are available to forecast population growth, including:

01 PROJECTIONS BY MATHEMATICAL FORMULAE

This is the most basic form of projecting population – and is most often done using Microsoft Excel to predict future population using trends. The trend based methods assume that population growth follows natural laws and, therefore, can be expressed in mathematical or graphical form. Population is forecast by examining and projecting past trends into the future. **Various types of expressions (also known as trend lines) can be used to explain past historical growth and predict future growth:**



The weakness of such projections is that they are founded on the assumption that the factors and conditions which produced population growth or decline in the area in the past will continue unchanged and will have the same effects in the future, or that they are derived from an assumed curve of population growth. In view of the changes that have taken place during the past two decades in fertility, mortality, and migration trends, projections of this kind are becoming less reliable. Graphic and mathematical projections are useful, however, as rough checks on those obtained by other methods. Usually, no analysis is made of factors that cause population changes, e.g., births, deaths, and migration.

02 COHORT COMPONENT POPULATION PROJECTION METHOD

The cohort-component method is based upon the balance equation extended for sex and age and is therefore internally consistent. Because it is based on age-structured populations and events (births, deaths, migration), it yields a rich set of demographic indicators. The cohort component population projection method follows the process of demographic change and is viewed as a more reliable projection method than those that primarily rely on census data or information that reflects population change. When the cohort component method is used as a projection tool, it assumes the components of demographic change, mortality, fertility, and migration, will remain constant throughout the projection period. The major disadvantage associated with this method is that it is highly dependent on reliable birth, death and migration data; which is not always readily available. Thus, it may be difficult to collect the information to apply this tool. Secondly, it assumes that survival and birth rates and estimates of net migration will remain the same throughout the projection period. In addition it does not consider the non-demographic factors that influence population growth or decline.

> *"When the cohort component method is used as a projection tool, it assumes the components of demographic change, mortality, fertility, and migration, will remain constant throughout the projection period."*

03 PROJECTIONS BY REGRESSION ANALYSIS

The most common regression-based approach data to estimating the total population of a given area is the ratio-correlation method. This multiple regression method involves relating between changes in several variables (known as symptomatic indicators) to population changes. Using this method it is possible to predict the future population of a municipality based on changes of population over time of a larger area (e.g. South Africa in total).

5.2.3 Projecting growth in non-residential customers

NORMS-BASED APPROACH

Arguably the easiest method to project growth in non-residential customers is to follow a norms-based approach, which is also the preferred method for estimating in particular the need for institutional customers. There are in the main three types of norms applied to determine the number of non-residential customers. The first is catchment-based: a social amenity (whether a hospital, school or church) needs a minimum population threshold to be viable. This same principle applies to businesses. This type of norm assumes a ratio of one facility or business for a stated number of people. Norms for amenities, that are institutional customers, are provided in the CSIR's Guidelines for the Provision of Social Facilities in South African Settlements (2012). The following are examples of norms for various non-residential customers:

TABLE 5.1: *Examples of norms to determine growth in non-residential customers*

CUSTOMER CATEGORY	CUSTOMER TYPE	NORMS	
Institutional	Tertiary hospital	2 400 000	People
	Police station	60 000 – 100 000	People
	Post office	10 000 – 20 000	People
	Primary school	7 000	People
	University	1 000 000+	People
Business	Filling station	2 500	Cars

Another norms-based method is to determine the demand for non-residential customers as a function of households to space required. An example of this is provision for neighbourhood activity centers, where a norm such as the following can be applied: 0.6m^2/per capita. The final method is to relate GVA per sector and growth in GVA per sector to land area per type of land use, and on that basis to determine whether more land (and therefore customers) are required. Applied to functions such as retail, the study would consider retail floor space as opposed to land area.

5.2.4 *Apportion growth in customers spatially*

Future customers will settle at particular points in space, and will generate demand at those specific points. To know whether their demand can be met, it is necessary to compare demand to supply capacity for defined areas, as supply capacities vary across the city. Having prepared customer growth forecasts, the next step therefore is to apportion growth in customers spatially. There are various approaches to apportioning the growth in customers spatially, including apportionment on the basis of:

1. Desired outcomes, such as density requirements necessary to achieve land use intensification in desired areas and to achieve viable public transport.
2. Available infrastructure capacities.
3. Land availability.
4. Cost of development in particular areas.
5. Existing and committed developments.
6. Some combination of the above approaches.
7. Some form of statistical apportionment, whether proportionally, randomly or through some other means.

A city will naturally want to direct growth in a manner that achieves its strategic objectives, and according to how it sees the optimal future functioning of the city. And it is right that cities do so. There are however practical considerations to take into account. There is a wealth of literature demonstrating past failures of urban planning in considering how future growth will play out, the impacts of spatial decisions on public transport, the functioning of urban land markets, the choices of investors and fixed capital formation. As a result actual development in the past often tended to follow a different path to the one planned. **When apportioning growth, cities are advised to follow this approach:**

1 QUANTIFY FUTURE LAND USE REQUIREMENTS

Take into account development controls e.g. density requirements and height restrictions

2 ID THE AVAILABILITY OF LAND FOR DEVELOPMENT WITHIN THE URBAN EDGE

Quantify per land use, considering various categories of land e.g. greenfields, brownfields...

3 CONSIDER EXISTING COMMITMENTS AND RIGHTS

Such as proclaimed townships, committed low income housing projects, approved building plans etc.

4 DETERMINE WHERE AND WHEN FUTURE DEVELOPMENT MAY CRYSTALIZE

Methods include consultation, considering development applications, rights not yet exercised etc.

5 APPORTION GROWTH SPATIALLY AND NOTE KEY ASSUMPTIONS

The outcome of the appointment exercise may warrant review of spatial structuring elements or development controls.

FIGURE 5.1: *Hierarchy of responses to scarce resource utilisation*

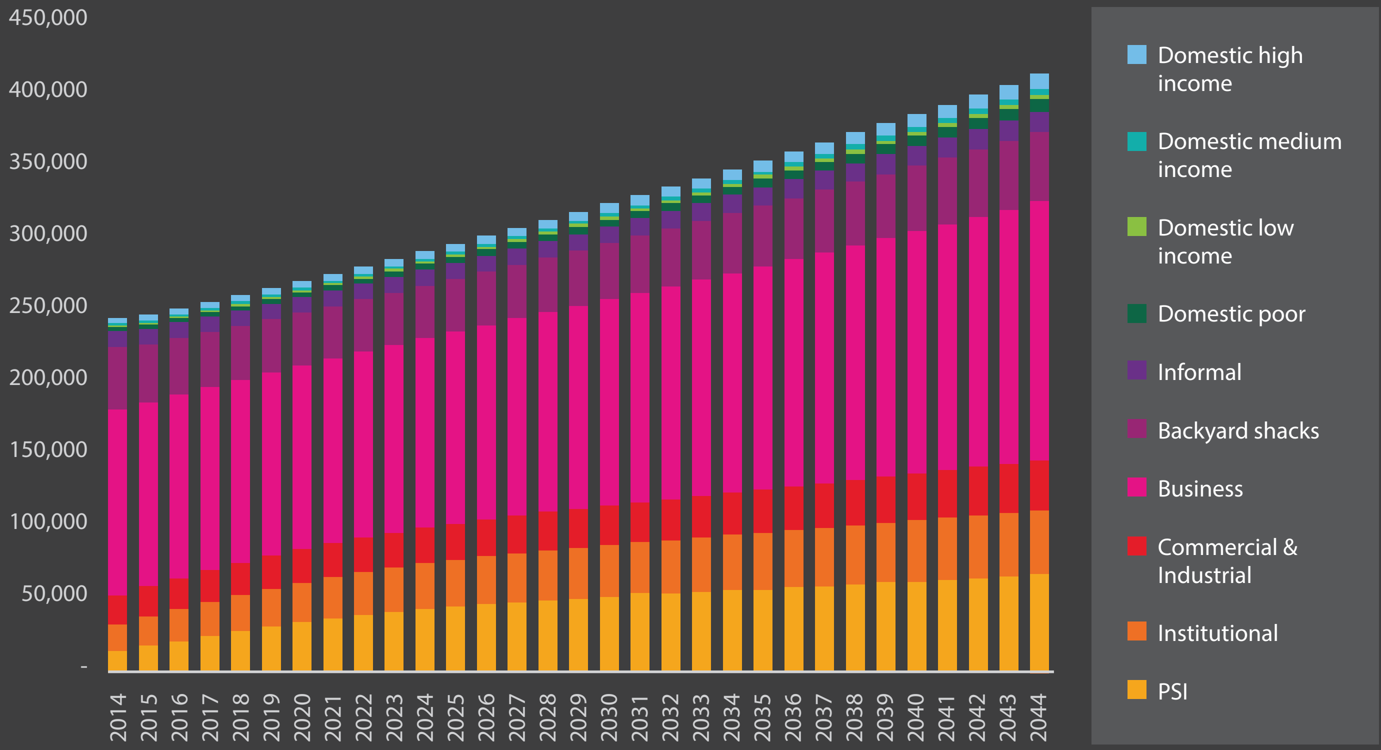
1. Quantify future land use requirements in hectares, taking into account development controls such as density requirements and height restrictions.
2. Identify the availability of land for development within the urban development boundary in various categories (e.g. available greenfield, no development constraints, greenfield some constraints, brownfield) and in various spatial segments.
3. Consider existing commitments. These include:
   - Proclaimed townships, with erven not yet developed
   - Committed low income housing projects – obtain data on location of projects, planned number of housing units and the timing of delivery
   - Approved building plans – obtain data on location, building type and size
   - Land use, title deed or zoning rights awarded but not yet taken up – obtain data on rights not yet taken up and the location thereof.
4. Next, consider where and how (type and pace) future development may crystallise. Several methods may be used, including:
   - Consulting with large developers, government departments, parastatals and utilities, and other investors
   - Development applications submitted but not yet approved – focus on location and type of application
   - Rights not yet exercised (see step 3), but be careful not to double count – the outcome of step 3 is to identify where commitments have already been made and how much space have been allocated already, this step aims to identity the nature and pace of development
   - More advanced methods such as gravity analysis and the identification of the strength of nodes, and identification of derelict brownfield spaces ideal for future redevelopment.
5. Apportion growth spatially and note key assumptions. It may be necessary to review spatial structuring elements or development controls.

1. **The outcome of this apportionment process indicates how, where and at what pace future growth is likely to materialise.**
2. **The outcomes of this process may indicate that future growth patterns do not correspond with the future spatial vision of the city. Where this is the case, and cities wish to retain its desired future spatial vision, specific measures are required to change the probable future growth pattern.**
3. **These measures should be documented and the apportionment exercise re-run.**

BOX 5.2: CASE STUDY

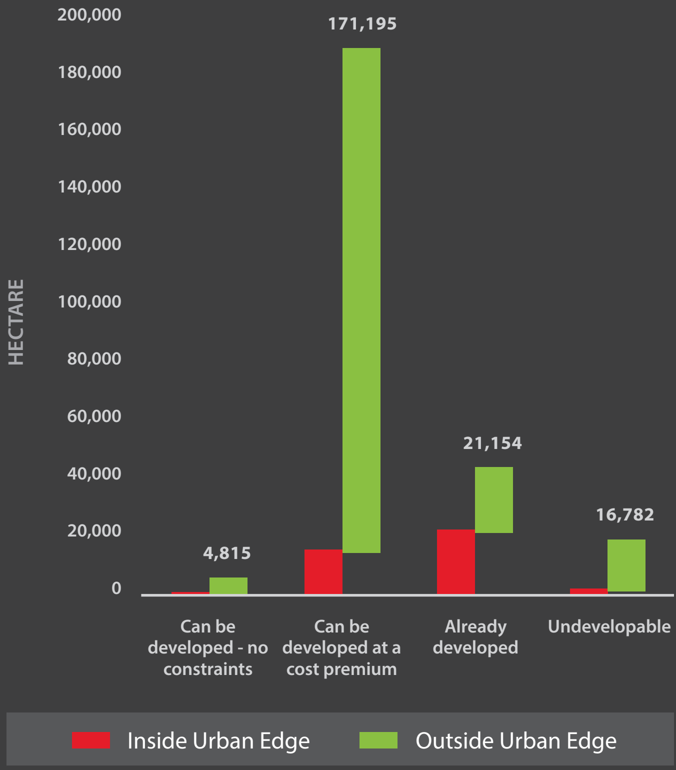
Spatial apportionment of customer growth in Buffalo City

Customer growth forecast up to 2044. Customer growth was projected for each category of customer upto 2044 (residential and non-residential).



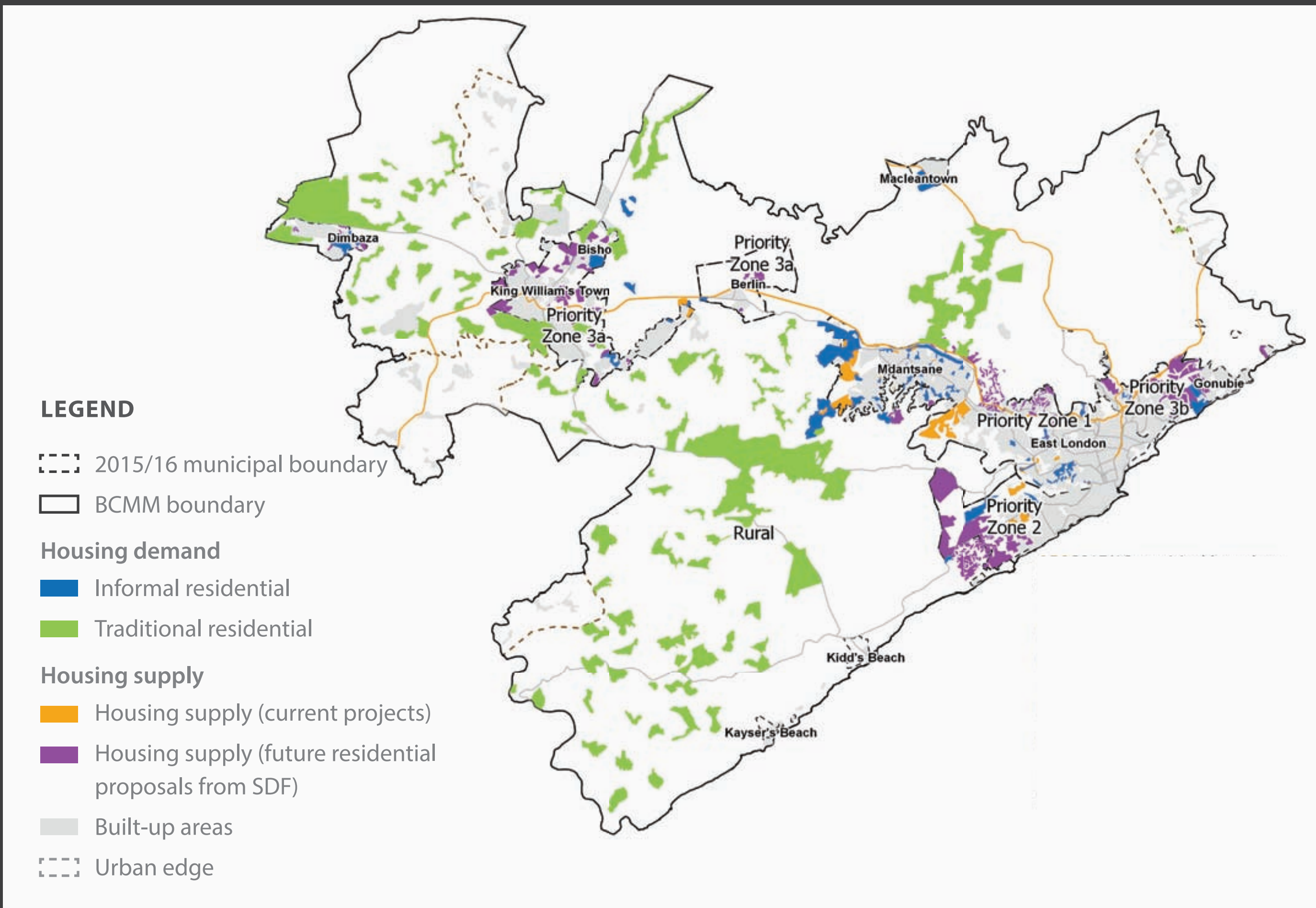
CALCULATING LAND AVAILABILITY

Land available for development was calculated, within and outside the urban edge, taking into account whether land is developed or not, and if not yet developed, whether it is developable (e.g. not protected green zones). Land remaining was then calculated according to the cost of development, taking into account factors such as slope and soil type.



CONSIDERATION OF CURRENT AND COMMITTED DEVELOPMENT, AND DEVELOPMENT PRESSURES

Multiple factors were considered in the spatial apportionment of future customers, some of which included current built status, development controls, current and committed low income housing projects, and building plans.



APPORTIONING CUSTOMER GROWTH SPATIALLY

Having considered all the factors noted above, future customers were allocated to the priority zones and added to current customers in 10-years increments to provide the basis for total demand per spatial priority area, as follows:

CUSTOMER GROUP	PZ 1 – CENTRAL	PZ 2 – WEST BANK	PZ 3A - BERLIN	PZ 3B - QUENNERA	RURAL	TOTAL – YEAR 10
Residential (rolled-up)	111 310	9 174	36 605	25 882	48 399	231 370
Informal	21 951	2 629	1 555	3 724	6 379	36 239
Backyard shacks	5 527	446	1 236	1 329	2 283	10 821
Business	2 918	90	771	237	76	4 091
Commercial & industrial	847	246	225	63	161	1 543
Institutional	984	132	315	85	242	1 758
PSI	3 331	211	717	582	351	5 193
TOTAL	146 867	12 929	41 424	31 904	57 892	290 796

5.2.5 Quantify current demand

Each infrastructure and community services function needs to interpret the corporate customer profile and growth forecast adopted and then quantify gross demand for that service. The starting point should be to quantify current demand per service. **In many instances a wealth of data should be available to determine current demand, such as:**

TABLE 5.2: *Quantifying current demand: available municipal data sources*

SERVICE	SOURCE OF DATA
Electricity	Electricity sales (meter readings and income from pre-paid electricity) – billing system
Low income housing	Housing waiting list, cross check with register of indigents and current number of informal housing structures
Public transport	Bus ridership statistics (ticket sales)
Roads and bridges	Traffic counts
Solid waste	Weighbridge statistics – consider landfill site classification to determine types of solid waste, and consolidate results across landfill sites
Water	Water sales (meter readings) – billing system

Master plans and other specialist studies may also provide useful information in quantifying current demand. **However, before using such information, first confirm the following:**

- Date that the plan or study was prepared – it may be outdated
- Source data used in the study (primary data, or data derived from other sources)
- Completeness of the data used
- Key assumptions made e.g. the current number of customers

Some datasets may be incomplete, outdated or not deemed credible for whatever reason. There may for example be multiple illegal dumping sites across the city space, and solid waste volumes as per weighbridge statistics are considered not to be representative of the total volume of waste generated. In such instances data sets can be substituted, augmented or moderated by considering norms provided in the Red Book.

5.2.6 *Identify factors and trends driving or influencing future demand*

DEMAND DRIVERS

When estimating future demand, which should be done for each service individually, it is necessary to (1) consider the drivers of demand, (2) trends that shape, nuance or redirect demand and (3) changes in the nature of demand.

Different approaches are used to forecast the demand for infrastructure services, and include:

- Top-down models that use limited macro indicators such as GDP (or provincial/regional GVA) to forecast demand.
- Bottom-up models such as residential models that typically forecast on the basis of number of households, household consumption and growth in number of households.

Each of these approaches has associated benefits and limitations. The following table provides some indication of factors that influence the demand for specific infrastructure services:

TABLE 5.3: *Factors driving demand for municipal services*

WATER AND SANITATION	ROADS & STORMWATER	ELECTRICITY	SOLID WASTE	PARKS & RECREATION
Government policy & regulation	Government policy & regulation	Government policy & regulation	Government policy & regulation	Government policy & regulation
Spatial planning and land use management	Spatial planning and land use management	Spatial planning and land use management	Spatial planning and land use management	Spatial planning and land use management
Population growth	Population growth	GDP growth	GDP growth	GDP growth
Weather patterns & climate change	Real disposable income	Population growth	Population growth	Population growth
Usage efficiency	Density and permeability	Energy costs	Real disposable income	Real disposable income
Consumer preference	Modes of transport available	Job creation and real disposable income	Environmental awareness	Leasure trends
	Location of commercial areas	Energy efficiency		

A major factor driving the demand for more infrastructure in most sectors is urban expansion. Johannesburg was noted in **Module 1 (Figure 1.5)** as an example of a city that expanded its spatial footprint by 20 per cent over the past twenty years. The additional built space needed to be serviced by new roads, piped services, electricity lines and cables, and amenities.

Think about what factors influence or drive demand. Population growth by itself, for example, does not translate into increased demand for roads. To be a road user, a person needs a car that in turn normally requires employment and sufficient income to qualify for a vehicle loan. Real disposable income also fuels consumption in general that results in more delivery trucks on the road.

TRENDS

Many forecasters use a set few variables to model future demand. These variables tend to be based on past experience, and forecasters most often extrapolate. They therefore assume that the future will play out under the same rules and trends as was or is currently the case, only influenced by the numerical values of their key variables. This is a fundamental mistake. Before undertaking future demand projections, take time to think about how things are likely to change in the future. First consider general trends (**Table 5.4**), and then more specifically future urban trends as they affect various infrastructure services (**see Figure 5.4**).

Take care when considering trends, they are often not as simple as one would like to think they are. Think for example of the economy. Most forecasters assume either linear economic growth or contraction in projecting the demand for infrastructure services. But this is not how the economy works. Instead there are economic cycles of growth and contraction. Negative growth is not only possible, it is part of the normal economic cycle **(see Figure 5.2).**

TABLE 5.4: *General trends affecting demand*

TRENDS	EXAMPLES
Economic	• Economic investment/disinvestment • Expanded/contracted job opportunities • Economic structuring, i.e. corporatization, outsourcing and workforce mobility
Social	• Population growth/decline • Household size • Education levels • Increased working hours • Social consciousness • Lifestyle issues and preferences • Travel and improved mobility • Diseases, notably HIV/AIDS
Environmental	• Global warming • Depletion of scarce natural resources • Greater environmental awareness
Technological	• Improved product and process technologies • Alternative fuels

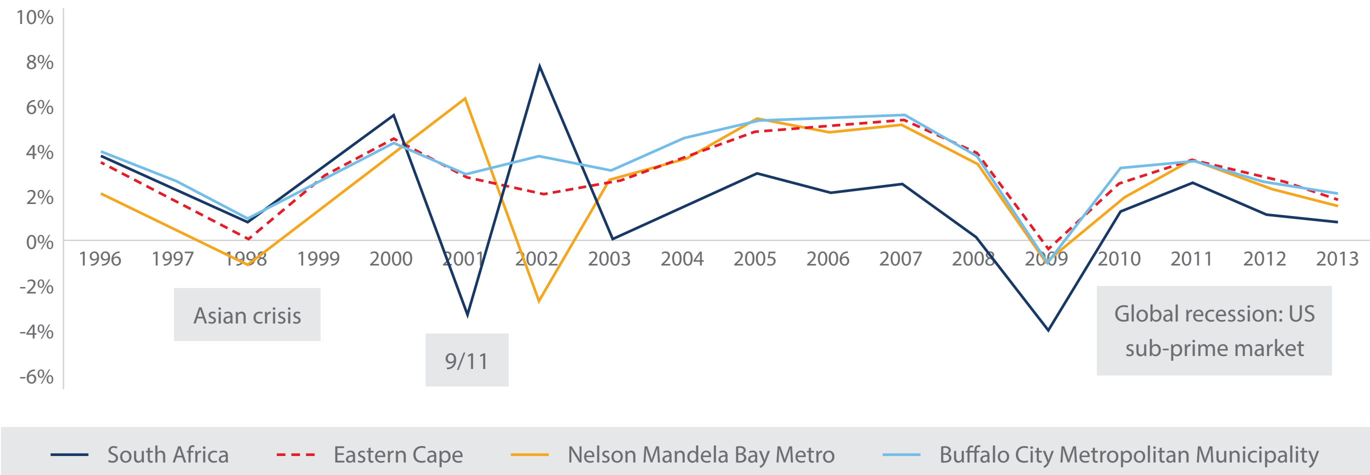
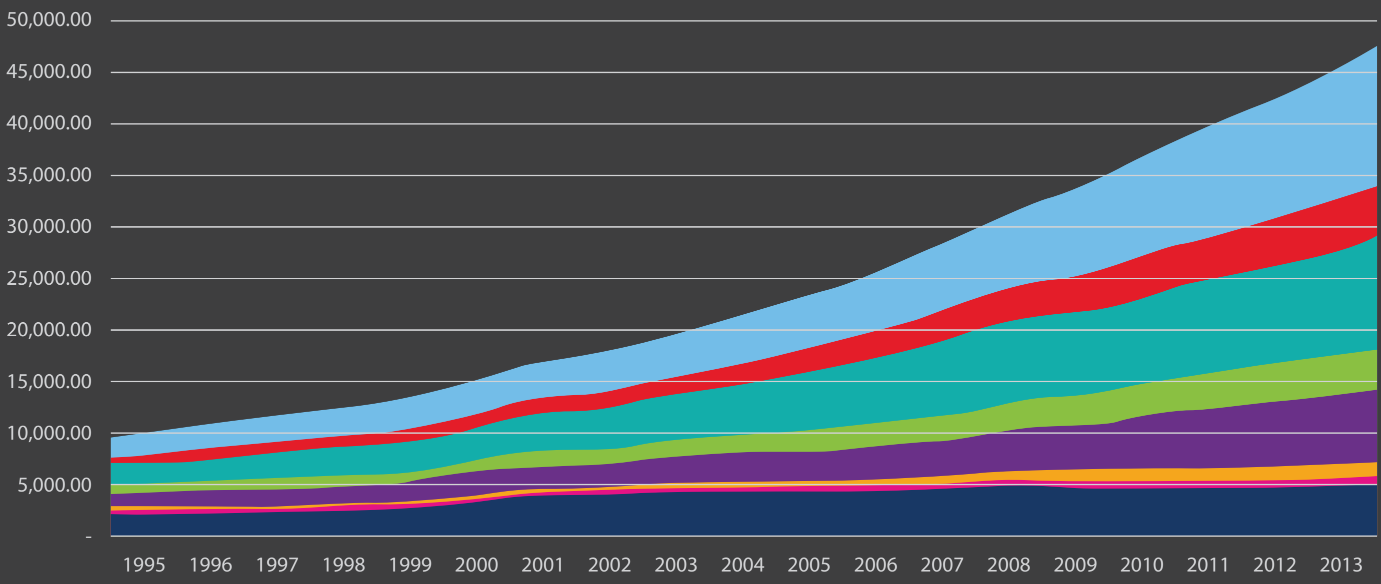


FIGURE 5.2: *National, provincial and city economies all go through cycles of growth and contraction*

A recession happens when negative growth is recorded for two consecutive quarters, measured in real gross domestic product (GDP). This can happen in particular sectors such as mining or manufacturing, or with the economy as a whole. A depression is a more severe form of a recession, typically lasting for two years or more, and tends to be characterised by declining output, significant increases in unemployment and bankruptcies, and reduced credit availability.

It is also possible that a city's economy as a whole may grow, whilst experiencing downturns in particular sectors **(see Figure 5.3).** In the long run, the primary and secondary sectors' (i.e. agriculture, mining and manufacturing) contributions to gross value add (GVA) will likely decrease, whilst the contributions of services (e.g. financial services) will likely increase. However, take care not to neglect sectors with declining contributions to GVA – the primary and secondary sectors are all large employers, they tend to employ lower skilled workers that may not be easily accommodated in other sectors, and they often anchor economic value chains.

FIGURE 5.3: *Over time there are structural shifts in the economy (Buffalo City)*



- **PA:** Agriculture, forestry and fishing [SIC: 1]
- **PB:** Mining and quarrying [SIC: 2]
- **SC:** Manufacturing [SIC: 3]
- **SD:** Electricity, gas and water [SIC: 4]
- **SE:** Construction [SIC: 5]
- **TF:** Wholesale and retail trade, catering and accommodation [SIC: 6]
- **TG:** Transport, storage and communication [SIC: 7]
- **TH:** Finance, insurance, real estate and business services [SIC: 8]
- **TI:** Community, social and personal services [SIC: 92, 95-6, 99, 0]
- **TJ:** General government [SIC: 91, 94]

Many societies now enjoy longevity, with people living longer as a result of improved health systems. Older people are generally also becoming more active, and this trend will likely continue with future generations of older people. Healthy life expectancy is also on the rise, but not as much as life expectation. As a result people live more years with sickness and infirmity. These are general global trends.

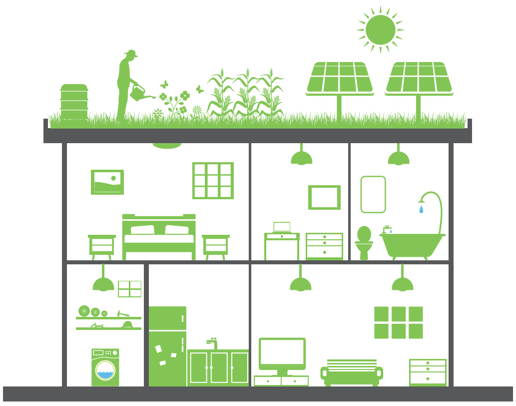
In South Africa however, life expectancy decreased from 60.46 years for men and 68.87 for women in 1990, according to Stats-SA, to 57.67 years for men and 63.01 years for women in 2013. The current South African life expectancy at birth is 62.50 years and the plan is to improve this to 70 years by 2030.

FIGURE 5.4: *Possible future urban infrastructure trends*

META FUTURE URBAN INFRASTRUCTURE TRENDS

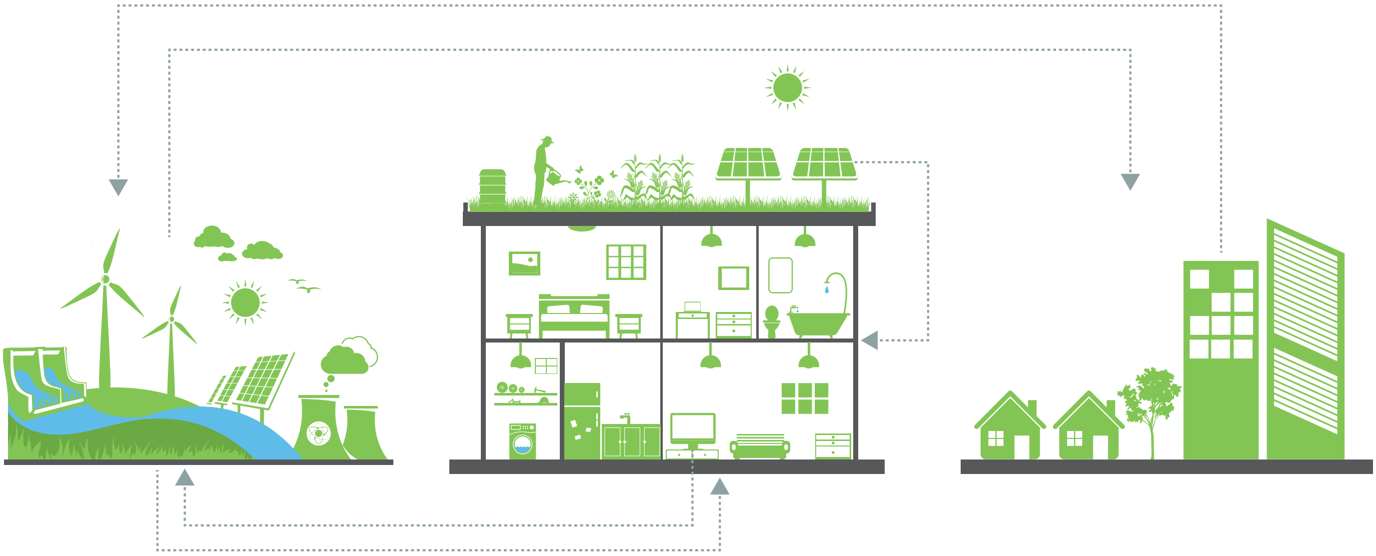
- Urban and infrastructure design and retrofitting for climate change adaptation, resiliency and long-term sustainability
- Increasing capturing of negative externalities and sharper focus on all elements of sustainability, including the economic, social and environmental dimensions thereof. Negative externalities are adverse impacts, such as pollution, that are not included in the cost of a product or service, and the social cost thereof is then carried by society at large
- Increasing fragmentation and democratisation of infrastructure through distributed infrastructure incorporated into the public realm and in buildings
- Built systems will increasingly mimic ecological systems, becoming regenerative, closed loop systems generating no waste
- Increasing shift towards green infrastructure as a less costly alternative to traditional grey infrastructure that augments cities' infrastructure capabilities
- Focus on multi-functional green spaces and green infrastructure that delivers a wide range of ecological services such as clean air and water, stormwater management, co^2 capture and to cool cities, whilst delivering more pleasant and attractive places that support social interaction through a range of recreation, leasure and education options, and land value capture
- Smarter, connected infrastructure able to control supply and provide real time information to customers enabling them to adjust consumption and achieve cost saving

BUILDINGS



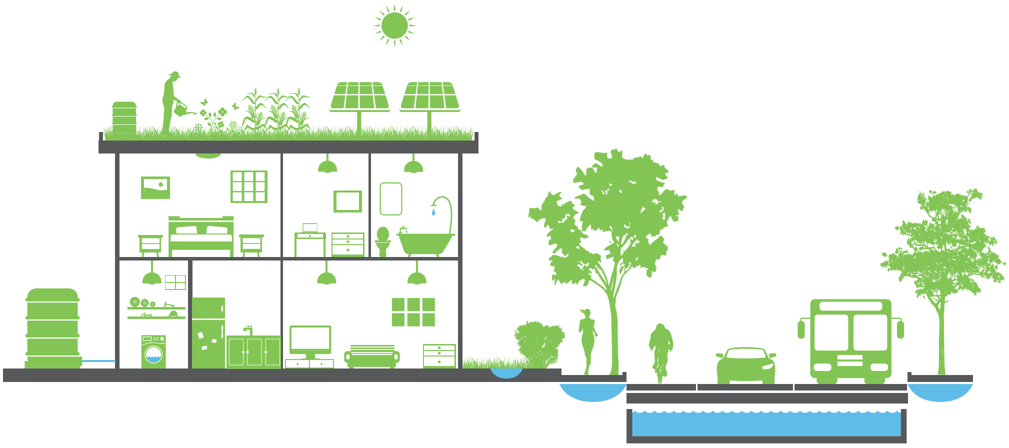
- Future buildings, whether flats, houses, offices, shops or factories, will increasingly use improved design, recyclable materials and internal systems for lighting, cooling, heating, water efficiency, and general improvements in air quality
- Future zoning will enable multiple use for buildings
- Buildings will be designed for multiple use, adaptability and connectivity to both outdoors and the internet.
- Existing buildings will be retrofitted for improved resource efficiency

ENERGY



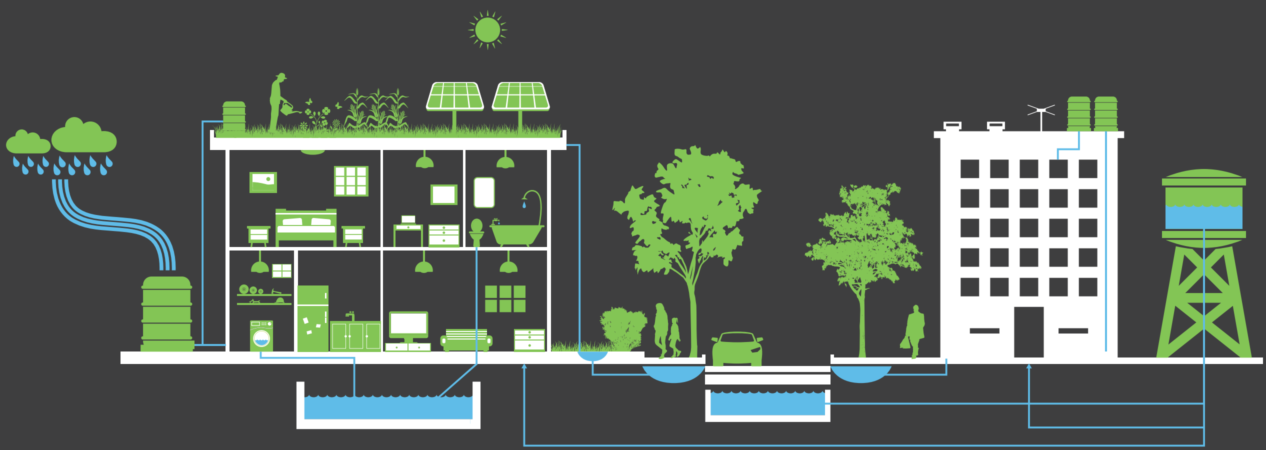
- The demand for energy will continue to rise whilst the natural resource base (e.g. coal) will continue to dwindle. Political and societal resistance to dirty energy will continue to mount. International protocols and targets will demand a shift towards clean energy production. Cities globally will be rated on resource efficiency and ecological impact, and those ratings will influence their global competitiveness and ability to attract investment and knowledge workers
- Energy supply will become more mixed, and will increasingly feature renewable energy such as solar, geothermal, cogeneration and wind. Successive generations of renewable energy technologies at all scales (from home to regional production scale) will become more widespread and cost-effective. To adapt to climate change cities will prioritise energy conservation, then local renewable energy generation and lastly drawing power from the regional grid
- Localised energy production: buildings across land use types will generate renewable energy through installations such as solar panels and heat pumps, and excess electricity will be sold back into the system, or shared on a credit basis
- Energy management systems and smart meters monitor energy use in real time, and manage the load and utilisation across the city by controlling consumption automatically

TRANSPORTATION

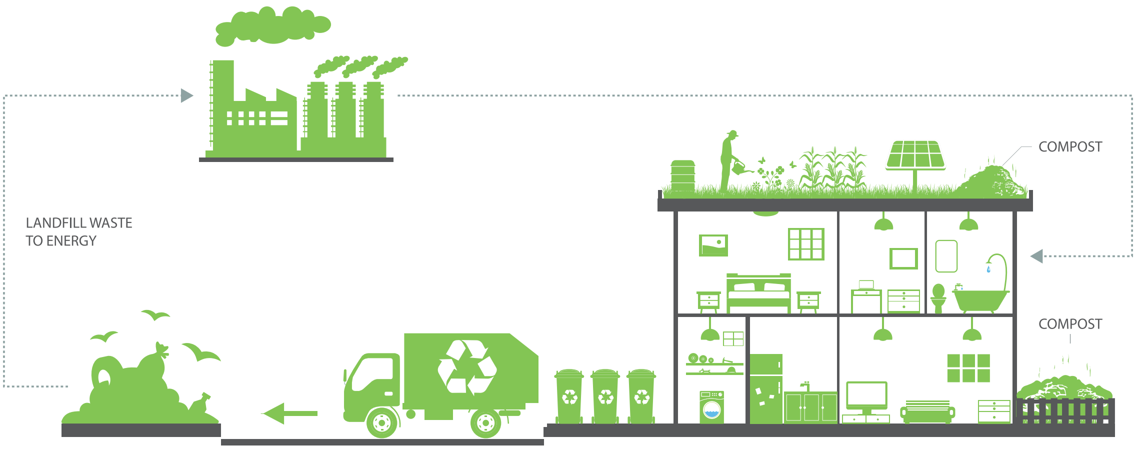


- Greater mix of travel modes, with new developments designed for firstly active travel (walking and cycling), access to public transport, and lastly by vehicle. This will require significant increases in investment in active travel infrastructure, including the development of complete streets in dense, high priority areas, cycling lanes and secure bicycle parking facilities and sidewalks.
- Existing roads will be retrofitted to accommodate not only multiple travel modes, but also to become walkable (focus on streetscaping), accommodate rainwater storage in the sub-base of the street and to be safer (e.g. switch to frangible poles)
- Bicycle and vehicle sharing facilities and schemes will over time become commonplace, and electric charging points will be rolled out through the city. Drones will increasingly be used for deliveries, reducing some pressure on the road system
- Cities will likely establish mobility management systems, provide real time traffic information, publish smart travel plans and develop specific traffic plans for facilities such as schools that generate high volumes of traffic at particular times of the day

WATER



WASTE



- Wastes of various types are increasingly viewed as input materials into agricultural, manufacturing and other economic and social processes. The ultimate aim is to close waste cycles to ensure zero waste
- Waste generation targets will be established for residential and non-residential customers. These will be monitored and reported on for compliance and accountability purposes
- Recycling and (where applicable) composting facilities will be incorporated into building designs e.g. grey water will be recycled on-site and used for purposes of irrigation and toilets
- Cities will increasingly fit waste-to-energy technologies to their solid waste facilities, and invest more in waste sorting and recycling facilities

- Water will become an increasingly scarce resource, whilst the demand for water will continue to increase. South Africa has run out of suitable dam sites and major freshwater resources are fully utilised. Coastal cities treat seawater for human consumption
- Cities in general distribute water catchment, in homes, businesses, permeable pavements, public green space, rain gardens etc.
- Water is allocated to uses as appropriate: potable water for human consumption and non-potable water for irrigation. Grey water to be re-used for non-potable purposes

Now, having considered both general and sector-specific drivers of demand and trends, take time to think about key influences and variables, and how they will affect demand forecasts. Box 5.3 provides an example of some of the things to think about prior to running forecasting models, by considering electricity. This is not an extensive list. The point is to think about how the future may play out, what will be different to current facts, trends and assumptions, and how it affects the design of the forecast model (variables, the relationship between variables and parameters adopted).

"The point is to think about how the future may play out, what will be different to current facts, trends and assumptions, and how it affects the design of the forecast model..."

Having thought about how future demand may shape, it is very likely that several scenarios or options may play out in the future. Consider for example Box 5.4 that contemplates various scenarios for the future of solid waste for a city.

BOX 5.3:

Things to think off prior to embarking on gross demand forecasting

Let us assume we are asked to prepare a gross demand forecast for electricity for the city. We already have the current customer profile and the corporate customer growth forecast, and we have a reasonable idea of electricity usage by customer type, based on time-series data on electricity consumption statistics compiled over the years. What are some of the things we should probably be thinking about? Consider the following – this is not an extensive list, merely illustrative of the sort of things to think about that may change in future, and the types of impacts it may have on demand forecasting:

ISSUE

Cost of bulk energy. Indications are that South Africa will in future increasingly diversify its energy mix, and the current main contender appears to be nuclear power. The CSIR (2015) estimates the levellised costs of different options to be:

WHY IS THIS IMPORTANT?

The cost of electricity, as is the case with any other product or service, may either stimulate or dampen demand. If the energy mix favours nuclear power, then the cost of bulk purchases will increase that may stifle demand. As green energy becomes economically more viable, customers who are able to might opt to provide for their own energy needs, and the city's revenue potential will in such an event be impaired. The city may however also decide to invest in own energy generation by for example establishing wind or solar farms where viable.

ENERGY SOURCE	COST/KWH
Nuclear power	R 1.00/kWh
New coal	R 0.80/kWh
Solar photovoltaic	R 0.80/kWh
Wind	R 0.60/kWh

ISSUE

New building regulations and sustainable accommodation. New building regulations, applicable to both residential and non-residential accommodation, require building design to reduce energy and water consumption, and to reduce their co^2 footprints.

WHY IS THIS IMPORTANT?

Not only do customers save on energy, at times some generate surplus energy that is sold back into the grid, turning customers into producers and suppliers. This increases available supply, but limits demand and the revenue potential of the city. On the other hand, such energy tends to be renewable in nature, assisting cities and the country to meet climate change targets. And when such surplus energy can be bought from private producers at lower rates than from Eskom, the city's financial performance is improved. But at some scale Eskom power is still required, and it needs to cover at least its operating expenditure. So the less units Eskom sells, the higher the unit cost rate becomes.

TECHNOLOGICAL ADVANCES

Each successive decade produces more appliances that increase the demand for energy. More energy efficient appliances may limit demand, but the sheer volume of technology may offset energy-efficiency gains made.

WHY IS THIS IMPORTANT?

The demand for energy per household, which is a key variable in forecasting future demand, may increase. Consider for example the electric car. Estimates vary on consumption costs, depending on factors such as the vehicle itself, driver behaviour and season, but may be in the order of 4 200 kWh for annual travel of 24 000 kms. Still considering electric cars, there will also likely be a future need for public charging points, requiring infrastructure investment. How will this be done? Will the city supply such points, enter into arrangements with the private sector, or simply leave the private sector to respond as they see fit? In the event that the city decides to provide such infrastructure, who will be responsible, the electricity department or the transport department?

BOX 5.4:

Scenario planning for solid waste

SCENARIO 1: CONTINUATION OF CURRENT TRENDS

Current growth in waste generated which is 2.27%, was used to indicate future results should current trends continue unchanged.

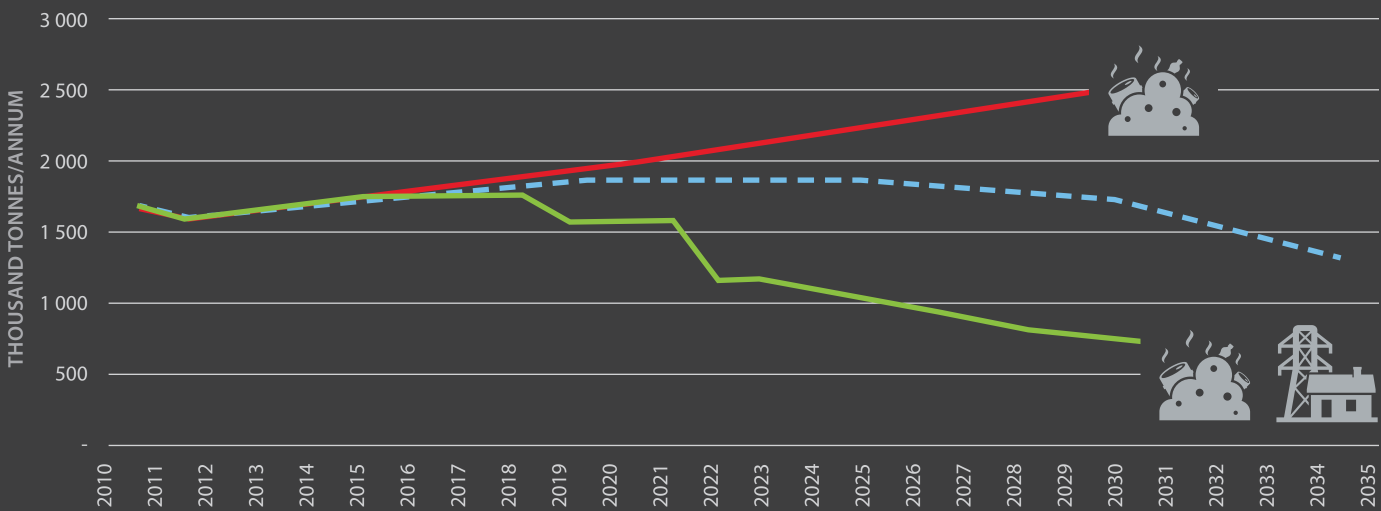
SCENARIO 2: CONSERVATIVE ESTIMATES ON WASTE REDUCTION THROUGH A COMBINATION OF WASTE-TO-ENERGY AND WASTE MINIMISATION METHODS

In this scenario a conservative approach is assumed, especially during the initial stage. An assumption was made that growth would be halved after 4 years, and reduced to 0% after a further 5 years. Waste generation will thereafter be steadily reduced, initially at 1.5% /annum, and after 2029/30 with 5%/annum till the end of the planning period by using a combination of waste to energy and waste minimisation methods.

SCENARIO 3: AGGRESSIVE ESTIMATES ON WASTE REDUCTION THROUGH A COMBINATION OF WASTE-TO-ENERGY AND WASTE MINIMISATION METHODS

Starting after 4 years growth will be reduced to 0 over 5 years, where after 10% and 25% reductions in the waste stream will be achieved by waste treatment project implementation during 2020 and 2023 respectively. It is assumed that 'Waste to Energy' processes will be employed. It is possible that this process may even be used to burn previously deposited solid waste. It is further assumed that the volume of waste generated during 2024 will be reduced by a further 25% over the next 5 years, and thereafter by 5% of the waste generated annually till the end of the planning period by using a combination of waste to energy and waste minimisation methods.

EXPECTED FUTURE SOLID WASTE VOLUMES UNDER VARIOUS SCENARIOS



5.2.7 Calculate net additional demand

CALCULATE GROSS DEMAND

Having interpreted demand drivers and trends, asset management planners should forecast gross demand per service (e.g. potable water or electricity), taking care to factor for addressing service access backlogs, growth (or decline) in all customers categories, as well as target levels of service per customer category and spatially defined area. The objective is to arrive at gross demand, the purity of the forecast should not at this point be tainted with particular objectives such as the desire to enhance revenue, curb expenditure or wastage, to implement new technologies or reconfigure current infrastructure systems. The forecast at this point should be regarded as a customer needs statement, and asset management responses will only be formulated following estimation of gross demand. Once the forecast model has been run, take time to assess the results. Do they make sense? Does the model yield answers to questions posed prior to running it?

Quantitative forecasts suffer from various limitations, largely due to the uncertain nature of the future. A particularly difficult aspect to model is transition that tends to happen in phases of unsure duration. Where this is the case, cities are advised to prepare a narrative supplementing the forecast model.

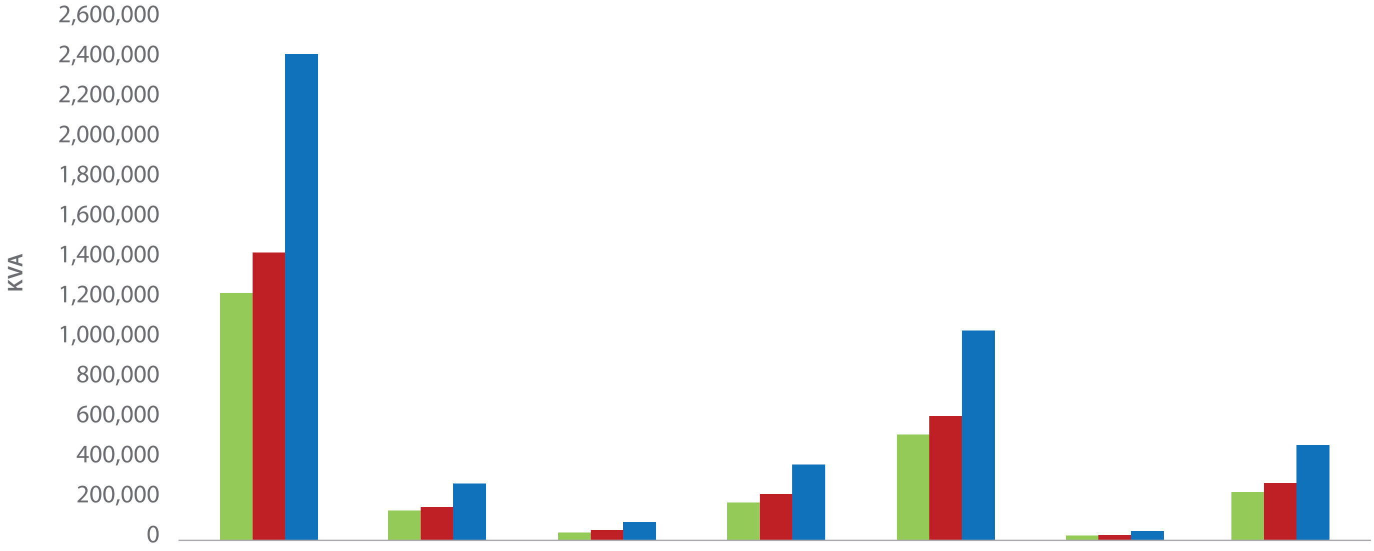
DOCUMENT CURRENT AND PLANNED SUPPLY CAPACITY AND ARRANGEMENTS

Once forecast models have been run and gross demand has been calculated, the next step is to compare gross demand with supply capacity to determine whether the city is able to meet demand now and in the future, and if not, how to appropriately respond to increased demand. **The process is as follows:**

1. Document current supply arrangements. In the case of water and electricity, who supplies it? Does the city abstract its own water and treat it, does it buy all bulk water from a water board and then treat it, does it only buy treated water, or some combination of these arrangements? In the event that the city abstracts water, what are the permitted abstraction limits? Ask similar questions of energy supply.
2. Calculate current bulk infrastructure capacities per spatial segment adopted (supply limits). Take care to allow for reserve margins or secure supply limits (e.g. not exceeding firm capacity in electricity supply systems or maintaining 48 hours supply in command reservoirs). In the case of landfill sites only consider remaining airspace.
3. Deduct current consumption (e.g. water or electricity), utilisation (roads or amenities), occupation levels (municipal buildings) or other measures of current demand and supply from available capacity. The result should be net available capacity, which in practice may be net negative capacity for some over-utilised facilities such as wastewater treatment works.
4. Next, consider the following:
   - Infrastructure coming to end of useful life, or to be decommissioned for whatever reason (e.g. technological change or system reconfiguration)
   - Supply risks relating to external suppliers, own bulk infrastructure and other factors

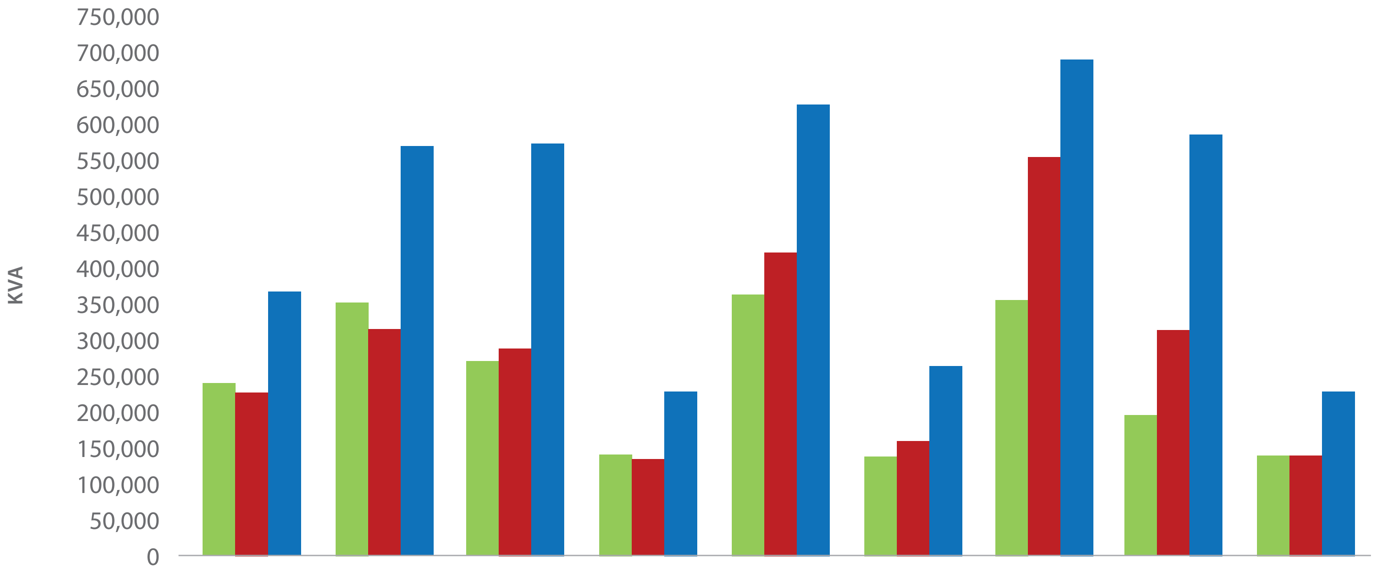
5. Then, arrive at net available capacity and compare with gross demand. The difference is net gross demand (the portion of gross demand that can't be serviced with current capacity) that requires appropriate asset management responses that may include a mix of asset and non-asset responses.
6. Finally, the city may already have some initiatives or projects in various phases of planning and implementation. Identify and record these in the asset management plan, including details on capacity, area(s) benefit, cost and timing – and ensure that these are taken into account in the plan to address net gross demand.

FIGURE 5.4(A): *Compare annual maximum demand to capacity per customer type (electricity)*



	Manufacturing	Commercial	General (municipality use & street lights)	Household (low usage)	Household (normal use)	Agriculture	Mining
Annual Demand	1,230,327	144,744	48,248	192,993	530,729	24,124	241,241
Firm Capacity	1,426,728	167,850	55,950	223,800	615,451	27,975	279,751
Installed Capacity	2,412,301	283,800	94,600	378,400	1,040,600	47,300	473,000

FIGURE 5.4(B): *Determine annual demand per service and compare to current capacity per supply area (electricity)*



	Alberton	Benoni	Boksburg	Brakpan / Kwatema	Germiston	Edenvale	Kempton Park	Springs / Nigel	Tembisa
Annual Demand	263,263	385,380	297,403	155,719	399,258	152,607	387,997	215,768	155,011
Firm Capacity	250,000	345,000	315,003	150,000	460,001	175,000	605,000	342,501	155,000
Installed Capacity	400,000	620,000	625,001	250,000	685,001	290,000	970,000	640,000	250,000

FIGURE 5.4(C): *Current ability to meet demand (electricity)*

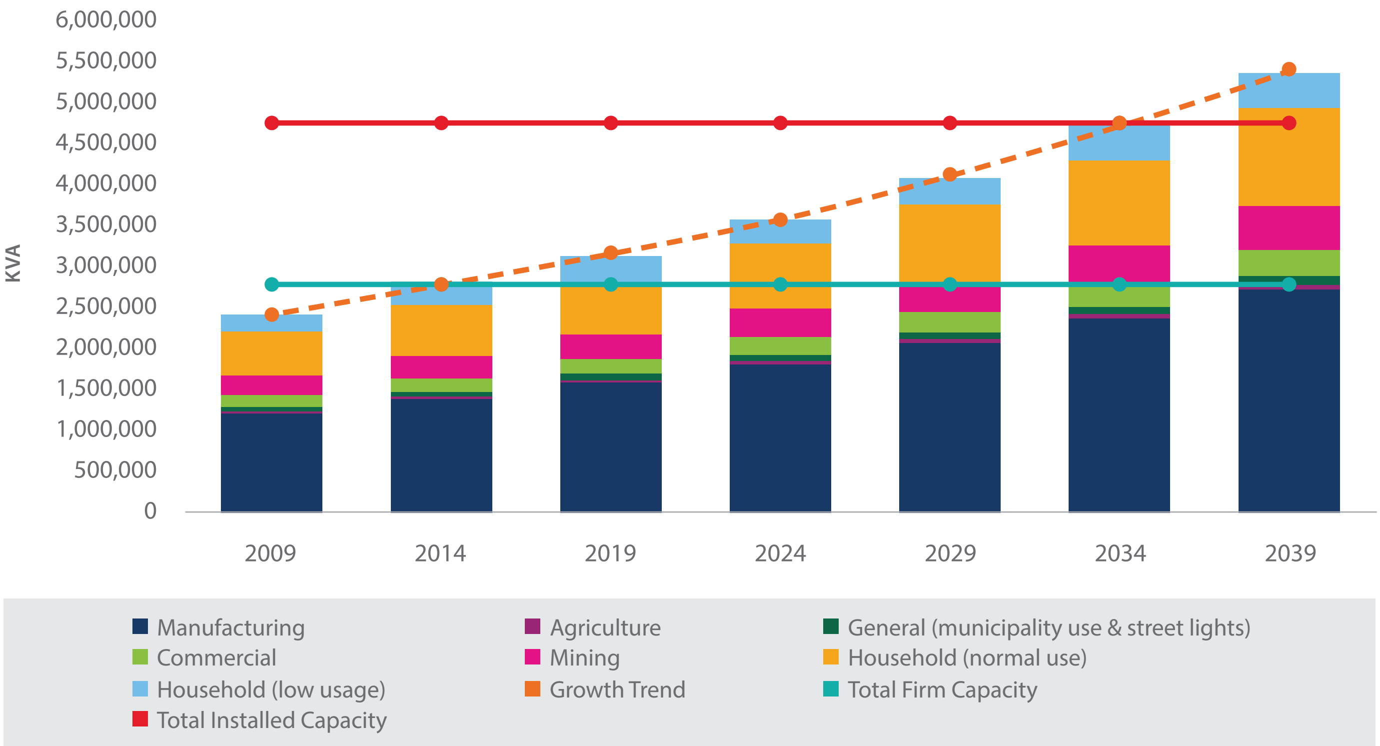
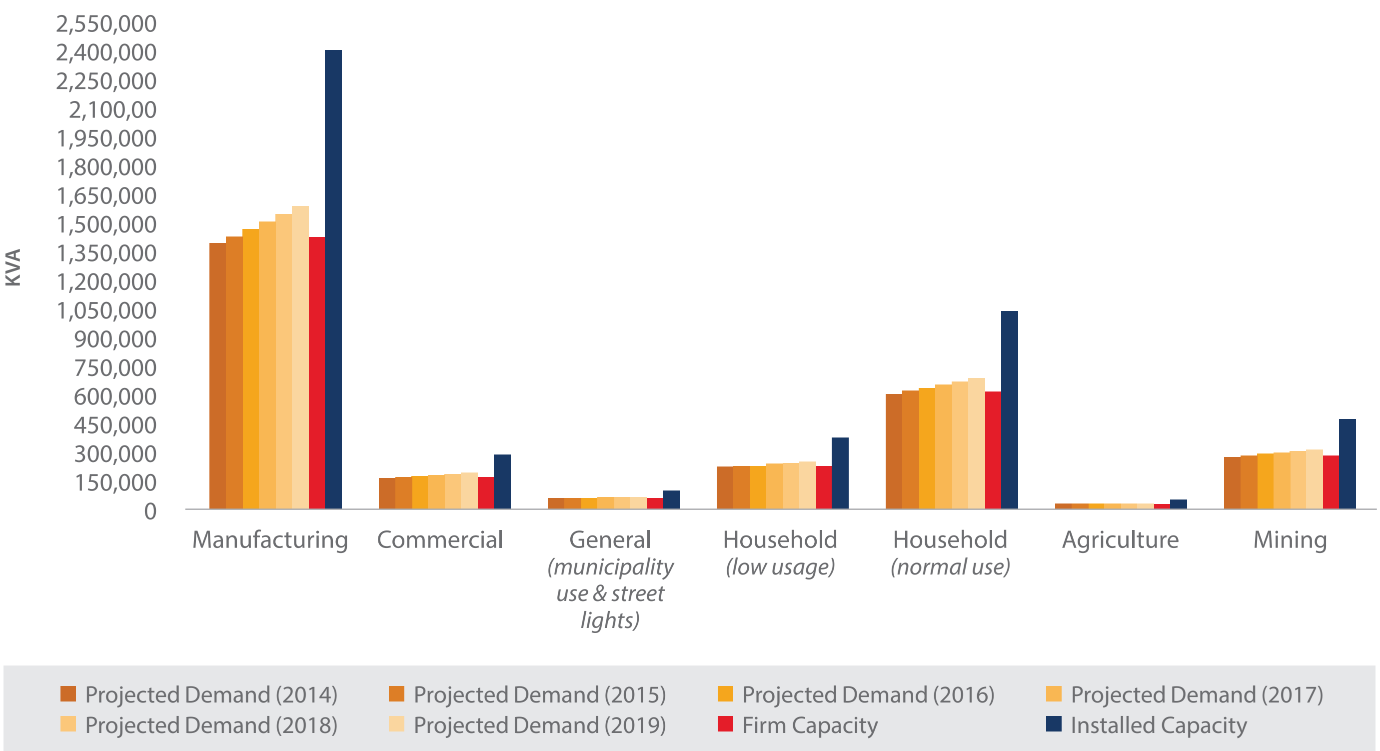


FIGURE 5.4(D): *Ability to meet future demand per customer type (electricity)*



5.3 RESPONDING TO DEMAND

5.3.1 Strategic objectives and hierarchy of responses to demand

There are different approaches to responding to demand. On the one side there is a grouping advocating responding to demand by increasing investment in infrastructure creation and accelerating the delivery of more assets. **Proponents of this approach argue that:**

- Increased investment in infrastructure supports economic growth.
- Infrastructure projects specifically stimulates the construction industry and lends itself to job creation by designing projects to be labour-intensive.
- A service access backlog exists that requires expansion of infrastructure system coverage, and the establishment of more amenities.
- Creating infrastructure for the poor demonstrates commitment to care for and improve their living conditions, and is therefore a political imperative.
- Cities will continue to grow, and more infrastructure is needed to support a growing population and economy.

On the other side there is a grouping that advocates all possible measures to avoid infrastructure creation. The departure point for this grouping is to first respond to demand with non-asset solutions to limit, reduce or switch demand. Such a set of responses is commonly referred to as demand management. **They argue that:**

Cities already have excess assets, and are not able to properly care for existing assets. Creating more assets will further stretch very constrained resources, and will likely lead to lower levels of asset care.

Creating more assets will, or should, lead to tariff increases that customers may not be able to afford.

Creating more assets in the context of climate change and resource depletion (e.g. water resources) is not sustainable.

Creating more assets tend to enable urban sprawl and expanded city networks.

There is merit in both sets of arguments, but neither position is correct. The size and composition of asset portfolios should be matched to a city's needs, resource base and strategic objectives, provided that needs and strategic objectives are financially, economically, socially and environmentally sustainable. **Some key guiding principles, presented in no particular order, include:**

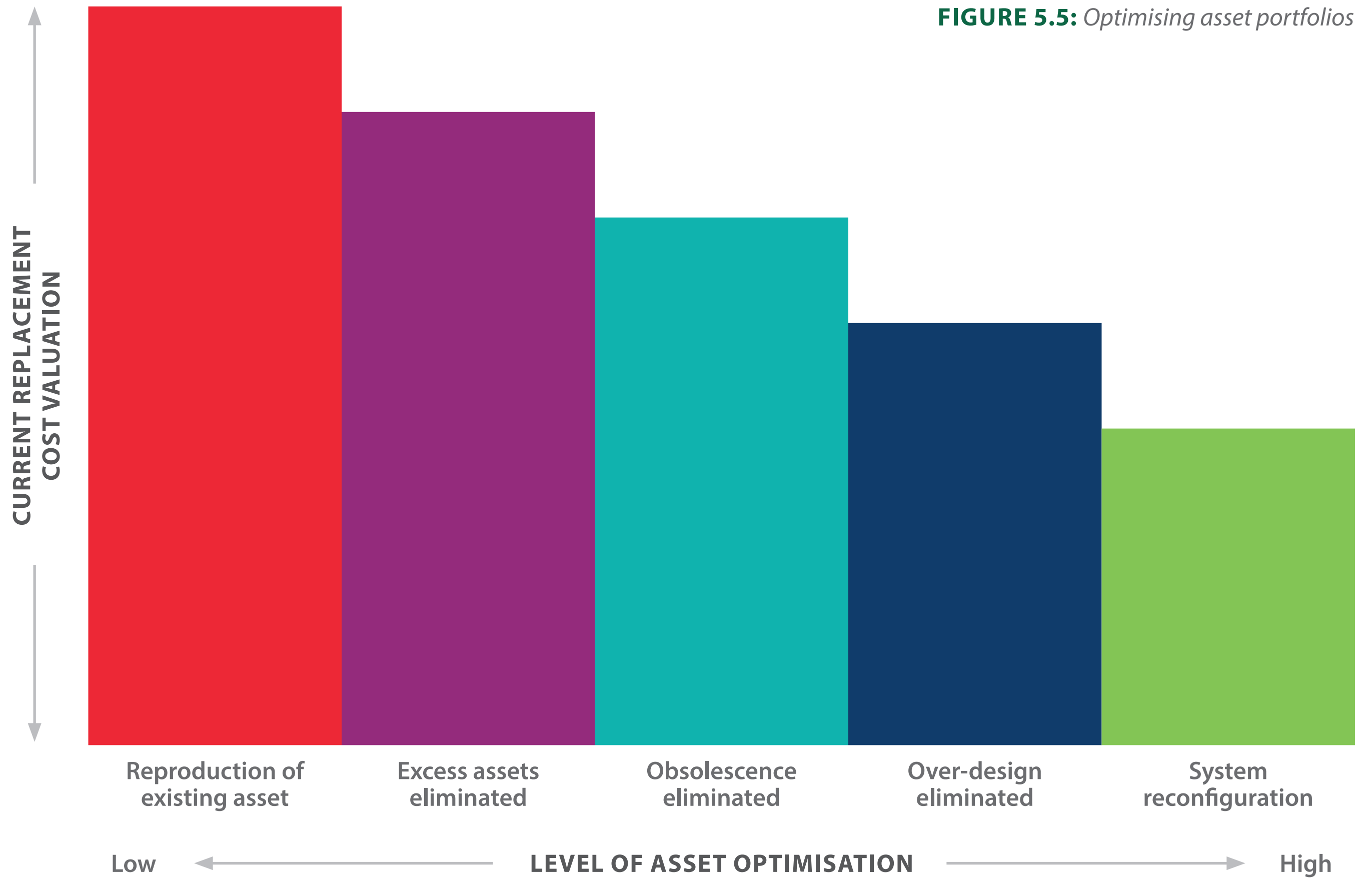
1. Limit and over time reduce investment in infrastructure that are resource inefficient, contribute to the carbon footprint of the city, or are not climate resilient. Resources in this sense means scarce natural resources such as land and water, but also scarce skills and financial resources. In other words, disinvest from, and rationalise infrastructure that are not effective, efficient or that are under-utilised.
2. Invest in sustainable infrastructure that is resource efficient and climate resilient.
3. Increase investment in infrastructure that bolsters the revenue streams of a city, whether through increased tariff income or higher levels of land value capture that in turn boosts property rates income.
4. Increase investment in infrastructure that improves the economic functioning of the city and allows economic growth.
5. Increase, within the financial means of the city, investment in infrastructure and amenities that ensures equitable access to services for all people, promotes social integration and leads to the creation of great, liveable places.
6. Infrastructure investment and provision should support spatial efficiency and optimisation, and likewise, spatial planning should consider the technical and financial dimensions of infrastructure systems when preparing and implementing spatial frameworks.

The question is therefore not to build or not, but rather what should be build, reconfigured or disposed of. Robust asset management therefore considers both supply-side management and demand-side management.

5.3.2 *Supply-side management*

Supply side management focusses on the planning, implementation and optimisation of infrastructure systems and value chains that deliver effective and efficient services.

FIGURE 5.5: *Optimising asset portfolios*



Techniques for optimising asset portfolio optimisation are presented in **Module 6: Lifecycle Strategies and Plans.**

5.3.3 Demand management

MULTIPLE APPLICATIONS OF DEMAND MANAGEMENT

There are often misconceptions about demand management and many assume it is simply a tool to permanently curb demand. **Consider the following definition of demand management:**

DEMAND MANAGEMENT IS DEFINED AS

The active intervention in the market to influence demand for services and assets with forecast consequences, usually to avoid or defer CAPEX expenditure. Demand management is based on the notion that as needs are satisfied expectations rise automatically and almost every action taken to satisfy demand will stimulate further demand.

The overwhelming intent of the definition appears to be to avoid capital expenditure, in this context infrastructure creation or upgrading. There is also value in the statement that satisfying demand now stimulates further demand – this is the basic economic problem: human needs will always be greater than their ability to satisfy those needs. Therein lies a timing problem: because needs exceed capacity to satisfy them, there often tends to be a lag in the manifestation of demand and the meeting thereof. This is what is meant by the statement "…or to defer capital expenditure". More recently, with increasing recognition that we are exceeding earth's carrying capacity with scarce resources being depleted or degraded beyond the planet's capacity to regenerate, coupled with the emerging impacts of climate change, demand management is seen as an instrument to limit resource depletion.

Demand management fulfils all these functions, and more. Its various applications include reducing, increasing, delaying or switching demand, as follows – this is not an extensive list:

01 TO MANAGE FLUCTUATIONS IN DEMAND

The intent here is not to reduce demand, but rather to smooth demand to avoid assets being over- or under-utilised. In other words, the tactic is to synchronise demand and supply in the most efficient way. An excellent example of this is the demand for electricity that peaks at certain times of the day, and where seasonal demand differs significantly. Likewise, roads may generally enable easy, free movement but are choked in rush hour.

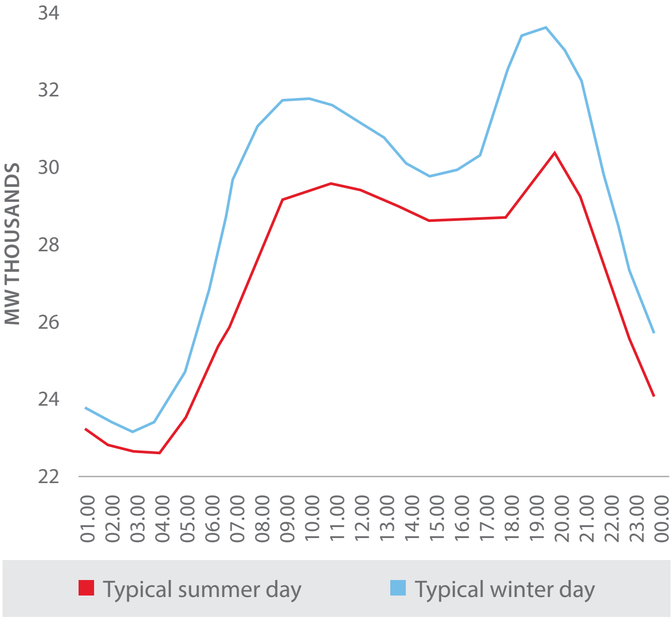


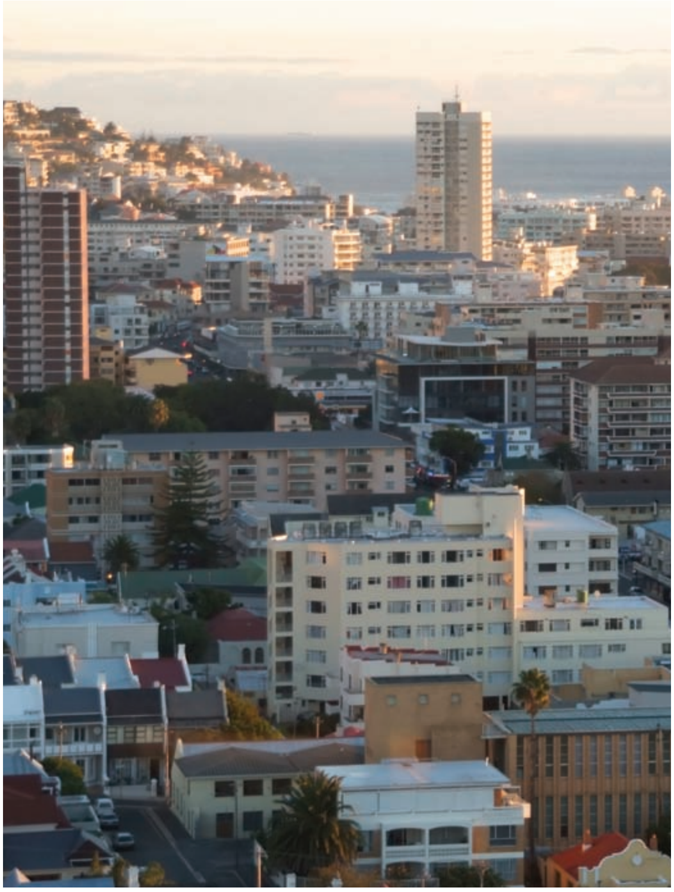
FIGURE 5.6:
Daily electricity demand patterns in South Africa
Source: Eskom Annual Report 2009

02 TO MANAGE DEMAND DURING TIME LAGS IN THE DELIVERY OF INFRASTRUCTURE

Either due to funding constraints, delivery capacity or other technical or regulatory constraints.

03 TO PURSUE OPTIMUM ASSET UTILISATION

In this application demand management aims to stimulate or increase demand for infrastructure services or assets, also referred to as economic optimisation. At times assets are constructed without sufficient demand to make those assets financially viable, or the natural rate of increase in demand is too slow to reach break-even in a reasonable period. Bus rapid transport (BRT) systems are examples of such assets. They require sufficient ridership to be economically viable. However South African cities generally do not have the population densities to deliver sufficient ridership. The demand management response in this case is to produce high-density mixed development around BRT stations. As noted in **Module 4 (see Section 4.4)**, sub-city places such as the CDB and other nodes and corridors go through cycles of investment and disinvestment. In periods of cyclical decline infrastructure capacities remain constant, and those portions of the infrastructure systems tend to be under-subscribed. Rather than construct new infrastructure elsewhere, demand management in this case offers incentives to achieve higher levels of utilisation of existing infrastructure.



04 TO ALLEVIATE PRESSURE ON SCARCE RESOURCES

Such as water or non-renewable energy.

05 TO ACHIEVE COST EFFICIENCIES AND REDUCE UNNECESSARY EXPENDITURE

Demand management in this context in large part relates to spatial efficiencies and optimisation. This includes:

- pursuing a more compact urban form to avoid unnecessary infrastructure creation and to pursue economies of scale in operations and maintenance;
- encouraging development in areas where sufficient infrastructure capacity exists; and
- where additional infrastructure needs to be constructed, to locate such infrastructure in areas without development constraints or development cost premiums, all other considerations being equal, and to encourage development around such infrastructure.

The following sub-sections provide guidance on the above aspects.

APPROACH TO INFRASTRUCTURE UTILISING SCARCE RESOURCES

Cities should progressively move towards implementing the hierarchy proposed in the figure below. The default approach to the utilisation of scarce, non-renewable resources should be one of conservation. Demand over the conservation limit should be responded to through on-site solutions such as rainwater harvesting, solar panels and heat pumps for energy generation.

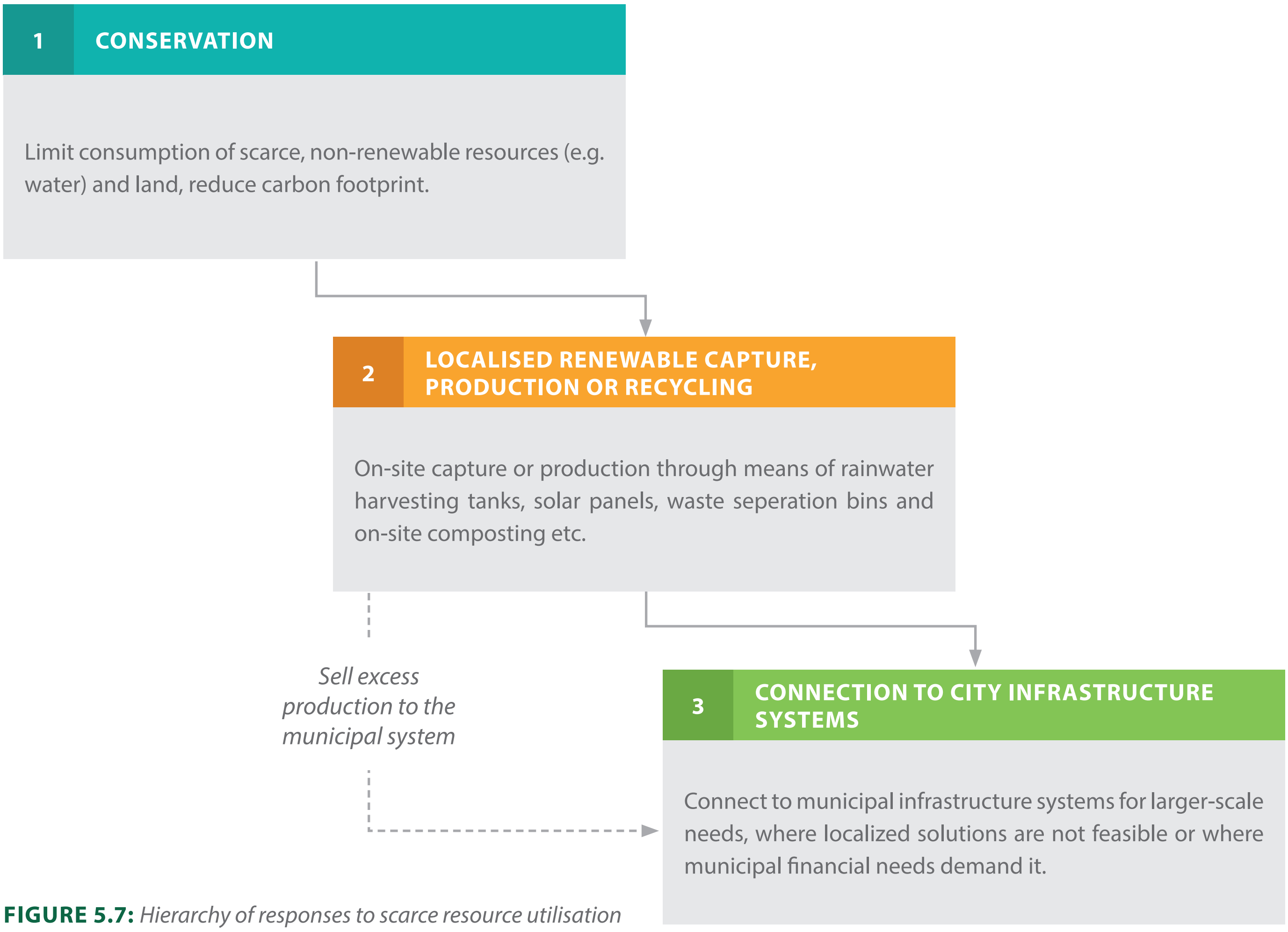
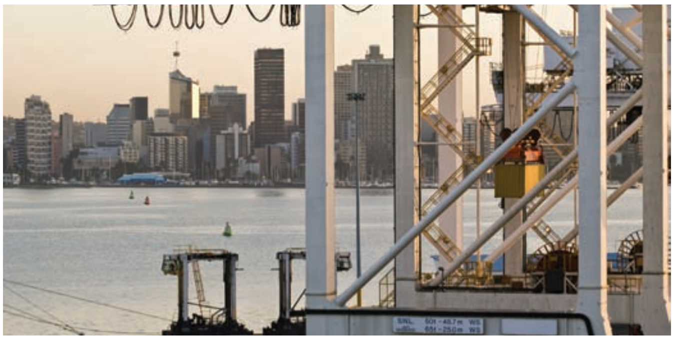


FIGURE 5.7: *Hierarchy of responses to scarce resource utilisation*



Considering the need for cities to remain financially viable, the preferred approach could be to install such onsite solutions (solar panels etc.) in low income housing units, to limit expensive bulk purchases of water and electricity, system losses and the adverse impacts of illegal connections. Higher income customers generate net revenue for the city through consumption of water and electricity, and should not be encouraged to switch to on-site solutions unless there are supply constraints, or until such time that the city can procure excess production from customers at rates lower than the cost of bulk purchases.

ACHIEVE COST EFFICIENCIES

Ideally, and provided that there are no other higher order spatial objectives stipulating that new infrastructure is required elsewhere or that the city footprint should expand, the urban development boundary should be respected and development applications outside the urban edge should be rigorously scrutinised, even when developers are willing to pay the full development costs of infrastructure outside the urban edge. Developments within the urban edge should ideally be located in proximity to available bulk capacity. This can be easily done with respect to government-sponsored low income housing developments, as cities normally choose the sites where such development will take place. **For private sector developments, the same result, though perhaps to a lesser degree, can be achieved by:**

- Communicating to developers where bulk capacity exists, and where not. The incentive for them in selecting areas where capacity exists is avoidance of delays in bulk infrastructure installation.
- Larger developers often buy land as stock for future development whilst land is relatively inexpensive, to be developed later when sufficient demand manifests, and they are able to achieve their desired profit margins. For such developers the existence of current bulk capacity is not a main concern, provided that developer contributions apply uniformly across the urban space. To encourage developers to take advantage of available infrastructure capacity and maintain a tight urban form, cities should consider spatially nuanced developer contributions.
- The publication of a weighted infrastructure and amenities capacity map may encourage developers to locate closer to well-serviced areas where the conditions for liveable, sustainable settlements are already in place, and developers can price their housing products accordingly.

Box 5.5 illustrates an innovative approach by Ekurhuleni to grade potential low income housing sites to both support spatial structuring elements and to maximise the use of existing infrastructure and amenities. Cities can also achieve cost efficiencies by selecting ideal sites and areas for infrastructure development and functioning. “Ideal” in this context means selecting sites where construction costs are neutral – the costs to construct on such a site will not be higher than on any other site. A basic development cost premium index is provided in **Table 5.5**, and examples of its application, the weighted capital development cost surface, are demonstrated in **Figure 5.8.**

4. **The development cost premium index does not override technical and environmental considerations, criteria and regulations regarding the appropriate siting of infrastructure. Its main use is to select from a range of technically and environmentally feasible sites the most ideal location to avoid additional construction costs.**
5. **Where sufficient construction cost information is available, cities should calibrate the index based on local experience and practice.**

BOX 5.5:

Locating developments in areas where capacity exists

Ekurhuleni identified 5 065 parcels of land for potential low income housing development at a density of 69 units per hectare. Development across so many sites is not feasible, and accordingly the city weighed the options of a rating of 1a (best option) to 5e (worst option), considering the following factors:

- **Proximity to spatial structuring elements identified in the SDF, inclusive of BRT routes.**
- **Availability of municipal infrastructure in each sector (e.g. water, electricity and sanitation).**
- **Proximity to municipal amenities such as sports and recreation centers, parks, clinics and libraries.**
- **Proximity to schools.**

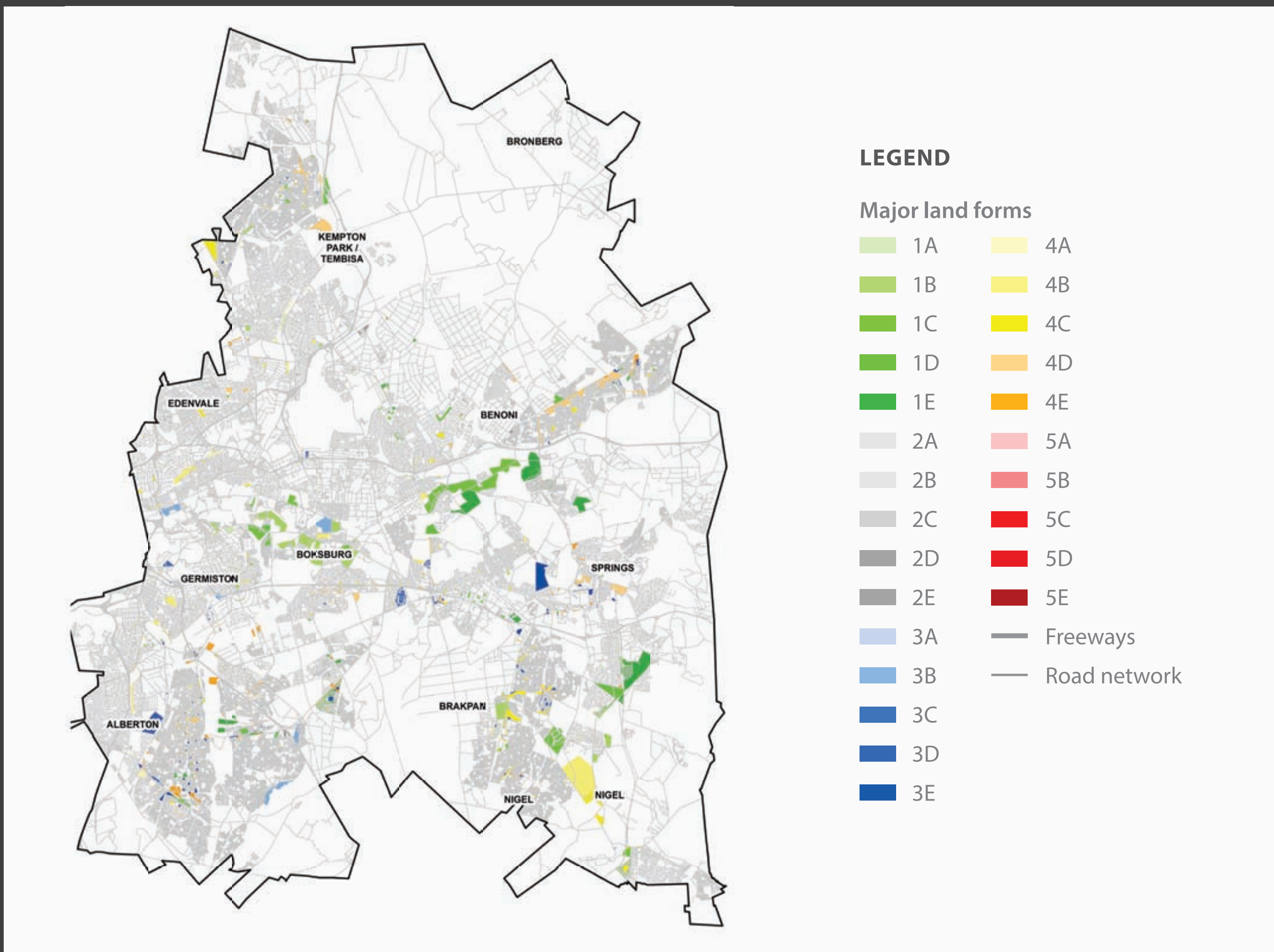


TABLE 5.5: *Development cost premium index*

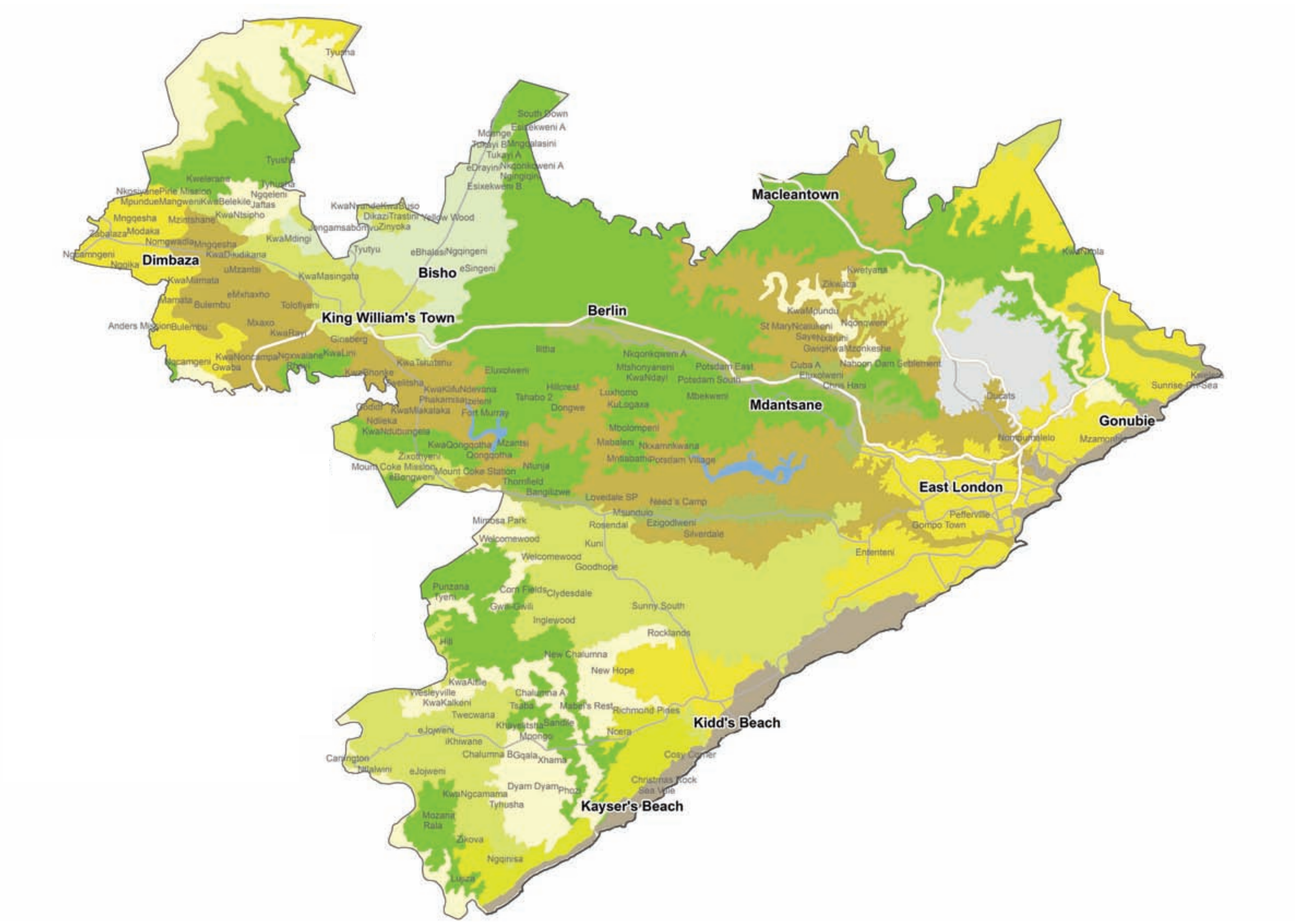
ROADS		% COST PREMIUM			
CATEGORY	DESCRIPTION	BULK FACILITY	BULK DISTRIBUTION	RETICULATION	CONNECTION
Topography	Flat (< 2%)	0%	0%	0%	N/A
	Rolling Hills (3 - 5%)	11%	13%	13%	N/A
	Steep (6 - 12%)	16%	20%	20%	N/A
	Mountainous (>13%)	21%	27%	27%	N/A
Geology	Low base status & restricted depth	0%	0%	0%	N/A
	High swell-shrink potential, plastic and sticky soils	10%	10%	10%	N/A
	Collapsing soils	8%	6%	5%	N/A
	Restricted soil depth; associated with rockiness	0%	0%	0%	N/A
	Dolomitic	25%	20%	15%	N/A

SANITATION		% COST PREMIUM			
CATEGORY	DESCRIPTION	BULK FACILITY	BULK DISTRIBUTION	RETICULATION	CONNECTION
Topography	Flat (< 2%)	0%	0%	0%	0%
	Rolling Hills (3 - 5%)	0%	0%	0%	0%
	Steep (6 - 12%)	5%	5%	5%	5%
	Mountainous (>13%)	10%	10%	10%	0%
Geology	Low base status & restricted depth	30%	30%	20%	5%
	High swell-shrink potential, plastic and sticky soils	20%	5%	5%	0%
	Collapsing soils	20%	10%	0%	0%
	Restricted soil depth; associated with rockiness	30%	30%	20%	5%
	Dolomitic	40%	0%	0%	0%

SOLID WASTE		% COST PREMIUM			
CATEGORY	DESCRIPTION	BULK FACILITY	BULK DISTRIBUTION	RETICULATION	CONNECTION
Topography	Flat (< 2%)	0%	0%	0%	0%
	Rolling Hills (3 - 5%)	0%	0%	0%	0%
	Steep (6 - 12%)	0%	0%	0%	0%
	Mountainous (>13%)	50%	0%	0%	0%
Geology	Low base status & restricted depth	80%	0%	0%	0%
	High swell-shrink potential, plastic and sticky soils	0%	0%	0%	0%
	Collapsing soils	0%	0%	0%	0%
	Restricted soil depth; associated with rockiness	80%	0%	0%	0%
	Dolomitic	40%	0%	0%	0%

STORMWATER		**% COST PREMIUM**			
CATEGORY	**DESCRIPTION**	**BULK FACILITY**	**BULK DISTRIBUTION**	**RETICULATION**	**CONNECTION**
Topography	Flat (< 2%)	0%	0%	0%	0%
	Rolling Hills (3 - 5%)	5%	5%	5%	0%
	Steep (6 - 12%)	10%	8%	8%	5%
	Mountainous (>13%)	15%	10%	10%	10%
Geology	Low base status & restricted depth	25%	25%	20%	20%
	High swell-shrink potential, plastic and sticky soils	5%	5%	5%	5%
	Collapsing soils	10%	10%	10%	10%
	Restricted soil depth; associated with rockiness	25%	25%	20%	20%
	Dolomitic	30%	25%	20%	20%

WATER		**% COST PREMIUM**			
CATEGORY	**DESCRIPTION**	**BULK FACILITY**	**BULK DISTRIBUTION**	**RETICULATION**	**CONNECTION**
Topography	Flat (< 2%)	0%	0%	0%	0%
	Rolling Hills (3 - 5%)	0%	0%	0%	0%
	Steep (6 - 12%)	0%	5%	5%	
	Mountainous (>13%)	0%	10%	10%	5%
Geology	Low base status & restricted depth	0%	30%	20%	0%
	High swell-shrink potential, plastic and sticky soils	10%	5%	5%	0%
	Collapsing soils	20%	0%	0%	0%
	Restricted soil depth; associated with rockiness	10%	30%	20%	0%
	Dolomitic	40%	0%	0%	0%



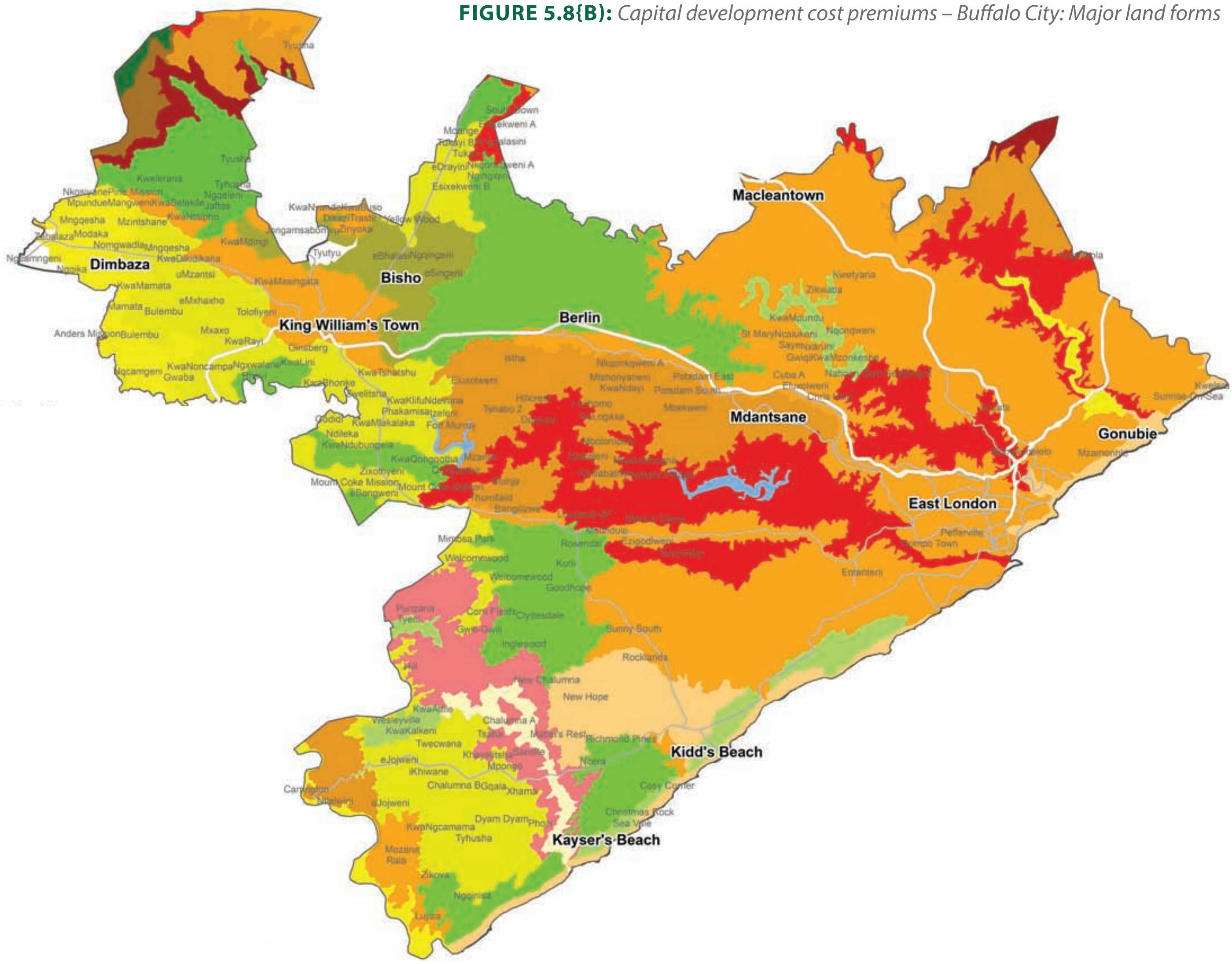
LEGEND

Soil constraints

- Low base status, restricted depth, imperfect to poor drainage, excessive wetness, high erodibility
- May be highly erodible
- May be seasonally wet
- May have restricted soil depth, excessive drainage, high erodibility, low natural fertility
- One or more of: high swell-shrink potential, plastic and sticky, restricted effective depth, wetness
- One or more of: low base status, restricted soil depth, excessive or imperfect drainage, high erodibility
- Restricted depth, imperfect drainage, high erodibility; slow water infiltration; seasonal wetness
- Restricted land use options
- Restricted soil depth; associated with rockiness
- No dominant constraints
- Water bodies

FIGURE 5.8(A): *Capital development cost premiums - Buffalo City: Soil Constraints*

FIGURE 5.8(B): *Capital development cost premiums – Buffalo City: Major land forms*

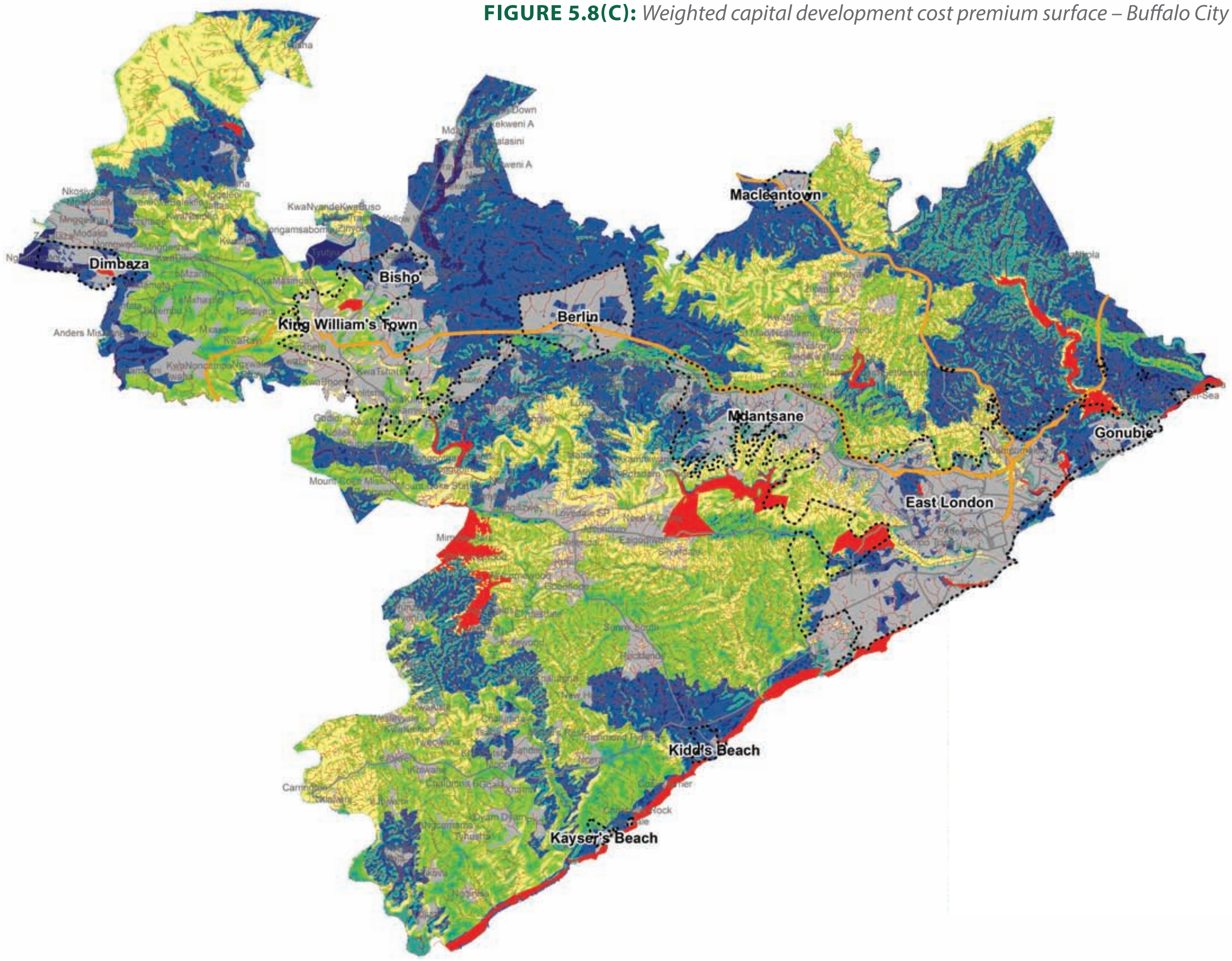


LEGEND

Major land forms

- Level plains
- Level plains with some relief
- Plains with open low hills or ridges
- Plains with open high hills or ridges
- Rolling or irregular plains with some relief
- Rolling or irregular plains with low hills or ridges
- Rolling or irregular plains with high hills or ridges
- Rolling or irregular plains with low mountains
- Open low hills or ridges
- Open hills or ridges
- Open high hills or ridges
- Open low mountains
- Low hills or ridges
- Hills or ridges
- High hills or ridges
- Low mountains
- Water

FIGURE 5.8(C): *Weighted capital development cost premium surface – Buffalo City*



LEGEND

Weighted development cost surface (% Premium)

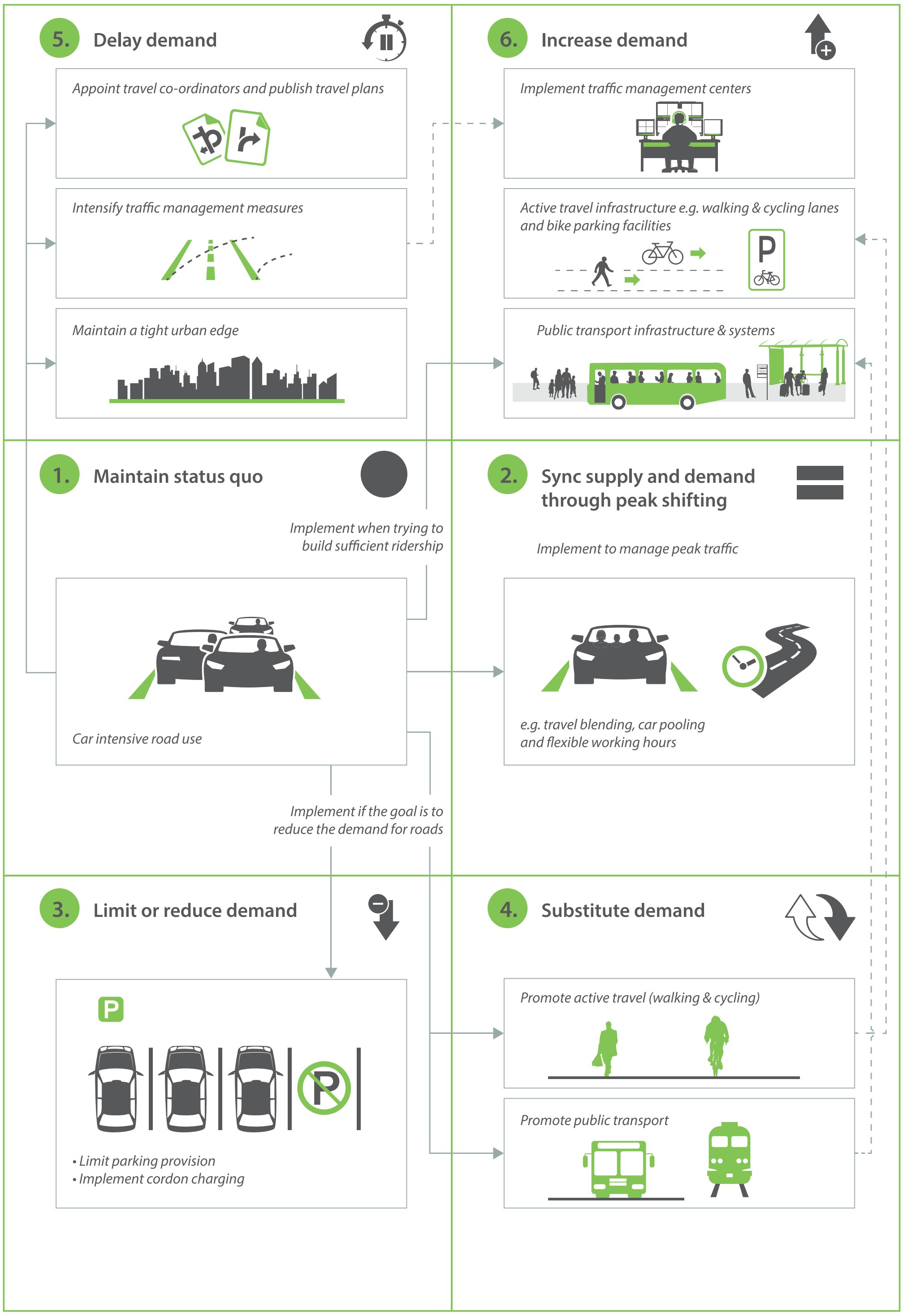
- 0% - 5%
- 6% - 10%
- 11% - 15%
- 16% - 20%
- 21% - 25%
- 26% - 28%

- Proposed Urban Edge
- Already development
- Undevelopable

DEMAND MANAGEMENT TACTICS

There are six main categories of demand management tactics available to asset management planners, as shown in the following figure.

FIGURE 5.9: *Range of demand management tactics*



Note the following about demand management tactics:

- Not all tactics are suited to all infrastructure services, at all times and places. It is for example not wise to stimulate the demand for water, though it may be appropriate to stimulate development in an area where excess water infrastructure capacity exists, rather than to construct new capacity elsewhere.
- In many instances though, the application of one tactic is not sufficient, and for best results several tactics should be employed simultaneously, as demonstrated in **Figure 5.9** that considers demand management for roads and transportation.
- As shown in **Figure 5.9,** tactics to substitute or delay demand often require creation of additional infrastructure, in this example traffic management centers and walking and cycling infrastructure. Provision should be made in the lifecycle sections of infrastructure asset management plans to provide such infrastructure, as well as for the operating and maintenance costs associated with implementing demand management measures.

> *“Demand management tactics and supportive measures...designed to nudge or encourage customers to consume more or less of a service.”*

- Demand management tactics and supportive measures range from “soft” measures designed to nudge or encourage customers to consume more or less of a service, to “hard” measures that force compliance.
- The type of measures adopted need to be carefully considered in advance: customers and communities should ideally voluntarily support them or at least agree with the need to implement them. Customer support generally requires education about the benefits of the tactic, supported by ongoing information about the success of implementation thereof. The two types of measures can be designed to be implemented in concert where circumstances warrant it, and where the need for demand management is serious enough.

TABLE 5.6(A): *Demand management methods: Electricity*

OUTCOME	TACTIC	DESCRIPTION	METHODS & MEANS
ELECTRICITY			
Load shifting (“peak shaving”) and matching	Critical peak shift	Shift customer demand during the ~ 12 hours per annum with the highest demand for electricity	• Peak tariffs • Customer awareness campaigns and media notices • Smart grid • Managed load shedding • Direct load control programmes
	Daily peak shift	Shift customer demand during the ~ 3 hours per day with the highest demand for electricity	
	Load matching	Advance or delay appliance operating cycles by a few seconds to increase the diversity factor of the set of loads	
Load reduction	Energy efficiency	Reducing the overall demand for electricity without limiting the utility that customers receive	• Building codes on energy efficiency • Use of geyser blankets, energy saving lightbulbs etc. • Use of efficient load intensive appliances such as refrigerators, or washing machines
	Loss control	Reduce system technical losses	• Vegetation clearance • Measures to curb illegal connections
	Shift production to customers	Move towards renewable energy (wind, solar, geothermal etc.)	Distributed generation and opt-in schemes
Resource efficiency and cleaner energy	Demand switching	Move towards renewable energy (wind, solar, geothermal etc.)	Installation of solar panels, heat pumps etc.

TABLE 5.6(B): *Demand management methods: Roads and transportation*

OUTCOME	TACTIC	DESCRIPTION	METHODS & MEANS
ROADS AND MOVEMENT NETWORKS			
Reduced pressure on road system	Rush hour congestion management	Reduce demand for roads in morning and afternoon peak traffic	• Promote travel blending: combining trips to minimise total travel time • Car pooling • Congestion charging • Publish school travel plans and develop more walking and cycling paths around schools, coupled with reduced speed limits
	Area-based congestion management	Reduce demand in identified areas experiencing	• Cordon charging • Parking policies • Pricing of parking
	Demand substitution	Reduce the number of vehicles on the road	• Promote working from home, and revisit zoning rights to enable this
		Offer viable alternatives to the car	• Expand public transport coverage, number of trips and trip quality • Offer special lanes for other modes of travel
	General traffic load management	Modulate or influence travel volumes or patterns of flows	• Implement traffic management centers • Publish travel plans and real-time traffic information
Increased use of public transportation	Concentrate development around public transport	Capture sufficient density along public transport routes	• Locate new low-income housing and subsidised housing projects in proximity to public transport routes and points • New higher income residential and mixed use developments to demonstrate explicit links to the public transport system
	Quality infrastructure	Quality bus stops and stations	• Accessible, well-marked bus stops • High volume bus stops to provide shelter from the elements
		Quality bus fleet	• Clean, comfortable buses • Accessible to people of all ages and the disabled
	Quality travel and service	Trip times	• Published, easy-to-read and accessible bus schedules • Adherence to bus schedules • Convenient trip times throughout the day
		Payment and ticketing	• Convenient ticketing and payment arrangements • Consider throughput ticketing and discount arrangements for regular users
Higher levels of active travel	Cycling	Enabling infrastructure	• Cycling lanes • Connected system linking roads, public open space and off-road trails • Secure bicycle parking facilities at main public buildings and spaces, shopping centers and key transport hubs
	Walking & jogging	Enabling infrastructure	• Cycling lanes • Connected system linking roads, public open space and off-road trails
Reduce traffic accidents	Build environment modifications	Infrastructure responses	• Introduce or intensify traffic calming measures e.g. speed humps • Improve pedestrian safety through • infrastructure such as pedestrian bridges, well-marked crossings, side rails etc.
	Regulatory responses	Intensified law enforcement	• Speed limit reduction and installation of speed cameras • Re-assess road lay-out and conditions

Potable water differs from all other commodities and services (with the exception of air) in that its availability is an absolute condition for life, and that it is a scarce natural resource. Outcomes should therefore always pursue a full sustainability balance that ensures that the basic human needs of all are met, without compromising ecological sustainability. The emphasis is on water conservation and management. The following are demand management tactics and methods aligned to these outcomes – however, note that there is a broader water cycle beyond potable water services that includes water resource management as well.

TABLE 5.6(C): *Demand management methods: Potable water*

OUTCOME	TACTIC	DESCRIPTION	METHODS & MEANS
POTABLE WATER			
Improve availability	Dam verge clearance	Ensure that full dam capacity remains available, and water not consumed by excess vegetation	• Structured, ongoing programme of dam verge clearance (for cities that have their own water supply dams)
	Demand substitution	Customer-end water harvesting infrastructure (e.g. rainwater harvesting tanks)	• Building regulations to require improved water efficiency • Subsidise rainwater harvesting • Investments by customers, either directly or through rebates • Fit as standard to low income housing developments
More effective water use (using the right type of water for the right purpose)	Eliminate alien vegetation	Focus on alien vegetation with high water usage	• Municipal by-laws banning alien vegetation, coupled with a system of penalty fees and periodic inspections • Programme of alien vegetation clearance in known areas of occurrence
	Promote greywater usage	Substitute potable water usage with greywater where appropriate (e.g. irrigation and flushing)	• Customer education and awareness programmes • New building regulations to require re-use
More efficient water use (using appropriate amounts of water, curbing excess usage)	Reduce water system losses (reduce the percentage of unaccounted for water)	Improved asset management	• Implement predictive maintenance programmes • Improve distribution pipe maintenance regimes, especially response times to large pipe bursts • Commit to a pipe replacement programme
		Clamp down on illegal connections	• Ensure that all households have access to water • Ensure that all customer connections are metered • Prosecute cases of illegal connections and meter tampering
		Water balancing and financial balancing	• Meter across the network, from bulk abstraction through to all customers connections • Conduct meter audits • Perform balancing on a monthly basis
	Reduce excess consumption	Customer behaviour	• Customer education and awareness programmes (e.g. water-wise gardening) • Implement full cost accounting over the lifecycle • Implement block tariff structures that penalise high levels of consumption • Restrict water usage in times of drought, and prosecute offenders
		Retrofitting	• Retrofit building structures with water saving devices (e.g. more effective flushing, valves and washers)

5.4 PREPARE DEMAND RESPONSE PLAN

The demand response plan should clearly articulate how net additional demand will be addressed, which may include a range of asset solutions (e.g. new construction or upgrading of existing infrastructure or amenities, or improved maintenance regimes) and non-asset solutions (e.g. demand substitution, regulation, pricing or customer education).

Cities are advised to consider adoption of appropriate levels of assessment to determine the most appropriate solutions for alleviation of existing infrastructure capacity constraints. **Module 3** presented a simple, scalable 5 point grading scale for assessing capacity failure mode. In this way, where sophisticated analyses are not appropriate or available, operator data can be captured. Where demonstrated to be cost effective (relative to the benefit of identification of the points of constraint and optimised responses) as determined in line with the processes indicated in **Module 8**, detailed capacity and utilisation analyses should be pursued, for example hydraulic modelling of pipe networks.

Selected asset and non-asset solutions should be scheduled, together with costs and impacts, across the 30-year planning horizon, indicating the following:

- **Projects and activities, classified as either capital or operating expenditure, inclusive of project description and benefit (how and to what extent it addresses net additional demand)**
- **Project or activity costs, together with a cash flow (expenditure only) forecast – financial viability is considered in Module 8**
- **Location or areas of benefit**

Cities are advised to present the outcomes of the demand management response plan in a format compatible with the requirements of the Municipal Standard Chart of Accounts (mSCOA), to avoid later repackaging when preparing budget submissions.

5.5 APPROVAL, COMMUNICATION, REVIEW AND UPDATING REQUIREMENTS

01 APPROVAL

The following arrangements should apply:

1. The corporate customer growth forecast, inclusive of the future spatial apportionment of customers, should be formally approved by city management and documented in the SAMP.
2. The corporate customer growth forecast, inclusive of the future spatial apportionment of customers, will be the official version of future growth expectations of the city, and should be included in the city strategic plan, the IDP (if there is a city strategy other than the IDP), the MSDF, the city's built environment performance plan and its SAMP. Sectoral plans such as asset management plans and master plans should interpret this forecast in analysing and planning for future demand.
3. To achieve the requirement of (2) above, the corporate customer growth forecast should be made available to all relevant departments, committees, task teams, project teams and consultants engaged in future planning.

> *"The corporate customer growth forecast... will be the official version of future growth expectations of the city..."*

02 REVIEW AND UPDATING

The following arrangements should apply:

1. The corporate customer growth forecast should be reviewed and updated annually.
2. When reviewing and updating the corporate customer growth forecast, cities should:
   - Update the spatially-based, corporate customer profile; and
   - Compare the updated corporate customer profile with the previous version prepared, and identify and quantify changes in the customer profile, both in terms of number of customers by type, as well as spatial changes in the customer profile.
3. When updating the corporate customer growth forecast, changes in both the number of customers and their spatial manifestation should be used as a check to review forecasting assumptions and estimates, and to adjust these as necessary based on actual changes in the customer profile over time.
4. Updated versions of the corporate customer growth forecast should be submitted to city management for approval, documented in the SAMP, and made available to all relevant departments, committees, task teams, project teams and consultants engaged in future planning.

5.6 SUMMARY

Coming to grips with future demand is a critical step in future city viability and prosperity. The three trickiest aspects of future demand are the (1) uncertain nature of future, (2) the matching of supply and demand spatially and over time, and (3) managing competing interests.

Typical errors in determining future demand include assuming that the future will play out under the same conditions that currently exist, undertaking deterministic demand forecasts, assuming that demand follows easy patterns that are mathematically predictable using two or three variables, that future customers will conveniently settle where we want them to, and not properly thinking through the implications of demand management responses. This module offered an approach, methodologies and several innovative instruments to guide cities through the potential pitfalls of planning for future demand. The macro process is summarised as follows:

1 PREPARE CONSOLIDATED CUSTOMER GROWTH FORECAST

Prepare one consolidated growth forecast for all customer categories for the city as a whole.

2 SPATIAL APPORTIONMENT OF CUSTOMER GROWTH

Approaches and proposed methodology to allocate growth in customers in accordance with the spatial segmentation system adopted.

3 QUANTIFY CURRENT DEMAND

Interpret per sector. Sources of municipal data on current demand. Factors driving demand, general trends and probable future urban infrastructure trends.

4 CALCULATE NET ADDITIONAL DEMAND

Calculate gross demand, document current and planned supply capacity and arrangements, and arrive at net additional demand.

5 RESPONDING TO DEMAND

Strategic objectives and hierarchy of responses to demand. Supply-side management. Demand management.

6 DEMAND RESPONSE PLAN

Asset and non-asset solutions in response to demand over the 30-year planning period.

FIGURE 5.10: *Demand process summarised*

The outcomes of the demand process feed into asset lifecycle planning discussed in **Module 6: Lifecycle planning**, and provide inputs for financial and investment appraisal, discussed in **Module 8: Investment appraisal and planning.**

REFERENCES

Swinney, P. and Thomas, E. March 2015. A Century of Cities: Urban Economic Change since 1911. Center for Cities. London.

Bischof-Niemz, T. 10 February 2015. Financial Costs and Benefits of Renewables in South Africa in 2014. CSIR. CSIR/02400/RD Core/IR/2015/0001/B.

Paton, C. 29 July 2015. Revealed: Real Price of Nuclear Energy. Business Day. http://www.bdlive.co.za/business/energy/2015/07/29/revealed-real-price-of-nuclear-energy.

Dabur, P, Singh, G and Yadav, NK. April 2012. Electricity Demand Side Management: Various Concepts and Prospects. International Journal of Recent Technology and Engineering (IJRTE). ISSN: 2277-3878. Volume 1, Issue 1.

Dziegielewski, B. November 2003. Strategies for Managing Water Demand. Universities Council on Water Resources. Water Resources Update, Issue 126, pp 29-39.

Davito, B., Tai, H. and Uhlaner, R. 2010. The Smart Grid and the Promise of Demand-Side Management. McKinsey.

Herbertson, P.W. and Tate, E.L. 2001. Tools for Water Use and Demand Management in South Africa. Technical Reports in Hydrology and Water Resources No. 73. Secretariat of the World Meteorological Organisation. Geneva, Switzerland. WMO/TD – No. 1095.

CITIES' **INFRASTRUCTURE DELIVERY** AND **MANAGEMENT** SYSTEM **CIDMS**