SURVEY ON ENVIRONMENTALLY-FRIENDLY URBAN DEVELOPMENT IN SOUTH AFRICA

FINAL REPORT

AUGUST 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIKKEN SEKKEI Research Institute
Hitachi, Ltd.

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Contents

Figure

Table

Abbreviations

ADSL	Asymmetric Digital Subscriber Line
AfDB	African Development Bank Group
B2B	Business to Business
BEMS	Building Energy Management System
BEPP	Built Environment Performance Plan
BISDN	Broadband Integrated Services Digital Network
BRT	Bus Rapid Transit
CAS	Country Assistance Strategy
CBD	Central Business District
CCAP	Climate Change Adaptation Plan (City of Johannesburg)
CoGTA	Department of Cooperative Governance and Traditional Affairs
CPUT	Cape Peninsular University of Technology
CSR	Corporate Social Responsibility
CTF	Clean Technology Fund
CTSDF	Cape Town Spatial Development Framework
DBO	Design-Build-Operate
DBSA	Development Bank of Southern Africa
DEA	Department of Environmental Affairs
DoC	Department of Communication
DPL	Development Policy Loan
DRMC	City has a Disaster Risk Management Centre
DSW	Department of Solid Waste
DTT	Digital Terrestrial Television
DVB-H	Digital Video Broadcasting - Handheld
DWA	Department of Water Affairs
ECA	Electronic Communications Act
EEDSM	Energy Efficiency Demand Side Management
EHTS	eThekwini Household Travel Survey

ESKOM	Electricity Supply Commission of South Africa
EWS	eThekwini Water and Sanitation
FAR	Floor Area Ratio
FDI	Foreign Direct Investment
FTTP	Fibre To The Premises
FWA	Fixed Wireless Access
GCIS	Government Communication and Information Systems
GDP	Gross Domestic Product
GDS	Growth and Development Strategy
GSM	Global System for Mobile Communications
GVA	Gross Value Added
HDS	Hitachi Data Systems Corporation
HSDG	Human Settlements Development Grant
IC	Integrated Circuit
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technology
ID	Identification
IDP	Integrated Development Plan
iied	International Institute for Environment and Development
IMEP	Institute of Medical Emergency Preparedness
IMEP(CCT)	Integrated Metropolitan Environmental Policy (City of Cape Town)
IndWMP	Industry Waste Management Plan
IRPTN	Integrated Rapid Public Transport Network
IRT	Integrated Rapid Transit
ISP	Internet Service Provider
ITU	International Telecommunication Union
IWMP	Integrated Waste Management Plan
JBIC	Japan Bank for International Cooperation
JDA	Johannesburg Development Agency
JICA	Japan International Cooperation Agency
JMPD	Johannesburg Metro Police Department

JRA	Johannesburg Road Agency
LAN	Local Area Network
LTDF	Long Term Development Framework
LTE	Long Term Evolution
MDGs	Millennium Development Goals
METI	Ministry of Economy, Trade and Industry of Japan
METI	Ministry of Economy, Trade and Industry of Japan
MMS	Mobile Money Service
NBP	National Broadband Policy
NDP	National Development Plan
NGO	Non-governmental organizations
NMT	Non-Motorized Transport
NURCHA	National Urban Reconstruction and Housing Agency
NWMS	National Waste Management Strategy
PCS	Power Conditioning Systems
PES	Payments for Ecological Services
PFI	private finance initiative
PFMA	Public Finance Management Act
PICC	Presidential Infrastructure Coordinating Committee
PMS	Pavement Management System
PPP	Public Private Partnership
PRASA	Passenger Rail Agency of South Africa
PTSN	Public Telephone Switched Network
PV	Photovoltaic
R&D	Research and development
RCR	Refuse Collection Rounds
RDP	Reconstruction and Development Programme
RISFSA	Road Infrastructure Strategic Framework for South Africa
SABS	South African Bureau of Standards
SANS	South African National Standard
SDF	Spatial Development Framework

SDH	Synchronous Digital Hierarchy
SEAs	Strategic environmental assessments
SHS	Sustainable Human Settlements
SIPs	Strategic integrated projects
SMEs	Small and medium enterprises
SNO	Second National Operator
SOC	State of charge
T-L-F-Link	Technique, law, finance relations
TOD	transit oriented development
Trans.	Transformer
UPS	Uninterruptible Power Supply
USAASA	Universal Service and Access Agency
USAF	Universal Service and Access Fund
USDG	Urban Settlements Development Grant
USDP	Urban Settlements Development Programme
VIP	Ventilated Improved Pit
VOIP	Voice over Internet Protocol
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WB	World Bank
WiFi	Wireless Fidelity
Wimax	Worldwide Interoperability for Microwave Access
WSA	Water Service Authority
WWTW	Waste Water Treatment Work

1. INTRODUCTION

1.1 Survey Background

Global warming has accelerated new approaches to urban development, such as introduction of low-carbon emission technologies and of advanced technologies for realization of smart city, which are for example smart grids, energy management system, etc. This stimulates the private sector to invest in innovative technological developments and the public sector to introduce financial instruments such as subsidization to promote sustainable technologies.

Republic of South Africa (hereinafter called South Africa) which accounts for about 30% of the total GDP in the continent of Africa plays a leading role in the African economy. At the same time, as the sole African member of G20, South Africa functions as an African leader in international society with its participation in the G8 summit since 2000 and its inclusion in BRICs in 2011. Domestically, however, South Africa is faced with a variety of urban issues such as incomplete infrastructure due to the rapid increase in population, urban expansion and motorization since the end of apartheid in 1994.

The three metropolitan areas to be covered by this survey, i.e., Johannesburg, Cape Town and eThekwini (Durban), have seen rapid increase in population and growth in urban areas. This results in confronting crucial issues of urban functions, such as public transport, power and other energy, ICT (Information and Communication Technology), waterworks, sewerage, waste disposal, security, or disaster prevention. In particular, essential infrastructure such as power and water are deficient in supply to the increasing demand. To address these urban issues, the three metropolitan areas are undertaking projects on smart city, transit oriented development (TOD), etc. under the Integrated Development Plan (IDP) formulated for the whole country in 2000.

To ensure the success of these projects, it is necessary to assess the adaptability of various low-carbon or environmentally-friendly technologies in the projects. This survey would undertake this purpose by evaluating the adaptability of existing low-carbon and environmentally-friendly technologies that have been developed jointly by Japanese government and companies for sustainable urban development. In addition, the sharing of the research outcome with Japanese enterprises might enhance their investment interests in South Africa especially in the three metropolitan areas.

Furthermore, successful experiences resulting from this survey for South Africa as an African leader may influence other African countries with regard to environmentally-friendly urban development in the future.

1.2 Survey Objectives and Elements

The objectives of this survey are to collect basic information on basic infrastructure and low carbonization approaches for the formulation of environmentally-friendly urban development

strategies for the three metropolitan areas in South Africa and to identify the opportunity areas for support by Japanese government and enterprises.

Given the aforesaid objectives, the survey comprises the following four elements:

- To collect and analyze information on the present state and future plans in the respective sectors in the three metropolitan areas.
- To augment the existing urban development plans and environmentally-friendly development strategies of individual municipalities by proposing enhanced concepts and strategies and recommending the appropriate technologies based on the characteristics and needs of individual metropolitan areas.
- To identify areas or sectors in South African cities with high potential for partnership with or support from Japanese government and enterprises.
- To hold discussions with local governments and relevant authorities in order to achieve unbiased survey results.

1.3 Survey Area

The survey area is composed of the three metropolitan areas: Johannesburg, Cape Town and eThekwini.

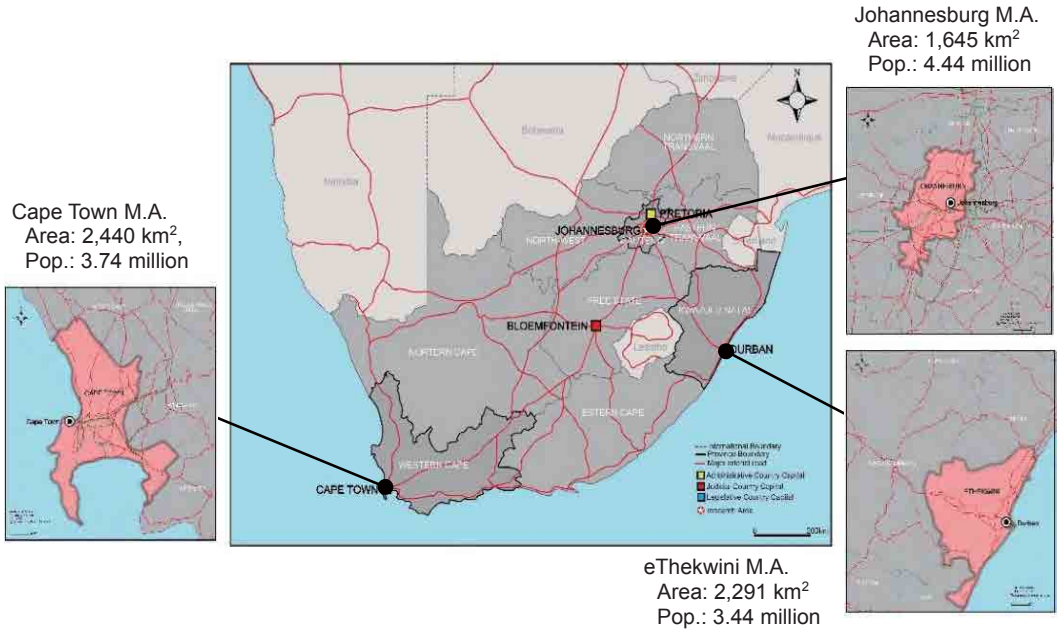


Figure 1-3-1 Survey Area

Table 1-3-1 Overview of three metropolitan municipalities

Category			Johannesburg	Cape Town	eThekwini	South Africa (the whole country)
Land	area (km2)		1,645	2,440	2,291	1,221,037
	green area (㎡)	green area per capita(㎡／person)	230.7 (2007)	289.5 (2010)	186.6 (2007)	
Economy	GDP(0.1billion USD)(2012)		766	568	476	3,843
	GDP per capita(USD)(2012)		17,418	15,721	12,564	7,508
Society	population (2011)	population (thousand people)	4,435	3,740	3,442	51,800
		population density(person/km2)	2,696	1,533	1,503	42.4
		population growth rate	3.18%	2.57%	1.08%	1.45%
	household (2011)	number(thousand)	1,435	1,068	957	14,450
		average number of people per household	2.8	3.3	3.4	3.6
	education (2011)	adult with no proper school education (20 yrs ～)	2.9%	1.8%	4.2%	8.6%
		adult with high school education or above (20 yrs ～)	19.2%	16.6%	12.3%	11.8%
	income (2011)	average monthly income per household (S. Africa Rand)	183,247	161,762	112,830	103,204
	poverty (2009)	poverty ratio (average in province the city belongs)	33.0%	35.4%	65.0%	56.8%
	employment status(2011	unemployment rate(15－64 years old)	25.0%	23.9%	30.2%	29.8%
	housing	household living in approved housing	81.4%	78.4%	79.0%	77.6%
Infra	internet	internet connection rate (access to internet)	49.6%	49.3%	41.2%	35.2%
	water and sewage	coverage of water supply (Piped water inside dwelling)	91.6%	87.3%	80.7%	73.4%
		water consumption per capita (liter／person／day)	348.7 (2008)	225.2 (2009)	252.9 (2007)	–
		coverage of sewage system (Flush toilet connected to sewerage)	90.5%	92.3%	75.7%	60.1%
		water leakage rate	25.1% (2008)	10% (2009)	36.4% (2007)	–
	electricity	system power connection rate (Electricity for lighting)	90.8%	94%	89.9%	84.7%
Traffic	traffic	path length of public transportation [ex: bus](km/km2)	6.8 (2003)	1.9 (2010)	9.2 (2011)	–
		car ownership ratio (average in province the city belongs)	11.6%	7.0%	10.2%	8.9%
Energy	energy	energy consumption per capita (GJ／person)	5.6 (2007)	13.9 (2009)	11.3 (2010)	–
co2	co2	CO2 emission per capita(kg／person)	1483.8 (2007)	4098.6 (2006)	3503.4 (2010)	–
Waste	garbage	waste generated per capita (kg／person／year)	401.3 (2007)	572.9 (2010)	519 (2007)	–

Reference:
1. Statistics South Africa http://beta2.statssa.gov.za/
2. Brookings Institution. "Global city GDP 2011-2012". http://www.brookings.edu/research/interactives/global-metro-monitor-3#
3. The World Bank. http://data.worldbank.org/indicator/NY.GDP.MKTP.CD
4. Population Reference Bureau. "2013 World Population Data Sheet". http://www.prb.org/pdf13/2013-WPDS-infographic_MED.pdf
5. Economist Intelligence Unit. "African Green City Index". http://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/report_africa_en.pdf

1.4 Basic Approaches to the Survey

First of all, efficient conduct of the survey is necessary to attain successful results in a relatively short period of four months. Thus, the survey team has adopted a hypothesis verification approach by making full use of expertise of the survey team.

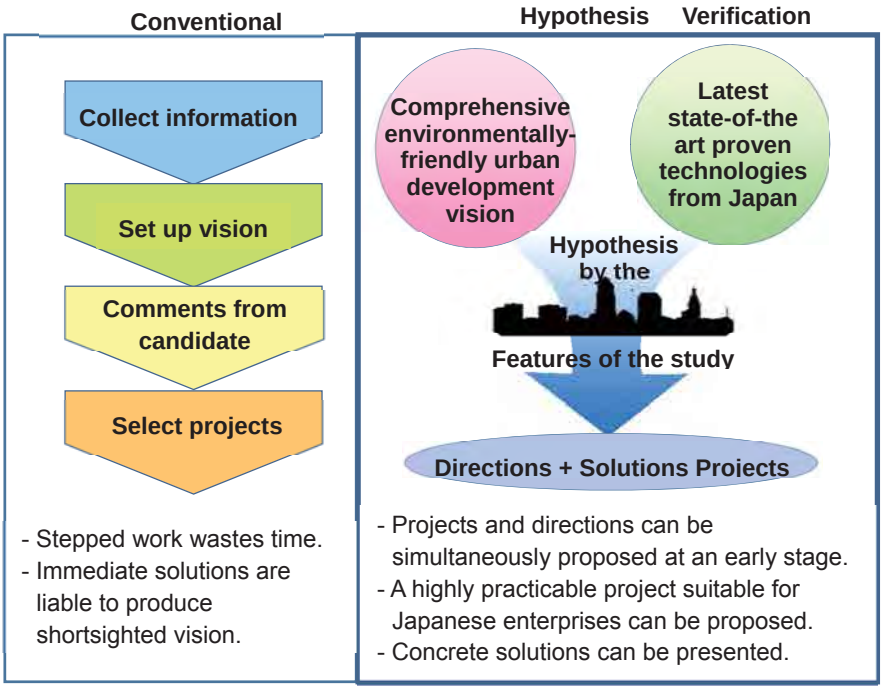


Figure 1-4-1 Hypothesis Verification Approach

More specifically, if conventional approach are applied, wider range of technologies can be picked up from the concept or vision stated by each metropolitan municipalities. One of this hypotheses verification approaches' advantages is able to pick up more practical technologies by assuming concrete projects in earlier stage of the survey. Therefore, it is possible to show more concrete vision with practical and specific technologies to each local government.

1.5 Composition of Tasks of the Survey

The survey is composed of the following tasks.

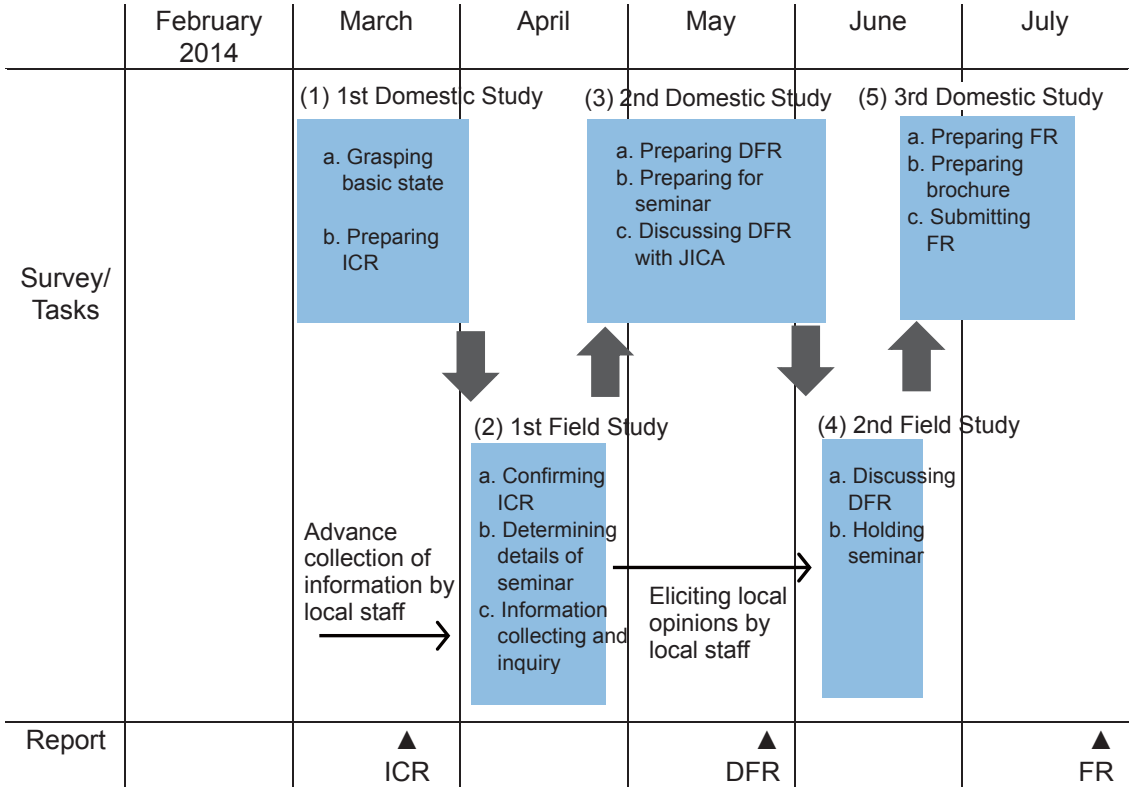


Figure 1-5-1 Survey Flow and Task Composition

2. CURRENT STATUS AND ISSUES

2.1 Urban Planning

2.1.1 Overview of development planning policies and plans

Figure 2-1-1 shows the hierarchy of urban planning and development policies. Based on National Development Plan, each metropolitan municipality has developed its own long term, medium term and spatial planning policies.

Figure 2-1-1 Hierarchy of planning policies

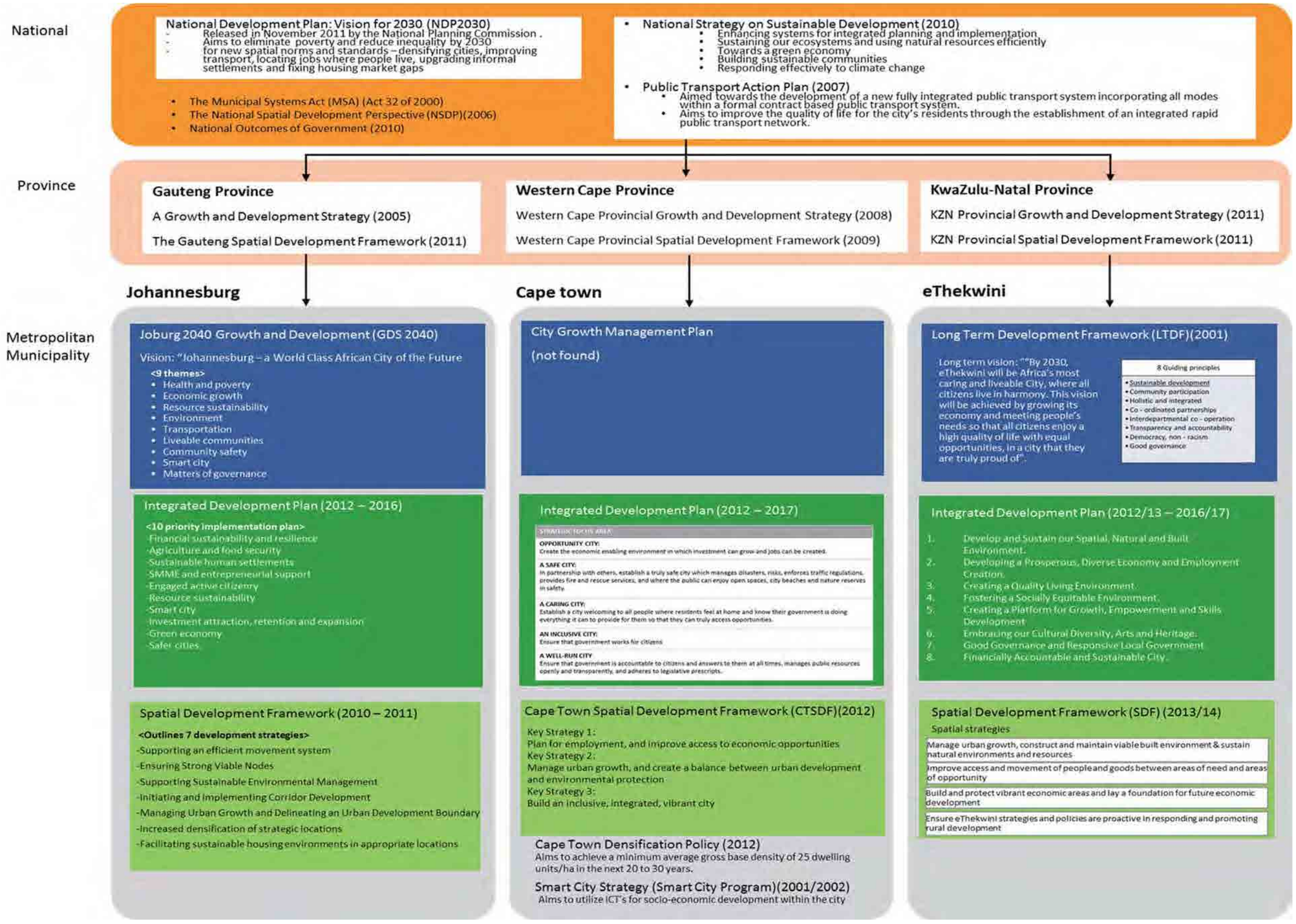


Figure 2-1-2 Overview of planning policies

2.1.2 National policies and plans

(1) National Development Plan: Vision for 2030 (NDP2030)

NDP 2030 was released in November 2011 by the National Planning Commission. It aims to eliminate poverty and reduce inequality by 2030; to allow for citizens to have capabilities to grasp the opportunities available; and, to change the life chances of South Africans, especially the youth of the country. It addresses such challenges:

- Too few South Africans are employed which anchors widespread poverty
- The quality of education for poor black South Africans is substandard
- Poorly located and inadequate infrastructure limits social inclusion and faster economic growth
- South Africa's growth path is highly resource-intensive and hence unsustainable
- Spatial challenges continue to marginalise the poor
- The ailing public health system confronts a massive disease burden
- Uneven performance of the public service
- Corruption undermines state legitimacy and service delivery.

It also identified the need for new spatial norms and standards – densifying cities, improving transport, locating jobs where people live, upgrading informal settlements and fixing housing market gaps.

(2) Other key national policies and plans

Table 2-1-1 shows other key national policies and plans.

Table 2-1-1 Overview of national policies and plans

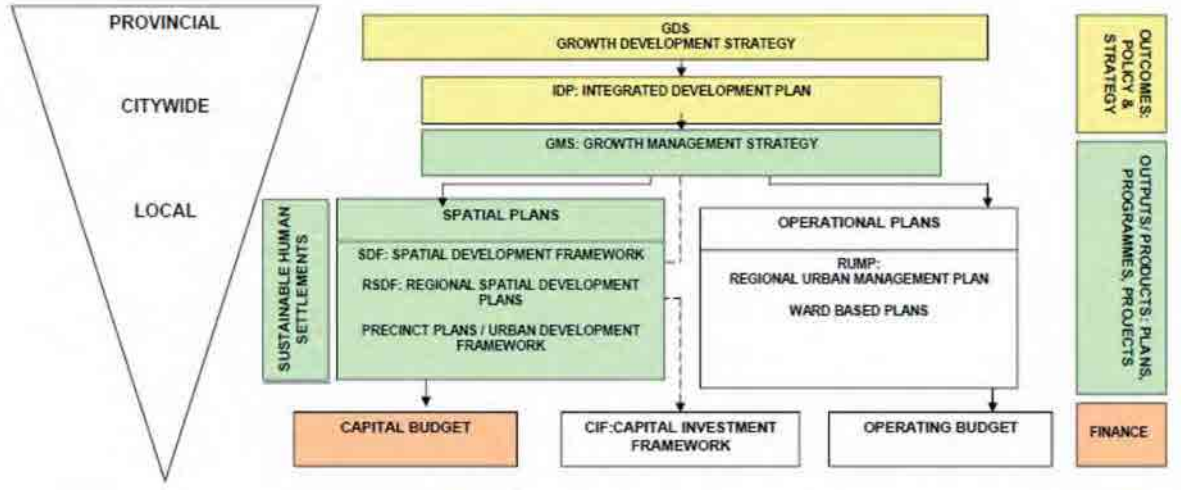
The Municipal Systems Act (MSA) (Act 32 of 2000)	- Requires that each Municipality prepare an Integrated Development Plan (IDP) to serve as a tool for transforming local governments towards facilitation and management of development within their areas of jurisdiction.
The National Spatial Development Perspective (NSDP)(2006)	- Aims to fundamentally reconfigure apartheid spatial relations and to implement spatial priorities that meet the constitutional imperative of providing basic services to all and alleviating poverty and inequality. - Requires local planning to: address spatial restructuring, and, reflect on and make proposals for the spatial implications of social investment.
National Outcomes of Government (2010)	- 12 outcomes were adopted by The Cabinet Lekgotla held in January 2010: - Improved quality of basic education. - A long and healthy life for all South Africans. - All people in South Africa are and feel safe. - Decent employment through inclusive economic growth. - A skilled and capable workforce to support an inclusive growth path. - An efficient, competitive and responsive economic infrastructure network. - Vibrant, equitable and sustainable rural communities with food security for all. - Sustainable human settlements and improved quality of household life. - A responsive, accountable, effective and efficient local government system. - Environmental assets and natural resources that are well protected and continually enhanced.

	- Create a better South Africa and contribute to a better and safer Africa and World. - An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship
National Strategy on Sustainable Development (2010)	- Builds on the National Framework for Sustainable Development and other initiatives to address sustainability issues in South Africa. - Five strategic priorities have been developed: - Enhancing systems for integrated planning and implementation - Sustaining our ecosystems and using natural resources efficiently - Towards a green economy - Building sustainable communities - Responding effectively to climate change
Public Transport Action Plan (2007)	- Aimed towards the development of a new fully integrated public transport system incorporating all modes within a formal contract based public transport system. - Aims to improve the quality of life for the city's residents through the establishment of an integrated rapid public transport network. - Consists of a three phased strategy as follows: - Accelerated Recovery and Catalytic Projects (2007-2010) - Promote and Deliver Basic Networks (2010-2014) - Advance and Sustain Accessible Networks (2014-2020)

2.1.3 Johannesburg

(1) Hierarchy of policies, strategies and plans

Figure 2-1-3 shows the hierarchy of policy, strategies and plans of Johannesburg.



Source: City of Johannesburg: Spatial Development Framework 2010-2011

Figure 2-1-3 Hierarchy of policy, strategies and plans

(2) Joburg 2040 Growth and Development (GDS 2040)

The Joburg 2040 GDS stated the following vision:

"Johannesburg – a World Class African City of the Future – a vibrant, equitable African city, strengthened through its diversity; a city that provides real quality of life; a city that provides sustainability for all its citizens; a resilient and adaptive society."

Table 2-1-2 shows the city's long-term planning.

Table 2-1-2 Overview of Joburg GDS 2040

6 principles	-Eradicating poverty -Building and growing an inclusive economy -Building sustainable human settlements -Ensuring resource security and environmental sustainability -Achieving social inclusion through support and enablement -Promoting good governance
outcomes	-Improved quality of life and development-driven resilience for all -Provide a resilient, liveable, sustainable urban environment – underpinned by infrastructure supportive of a low-carbon economy -An inclusive, job-intensive, resilient and competitive economy -A leading metropolitan government that pro-actively contributes to and builds a sustainable, socially inclusive, locally integrated and globally competitive GCR
themes	-Health and poverty -Economic growth -Resource sustainability -Environment -Transportation -Liveable communities -Community safety -Smart city -Matters of governance

(3) Integrated Development Plan (2012 – 2016)

Table 2-1-3 shows the city's medium-term planning (every five years)

Table 2-1-3 Overview of Joburg IDP

10 Key flagship programmes	- Financial Sustainability - Shift to Low Carbon Infrastructure - Integrated Waste Management - Green Ways and Mobility - From Informal Settlements to Sustainable Human Settlements - Urban Water Management - Citizen Participation and Empowerment - Strategic communications and marketing - Human Capital Development and Management - A safe, secure and resilient City that protects, serves, builds and empowers communities
10 priority implementation plans	- Financial sustainability and resilience - Agriculture and food security - Sustainable human settlements - SMME and entrepreneurial support - Engaged active citizenry - Resource sustainability - Smart city - Investment attraction, retention and expansion - Green economy - Safer cities

(4) Spatial Development Framework (SDF) (2010 – 2011)

SDF details the spatial planning policy of the City and provides the policy basis for assessment and determination of development proposals and applications that fall outside the scope of prevailing Town Planning Schemes.

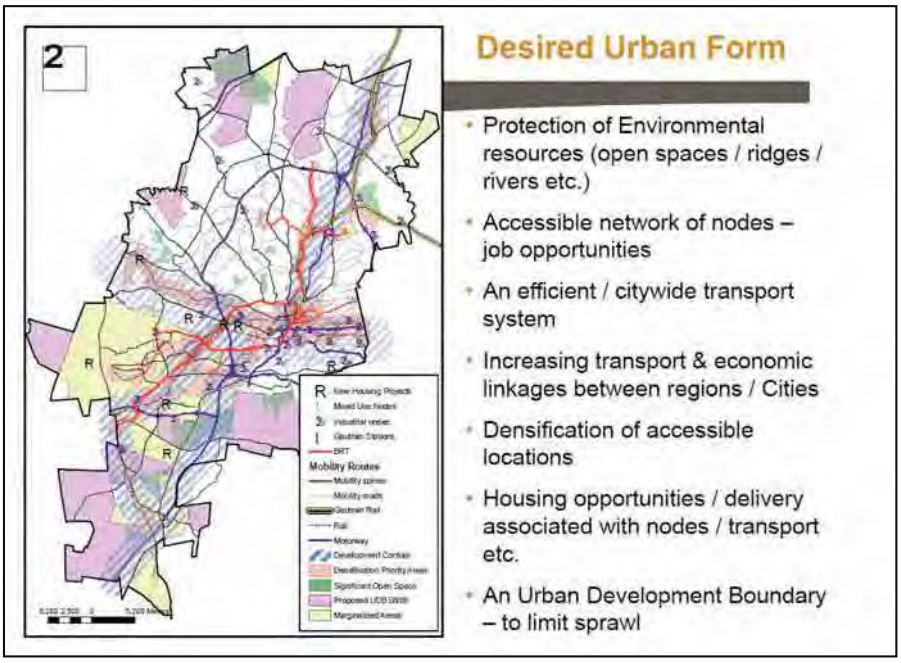
a. 7 development strategies

It outlines the following 7 development strategies

- Supporting an efficient movement system
- Ensuring Strong Viable Nodes
- Supporting Sustainable Environmental Management
- Initiating and Implementing Corridor Development
- Managing Urban Growth and Delineating an Urban Development Boundary
- Increased densification of strategic locations
- Facilitating sustainable housing environments in appropriate locations

b. Desired Urban Form

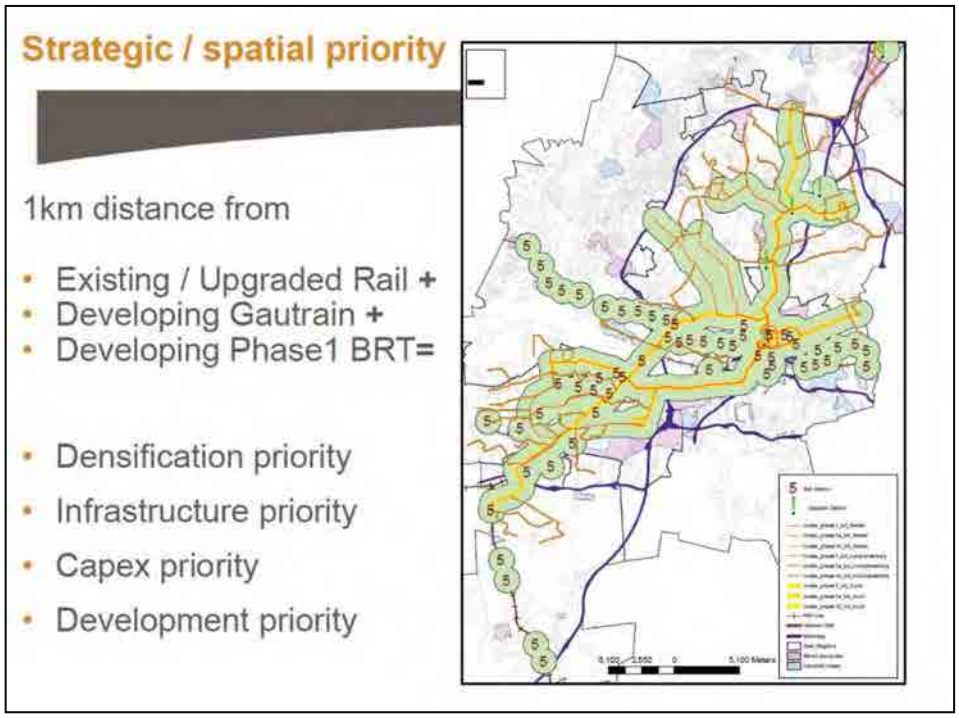
Figure 2-1-4 shows desired urban form of Johannesburg.



Source: Spatial Development Framework, Johannesburg

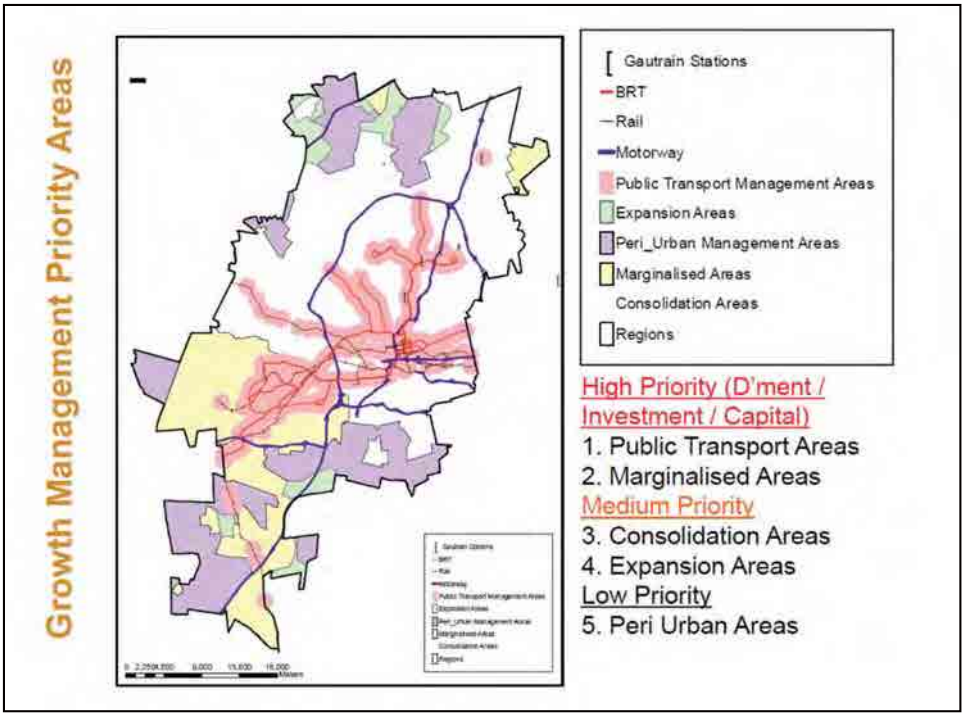
Figure 2-1-4 Desired Urban Form

According to Figure 2-1-5, 2-1-6, SDF designates area with 1km distance from public transport hub as “Public Transport Management Area” and assigns various priorities such as densification, infrastructure, capex, and development.



Source: Spatial Development Framework, Johannesburg

Figure 2-1-5 Spatial priority for public transport area



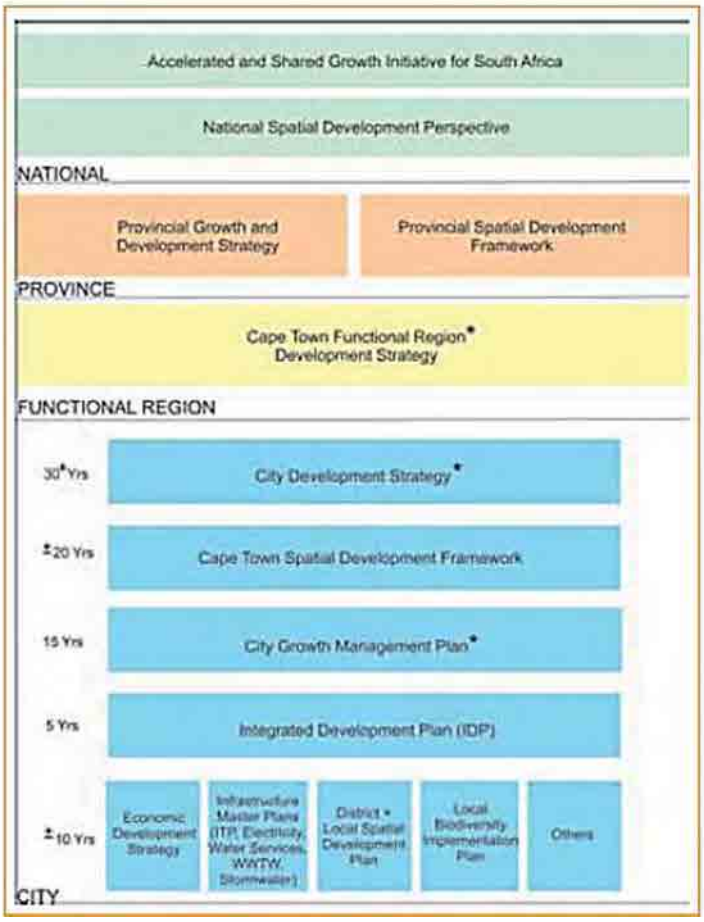
Source: Spatial Development Framework, Johannesburg

Figure 2-1-6 Growth Management Priority Areas

2.1.4 Cape Town

(1) Hierarchy and structure

Figure 2-1-7 shows the hierarchy of policies, strategies and plans of Cape Town.



Source: Cape Town Spatial Development Framework 2012

Figure 2-1-7 Overviews of policies, strategies and plans of Cape Town

(2) Integrated Development Plan (2012 – 2017)

IDP informs all planning, management, development and service delivery actions. In order to implement the City's vision, IDP is organized around 5 focus areas:

Table 2-1-4 Strategic focus area of Cape Town's IDP

STRATEGIC FOCUS AREA
OPPORTUNITY CITY: Create the economic enabling environment in which investment can grow and jobs can be created.
A SAFE CITY: In partnership with others, establish a truly safe city which manages disasters, risks, enforces traffic regulations, provides fire and rescue services, and where the public can enjoy open spaces, city beaches and nature reserves in safety.

A CARING CITY: Establish a city welcoming to all people where residents feel at home and know their government is doing everything it can to provide for them so that they can truly access opportunities.
AN INCLUSIVE CITY: Ensure that government works for citizens
A WELL-RUN CITY Ensure that government is accountable to citizens and answers to them at all times, manages public resources openly and transparently, and adheres to legislative prescripts.

(3) Cape Town Spatial Development Framework (CTSDF) (2012)

CTSDF is a long-term (20+ years) plan that will be used to manage the spatial growth and development of Cape Town. It has identified 3 key strategies (and sub-strategies).

Table 2-1-5 Key strategies of CTSDF

Key Strategy 1: Plan for employment, and improve access to economic opportunities	- Promote inclusive, shared economic growth and development - Address spatial economic imbalances - Establish an integrated, city-wide public transport system that supports the accessibility grid - Integrate land use, economic and transport planning - Support the rationalisation, upgrade and/or development of economic gateways, and manage land uses around them appropriately
Key Strategy 2: Manage urban growth, and create a balance between urban development and environmental protection	- Facilitate urban development - Support incremental development processes - Encourage a more compact form of development - Appropriately protect the citizens of Cape Town from hazardous areas/activities - Appropriately manage urban development impacts on natural resources and critical biodiversity networks - Make efficient use of nonrenewable resources - Protect and enhance the city's rural environment
Key Strategy 3: Build an inclusive, integrated, vibrant city	- Transform the apartheid city - Proactively support publicly led land reform and new housing delivery - Encourage integrated settlement patterns - Enhance the unique sense of place and quality of the built form of Cape Town - Enhance the value of heritage resources and scenic routes - Promote accessible, citywide destination places

Source: Cape Town Spatial Development Framework

Figure 2-1-8 Cape Town Spatial Development Framework

(4) Cape Town Densification Policy (2012)

CTSDF maintains that rapid and continuous low-density development is threatening the long-term sustainability of Cape Town. Cape Town Densification Policy aims to improve the city's sustainability and to enhance the quality of the built environment.

It aims to achieve a minimum average gross base density of 25 dwelling units/ha in the next 20 to 30 years. The key directives are stated below:

(5) Smart City Strategy (Smart City Program)

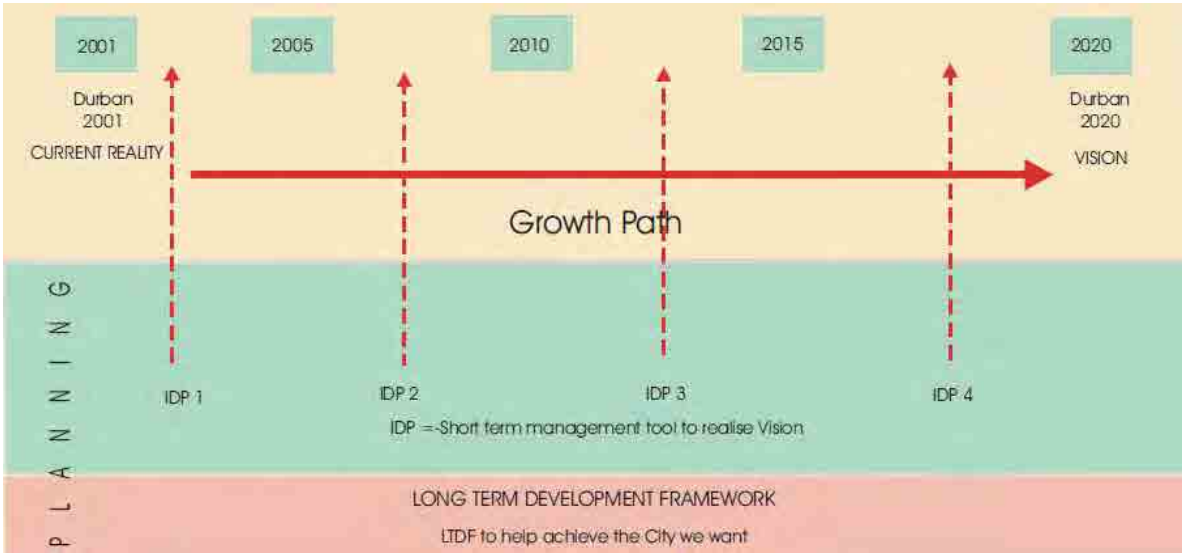
Smart City Strategy was developed in 2001/2002 by City Council. It aims to utilize ICT's for socio-economic development within the city and focuses on providing ICT skills enhancement opportunities, access to ICTs and business development opportunities.

The program has won multiple awards, including 2004 Computer World Honours Award, Bill and Melinda Gates Access to Learning Award 2003.

2.1.5 eThekwini

(1) Hierarchy and structure

Figure 2-1-9 shows the hierarchy of policies, strategies and plans of eThekwini.



Source: eThekwini Municipality (2001) Long Term Development Framework

Figure 2-1-9 Hierarchy of policies, strategies and plans of eThekwini

(2) Long Term Development Framework (LTDF) (2001)

LTDF mapped out the developmental challenges and strategic vision for the eThekwini Municipality over a period of 20 years (long-term).

The long term vision established by LTDF: “By 2030, eThekwini will be Africa’s most caring and liveable City, where all citizens live in harmony. This vision will be achieved by growing its economy and meeting people’s needs so that all citizens enjoy a high quality of life with equal opportunities, in a city that they are truly proud of”.

It identified 7 key development challenges and 8 guiding principles stated in Table 2-1-6.

Table 2-1-6 Development challenges and guiding principles in LTDF

7 Critical development challenges	- Creating Economic Growth, Jobs and Income - Meeting Basic Needs - Alleviating Poverty - Developing our People - Managing the AIDS Pandemic - Ensuring a Safe & Secure Environment - Striving for Sustainability
8 guiding principles	- Sustainable development - Community participation - Holistic and integrated

	- Co - ordinated partnerships - Interdepartmental co - operation - Transparency and accountability - Democracy, non - racism - Good governance

(3) Integrated Development Plan (2012/13 – 2016/17)

IDP outlines short-term (5-year) strategies and outcomes addressing the challenges and achieving the long term vision. It identified 6 priority areas and an 8-point delivery plan as shown in Table 2-1-7.

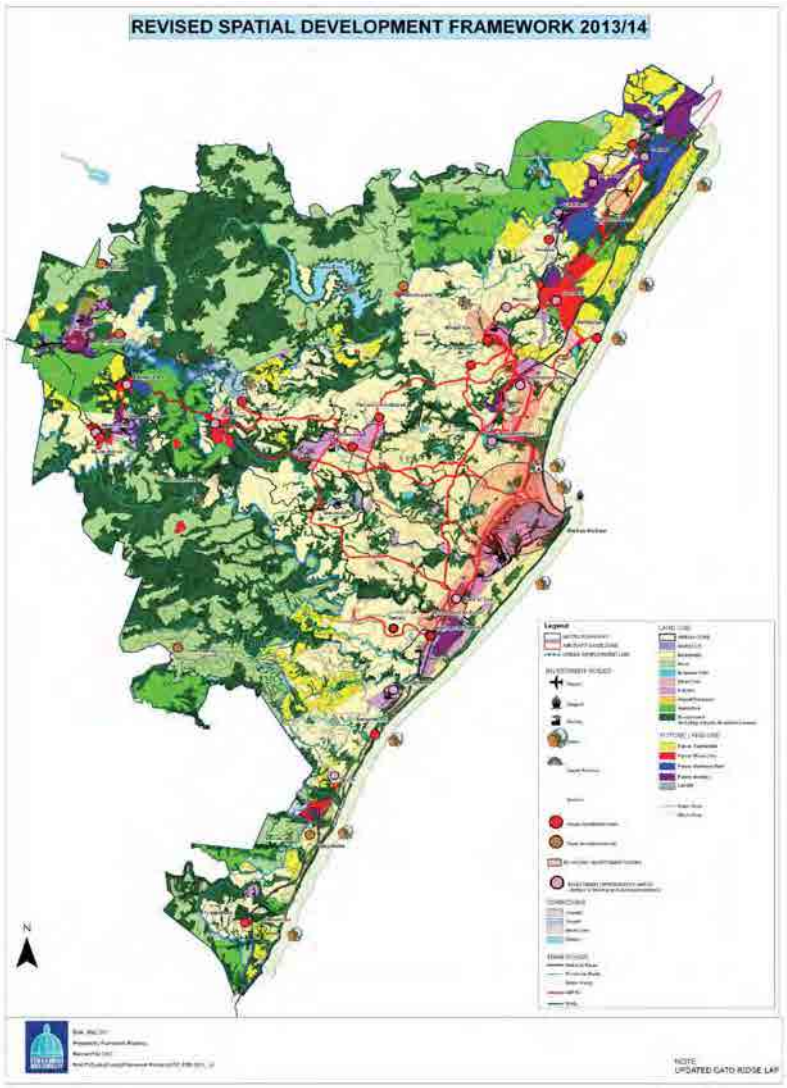
Table 2-1-7 6 Priority areas and 8 point plan in IDP

Strategic Priority Area	Goal
Creating Sustainable Livelihoods	All citizens in a prosperous eThekwini earn a decent living and support a sustainable lifestyle.
Socially Cohesive City	eThekwini has well rounded and caring citizens who act to support the common well being of eThekwini and embrace mutual respect, tolerance and compassion for those in need.
A Financially Sustainable City	To maximise the Municipality's financial resources to ensure long-term financial viability and sustainability, thus improving service delivery.
Creating a Safer City	All those who live, work, play and invest in eThekwini feel and are safe in private and public spaces.
Promoting an Accessible City	All citizens of eThekwini can easily and affordably access the facilities and service that they require for a sustainable lifestyle.
Environmentally Sustainable City	The environment of eThekwini protects and promotes the health of its citizens and its biodiversity.

The Eight Point Plan
1. Develop and Sustain our Spatial, Natural and Built Environment. 2. Developing a Prosperous, Diverse Economy and Employment Creation. 3. Creating a Quality Living Environment. 4. Fostering a Socially Equitable Environment. 5. Creating a Platform for Growth, Empowerment and Skills Development 6. Embracing our Cultural Diversity, Arts and Heritage. 7. Good Governance and Responsive Local Government. 8. Financially Accountable and Sustainable City.

(4) Spatial Development Framework (SDF) (2013/14)

SDF translates requirements of IDP spatially and guides the overall spatial distribution of current and desirable land uses within City. Its vision is to have "by 2030 a socially equitable, environmentally sustainable and functionally efficient Municipality that bolsters its status as a gateway to Africa and the world".



Source: eThekwini Municipality Spatial Development Framework 2013/2014

Figure 2-1-10 Spatial Development Framework of eThekwini Municipality

2.1.6 Current Issues

(1) Johannesburg

- Although the city of Johannesburg aims to promote TOD (Transit Oriented Development), it has not made much progress. For example, Corridor of Freedom has been set as a core project in the city center with intentions of integrating city functions and conducting joint development, including provision of social housing in the vicinity of BRT stations. Under the present circumstances, however, the private sector is not well motivated due to the rise in land prices around the station and lack of public subsidies.
- Precariousness following the abolition of Apartheid still remains a problem in urban central area. Meanwhile, there are some assets such as historical constructions in the city center, and effective utilization of those assets is recognized as a challenge due to a recent movement to

reconsider their significance.

(2) Cape Town

- In Cape Town, the large variances in population density between different parts of the city are obvious; the urban central area where city functions concentrate has a low population density, while the suburban area including Township has a high population density. The city has issued the Densification Policy to address this situation, but not much progress has been made due to institutional and financial problems.
- While population is expected to grow in the future in Cape Town, developable sites are limited due to the periphery being surrounded by sea and mountains. Also because the city is surrounded by lush greenery environment, it is required to have a system where the surrounding natural environment can be maintained for coexistence.

(3) eThekwini

- The city which is promoting TOD (Transit Oriented Development) specifically instituted a plan to centralize the city function by setting 500 meters from the traffic hub as a walking sphere. However, it has not yet been materialized. Because government-owned land is few within the vicinity of stations, it is challenging to come up with policies that could give the private sector incentives for development. Besides, incentive policies regarding zoning and development density are considered inadequate.

2.2 Transportation Planning

2.2.1 Johannesburg

(1) Length of road network

The extent of the road network in the City of Johannesburg that is managed by the Johannesburg Road Agency (JRA), per administrative region is shown in Table 2-2-1 (as of February 2008). Total road length is 9,719 km and road ratio (road length / land area) is 5.9 km/km2.

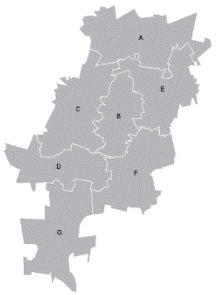
Table 2-2-1 Extent of roads in City of Johannesburg

Infrastructure component	Region							Total
	A	B	C	D	E	F	G	
Paved roads (km) - CoJ-Owned	678	1408	1298	1462	1245	1534	700	8324
Gravel roads (km)	376	1	180	39	10	6	384	997
Motorway (Lane Kms)								398

Source: City of Johannesburg. Strategic Integrated Transport Plan Framework for the City of Joburg Draft 13 May 2013

Reference: Regions of the City of Johannesburg Metropolitan Municipality

Region	
A	Diepsloot, Kya Sand
B	Randburg, Rosebank, Emmarentia, Greenside, Melville, Northcliff, Rosebank, Parktown, Parktown North
C	Roodepoort, Constantia Kloof, Northgate
D	Doornkop, Soweto, Dobsonville, Protea Glen
E	Alexandra, Wynberg, Sandton
F	Inner City
G	Orange Farm, Ennerdale, Lenasia



(2) Modal split

Table 2-2-2 and 2-2-3 show the modal split of travel to work / school in Johannesburg. For trips to work, split of car is more than 40% and, car and taxi combined exceeds 80% in 2011. Split of train and bus combined is less than 10% in 2011. For trips to school, modal share of bus has increased from 3% to 12% due to the introduction of school bus and BRT system.

Table 2-2-2 Main mode of travel to work in Johannesburg

	2002 Gauteng Household Travel Survey	2011 Gauteng Quality of Life Survey
Car driver/passenger	42%	42%
Minibus-taxi	35%	42%
Walk	9%	7%
Train	8%	5%
Bus	4%	4%
Bicycle	<1%	<1%
Other	2%	<1%
Total	100%	100%

Source: City of Johannesburg. Strategic Integrated Transport Plan Framework for the City Of Joburg Draft 13 May 2013

Table 2-2-3 Main mode of travel to school in Johannesburg

	2002 Gauteng Household Travel Survey	2011 Gauteng Quality of Life Survey
Car driver/passenger/lift club	25%	23%
Minibus-taxi	14%	15%
Walk	55%	46%
Train	2%	1%
Bus	3%	12%*
Bicycle	<1%	2%
Other	<1%	<1%
Total	100%	100%

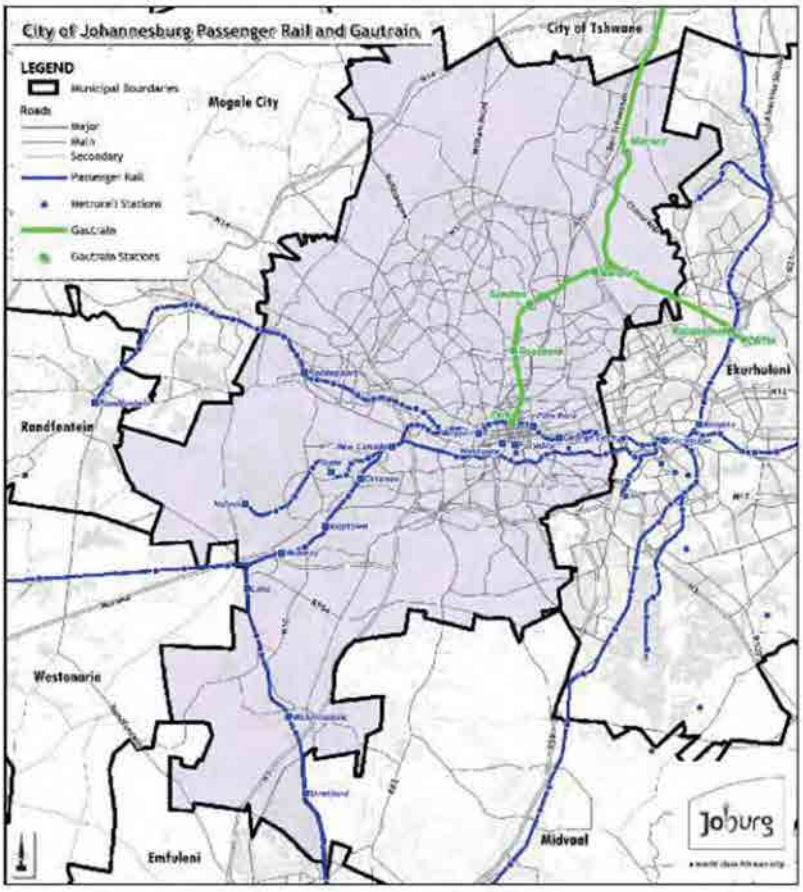
*Made up of 9.1% school bus, 2,2% other bus and 0.3% Rea Vaya.

Source: City of Johannesburg. Strategic Integrated Transport Plan Framework for the City Of Joburg Draft 13 May 2013

(3) Road and public transportation network

a. Railway network

Passenger railway is operated by the Passenger Rail Agency of South Africa (PRASA) that operates long-distance (intercity) passenger rail services. Metrorail operates a commuter rail service in Johannesburg and the surrounding area. Metrorail network was built in Johannesburg's infancy and covers only the older areas in the city's south. The northern areas, including the business districts of Sandton, Midrand, Randburg, and Rosebank, are served by the rapid rail link Gautrain.

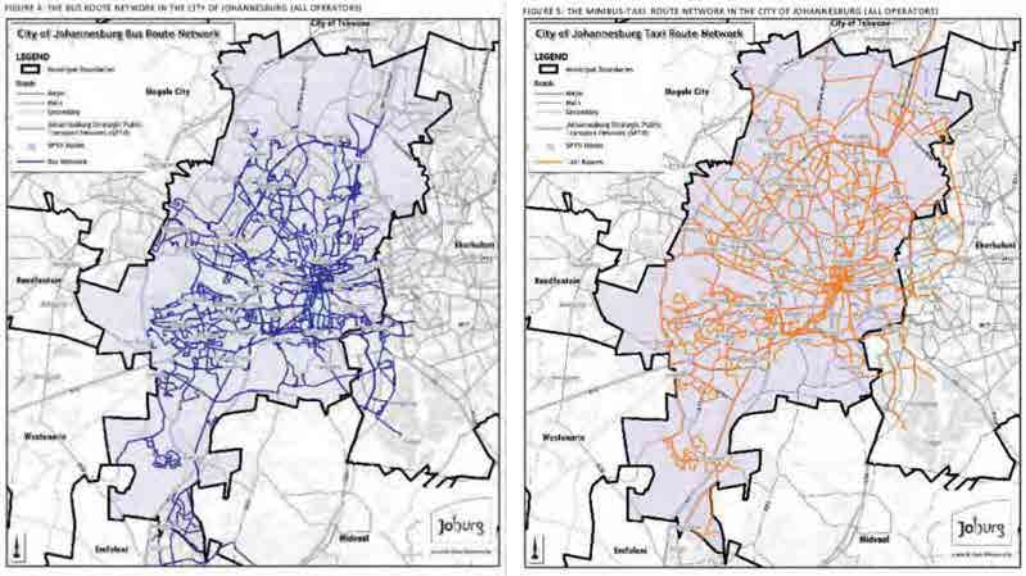


Source: City of Johannesburg. Strategic Integrated Transport Plan Framework for the City Of Joburg Draft 13 May 2013

Figure 2-2-1 PRASA, Metrorail and Gautrain networks and stations

b. Bus route and Mini-bus taxi network

Bus network in Johannesburg is operated by Metrobus, a corporate unit of the City of Johannesburg. Mini-bus taxi is an essential form of transport for the majority of the population.

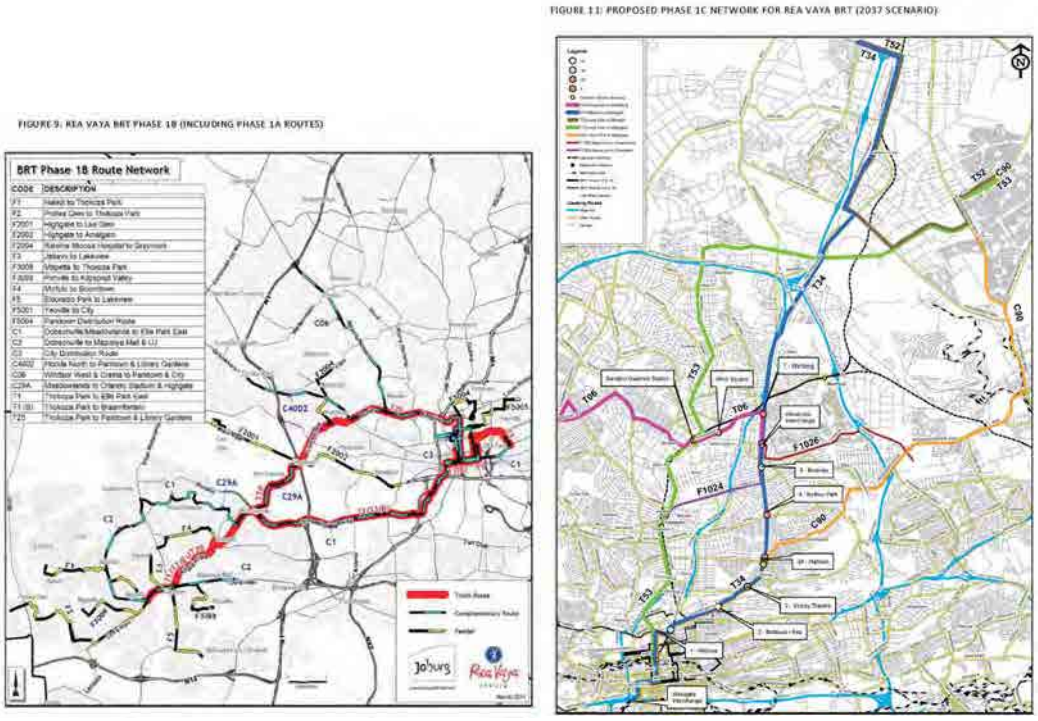


Source: City of Johannesburg. Strategic Integrated Transport Plan Framework for the City Of Joburg Draft 13 May 2013

Figure 2-2-2 Bus route and Mini-bus taxi network

c. BRT network

A new bus rapid transit named Rea Vaya has also been implemented. It currently serves to transport people from Johannesburg's southern neighborhoods into and around the CBD.



Source: City of Johannesburg. Strategic Integrated Transport Plan Framework for the City Of Joburg Draft 13 May 2013

Figure 2-2-3 BRT network

(4) Current public transportation condition

a. Bus Rapid Transit (BRT)

As stated earlier, Rea Vaya BRT is now in operation in the center of Johannesburg. Well-designed terminal is located at the center of the street and IC card system is available to get on the BRT.

Source: JICA study team

Figure 2-2-4 Current status of BRT system

b. Gautrain

Since Gautrain is safe and clean, it has high utilization for intercity transportation. Public parking and park & ride terminal are built next to Gautrain station, and feeder bus network is in operation from each station to enhance public transportation use. IC card is available, but the card system is different from the one for Rea Vaya BRT.

Source: JICA study team

Figure 2-2-5 Current status of Gautrain and station

2.2.2 Cape Town

(1) Length of Roads and Public Transport

Table 2-2-4 shows total length of roads and public transport, number of stations of public transport in Cape Town. Total road length is 9,392 km and road ratio (road length / land area) is 3.8 km/km2.

Table 2-2-4 Summary of length and number of road and rail infrastructure in Cape Town

Element	Private transport			Public transport			
	Road	NMT		Rail	BRT	Bus	Minibus-taxi
		Cycle	Pedestrian				
Carriageway	9 392.3[1]	N/A	N/A	610[2]	17.7	25[3]	25[3]
Main Terminal (No)				118	21[4]	20	112
Feeder stations (No)					256[4]	5 000[5]	Unlimited

With regard to the above figures, please note the following:

- The road length is estimated according to chain length and not number of lanes, i.e. a six-lane highway implies that there are 6 km of drivable route per 1km of carriageway.
- Multiple routes operate over a total of 610 km of constructed railway lines.
- The total length of dedicated Bus and Minibus-taxi (BMT) lanes, located mostly or feeding into the N2.
- Forecasted number of BRT stations to be operational in Phase 1A, Milestone 1.
- This is the estimated number of feeder stations along all routes.

Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

(2) Modal split

Daily passenger trips per mode entering the CBD of Cape Town between 2001 and 2011 are shown in Table 2-2-5.

Table 2-2-5 Historic daily passenger trips per mode entering the CBD

Year	Source	Car	Bus	Taxi		Rail	Other'		TOTAL
				Metered	Minibus		NMT	Heavies	
2001	CoCT[1]	257 370	14 716	1 048	39 972	71 256	-	-	384 362
2003		268 288	15 382	2 033	45 537	68 783	190	-	400 213
2007		244 560	21 004	1 943	54 238	62 884	-	-	384 629
2011	TRS[2]	210 827	24 003	2 732	34 757	64 983	8 381	9 368	355 051

NOTE: 2011's Transportation Reporting System (TRS) counts were captured in more detail than those previously, and included additional groupings for NMT and general heavy vehicles. Those numbers have been separated above to accurately compare annual figures across the other modes. The *Total* column reflects all captured passengers.

Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

Table 2-2-6 shows the daily modal split of private (Car) and public (Bus + Rail + Taxi). Public modal share was 33% in 2001, but has increased to 37% in 2011.

Table 2-2-6 Daily modal split for passenger trips (excluding “Other”) entering the CBD

Year	Private	Public
2001	67%	33%
2003	67%	33%
2007	64%	36%
2011	63%	37%

Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

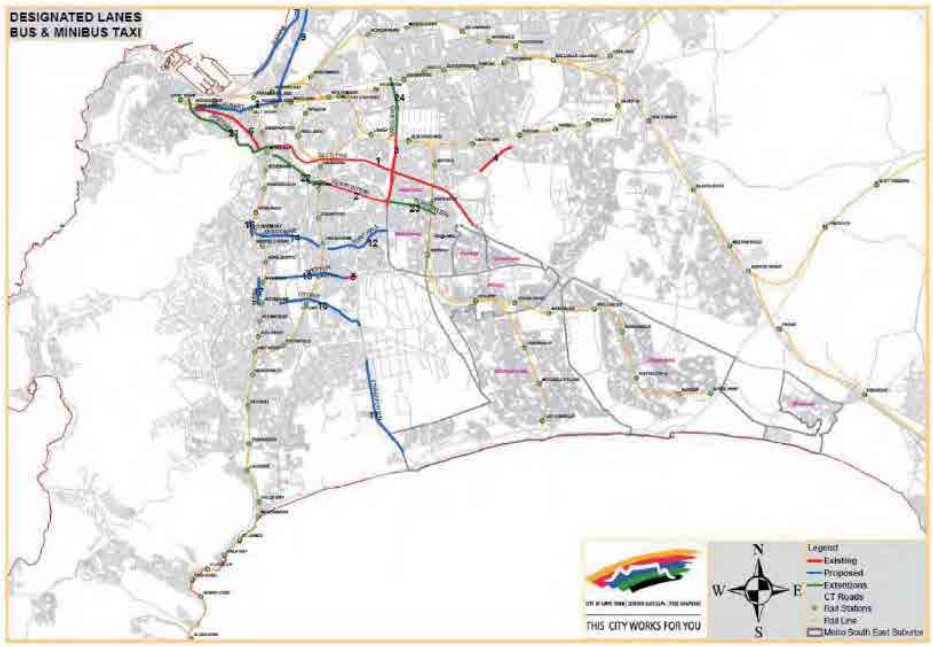
(3) Road and public transportation network

a. Railway network

Passenger railway is operated by the Passenger Rail Agency of South Africa (PRASA) that operates long-distance (intercity) passenger rail services. Metrorail operates a commuter rail service in Cape Town and the surrounding area.

b. Bus and Minibus-taxi network

Bus services are operated by Golden Arrow Bus Services throughout the Cape Town metropolitan area.

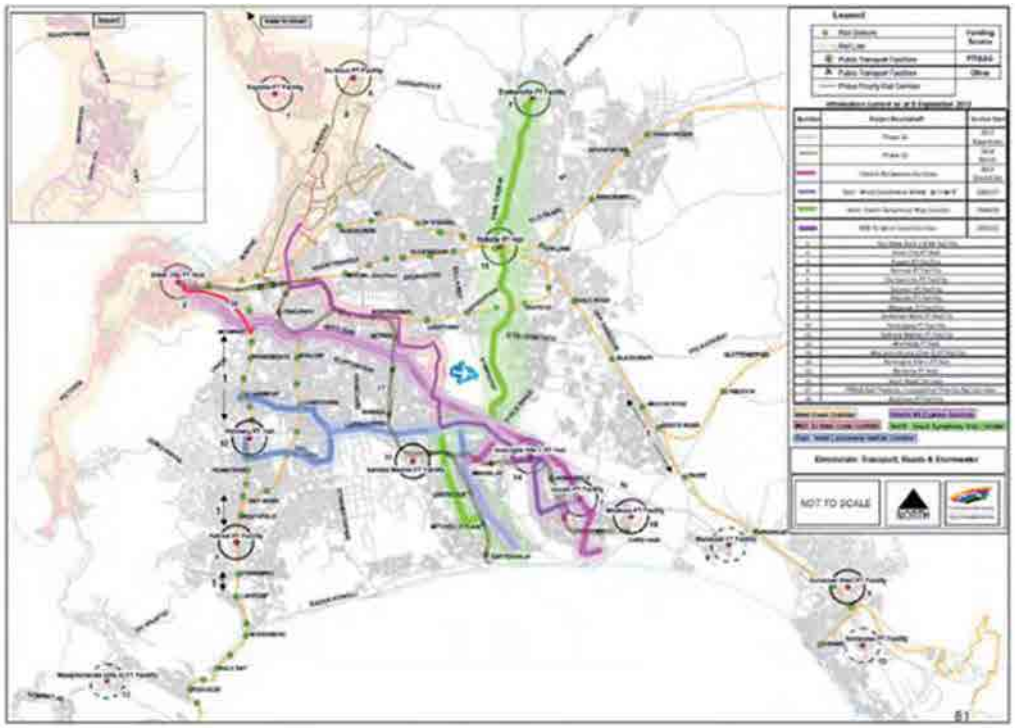


Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

Figure 2-2-6 Railway, Bus and Minibus-taxi network

c. BRT corridors

The City of Cape Town is currently planning to roll out its BRT system across the whole Metropolitan area in five phases. Figure 2-2-7 shows the service areas and implementation horizons of the five phases. Phase 1A is currently underway, with completion scheduled for November 2013.



Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

Figure 2-2-7 Schematic of the current and planned BRT corridors

d. Bicycle network

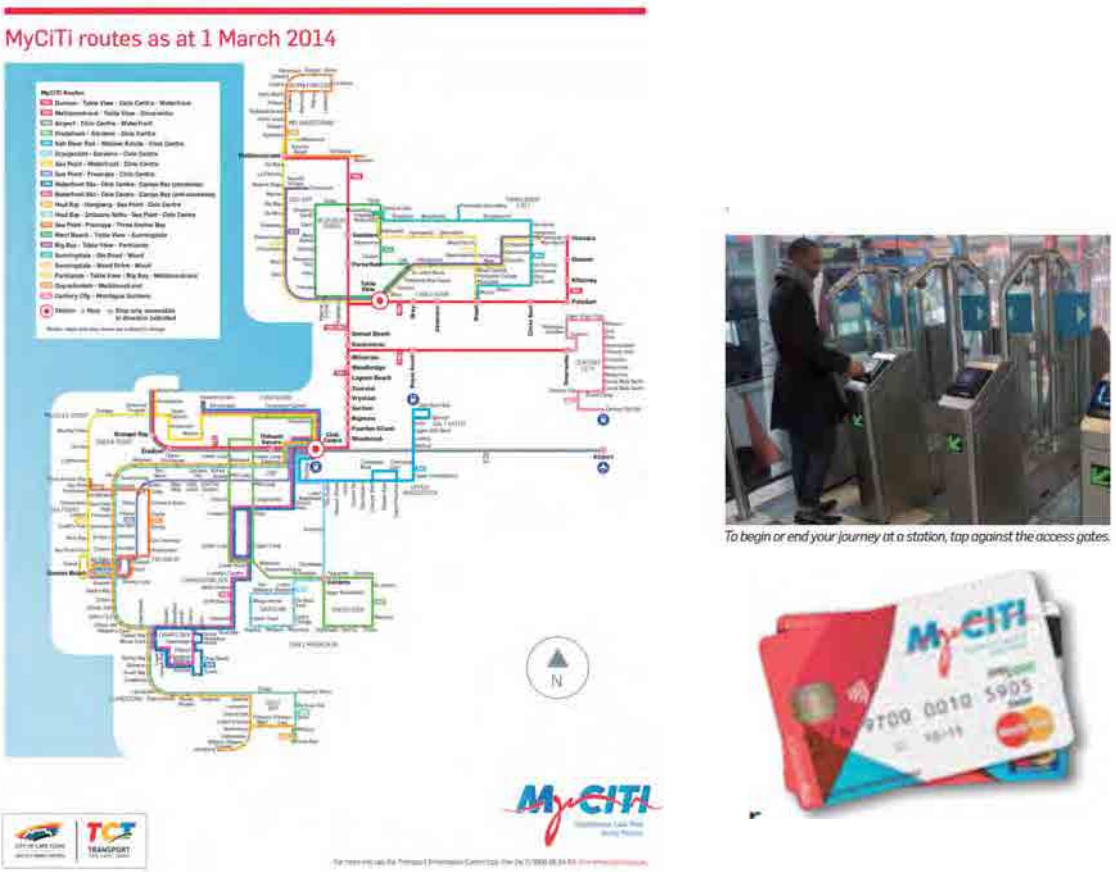
The City of Cape Town is working to develop its bicycle infrastructure which includes a growing number of safe cycling routes and places to ride in the city and surrounds. Figure 2-2-8 shows its bicycle network.

Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

Figure 2-2-8 Map of the Bicycle Masterplan

e. Integrated Rapid Transit (IRT) System

IRT system, which is called MyCiTi, is a bold initiative to integrate all of the current transport modal options into a coherent package: Metrorail services, road-based services on trunk routes, conventional bus services, minibus taxi integration, feeder bus services, improved pedestrian and bicycle access, metered taxi integration and park-and-ride facilities. IC card system, which is called MYCONNECT card is available in IRT system.



Source: City of Cape Town 2013. Draft 2013 – 2018 Integrated Transport Plan

Figure 2-2-9 IRT route map and IC card system

2.2.3 eThekwini

(1) Road network statistics

Table 2-2-7 shows the total length of road by road category in eThekwini. Total road length is 6,979 km and road ratio (road length / land area) is 3.0 km/km2.

Table 2-2-7 Road network statistics

eThekwini Road Network Statistics

RISFSA Category	Road Length (km)	Road Length (km)	PMS Category	Road Length (km)	Road Length (km)	Total Road Length (km)
	Surfaced	Gravel		Surfaced	Gravel	
2	117	0	A	117	0	117
3	359	0	B	1 343	0	1 343
4	2 259	0	C	1 275	0	1 275
5	3 192	1 052	D	3 192	1 052	4 244
Total	5 927	1 052	Total	5 927	1 052	6 979

According to the TRH 4 *Structural Design Life* publication and TRH 22 *Pavement Management Systems* (CSRA, 1994), roads can be divided into four categories for pavement management purposes:

Class	Description
Road Class A:	Inter-urban freeways, major inter-urban rural roads;
Road Class B:	Inter-urban collectors, major rural roads, major industrial;
Road Class C:	Lightly trafficked rural roads, strategic roads;
Road Class D:	Special pavements, access roads.

Source: DBSA Regional Transport Integration Roundtable 2012. Approach to Sustainable Road Asset Management in eThekwini.

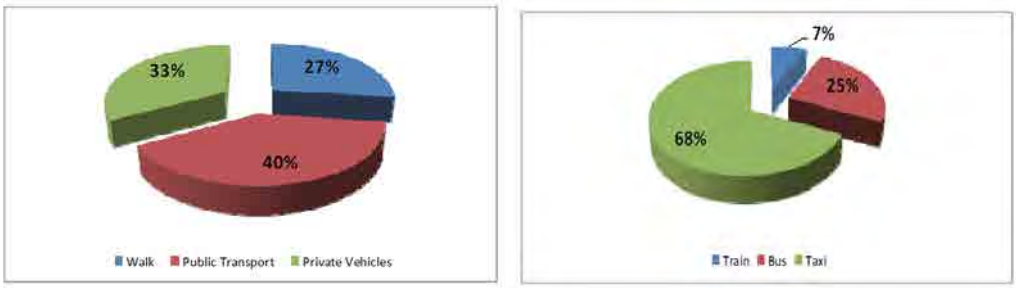
According to the Road Infrastructure Strategic Framework for South Africa (RISFSA) (DOT, 2006), roads can be divided into six functional classes as stated below.

Number	Function	Description
Class 1	Mobility	Principal arterial
Class 2		Major arterial
Class 3		Minor arterial
Class 4	Access/activity	Collector street
Class 5		Local street
Class 6		Walkway

Source: TRH 26 South African Road Classification and Access Management Manual (Committee of Transport Officials, 2012)

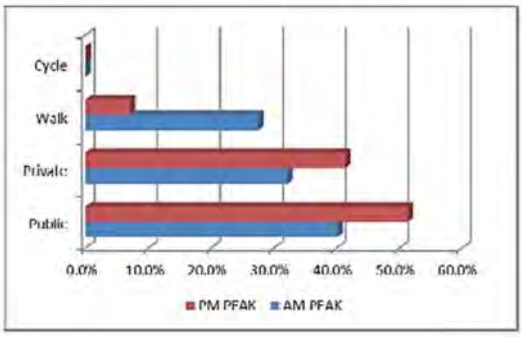
(2) Modal split

Modal split based on eThekwini Household Travel Survey (EHTS) 2008 and the Quality of Life Survey 2009-2010 are shown in Figure 2-2-10. More than 25% of the population walk to their destination and 33% use private vehicles. Taxi users account for almost 70% of total public transport users.



Source: eThekwini Municipality 2010. Integrated Transport Plan Update 2010-2015.

Figure 2-2-10 Modal split (all day) and public transport modal split



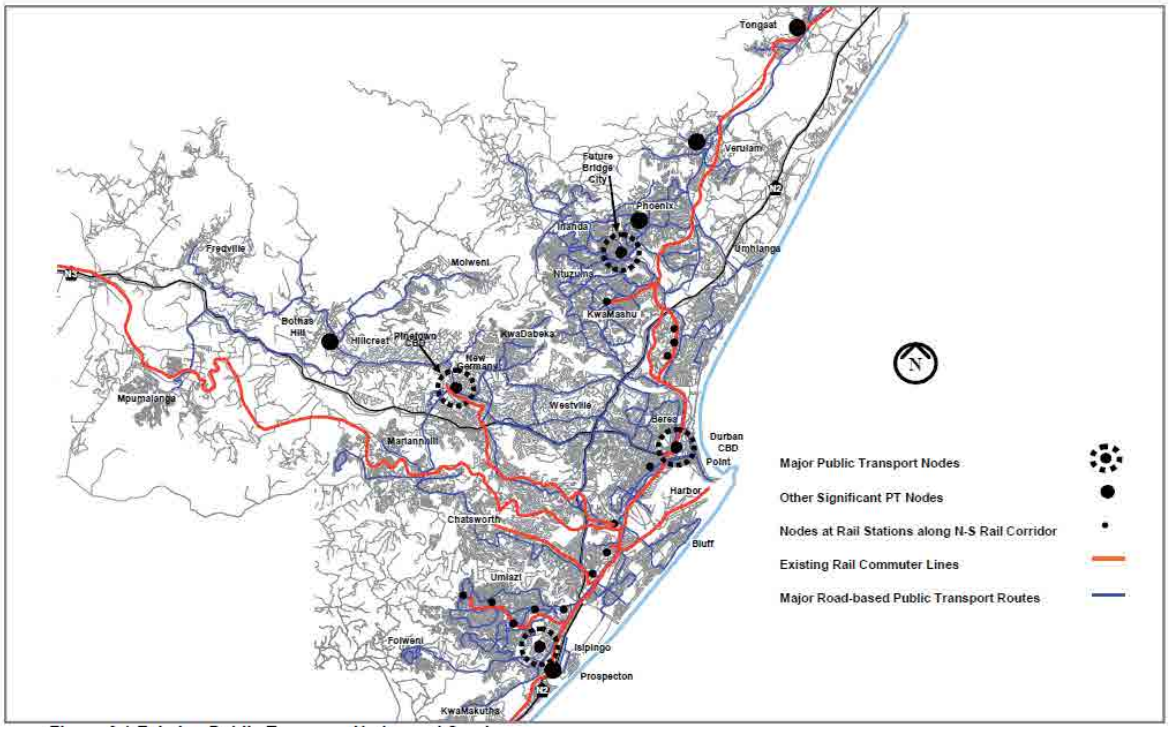
Source: eThekwini Municipality 2010. Integrated Transport Plan Update 2010-2015.

Figure 2-2-11 Modal split by peak periods

(3) Road and public transportation network

a. Public transport network

Figure 2-2-12 shows existing public transport nodes and services in the whole Metropolitan area. It has four major public transport nodes with a number of other nodes of local significance. The major nodes are located at 1) Isipingo in the south, 2) Durban CBD, 3) Bridge City to the north, 4) Pinetown to the west.

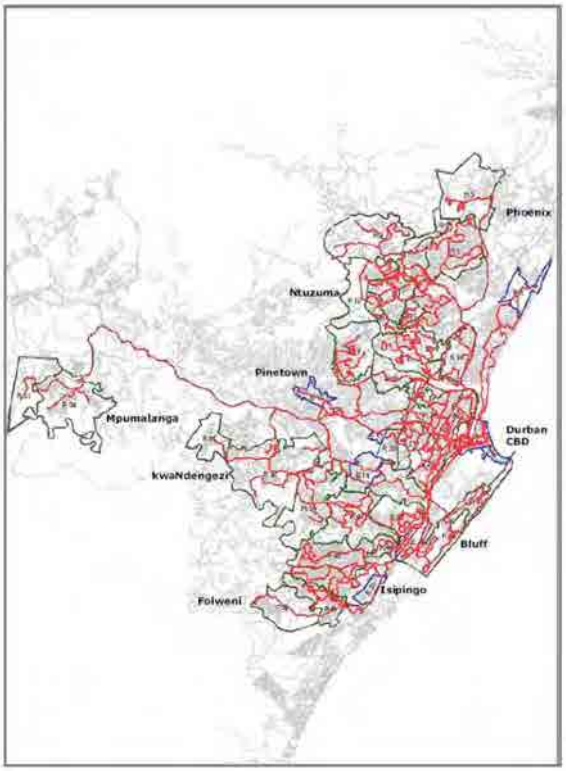


Source: eThekwini Municipality 2010. Integrated Transport Plan Update 2010-2015.

Figure 2-2-12 Existing public transport nodes and services

b. Bus routes

Figure 2-2-13 shows the bus routes at the afternoon peak. Bus network has a wide coverage of the Durban metropolitan area.

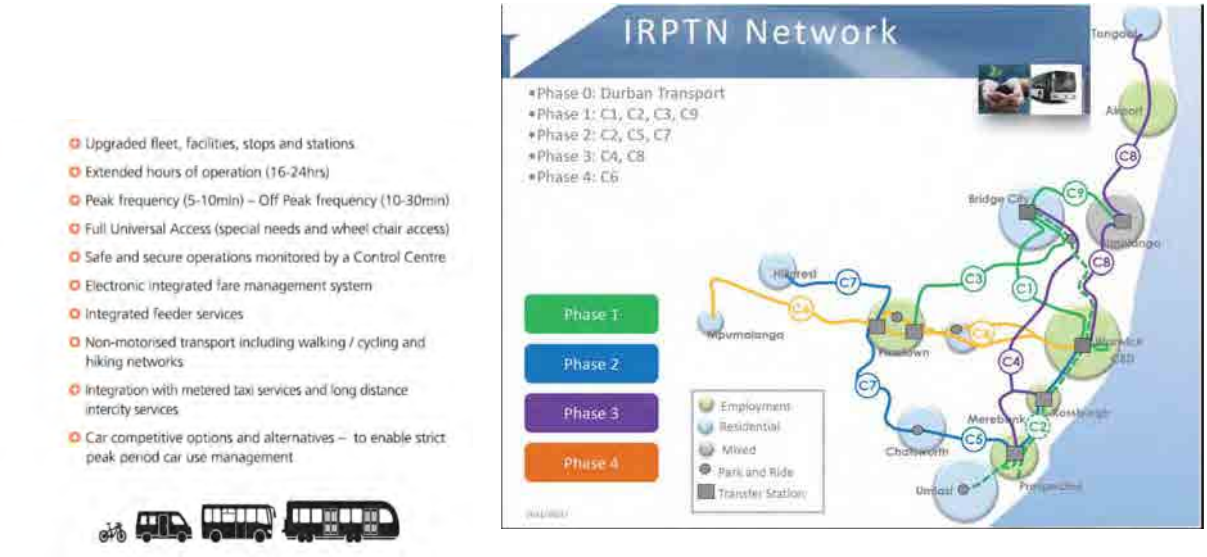


Source: eThekwini Municipality 2010. Integrated Transport Plan Update 2010-2015.

Figure 2-2-13 Area to Area Corridor Service Analysis Bus Routes from Durban CBD

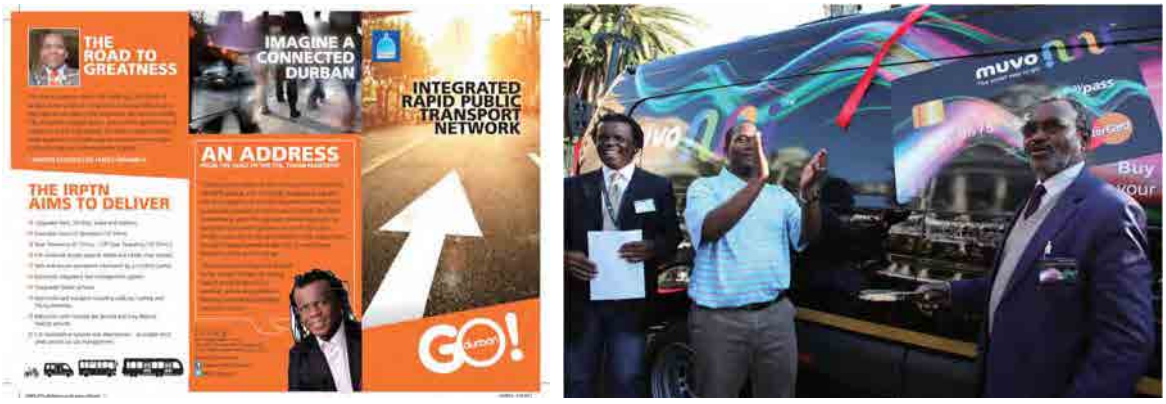
c. Integrated Rapid Public Transport Network (IRPTN)

Figure 2-2-14 shows overview of Integrated Rapid Public Transport Network (IRPTN) which eThekwini is now trying to develop. It will see the development of nine corridors linked by various modes of transport (Bus. Rail and Taxi) by 2027. EThekwini is planning to improve its use by distributing brochure and introducing IC card system which is called “muvo” (Figure 2-2-15).



Source: eThekwini Municipality 2010. Integrated Transport Plan Update 2010-2015.

Figure 2-2-14 Overview of IRPTN



Source: eThekwini Municipality homepage

Figure 2-2-15 Brochure of IRPTN and sales promotion of IC card system (muvo)

BOX. "Transport Indicators" by African Green City Index

Table 2-2-8 shows "Transport Indicators" for 3 metropolitan municipalities in South Africa. Johannesburg and eThekwini has large "length of mass transport network" compared with Cape Town. On the other hand, "superior public transport network" in Johannesburg is almost half of that in eThekwini.

Table 2-2-8 Transport Indicators for 3 metropolitan municipalities

	Length of mass transport network (km/km2)	Superior public transport network (km/km2)
Johannesburg	6.8	0.08
Cape Town	1.9	0.11
eThekwini	9.2	0.16

Notes:

- Mass transport network includes dedicated public and private bus routes; length is measured in km per km2 of city area.
- Superior transport network includes bus rapid transit, trams, light rail and subway, length is measured in km per km2 of city area.

Source: Economist Intelligence Unit (2011). African Green City Index.

2.2.4 Current Issues

Comparison of transportation related data for 3 metropolitan municipalities area stated as below.

Table 2-2-9 Comparison of transportation related data for 3 metropolitan municipalities

			Johannesburg	Cape Town	eThekwini
Land area		km2	1,645	2,440	2,291
Road network	Total length	km	9,719	9,392	6,979
	Road ratio	km/km2	5.9	3.8	3.0
Modal Split	Private		45%	63%	45%
	Bus		4%	7%	14%
	Taxi (including Minibus)		45%	11%	37%
	Train		5%	19%	4%
	Total		100%	100%	100%

(1) Johannesburg

- Road ratio (5.9 km/km2) is higher than those of other two cities, but lower than those of the developed cities such as Tokyo (15.4), London (16.6).
- Minibus-taxi is still considered main measures of transport for the majority of the population

based on its network and modal split compared to other public transport measures.

- Although the city of Johannesburg intends to promote TOD (Transit Oriented Development), it has not made much progress. Gautrain and Metrorail networks are planned in the limited area of the city and does not contribute to increase the modal split of train (5%).
- In parts of the city, construction of BRT stations and Gautrain which connect to peripheral cities has been in progress, and a bus terminal which connects to the train station and Park & Ride terminal has also been developed. However, the development is confined to the station itself and ripple effect to the surrounding urban area is limited.
- An IC card system has been introduced for BRT and Gautrain riders, but each card has different system and are not compatible for each other. Those cards cannot be used for other purposes such as shopping.

(2) Cape Town

- Road ratio (3.8 km/km2) is lower than that of Johannesburg. It is considered that land area for road construction is limited because the city is surrounded by mountains and sea.
- Modal split of train in Cape Town is around 19% which is higher than those of Johannesburg (5%) and eThekwini (4%).
- In Cape Town, the city aims to promote TOD (Transit Oriented Development), but it has not made much progress.
- City is introducing IRT (Integrated Rapid Transit) System throughout the whole city, but BRT system has only been partially introduced and not much progress has been made.
- An IC card system named MYCONNECT has been introduced for BRT riders, but is limited to use of public transportation.

(3) eThekwini

- Road ratio (3.0 km/km2) is lower than those of Johannesburg and Cape Town. It is considered that land area for road construction is limited because the city is surrounded by mountains and sea shores.
- Modal split of train in eThekwini is around 4% which is lower than those of Cape Town (19%) and Johannesburg (5%).
- The IRPTN (Integrated Rapid Public Transport Network) which the city has drawn up is still in a planning phase, so nothing has been put into practice.
- The city is promoting TOD (Transit Oriented Development), but it is considered that it has not yet been materialized.

2.3 Current status of housing and building market

2.3.1 National trends

(1) Housing policies and programs

Table 2-3-1 shows key national housing policies and programs. The common themes among them appear to be “creation of sustainable human settlements” and “upgrade of informal settlements”. In order to attain those objectives, large amount of funding has been granted to housing development projects such as “Lufhereng” in Johannesburg.

Table 2-3-1 Key national housing policies and programs

Human Settlements Vision 2030	“By 2030, most South Africans will have affordable access to services and quality environments. New developments will break away from old patterns and significant progress will be made in retrofitting existing settlements”.

Human Settlement Development Grant (HSDG)	- Allocated R15.7 billion (2012/13) & R16.98 billion (2013/14) to all provinces - To facilitate the creation of sustainable human settlements that enabled an improved quality of household life. - Allocated R182.9 million to Lufhereng housing development project
Urban Settlements Development Grant (USDG)	- Allocated R7.4 billion (2012/13) & R9.1 billion (2013/14) to 8 metropolitan municipalities (including Johannesburg, Cape Town, eThekwini) - To upgrade informal settlements, either by creating formal housing or by upgrading services to informal settlements.
National Urban Reconstruction and Housing Agency (NURCHA)	- Allocated R100 million (2012/13) - To accelerate housing delivery - Assists small and medium construction enterprises to produce quality houses, to become competitive through training and mentoring, and to be profitable and sustainable.

(2) Building investment statistics

According to Figure 2-3-1 and 2-3-2, investment in private residential sector, especially dwelling houses with more than 80m2 has increased between 2006 and 2008. However, after 2008, investment in public residential has increased considerably; this is likely because of the increase in grant programs for public housing.

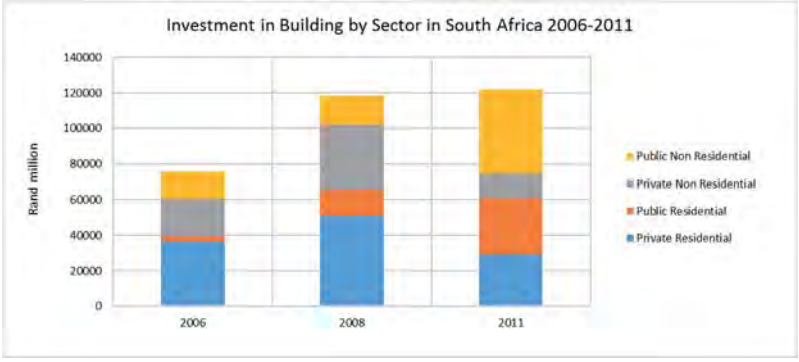


Figure 2-3-1 Investment in building by sector in South Africa

Sources:

1. BMI Building Research Strategy Consulting Unit 2006. Strategic Research into the Opportunities for Job Creation, New Enterprise Development and Empowerment in the Value System of the Building Industry
2. BMI Building Research Strategy Consulting Unit 2009. Strategic Research into the Competitive Positioning Of the Clay Brick Industry within the Context of Current and Future Building Activity in South Africa 2009-2020
3. BMI Building Research Strategy Consulting Unit 2012. Strategic Research into Leveraging Affordable Housing Finance for Gauteng Partnership Fund

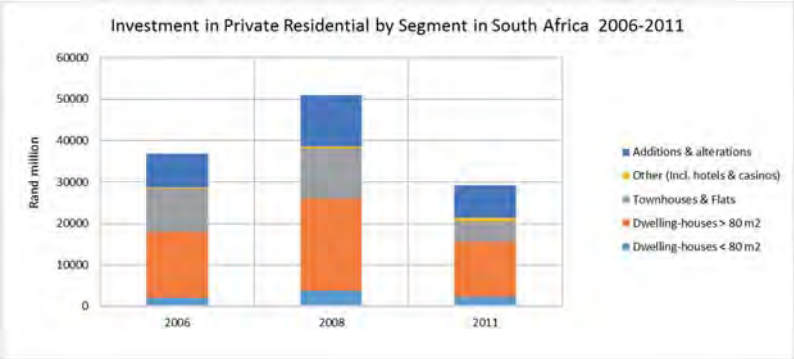


Figure 2-3-2 Investment in private residential by segment in South Africa

2.3.2 Housing

(1) Johannesburg[1]

- There are more than 200 informal settlements located in the City. Some of them are on private owned land, others are on public owned land.
- Over development has occurred in areas without adequate infrastructure.
- Marginalised communities exist in older settlements and at the periphery of the city.
- Trends in the city show increased densification of informal settlements as compared to the creation of new settlements.

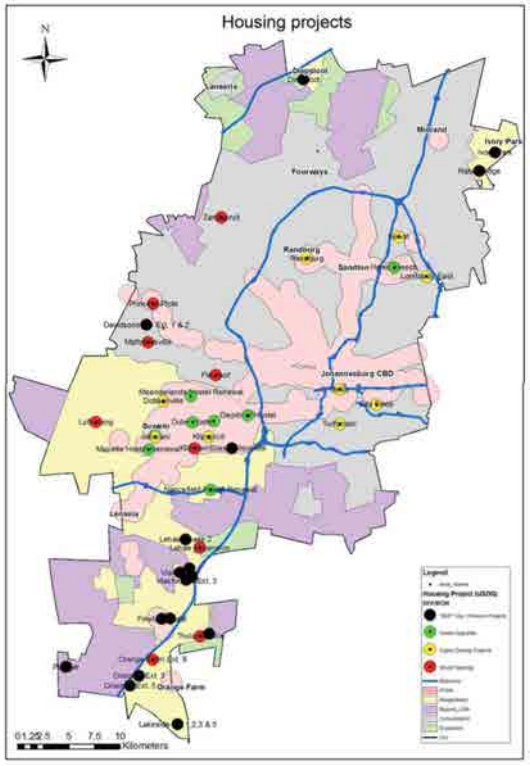
Table 2-3-2 Housing supply estimates for Johannesburg 2003-2007

	Monthly Income Target	2003	2004	2005	2006	2007
		Actual			Forecast	
Public Sector Delivery	R0k-R3,5K	5,800	29,318	20,322	25,720	6,991
Private Sector Delivery						
Social Housing	R3,5k-R,5k		200	680	315	315
Sectional Title	R7,5k plus	3,964	4,000	3,000	2,000	2,000
Better Building	R2k R7,5k			1,000	1,000	1,000
Mortgage Units (low income) 30-80m2	R3,5-R7,5k	1,434	4,000	4,000	3,000	3,000
Mortgage Units (low income) 80m2	R7,5k plus	2,197	4,000	4,000	3,000	3,000
Total Private		7,595	12,200	12,680	9,315	9,315
Total new Housing Opportunities		13,395	41,518	33,002	35,034	16,306

Source: City of Johannesburg Spatial Development Framework 2010/2011

[1] The descriptions in this section are mainly quoted from City of Johannesburg Spatial Development Framework 2010/2011 directly.

Figure 2-3-3 shows the deliverables for Sustainable Human Settlements (SHS) by the Urban Settlements Development Programme (USDP) in Johannesburg. New housing development is required to conform to development strategy and SHS index standards.



Source: Built environment performance plan for Johannesburg, 2011

Figure 2-3-3 Deliverables for Sustainable Human Settlements

(2) Cape Town[2]

- The city grew by 40% in developed land area over the period between 1985 and 2005.
- Cape Town's geography – its long coastline and mountains – the airport and hazardous and noise generating activities limit the developable land available.
- The average population density for the city is low (39 persons per ha). However, it varies between 100 and 150 in the informal settlement areas of Khayelitsha and between 4 and 12 in the former white suburbs.
- In 2010, 72.5% of households lived in formal housing, 17.1% in informal housing, 10.4% were backyarders, 0.4% occupied traditional structures, and 0.6% other types of housing.
- The number of households living in informal dwellings is estimated to grow to 417,213 by 2019.
- Informal structures in formal townships – i.e. the backyarder phenomenon – are increasing steadily.
- Currently, the City builds approximately 9,000 housing units per year, while there were approximately 340,000 households on the waiting list for low-income public housing.
- City's focus is primarily on informal settlements and backyard dwellings in public housing developments.

[2] The descriptions in this section are mainly quoted from City of Cape Town: Built Environment Performance Plan (BEPP) 2012/13 directly.

(3) eThekwini[3]

- 314,000 households in informal dwellings, with many not eligible for subsidies.
- About 239,000 households in informal settlements and 45,000 in backyards.
- About 370,000 households in inadequate housing.
- Long waiting lists (10 yrs +) are increasingly being circumvented ("special cases")
- Non-subsidy market is delivering less than 1,000 units/year, but backlog is 50,000 units.
- Many households are not eligible for subsidy (earning between R3,500 –R9,000 per month) but are unable to afford market prices.
- Current housing subsidy allocation is less than 50% of demand.

2.3.3 Office building

Table 2-3-3 shows the office stock in Johannesburg, Pretoria, Durban and Cape Town. Johannesburg and Pretoria has much larger office stock than Durban and Cape Town. However, around 70% of stock is located in decentralized area in both Pretoria and Johannesburg.

Table 2-3-3 Office stock in main metropolitan areas

	Stock Inventory	CBD	%	Decentralised	%
Pretoria*	3,217,000	995,600	30.95%	2,221,400	69.05%
Johannesburg	8,441,000	2,258,600	26.76%	6,182,400	73.24%
Durban	1,351,000	738,200	54.64%	612,800	45.36%
Cape Town	2,174,000	878,000	40.39%	1,296,000	59.61%
Total	15,183,000	4,870,400	32.08%	10,312,600	67.92%

* Arcadia and Sunnyside included in CBD figures
Source: The Annual Broll / Property Report 2013

Table 2-3-4 shows the vacancy rates in Johannesburg, Pretoria, Durban, Cape Town and Port Elizabeth. Vacancy rates in decentralized areas are comparatively lower than those in CBD.

Table 2-3-4 Vacancy rate of office

Decentralised	Prime	A-Grade	B-Grade
Pretoria - Menlyn	0.0%	13.0%	12.5%
Johannesburg - Sandton	1.9%	8.9%	9.8%
Durban – Umhlanga	2.1%	7.2%	2.0%
Cape Town – Century City	0.0%	5.4%	10.5%
Port Elizabeth	n/a	5.0%	n/a

CBD's	A-Grade	B-Grade	C-Grade
Pretoria	1.8%	11.2%	7.0%
Johannesburg	11.0%	21.9%	29.0%
Durban	20.6%	12.8%	24.8%
Cape Town	13.5%	7.9%	29.0%
Port Elizabeth	10.0%	10.0%	n/a

Source: The Annual Broll / Property Report 2013

3 The descriptions in this section are mainly quoted eThekwini Metro Municipality Built Environment Performance Plan (BEPP) 2011/12 directly.

2.3.4 Current Issues

(1) Johannesburg[4]

- In the suburbs, new towns, including social housing and affordable housing, have been developed by the government. Although residents in informal settlements mostly in urban central area have moved into the social housing in the suburbs, there is no such system that encourages their independence for instance by giving them ownership of the housing or access to a certain level of infrastructure for free.
- Job creation is necessary for low income people living in the suburban new towns.

(2) Cape Town

- While traditional township is spread in the suburbs, the higher population density compared to the city center and improvement of living environment are major problems as described above.

(3) eThekwini

- While the government is aspiring to create Inclusive Communities, a combination of affordable housing and social hosing, etc., revenue shortage for development of the social housing and the lack of motivation in the private sector are cited as main obstacles.

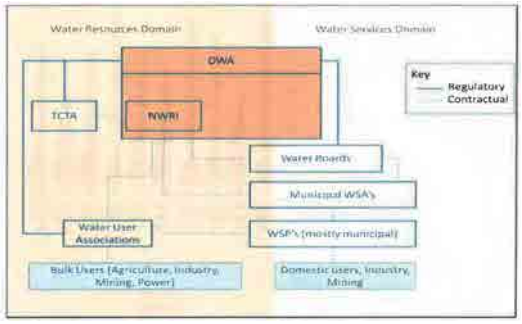
[4] The descriptions in this section are mainly quoted from City of Johannesburg Spatial Development Framework 2010/2011 directly.

2.4 Water Supply

2.4.1 Regulations and Planning in South Africa

(1) Stakeholders in water supply sector

- "DWA" focuses on policy development, strategic planning, regulatory oversight and support.
- "Water Boards" develop and manage regional water resources, regional bulk water services, and regional infrastructure. There are 15 Water Boards in South Africa.
- "Municipal Water Service Authorities" are responsible for planning, ensuring access and regulating provision of water supply and sanitation services.

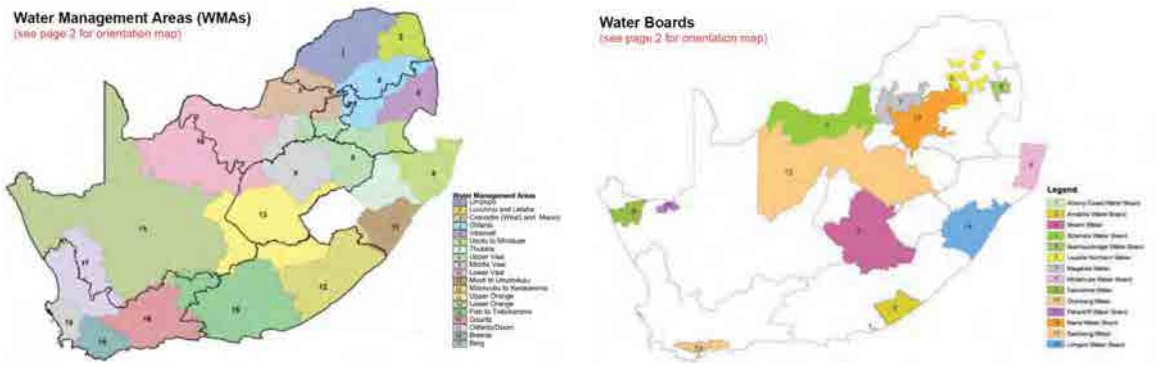


Source: Market research and analysis of the South African water sector 2014

Figure 2-4-1 Stakeholders in water supply sector

Table 2-4-1 Water supply management entities

Government	Department in charge
National government	- Department of Water Affairs
City of Johannesburg	- Rand Water (Water Board) - Johannesburg Water (Municipal)
City of Cape Town	- City of Cape Town Water and Sanitation Department (Municipal)
eThekwini Municipality	- Umgeni Water (Water Board) - eThekwini Water and Sanitation (Municipal)



Source: Strategic Overview of the Water Sector in South Africa 2010

Figure 2-4-2 Water Management Areas and Water Boards

(2) National Water Supply legislation and policies

- Water supply legislations and policies
  + Water Supply and Sanitation Policy 1994
  + White Paper on Water Policy 1997
  + Water Service Act 1997
  + National Water Act 1998
  + Free Basic Water Policy 2001
- National Development Plan 2030
  + Establish a national water-resources infrastructure agency
  + Reduce demand.
  + Manage agricultural use better
  + Investigate water reuse and desalination
- National Water Supply Strategy
  + National Water Resource Strategy 2012
  + Blue Drop programme

2.4.2 Current status in South Africa

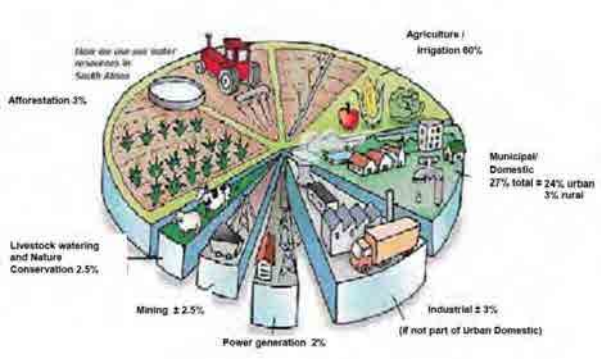
(1) Water Resource

- The average rainfall in South Africa is 450 mm per year, well below the world average of 860 mm per year.
- South Africa's water resource comprises 77% surface water, 9% groundwater and 14% re-use of return flows.
- The natural mean annual runoff is about 49 billion m3. Of the total runoff, a yield of some 14 billion m3 is available for use through dams, basin transfers and other water resource developments throughout the country.
- It is estimated that return flows from irrigation, urban domestic uses and bulk industrial and mining effluents could offer re-use opportunities of up to 1,900 million m3 per year.

Table 2-4-2 Natural Mean Annual Runoff and provisional estimates of Ecological Reserve (million m3 per year)

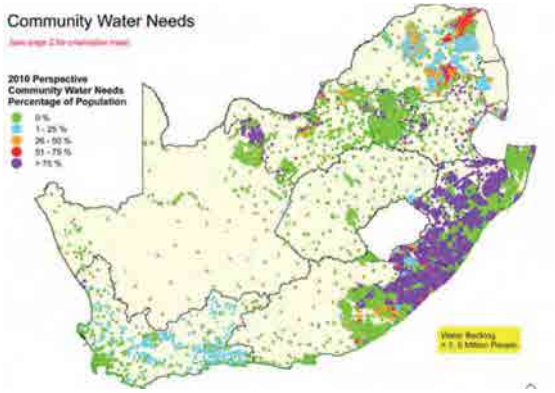
Source: Overview of the South African Water Sector

	Water Management Area	Natural Mean Annual Runoff	Ecological Reserve	Difference	Total Local Yield
1	Limpopo	985	156	829	282
2	Luvuvhu/Letaba	1 185	224	961	310
3	Crocodile West and	855	165	690	693
4	Olifants	2 042	460	1 582	611
5	Inkomati	3 539	1 008	2 531	943
6	Usutu to Mhlatuze	4 780	1 192	3 588	1 010
7	Thukela	3 799	859	2 940	738
8	Upper Vaal	2 423	299	2 124	1 723
9	Middle Vaal	888	109	779	201
10	Lower Vaal	368	48	320	50
11	Mvoti to Umzimkulu	4 798	1 160	3 638	527
12	Mzimvubu to Keiskamma	7 241	1 122	6 119	855
13	Upper Orange	6 981	1 349	5 632	4 557
14	Lower Orange	502	69	433	(1 007)
15	Fish to Tsitsikamma	2 154	243	1 911	437
16	Gouritz	1 679	325	1 354	277
17	Olifants/Doring	1 108	156	952	335
18	Breede	2 472	384	2 088	868
19	Berg	1 429	217	1 212	501
Total for SA		49 228	9 545	39 683	13 911



Source Strategic Overview of the Water Sector in South Africa 2010

Figure 2-4-3 Proportional water use per main economic sector



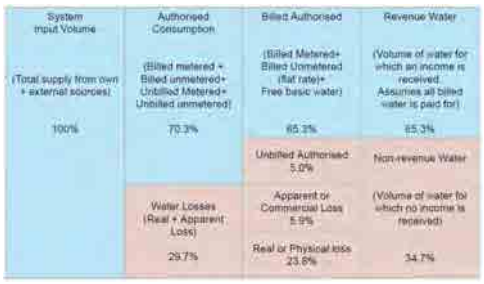
Source: Strategic Overview of the Water Sector in South Africa 2010

Figure 2-4-4 Community Water Needs

(2) Water supply

- Currently, high and medium levels of service use about 3,700 million m3 per year (78% of the total urban and rural use) which translates to approximately 21% of the total water requirement.
- In 2010, out of a national population of 49.9 million people there are currently 1.63 million people with no access to a basic level of water supply and a further 2.0 million people that have access to a water supply that does not meet the basic services standard.
- In 2001 free basic water policy is adopted as a national policy. It is recommended that 6 m3 of clean water is provided free per household per month. This policy can be implemented by local government.
- In South Africa, it is estimated that the non-revenue water for the country as a whole is approximately 35% of the water supplied.
- The strategic self-assessments by Water Service Authority (WSA) indicate that:
  + 45% of WSA's indicated they had sufficient water infrastructure resources (no supply shortages).
  + 75% of WSA's indicated they monitor the drinking water quality of all their communities.
  + 45% of WSA's indicated they had adequate equality skilled staff.
  + 25% of WSA's indicated they had adequate staff levels.
  + 25% of WSA's indicated they had sufficient budged for maintenance.
- It was found that 75% of WSAs meet water service reliability requirements.

Table 2-4-3 Standard IWA Water Balance: National (2009)



Source: Strategic Overview of the Water Sector in South Africa 2010

Table 2-4-4 Access to basic water supply services in 2010

Population (million)	49.9
People equal to or above RDP (million)	46.3
% People equal to or above RDP	93%
People below RDP (million)	3.6
% People below RDP	7%

Source: Strategic Overview of the Water Sector in South Africa 2010

(3) Water quality

- The design capacity of the collective water treatment works is about 3.1 billion m3 per year, while their current demand for potable water is about 2,4 billion m3 resulting in an average utilization of 77%.
- Only 45% of WSAs indicated that they fully comply to the basic drinking water quality monitoring criteria for the delivery of safe drinking water.
- Number of WSAs having at least 70% of households received a water quality considered ideal and/or good.
- In 2008 the Department of Water Affairs introduced an assessment programme called “Blue Drop “ that is aimed attesting the quality of drinking water provided by South African municipalities, water authorities and providers. Municipalities must score at least 95% overall and achieve greater than 99% microbiological compliance and 90% chemical compliance to obtain the Blue Drop status.

2.4.3 Current status in City of Johannesburg

- Johannesburg is one of the few cities in the world not located near a large water source and the potable water is purchased in bulk water form Rand Water, and has to be pumped up about 50km from the region of the Vaal River.
- Rand Water develops and manages regional water resources, regional bulk water services, and regional infrastructure. Rand water has the following infrastructures; Vaal Dam, 2 water purification plant, 3,056km pipeline, 58 reservoirs, 3 primary pumping stations and 4 booster pumping stations.
- Water supply in Johannesburg is depending on Vaal Dam, and water is purified in two water purification plants, Zuikerbosch and Vereeniging. The purification process involves seven stages, which are coagulation, flocculation, sedimentation, stabilization, filtration, disinfection and chloramination.
- Johannesburg Water is responsible for planning, ensuring access and regulating provision of water supply and sanitation services. And Johannesburg Water has below infrastructures; 89

Water Reservoirs & 28 Water Towers, 11419 km Water-Network Pipes, 31 Water Pump Stations, 92,164 Valves and Hydrants, 81% of Water Connections Metered.

- 99% compliance with drinking water quality standard SANS 241 Class1 Drinking Water
- The City of Johannesburg's water demand is continuously increasing in line with the population and economic growth. The current annual demand as at June 2012 is at 536 Million m3.
- The 2003 State of Environment Report concluded that while potable water is of acceptable standard, the water quality of many of the rivers is poor. The source of this contamination was aimed at the mines, overloaded and poorly managed sewers. Illegal industrial discharges, high silt levels were also responsible for the poor water quality in many rivers.
- It is estimated that the non-revenue water for the City of Johannesburg as a whole is approximately 40% of the water supplied. Commercial or apparent loss is higher than national average.

Source: Johannesburg Water Ltd Business Plan 2013/14

Figure 2-4-5 Johannesburg Water Regions

Table 2-4-5 Blue Drop Score of City of Johannesburg

Water Services Authority	City of Johannesburg
Water Services Provider(s)	Rand Water & Johannesburg Water
Municipal Blue Drop Score	98.92%

Performance Area	City of Johannesburg
Water Safety Planning	100
Treatment Process Management	100
DWQ Compliance	100
Management, Accountability	85
Asset Management	100
Bonus Scores	0.47
Penalties	0
Blue Drop Score (2012)	98.92%
2011 Blue Drop Score	97.69%
2010 Blue Drop Score	98.38%
System Design Capacity (Ml/d)	Not Applicable
Operational Capacity (% to Design)	Not Applicable
Population Served	3 755 125
Average daily Consumption (l/p/d)	368.63
Microbiological Compliance (%)	99.9%
Chemical Compliance (%)	99.0%

Source: 2012 Blue Drop Report

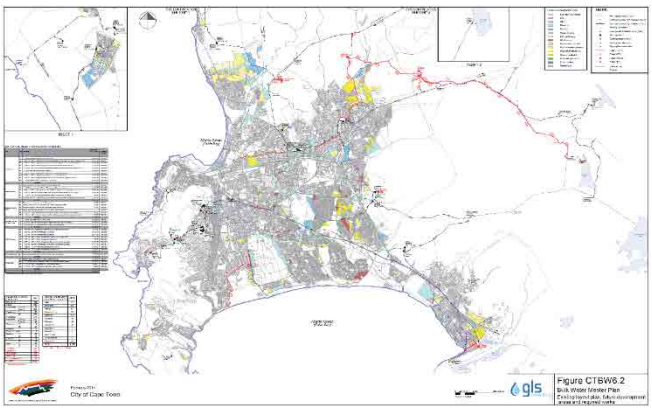
- In Integrated Development Plan, the targets included in the water supply section are water demand reduction, water smart initiative, rain water harvesting initiative, development of water wise gardens , acid mine drainage mitigation, water resource protection.
- Johannesburg Water currently has the following projects: Pressure-Management Project, Water-Pipe Replacement Project, Soweto Infrastructure Upgrade and Rehabilitation Project, Smart Metering Project, Infrastructure Upgrade and Renewal Programme, Operation Gcin Amanzi – Water Consevation, New Diepslootwes reservoirs.

2.4.4 Current status in City of Cape Town

- The Water Supply System in the Western Cape province is a complex water supply system comprising an inter-linked system of six dams, pipelines, tunnels and distribution networks.
- The total storage capacity of the six major dams on November 2011 is 898,300 million m3,

78.5% of total storage capacity is occupied. Including the Berg River scheme, the City of Cape Town obtains 74% of its allocated water from DWA owned sources, with the balance of 27% from the City of Cape Town owned sources.

- The Bulk Water Supply System comprises: 11 raw water dams owned and operated by the City of Cape Town; 12 water treatment works with a current approximate potable water production capacity of 1,600,000 m3/day; 32 pump stations; 24 bulk reservoirs with a total storage capacity of 2,825,000 m3; and 659km of raw and potable water pipelines.
- In 2009, 63% of the water in the system was being used for domestic and industrial purposes in the City of Cape Town, 5% in smaller towns and 32% in agriculture.
- The city currently does not recycle water for potable use, but it does treat wastewater for reuse in industry, and for the watering of sports grounds and golf courses. In 2011 the city recycled 13.6 million m3 of wastewater.
- The water quality report indicates the analytical data and approximate distribution for Cape Town drinking water for June 2011. The SANS Specification is also stipulated on this report. Water Compliance has exceeded the target of 96% at 98% The Blue Drop inspectors were truly impressed by the neatness and overall appearance of Wemmershoek Water Treatment Work.
- It is estimated that the non-revenue water for the City of Cape Town as a whole is approximately 23% of the water supplied.



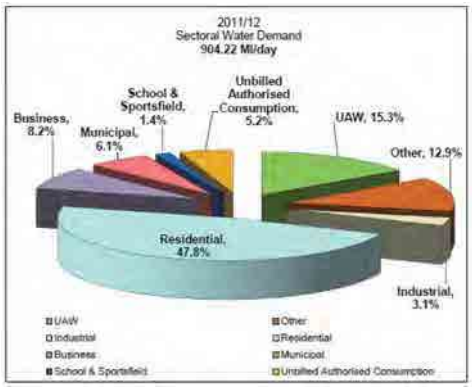
Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15

Figure 2-4-6 Bulk Water Master Plan

Table 2-4-6 List of Water Treatment Plants

Water Treatment Plant	Capacity in Ml/day	Constructed
Faure WTP	500	1994
Blackheath WTP	420	1982
Voëlvlei WTP	230	1971
Wemmershoek WTP	250	1958
Steenbras WTP	150	1946
Brooklands WTP	5	1974
Witzands WTP	14	1986
Silwerstroom WTP	3	1975
Kloof Nek WTP	18	1938
Constantia Nek WTP	3	1934
Helderberg WTP	12	
Albion Spring	5	1890
Total	1610	

Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15



Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15

Figure 2-4-7 Sectoral Water Usage in 2011

Table 2-4-7 Situation of the Basic Water Supply

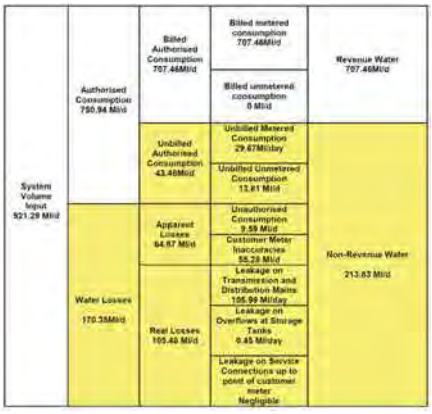
Item	In 2012
Total Household serviced	1,088,631
% all Household serviced	99%
Formal Household Serviced	909,231
Informal Settlement Household serviced	179,400
% Informal Settlement Household serviced	92%
% Poor Household serviced	98%

Source: Water Service Development Plan for City of Cape Town

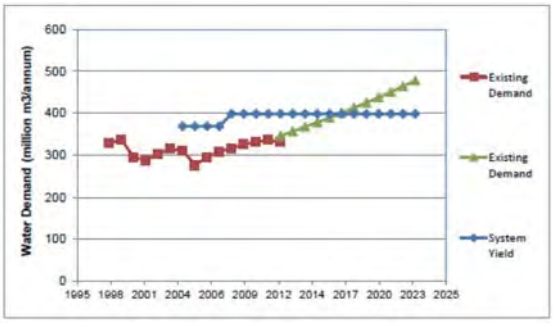
Table 2-4-8 Blue Drop Score of City of Cape Town

Source: 2012 Blue Drop Report

Table 2-4-9 Non-revenue water demand in 2010



Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15



Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15

Figure 2-4-8 Annual Water Demand Growth

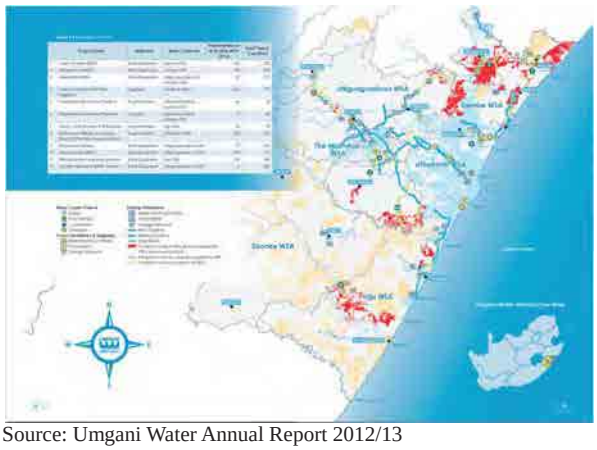
- In Integrated Development Plan, the targets included in the water supply section are:
  + Reducing the rate of demand growth
  + Pressure management
  + Replacement of failing pipelines
  + Informal settlement water installations.

+ Upgrade of treatment and pumping plants
+ Development of the required bulk water infrastructure
(greywater reuse, rainwater harvesting, groundwater and desalination)
+ Construction of the Berg River Dam
+ Construction of the Muldersvlei treatment plant
+ Maintenance of high water quality standards

- City of Cape Town has the following projects:
  + Cape Town Desalination project
  + Water meters – reticulation

2.4.5 Current status in eThekwini Municipality

- In eThekwini municipality, the DWA is responsible for the building of water dams. Umgeni Water is responsible for extracting water from dams, and processing it into potable water in bulk, and supplying it to EWS, for distribution to their various Customers.
- Most potable water starts its transformation from rainwater / runoff water, in a dam of some kind, e.g. Midmar Dam. The water is then pumped to a Water Treatment Works, where it undergoes its process off flocculation filtration, and sanitation.
- eThekwini Municipality's water supply depends on Lower Mgeni system in Mgeni River basin. The system has 3 dams and 3 water treatment works. Water treatment process in Durban Height WTW includes Pre-Oxidation with Prechlorination, Polymeric Coagulation, Rapid Gravity Filters and Chlorine gas.
- It is estimated that the non- revenue water for the eThekwini municipality is 35.4% in 2011.



Source: Umgani Water Annual Report 2012/13

Figure 2-4-9 Umgeni Water Infrastructure Map

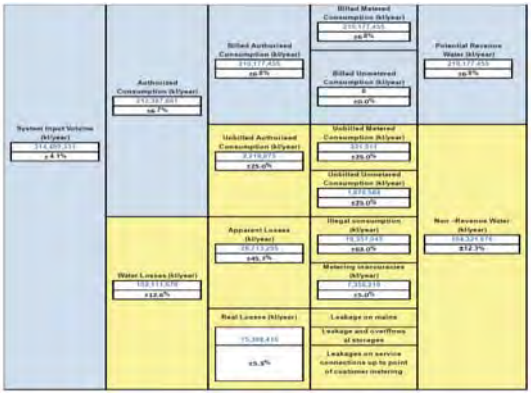
Source: eThekwini Municipality Water Service Development Plan 2012

Figure 2-4-10 eThekwini Water Network

Table 2-4-10 Blue Drop Score of eThekwini Metropolitan Municipality

Water Services Authority	eThekwini Metropolitan Municipality	
Water Services Provider(s)	Umgeni Water ; Tongaat Hulett	
Municipal Blue Drop Score:	98.77%	
Performance Area	eThekwini Main	Ogunjini
Water Safety Planning (35%)	100	97
Treatment Process Management (10%)	98	75
DWQ Compliance (30%)	100	28
Management, Accountability (10%)	100	93
Asset Management (15%)	91	80
Bonus Scores	0.46	6.99
Penalties	0	0
Blue Drop Score (2012)	98.79%	77.87%
2011 Blue Drop Score	96.05%	79.08%
2010 Blue Drop Score	96.08%	Not assessed
System Design Capacity (Ml/d)	1456.55	1.1
Operational Capacity (% its Design)	77.68	118.18
Population Served	3 285 026	4 800
Average daily Consumption (l/p/d)	344.43	270.83
Microbiological Compliance (%)	99.0%	95.5%
Chemical Compliance (%)	98.4%	99.9%

Source: 2012 Blue Drop Report



Source: eThekwini Municipality Water Service Development Plan 2012

Figure 2-4-11 eThekwini Municipality water balance for 2010/11

- In Integrated Development Plan, the targets included in the water supply section are:
  + Meet infrastructure and household service needs and backlogs
  + Reduction of the non-revenue water loss

-The targets set forth in Water Services Development Plan of eThekwini Municipality are:
  + Access to potable water for households
  + Planning two major water supply projects, the western aqueduct and the northern aqueduct augmentation scheme.
  + Water supply reconciliation strategy (conservation and demand management)
  + Desalination and re-use of treated effluent for potable water use
  + Progress the two new large dams by DWA, Spring Grove and Umkomazi.

- eThekwini Municipality has four large water capital projects.
  + Western Aqueduct Project: Increasing the capacity of the bulk water supply to the western and northern areas
  + Northern Aqueduct Project: Augmentation of existing pipelines and existing bottlenecks
  + Water Loss: Pressure management, replacement of aging infrastructure, leak detection and accurate metering
  + Umhlanga Reservoir: Construction of 10,000 m3 reservoir in the Umhlanga Ridge area

2.4.6 Current Issues

(1) City of Johannesburg

- In the city of Johannesburg, there are three major issues in water supply sector.
  + One is measures for water shortage, and they are included as the concrete measures, water re-use system, and mining drought recovery.
  + The second is measures for the deterioration of the pipe network.
  + The third is measures for high leakage

(2) City of Cape Town

- In the city of Cape Town, there are three major issues in water supply sector.
  + One is measures for water demand growth, and they are included the basic direction, reducing the rate of demand growth, replacement of failing pipelines, pressure management, construction of the Berg River Dam, and construction of the Muldersvlei treatment plant.
  + The second is development of the required bulk water infrastructure, and they are take into consideration as the basic direction, wastewater reclamation, groundwater and desalination, expansion of water supply, and water installations for informal settlements.
  + The third is renewal and maintenance of existing infrastructure, and they are take into consideration as the basic direction, upgrade of treatment and pumping plants, and maintenance of high water quality standard.

(3) eThekwini Municipality

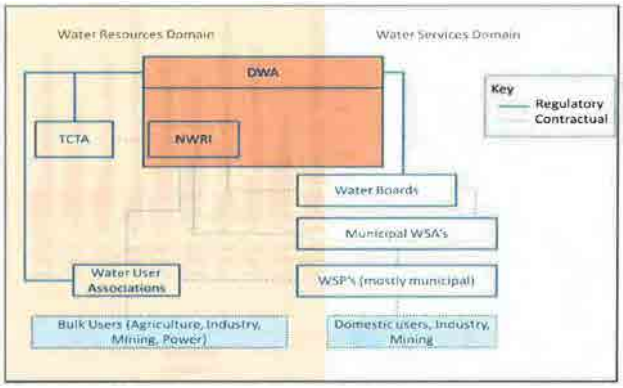
- In eThekwini Municipality, there are two major issues in water supply sector.
  + One is measures for the water demand growth, and they are took in progress, construction of the two new large dams by DWA, Spring Grove and Umkomazi, reduction of the non-revenue water loss, desalination and re-use of treated effluent for potable water use, and water supply reconciliation strategy (conservation and demand management).
  + The other is measures for the water supply expansion, and they are took in progress, provision of infrastructure and household service, and implementation of the western and the northern aqueduct augmentation scheme

2.5 Wastewater

2.5.1 Regulation and Planning in South Africa

(1) Stakeholders in wastewater sector

- "DWA" focus on policy development, strategic planning, regulatory oversight and support.
- "Municipal Water Service Authorities" are responsible for planning, ensuring access and regulating provision of water supply and sanitation services.



Source: Market research and analysis of the South African water sector 2014

Figure 2-5-1 Stakeholders in wastewater sector

Table 2-5-1 Wastewater management entities

Government	Department in charge
National government	- Department of Water Affairs
City of Johannesburg	- Johannesburg Water (Municipal)
City of Cape Town	- City of Cape Town Water and Sanitation Department (Municipal)
eThekwini Municipality	- eThekwini Water and Sanitation (Municipal)

(2) National legislations and policies

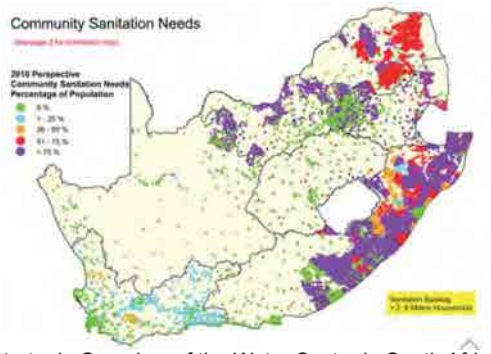
- National Wastewater legislations and policies
  - + Water Supply and Sanitation Policy 1994
  - + National Sanitation Policy 1996
  - + White Paper on Water Policy 1997
  - + Water Service Act 1997
  - + National Water Act 1998
  - + White Paper on Basic Sanitation 2001
  - + National health Act 2003
- National Development Plan 2030
  - + Comprehensive wastewater management strategy
  - + Regulating wastewater uses
  - + Access to basic sanitation

- National Sanitation Strategy
  + Free Basic Implementation Strategy 2002
  + National Sanitation Strategy 2005
  + Free Basic Sanitation Implementation Strategy 2009
  + National Water Services Regulation Strategy 2010
  + Green Drop programme
- A basic toilet facility is a toilet which is safe, reliable, environmentally sound, easy to keep clean, provides privacy and protection against the weather, well ventilated, keeps smells to a minimum and prevents the entry and exit of flies and other disease-carrying pests.
- National Sanitation Target is below
  +All people in South Africa to have access to a functioning basic sanitation facility by 2014.
  + All schools to have adequate and safe water supply and sanitation services by 2010.
  + Investment in water services infrastructure in the sector totals to be at least 0.75% of GDP.

2.5.2 Current status in South Africa

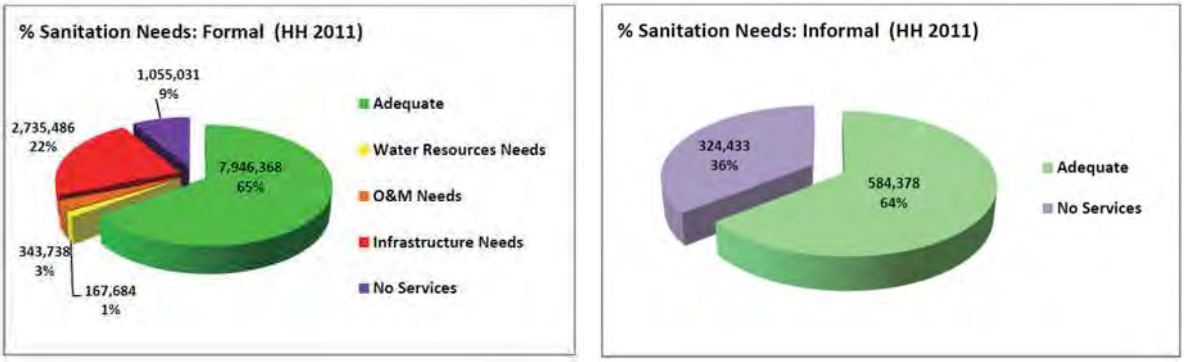
(1) Sanitation

- Approximately 11% of all households in South Africa still have to be provided with sanitation services. Additionally at least 26% of households within formal areas disturbingly have sanitation services which do not meet the standards due to the deterioration of infrastructure caused by a lack of technical capacity to ensure effective operation, timely maintenance, refurbishment and/or upgrading, pit emptying services and/or insufficient water resources.



Source: Strategic Overview of the Water Sector in South Africa 2010

Figure 2-5-2 Community Sanitation Needs



Source: Report on the Status of Sanitation Services in South Africa 2012

Figure 2-5-3 National Sanitation Needs: Formal and Informal (HH 2011)

Table 2-5-2 National Sanitation Needs

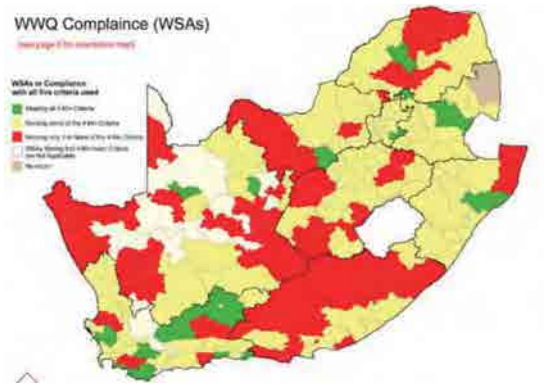
Province	Formal					Informal	
	Adequate	Water Resources Needs	O&M Needs	Infrastructure Needs	No Services	Adequate	No Services
Eastern Cape	829 274	0	0	503 789	165 919	11 243	113 223
Free State	674 502	101 469	12 650	386 432	1 505	8 770	1 161
Gauteng	2 334 964	0	0	0	1 570	205 892	143 917
KwaZulu-Natal	779 027	19 030	99 849	244 269	554 460	121 069	12 937
Limpopo	591 687	44 561	213 546	796 552	0	2 965	6 550
Mpumalanga	583 210	0	0	439 943	975	5 539	28 701
North West	478 338	2 624	39	340 389	294 747	39	3 088
Northern Cape	196 661	0	17 654	24 022	22 072	18 940	5 922
Western Cape	1 478 705	0	0	90	13 783	209 921	8 934
South Africa	**7 946 368**	**167 684**	**343 738**	**2 735 486**	**1 055 031**	**584 378**	**324 433**

Source: Report on the Status of Sanitation Services in South Africa 2012

(2) Wastewater Treatment

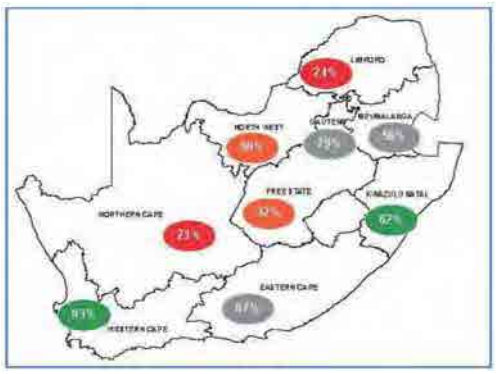
- There are estimated to be 951 wastewater treatment works (WWTWs) in South Africa. All WWTWs should achieve the receiving water quality objectives and comply with the licensing criteria in order to minimize the environmental impact and the human health risks.
- On Average, 7.5 million m3 of wastewater is treated by WWTWs. Plants use various technologies ranging from extended aeration, activated sludge trickling, bio filters and oxidation ponds.
- A high proportion of WSAs (60%) do not have appropriate licenses / permits for all of their wastewater treatment works (vs. 55% in November 2008).
- Almost half of WSAs (47%) admit that they do not adhere to their specified license / permit conditions (vs. 39% in November 2008).
- Only 47% of WSAs stated that they operate within their design capacity of the works.

- Routine maintenance has been lacking at most municipalities' WWTWs, causing further damage to the plants.
- Almost a third of WSAs (31%) admit that they do not monitor treated effluent quality on at least a monthly basis.
- 23% of WSAs do not use a laboratory for wastewater quality analysis.
- Between 60% and 80% of WWTWs does not meet regulatory norms and stipulated water quality standards.
- The "Green Drop" regulation programme was established by the DWA in 2008. This is to certify the wastewater system of all municipalities and water service providers in South Africa.
- Only 40 out of 826 works assessed achieving Green Drop status. The results of the 2011 survey indicate:
  + 317 WWTWs require urgent attention.
  + 143 WWTWs have a high risk of failure.
  + 20% of WWTWs are running over their design capacity.
  + 90% of WWTWs are non-compliant on more than 3 effluent determinants.



Source: Strategic Overview of the Water Sector in South Africa 2010

Figure 2-5-4 Wastewater Quality Compliance (WSA's)



Source: Report on the Status of Sanitation Services in South Africa 2012

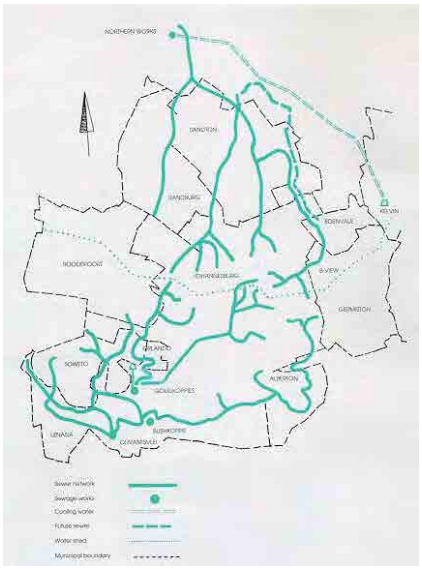
Figure 2-5-5 National average Green Drop Scores per Province

2.5.3 Current status in City of Johannesburg

- In City of Johannesburg, 91% households with access to at least sanitation Level of Service 1 (LoS 1 is communal standpipe plus in-plot VIP latrine, as nominally provided to informal settlements).
- Johannesburg Water operates 6 wastewater treatment works, with a combined process capacity of 960,000 m3/day, 38 sewer pumping stations and 10,058.03km of sewer pipelines, stretching from Midrand to Ennerdale.
- The largest Plant is Northern Works. It treats 400,000 m3 of wastewater every day from

around 1,6 million people. This plant serves the area north of the Hillbrow ridge including Alexandra, Edenvale, Randburg, Sandton and parts of Midrand and Roodepoort. It is situated in the Diepsloot area.

- Typical wastewater treatment process consists of screening, degritting, primary sedimentation, acid fermentation of raw sludge, flow balancing, bioreactors, final clarification and chlorination.
- The treated effluent from this plant is either discharged into the Jukskei River, used to irrigate Johannesburg Water's farm lands, or pumped to the Kelvin Power Station for use as cooling water. This ensures that expensive high quality drinking water is not used for this purpose.
- In addition, Johannesburg Water has found a use for the 100,000 dry tons of wastewater sludge produced yearly at the treatment works. Johannesburg Water produces a compost by-product – JO-GRO – made from the sludge and waste wood from the tree-felling industry. The technology to convert sludge into compost was adapted from technology used by many US cities.



Source: Greater Johannesburg Metropolitan Council Homepage

Figure 2-5-6 Sewage Network in City of Johannesburg

Table 2-5-3 WWTW in City of Johannesburg

WWTW Name	Start Operating	Average flows treated daily	Conpliants with standards
Northern Wastewater Treatment Works	5 units 1962,1963,1979 1993,2009		97.8%
Bushkoppie Wastewater Treatment Works	1984, 1985	211,000 m3/d	98.3 %
Driefontein Wastewater Treatment Works	2 units 1973, 1986	31,000 m3/d	98.9%
Olifantsvlei Wastewater Treatment Works	3 units 1956,1973,1996	171,000 m3/d	99.6%
Ennerdale Wastewater Treatment Works	1982	6,000 m3/d	99.7%
Goudkoppies Wastewater Treatment Works	1978		

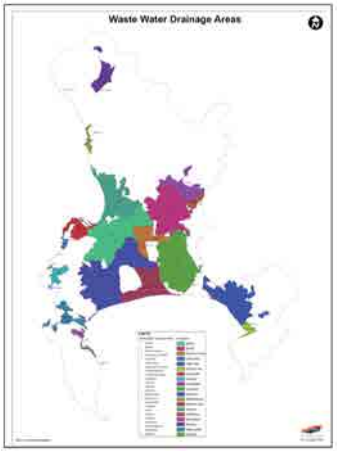
Source: Report on the Status of Sanitation Services in South Africa 2012

- In Integrated Development Plan, the wastewater section targets are:
  + Provision of a basic level of sanitation
  + WWTW Expansion & Renewal
- Johannesburg Water has the following projects:
  + Infrastructure Upgrade and Renewal Programme
  + WWTWs Expansion & Renewal (Lanseria WWTW, Northern WWTW etc)
  + Sewer – Network Update and Pipe Replacement

+ Provision of Basic Service
+ Water Resource Management

2.5.4 Current status in City of Cape Town

- The Wastewater System comprises: 27 WWTW owned and operated by the City of Cape Town; 379 pump stations; and 8752km of Sewer pipelines.
- All of the City's 27 WWTWs have to be upgraded to meet the DWA's requirements. For the Financial Year 2011/2012, the overall average compliance level of treated effluent quality stood at 85.7% which is an improvement from last year's overall compliance of 83.7%.
- Wastewater treatment process at Cape Flats WWTW consists of the following;
  + Activated sludge with primary sedimentation
  + Partial de-nitrification and for excess biological phosphorus removal.
  + Anaerobic sludge digestion followed by mechanical dewatering and pelletisation.
  + Extensive maturation pond system.



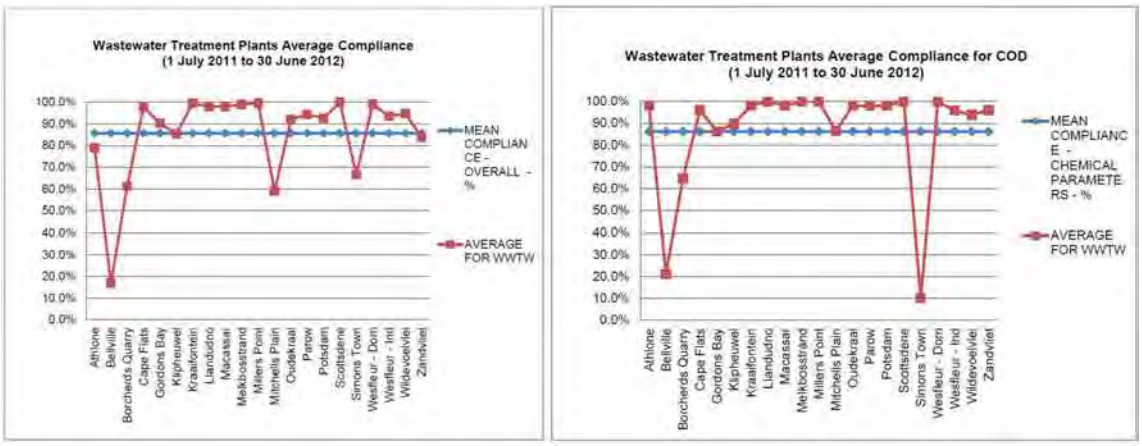
Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15

Figure 2-5-7 Waste Water Drainage Areas

Table 2-5-4 Situation of the Sanitation Service

Item	In 2012
Total Household serviced	1,022,818
% all Household serviced	93%
Formal Household Serviced	909,231
Informal Settlement Household serviced	113,587
% Informal Settlement Household serviced	59%
% Poor Household serviced	87%

Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15



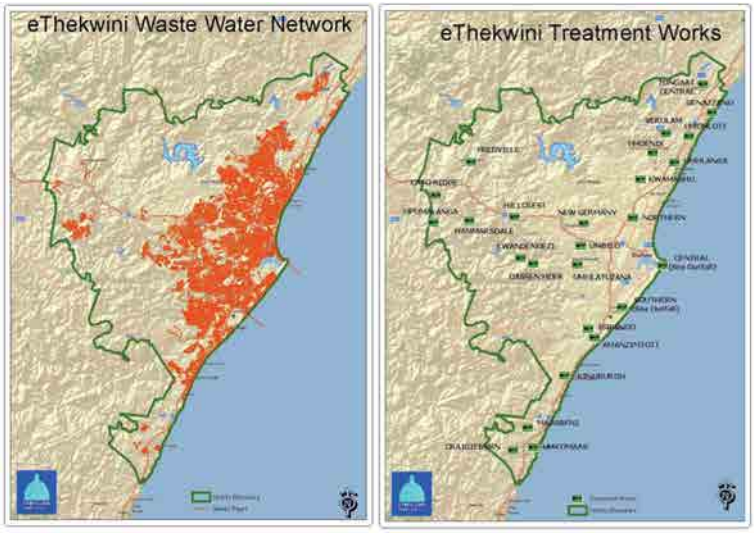
Source: Water Service Development Plan for City of Cape Town 2012/13-2016/15

Figure 2-5-8 Waste Water Treatment Plants Average Compliance in 2011

- In Integrated Development Plan, the targets in the wastewater section are:
  + Maintenance and expansion of essential sanitation utilities and services
  + Environmental health-care (Wastewaster management for water quality)
- City of Cape Town has the following projects:
  + Potsdam WWTW extension
  + Zandcliet WWTW extension
  + Mitchells Plain WWTW
  + WWTW infrastructure replace and refurbish

2.5.5 Current status in eThekwini Municipality

- According to the 2011 Water Services Development Plan, about 54% of households have flush toilets connected to sewerage, about 4% have flush toilets connected to septic tanks, about 10% have urine-diverting dry toilets, about 4% have improved pit latrines, and 4% have access to community ablution blocks, with a backlog of 24%.
- eThekwini Municipality has 7,000km sewer main pipelines and 27 wastewater treatment works. All of WWTW treat 500,000 m3/day of wastewater. Two of the works discharge final effluent into the sea, while the remainder discharge to river.
- These 27 wastewater treatment works make use of a number of different treatment steps to remove pathogens, bacteria and other contaminants to make it clean enough to enter into the river or sea. The wastewater discharged to the environment once it meets all requirements set by the national Department of Water Affairs.



Source: eThekwini Municipality Water Service Development Plan 2012

Figure 2-5-9 eThekwini Waste Water Network and Treatment Works

Table 2-5-5 Sanitation Service Delivery Levels

Table 3.3.1 Sanitation Service Delivery Levels		
Description	2010/2011	2011/2012
	Actual No	Actual No
Sanitation/sewerage: (above minimum level)		
Flush toilet (connected to sewerage)	498,341	449661
Flush toilet (with septic tank or package plant)	37,288	107525
Urine Diversion (UD)	89,307	79049
Pit toilet (ventilated)	40,000	35000
Other toilet provisions (above minimum service level) (ablution blocks)	34,681	48118
Total households above minimum level	702,611	719353
Sanitation Backlog	209,847	226557
*Total number of households including informal settlements	912,458	945910
Percentage below minimum level	24%	23.95%
Percentage above minimum level	76%	76.05%

Source: eThekwini Municipality Annual Report 2011/12

Table 2-5-6 Wastewater indicators

Indicator	2007/08
1. Number of households without access to sanitation facilities in Durban.	168 216 households
2. Volume of treated wastewater discharged to sea daily.	261,000m3l/d
3. Volume of treated wastewater discharged to rivers daily.	242,000 m3/d
4. Rate of compliance with marine discharge permit.	78 %
5. Rate of compliance with river discharge permit.	71 %
6. Wastewater treatment capacity in Durban.	681,000 m3/d
7. Utilisation of existing wastewater treatment works.	74 %
8. Warnings and prosecutions from DWAF to EWS in 2007/2008.	0
9. Warnings and prosecutions for non-compliant discharges to its sewers by EWS.	840

Source: State of the Environment Report 2007/8

- Located in the south of Durban in the grounds of the eThekwini Water Services' Southern Wastewater Treatment Works, the sewage-to-clean-water recycling plant was commissioned in May 2001. This plant can treat 47,500 m3 of domestic and industrial wastewater to a near potable standard for sale to industrial customers for direct use in their processes. The two largest customers so far are the Mondi Paper Mill in Merebank and the Sapref Refinery, owned by Shell and BP. The plant can free up sufficient drinking water for approximately 300,000 people.

2.5.6 Current Issues

(1) City of Johannesburg

- In the city of Johannesburg, there are five major issues in wastewater sector, expansion of the sewage network, improvement of waste water treatment plant, installation of the heat recovery system of the WWTP, measure of the high leakage and deterioration of the pipe network, and development of the water management system.

(2) City of Cape Town

- In the city of Cape Town, there are three major issues in wastewater sector, provision of basic sanitation services, maintenance and expansion of essential sanitation utilities and services, and development of environmental health-care (waste water management for water quality).

(3) eThekwini Municipality

- In the eThekwini Municipality, there are three major issues in wastewater sector.
  + One is provision of basic sanitation services, and providing urine diversion toilets is took in consideration as the basic direction.

  The second is Collection and treatment of wastewater, and they are took in consideration as the basic direction, updating sewer network and pipe replacement, and Expansion & Renewal WWTWs.
  + The third is Reuse of treated sewage effluent.

2.6 Solid Waste

2.6.1 Legislations and strategy in South Africa

(1) Solid waste management entities

Table 2-6-1 Solid waste management entities

Government	Department in charge
National government	- Department of Environmental Affairs
City of Johannesburg	- Pikitup
City of Cape Town	- City of Cape Town Solid Waste Department
eThekwini Municipality	- Ethekwini Municipality Cleansing and Solid Waste Department

(2) Definitions of solid waste

- As defined in National Environmental Management: Waste Act 2008:

"waste" means any substance, whether or not that substance can be reduced, re-used, recycled and recovered and divided two classifications "general waste" and "hazardous waste".

"general waste" means waste that does not pose an immediate hazard or threat to health or to the environment, and includes

(a) domestic waste;

(b) building and demolition waste;

(c) business waste; and

(d) inert waste;

"**hazardous waste**'' means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment;

Table 2-6-2 General and hazardous waste classification

Level 1	Level 2	
General Waste	GW01	Municipal waste
	GW10	Commercial and industrial waste
	GW13	Brine
	GW14	Fly ash and dust from miscellaneous filter sources
	GW15	Bottom ash
	GW16	Slag
	GW17	Mineral waste
	GW18	Waste of Electric and Electronic Equipment (WEEE)
	GW20	Organic waste
	GW21	Sewage sludge
	GW30	Construction and demolition waste
	GW50	Paper
	GW51	Plastic
	GW52	Glass
	GW53	Metals
	GW54	Tyres
	GW99	Other

Level 1	Level 2	
Hazardous Waste	HW01	Gaseous waste
	HW02	Mercury containing waste
	HW03	Batteries
	HW04	POP Waste
	HW05	Inorganic waste
	HW06	Asbestos containing waste
	HW07	Waste Oils
	HW08	Organic halogenated and /or sulphur containing solvents
	HW09	Organic halogenated and/or sulphur containing waste
	HW10	Organic solvents without halogens and sulphur
	HW11	Other organic waste without halogen or sulphur
	HW12	Tarry and Bituminous waste
	HW13	Brine
	HW14	Fly ash and dust from miscellaneous filter sources
	HW15	Bottom ash
	HW16	Slag
	HW17	Mineral waste
	HW18	Waste of Electric and Electronic Equipment (WEEE)
	HW19	Health Care Risk Waste
	HW20	Sewage sludge
	HW99	Miscellaneous

Source: National Waste Information Baseline Report 2012

(3) National Waste Management Strategy (NWMS)

- The NWMS is structured around a framework of eight goals, which are listed in the table below along with the targets for each goal that must be met by 2016:

Table 2-6-3 Summary of NWMS Goals

	Description	Targets (2016)
Goal 1:	Promote waste minimization, reuse, recycling and recovery of waste.	- 25% of recyclables diverted from landfill sites for re-use, recycling or recovery. - All metropolitan municipalities, secondary cities and large towns have initiated separation at source programmes. - Achievement of waste reduction and recycling targets set in IndWMPs for paper and packaging, pesticides, lighting (CFLs) and tires industries.
Goal 2:	Ensure the effective and efficient delivery of waste services.	- 95% of urban households and 75% of rural households have access to adequate levels of waste collection services. - 80% of waste disposal sites have permits.
Goal 3:	Grow the contribution of the waste sector to the green economy.	- 69,000 new jobs created in the waste sector - 2,600 additional SMEs and cooperatives participating in waste service delivery and recycling
Goal 4:	Ensure that people are aware of the impact of waste on their health, well-being and the environment.	- 80% of municipalities running local awareness campaigns. - 80% of schools implementing waste awareness programmes.
Goal 5:	Achieve integrated waste management planning.	- All municipalities have integrated their IWMPs with their IDPs, and have met the targets set in IWMPs. - All waste management facilities required to report to SAWIS have waste quantification systems that report information to WIS.
Goal 6:	Ensure sound budgeting and financial management for waste services.	- All municipalities that provide waste services have conducted full-cost accounting for waste services and have implemented cost reflective tariffs.
Goal 7:	Provide measures to remediate contaminated land.	- Assessment complete for 80% of sites reported to the contaminated land register. - Remediation plans approved for 50% of confirmed contaminated sites.
Goal 8:	Establish effective compliance with and enforcement of the Waste Act.	- 50% increase in the number of successful enforcement actions against noncompliant activities. - 800 EMIs appointed in the three spheres of government to enforce the Waste Act.

Source: National Waste Management Strategy 2011

2.6.2 Current status in South Africa

(1) Waste collection

- 61% of all South African households had access to domestic waste collection services in 2007.

(2) Waste generation

- Over 42 million m3 of general waste is generated every year in South Africa.
- More than 5 million m3 of hazardous waste is produced yearly. This is a result of the concentration of mining activities and fertilizer production in Mpumalanga and KwaZulu-Natal provinces.

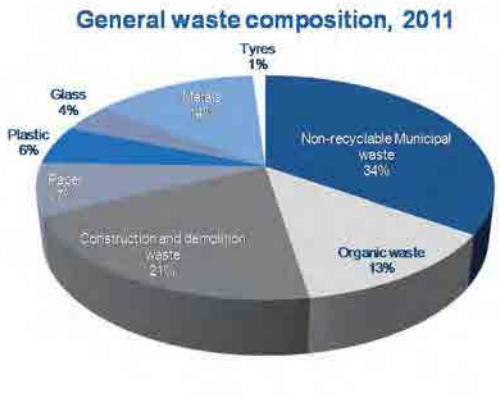
Province	kg/capita/annum	Waste generated as % of Total waste
Western Cape	675	20
Eastern Cape	113	4
Northern Cape	547	3
Free State	199	3
KwaZulu Natal	158	9
North West	68	1
Gauteng	761	45
Mpumalanga	518	10
Limpopo	103	3

Source: The Current Waste Generation and Management Trends in South Africa: A Review

Figure 2-6-1 Municipal waste contribution by province in South Africa in 2011

(3) Waste composition

- According to the National Waste Information Baseline Report 2012, South Africa generated 59 million tonnes of general waste in 2011. It is estimated that 10% of general waste was recycled, and the remaining was landfilled. Metals, Commercial and industrial waste, and Paper are highly recycled.



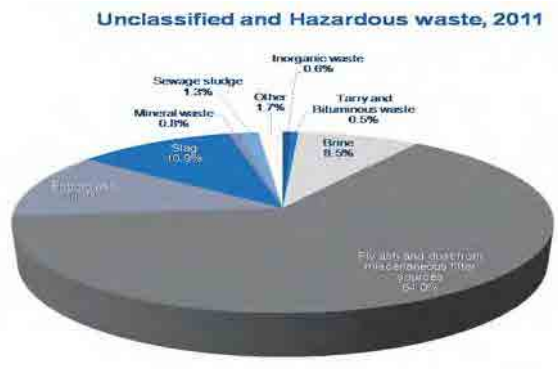
General Waste 2011		Generated	Recycled	Disposed	Recycled
		Tonnes			%
GW01	Municipal waste	7 878 564	-	7 878 564	0
GW10	Commercial and industrial waste	12 111 267	9 325 676	2 785 591	77
GW13	Brine	See Table 9			
GW14	Fly ash and dust from miscellaneous filter sources	See Table 9			
GW15	Bottom ash	See Table 9			
GW16	Slag	See Table 9			
GW17	Mineral waste	See Table 9			
GW18	Waste of Electric and Electronic Equipment (WEEE)	See Table 9			
GW20	Organic waste	2 954 461	1 034 061	1 920 400	35
GW21	Sewage sludge	See Table 9			
GW30	Construction and demolition waste	4 725 542	756 087	3 969 455	16
GW50	Paper	1 694 752	966 009	728 743	57
GW51	Plastic	1 278 713	230 168	1 048 545	18
GW52	Glass	937 869	300 118	637 751	32
GW53	Metals	3 121 203	2 496 962	624 241	80
GW54	Tyres	246 831	9 885	236 788	4
GW99	Other	36 171 127	-	36 171 127	0
Total general waste [T]		59 008 862	5 793 271	53 215 591	10

(-) means no data on recycling was available. GW01 – only the non-recyclable portion is reported here.

Source: National Waste Information Baseline Report 2012

Figure 2-6-2 General waste composition estimated from the modeled waste data

- The report also estimated that South Africa generated 49 million tonnes of unclassified and hazardous waste in 2011. It is estimated that 10% of hazardous and unclassified waste was recycled, and the remaining was landfilled. Batteries, slag, and Waste Oils are highly recycled. Only 1% of hazardous and unclassified waste was treated. About Health Care Waste, almost all waste is treated.



Hazardous and Unclassified Waste		Generated	Recycled	Treated	Landfilled	Recycled
		Tonnes				%
HW01	Gaseous waste	55	-	55	-	-
HW02	Mercury containing waste	868	-	-	868	-
HW03	Batteries	32 912	32 254	-	658	98
HW04	POP Waste	486	-	80	406	-
HW05	Inorganic waste	283 520	-	-	283 520	-
HW06	Asbestos containing waste	32 506	-	-	32 506	-
HW07	Waste Oils	120 000	52 800	-	67 200	44
HW08	Organic halogenated and /or sulphur containing solvents	109	-	-	109	-
HW09	Organic halogenated and/or sulphur containing waste	8 198	-	64	8 134	-
HW10	Organic solvents without halogens and sulphur	753	-	-	753	-
HW11	Other organic waste without halogen or sulphur	198 073	-	-	198 073	-
HW12	Tarry and Bituminous waste	255 832	-	-	255 832	-
HW13 & GW13	Brine	4 166 129	-	-	4 166 129	-
HW14 & GW14	Fly ash and dust from miscellaneous filter sources	31 420 488	1 885 229	-	29 535 259	6
HW15 & GW15	Bottom ash	5 717 324	-	-	5 717 324	-
HW16 & GW16	Slag	5 370 968	2 885 484	-	2 885 484	50
HW17 & GW 17	Mineral waste	369 000	-	-	369 000	-
HW18 & GW18	Waste of Electric and Electronic Equipment (WEEE)	62 581	6 884	-	55 697	11
HW19	Health Care Risk Waste	45 232	-	45 232	-	-
HW20 & GW 21	Sewage sludge	657 963	125 013	39 478	493 472	19
HW99	Miscellaneous	327 250	-	-	327 250	-
Total Hazardous & Unclassified [T]		49 070 248	4 787 664	85 555	44 197 030	10

(-) Blank cell means that we have no data on this waste stream being recycled or treated.

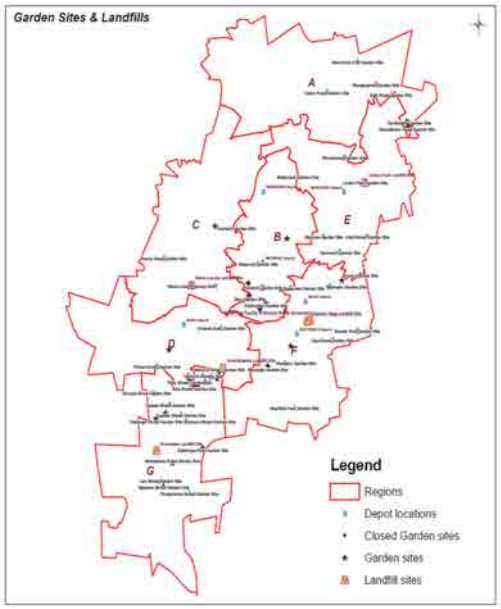
Source: National Waste Information Baseline Report 2012

Figure 2-6-3 Unclassified and Hazardous waste composition estimated from the modeled waste data

2.6.3 Current status in City of Johannesburg

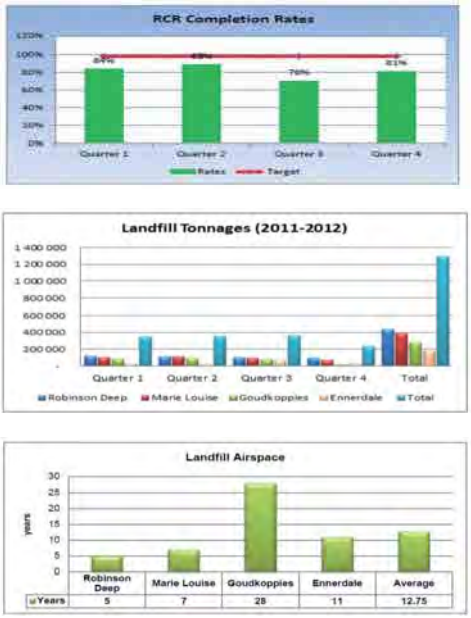
- Johannesburg's waste collection company, Pikitup, has 11 depots, 4 landfill sites, 42 garden sites and one composting site.

- Pikitup customer consists of 215,576 households. Refuse collection rounds (RCR) completion rates in 2011 is about 70-90%. 47% of informal settlements receive daily cleaning service.
- Total volume of yearly landfill waste amounted 1,294,045 tonnes in 2011-2012. Landfills are currently facing critical landfill airspace shortage (average spaces are 12.75 years) due to increase consumerism and growth in waste.



Source: Pikitup Home page

Figure 2-6-4 Pikitup Facilities including Garden Refuse Transfer Sites



Source: Pikitup Anuual Report 2011/12

Figure 2-6-5 RCR Completion rates, Landfill Tonnages and Landfill Airspace in 2011/12

- Pikitup makes gas-to-energy projects at Marie Louise and Robinson Deep landfill site. Landfill gas is extracted, combusted and flared as carbon dioxide, to generate electricity. A total of 19MW of electricity was generated from 5 landfill sites, which could be used by about 12,500 middle-income households.
- The Panorama Compost Plant was established as a pilot plant around 2004 to process green waste into compost with a view to saving landfill airspace. But recently the Compost Plant is not generating enough processed compost to sell due to plant availability and poor terrain conditions, revenue is also down.
- Pikitup is promoting recycling. 75% of dry waste recovered from existing facilities and initiatives for recycling purposes is indicated in the following table.

Dry Waste Recycled	Q1 total	Q2 Total	Q3 Total	Q4 Total	YTD Total
Landfills	943	1036	1040	1019.00	**4038.00**
Buyback Centre	733	774	928	844.00	**3279**
Garden Sites	1039	1106	1158	1362.00	**4665**
Lonehill separation at source	39	53	85	81.00	**258**
Parkmore separation at source	61	63	66	78.00	**268**
Sunninghill separation at source	53	88	105	111.00	**357**
Earth & Moon	3.544	10.4	22	14.00	**49.944**
Waterval separation at source	743	780	768	635.00	**2926**
E-Waste – Woodmead / Balyclare	1.786	6.5	3.7	4.50	**16.486**
Rose Foundation Oil Recycled	1	2	1	1.00	**5**
Schools	1.245	0.5	2	0.50	**4.25**
Pikitup Internal Recycling	2.994	1.628	1.7504	2.42	**8.7954**
Special Events	0	0	0	0.00	**0**
DRY WASTE Total	**3621.6**	**3921.0**	**4180.5**	**4152.4**	**15875.5**

Source: Pikitup Anuual Report 2011/12

Figure 2-6-6 Dry Waste Recovered for Recycling

- In Integrated Development Plan, the targets in the waste management section are:
  + 50% reduction in waste to landfill by 2012 and zero waste to landfill by 2022.
  + Integrated waste management for CO2 Emissions generated by landfill site.
  + Diversion of waste from landfill sites
  + Sustainable waste disposal (landfill waste optimization)
  + Pollution control (prevention, cleaning and clearing of illegal dumping spots)
  + Ensure effective and efficient waste management services (RCR optimization)
- The targets set forth in the Integrated Waste Management Plan of City of Johannesburg are:
  + 20% reduction of waste disposal to landfill
  + Divert the following amounts of green waste from landfill sites, 60% by 2015, 100% by 2020
  + 20% reduction of domestic and commercial waste stream s disposed to landfill by 2015
  + The percentage increase in the volume of waste disposed to landfill should not exceed its proportional population increase
  + All landfill should be licensed and compliant to their license conditions by June 2011.
  +All households within the City of Johannesburg to receive at least a basic level of waste service, including a daily cleansing service to all informal settlements by 2014.
  + Improve the Environmental prosecution rate and EMI's success by 10%.
  + Reduce by 50% incidences of pollution that come as a result of poor waste management.

2.6.4 Current status in City of Cape Town

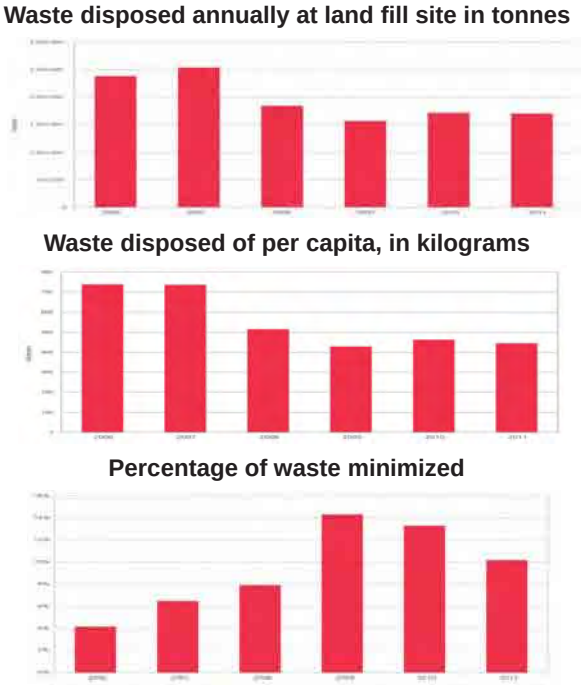
- City of Cape Town has 25 public drop-off sites, 3 transfer stations, 3 landfill sites and 2 materials recovery facilities.
- City of Cape Town has three municipal landfill sites in operation. Coastal Park has area of 75ha and is for general waste. Bellville South has area of 60ha and is for general waste. Vissershok is for hazardous waste and managed with distinguished between low-risk and high-risk waste. Life spans of these site are varying from 5 to 13 years.
- City of Cape Town has three transfer stations: Athlone, Swartklip and Kraaifontein.

Kraaifontein facility is operated as Integrated Waste Management facility (drop-off, materials-recovery, refuse-transfer, and green-waste-chipping).

- Recently, for landfill airspace saving, it is started composting of garden greens and reuse of builder's rubble.
- Currently 100% of formal and informal households in the City receive a weekly refuse collection services.
- Total volume of yearly landfill waste amounted about 1.7 million tonnes and waste disposed of per capita is 0.45kg per person per day in 2011. 10% of waste is minimized by City waste minimization programs.
- It is estimated that households generate approximately 46%, industry approximately 27%, and commerce approximately 26% of waste in the City.

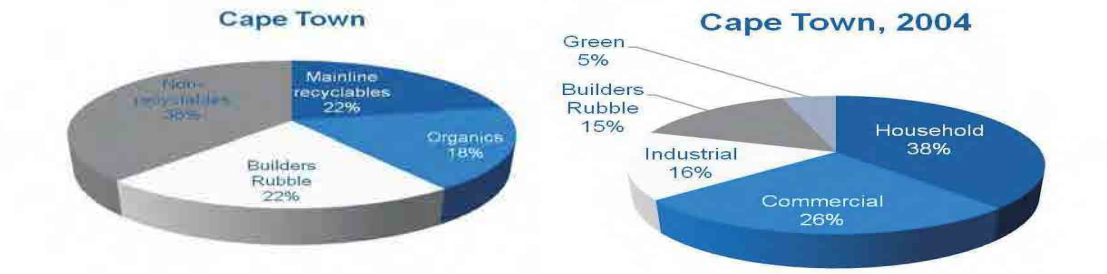
Source: City of Cape Town Home Page

Figure 2-6-7 Drop-off and landfill sites in City of Cape Town



Source: State of the Environment Report 2012

Figure 2-6-8 Waste situation in City of Cape Town



Source: National Waste Information Baseline Report 2012

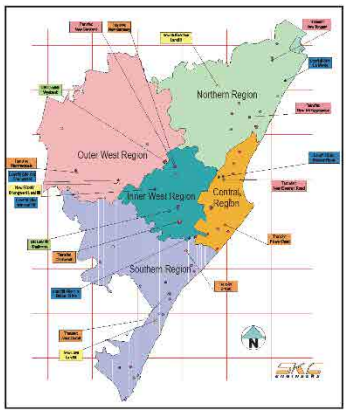
Figure 2-6-9 Municipal waste composition

- The Kraaifontain Waste Management Facility, commissioned in September 2010, is the first integrated waste management facility in South Africa. Main facility can handle up to a thousand tons of waste a day. Other facilities are a garden refuse chipping facility, a domestic recycling centre where materials are recovered and a public drop-off site for residents. Materials recovery also takes place at Athlone Refuse Transfer Station, which is situated in Langa.
- The City is to establish an effective system for the separation of waste at source, **"Think Twice"** campaign as a pilot in some Cape Town residential areas. It is estimated that this diverts approximately 1 300 tons of recyclables from landfill each month.
- The Solid Waste Management Department has developed a communication and awareness program called **"WasteWise"**. This aims to raise awareness and encourage action among the general public and businesses to minimize waste, reduce littering, stop illegal dumping, and increase recycling.
- In Integrated Development Plan, targets in the waste management section are:
  + Maintenance of infrastructure
    - The replacement of aging waste collection vehicles
    - Bellville South refuse transfer facility
    - Development drop off facilities
  + Investment in infrastructure
    - Landfill airspace and strategic infrastructure programme
- The targets set forth in the Waste Management Plan in City of Cape Town are:
  + The tons of waste diverted from landfill
  + Percentage of the total tons of waste received by the city
- In the IMEP Environmental Agenda 2014 Target 9 sets a goal of a 20% reduction in waste to landfill from the 2008 baseline.

2.6.5 Current status in eThekwini Municipality

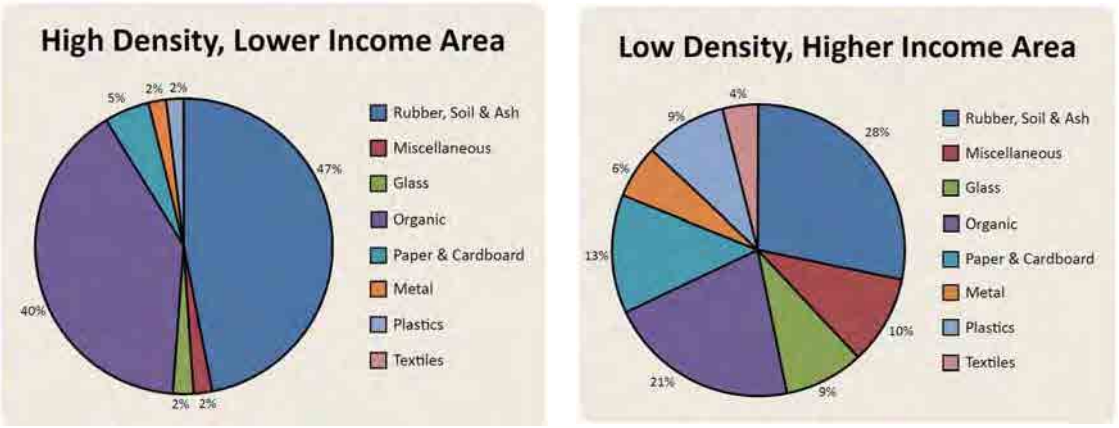
- The Cleansing and Solid Waste Department (DSW) has 23 Operational Centres, 6 Transfer Stations, 3 Active Landfill Sites, 23 Recycling Plants, 3 Landfill Gas Projects, and 2 Leachate Plants.
- These assets enable DSW to offer a full range of services to 3.1 million residential, industrial and commercial customers. A weekly refuse removal service is provided to 1,670,392 households, 945,910 being formal households and 724 482 informal in 2011.
- DSW manages the Municipality's four landfill sites: Bisasar, Buffelsdraai, La Mercy and Mariannhill. The landfill site at La Mercy has reached its capacity and is closed but remains under the management of DSW. Future capacity is planned at Lovu. This site is designed to accept some 400 tonnes/day.

- Two privately owned permitted landfill sites for low hazardous waste are situated at BulBul Drive and Shongweni.



Source: Integrated Waste Management Plan for eThekwini Municipality 2004

Figure 2-6-10 Landfill / Transfer sites in 2004



Source: Sustainable Waste Management Guideline

Figure 2-6-11 Typical Municipal General Waste Composition for Different Communities in Urban Area (% by mass)

- eThekwini launched Africa's first landfill gas to electricity project in 2007. It involved the extraction of methane from three council owned landfill sites (Mariannhill, La Mercy and Bisasar Road) for electricity generation. Electricity generation capacity of 0.5MW, 1MW and 6.5MW was installed at La Mercy, Mariannhill and Bisasar respectively. Currently 50.00 MWh is generated per year, enough to power 3,750 small houses, and CO2 emissions are reduced by 20,000 tonnes per month.
- In total DSW have 22 recycling centres that are strategically located allowing easy access to the public. Approximately 8.1% of all waste is being recycled. The two major achievements was the re-opening of the North Coast Road Buy Back Centre and the establishment of the Hammarsdale Ecological Centre.
- One of the successes is the Domestic Orange Bag Project that is now provided to all formal households within the eThekwini region and is currently generating 1,500 tonnes of recyclables

per month.

- Black refuse bags are used mainly for household refuse; they are manufactured from high density polyethylene which makes the bag light weight, yet strong. Each residential property receives up to two bags per week - depending on the need; in some areas, 26 bag packs are delivered for every three month period.
- In Integrated Development Plan, the targets in the waste management section are:
  + Address infrastructure backlogs: Additional consumer 26,000 units provided with a once/week, curbside Refuse removal service (5 year target)
  + Infrastructure asset management: waste recycled as 20% of total waste disposed at municipal landfill sites (5 year target)
- The targets set forth in the Waste Management Plan in eThekwini Municipality are:
  + Expansion of Service Delivery
  + Waste Separation at source
  + Waste Minimization
  + Recycling
  + Zero Waste to Landfill by 2020
  + Raising Awareness of the community
  + Optimization of Solid Waste Management

2.6.6 Current Issues

(1) City of Johannesburg

- In the city of Johannesburg, there are four major issues in waste sector, improvement of refuse collection system, expansion of reduce / reuse / recycle system, development of recover energy system form waste, and environmental control of landfill site.

(2) City of Cape Town

- In the city of Johannesburg, there are seven major issues in waste sector, improvement of access to basic waste management services, construction and commissioning of a new Northern region landfill site, rehabilitation of old landfill sites, establishment of new integrated waste management facilities, minimization of waste to landfill, licensing of all drop-off facilities to comply with applicable regulations, and development of landfill gas mitigation project.

(3) eThekwini Municipality

- In the city of Johannesburg, there are three major issues in waste sector.
  + One is Provision of basic waste collection service.
  + The second is waste minimization, and they are took in consideration as the basic direction, waste separation at source, zero waste to landfill by 2020, and recycling.
  + The third is expansion of the recovery projects, and landfill gas to electricity project is took in progress.

2.7 Electric Power

2.7.1 Power Generation

Rich natural resources are the main economic driver for South Africa. Providing rich Electric Power to the mining industry has been one of the top priority for electric infrastructure construction. Figure 2-7-1 shows the location of the natural resources. Most of the Gold mines are located near the Johannesburg and coal mines are also near the east of the gold mines. 95% of the Electricity are generated by ESKOM (Electricity Supply Commission of South Africa). Annual Power Generated in 2012 was 237TWh, Peak Power Demand in 2012 was 36.5 GW. Table 2-7-1 shows the breakdown of Electric Plants. 90% of the electricity are generated by Coal Thermal Power Stations in the north east region. Figure 2-7-2 shows power usage by each sector. Approximately 18% of the total electricity is consumed by Mining Industry.

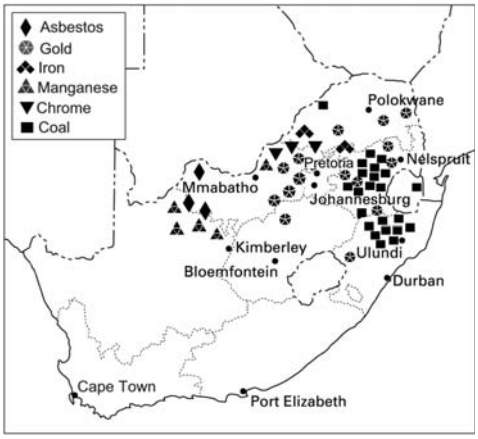


Figure 2-7-1 Map of natural resources[1]

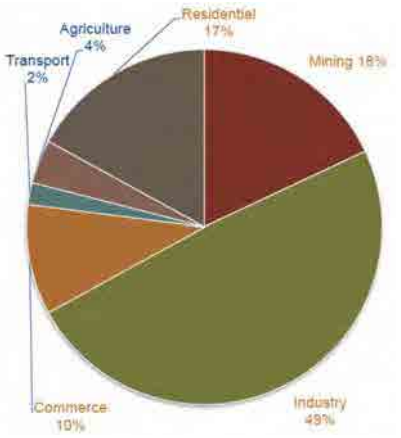


Figure 2-7-2 Power by industry sector[2]

Table 2-7-1 ESKOM Power Plants

Generator Type

Type	Ratio	Power(MW)
Coal Thermal	88%	35,650
Gass Turbine	6%	2,409
Nuclear	5%	1,860
Hydro	1%	600
Wind Power	0%	3
Pumped Hydro	(3%)	1,400
Total		41,922

Base Load

Type	Province	Name	Power(MW)
Coal Thermal	MPUMLANGA	Arnot	2,232
		Duvha	3,450
		Hendrina	1,865
		Kendal	3,840
		Kriel	2,850
		Majuba	3,843
		Matimba	3,690
		Matla	3,450
		Tutuka	3,510
		Camden	1,480
		Grootvlei	1,090
		Komati	792
	FREE STATE	Lethabo	3,558
Nuclear	WESTERN CAPE	Koeburg	1,860
Total			37,510

Peak Power

Type	Province	Name	Power(MW)
Hydro	NORTHERN CAPE	Gariep	360
		Vanderkloof	240
Wind	WESTERN CAPE	KlipheuwelWind	3
Gass Turbine	EASTERN CAPE	PortRex	171
	WESTERN CAPE	Acacia	171
		Ankerlig	1,327
		Gourikwa	740
Pumped Hydro	KWAZULUNATAL	Drakensberg	1,000
	WESTERN CAPE	Palmiet	400
Total			4,412

Distribution

Type	Province	Name	Power(MW)
Hydro	EASTERN CAPE	FirstFalls	6
		SecondFalls	11
		ColleyWobbles	43
		Ncora	2
Total			62

Before 1990's, South Africa had richest Electricity Resource in Africa, providing power to

[1] http://cnx.org/content/m22302/latest/
[2] Eskom's Integrated Demand Management (IDM) Programme and Funding Options

neighboring countries. However during the 1990's insufficient investments for power plants and growth of GDP led to critical power shortage. Figure 2-7-3 shows the Power Reserve Margin from 1999 to 2011. Scheduled blackout (power shedding) had to be taking after 2007.

Figure 2-7-3 Power reserve margin by year[3]

2.7.2 Transmission

Figure 2-7-4 shows the location of Coal Thermal Power Plant which generates 90% of electricity, and Transmission lines. Long Transition Line distributes The Electric Power Generated in the north east to all parts of South Africa including major costal city such as Cape Town and eThekwini.

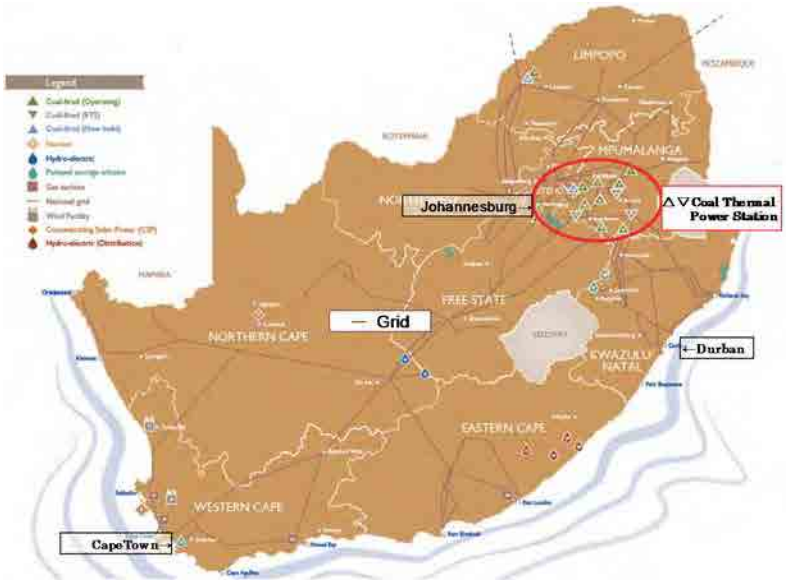


Figure 2-7-4 Location of ESKOM power stations[4]

Figure 2-7-5 shows the middle voltage line (in red) and non electrified area (in black). Power

[3] http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71619?oid=230322&sn=Detail&pid=71619
[4] http://www.eskom.co.za/Whatweredoing/ElectricityGeneration/PowerStations/Pages/Map_Of_Eskom_Power_Stations.aspx

grid coverage are weak in non-industry rural area. 16% of the household are not electrified. Even Major cities like Johannesburg, Cape Town and eThekwini have a Un-electrified area. Fighting Poverty is one of the top priority for the South African government.

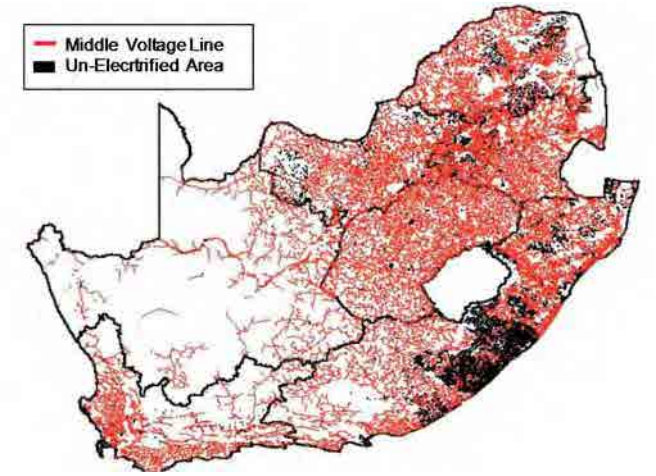


Figure 2-7-5 Medium voltage line and non-electrified areas[5]

2.7.3 Power Demand

Figure 2-7-6 shows the power demand curve of typical summer and winter day. Hourly Power Demand shows that there is main peak in 18:00 to 20:00 in the winter have the demand peak. The peak time comes after business hour indicates that home power usage such as cooking are involved. Also constant gap during 21:00 to 6:00 between summer and winter indicate that power is used for heating homes in cold day.

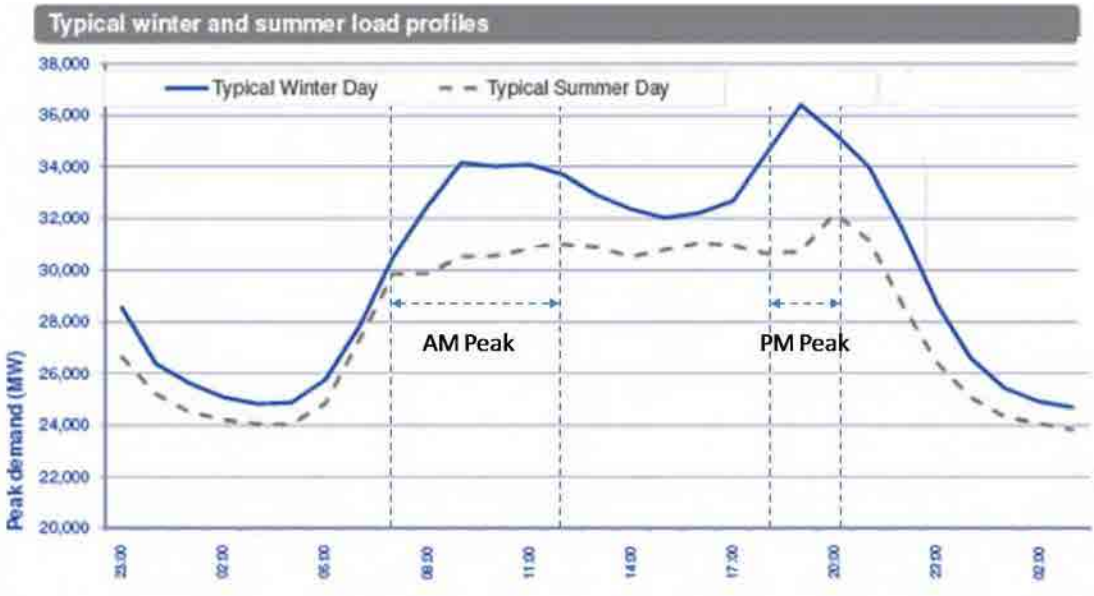


Figure 2-7-6 South Africa power demand peak[6]

Table 2-7-2 shows the electricity Tariff. Figure 2-7-7,8 shows the time period of the day for

[5] http://www.globalelectricity.org/upload/File/South-Africa_Mini_Grid_Assessment.pdf
[6] http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71619?oid=230322&sn=Detail&pid=71619

Peak, Standard, Off-Peak time for Industry and Residents. Electric tariff are set to rise on this peak time, in order to encourage customer reduce the electricity usage on this time period.

Table 2-7-2 Example of electricity tariff

Sector	Season	Peak(R)	Standard	Off-Peak
Industry (MegaFlex)	Winter(Jun~Aug)	1.83	0.56	0.30
	Other	0.60	0.41	0.26
Residence	Winter(Jun~Aug)	1.74	0.55	-
	Other	0.66	0.44	-

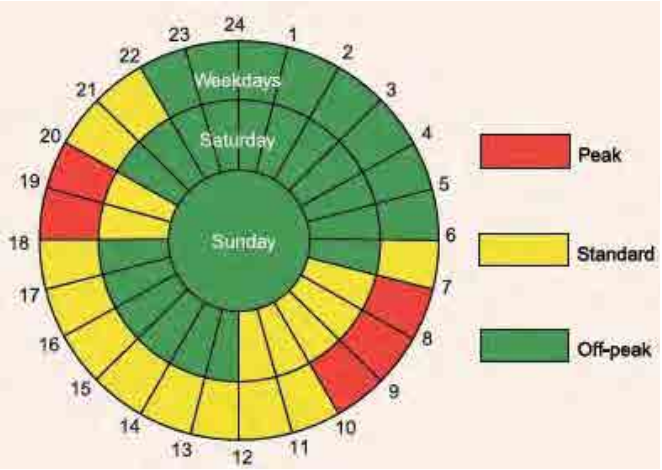


Figure 2-7-7 Time-of-use price periods for industries[7]

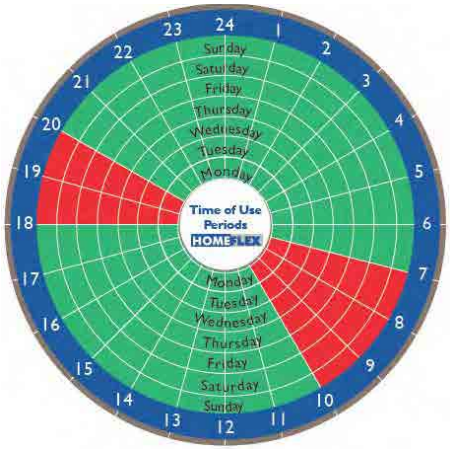


Figure 2-7-8 Time-of-use price for residences[8]

2.7.4 Electricity usage of major cities

Table 2-7-3 summarize the outlook of Major Cities. (Johannesburg, eThekwini, Cape Town) Three Cities has total Capital of 22% of South Africa, produces 34% of GVA (Gross Value Added) and Consumes 20% of electricity.

Table 2-7-4 shows annual income, number of Households of each province the major cities are located. Table 2-7-5 shows adoption rate Major Electric Appliances

Table 2-7-6 shows the power consumption change in 10 years. Annual power consumption of Residential sector have increased from 7.3GWh to 10.5GWh. Monthly Household electricity usage also increased from 54KWh to 61KWh.

[7] http://turboelement.com/wp/baseload-reduction/
[8] http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Documents/Eskom%20Leaflet%20final%20Understanding%20your%20Homeflex%20Bill.pdf

Table 2-7-3 Electricity usage and issues of major cities[9]

City	Capital (M) (% of SA)	GVA (M R) (%of SA)	Electricity (% of SA)	Power/Capital (Electrification)	Major industries Major functions
Johannesburg	3.88 (8.0%)	238,803 (14%)	14.6 TWh (7.5%)	3,486 (89%)	Mining Finance
eThekwini	3.47 (7.2%)	153,516 (9%)	10.9 TWh (5.6%)	3,153 (87%)	Manufacturing Shipping
Cape Town	3.50 (7.2%)	187,631 (11%)	13.5 TWh (6.9%)	3,862 (94%)	Tourism Shipping

Table 2-7-4 Household statistics of major provinces and national averages[10]

Province	West Cape (Cape Town)		KwaZulu (eThekwini)		Gauteng (Johannesburg)		South Africa	
	2001	2011	2001	2011	2001	2011	2001	2011
Income (000 R)	78.2	143.4	38.9	83.1	78.5	156.2	48.4	103.2
Households(M) (% of Cape Town, Johannesburg, eThekwini)	1.21 (64%)	1.64 (65%)	2.23 (37%)	2.53 (38%)	2.98 (35%)	3.90 (37%)	11.8 (22%)	14.4 (24%)

Table 2-7-5 Home Appliance Adoption Rate[11]

Province	West Cape (Cape Town)		KwaZulu (eThekwini)		Gauteng (Johannesburg)		South Africa	
	2001	2011	2001	2011	2001	2011	2001	2011
TV	74	86	47	67	65	81	54	75
Lighting	85	93	58	78	75	87	66	84
Cooking	76	87	45	69	67	84	49	74
Heating	71	63	44	57	65	75	47	59
Refrigerator	74	81	46	63	62	73	51	68

Table 2-7-6 Household power consumption growth[12]

	2001	2011	Growth
Consumption (GWh)	7.3	10.5	44%
Per Household KW/month	54	61	12%

2.7.5 Blackouts caused by transmission lines

Major cities such as Cape Town, eThekwini which are far from coal thermal power stations are having a blackout due to Power Transmission line failure, due to wild fire bird strike, Lightning. Figure 2-7-9 shows the graph of Transmission line failure occurrence and its cause. Figure 2-7-10 shows the location of Transmission line failure.

9 ·STATE OF ENERGY IN SOUTH AFRICAN CITIES 2011 http://www.cityenergy.org.za/getfile.php?id=83&category=

10 Census 2011 Provinces at a glance
http://www.statssa.gov.za/Census2011/Products/Provinces%20at%20a%20glance%2016%20Nov%202012%20corrected.pdf

11 Census 2011 Provinces at a glance
http://www.statssa.gov.za/Census2011/Products/Provinces%20at%20a%20glance%2016%20Nov%202012%20corrected.pdf

12 ESKOM Annual Report 2011 http://financialresults.co.za/2011/eskom_ar2011/downloads/eskom-ar2011.pdf
ESKOM Annual Report 2001 http://s3.amazonaws.com/zanran_storage/www.eskom.co.za/ContentPages/768217721.pdf

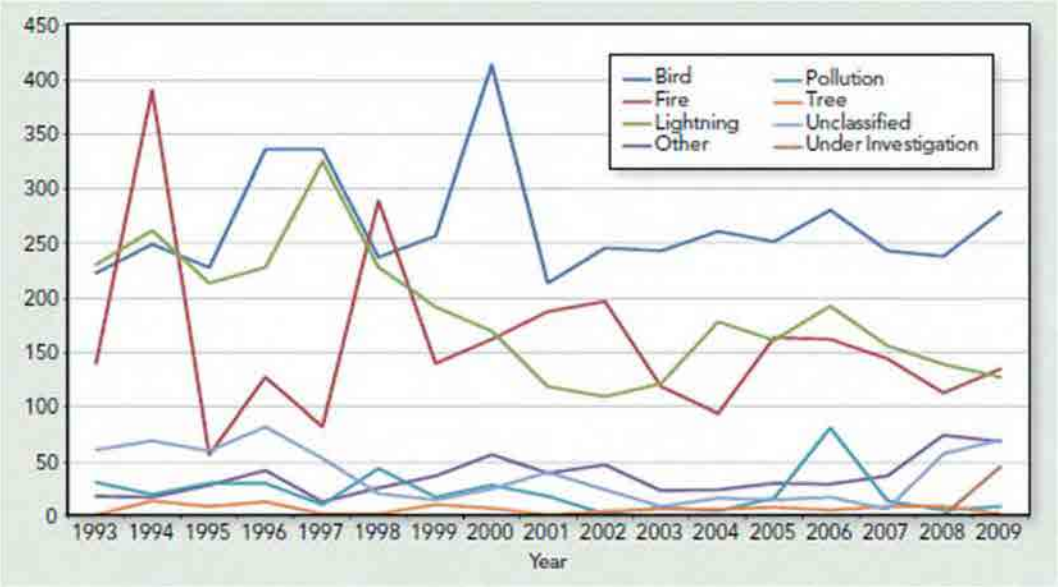


Figure 2-7-9 Power line failure by cause[13]

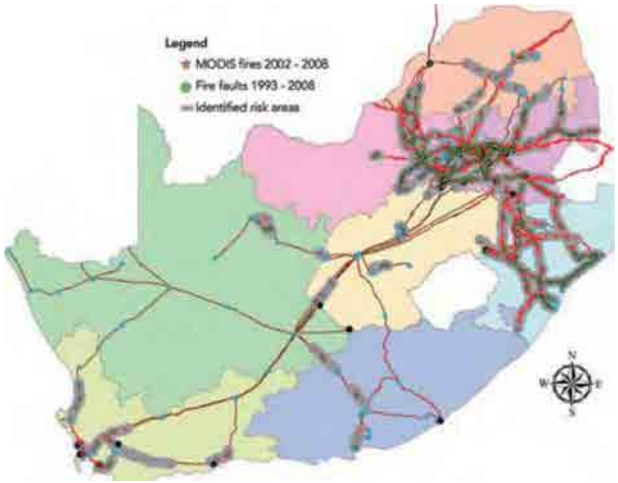


Figure 2-7-10 Locations of power line failure (Gray area)[9]

One of reason for Black out due to transmission line fault means that lack of secondary route which have enough power to carry in case of primary line fault. The secondary or third route cannot handle the power increase due to the primary line fault.

ESKOM is using satellite to detect wild fire from space. Dispatching fire extinguish party to the wild fire before wild fire reaches the transmission line. Also using historical record of wild fire database, party are send to cut the bushes which have a potential to be fuel for the wild fire.

[13] http://afis.co.za/index.php/documents/doc_download/2-eskom-readies-for-fires-real-time-weather-and-transmission-system-monitoring-improves-operations-and-speeds-response

2.8 Energy and Environmental Planning

2.8.1 Overview and basic information

(1) Energy sources and consumption[1]

South Africa's primary energy mix is dominated by fossil fuels: the energy share of coal, crude oil and petroleum products is 61.8%, 13.2% and 16.3% respectively in 2009. Having the world's sixth largest coal reserves, South Africa uses coal mainly for electricity production and manufacturing. Historically, the share of renewable energy has been low, at about 5% between 2002 and 2009. The largest consumers of energy are the manufacturing sector and the transportation sector, each accounting for 37% and 31% of the total energy consumption. About half of the electricity production

In contrast with the national profile, the dependence on petroleum products as the main energy supplier is prominent in the three major cities in this study. Petroleum products provide about 60% of each city's energy, mainly to meet the transportation needs. The transportation sector consumes more than half of the final energy in each of the three cities.

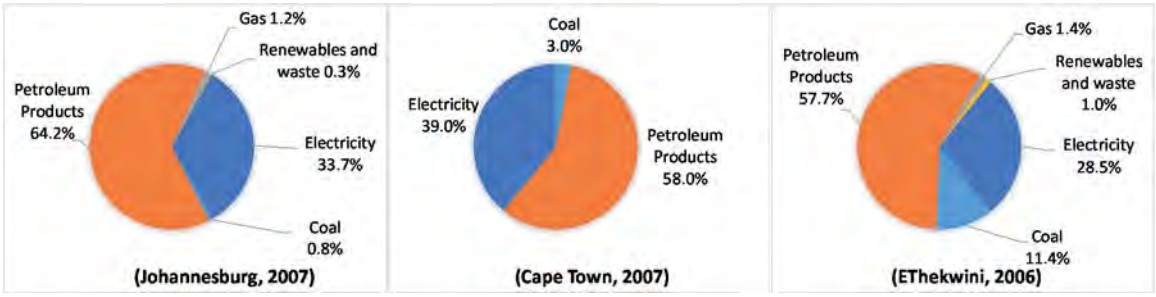


Figure 2-8-1 Energy consumption by fuel type in three major cities

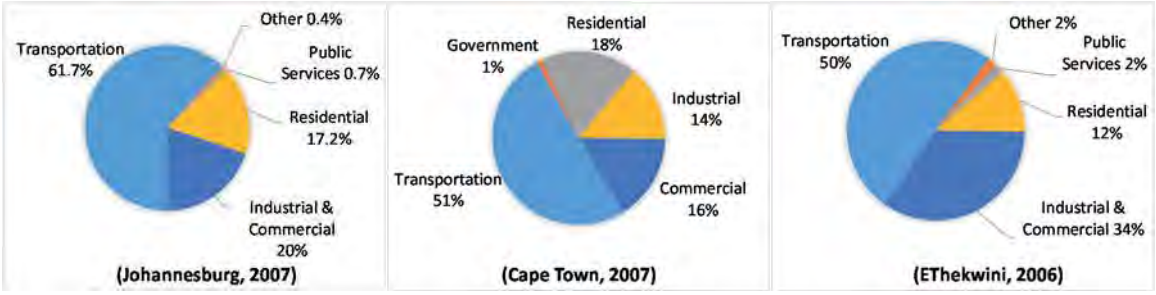


Figure 2-8-2 Energy consumption by sector in three major cities

According to the national household surveys, the main energy source in the residential sector for all three cities is electricity, followed by paraffin. However, the consumption patterns in residential buildings are strongly influenced by affordability and access to electricity. In Cape Town, high and very high-income households who make up on 24% of all households are

[1] Unless otherwise noted, the energy source and consumption facts in this section have been adapted from the following sources: City of Johannesburg State of Energy Report 2008; City of Cape Town State of Energy and Energy Futures Report 2011; EThekwini Municipality State of Energy Report 2006; the annual General Household Surveys conducted by Statistics South Africa; and Statistics South Africa (2012). Energy Accounts for South Africa: 2002-2009.

responsible for 43% of total energy consumed[2].

This shows that significant energy efficiency gains are to be made within this affluent sector

The 2011 survey shows that electricity was used as the primary energy carrier for cooking, heating or lighting for more than 80% of the households in Johannesburg and over 75% of the households in eThekwini. Even though electricity has been the main energy source for domestic purposes in Cape Town, paraffin and LPG are still regularly used in low-income households for space heating and water heating[3].

(2) CO2 emissions

The annual CO2 emissions per capita produced by Johannesburg, Cape Town and eThekwini are 1,484, 4,099 and 3,503 kg/person respectively[4]. The CO2 emission breakdown by sector in Johannesburg and Cape Town shows a fairly equal split between transportation, industrial/commercial sector, and residential sector (see Figure 2.8-3). This composition is in line with that of major urban areas such as Tokyo. In contrast, eThekwini, has demonstrated a somewhat different profile, with much lower CO2 contribution from the residential sector than the other two cities.

Figure 2-8-3 CO2 emissions by sector in three major cities

(3) Energy and environmental legislations and policies

After the 1994 democratic elections, South Africa government has accelerated its electrification programs to serve the underdeveloped urban and rural areas. Subsequently, a number of energy-related legislations and policies were introduced, including *National Energy Act*, *Electricity Regulation Act No. 4 (Integrated Resource Electricity Plan 2010-2030)*, *National Energy Efficiency Strategy*, *White Paper on Energy Policy*, and *White Paper on Renewable Energy*.

South Africa also has a comprehensive set of legislations on natural resources management as well as its own effluent and emission standards, which cover water resources, air quality, solid waste, land planning etc.

2 Cape Town Environmental Resource Management (2011). State of Energy Report.
3 In 2007, more than 45% of the households in Cape Town are low-income households, 15% live in informal settlements and 7% are non-electrified.
4 Economist Intelligence Unit (2011). African Green City Index.

(4) Building legislations and policies

The National Building Regulations and Building Standards Act (Act 103 of 1977 and subsequent amendments) were promulgated in 1985. The intention of the act was to "provide for the promotion of uniformity in the law relating to the erection of buildings in the areas of jurisdiction of local authorities; for the prescribing of building standards; and for matters connected therewith". The act provides guidelines for building site operations, design and construction.

The National Building Regulations was accompanied by a code of practice for the application called SABS 0400, which serves "as a guide to the understanding and correct interpretation of the National Building Regulations" for building design professionals by prescribing the provisions that are deemed to satisfy the technical aspects of the National Building Regulations. Additionally, there are presently two national standards that regulate building energy. The SANS 204: Energy Efficiency in Buildings standard, a voluntary standard when it was first published in October 2008, became a mandatory standard for new building plans and renovations after the 2011 revision. It outlines the general requirements for achieving energy efficiency in all types of new buildings, both for naturally ventilated buildings and for artificially conditioned buildings.

(5) Energy efficiency and environmental management strategies and initiatives

Various energy efficiency strategies and initiatives[5] have been introduced at the national level since 2010 since demand side management was recognized as the most economical way to reduce demand and avoid power shortages. Examples of such strategies or initiatives include *Energy Efficiency Demand Side Management (EEDSM) program, Eskom's EEDSM residential programs, Appliance Labelling campaign* and *Energy Efficiency Standards and Labeling of Appliances*.

Additionally, the three municipalities in this study have developed and adopted city-level strategies and initiatives that address climate change and sustainability issues, such as:

a. City of Johannesburg

- *Climate Change Programme* (2006)
- *Climate Change Adaptation Plan (CCAP)* (2009)

b. Cape Town

- *Integrated Metropolitan Environmental Policy (IMEP(CCT))* (2003)
- *City of Cape Town Environmental Agenda 2009-2014* (2008)
- *Energy and Climate Change Strategy* (2007)
- *Moving Mountains: Cape Town's Action Plan for Energy and Climate Change* (2011)

c. eThekwini (Durban)

- *Durban Climate Change Strategy* (2013)

[5] Ernest Orlando Lawrence Berkeley national Laboratory (2013). Energy Efficiency Country Study: South Africa.

In addition to the broad-based strategies presented above, each municipality has also been diligent in air quality monitoring and management. Air pollution levels have been high in all three cities due to vehicle emissions, smoke from fuel (coal, paraffin or wood) burning, coal power plants and meteorological conditions. Each city has developed its own Air Quality Management Plan and air quality monitoring stations have been installed at various sites[6].

(6) Energy efficient and sustainable building strategies and initiatives

a. Green Star SA

The Green Star SA green building rating system, an adaptation of the Australian Green Star system, was developed by the Green Building Council of South Africa and launched in 2008. As of March of 2014, four rating tools (office tool, retail tool, multi-unit residential tool, and public and education tool) have been developed which benchmark buildings against a 6-star rating scale. Since its inception, Green Star SA has been widely adopted as the benchmark tool for green buildings in South Africa. In 2011, the Construction Industry Development Board and the Department of Public Works announces that all new public buildings must be designed to achieve a 4-Star Green Star rating.

b. Municipal guidelines for green buildings

To support the development of energy efficient or sustainable construction within their city, each of the three cities has developed their own guidelines, namely the following:

- Johannesburg: Design Guidelines for Energy Efficient Buildings in Johannesburg (2008).
- Cape Town: City of Cape Town Smart Building Handbook (2012)
- eThekwini: Green Guidelines series (under Greening Durban 2010 Programme)

These guidelines provides general guidance and resources to the building design and construction professionals (architects, engineers, developers, contractors, etc.) and building owners on sustainable construction on aspects such as building design, building energy efficiency, and building management and commissioning.

c. Other initiatives[7]

The following initiatives have also been introduced by the three municipalities to reduce energy consumption and increase energy efficiency in the building sector:

- Cape Town Solar Water By-Laws
- Cape Town Partnership Energy-efficient Initiative
- EnerKey Programme (energy-efficiency projects in Johannesburg)
- Cosmo City (Johannesburg) housing energy efficiency upgrade

[6] Economist Intelligence Unit (2011). African Green City Index.
[7] United Nations Environment Programme (2009). Greenhouse Gas Emission Baselines and Reduction Potentials from Buildings in South Africa.

The critical issues pertaining to the local energy and environmental planning of the three metropolitan areas identified by this study are discussed in the following sections.

2.8.2 Common Issues

All the three cities in this study face the following issues in energy and environmental planning of their city.

(1) Deficiencies in energy infrastructure planning

South Africa experienced rolling blackouts in 2007-2008, and recently in February and March of 2014 due to insufficient power generation. The slow development of electricity generation infrastructure is described as a countrywide issues in a DBSA's report[8], which listed some of the reasons as "delays in generation capacity investments, financial constraints, long lead times required to build new power stations, and coal-fired power stations approaching the end of their lifespan".

It has been a great concern for the municipalities that the construction of electric power infrastructure cannot keep up with construction of social housing and other residential development. The continuous growth in housing development in the three major metropolitan areas requires that the power distribution network to be expanded to service the new development areas, and, sufficient power capacity to provide for them.

(2) Lack of local authority over energy and environmental planning

All three major cities have developed a great deal of concepts, strategies or initiatives in relation to energy and environmental planning, but the degree of implementation of actual programs or projects remains low. One main reason is that local governments are not do not have the autonomy to mobilize and manage their own financial resources to undertake development projects. The central strategies and policies on environment and energy planning as well as the funding distributions are basically established by the national government, including how region or city and type of projects are prioritized. The projects with clear benefits or effects are generally selected to be implemented.

In general, local governments do not have sufficient authority to implement their own subsidy or incentive schemes and most financing schemes are provided by the central government.

To increase the city's authority over energy and environmental planning, the City of Cape Town founded the Environmental Resource Management Department whose main task is to lead the implementation of the City's Integrated Metropolitan Environmental Policy (IMEP(CCT)) - a framework of strategies and programs for environmental sustainability. Its function include overseeing energy efficiency programs, biodiversity management, environmental capacity

[8] DBSA (2012). Infrastructure Barometer.

building, sustainable livelihoods and communications, and environmental strategies for the City. Similarly, the eThekwini Municipality established the Environmental Planning and Climate Protection Department to enhance the municipality's ability to protect its biodiversity and adaption to climate change; it oversees the development and implementation of the Municipal Climate Protection Programme.

(3) Challenges in renewable energy projects

Despite South Africa's ambitious plan to increase the generation capacity of renewable energy to 42% of the total electricity mix by 2030 according to the 2010 Integrated Resource Plan, the implementation of renewable projects remains challenging throughout the country. The main challenge is the high investment costs required for massive installation of PV panels, wind turbines, cogeneration plants, etc. and the associated operation costs. Very limited government subsidies have been allocated by the central government for renewable energy projects, making them unfeasible to be undertaken by any local governments without outside funding support.

Nonetheless, there are a few ongoing renewable energy projects in the eThekwini areas operated under the public–private partnership (PPP) scheme, including the *KwaDabeka Hostel Hot Water Pilot Project*, the *Low-cost Solar Water Heating Programme*, the *Wind Repowering Project*, and the *Shisa Solar Programme*. However, the local government plays very limited role in the construction, maintenance and operation of these projects; issues arise during project implementation must be solved by the project undertaker without support from the local government.

In addition to the common issues shared among the three cities, specific issues faced by individual cities are presented in the sections below.

2.8.3 Johannesburg

(1) Underutilization of energy and environmental data

The City of Johannesburg has compiled an extensive amount of energy- and environmental-related data of the city such as energy consumption rates, air pollution emission rates, CO2 emission per capita, waste generation rates, water quality levels, etc. At the same time, the City has been evaluating the impact of socioeconomic factors on the environment, and therefore has collected statistics such as population density and growth, migration patterns and rates, incomes and expenditure, housing supply rates, etc.

All of these data are currently used as benchmark indicators for monitoring the progress on various environmental aspects in Johannesburg[9]. However, these data, energy-related data in particular, largely represent the averages or sums of the entire city, and do not differentiate

[9] City of Johannesburg Environmental Management (2008). State of Environment Report 2008.

between parts of the city with different social or economic profile. It may be to the benefit of the city if the development of its energy and other basic infrastructure could be prioritized based on a comprehensive cross-sectorial review that takes into accounts the specific needs and growth profile of different parts of the city. In this regard, the collection and analysis of location-based energy and environmental statistics will be necessary.

(2) Water shortages and pollution

Due to the low average rainfall rate, surface and groundwater pollution, poor water infrastructure maintenance, and the fact that Johannesburg is not located near a large water source, the City is constantly under pressure of water scarcity.

Underground water pollution problem is severe in the Johannesburg area. The contamination of groundwater is mainly due to mining activities, which are expected to expand in the coming years. In old mine tunnels, a large amount of water has been collected and the chemical substances and heavy metals in these old mine tunnels have resulted in groundwater pollutions. Additionally, the continued demand on housing has resulted in active construction activities, which also contribute to groundwater quality deterioration.

(3) Security and safety issues in downtown

The crime rates in downtown Johannesburg remain very high. The city's current priority in this area is the safety and security of its residents; most energy upgrade or environmental measures in this area are deemed impracticable. Therefore, the city government currently focuses its energy and environmental conservation efforts in areas outside of downtown such as the housing energy efficiency upgrade in Cosmo City in Roodeport.

(4) Air pollution

Air pollution is a major concern of City of Johannesburg. In 2011, the annual mean of fine particulate matter, PM_{10} and PM_5, was estimated to reach 98 $\mu g/m^3$ and 51 $\mu g/m^3$ respectively[10]. These pollutant concentrations, which are considerably higher than the other two metropolitan areas, are posing great health risks to its residents[11].

The main contributors of air pollution have been identified by the City as burning of domestic fuel such as coal and paraffin, vehicle emissions, mining operations, industrial activities, and waste disposal and incineration[12].

2.8.4 Cape Town

(1) Deteriorated buildings and citywide energy conservation measures

[10] World Health Organization (2014). Ambient (outdoor) air pollution in cities database 2014.
[11] Annual mean of PM_{10} and PM_5 of Cape Town is 30 $\mu g/m^3$ and 16 $\mu g/m^3$; of Durban is 26 $\mu g/m^3$ and 14 $\mu g/m^3$.
[12] City of Johannesburg (2008). State of the Environment Report.

Most buildings in the city, in both commercial and residential sectors, are very old and badly deteriorated. It is very difficult for the City to enforce the insulation requirements in these existing buildings especially without any financing schemes.

The City of Cape Town is currently promoting low-cost demand-side energy and environmental conservation efforts among its residents, mainly focusing on water conservation and energy saving awareness, and pipe insulations. The City had also implemented interventions in street lighting (LED lamps), traffic lighting, and municipal buildings using the funds from EEDSM municipal programs.

(2) Water shortages

Since 1980's, there are widespread water shortages throughout the Cape Town metropolitan area. The only water resource for Cape Town is surface water; no wastewater reuse or groundwater use systems are currently implemented in the area.

Another critical factor of water shortage is leakages in the water supply system due to aged water pipes and other system components. However, the water supply to the city is provided and managed the provincial government, and therefore the City government has no authority in resolving water leakage issues or installing water supply monitoring system such as smart meters. With the growing demand for water due to population growth and urban development, pressure on water resources will continue to increase in the Cape Town area. The City must look for alternative sources before the demand overruns the supply.

2.8.5 eThekwini

(1) Underuse of local energy resources

Areas surrounding the eThekwini metropolitan areas have been identified as having among the highest biomass (wood, agricultural and grass residues) potential throughout South Africa, but at present the biomass energy is mainly being harvested in the form of are fuelwood in the rural domestic sector[13]. Commercial energy production has been very little due to the generally underdeveloped renewable energy technologies in South Africa. Additionally, relatively high initial costs have contributed to the underutilization of biomass energy in the eThekwini areas.

[13] Ethekwini Municipality (2006). State of Energy Report 2006.

2.9 ICT Planning

2.9.1 Stakeholders in ICT sector

(1) Public Sector (Permission & Authorization)

Department of Communication (DoC), Independent Communications Authority of South Africa (ICASA) and Universal Service and Access Agency (USAASA) are the major permission and authorization entities in the South African public sectors related to the ICT businesses. The roles and relationship among these entities are shown in the figure below.

Figure 2-9-1 Role Clarification in the broader ICT industry[1]

a) Department of Communication (DoC)

In South Africa, Department of Communication (DoC) is responsible for the development of ICT industry, popularization of ICT services and drafting ICT policies which mainly support government-managed business entities.

b) Independent Communications Authority of South Africa (ICASA)

Independent Communications Authority of South Africa (ICASA), established in July 2000, is responsible for drafting regulations on telecommunication sector, giving licenses, regulatory oversight and dispute resolution of business entities, allocation and administration of frequencies and numbers, user protection and certification of equipment. This scope of work

[1] USAASA, Corporate Plan 2009-2014, http://www.usaasa.org.za/export/sites/usaasa/resource-centre/download-centre/downloads/USAASA_Corporate_Plan_2009-2014.pdf, accessed 2014 March 16th

was defined in terms of the Electronic Communications Act (ECA) published in 2005.

c) Universal Service and Access Agency (USAASA)

Universal Service and Access Agency (USAASA) is established in 1996 to be responsible for managing Universal Service and Access Fund (USAF)[2], implementation of ICT policies, such as the improvement of ICT accessibility and promotion of e-government. According to the research by the Japanese ministry of internal affairs and communication[3], its budget of fiscal 2011/2012 year was about 260 million ZAR.

(2) Private Sector (Business & Operation)

a) Telkom S.A. Ltd.

Telkom was established in 1991 as state-owned company and now in the process of privatization with major share holders being government 39.8%, governmental pension fund 10.9% in 2011. Telkom holds 35% of share of Vodacom and its subsidiary company has been promoting fixed-line communication, VSAT (Very Small Aperture Terminal) and ISP(Internet Service Provider) businesses. Total sales in 2011/2012 fiscal year was approximately 33 billion ZAR, which was 1% decrease from previous year. In 2011/2012, subscriptions of fixe-line telephone were 3,350 thousands, mobile phone 185 thousands and broadband 304 thousands respectively.

b) Vodacom

Vodacom was jointly found by a major mobile communication company in the United Kingdom, Vodafone, and Telkom. Initially, Vodacom's share was evenly owned by these two companies. Vodafone has gradually been increasing share hold ratio, being 65% in the middle of 2012. Vodacom has the largest subscriptions in South Africa and has been promoting business also in Tanzania, Lesotho, Mozambique and Congo with total subscriptions in these countries being 47 millions in 2011/2012. Total sales in 2011/2012 fiscal year was over 58 billions ZAR, which was 7.8% increase from previous year.

c) MTN

MTN is a mobile telecommunication company established in 1994 with 100% of share is owned by a South African capital holding company. Having the second largest subscriptions in the South African market, MTN has been promoting businesses in over 20 countries in Africa and the Middle and Near East. MTN's total subscriptions has reached 210 millions which is the largest in Africa[4]. The total sales in 2011/2012 fiscal year was 121 billions ZAR which was 9.7% increase from previous year. MTN was an official sponsor of FIFA world cup held in 2010 in South Africa.

[2] Universal Service and Access Fund, http://www.usaasa.org.za/usaif/, accessed 2014 March 14th
[3] Japan Ministry of Internal Affairs and Communications, Global trend of ICT sector, http://www.soumu.go.jp/g-ict/country/safrica/pdf/027.pdf, accessed 2014 March 14th
[4] IT NEWS AFRICA, http://www.itnewsafrica.com/2014/04/mtn-group-records-210-million-subscribers/, accessed 2014 July 1st

d) Cell C

Cell C is South Africa's third cell network after Vodacom and MTN Group, and the first cellular provider operating a dual band GSM(Global System for Mobile Communications) 900/1800 MHz data network, with over 11.5 million subscribers according to recent reports in My Broadband[5]. Founded in November 2001, Cell C is owned by 3C Telecommunications, which is 60% owned by Oger Telecom South Africa, a division of Saudi Oger; 25% owned in an unencumbered holding by CellSAf, (a Broad-Based Black Economic Empowerment entity representing over 30 black empowerment companies and trusts), and 15% by Lanun Securities SA, which is a wholly owned subsidiary of Saudi Oger Ltd.

e) Neotel

Neotel (Pty) Ltd., previously SNO Telecommunications, is the second national operator (SNO) for fixed line telecommunication services in South Africa. It was unveiled on 31 August 2006 in Kyalami in northern Johannesburg. Neotel is South Africa's first direct telecommunications competitor to the current telecommunications parastatal, Telkom. The new company announced its business services on 15 November 2007 and its consumer services in May 2008. Its business services include local and international leased line services, as well as a suite of voice, data (VPN), and Internet offerings delivered over its converged, next-generation network. International Transit services for wholesale customers have been available since September 2006. They plan to use wireless broadband technologies, amongst others, which not only allows data transfers but also voice in the form of VOIP (Voice over Internet Protocol)[6].

2.9.2 ICT-related legislations

a) Electronic Communications Act, 2005

This act mainly defines principles of regulating businesses and relevant entities' scope of work after the liberalized market, such as criteria in giving license to telecommunication business entity, administration of frequency, interoperation and management conditions of USAF.

2.9.3 ICT policy trend

a) National Broadband Policy (NBP)

On December 6th 2013, Cabinet approved a new National Broadband Policy (NBP) 2013 that was to replace the previous broadband policy published in 2010. Below is the summary of the four central targets adopted in the NBP 2013.

[5] My Broadband, MTN losing market share to Cell C, http://mybroadband.co.za/news/cellular/97075-mtn-losing-market-share-to-cell-c.html, accessed 2014 March 17th
[6] Wikipedia, Neotel, http://en.wikipedia.org/wiki/Neotel, accessed 2014 March 17th

Table 2-9-1 Summary of the four central targets in NBP 2013[7]

Target	Penetration measure	Baseline (2013)	By 2016	By 2020	By 2030
Broadband access in Mbps user experience	% of population	33.7% Internet access	50% at 5Mbps	90% at 5Mbps 50% at 100Mbps	100% at 10Mbps 80% at 100Mbps
Schools	% of schools	25% connected	50% at 10 Mbps	100% at 10Mbps 80% at 100Mbps	100% at 1Gbps
Health facilities	% of health facilities	13% connected	50% at 10Mbps	100% at 10Mbps 80% at 100Mbps	100% at 1Gbps
Public sector facilities	% of government offices		50% at 5Mbps	100% at 10Mbps	100% at 100Mbps

b) ICASA Strategic Plan

The Vision 2020 landscape defines a new era in ICTs for South Africa that rests on six pillars as shown in the figure below.

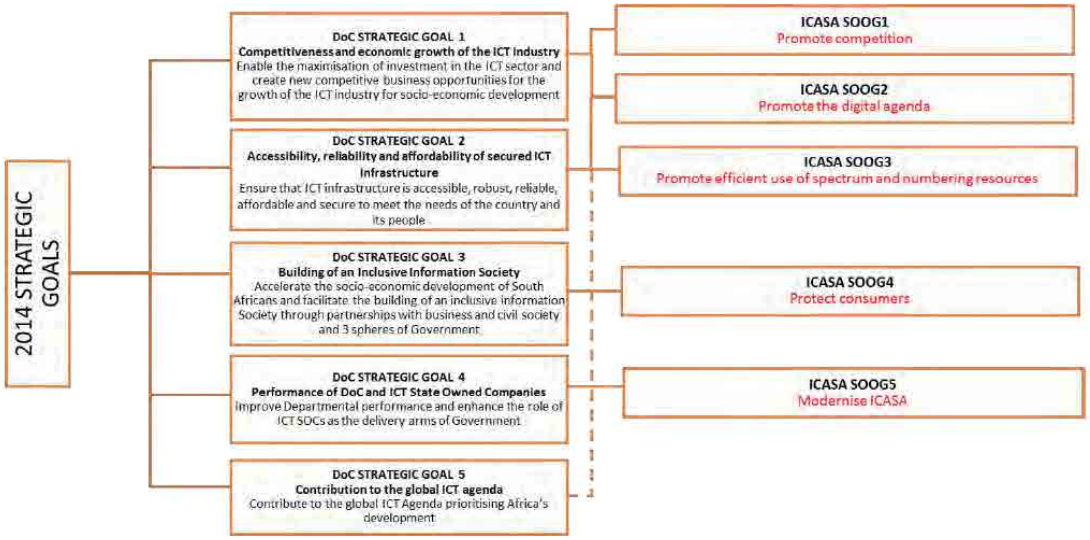


Figure 2-9-2 Summary of ICASA Strategic Plan 2014-2018[8]

That is, boost Foreign Direct Investment (FDI) in the ICT sector, increase experts in the ICT, increase ICT contribution to GDP, job creation, broadband access and e-skills. As a precursor to this new era in ICTs for all South African the Authority will ensure that it implements regulations on migration to Digital Terrestrial Television (DTT), Local Loop Unbundling and Universal Access to broadband. In 2013 October 18th, ICASA published Three-Year Corporate Strategy where five strategic objectives, schedule and key performance indicators are stated. The authority's response to the DoC's strategic plan is illustrated in the mapping of ICASA SOOGs to the DoC's Strategic Goals in the diagram above.

c) USAASA Corporate Plan

USAASA develops programmes that align with the objectives of the Universal Service and

[7] Ellipsis regulatory solutions, National Broadband policy 2013, http://www.ellipsis.co.za/national-broadband-policy/, accessed 2014 Mach 16th

[8] ICASA, ICASA Strategic Plan 2014-2018, https://www.icasa.org.za/AboutUs/StrategicPlans/tabid/752/ctl/ItemDetails/mid/2720/ItemID/1711/Default.aspx, accessed 2014 March 16th

Access Fund (USAF) in order to adhere to national government priorities in the NDP which seeks to attain universal access to broadband by 2020 (at speeds >2Mbs)[9]. The USAF was found in 1998 and is financed mostly by the national government. Telecommunication business entities have an obligation to pay 0.2% of their income to the fund. The agency has been promoting the following three programmes to improve the ICT environment in South Africa[10].

Programme 1: Community and Institutional Broadband Access

1a) Backbone Network Extension

1b) Institutional Broadband Connectivity

1c) Broadband ICT for Schools

1d) Post Offices and Public Access

1e) Broadband ICT for Health Clinics

1f) Broadband ICT for Local Government

Programme 2: Universal Basic Mobile Telephone Service

Programme 3: ICT Training and Capacity Building Support

Programme 4: ICT Content and Applications

Programme 5: Universal Access to Broadcasting

5a) Television Set-Top Boxes

5b) Community Broadcasting

Programme 6: Affordable ICT's

Access and service programme for people with disabilities (PWD)

2.9.4 ICT infrastructure development status

(1) Fixed-telephone

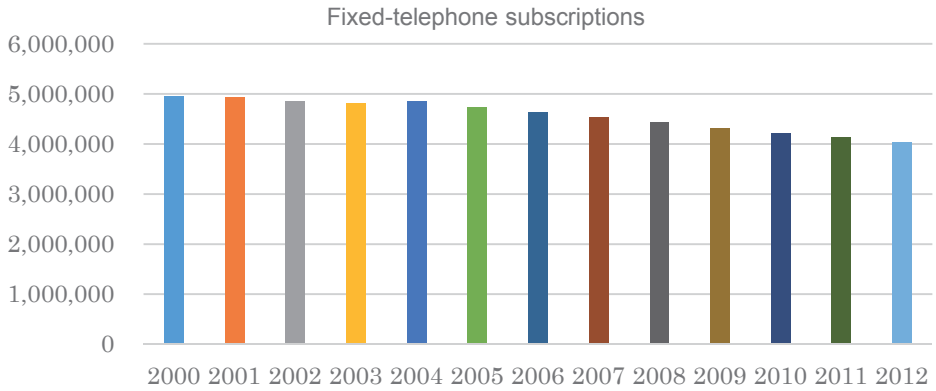


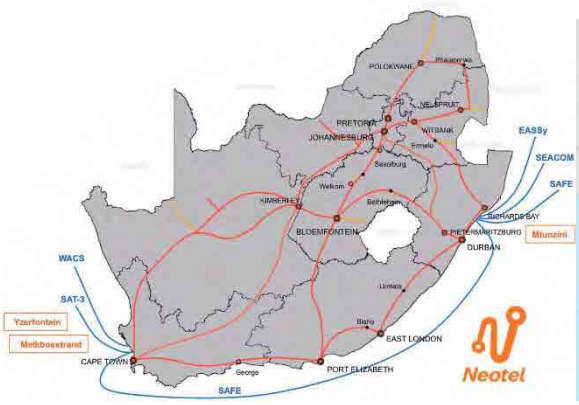
Figure 2-9-3 Fixed-telephone subscription 2000-2012[11]

[9] USAASA, Corporate Plan 2009-2014, http://www.usaasa.org.za/export/sites/usaasa/resource-centre/download-centre/downloads/USAASA_Corporate_Plan_2009-2014.pdf, accessed 2014 March 17th

[10] USAASA, National Strategy on Universal Service & Access – Consultative Document, http://www.usaasa.org.za/export/sites/usaasa/resource-centre/download-centre/downloads/Consultative-Document-on-National-Strategy-signed.pdf, accessed 2014 March 16th

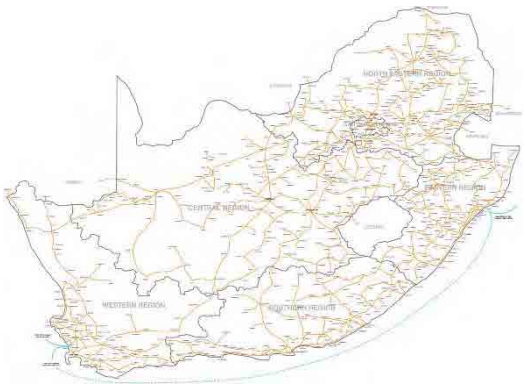
[11] ITU Statistics, http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx, accessed 2014 March 5th

According to the ITU (International Telecommunication Union) statistics, subscription of fixed-telephone is approximately 8% in 2012 and has been decreasing every year. Especially in the rural areas, there are considerable numbers of districts with less than 5% of penetration ratio due to the spread of mobile phones. As South African PTSN(Public Telephone Switched Network) cable are mostly owned and managed by the state-owned Telecom, new players such as Broadband Infraco, Neotel and three mobile network operators have started to construct optical fiber network. The central government has been supportive to these new comers and collaborating with Broadband Infraco in the development of optical fiber network from 2007. In 2011 March, total length of South African fiber network reached 13,612km, enabling the international connection to the neighboring countries. From 2009, Neotel, state-owned fixed communication company, has been jointly developing 10,000km optical fiber network in rural areas with two major mobile communication companies, MTN and Vodacom. In the end of 2010, a consortium called FibreCO, with a mobile network operator Cell C as a principal company, published a plan to construct 12,000km optical fiber network and the 4,500km network to be constructed for the first phase of the project. Undersea optical fiber cables (SAT3/WASC, SAFE, Essay) and satellite communication has been deployed for international telecommunications.



Neotel

Infraco



Telkom

Figure 2-9-4 South African fibre map[12]

[12] Mybroadband, Fibre in SA, http://mybroadband.co.za/news/broadband/42651-fibre-in-sa-an-eye-opener.html, accessed 2014 March 17th

(2) Mobile cellular phone

The penetration ratio of mobile phone in 2012 was approximately 130%. Vodacom, a subsidiary company of Vodafone, MTN, Cell C and Telcom are providing mobile communication services. These companies are already providing 3G services and 3G service subscriptions are exceeding 20% of all. Vodacom started LTE (Long Term Evolution) services in Johannesburg from October 2010. The rest of major companies are conducting the trial project in rural areas, foreseeing the introduction of LTE service in near future. The ratio of smart phone among the all mobile phone terminals is about 30% in December 2011. In terms of integrated service, a broadcasting company called Multi-choice is providing TV viewing service with DVB-H (Digital Video Broadcasting - Handheld) system which can work with Vodacom, MTN and Cell C mobile phones. According a research conducted by Ericsson in 2012, subscriptions of Mobile Money Service (MMS), provided by Vodacom and MTN, have reached 25% of all mobile phone users[13]. The breakdown of MMS users by purpose are 19% for payment at shops, 4% for international and domestic money transfer and 13% for mobile banking. Vodacom has also been providing services in the four neighboring countries gaining the 47 millions users including South African market. MTN has the second largest market share in South African market and providing services in more than 20 countries both in African and Middle east regions with 170 million in total users.

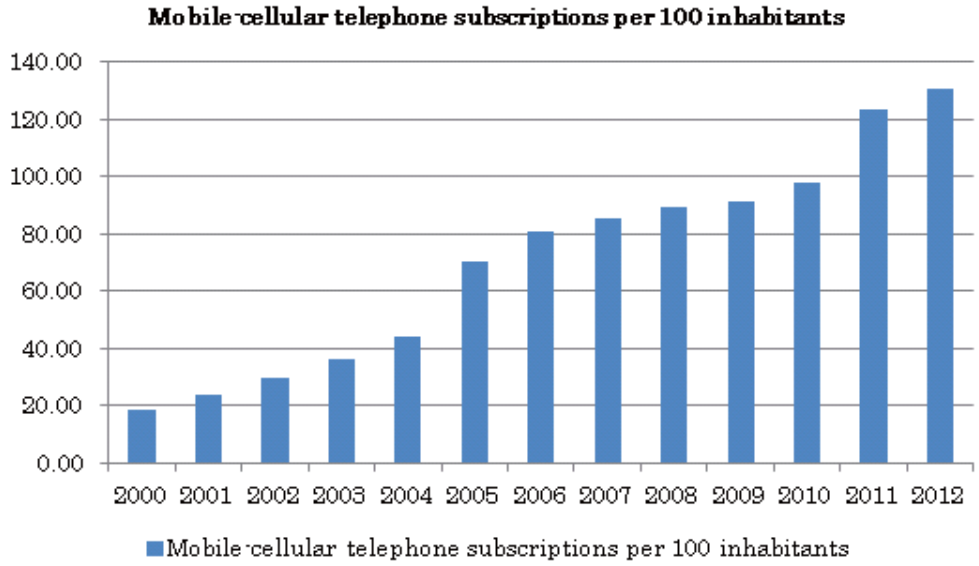


Figure 2-9-5 Mobile phone subscriptions 2000-2012[14]

[13] Ericsson Consumer Lab, M-commerce in Sub Saharan in Africa, http://www.ericsson.com/res/docs/2012/consumerlab/m-commerce_sub_saharan_africa.pdf, accessed 2014 March 16th
[14] ITU Statistics, http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx, accessed 2014 March 5th

(3) Internet Communication

The penetration ratio of wired broadband is approximately 2.2% in 2012 and about 90% of users are using ADSL (Asymmetric Digital Subscriber Line). Telkom and other major 4 companies, Mweb, Vox, Axxess DSL, iBurst, are taking more than 80% share in the market. The maximum connection speed of ADSL has reached 10Mbps and Wimax (Worldwide Interoperability for Microwave Access) 8Mbps. Telkom also provides satellite internet service by VSAT which gives maximum 512Mbps. Subscriptions of mobile internet exceeded 20 million in the middle of 2011. On the other hand, subscriptions of wired broadband are still 1.15 millions despite of the fact that the wired network widely covers South African cities. Telkom was having a monopoly in the South African broadband market Up to 2006. After 2007, when the resale of Telkom's network was permitted, other company can also develop their own network and therefore accelerating the transformation of broadband market.

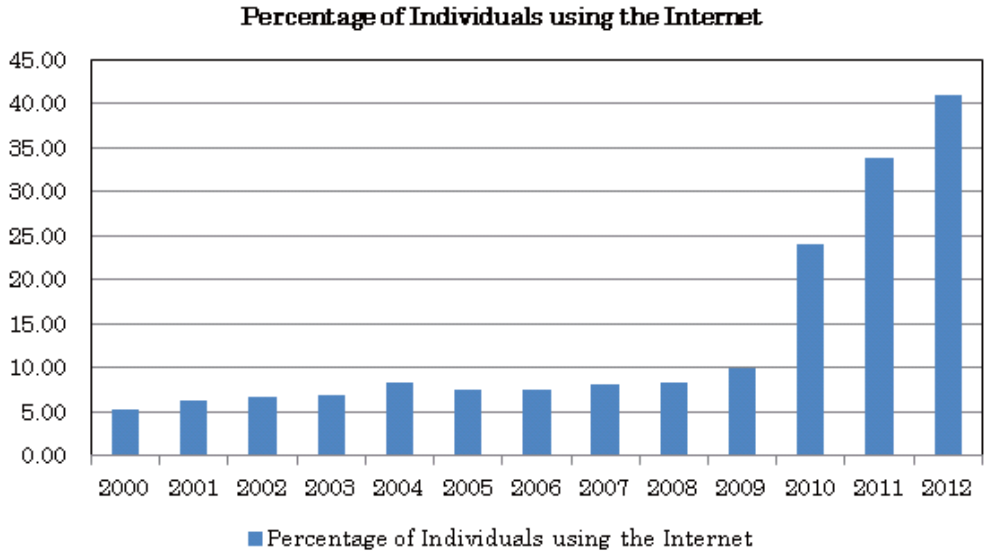


Figure 2-9-6 Wired broadband subscriptions 2000-2012[15]

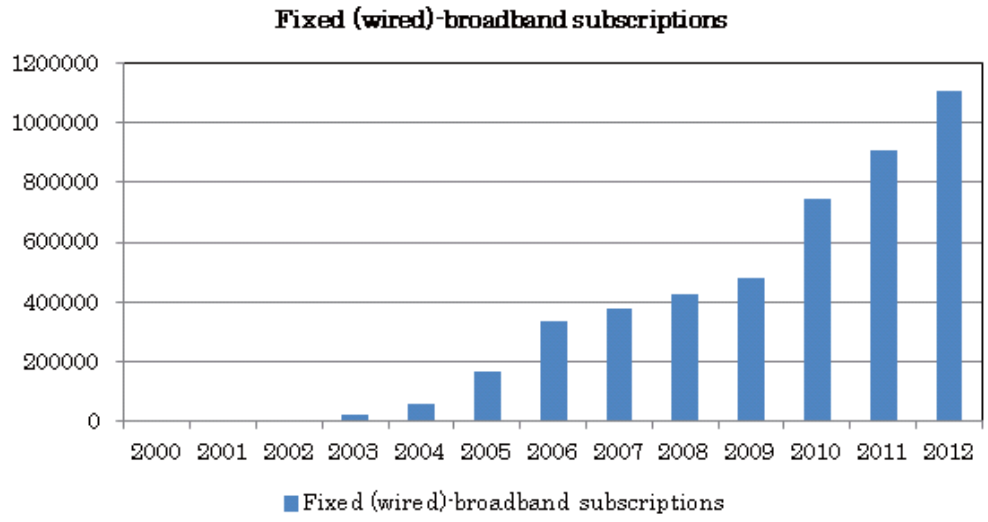


Figure 2-9-7 Wired broadband subscriptions 2000-2012[16]

[15] ITU Statistics, http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx, accessed 2014 March 5th

(4) ICT accessibility by households

In South Africa, as the penetration ratio of fixed-line telephone cables are considerably low, wireless broadband therefore becomes major choice among most of all users. Whereas, ADSL took major roles in developing broadband in Japan or other developed countries, it is popular in South Africa to use a dongle, an electronic device that must be attached to a computer in order for it to use protected software, to connect to the internet.

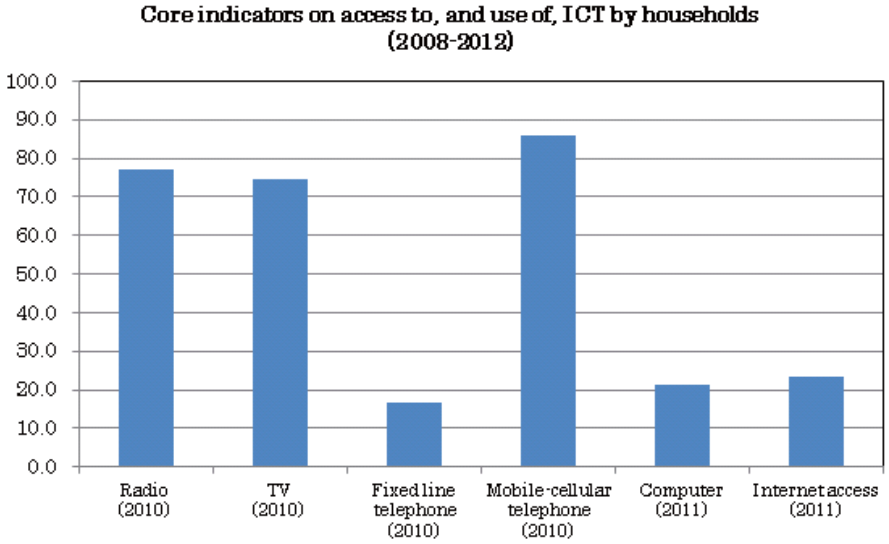


Figure 2-9-8 ICT accessibility by households (2008-2012)[17]

2.9.5 South African ICT market penetration by foreign companies

(1) Japanese companies

With regard to the Japanese companies' market penetration in South Africa, private sector investments have been prominent and activities by public sectors such as Official Development Assistance (ODA) are not present in the ICT sector. This section describes major activities by Japanese companies in the South African ICT market.

a) HIATCHI

Hitachi established a Johannesburg office in 1963 and has been conducting business in South Africa for over 50 years. The Company has supplied products such as compressors to mining companies, trains, mainframes, and consumer goods. Hitachi Power Europe and Hitachi Power Africa contracted with ESKOM to deliver and install boilers for power stations. Currently, for consumers, Hitachi provide audiovisual products and white goods and for industries power tools, ink jet printers, chillers and chains. Hitachi Construction Machinery Southern Africa is supplying excavators, dump trucks and wheel loaders to the region. The company has also developed a landmine sweeper. Hitachi also supplies storage and server systems together with a

[16] ITU Statistics, http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx, accessed 2014 March 5th
[17] ITU Statistics, http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx, accessed 2014 March 5th

local partner[18]. In 2011, Hitachi Data Systems Corporation (HDS) acquired Shoden Data Systems, South African IT product merchandise and service company, to promote its storage solution business.

b) KDDI

In 2010, Telehouse, high-quality data centers deployed globally by KDDI, set up its first South Africa data centres in Cape Town and Johannesburg through a partnership with Teraco[19].

c) NEC

NEC has been promoting businesses in telecommunication, broadcasting, postal and other IT system equipments for government, municipal offices and local enterprises. NEC Africa manages and promote security solution businesses (such as National ID system, Border Control system, etc) based on its biometrics technology[20].

d) NTT

NTT acquired South African ICT service provider Dimension Data Holdings in 2010.

(2) Other international companies

In Africa, Chinese company such as Huawei and ZTE have been showing a presence in various sectors. These two companies have been promoting a wide range of businesses from mobile base stations to terminal devices as well as CSR activities with local educational and medical institutions[21].

a) Huawei (China)

Huawei is the largest telecom equipment manufacturer and network solutions provider in China and the third-largest in the world. It entered African market in 1997 and has invested approximately 15 billion USD over these 10 years. Africa accounts for about 12 to 13 per cent of Huawei's revenue (about US$ 3.5 billion from Africa, 2010). It operates more than 20 regional offices, 2 R&D (Research and development) centers and 6 training facilities in Africa. Its major products are switching circuit, intelligent network, synchronous digital hierarchy (SDH), telecommunication network, wireless system and broadband integrated services digital network (BISDN).

b) ZTE (China)

State-owned ZTE is the second in China and the fifth largest in the world. For ZTE, Africa sales make up a slightly lower proportion at about 11 per cent or US$ 1 billion in 2009. Annual sales of mobile phones in the region is about US$ 4 to 5 billion a year with an estimated growth rate about 15 per cent. ZTE in Africa has 1,000 employees, representatives in nearly 50 African countries, 1 training centre and 15 training bases in Africa, providing training for 4500

[18] Hitachi, Hitachi in Sub-Saharan Africa, http://www.hitachi.co.za/about/hitachi/, accessed 2014 March 16th
[19] KDDI, South Africa Data Centres, http://www.telehouse.net/South-Africa-Data-Centres/, accessed 2014 March 16th
[20] NEC, South Africa, http://www.nec.com/en/global/office/south_africa.html, accessed 2014 March 16th
[21] Brown, Peter J, Asia Times, http://www.atimes.com/atimes/China_Business/KK18Cb01.html, accessed 2014 May 20th

Africans annually[22]. ZTE's major products are fixed phone, mobile phone, data base, optical communication network, intelligent network and telecommunication equipment[23].

2.9.6 Integration of ICT into urban development (Smart City)

South Africa is increasingly becoming a popular destination for businesses and individuals. As such, it is important for the country to efficiently offer world-class services to residents and visitors. This increasing need for efficient service delivery in South Africa has motivated the government to consider the idea of having smart cities in the country. A smart city relies on ICT enabled services and applications as part of the city system in order to be more effective.

This section shows general information regarding plans and actions related to smart city development, covering the following aspects:

1) Development of E-government systems

The development of efficient e-government services allows the city's management to be more effective in service delivery to both residents and visitors to the city. This is a critical prerequisite for the development of other areas of the smart city concept. E-government creates the necessary platform for the city to manage all other forms of infrastructure.

2) Intelligent Transportation systems

Transport systems facilitate movement within cities. It is essential to have transport systems that enable efficient movement within a city. This requires the systems to address; Causes of traffic, accidents (Disaster Management Systems) and any related transport matters. A smart city's goal is to have efficient, cost-effective transport systems in order to reduce time spent travelling, pollution and energy use in the city. These transport systems can be achieved through the use of appropriate ICT and are built on the back-bone of robust and well developed e-government systems.

3) Smart grids, energy efficiency and the environment

Energy saving is a fundamental component of any smart city. Given the current energy challenges in South Africa, it is essential for cities to start adopting innovative energy saving approaches. A fundamental building block to saving energy is having smart grids, energy efficiencies and environment friendly energy sources. ICT infrastructure that can be used to monitor power grids and allocate energy use are necessary to achieve energy efficiency in a smart city, and adopting the use of various forms of power sources (cogeneration) is critical to saving the environment by using less polluting energy sources.

4) Smart Water and Sanitation systems

Water and sanitation are key infrastructural elements for South Africa's cities. The lack of water and sanitation has led to public strikes in several cities and it is fundamental for a smart

[22] Andrea Marshall, China's mighty Telecom footprint in Africa, http://www.newsecuritylearning.com/index.php/archive/75-chinas-mighty-telecom-footprint-in-africa, accessed 2014 May 20th
[23] IDE-JETRO, China in Africa, http://www.ide.go.jp/Japanese/Data/Africa_file/Manualreport/cia09.html, accessed 2014 May 20th

city programme to have appropriate water and sanitation systems in order to deliver services effectively. Furthermore, water and sanitation are important for the health of citizens, and a healthy population is necessary for development. ICT infrastructure in a smart city can be used to manage water and sanitation infrastructure from basic water treatment, to distribution. Smart water and sanitation systems are necessary to monitor water quality, leakages, water usage, revenue collection and service delivery levels in a city.

(1) Johannesburg[24]

The city of Johannesburg has a smart city master plan and has started rolling out some aspects of the plan. Currently the city is rolling out broadband cables across Johannesburg in partnership with Ericsson. Broadband is identified as the most critical aspect of the city's plans as it provides the backbone infrastructure for the delivery of all other aspects of the smart city.

The city of Johannesburg does not consider intelligent transportation systems to be a priority as there is already the Gautrain (High speed train connecting key hubs in the city) and Rea Vaya buses (Bus Rapid Transport System implemented for mass public transport).

The city currently considers Smart grids, energy efficiency and the environment and Smart Water and Sanitation Systems as a priority. These will be built on the broadband infrastructure that is currently being rolled out.

The biggest challenges to implementing the smart city master plan are:

- Lack of funding
- Broadband infrastructure exists but there are limited connections to the infrastructure

(2) Cape Town[25]

The city of Cape Town has a smart city master plan and started implementation of some aspects (SAP-ERP Integration) of the plan almost 10 years ago. The city has rolled out a core broadband network of 70Km and 200Km of connectors. The City plans to expand this annually over the next 10 years.

The city has connected approximately 100 city offices to the existing broadband infrastructure and plans to connect all key municipal office by the end of 2013. In partnership with the Western Cape Provincial government, there are plans to connect 45 key provincial buildings and hospitals by June 2013.

The city has prioritized the following aspects of a smart city:

-Governance – ICT driven access to government information and related audits. To enhance

[24] City of Johannesburg, Integrated Development Plan (IDP) 2013-2016
http://www.joburg.org.za/images/stories/2013/June/2013-16%20idp%2017may2013%20final.pdf, accessed 2014 March 17th

[25] City of Cape Town, Integrated development Plan (IDP) 2012-2017
http://www.capetown.gov.za/en/IDP/Documents/CCT_IDP_prf82013.pdf, accessed 2014 March 17th
City of Cape Town, Smart City Strategy
http://www.stadtentwicklung.berlin.de/archiv/metropolis2005/download/doku/frauen/fk_ppp_samuels_en.pdf
http://web.capetown.gov.za/eDocuments/Smart_City_Public_Private_Partnership_Conference_228200310231_389.pdf

the governance structures, the City provides each elected councilor with a computer.

-Administration – ICT driven City management and operation

-Environment and Sustainability – ICT Socio-economic aspects of a smart city such as; Smart grids, Smart water use and smart transport systems

The city is looking at green energy sources and has rolled out smart metering, invested in a wind-farm (Power off-taker) and investigating solar power water heating options. The City is also looking at unique solutions for local government processes. These are not currently part of the integrated SAP environment but have to plug into SAP.

There are future plans to use technology to enable social services across the city. These include key services such as;

-Safety and security

-Smart metering

-Smart mobility

The biggest challenges to implementing the smart city master plan have been:

-Prioritizing and managing resource (Financial and skills) allocation.

-Skills attraction and retention

-Changing the mind-set within governance structures to appreciate the importance of various aspects of a smart city

-Meeting the created smart city expectations

-Managing lengthy government procurement processes

Despite the challenges, the governance structures in the city are realizing the importance of a smart city gradually and their mind-set is changing.

(3) eThekwini[26]

The city of EThekwini has a smart city master plan and started implementation of some aspects of the plan in June 2008. Currently the city has rolled out broadband cables across most of EThekwini. Broadband is identified as the most critical aspect of the city's plans as it provides the backbone infrastructure for the delivery of all other aspects of the smart city.

The city has connected all its 400 municipal offices to the existing broadband infrastructure and provides access to broadband to businesses in the city through their Metro Connect services to enhance business to business (B2B) and business to municipality connectivity.

Furthermore, the city has rolled out free public WiFi (Wireless Fidelity) access at 50 of their 100 public libraries based on the existing broadband infrastructure. This WiFi infrastructure is also shared by public clinics that are within proximity of the libraries. The clinics use the network to share information collected at each clinic across a common database.

The city of EThekwini does not consider intelligent transportation systems to be a priority as

[26] EThekwini Municipality, Integrated Development Plan (IDP 2012/2013, http://www.durban.gov.za/City_Government/City_Vision/IDP/Pages/default.aspx, accessed 2014 March 17th)

there are already plans and developments to build transport corridors in the city. The current corridors planned are:

-KwaMashu to Durban CBD

-KwaMashu to Pine Town

The city currently considers Smart grids, energy efficiency and the environment (Pilot currently running for wireless smart metering systems) and Smart Water and Sanitation Systems as a priority. These will be built on the broadband infrastructure that is currently being rolled out. Other future priority areas are:

-Expansion of the current video surveillance systems across the city as part of the crime prevention initiative.

-Enhancement and expansion of the current disaster management centre systems

-E-learning systems as a critical enabler for delivery of education material to schools

The biggest challenges to implementing the smart city master plan have been:

-Lack of funding

-Lengthy procurement processes

In order to overcome the challenges identified, the city is considering engaging in Public Private Partnership (PPP) possibilities with a view to meeting the funding gap and having a more efficient procurement process in order to deliver on the smart city master plan.

2.9.7 Summary of major issues in South Africa's ICT sector

This section summarizes the major issues and challenges in the South Africa's ICT sector according to the findings from field survey as well as the gap analysis in South Africa's Broadband Policy published in November 2013[27]. These issues stated below are structured by the aspects of availability, affordability, application and capability.

(1) Availability of ICT infrastructure:

"The real gap is in the last-mile or local loop infrastructure"

The slow deployment of fixed broadband services ADSL and the relatively high costs have meant that, over the last five years, mobile broadband has rapidly become main form of broadband access, rather than providing a complementary service to fixed broadband, as is the case in mature economies. Despite this take-off in mobile broadband, South Africa's broadband penetration remains poor compared to that of other lower middle-income countries.

The national broadband infrastructure value chain can be understood as consisting of the following elements, all of which require supply side strategies to ensure coordination and integration:

-International connectivity, provided via under-sea cables;

[27] South Africa's Broadband Policy, www.gov.za/documents/download.php?f=205142v , accessed 2014 May 21st

-Domestic backbone, long distance fibre optic links, including regional (rural) district extensions;
-Metropolitan networks
-Local access networks; and
-On-site (Local Area Network) connectivity and devices.

a) International connectivity:

Until 2009, South Africa was connected to the rest of the world via a single submarine cable, SAT3, four submarine cables provide a combined capacity of 11.5 terabits per second of international connectivity, available on a wholesale basis from at least 5 providers. Additional cables that are under construction will bring the total capacity to 29.5 terabits per second. Since the introduction of under sea cable competition in 2009, prices have dropped dramatically, driving demand and resulting in better use of available capacity. Despite this, there is still considerable capacity available to meet immediate future needs.

b) Domestic backbone or National long distance network:

Long distance inter-city fibre optic connectivity is provided by a number of private sector players and state-owned companies. An extensive long distance fibre network exists in South Africa, to the extent that approximately 86% of the South African population is within 10km of access to fibre. There are concerns that some long haul fibre may not be sufficient to cater for future demands. A key part of this is the regional (rural) district extensions: Rural networks exist in large parts of South Africa, but as a consequence of spatial legacy of Apartheid, limited infrastructure exists in the former homelands and other historically disadvantaged areas.

Additionally, with the increasing reliance on mobile or wireless communications, there is more demand than ever for radio spectrum.

c) Metropolitan Area Networks:

The gap in high-capacity backbone infrastructure is greatest in rural areas and in particular in former homelands. There are also some urban areas with high population densities that remain unserved. In high demand metropolitan areas there is considerable duplication of infrastructure, but outside these areas, ADSL is limited, The delay in releasing spectrum and the cost of building out high-speed next generation networks to low demand areas, mean that the substitution of mobile broadband for ADSL is not as prevalent as it is in metropolitan areas.

Most municipal areas have considerable core network infrastructure, dominated by Telkom's network infrastructure developed over many years. The relatively new entrant, Dark Fibre Africa has built nearly 8000km of metro ducts and fibre in all major metros and a number of secondary cities providing open access dark fibre on a wholesale basis. In addition, many municipalities have built their own municipal fibre networks to serve the needs of local government. As is the case of longer distance networks, this metropolitan area infrastructure

reflects South Africa's unequal spatial development, with limited network infrastructure in townships. Local governments have invested significantly in broadband infrastructure roll-out for the last 10 years and there are a number of successful projects and initiatives. This drive by local and provincial government has resulted in two undesirable unintended consequences. The first is the proliferation of projects in an uncoordinated manner and the duplication of effort and networks and the possible wasting of resources. The second unintended consequence has been the conflict that has arisen between municipalities with vested interests in their own infrastructure deployment in those areas.

d) Access networks:

The real gap is in the last-mile or local loop infrastructure. The increased availability and reduced cost of international bandwidth that resulted from the landing of multiple undersea cables since 2009, together with the take-off of mobile broadband, has massively increased demand for data services. With increased access to the internet, particularly through wireless broadband devices, the critical infrastructure constraint is no longer a lack or high cost of international bandwidth, but the development of national terrestrial networks. In particular, a high capacity access network is necessary.

In South Africa the biggest gap in the national broadband infrastructure is currently in the access network illustrated by the fact that 86% of the population is within 10km from a fibre access point. Broadband access is provided via mobile, fixed wireless, ADSL and, to a very limited scale, by fibre to the premises (FTTP). Of the access mechanisms, mobile coverage is the most extensive, but mobile broadband access is limited to lucrative urban areas and data costs are relatively high. Extending broadband access is dependent on allocation of high demand spectrum. It is also dependent on higher tower density, which requires additional investments by mobile operators.

The fixed-line incumbent, Telkom is the sole providers of ADSL connectivity and has only 800,000 subscribers. Although a large number of internet service providers can legally provide internet services over ADSL, their ability to differentiate their offerings and service levels is limited by the cost and points of interconnection into the Telkom network. Fixed wireless is available in limited areas and fibres to the premises (FTTP) to a very limited extent at a high cost. Access networks are generally available as a retail service only.

e) On-site (LAN) connectivity and devices:

Previously the cost of personal computers represented a significant barrier to access by individual users. The advent of low cost mass produced smart phones and tablets has however to a significant extent overcome this. Gaps that remain related to:

Affordability of devices amongst a significant portion of the population

Institutional absorption of such devices, for instance in schools; and

Inability of these devices to address all user requirements.

(2) Affordability of ICT services

"Competition in international bandwidth has brought down the cost significantly, but this has not all been passed through to end users"

High communication cost has constrained investment in South Africa as a regional hub, and particularly investment in large-scale business process outsourcing and similar job-creating industries. Despite recent reductions in both fixed and mobile data prices, broadband pricing remains a barrier to exponential growth in broadband use.

The high prices charged for communications services are identified as one the primary factors hampering South Africa's competitiveness. The lack of effective regulation of wholesale markets and the inability to provide incentives to operators to share infrastructure means that wholesale broadband has not been widely accessed thus affecting the development of services based competition. Competition in international bandwidth has brought down the cost significantly, but this has not all been passed through to end users – terrestrial network charges and IP transit charges remain high and, as yet, are not regulated.

(3) Applications of ICT

"applications to support the promotion of safety and security"

"unequal capabilities of individuals and groups"

The key to leveraging the benefits of broadband lies in the effective application of ICT both by supply and demand sides, namely government's coordination ability across different sectors and stimulation of demand through the development of people's digital literacy, computer skills, and availability of devices.

Government can play a significant role in encouraging uptake and usage of ICT through ensuring the availability of relevant content to drive demand – this includes ensuring e-education and e-health content and applications to support the promotion of safety and security, social development schemes, and home affairs, amongst others.

There is now considerable evidence to demonstrate that inequality of access and use of ICTs and therefore the ability to deploy their full potential – is rooted in the unequal capabilities of individuals and groups, such as the poor, particularly poor women, those living in rural areas, persons with disabilities, and the elderly. The greatest gap for South Africa is overcoming human development and having the skills base necessary to operate a knowledge economy.

Table 2-9-2 Major issues in ICT sector in terms of urban development

	Urban	Suburban
ICT Infrastructure Development	- Lack of multiple telecom infrastructure options - Insufficient level of infrastructure security - Redundant duplication of infrastructure investment	- Fibres are not covering last miles - Considerable construction cost of fibres due to the sparsely spread suburban communities - Most people are dependent on their mobile devices for internet connection
ICT Application	- Insufficient level of public security & safety - Insufficiency of BCP Counter measures in case of emergency -Inefficient operation and maintenance of utilities	- Unequal opportunities in education, Skill development, and medication - Insufficient accessibility to critical information to live - Insufficient capabilities to utilize ICT to improve quality of life

2.10 Disaster and Crime prevention

2.10.1 Johannesburg[1]

(1) Disaster Risk Management

- City of Johannesburg has developed a Level 1 Disaster Management Plan, which focuses primarily on establishing institutional arrangements for disaster risk management, putting in place contingency plans for responding to known priority threats and developing the capability to generate a Level 2 Disaster Risk Management Plan.
- The top most prevalent hazards identified by the City are:
  - Fires in informal settlements;
  - Floods and storms affecting informal settlements;
  - Rail accidents;
  - Spillage of hazardous materials; and
  - Sinkholes as result of dolomite.

(2) Crime prevention

- Johannesburg Metro Police Department (JMPD)
- Drug & Crime Prevention Program & Gateway Project for ex offenders

(3) Problem recognition

- Although fire and flood are pointed as risk factors in high-density and fireproofed residential district as typified by informal settlements, there is no sufficient countermeasure. Prompt improvement of the environment including fireproofing of the buildings and construction of drainage system for the residential district is required as can be seen in the informal settlements.
- According to our pre-study and field study, there is a tendency of security deterioration and high crime rate especially in downtown. However, it is necessary to address this issue from various aspects including income disparity because of the insufficiency of security and guarding function. It is required to realize a safe environment, starting with a particular area such as the station vicinity where people tend to gather.

2.10.2 Cape Town[2]

(1) Disaster Risk Management

The City has a Disaster Risk Management Centre (DRMC) tasked to identify, prevent or reduce the occurrence of disasters, and to soften the impact of those hazards that cannot be prevented. The DRMC perform a co-ordination role, ensuring that multiple emergency and essential services work in an integrated and efficient manner, both pro-actively (risk reduction, planning and preparedness) and re-actively (response, relief, recovery and rehabilitation).

[1] The descriptions in this section are mainly quoted from City of Johannesburg: 2012/16 Integrated Development Plan (IDP) directly.

[2] The descriptions in this section are mainly quoted from Source: City Of Cape Town: Built Environment Performance Plan (BEPP) 2012/13 directly.

(2) Community safety

The City has three policing departments: Metro Police, Traffic Services, and Law Enforcement and Specialized Services.

The City's neighborhood watch assistance program was initiated in August 2008, of which the main objective is to strengthen the local communities' capacity to prevent crime and disorder.

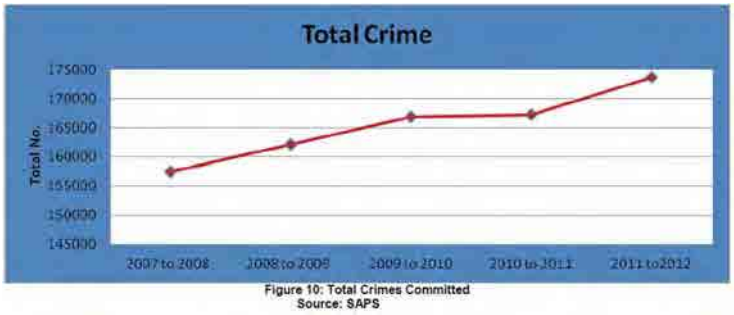
2.10.3 eThekwini[3]

(1) Disaster Risk Management

- The city has a Municipal Disaster Management Centre and Disaster Operations Centre.
- Plan and policies for disaster management in place include the following:
  - Municipal Disaster Management Policy Framework (September 2009)
  - Municipal Disaster Management Plan
  - Municipal Disaster Management Advisory Forum
  - Disaster Management City Wide Risk Assessment Study

(2) Crime Prevention

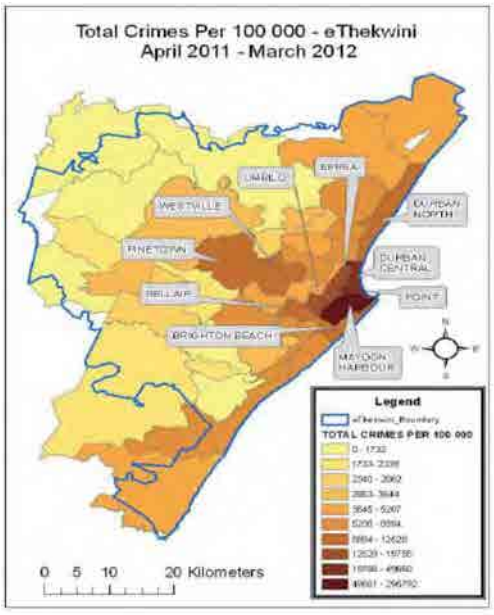
- The key issues relating to crime include:
  - Unacceptably high levels of crime
  - Urban design is not conducive to ensure a safe environment
  - Limited funding to address high crime levels
- Total crime number has increased year by year (Figure 2-10-1), and it is concentrated in the center of eThekwini (Figure 2-10-2).



Source: eThekwini Municipality Integrated Development Plan 2012/13 to 2016/17 Annual Review 2013/2014

Figure 2-10-1 Total Crimes Committed

[3] The descriptions in this section are mainly quoted from eThekwini Municipality Integrated Development Plan 2012/13 to 2016/17 Annual Review 2013/2014 directly.



Source: eThekwini Municipality Integrated Development Plan 2012/13 to 2016/17 Annual Review 2013/2014

Figure 2-10-2 Spatial Location of Crimes

2.10.4 Current issues

(1) Johannesburg

- Although fire and flood are pointed as risk factors in high-density and fireproofed residential district as typified by informal settlements, there is no sufficient countermeasure. Prompt improvement of the environment including fireproofing of the buildings and construction of drainage system for the residential district is required as can be seen in the informal settlements.
- According to our pre-study and field study, there is a tendency of security deterioration and high crime rate especially in downtown. However, it is necessary to address this issue from various aspects including income disparity because of the insufficiency of security and guarding function. It is required to realize a safe environment, starting with a particular area such as the station vicinity where people tend to gather.

(2) Cape Town

- Although fire and flood are pointed as risk factors in high-density and fireproofed residential district as typified by informal settlements, there is no sufficient countermeasure. Prompt improvement of the environment including fireproofing of the buildings and construction of drainage system for the residential district is required as can be seen in the informal settlements.
- There is a risk of flood in downtown as well, so that the performance of its early detection and information distribution system should be upgrade.
- Since there is a tendency of security deterioration and high crime rate especially around major

stations in downtown, it is necessary to address this issue from various aspects including income disparity because of the insufficiency of security and guarding function. It is required to realize a safe environment, starting with a particular area such as the station vicinity where people tend to gather. It is required to realize a safe environment, starting with a particular area such as the station vicinity where people tend to gather.

(3) eThekwini

- Although fire and flood are pointed as risk factors in high-density and fireproofed residential district as typified by informal settlements, there is no sufficient countermeasure. Prompt improvement of the environment including fireproofing of the buildings and construction of drainage system for the residential district is required as can be seen in the informal settlements.
- Since there is a tendency of security deterioration and high crime rate especially around major stations in downtown, it is necessary to address this issue from various aspects including income disparity because of the insufficiency of security and guarding function. It is required to realize a safe environment, starting with a particular area such as the station vicinity where people tend to gather. It is required to realize a safe environment, starting with a particular area such as the station vicinity where people tend to gather.

2.11 Investment and Lending

2.11.1 Fiscal Situation of South Africa

(1) Fiscal Situation

The fiscal balance of the South African government recorded a surplus, but in 2008 against the background of expanding expenditures for infrastructure improvements related to the Soccer World Cup, etc. it turned into a deficit. Since then, the deficits have continued due to increased expenditures associated with the implementation of a new growth strategy including employment countermeasures, etc. which was expected to provide increased tax revenues with a background of economic growth.

Table 2-11-1 Changes in Fiscal Balance of South Africa (Units: Billion rand, %)

	FY07	FY08	FY09	FY10	FY11	FY12	FY13
Revenue	1 626.7	683.0	664.8	755.0	824.5	908.7	1,017.2
(% of GDP)	30.1	29.5	27.2	28.3	28.3	28.4	28.8
Expenditures	591.5	710.5	825.9	897.4	979.3	1,061.6	1,151.8
(% of GDP)	28.5	30.7	33.8	33.6	33.6	33.2	32.6
Fiscal balance	35.2	-27.5	-161.1	-142.4	-154.8	-152.9	-134.6
(% of GDP)	1.7	-1.2	-6.6	-5.3	-5.3	-5.3	-3.8
GDP	2,078.8	2,313.0	2,442.6	2,666.9	2,914.9	3,201.3	3,536.0

Source: Ministry of Finance, Republic of South Africa

(2) South Africa's economic growth strategy

The South African government has announced economic growth strategies one after another: Industrial Policy Action Plan (IPAP), New Growth Path, Energy Field/Integrated Resource Plan (IRP2), etc. An outline of each growth strategy is described below. (Source: Republic of South Africa – Infrastructure Map, March 2011, JETRO Johannesburg Center)

Industrial Policy Action Plan (IPAP)

Announced in February 2010. For a 3-year period beginning in November 2010, it specified 13 priority sectors with the aim of shifting to an employment-absorption type industrial structure. Among the priority sectors, those with deep connections to infrastructure businesses include: a) Renewable energy/energy-conservation industries (verification of the feasibility of a concentrating-type solar power system as a large-scale energy source, introduction of 250,000 solar water heaters, etc.); b) Biofuels (construction of a biodiesel refinery); and c) High-technology industries (cultivation of nuclear power and supporting industries, upgrading of communication infrastructure for transition to digital broadcasting, etc.).

New Growth Path

Announced in November 2010. It is a policy to achieve simultaneous employment creation and correction of income disparities. The aim is to create employment for 5 million people through expanded investment in public infrastructure, etc. Areas of priority and their respective

employment creation targets are: a. Infrastructure development; b. Agriculture sector and related industries; c. Mining sector and related industries; d. Environmental industries; e. Manufacturing industries; and f. Tourism and service sector.

Integrated Resource Plan (IRP2)

Announced in October 2010. It set a target of increasing power generation capacity from 44,000MW in 2010 to 85,000MW by 2030. In addition, in order to move away from the dependence on coal which occupies virtually 90% of the current power generation capacity, it aims to reduce the ratio of coal-fired thermal power to 48% by 2030 and instead increase the ratios of renewable energy (16%), nuclear power (14%), etc. In the renewable energy field, introduction of new technologies such as solar power generation and wind power generation will be investigated.

(3) South Africa's infrastructure investment policy and investment situation

In February 2012, the National Infrastructure Development Plan (NIDP） was promulgated. In October 2012 an infrastructure improvement support initiative was announced, which will contribute 4 trillion rand in the next 15 years for infrastructure upgrading projects. In addition, in September 2011 the Presidential Infrastructure Coordinating Commission (PICC) was established to perform coordination between the ministries for infrastructure projects. Departments and agencies were reorganized into 18 Strategic Integrated Projects (SIP).

In 2013, budgets were increased mainly for education, medical care, housing construction, regional development, and security measures. Priority also continues to be placed on infrastructure improvement, with the budget concentrated on the transportation and electrical sectors in particular. The finance minister has announced that in the next 3 years 827 billion rand will be contributed toward infrastructure projects. Of this, 430 billion rand was allocated for the construction or improvement of schools, hospitals, clinics, dams, and water supply/power supply networks, increasing the regions supplied with electricity, construction of additional courts and prisons, public health infrastructure development, and improvement of bus, commuter rail, and road links.

Table 2-11-2 Breakdown of Expenditures for South Africa's Public Infrastructure (Units: Billion rand)

Field	FY10/11	FY11/12	FY12/13	FY13/14
Energy	95.6	107.2	106.7	113.3
Water supply and sanitation	24.1	30.5	27.3	29.4
Transportation and logistics	74.4	68.9	70.8	72.3
Other economic services (Note 1)	18.8	20.2	23.2	23.2
Health care	9.4	9.9	10.3	10.4
Education	7.6	8.9	10.6	13.2
Other social services (Note 2)	8.4	9.1	8.6	8.6
Judiciary and defense services	3.8	4.1	5.5	6.7

Central government and administrative services	2.6	4.3	4.9	3.2
Total	244.7	263.1	267.9	280.3

Note 1: Agriculture, environmental infrastructure, communications, industrial development sectors, etc.
Note 2: Labor centers, heritage facilities, national libraries, community facilities, etc.
Source: Ministry of Finance, Republic of South Africa

Looking at the breakdown of financial resource expenditures on the one hand, the ratio between new development and maintenance in the public sector is roughly 3:7. For private sector, more than 50% of expenditures are for ICT.

Table 2-11-3 Breakdown of financial resources for infrastructure-related expenditures in South Africa (Average for 2001 to 2006) (Units: Billion US dollars)

	Capital expenditure					Operation & maintenance
Infrastructure sector	Public sector	private sector	ODA	the others	Total	Public sector
Power	2.4	0.5	0.7	1.1	4.7	7
Transport	4.5	1.1	1.8	1.1	8.5	7.8
Water supply system	1.1	2.1	1.2	0.2	4.6	3.1
ICT	1.3	5.7	0	0	7	2
Irrigation	0.3	-	-	-	0.3	0.6
Total	**9.6**	**9.4**	**3.7**	**2.4**	**25.1**	**20.5**

Source: Foster, Vivien; Briceno-Garmendia, Cecilia; Africa's infrastructure: a time for transformation, http://documents.worldbank.org/curated/en/2009/01/11487313/africas-infrastructure-time-transformation

2.11.2 Investment and lending policies in South Africa

(1) World Bank (WB)

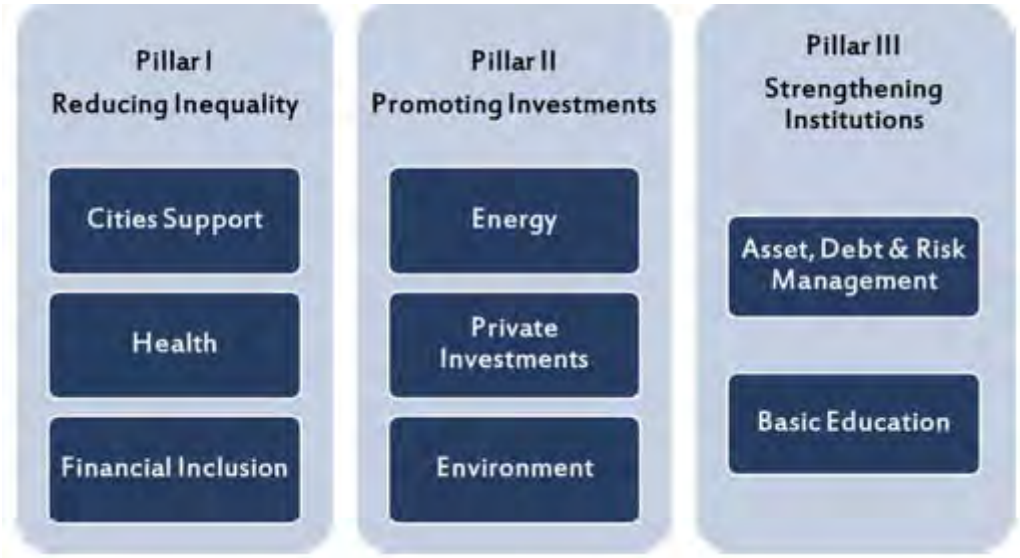
Strategy

As overall strategy of the World Bank Group for global climate change, the "Development and Climate Change: A Strategic Framework for the World Bank Group"[1] was adopted in 2008. Its principles and recommended actions are followed by the "Making Development Climate Resilient: A World Bank Strategy for Sub-Saharan Africa"[2] issued in 2009, adding Climate change dimension. In 2010, "World Development Report 2010"[3] was issued on climate change as the World Bank's operational responses to a climate variability and changes on the continents. The World Bank Group has laid out a plan of action that aims at adaptation to climate change in Africa, seizing mitigation opportunities on the continent, knowledge and capacity building, and making more financing available. Based on the vision of each country, the climate change terms will be developed into a Country Assistance Strategy (CAS) by the World Bank.

1 http://siteresources.worldbank.org/DEVCOMMINT/Documentation/21928837/DC2008-0009(E)ClimateChange.pdf
2 http://siteresources.worldbank.org/INTAFRICA/Resources/ClimateChange-StrategyReport2010-Full_vNoImages.pdf
3 http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTWDRS/0,,contentMDK:23062354~pagePK:478093~piPK:477627~theSitePK:477624,00.html

In 2013, the latest "Country Partnership Strategy (CPS) for 2014-2017" was issued, supporting the Government's National Development Plan (NDP) which was released in 2012. The CPS program is focusing on the three pillars of NDP objectives: (i) reducing Inequality (ii) promoting Investments, and (iii) strengthening Institutions. The following figure is the World Bank Group programs and activities which will be organized under three NDP pillars reflect client demand and World Bank Group's advantage.

Figure 2-11-1 CPS pillars and Areas of Engagement



Source: World Bank "Country Partnership Strategy for 2014-2017"

a. Finance Program and Funds

Climate Investment Funds (CIFs)

Established by the Bank jointly with the regional development banks (AfDB, AsDB, EBRD, and IDB) to promote international cooperation on climate change and support progress toward the future of the climate change regime. The CIFs seek to mobilize new and additional resources at significant scale. CIFs include the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The CTF, targeted at high-emitting developing countries, is designed to promote scale-up demonstration, deployment, and transfer of low-carbon technologies in the power sector, transportation, and energy efficiency in buildings, industry, and agriculture. The SCF include the Pilot Program for Climate Resilience (PPCR), the Forest Investment Fund (FIF), and the Scaling-up Renewable Energy Program for Low-Income Countries (SREP).

Global Environment Fund (GEF)

The Global Environment Fund is a partnership established in 1994 for international cooperation

where 183 countries work together with international institutions, civil society organizations and the private sector, to address global environmental issues to developing countries. The GEF work focuses on the following main areas:

(i) Climate Change (mitigation and adaptation) (ii)Biological Diversity (iii)International Waters (iv)Land Degradation (v)Ozone Layer Depletion. The GEF is a pioneer of multi-tool aid for developing countries in environment sector.

a. Project

(A) Eskom Investment Support Project

The Purpose of the project is enhancing its power supply and energy security in an efficient and sustainable manner so as to support both economic growth objectives and South Africa's long term carbon mitigation strategy.

International Bank for Reconstruction and Development (IBRD) supports the following:

- financing of the Medupi coal-fired power plant (4,800 MW using supercritical technology) ,
- financing investments in renewable energy (Wind and Concentrating Solar Power Plants) and
- supporting for other low carbon energy efficiency components comprising the Majuba Rail Project (railway for coal transportation) and a technical assistance program for improving supply side efficiencies.

- Schedule: closing date will be on 31 October, 2015

The project targeted theme is Transmission and Distribution of Electricity (81%), Energy efficiency in power sector (12%), Other Renewable Energy (7%). The project is scheduled to be closed in October 2015.

(Funding Structure)

The IBRD which aims to reduce poverty in middle-income countries by promoting sustainable development, the US 3.75 billion IBRD loan to Eskom for the Eskom Investment Support Project was approved in April 2010.

Table 2-11-4 Eskom Investment Support Project fund scheme

FINANCIER	COMMITMENTS
International Bank For Reconstruction And Development	3,750
Foreign Multilateral Institutions	2,000
Borrower	5,000
Project Total Amount	10,750

Source: World Bank

(B) Eskom Renewables Support Project

The objective of the project is Establishing policy and regulatory frameworks and building institutional capacity for renewable energy development in South Africa.

The World Bank approved finance to Eskom Renewables Support Project in October 2011 and

the project will terminate in December 2016.

Removing barriers to, and reducing the implementation costs of, renewable energy technologies to help mitigate greenhouse gas emissions, the projects established two components; 1) Renewables-based power generation and 2) Commercial Solar Water Heating (CSWH) to build capacity of local SWH industry and help establish a local SWH supply chain.

The Project key themes are Renewable Energy (49%), Central government administration (48%), General finance sector (3%).

(Funding Structure)

To support the expansion of renewable energy in South Africa which is ranked twelve in all the countries and first among upper middle income group in 2005, the aforesaid Clean Technology Fund (CTF) is financed with amount of US$250 million and US $100 million from African Development Bank. The CTF aims in this project to fund low carbon projects that are embedded in national plans and strategies, scaling up development and accelerating the diffusion and transfer of clean technologies.

Table 2-11-5 Eskom Renewables Support Project fund scheme

FINANCIER	COMMITMENTS
Clean Technology Fund	250
Bilateral Agencies (Unidentified)	390
Foreign Multilateral Institutions (Unidentified)	100
Borrower	488
Project Total Amount	1,228

Source: World Bank

(C) Renewable Energy Market Transformation

This is the first World Bank energy project in South Africa, approved in 2007 and closed the project in 2013 and it is a result of several years of dialogue and discussion with South African Government. Since South Africa is the world's sixth largest coal producer, 90% of which was used for electricity generation and the synthetic fuel industry, South Africa has been heavily relied on coal to meet its energy needs. In this context, the REMT project is designed to remove the barriers and reduce implementation costs of renewable energy technologies to help mitigate greenhouse gas (CHG) emissions. The Government's White Paper on Renewable Energy has set a target of 45 of electricity demand (equivalent to 10,000GWh) from renewable energy sources in 2013. This project aims to assist the government in meeting this target and provided technical assistance and capacity building for (i) renewables- based power generation and (ii) commercial solar water heating (CSWH).

(Funding Structure)

Since the early time of Global Environment Facility (GEF) Trust Fund's establishment in 1994, South Africa has been assigned US $25.7 million for climate change, US$21.7 million for biodiversity and US$5.3 million for land degradation.

Table 2-11-7: Renewable Energy Market Transformation fund scheme

FINANCIER	COMMITMENTS
Government of South Africa	2.3
Private Sectors	9
Global Environment Facility (GEF)	6
Project Total Amount	17.3

Source: World Bank

(2) African Development Bank Group (AfDB)

African Development Bank Group is a locally-based multilateral development bank (MDB), which is composed of African Development Bank (AfDB) and African Development Fund (AfDF). AfDB provides a loan to relatively high-income countries by a quasi-commercially-based form of financing. Currently AfDB is providing loans to 78 member countries, which include the Climate Investment Fund (CIF) with the approximate amount of 7.6 billion USD. On the other hand, AfDF provides a low-interest loan and a grant aid to low-income countries. Currently AfDF is providing such loans and aides to 27 member countries and financial institutions.

a. AfDB's Republic of South Africa Country Strategy

In the Country Strategy Paper (CSP) 2008-2010, the key strategic directions are (i) enhancing private sector competitiveness, (ii) partnership for regional integration and development and (iii) knowledge management and capacity building. The overall performance of the Bank Group Portfolio is satisfactory with the average disbursement rate was 53 percent at end of June 2012 and the progress towards achieving CSP outputs has generally been satisfactory with noticeable progress in implementation in the priority sectors. Despite these, South Africa continues to face complex development challenges, including significant poverty, highly carbon-intensive economy, its greenhouse gas emissions per capita. In these backdrop, the new CSP for 2013-2017[4] was issued in 2013, which seeks to adapt to South Africa's rapidly changing circumstances and set a new foundation for the continuously evolving partnership with the Bank.

The AfDB built its strategy for 2013-2022 around two objectives to improve the equality of Africa's growth: Inclusive growth and Green Growth.

The Inclusive growth is achieving growth that is more inclusive, leading not just to equality of treatment and opportunity but to deep reductions in poverty and a correspondingly large increase in jobs. Green Growth is to ensure that inclusive growth is sustainable by helping Africa gradually transition to Green Growth that will protect livelihoods, improve water, job creation and economic development.

[4] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2013-2017%20-%20South%20Africa%20-%20Country%20Strategy%20Paper.pdf

b. Finance Program: ClimDev for African initiative

The ClimDev-Africa program is a joint initiative of the African Union Commission (AUC), the United National Economic Commission for Africa (UNECA), and the African Development Bank. The program enjoys strong political support from African heads of government, as well as Africa's ministers of finance, planning, and the environment. ClimDev supports Africans response to climate variability and change by building regional, sub-regional, and national policy capacity. It will improve the quality and availability of information and analysis to decision makers. ClimDev will be implemented by the African Climate Policy Center (ACPC) based in UNECA (newly established), and financial management of the ClimDev Trust Fund will be provided by the AfDB. Political leadership of ClimDev will be provided by the UC. The program's first four-year provisional budget is estimated to be $134 million, expected to be disbursed on a demanded-driven basis through a blend of programmatic and Trust Fund modalities. The program includes three main focus areas:

-Making climate information widely available, organized into nine groups of products, and aimed at ensuring that policy makers across Africa, policy support organizations, and the population at large have access to comprehensive and understood climate information.

- Providing analytical tools and technical support, organized into 10 groups of products, and aimed at enhancing the scientific capacity of local and regional institutions to produce effective and quality policy-supporting analyses and best practices.
- Increasing awareness and advocacy for enhanced decision making, organized into seven groups of products, and aimed at strengthening the capacity of African policy makers to make use of best available information and policy and practice recommendations in response to climate change.

c. Sector Focus

(A) Energy

The targets have been set by the Integrated Resource Plan to improve energy efficiency, reducing carbon emissions and encouraging development of clean energy resources. The Bank's support to the energy sector will seek to play a leadership role in introducing the latest technologies for climate change mitigation. The Bank will provide support in five areas: (i) energy efficiency and conservation, development of energy service companies, and application of smart grid technologies; (ii) renewable energy, including wind, concentrated solar, biomass, geothermal and small hydropower; (iii) cleaner and lower carbon fossil fuel technologies and carbon capture and storage; (iv) access and transmission grid strengthening; and (v) development of regional power projects and trading arrangements.

(B) Transport

The Bank's support will increase the role of lower carbon and safer transport modes. It will improve the management and maintenance of transport assets, encourage efficient delivery of public transport services, and contribute to regional connectivity and trade facilitation. Key areas of support include: (i) road network rehabilitation, rural roads, more effective road maintenance systems, and road safety; (ii) efficient and safe railways and ports with strong regional dimensions and facilitation of containerization; (iii) urban public transport, multimodal passenger hubs, and traffic demand management; (iv) inland waterways and inland ports; and (v) multimodal logistics centers, logistics services, and intelligent transport systems.

(C) Natural resources, water, and agriculture

The Bank will support demonstration projects that contribute to sound land, water and natural resources management and climate change initiatives that also support rural livelihood improvement through contract farming schemes and other market-driven opportunities. The Bank will also support water and sanitation operations geared towards achieving the sector goal of attaining universal access to affordable and sufficient water supply and sanitation services.

(D) Public–private partnership

Key risks include inability of the government to address issues in land acquisition, tariff setting, and state-owned enterprise reform that are needed to encourage PPPs in infrastructure investments. The Bank will work with the government to develop a pipeline of feasible PPP projects, and will focus its policy dialogue and capacity development support in areas with sound prospects for advancing private participation in infrastructure provision.

d. Project

AfDB project No.1

Project Title	ESKOM Renewable Energy Investment Project
Target	Renewable Energy
Type of fund	Title: Clean Technology Fund (CTF) investment plan by The Climate Investment Funds (CIF) $350 million Amount of investment or lending: Co-financing $1.23 billion including; - $260 million by AfDB, - $100 million by CTF (Clean Technology Fund), the rest are World Bank , EIB（European Investment Bank）and AFD (Agence Francaise de Development) Finance Scheme: Unknown
Location	Cape Town, Johannesburg, Pretoria
Department of local government	Unknown
Abstract	Purpose: The Project Development Objective (PDO) is to enable Eskom Holdings to enhance power supply and energy security in an efficient and sustainable manner to support the long term carbon mitigation strategy of South Africa. Approach: The project comprises two components; Sere Wind Power Project (100MW), at the Western Cape Province Wind Energy Facility located 300 km north of Cape Town. Upington Concentrating Solar Power Project (100 MW) for the renewable energy source Schedule: expected to deliver first power to the national grid in the first half of 2014, with full commercial operation scheduled by the end of 2014. 
Sources	<http://www.eskom.co.za/Whatweredoing/NewBuild/Pages/Renewable_Energy.aspx> <http://www.afdb.org/en/projects-and-operations/project-portfolio/project/p-za-f00-002/>

AfDB project No.2

Project Title	Renewable Energy independent power producer project
Target	Renewable Energy
Type of fund	Title: senior loan of USD 142 million Amount of investment or lending: - $101.5 million by AfDB, - $141.5 million by CTF (Clean Technology Fund), Finance Scheme: Unknown
Location	Cape Town (Northern Cape Province)
Department of local government	Unknown
Abstract	Purpose: Xina Solar One* produce the clean energy equivalent to that needed to power approximately 90,000 households, thus preventing the emission of 315,000 tCO_2 annually. Additionally, the construction, operation and maintenance of the plant will stimulate regional socio-economic development by creating numerous direct and indirect jobs, as well as a supply chain that will foster economic growth in the country. *)The XiNa Solar One project is the first renewable energy Independent Power Producer (IPP) and the first private sector Clean Technology Fund (CTF) that the AfDB has financed in South Africa. Approach: The AfDB's perspective will play an important role by providing much needed long-term finance, enforcing environmental and social standards and working to enhance the development impact of the Project. The project well aligns with the green and inclusive growth objectives of the AfDB's Ten Year Strategy. Schedule: expected to begin in 2014 
Sources	http://www.afdb.org/en/news-and-events/article/afdb-to-finance-its-first-renewable-energy-independent-power-producer-project-in-south-africa-13332/ http://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/South_Africa_-_Xina_Solar_One_Project_-_ESMP_Summary.pdf

(3) Development Bank of Southern Africa (DBSA)

a. DBSA mandate

The DBSA Regulations define the Bank's mandate of the DBSA Act as follows:

"The main objects of the Bank shall be the promotion of economic development and growth, human resources development, institutional capacity building, and the support of development projects and programs in the region by: Appraising, planning and monitoring the implementation of development projects and programs;

Providing technical assistance, particularly in respect of human resource development and training with regard to the identification, preparation, evaluation, financing, implementation and management of development projects and programs

-Sector

Education, Energy Strategy, Health, Housing and Construction, Transportation, Water

b. Fund: The Green Fund

The Government of South Africa through the Department of Environmental Affairs (DEA) has made available R800m funding over three years to initiate a Green Fund which aims to facilitate investment in green initiatives, transition South Africa to a greener economy of low carbon, resource efficient and climate resilient development path, and to support socio-economic development delivering high impact economic, environmental and social benefits.. DBSA was appointed as the implementing agent to operate the Green Fund in partnership with DEA.

- Initial Funding Focus

Based on research and extensive consultation the following three thematic windows were identified for the initial focus of the Green Fund

-The focus areas and eligibility criteria for each window is different and informed by key national policies

Source: DBSA

Figure 2-11-2 Initial Funding Focus

(A) Green Cities and Towns

Vision: well run, compact and efficient cities and towns that deliver essential services to their residents without depleting natural resources

Storyline:

-Greening core municipal engineering services, especially where cost savings can be realized

-Waste management and recycling, water demand management, public transport, RE and EE on municipal buildings and infrastructure, urban greening

-Primary applicants are municipalities and municipal entities, also support organizations

-Strong emphasis on project preparation, with grants and concessional finance to take to scale

-Capacity and regulatory support on green procurement, planning, green built environment toolkit

(B) Low Carbon Economy

Vision: a low carbon economy that is aligned with the targets for a peak, plateau and decline trajectory for greenhouse gas emissions

Storyline:

· Focused on climate mitigation, renewable energy, energy efficiency, cleaner production, sustainable transport and bio-fuels

· Interventions include innovative structuring of EE and RE rollout, vehicle fleet conversions, clean production programs

· Primary applicants are private companies, research organizations, Small and medium enterprises (SMEs), Non-governmental organizations (NGOs)

· Initial emphasis on project preparation, support projects with matching grants and concessional finance

· Regulatory support for development of standards, Strategic environmental assessments (SEAs)

(C) Environmental and Natural Resource Management

Vision: resilient eco-system services supporting the long term development path

Storyline:

· Focused on biodiversity and ecosystem management, sustainable agriculture, fisheries, rainwater harvesting

· Demonstrate Payments for Ecological Services (PES), convert conventional to sustainable agriculture and replicate success

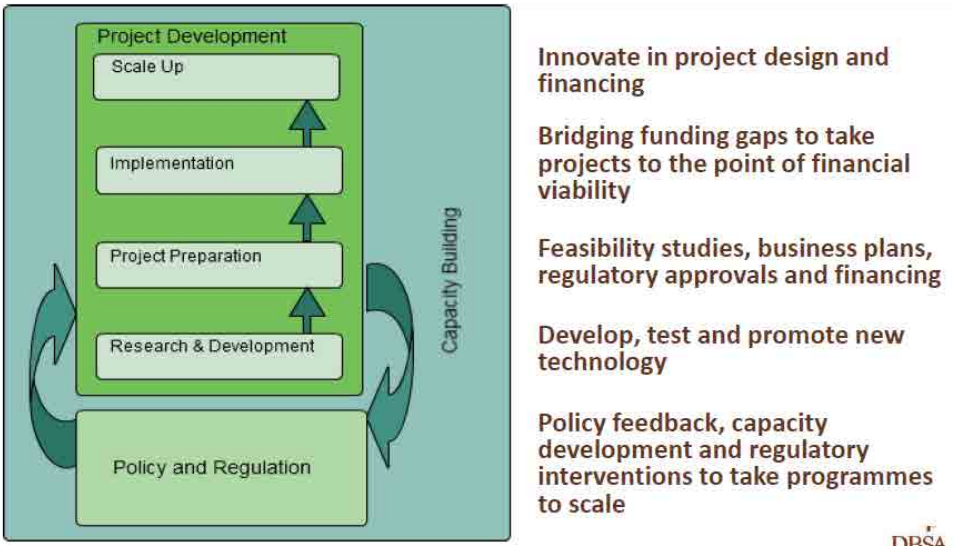
· Primary beneficiaries are farmer and community based organizations, research organizations, private sector, NGOs

· Small grants to target community based enterprises, project preparation for PES projects,

supported by grants and concessional finance

· Regulatory support on adaptation planning, biodiversity offsets, PES, standards and eco-labelling

- Stage of development



Source: SA GREEN FUND OECD/AfDB, Green Growth in Africa Workshop: 16 January, 2013

Figure 2-11-3 Stage of Development

DBSA project No.1

Project Title	The Green Fund program
Target	Environmental program
Type of fund	Title : The Green Fund Amount of investment or lending: ZAR800,000,000 (JPY 7,400 million) to establish the Green Fund by the Government of South Africa, through the Department of Environmental Affairs (DEA).
Location	Entire South Africa
Department of local government	Department of Environmental Affairs (DEA)
Abstract	- providing catalytic finance to facilitate investment in green initiatives that will support South Africa's transition towards a green economy -Approach: providing support through three funding windows as follows; 1) "Green Cities and Towns" where local government , through public sector procurement and alignment of spending on infrastructure and services, with environment performance indicators, can play a significant role in generating the demand for green products and services. 2) "Low Carbon Economy" aim at lower environmental impact and resource consumption, and 3) "Environmental and Natural Resource Management" is for the protection of biodiversity and securing the sustainable delivery of ecosystem services. 
Sources	http://www.sagreenfund.org.za/Pages/About.aspx http://www.dbsa.org/EN/prodserv/FundManagement/Pages/default.aspx

DBSA project No.2

Project Title	Renewable Energy Independent Power Producer Program (REIPPP)
Target measures	Renewable Energy
Type of fund	Title : IPP Procurement Programme Amount of investment or lending: Schedule: from 2010 to 2013
Location	Unknown
Department of local government	Department of Environmental Affairs (DEA)
Abstract	- Purpose: contributing towards the target of 3 725 megawatts and towards socio-economic and environmentally sustainable growth, and starting and stimulating the renewable industry in South Africa -Approach: The Minister allocated 100 MW of the 3725 MW to the procurement of small projects which individually have a maximum contracted capacity of 5 MW. The projects with a generation capacity of not less than 1MW and not more than 5MW utilizing the following technologies shall be considered as qualifying technologies for selection under this Small Projects IPP Procurement Programme: •onshore wind •solar photovoltaic •biomass •biogas •landfill gas, etc.
Sources	http://www.ipprenewables.co.za/#page/303

Technology	MW
Onshore wind	1 850 MW
Concentrated solar thermal	200 MW
Solar photovoltaic	1 450 MW
Biomass	12,5 MW
Biogas	12,5 MW
Landfill Gas	25 MW
Small hydro	75 MW
Small Projects	100 MW

2.11.3 Current status and issues

Based on the above, the current situation and problem points can be organized as follows:

South Africa's financial situation and economic strategy

- The financial situation of South Africa is that deficits continue, and it can be thought that sufficient capital investment in infrastructure development is not being provided. In addition, 70% of public sector expenditures for infrastructure development are devoted to maintenance of existing infrastructure, and expenditures for environment-friendly technologies such as renewable energy are insufficient. In the private sector, more than half of expenditures are devoted to ICT.
- As economic growth strategies for the future, Industrial Policy Action Plan (IPAP), New Growth Path, Energy Field/Integrated Resource Plan (IRP2), etc. are being promoted. In the Industrial Policy Action Plan (IPAP), a) Renewable energy/energy-conservation industries (PV, introduction of solar water heaters); b) Biofuels (construction of a biodiesel refinery); and c) High-technology industries (ICT infrastructure development) are being promoted. In the New Growth Path, expansion of public infrastructure investments, etc. in order to create employment is being promoted. In the Integrated Resource Plan (IRP2), introduction of renewable energy (PV, wind power generation, etc.) technology is being promoted together with increased power generation capacity.

Current situation of investments by financial institutions

- WB, AfDB, and DBSA have the promotion of environment-friendly urban development as one of their investment options.
- The WB is performing fundraising for the introduction of climate-change-related technology such as renewable energy. The AfDB is placing emphasis on fundraising for energy, transportation, natural resources, and water. The DBSA has established a Green Fund, and is performing fundraising for energy strategies, residences and construction, transportation, water, etc.

Applicability of existing systems at financial institutions to environment-friendly urban development

The relationship between existing investment programs and environment-friendly urban development can be considered to be as follows:

- For urban and transportation plans, application of the "Green Fund" of the DBSA can be considered.
- For environmental and energy plans, application of the "South African Cities Energy Efficiency and Renewable Energy Program", the "Development Policy Loans" (DPL), and the "Clean Technology Fund" (CTF) of the WB, the "Lending Program" of the AfDB, and

the "Green Fund" and the "Renewable Energy Independent Power Producer Procurement Programme" (REIPPP) of the DBSA can be considered.

- For water supply and sewerage plans, application of the "Lending Program" of the AfDB, and the "Green Fund" of the DBSA can be considered.
- For ICT plans, application of the "Green Fund" of the DBSA can be considered.

3. PROPOSED MEASURES FOR ENVIRONMENTALLY-FRIENDLY URBAN DEVELOPMENT

3.1 Overview

Based on the current status and issues discussed in Chapter 2, we are proposing directions and concrete measures to overcome the challenges in each sector. The proposed measures are categorized into “Implementation of Institution or Planning and Technologies” and “Program Implementation”. These measures are considered to make the best use of the know-how and experiences of Japanese government and enterprises. Furthermore, the applicable scale (entire city, limited urban development area) and location (city center or suburban) for each measure are indicated accordingly. A summary of the measures is presented in Table 3-1-1.

Table 3-1-1 Directions and proposed measures for each sector

Direction			Solution		Applicable area								
			P&T: Planning & Technologies I: Institution I.P: Implementation Program		Johannesburg			eThekwini			Cape Town		
					City(entire city	Urban (redevelopment level of city center)	Suburb (suburbs new town level)	City(entire city	Urban (redevelopment level of city center)	Suburb (suburbs new town level)	City(entire city	Urban (redevelopment level of city center)	Suburb (suburbs new town level)
Proposal of Institution, Planning and Technologies	Urban. Transportation Planning	**Integrated Traffic Hub** Create an integrated traffic hub where users can easily transfer between railway, BRT and other public transportation, including bus and taxi. **Compact & Mixed Use Development** Improve convenience for the public transportation users and contribute to create an energy-saving and low-carbon city by having down-sized and composite city function centralized around the integrated traffic hub. **Safe & Livable Community** Create a community in peripheral area of the traffic hub where various people can live in a safe and comfortable manner. **Traffic Management** Implement an effective traffic management for traffic jam reduction at the hub where various transportation modes concentrate. **PPP implementation** Appropriately cooperate with private entities and implement planned guidance policies to realize the above direction.	① Joint development with station facilities	P&T		○			○			○	
			② Creating a shopping mall at Ekinaka (in-station) and Ekiue (above-station)	P&T		○			○			○	
			③ Comprehensive IC card system	P&T		○			○			○	
			④ Smart nagivator system	P&T		○			○			○	
			⑤ Middle densification of social / affordable housing	P&T			○			○			○
			⑥ Land readjustment project	I		○	○		○	○		○	○
			⑦ Incentive policy for pricate development	I		○			○			○	
	Water & Waste	Water Planning **Water recycle** Introduce a water recycle system on a district level and a community level to secure water source. **Water management** Implement water management for leakage rate improvement and reduction of maintenance cost. **Distributed sewage treatment** Introduce an independent processing system to spread sewage disposal.	① Purification of mine wastewater by membrane treatment, and desalination treatment of seawater	P&T	○			○			○		
			② Water management system which utilizes smart mete	P&T	○			○			○		
			③ Pipeline investigation and correction system	P&T	○			○			○		
			④ Prevalence of sanitary treatment	P&T			○			○			○
			⑤ Greywater system which utilizes rainwater（mini-reservoir）	P&T		○	○		○	○		○	○
		Waste Planning **3R（Reduce, Reuse, Recycle） implementation** Introduce various techniques and technologies on a city level and a community level for waste reduction. **Waste to Energy** Power generation by utilizing waste, etc.	⑥ Waste separation system by separation machine	P&T		○	○		○	○		○	○
			⑦ Mature compost production facilities	P&T	○			○			○		
			⑧ Waste energy recovery facilities	P&T	○			○			○		
			⑨ Highly-efficient incinerator	P&T	○			○			○		
			⑩ Waste separation and reuse system in community	P&T	○			○			○		
	Energy & Environment	Electric Power Planning **Energy efficiency** Introduce adequate technologies depending on the characteristics of each facility. **Local energy generation** Generate power by utilizing unharnessed and renewable energies, etc. depending on the local characteristics. **Resilience** Establish an energy system which can cope with a disaster.	① Highly-efficient inverter system（energy conservation in mines）	P&T	○								
			② GAP cable（enhancement of transmission capacity）	P&T	○			○			○		
			③ Underground substation equipment（countermeasure against ash fall from wildfire）	P&T				○					
			④ Rechargeable battery system（portable）	P&T				○					
			⑤ Local grid which combines solar and wind power generation	P&T							○	○	○
		Energy and Environmental Planning **Comprehensive policy planning** Comprehensive and practical environmental policy making based on analysis of big data **Natural energy utilization** Introdcution of passive technologies such as utilization of natural light, wind etc. **Local resources utilization** Utilization of natural resources as energy power **Energy and environmental management** Encourage individual activities that lead to energy conservation such as provision of energy-saving guidelines.	⑧ Energy and environmental data utilization for policy and development planning	P&T	○			○			○		
			⑦ Hybrid Design (combination of passive and active system)	P&T		○			○			○	
			⑥ Using sugar cane as biomass	P&T						○			
			⑨ Utilization of water resources	P&T			○			○			○
			⑩ Utilizing solar energy	P&T			○			○			○
			⑪ Guidelines for energy saving in community	I			○			○			○
	ICT Planning	**Accessibility** Achieve an easy-to-access environment for everyone by efficient and economical infrastructure development. **Security & Safety** Improve safety and productivity in urban areas, etc. by introducing an effective and advanced monitoring system. **Education & Skill Development** Implement education and training for low-income earners, etc. in an effective manner. **Comprehensive Management** Improve efficiency for the government by monitoring city planning and infrastructure project in an integrated manner.	① Wireless broadband (replacement for light fiber)	P&T	○			○			○		
			② Security camera (with face recognition function)	P&T		○	○		○	○		○	○
			③ Remote education (electronic blackboard: starboard)	P&T		○	○		○	○		○	○
			④ Smart City infrastructure（cross-departmental urban control system）	P&T	○			○			○		
			⑥ Data backup system in an emergency	P&T	○			○			○		
Implementation Program		**Financial support** **Support for institutional frameworks** **Capacity building**	① Financial support by governmental fund (JICA, JBIC, DBSA etc.)	I.P	○			○			○		
			② Establishment of institutional frameworks	I.P	○			○			○		
			③ Capacity building of public, private sectors	I.P	○			○			○	○	○

Source: JICA study team

3.2 Urban and Transportation Planning

3.2.1 Formulation of Measures or Solutions

(1) The idea of direction

The direction of problem solution in the urban transportation field is set as follows.

a. Actualization of TOD in each urban area

As described in Chapter 2, improvement of convenience by restructuring public transportation network, and hub development in the nodes of the network, that is promotion of TOD, are listed in the policy of city planning and traffic planning in each urban area. In order to realize the policies, however, more concrete know-how including legal system is required.

There is a railway-based public transportation network in the metropolitan area in Japan, and the station-centered integrated city function, namely TOD, has been realized. By utilizing this knowledge, the focus goes to proposal for actualization of TOD in each urban area of South Africa.

b. Comprehensive and integrated proposal

Each urban area has a wide range of problems and their solutions are also extensive. Not only by introducing individual strategy and technology but also by combining a number of strategies and technologies, a comprehensive and integrated proposal should be presented so that multiple problems can be solved more effectively.

(2) Direction in the urban traffic field

In accord with the above idea, specific directions are listed below.

a. Integrated Traffic Hub

Create an integrated traffic hub where users can easily transfer between railway, BRT and other public transportation, including bus and taxi.

b. Compact & Mixed Use

Having down-sized and composite city function centralized around the integrated traffic hub not only improves convenience for the users of public transportation, but also contributes to create an energy-saving and low-carbon city.

c. Safe & Livable

Create a community in peripheral area of the traffic hub where various people can live in a safe and comfortable manner.

d. Traffic Management

Implement an effective traffic management at the hub where various transportation modes concentrate so that traffic congestion can be reduced.

e. PPP Implementation

Appropriately cooperate with private entities and implement planned guidance policies in order to realize the above direction.

3.2.2 Specific Measures or Solutions

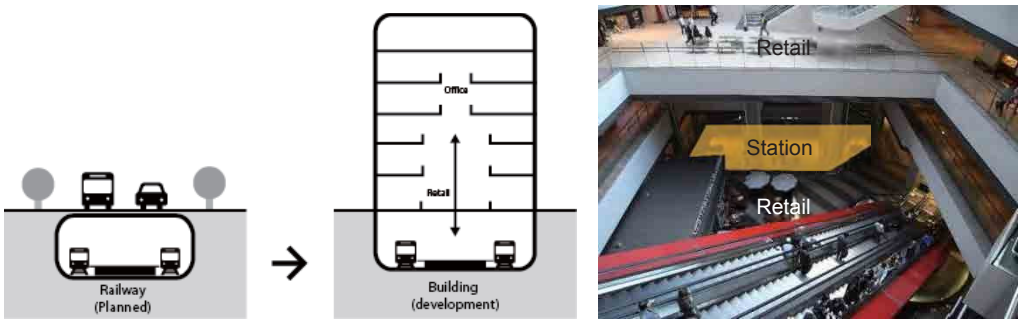
In order to embody the direction described in 3.2.1, specific measures or solutions are proposed from the aspects of “technology and planning of Japanese companies” and “support of policy development for the government”.

(1) Technology- and planning-related measures or solutions

The solutions for technology and planning which Japanese company groups have are listed below.

a. Joint development with station facilities

In order to improve convenience for the station users and to make stations more attractive, city functions including commercial facilities and offices are concentrated to where the passengers can have direct access from the station. Also by setting up decks and the like to provide connection to the surrounding, the station is characterized as a hub of the community.



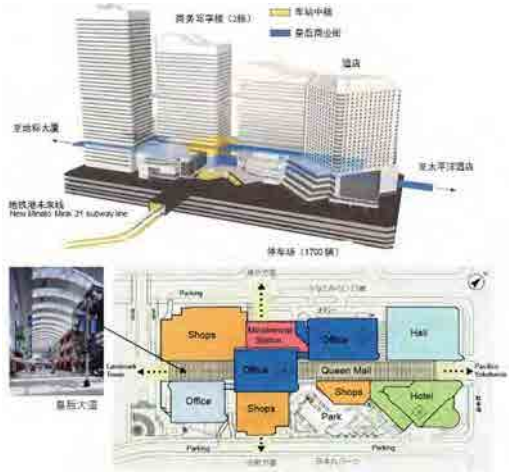
Source: JICA study team

Figure 3-2-1 Image of joint development with station facilities

BOX. Queen’s Square Yokohama (Yokohama, Japan)

Complex urban development consisting of offices, commercial facilities, a hotel and a concert hall, etc. all combined with the subway station. There is an open ceiling space down from the subway station on the third basement floor up to the fourth aboveground floor, and a pedestrian mall intersects with the space for continuity to the peripheral town blocks.

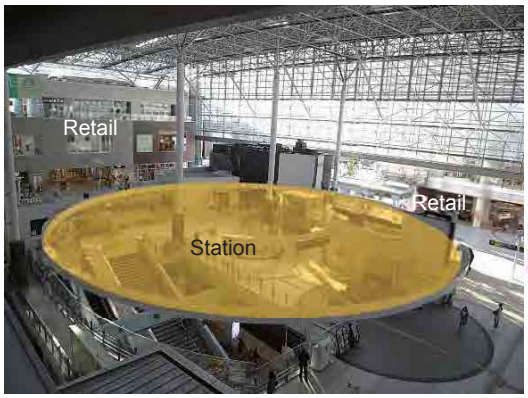
Site area : 44,407m2
Gross floor area : 496,386m2

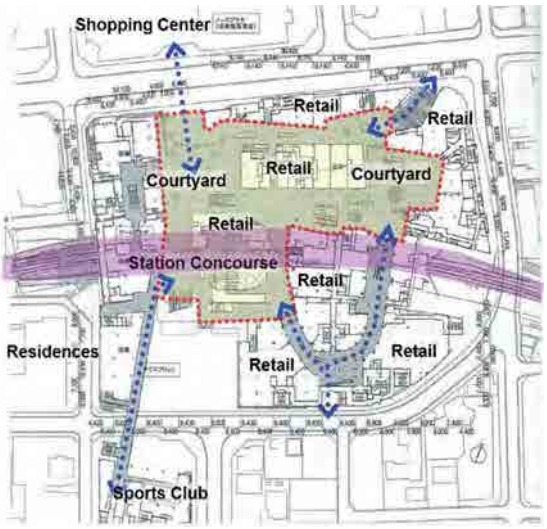


Source: JICA study team,
Queen’s Square Yokohama homepage

BOX. Tama-Plaza Station (Yokohama, Japan)

A grand-scale roof constructed over the railway provides ample open space available to the public, and commercial facilities and a childcare facility, etc. are located so as to be connected to the station.



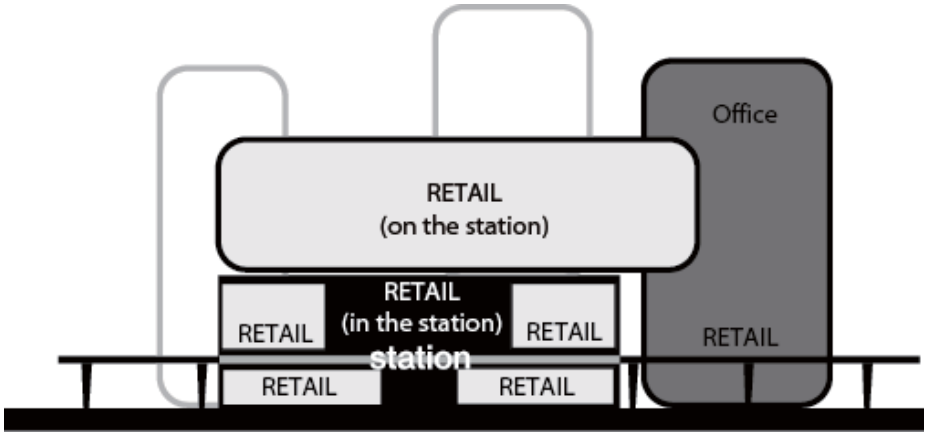


Site area : 50,000m2
Gross floor area : 174,000m2

Source: JICA study team

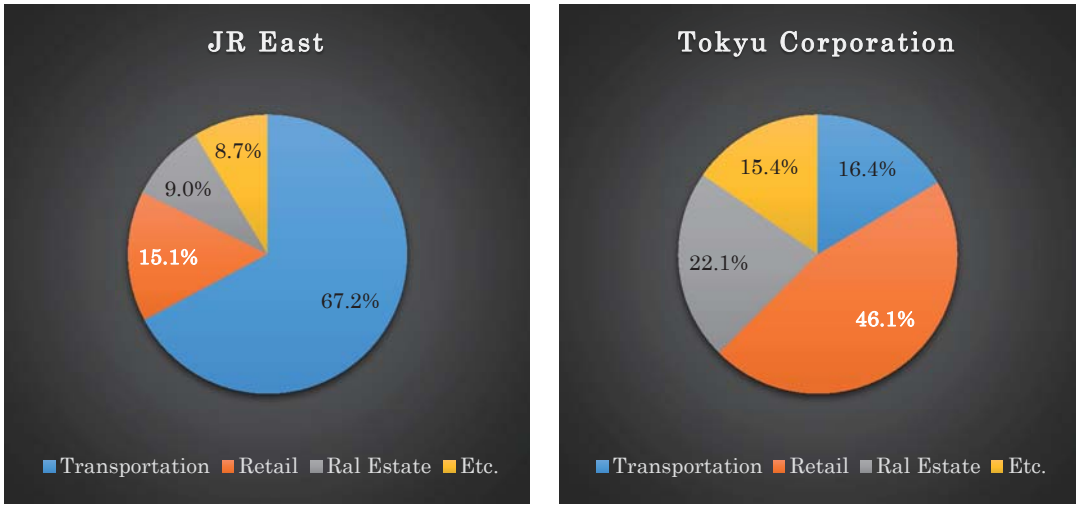
b. Creating a shopping mall at Ekinaka (in-station) and Ekiue (above-station)

By developing commercial facilities right above the station or inside the station concourse, it is possible to increase the time the public transportation users spend there as well as to improve the business feasibility of the railway companies. In fact, JR and private railway companies in Japan are operating similar businesses in Tokyo metropolitan area, and they are now a major source of the companies' income.



Source : JICA study team

Figure 3-2-2 Image of Ekinaka and Ekiue shopping mall



Source:,JICA team based on financial results of both companies in March, 2013

Figure 3-2-3 Profit structure of railway companies in Japan

BOX. e-cute (some stations in Tokyo, Japan)

Ekinaka (In-Station) shopping malls are operated by JR East at major stations in Tokyo central area. Specifically, there are restaurants, shops that sell lunch boxes, souvenirs, etc. all integrated so that the shop structure can meet the needs of railway users. In actual cases, the sales per floor area are higher compared to commercial facilities in the station vicinities, proving that high profitability has been achieved.

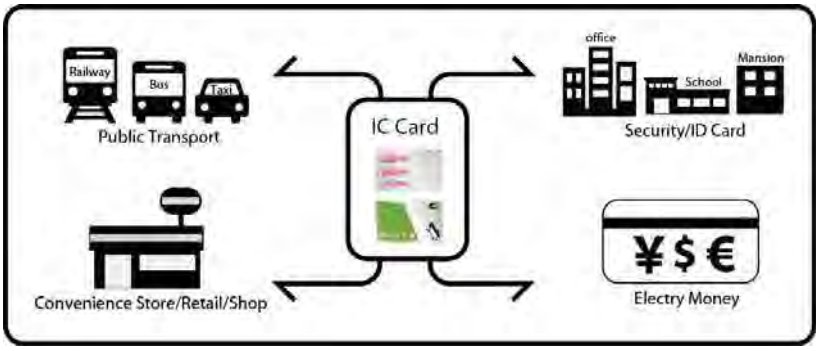
JR Omiya Station (Retail area : 5,000m2)

Source : JR East Station Retailing, JR East

Source : Nikkei MJ, 2006

c. Comprehensive IC card system

IC card system which allows for transfer between different public transportation modes is in the process of introduction in metropolitan areas in South Africa. The system could be expanded such that IC cards can be used for shopping at commercial facilities in the above-mentioned Ekinaka (In-Station) and around the station. It may be possible to develop it as a comprehensive system, for example, to utilize it as an authentication card for security gate in office and residence.



Source : JICA study team

Figure 3-2-4 Image of comprehensive IC card system

BOX. SUICA system (Japan)

Suica, a non-contact IC card system developed by JR group, allows IC cards be used as electronic money not only for railway ride but also for shopping at affiliated stores. By ensuring compatibility with similar IC card systems owned by other railway companies, it is usable for most of the railways in Japan today. Recently, it is used as employee ID card or student ID card, and IC condo system, which can be used as a key to condominium, has also been introduced. After these cards are used, part of the income is distributed to the affiliated companies. This accelerates the spread of necessary infrastructure including IC card readers.

Public Transport

Security Card (Mansion Key)

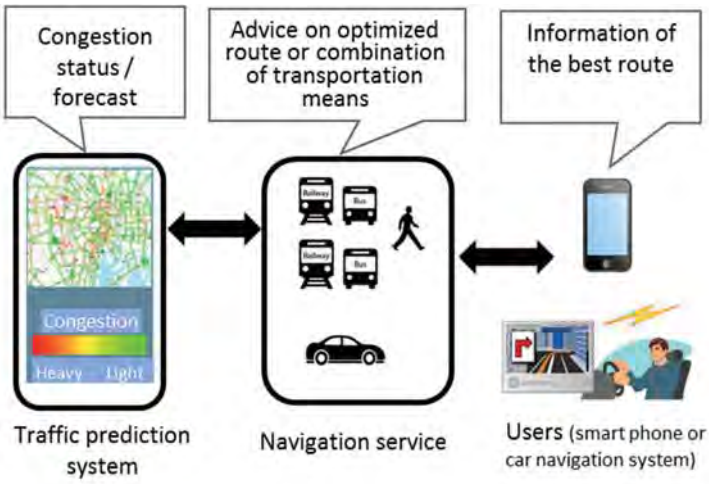
Shopping / Electric Money

Student and Employee ID Card

Source : JICA study team, JR EAST homepage

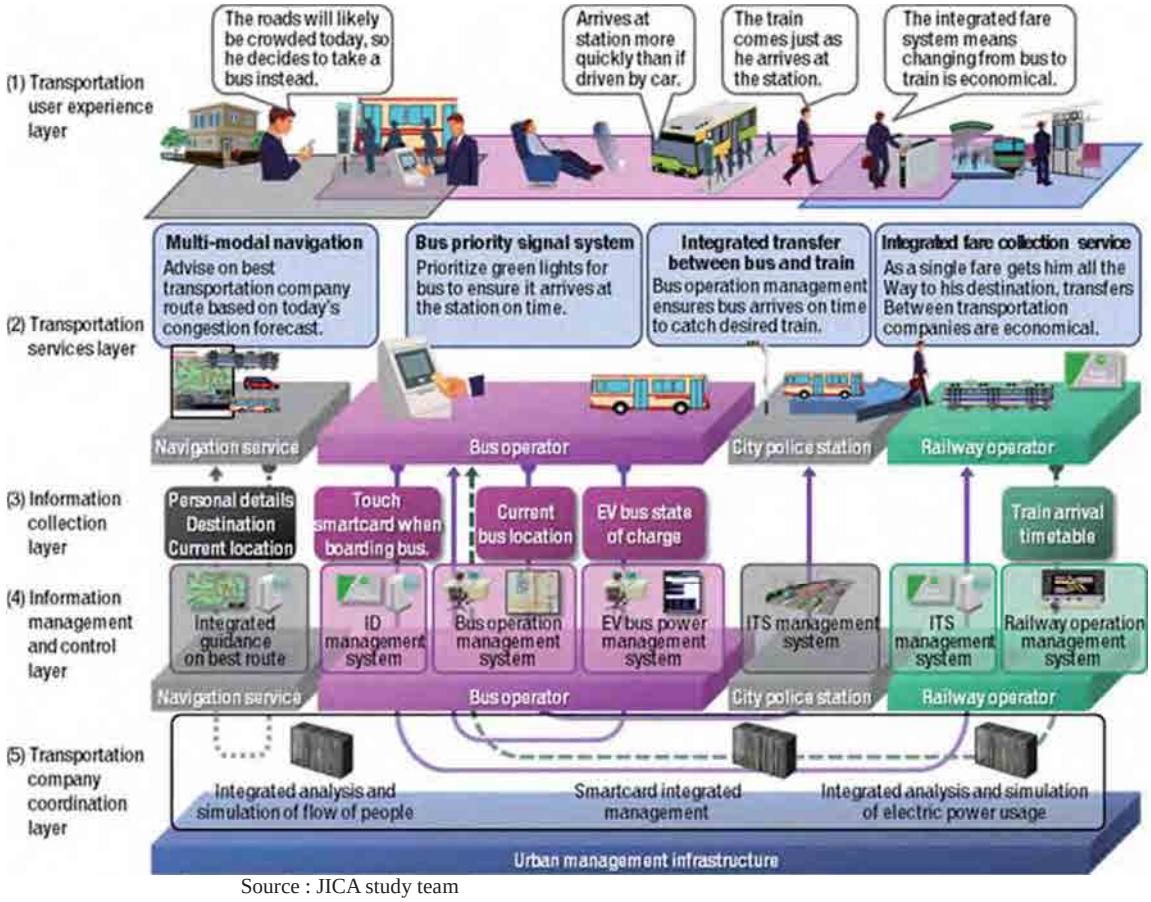
d. Smart (multi-modal) navigator system

There is no traffic navigator system currently in South Africa. It is predicted to supply information about optimized travel time and route to destination is necessary to improve public transportation usage. In the future, smart city commuting scenario can be realized by introducing more comprehensive system and can enhance usability of public transportation.



Source : JICA study team

Figure 3-2-5 Concept of smart navigator system



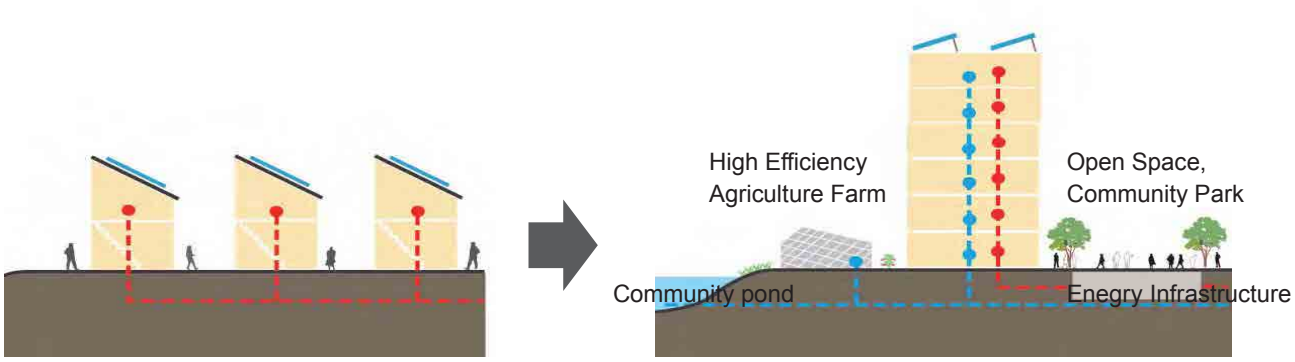
Source : JICA study team

Figure 3-2-6 Image of traffic prediction system

e. Middle densification of social/affordable housing

Currently developed social/affordable housing is almost composed of detached housing. If those housings will be combined vertically and built in 4 or 5 stories, more open space can be secured around the building. The open space can be utilized as community park for residents, underground energy infrastructure space, community pond, agriculture farm, etc. and can improve not only low energy, but also job creation and community activation.

Current situation is considered partly because of condition for subsidization, however, from the view point of environmentally-friendly development, this middle densification trial program should be implemented in certain social/affordable housing.



Source: JICA team

Figure 3-2-7 Concept of middle densification of social/affordable housing

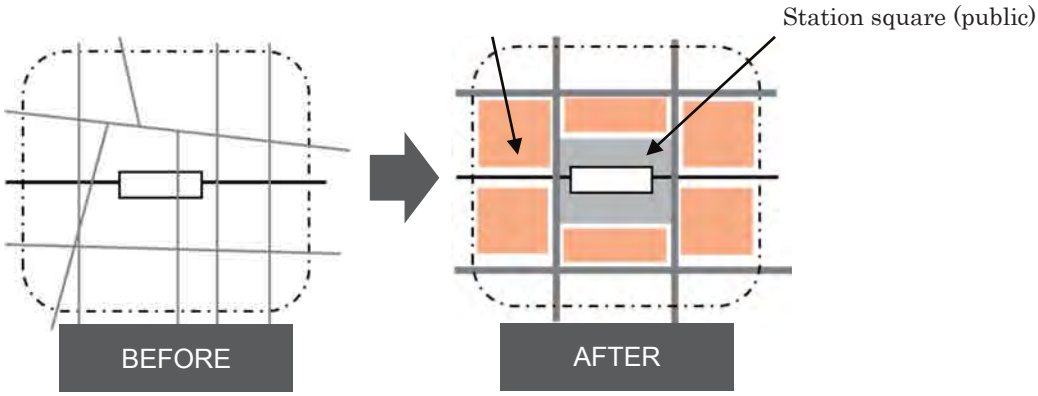
(2) Legal system-related measures or solutions

At a planned site for new railway station or BRT station, etc., there might be issues such as that urban district has already been formed or that government-led business is difficult to conduct because the lands are predominantly owned by private sector. In those cases, some back up methods will be introduced from the legal aspect to provide support in cooperative business with the former land owners or in planned guidance for the private businesses who wish to participate in the business around the station.

a. Land readjustment project

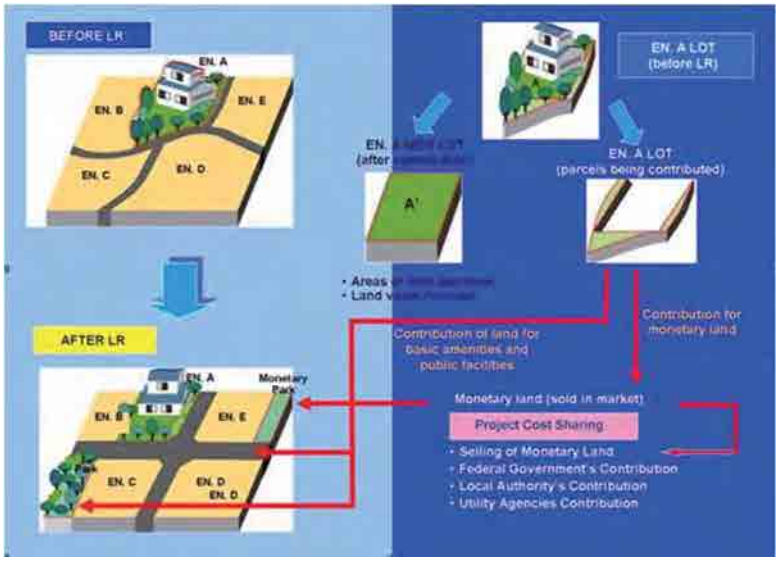
This is a method of ownership conversion from an existing plot to a new plot while preserving the ownership. It allows for upgrading of urban infrastructure, and therefore it can be introduced when there are not enough sites for infrastructure around the station or when public use land cannot be secured.

Land for mixed-use development



Source: JICA study team

Figure 3-2-8 Concept of land readjustment project



Source : JICA study team, Tokyo metropolitan government homepage

Figure 3-2-9 Overview of land readjustment system

BOX. Land readjustment project along Tokyu Tama Den-en-toshi Line (Tokyo, Japan)

Along a railway line of Tokyu Tama Den-en Toshi, Tokyu Corporation conducted a land readjustment project around the station at the same time as railway construction and has induced commercial and housing development. Specifically, existing land owners and Tokyu Corporation formed a union for land readjustment project, which induced not only integration of commercial facilities and operational function into the station square and station vicinities but also development of housing in the periphery. As a result, a favorable metropolitan environment with a strong brand was established along the railway line.

Around the Tama Plaza Terrace

Around the Hutagotamagawa Station

Source : Google earth

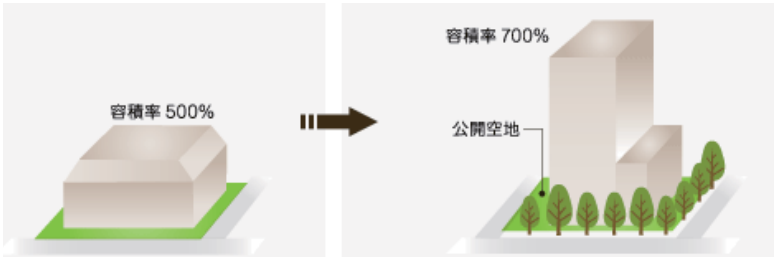
b. Incentive policy for private development

There are various incentive policies for planned guidance to the public sector.

Table 3-2-1 Incentive samples for private development

Method	Case example in Japan	Introduction image in this case
Guidance by guidelines	Guidance on Public space and traffic line, etc.	Development of station-centered free walkway and pedestrian mall
Guidance by relaxation of regulations	Guidance on public open space and facilities with public significance	For example, development of social housing. Also conservation of historical buildings.

Source: JICA study team



Source : Tokyo Metropolitan Government Homepage

Figure 3-2-10 Image of Floor-Area-Ratio (FAR) bonus by securing open space

BOX. Town Development Guidelines (Yokohama, Japan)

In Minato Mirai district, a new city center in Yokohama City, next to Tokyo, the distinctive skyline and a station-centered public pedestrian network are secured by defining the public traffic line and the building height in the guidelines.

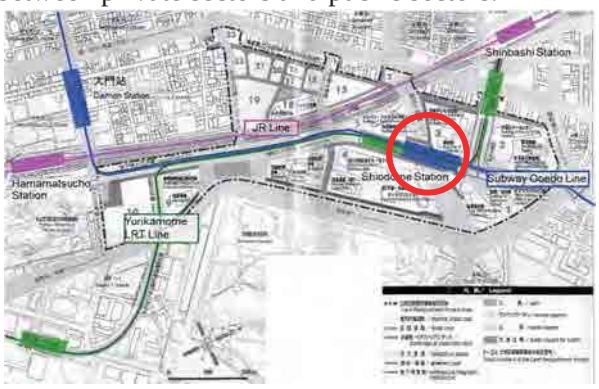
Pedestrian deck installation guidelines

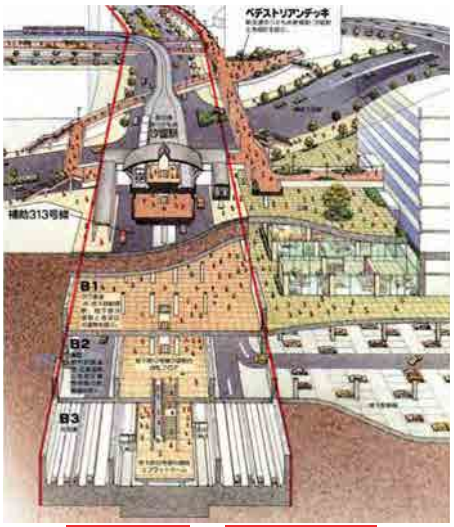
Pedestrian deck of Queen's Square (Mall)

Source : Basic Agreement on Town Development under Minato Mirai 21, NSRI(Picture)

BOX. PPP around the railway station in Shiodome District (Tokyo, Japan)

Shiodome District is large scale urban development project of an old railway yard in the center of Tokyo. Ground streets, subway station, station square, underground pedestrian mall, pedestrian deck, etc. were built by application of "Land Readjustment System". At the same time, FAR bonus was given to private developers and adjacent landowners who connect private development facilities and public facilities at the underground level or the deck level. As a result, a pedestrian network around the station was formed by cooperation between private sectors and public sectors.





Source : JICA study team, Nikkei BP

3.2.3 Measure or Solutions for Each City

The proposed strategies and solutions for enhancing the future urban and transport planning of the three metropolitan municipalities have been described in the previous sections. The specific strategies or solutions recommended for urban area and suburb area are summarized in Table 3-2-2 below. Most issues are corresponded all municipalities, but more important points for each municipality are picked up as follows.

Table 3-2-2 Specific Measures and Solutions

City	Major Issues	Specific Measure or Solution
Three Cities	- Integrated Traffic Hub - Compact & Mixed Use Development - Safe & Livable Community	- Joint development with station facilities - Creating a shopping mall at Ekinaka (in-station) and Ekiue (above-station) - Comprehensive IC card system - Middle densification of social / affordable housing -
Johannesburg	- No available land around the station	- Land readjustment project - Incentive policy for private development
Cape Town	- High densification around the station	- Joint development with station facilities - Land readjustment project
eThekwini	- Improvement of public transportation usage - PPP implementation	- Incentive policy for private development

3.3 Water and waste

3.3.1 Water Planning

In this section, we organized the directions for resolving issues in the water and wastewater sector in South Africa, and offer proposals on the specific Japanese technologies that can provide solutions to such issue.

Table 3-3-1 Specific Measures and Solutions for Each City (Water and Wastewater)

	Intention of Measure or Solution	Specific Measure or Solution
Common to all regions	-Securing of water sources (Reuse of treated water) -Securing of water sources (Harvesting of rainwater)	-Utilization of rainwater and greywater that has undergone simplified purification
	-Management of water supply systems	-Smart waterworks system
	-Countermeasures for deterioration of pipelines	-Pipeline inspection system and pipeline rehabilitation work
	-Popularization of sanitation processing	-Bio-toilets
Johannesburg	-Securing of water sources (Reuse of mine wastewater)	-Treatment of mine wastewater using reverse-osmosis membrane
eThekwini	-Securing of water sources (Desalination of seawater) -Recovery of energy from waterworks and wastewater systems	-Desalination of seawater using reverse-osmosis membrane
Cape Town	-Securing of water sources (Desalination of seawater)	-Desalination of seawater using reverse-osmosis membrane

3.3.1.1 Formulation of Measures or Solutions

(1) Common to all regions

The amount of precipitation in South Africa is small, and there are rainy and dry seasons. In addition, it is forecast that the population will greatly increase in the future, and securing of various water resources can realize the stable water supply. To resolve this issue, the order of measure are considered with feasibility, rainwater harvesting in the first, reuse of the graywater in the second, and followed by the wastewater treatment and desalination for bulk water, etc. In particular, in order to improve water conservation in affordable housing area, etc. being developed in the suburbs, it is desirable to consider the utilization of rainwater which has undergone simplified purification.

In addition, in South Africa the high rate of non-revenue water for waterworks nationwide is a problem. The cause is the high water leakage in many cases, but it is thought that water theft, leakage due to supply water pressure, etc. also have some effect. In order to handle this situation, it would be good to introduce a waterworks management system.

As stated above, in South Africa water leakage is common for both waterworks and wastewater

systems, with the deterioration of pipelines being a factor. Since the high leakage rate in South Africa is a factor in the increasing rate of non-revenue water for waterworks and environmental deterioration from sewerage, drastic reductions in the leakage rate are desirable.

Furthermore, there are areas in South Africa where sanitation processing has still not been properly developed, particularly for suburban homes or areas with informal settlements. Sewerage development to such areas is difficult, so it may be necessary to promote bio-toilets, etc. as the minimum sanitation processing.

(2) Johannesburg

In Johannesburg, the environmental effects of mine groundwater is becoming a problem. Since securing water sources is becoming more important throughout South Africa, the vast amounts of mine groundwater have attracted attention, and it is desirable to enable reuse through treatment of the contaminated water in the mine.

(3) eThekwini

As stated before, securing water sources is becoming more important throughout South Africa. Since eThekwini is a city located along the coast, desalination of seawater can be considered one method of securing water sources.

In eThekwini, we are actively promoting water-related businesses using the PPP method. Although the business content is diverse, in many cases it includes energy recovery, particularly generation of electricity. Since there are many energy recovery technologies in Japan, it is desirable to propose the utilization of such technologies.

(4) Cape Town

As stated before, securing water sources is becoming more important throughout South Africa. Since Cape Town is a city located along the coast, desalination of seawater can be considered one method of securing water sources.

3.3.1.2 Specific Measures or Solutions

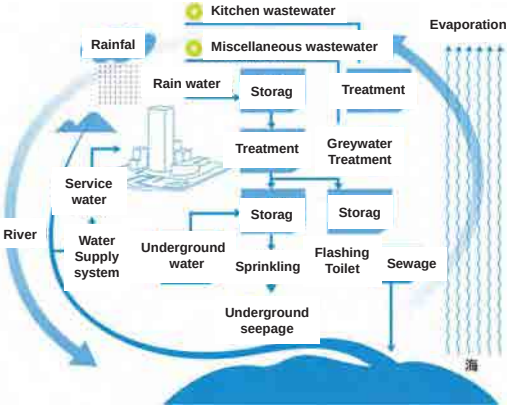
(1) Simple purification of rainwater and greywater

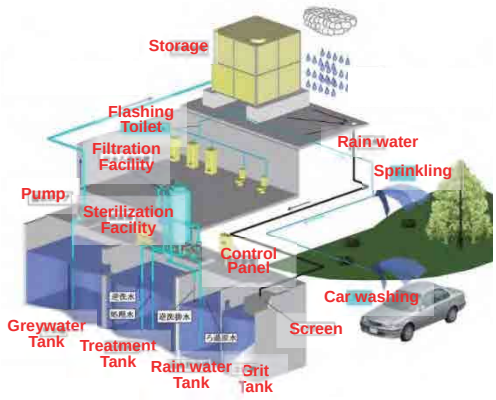
In Japan, reuse of greywater at the building level or community level is being promoted from the viewpoints of 1) water shortage countermeasure, 2) reduction of load on sewerage systems, 3) water conservation measure, 4) securing of emergency water supplies, 5) savings on waterworks and sewerage bills, etc. In particular, for utilization of rainwater there are many examples at the building level where temporary storage, filtration/sterilization, and use as toilet flush water or for watering greenery is performed, and there are also examples at the community level where greywater is collected and biologically treated, filtered/disinfected, and then reused.

For South Africa, we propose utilizing technology for simplified purification of rainwater and greywater for suburban affordable housing, etc. and can alleviate the demands of water shortages in the future.

BOX. Examples of rainwater/greywater usage (Tokyo Midtown, Yebisu Garden Palace, etc.)

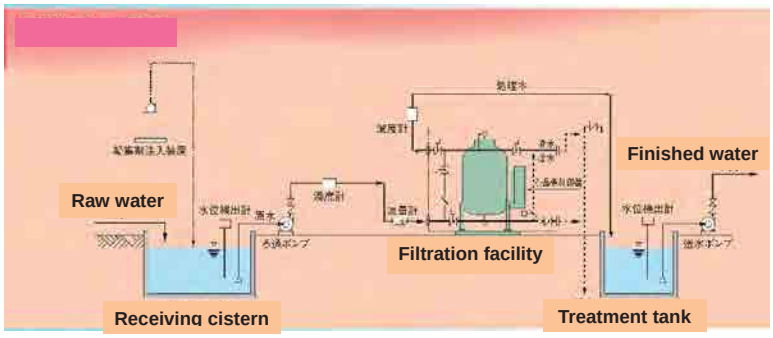
At Tokyo Midtown, rainwater that falls on the building roof or man-made grounds is stored in a rainwater storage tank, is filtered and sterilized, and is then used as water for flushing toilets, watering greenery, etc. In addition, miscellaneous drainage greywater, cooling tower blowdown water, etc. are treated in a greywater processing plant and then reused as toilet flush water, etc. Plus, at Tokyo Midtown and Yebisu Garden Palace, kitchen wastewater also undergoes onsite wastewater treatment and a part of the treated wastewater is re-used.





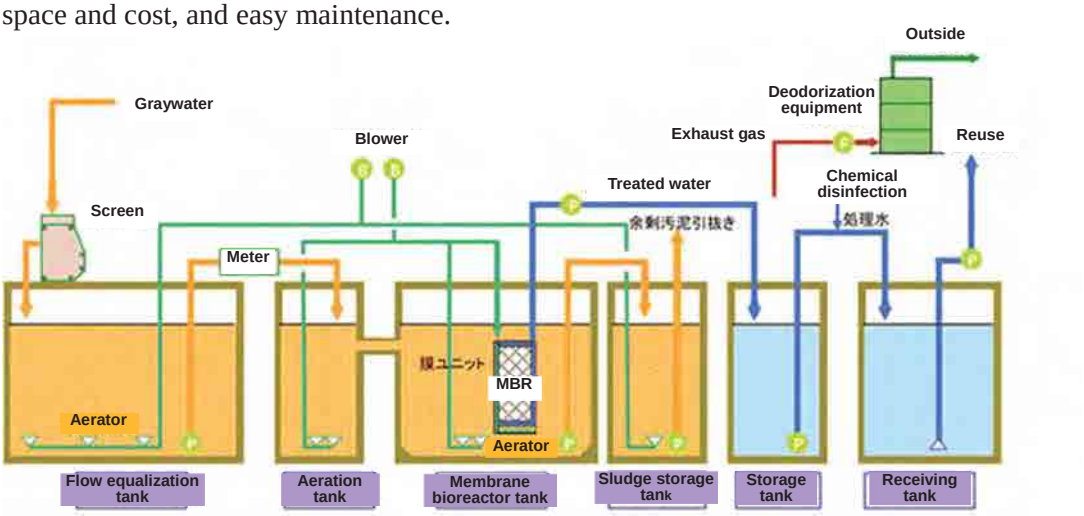
BOX. Examples of rainwater harvesting system (Ishigaki, Watt Kobe, etc.)

For rainwater harvesting, since treatment by sedimentation, filtering, and disinfection is sufficient for reuse, it is being promoted for water reuse by individual home collection or small-scale wastewater treatment. Development is being promoted by small- to medium-scale companies, so it can also be connected to the viewpoint of infrastructure export support for small-/medium-scale businesses.



BOX. Examples of graywater treatment system (Nishihara Engineering Co., Ltd, etc.)

This is the graywater treatment plant used as water for flushing toilets, watering greenery, etc. The plant is introduced the membrane bioreactor technology, and it is realized saving the space and cost, and easy maintenance.

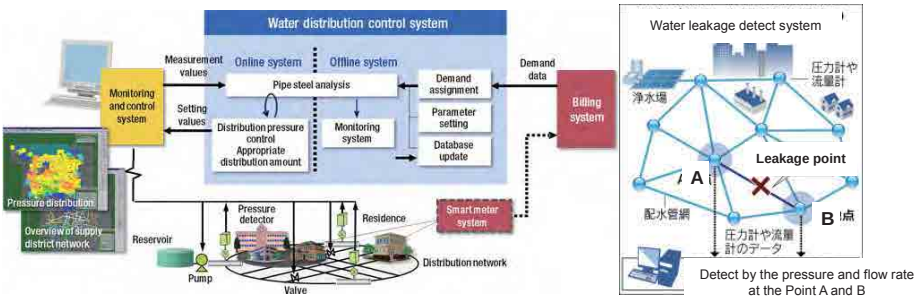


(2) Waterworks management system utilizing smart meters

With the increasing interest throughout the world in smart grids for efficient energy usage through optimum control utilizing IT, the introduction of electronic meters with the bidirectional communication function that is an important component in the smart grid structure is considered. In South Africa, with issues such as high water leakage rate and illegal use of water, the introduction of this type of system could help to rapidly confirm problem locations, reduce leakage rates by controlling pressure, etc.

BOX. Example of waterworks management system utilizing smart meters (Hitachi, Ltd.)

Hitachi has developed a system that can analyze the water pressure and water volume in waterworks pipelines and detect water leakage and the leakage location. Hitachi aims to introduce it into emerging-market countries such as India, Viet Nam, etc. where the population is growing but there are problems with high water leakage due to insufficient development of waterworks networks. The system can forecast and detect the presence and location of water leakage from the pipeline length and variations in flow volume and water pressure.



(3) Pipeline inspection system and pipeline repair

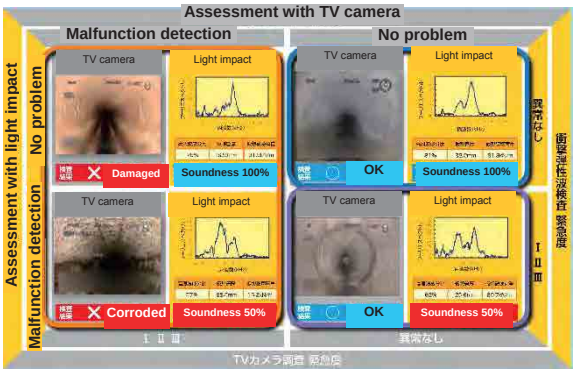
The sewerage pipeline facilities in Japan have a total length of more than 400,000 km due to aggressive development, and in addition to holding a huge stock, pipelines that have exceeded the standard useful lifetime are gradually increasing and their deterioration is progressing. As a countermeasure against such deterioration, facility maintenance based on condition monitoring is required, and in order to evaluate current risks, it is necessary to promote efficient and effective patrolling, inspection, and investigation. In addition, for future preventive maintenance that presumes the promotion of planned maintenance management, it is necessary to evaluate risks and then based on such information, to promote appropriate deterioration countermeasures such as repair, reconstruction, etc.

In South Africa, although the amount of pipelines which are older than 50 years is increasing in the same way as in Japan, repair of pipelines is not progressing. Efficient pipeline inspection together with efficient and inexpensive pipeline repair methods are necessary.

BOX. Example of pipeline inspection system (Sekisui Chemical Co., Ltd.)

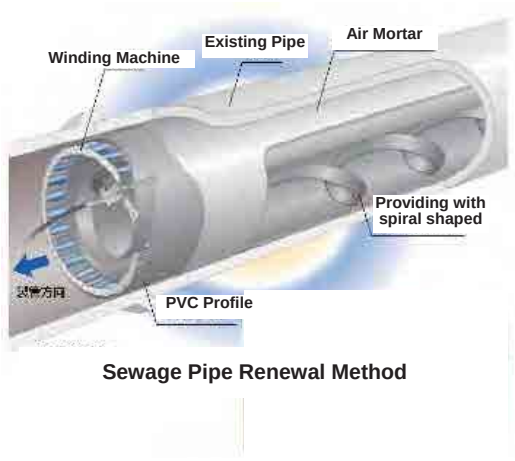
In order to investigate pipeline reconstruction and repair methods, it is necessary to accurately grasp the condition of the deteriorated pipeline of the sewerage system.

For pipelines that humans cannot enter, TV camera inspection is generally used. At Sekisui Chemical, an inspection method has been developed to estimate thickness and destructive overloading by applying light impacts to the pipe in addition to using the TV camera. This allows a more accurate understanding of the pipeline condition.



BOX. Example of pipeline rehabilitation method (SPR method; Sekisui Chemical Co., Ltd.)

Sekisui Chemical, together with Tokyo, has developed the SPR method that creates a rehabilitated pipeline of strong, hard vinyl chloride inside existing old pipes by drawing hard vinyl chloride liners into the pipelines from manholes. This method has the features of not requiring excavation of the ground, being able to handle shapes flexibly, and enabling construction to be performed even while a certain amount of water continues to flow through the pipeline.



Sewage Pipe Renewal Method

(4) Popularization of sanitation processing

The development of bio-toilets in which the excreted feces and urine are mixed with sawdust, etc. in a tank and aerobically decomposed and composted is progressing. They have the merits of being able to be installed anywhere since they are not water-flush types, and periodic collection of the night soil as with a septic tank is not required. In Japan, since sewerage systems are spreading, the use of bio-toilets is limited to urban parks, mountain areas, etc., but they are often used in Southeast Asia, etc. where development of sewerage facilities has not progressed.

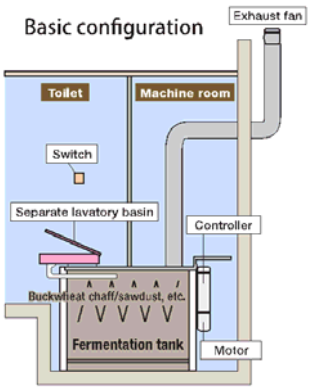
In South Africa, there are areas where the popularization of toilets has not progressed, particularly in areas that the sewerage system has not yet reached such as informal settlements,

etc., and providing a minimum level of sanitation processing is an important measure. For such places, the introduction of simple sanitation processing facilities is desirable.

BOX. Example of simple sanitation processing plant (Daio Densetsu Industrial Co., Ltd.)

For the septic tanks widely used by individual households in Southeast Asia, etc., treatment of discharged water is insufficient and periodic maintenance is not performed, and this has led to problems with water quality. Against this background, Daio together with Seiwa Denko Co., Ltd. is constructing a decentralized wastewater treatment system in which urine and feces are treated by bio-toilets and household greywater is treated by a new purification system.

The bio-toilet has the merits of being able to be installed anywhere since it is not a water-flush type, and periodic collection of the nightsoil as with a septic tank is not required. A pilot project using the system is currently underway in Viet Nam.



(5) Treatment of mine wastewater using reverse-osmosis membranes

There are many mines in the region around Johannesburg, and also many mines have shut down, and the water pollution from mine wastewater has become an environmental problem. Mine wastewater is divided into two types, one is the wastewater from the mine in operation, the other is mainly produced by abandoned mine called “Acid Mine Drainage”. Both wastewater are regarded to be hard to reuse for potable water and the latter is quite difficult to treat with general system in order to the high acidity. With this situation, it is conceivable that by treating the wastewater from the active mine using a relatively compact and inexpensive system, the treated water could be used as a water source to handle future increases in water demand.

BOX. Example of mine wastewater treatment plant using reverse-osmosis membranes (Marubeni Corp.; Toray Industries, Inc.)

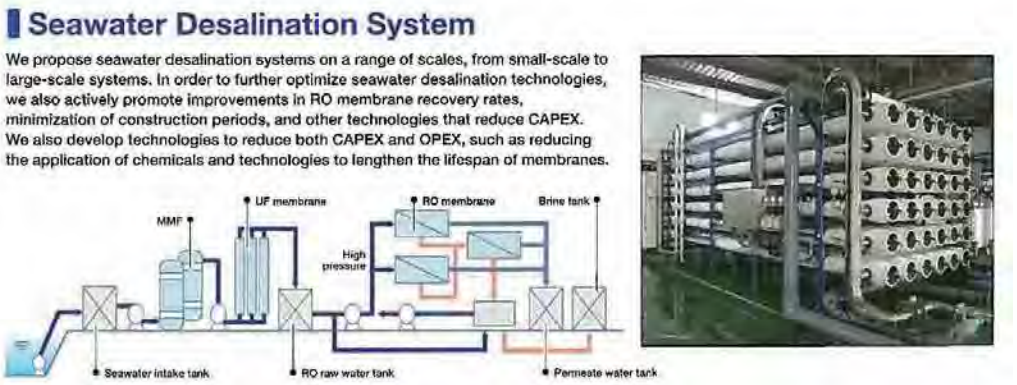
Marubeni has supplied a mine wastewater treatment plant through Rand Water, the largest Water Board in the Republic of South Africa. Through secondary treatment using the method of a reverse-osmosis membrane technology system, it enables mine wastewater to be reused for household purposes. At present, they have installed the pilot plant and plan to conduct verification operations from now on.

(6) Seawater desalination using reverse-osmosis method

Seawater desalination methods can be broadly grouped into the multi-stage flash distillation method, multiple-effect distillation method, and reverse-osmosis method. In recent years, the reverse-osmosis method has become the mainstream method due to its simplicity, low energy requirements, and relatively low cost, and Japan's osmosis membrane technology can be utilized. In South Africa, where there is a growing focus on securing water supplies that can handle future water demands, it is conceivable that seawater desalination could be one measure for securing water supplies in the coastal cities of Durban and Cape Town.

BOX. Example of seawater desalination plant using reverse-osmosis (Hitachi, Ltd.)

Employment of the reverse-osmosis method is spreading as a mainstream method for seawater desalination, but the construction costs and energy consumed is relatively high. Because of this, technology to prevent clogging of the membrane pores, system technology to enable efficient operation, etc., in order to extend service life and reduce initial investment as well as running costs has been developed.



3.3.2 Waste planning

In this section, we organized the directions for resolving issues in the waste management field in South Africa, and offer proposals on the specific Japanese technologies that can provide solutions to such issues.

Table 3-3-2 Specific Measures and Solutions for Each City (Waste Planning)

	Intention of Measure or Solution	Specific Measure or Solution
Common to all regions	-Waste reduction (Reuse) -Waste reduction (Recycle)	- Advanced intermediate processing using sorting system - Rapid composting plant - Community-based sorting processing
	-Energy recovery (Recovery)	- Waste-to-energy power plant - Biogasification plant - Fuel conversion plant
	-Waste reduction (Incineration)	- High-performance waste incineration plant

3.3.2.1 Formulation of Measures or Solutions

(1) Common to all regions

In South Africa, intermediate processing of wastes has not progressed much, and the recovery ratio is around 10%. Against this background, reuse is an important measure for reducing the final disposal amount. On the other hand, in many regions, waste sorting and recovery has also not progressed, and sorting of wastes can be considered an important measure.

In the same way, resource recovery from wastes is also a useful measure for reducing the final disposal amount, and it is desirable to promote resource recovery through composting, etc. together with reuse.

Furthermore, in Cape Town for example, waste sorting and recovery has still not progressed. By promoting sorting, recovery and reuse at the community level alongside progress in the intermediate processing of wastes, there will also be progress in job creation, etc.

In some regions in South Africa, methane gas generated in landfills is being recovered and used to generate electricity. On the other hand, in Japan waste sorting has progressed, and efficient energy recovery such as by biogasification or conversion to fuel directly from waste is being performed. It is desirable to promote waste reduction and energy recovery through the introduction of these kinds of facilities.

In addition, in South Africa where incineration is not adopted a typical waste disposal option because of the risk of the environmental deterioration. While the problem of final disposal is becoming obvious and so it is conceivable that there would be some value in considering it as a method for significantly reducing the amount of waste. In Japan, incineration is the main waste disposal option, and since efficiency increases and environment-friendly technologies are advanced, proposing such method is desirable.

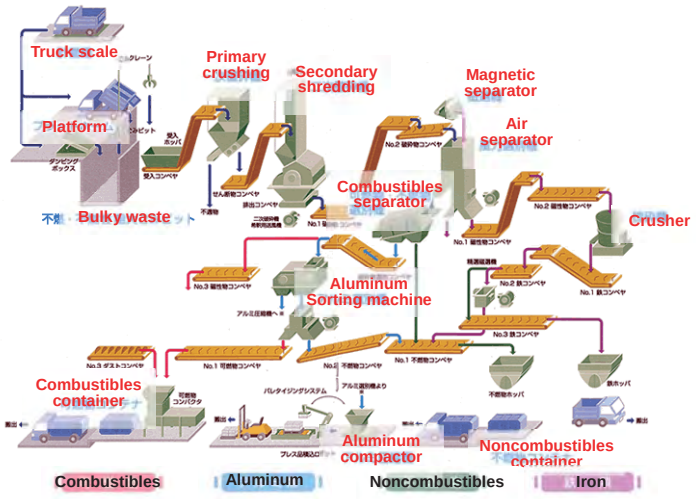
3.3.2.2 Specific Measures or Solutions

(1) Advanced intermediate treatment using waste sorting system

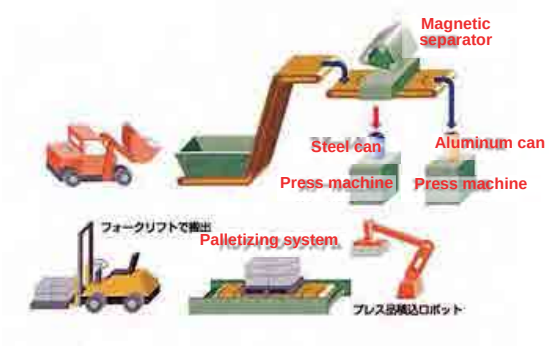
Machinery will be used to sort out and recover steel, aluminum, glass, plastics, etc. from non-combustible waste or bulky waste, and the recovered materials will be reused as resources. As a result, reuse and resource recovery will be advanced, and the final disposal amount will be greatly reduced.

BOX. Example of waste sorting system (Toyama District Regional Affairs Association)

At the recycling facility, recyclable waste such as metals, cans, bottles, plastics, etc., are automatically sorted out from the non-combustible waste, processed, and reused as resources.



Bulky garbage resource recovery process



Can sorting process

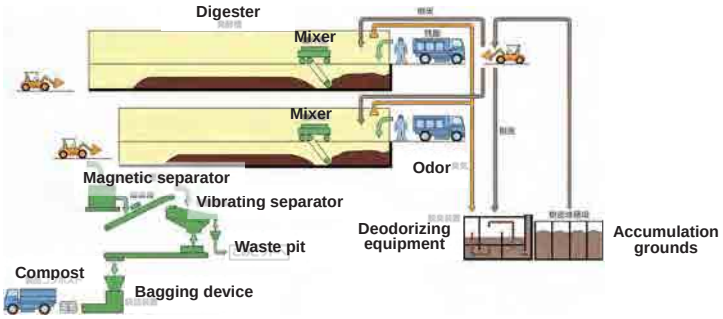
Bottle sorting process

(2) Maturation composting facility

A maturation composting facility promotes the aerobic decomposition of wastes, and together with its stabilization and volume reduction, the resulting materials can be used as fertilizer or soil improvement agents. Raw garbage, cow manure, and dewatered sewer sludge could be processed into high-quality compost at the composting center, which is spread on agricultural land, and used to produce safe, worry-free crops in order to promote the construction of a resource-recycling society. In Japan, since incineration is given priority, recovery of good organic waste is laborious, and coordination of compost supply and demand cannot be done well, composting is only done on a small scale. However in South Africa, where intermediate processing has not advanced, it can be considered an effective measure from the viewpoint of reducing the final disposal amount, fertilizing agricultural land, etc.

BOX. Example of rapid composting facility (Morioka-Shiwa District Environmental Facility Union)

Raw wastes from general households are mixed with forestry-waste bark, fermented, and composted, and recycled as compost products.

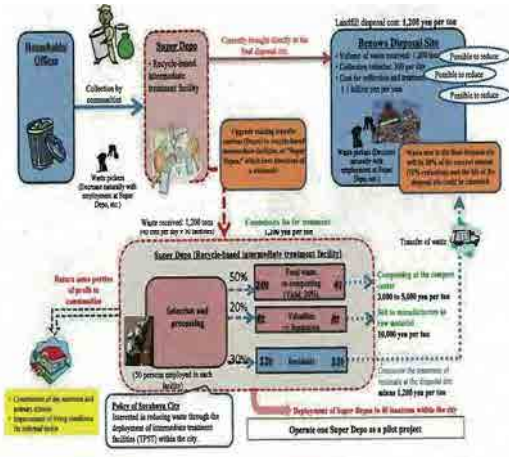


(3) Community-based sorting processing system

Although sorting can be performed by machinery, resource recovery may be difficult depending on sorting accuracy, and in some cases sorting must be performed again. For this reason, even in Japan in some areas waste sorting is performed manually by elderly people, etc. to improve sorting accuracy.

BOX. Example of intermediate waste processing utilizing the community workforce (JICA pilot project (JICA pilot project; Nishihara Corp.)

This project is a compound pilot project that takes advantage of the sorting and valuable material sales business in Japan and employing pickers in Surabaya, Indonesia to perform sorting processing and raw-garbage composting. It is realized with the installation of the advanced technology that the compost is made in three weeks or so. As a result, it has been estimated that the final disposal amount has been reduced by around 20 to 30%.



(4) Energy recovery during waste processing

In Japan, the process of recovering energy during waste processing involves generation of electricity by incineration, biogas recovery, generation of solid fuel from wastes, etc. In South Africa, generation of electricity from recovered methane is being performed, but rather than recovery from landfills, the use of fermenting tanks would enable gas recovery to be performed more stably and at a higher efficiency.

BOX. Example of energy recovery during waste processing (JFE Engineering Corp.)

In Nagaoka, Niigata Prefecture in Japan, a system in which raw garbage is sorted out and put in a fermentation tank where it is fermented and decomposed by microorganisms, and the generated biogas is used to generate electricity has been developed as a PPP project.

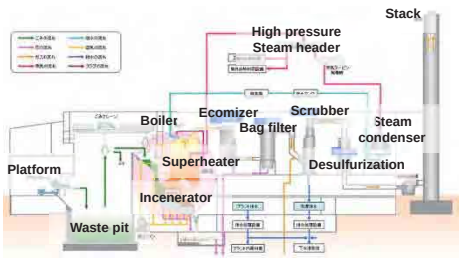
As a result, incinerated amounts have been reduced by approximately 40%, and efficiency has been improved by using the generated biogas to generate electricity. The processing capacity is 65 tons/day, the generated biogas volume is approximately 8,900Nm3/day, and the amount of generated electricity is approximately 12,300kWh/day.

(5) High-performance waste incineration plant

In Japan, waste processing is centered on incineration, with 20% of common waste being recycled in general, the remaining 80% is incinerated to reduce its volume to 10%, and the residue is finally disposed of. Furthermore, to alleviate the environmental effects of dioxins, etc., measures such as incinerator improvements to enable complete incineration and dust collector improvements for removing fine particulates in exhaust gases have been implemented. In South Africa, this technology is not adopted a typical waste disposal option because of the risk of the environmental deterioration. While it is worth for waste minimization, it should be took into consideration in the near future.

BOX. Example of high-performance waste incineration plant (Hitachi Zosen Corp.)

For the high-efficiency incineration method, a stoker-type incinerator is used, the energy in the exhaust gas generated by incineration is recovered as steam in a boiler, and the steam is sent to a steam turbine generator to create electricity. For the Osaka City Environment Bureau's Maishima Plant, the processing capacity is 900t/day, and the electricity generation capacity is 32,000kW



3.4 Energy and Environment

3.4.1 Electric Power Planning

As described in section 2.7 South Africa electric infrastructure are having tough time to meet the growing demand of electricity. Also transmission line to carry the electricity are experiencing interruption due to natural incidents such as wild fire, bird strikes. ESKOM (Electricity Supply Commission of South Africa) have a plan for Installing new generators, making a new route for transmission line target to finish by 2030, these will require long lead time, with cost.

Figure 3-4-1 and Table 3-4-1 shows the outlook picture for relatively short lead time and effective solution mentioned in following sections.

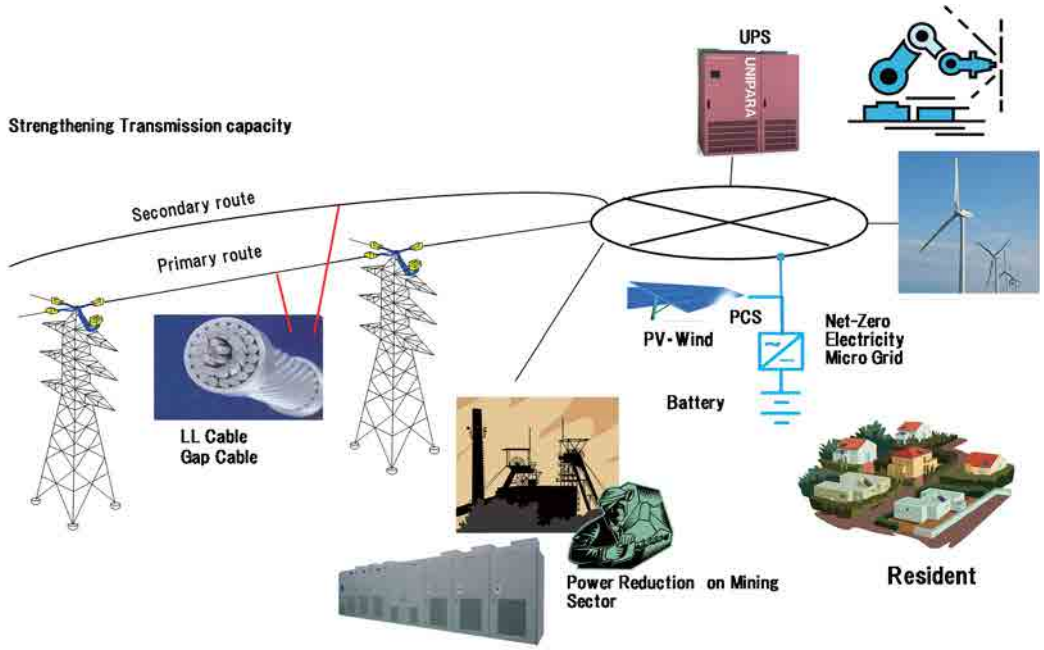


Figure 3-4-1 Overview of the proposed measures

Table 3-4-1 Improvement Proposals

Section	Proposal	Residential Development	Power Shortage	Line Fault Blackouts	Carbon Reduction
3.4.1.1(1)	Reallocating power from the mining sector to new development	○	○		○
3.4.1.1.(2)	Enhancing transmission line	○		○	○
3.4.1.1.(3)	Net-Zero electricity by PV and battery	○	○		○
3.4.1.1.(4)	Net-Zero electricity by wind power and battery	○	○		○
3.4.1.1.(5)	Large Scale Wind Farm for Costal Area		○		○
3.4.1.1.(6)	UPS Battery for sudden power outage			○	
3.4.1.1.(7)	Underground substation to avoid ash flow of wild fire			○	

3.4.1.1 Specific Measures or Solutions

(1) Reallocating power from the mining sector to new development

Mining consumes large amount of electricity. Table 3-4-2 shows the power consumption of 4 mines near Johannesburg's new housing development Lufhereng. 4 mines consumes 1,760 GWh of electricity annually.

Table 3-4-2 Power consumption of major mines near Johannesburg

Mine	Electricity (GWh)
Dornkop	216
Mpoeng	850
TauTona	489
Savuka	206
Total	1,760

Power usage break down of typical mine are shown in Figure 3-4-2 Power demand curve of typical mine are showed Figure 3-4-3. The demand curve of gold mine indicates that demand are fairly flat all day.

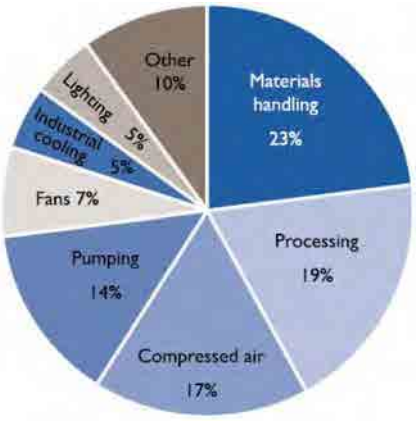


Figure 3-4-2 Power usage of gold mine[1]

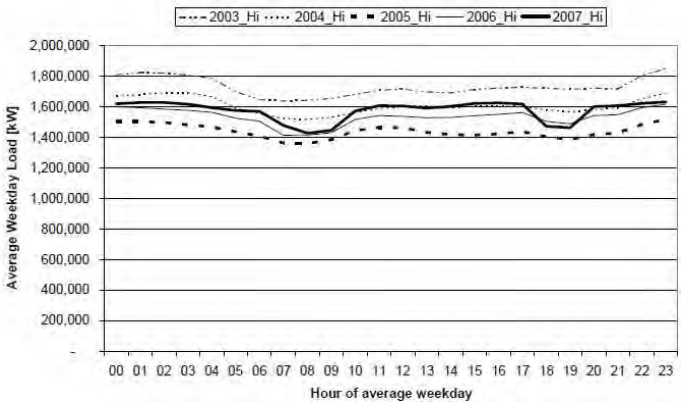


Figure 3-4-3 Typical power demand curve of a mine[2]

Eskom is instructing Mine industry for power saving, encouraging user to use inverter for motor control instead of conventional motor control.

It is said that changing the motor and motor controller from to high efficient inverter type, large amount of electricity can be saved. For example in order to control the air flow volume in ventilation system, or a liquid flow from the pump with fixed speed motor, reducing flow is

[1] http://www.ameu.co.za/library/industry-documents/eedsm-and-renewable-energy/Eskom%2520DSM%2520-%2520121040%2520Mining%2520Brochure.pdf&sa=U&ei=k0aDU7CzBoyOlQXp9YHYBA&ved=0CCQQFjAB&usg=AFQjCNFQTuPX3vQsod_VDx0g43pQimtyow

[2] http://upetd.up.ac.za/thesis/available/etd-03102010-161210/unrestricted/dissertation.pdf&sa=U&ei=M0eDU-r_H4bkkgXok4DABQ&ved=0CB4QFjAA&usg=AFQjCNFX75xk_hNmuc8GzTkiT0CIpDuYrg

done by using a mechanical valves which reduces the flow by adding resistance to flow. By using an inverter, motor rotation speed can be changed without adding resistance to the flow. Power consumption of motor raises as cubic of rotation speed. So compared against running fixed speed motor with valve to make the flow at 50%, energy reduction in to 1/8th.

If the each power consumption of the mining can be reduced by 10% to 40% as in Figure 3-4-4, 26% of power reduction can be achieved.

Power Reduction Estimate

Item	Current	Reduction	Improvement
Material handling	23%	18%	−20%
Processing	19%	15%	−20%
Compressed air	17%	12%	−30%
Pumping	14%	10%	−30%
Fans	7%	4%	−40%
Industrial cooling	5%	4%	−30%
Lighting	5%	3%	−40%
Other	10%	8%	−20%
Total	100%	74%	−26%

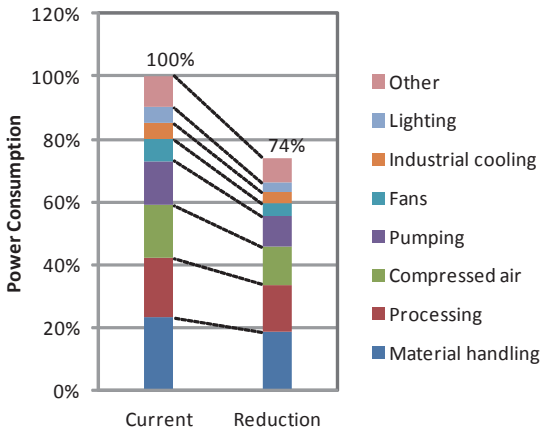


Figure 3-4-4 Power reduction of mining facility

26% of power reduction of 4 mines near Johannesburg can allocate annual power of 457GWh.

Figure 3-4-5 shows example of High Efficiency Inverter and its spec.

Technical Specification

Series Name	HIVECTOL-HVI
Capacity	upto 16,700A
Input Voltage	AC 2,400V to 11,000V
Input Frequency	50 / 60[Hz]
Voltage fluctuation	within ＋/－10%
Frequency fluctuation	within ＋/－5%
Type	Medium Voltage Multi-level IGBT Inverter
Driving Method	2 quadrant Operation
Deceleration	Natural Deceleration
Speed Control Range	1%～100% speed
Accuracy	＋/－0.5% at 100% speed without sensor / ＋/－0.05% at 100% speed with sensor
Overload	125% 60sec
Efficiency	approximately 97% (including Transformer)
Power factor	above 95%

Figure 3-4-5 Example of a high efficiency inverter

(2) Enhancing transmission line

Power carrying capacity of Transmission line also must be enhanced in order to meet the growing demand of electricity, providing electricity to newly developed area.

Enhancing transmission line can also be a countermeasure against blackout due to transmission line fault. In the case of primary line fault, if the other route can handle the capacity of primary

route, it can be used as backup route. Figure 3-4-6 shows the image of backup route.

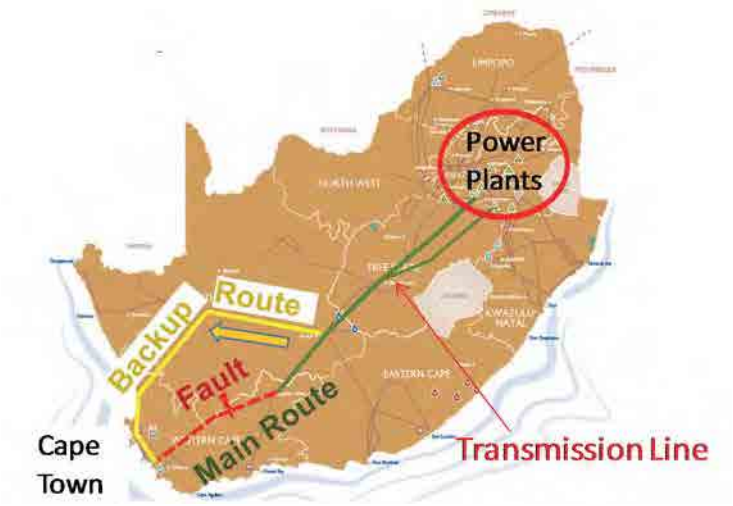


Figure 3-4-6 Power supply backup route

Backup route can be made by constructing a new transmission line. Constructing a new transmission line requires time and cost such as environment survey, new land acquire, transmission tower construction.

Another way for enhancing the transmission line is to enhance the capacity of the existing transmission route by upgrading the transmission route by using capacity enhanced cable such as Low Electrical Power Loss Conductor Type Cable or Low sag GAP Cable.

a. Low Electrical Power Loss Conductor Type Cable.

Low Electrical Power Loss Conductor type Cable(LL Cable) such as LL-TACSR/AS (J-Power Systems) has 25% less resistance at 20℃ compared to normal cable (ACSR (Aluminium Conductor Steel Reinforced cable)). For example, the loss of sending 481A (half of upper limit of normal cable) for 100Km by normal cable is 4.9MW, 43GWh annually) (on three phase line), the loss for LL Cable will be 3.8MW, 33GWh annually). So power saving will be 10GWh annually. For distance of 1200Km (Northeastern coal thermal power supply to Cape Town), this loss will be 120GWh annually. Reducing transmission line loss can help to solve the power shortage, lowering the CO2 footprint.

LL Cable can also be used for transmission capacity enhancement. LL cable is designed to operate up to 150℃, which is higher than 90℃ of normal cable. With other enhancements, LL Cable are rated to transmit 86% more power compared to normal cable.

Mechanical spec of LL Cable are designed so that it can replace the existing normal cable if the transmission capacity kept same. However if power is send beyond the normal cable capacity limitation, sag will increase. Figure 3-4-7 shows the sag difference. For example, sag on 400m span, the sag will increase for about 2.5m when sending 86% more power compared to normal

cable. So for replacing existing cable for transmission capacity enhancement, transmission tower may need to be upgraded to handle the increased sag.

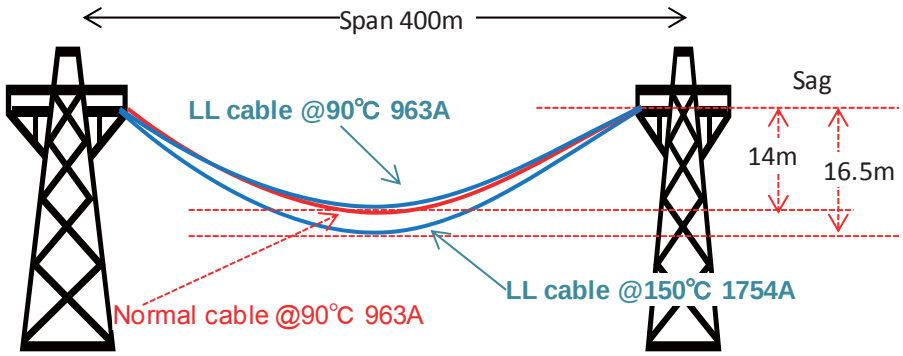


Figure 3-4-7 Sag difference

b. Low Sag GAP Cable

For the capacity enhancement purpose only, GAP Cable can be used. GAP Cable is designed so that SAG is half on same temperature compared with normal cable. Typical usage for conventional cable is up to 90℃. On the other hand, GAP cables stretch from heat is half compared to normal cable, so it can operate up to 210℃ on typical usage. The sag will be same when sending twice the capacity. Figure 3-4-8 shows the sag comparison between cables. GAP cable are designed so that external dimension and weight are compatible with conventional cable. So it can easily replace conventional cable. Therefore it can double the capacity of current transmission line without the need of environmental survey, land acquisition, new tower constructions.

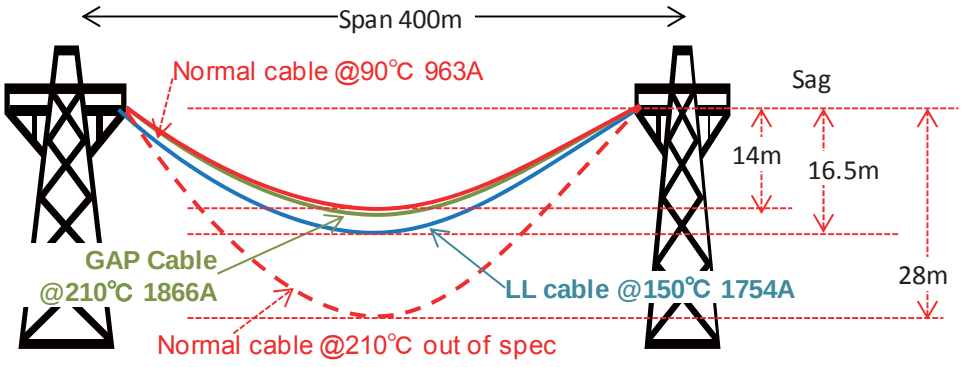


Figure 3-4-8 Sag difference between Cables.

c. Transmission Line Reliability enhance by High Capacity Cable

For important Main transmission line, two wires are laid as pair so that in case of one wire fails, other wire will carry the power of failed wire. Normal cable has narrow temperature operation

range(up to 90℃), therefore it does not have enough margin to handle increased heat from power increase. On the other hand, LL Cable or GAP can withstand to higher temperature (150℃ for LL Cable, 210℃ for GAP Cable), therefore it can handle the heat from power increase from other pairs fault. Figure 3-4-9 describes the redundancy example. For this example, in normal case, one wire of each pair carries 648A and the temperature is 70.1℃ (total of 1,296A with two wires). In case of one wire fault from the pair, other cable needs to handle 1,296A alone. In such case, wire temperature will rise to 118.3℃ by heat increase from increased current. Because temperature which normal wire can handle is up to 90℃, it will eventually collapse. On the other hand, GAP Cable or LL Cable can handle this temperature (118.3℃) so this route can still provide power.

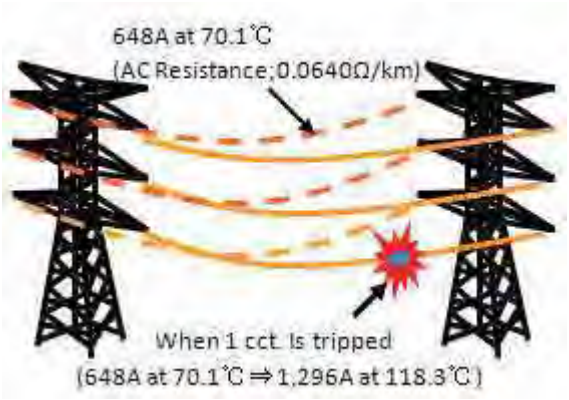


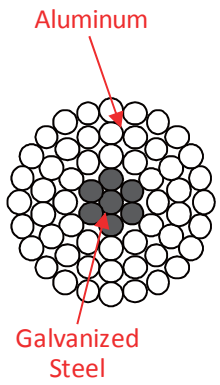
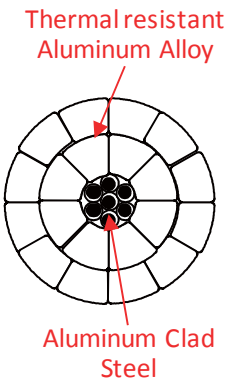
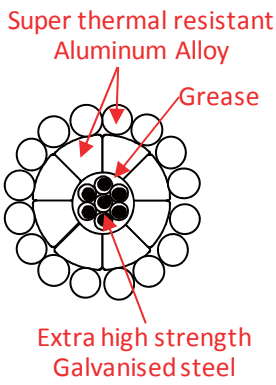
Figure 3-4-9 Line redundancy

Table 3-4-3 shows the summary of comparison between normal cable, LL Cable, Gap Cable. For this table, characteristics is compared by the factor of ratio from normal cable. As shown, LL cable has up to 25% lower power loss, Sag of Gap cable is half of normal cable. Table 3-4-4 shows the specification and cross section view of each cables.

Table 3-4-3 Summary of comparison

	Normal Cable	LL Cable	GAP Cable
MAX Transmission Power	1.00	1.86	2.00
Power Loss	1.00	0.75	1.00
Sage at 1 x Normal Cable Power	1.00	1.00	0.50
Sage at 1.86 x Normal Cable Power	N/A	1.17	-
Sage at 2.00 x Normal Cable Power			1.00
Tower Upgrade for power savings (Capacity up to normal)	-	No	-
Tower Upgrade for Power Enhance (Capacity beyond normal)	-	Yes	No

Table 3-4-4 Spec of Normal Cable, LL Cable and GAP Cable.

		Normal Cable	LL Cable	GAP Cable
		ACSR	LL-TACSR/AS	GZTACSR
Cross Sectional View				
Overall diameter (mm)		32	32	32
Nominal weight (kg/km)		1,980	2,190	2,180
Rated breaking load (kN)		163	166	178
D.C resistance at 20℃ (Ω/km)		0.0552 (100%)	0.0430 (78%)	0.0478 (86%)
Ampacity (A)	71℃	669*	731	669*
	75℃	731	808*	731
	90℃	963	1,004*	963
	150℃	Out of Spec	1,754	1,377*
	210℃	Out of Spec	Out of Spec	1,866

*:estimate

d. Phases for transmission line enhancements

Typically, enhancing the transmission line capacity will be done in two phases. In first phase, transmission line will be replaced. Transmission Capacity will be increased to upper margin of substation, which are typically +30 to +40% of transmission line. In second phase, substation will be enhanced to handle the double of capacity with margins. Figure 3-4-10 summarize the phases.

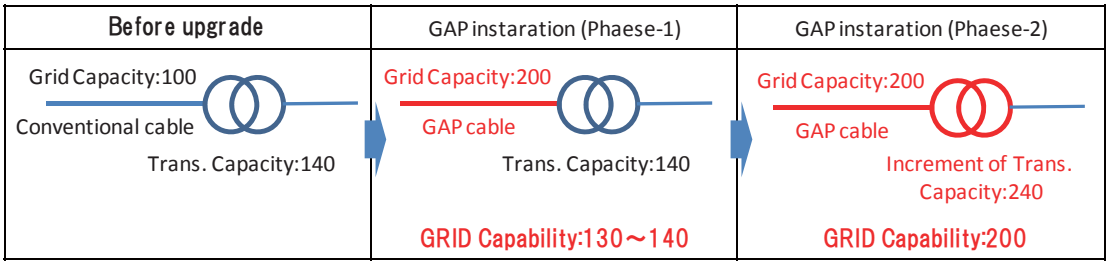


Figure 3-4-10 Phases of Transmission line enhancement.

(3) Net-Zero electricity by PV and battery for Residential developments

In area where the power from the grid is limited, combination of PV (PhotoVoltaic) and Battery storage can be used as providing electricity for residential area. Figure 3-4-11 shows the outlook of this proposal.

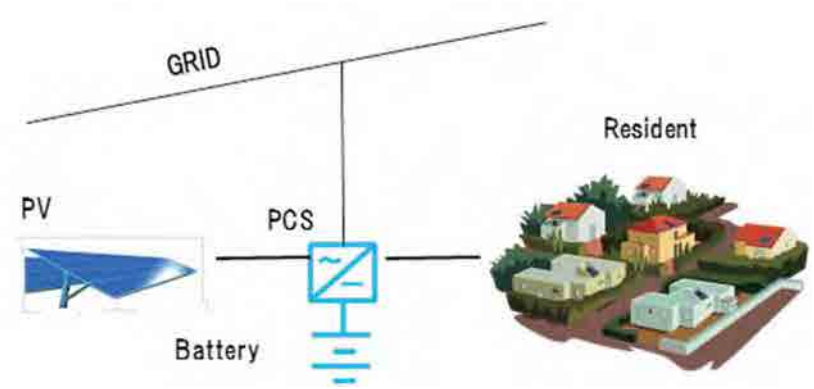


Figure 3-4-11 Overview of PV + Battery systems

As in Figure 3-4-11 PCS (Power Conditioning Systems) are located in center of Grid, PV, Battery, Residential area, controlling the electricity flow between the Grid, PV, Battery Charge, Battery Discharge and Power to the Resident. In the noon time, Power from the PV will be used to power to the resident and charge the battery. In the night time, power from the Battery will be used to power the residents.

Solution without battery can also reduce the total carbon footprint, but due to PV only operates under the solar radiation, PV alone has limited contribution to Generation Capacity Limitation, because in South Africa, demand peak occurs from 18:00 to 20:00 where PV cannot contribute. By adding battery storage, it can contribute to Generation Capacity Limitations. Draw backs for the battery are that in there are loss in both charge and discharge. Also there will be some loss in PCS. In this consideration, 10% loss was used for each charge, and discharge, 5% loss for PCS. Battery Capacity utilization are considered as 60%.

Two scenario was considered for PV + Battery. First is Net-Zero Electricity which annually power from grid is zero (Section 3.4.1.1(3)-b). Second is peak cut scenario (Section 3.4.1.1(3)-c). The scenario is based for land size of 100,000m2. Assumption for household electricity usage, solar radiation are described in following section (Section 3.4.1.1(3)-a).

a. Assumption of Household Electricity Usage and Solar Radiation

Household electricity are assumed that major average household appliance energy usage as in Table 3-4-5. Total Power consumption from Cooking to Light are 48KWh which will be close value to Government policy of Free Basic Electricity of 50KWh. Demand Peak was reverse calculated by Actual Demand Curve of Small Community as in Figure 3-4-12 Integrating the curve to make the total power consumption and linearly scaled down to daily usage of

6,291Wh. Then recalculated the peak as 515 W.

Table 3-4-5 Low income home power usage estimate

Appliance	Spec (W)	Hours Per day	Day use Per Month	Demand Peak (W)	Power Consumption (WH)		
					Per Day	Month	Annual
Cooking	2,000	0.5	30	Same as Spec	1,000	30 K	3,600 K
TV	50	6.0	30		300	9 K	180 K
Iron	1,000	0.5	6		100	3 K	36 K
Light	36	6.0	30		216	6 K	778 K
Refrigerator	550	8.5	30		4,675	140 K	1,683 K
Per House Holds				515	6,291	189 K	2,264 K
24,000 Homes (Lufhereng)				12.4 M	151 M	4.5 G	54 G
For 200,000 homes				103.0 M	1,258 M	37.8 G	452 G

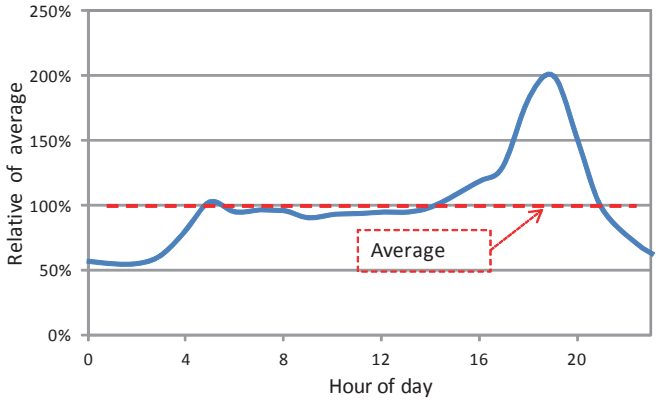


Figure 3-4-12 Power Demand of small community

Annual power generation of 1MW PV was estimated from solar radiation of Cape Town. Solar radiation data was down loaded from SoDa[3] and showed in Table 3-4-6.

Table 3-4-6 Solar Radiation and expected power output from 1MW PV

Average Montly Soloar Radiatin per w/hour

Month	Cape	Joburg	eThekwini
1	328	310	227
2	296	288	218
3	242	262	209
4	172	222	175
5	131	197	150
6	111	175	131
7	64	128	83
8	152	223	167
9	197	259	176
10	260	291	190
11	300	305	214
12	324	319	233
Average	215	248	181
Annual	2,577	2,980	2,172

Annual Power output(MW) from 1M PV

Month	Cape	Joburg	eThekwini
1	244	230	169
2	199	193	146
3	180	195	155
4	124	160	126
5	97	146	111
6	80	126	94
7	48	95	62
8	113	166	124
9	142	187	127
10	194	217	142
11	216	220	154
12	241	237	173
Averege	156	181	132
Total	1,877	2,173	1,583

[3] http://www.soda-is.com/eng/index.html

b. Net-Zero Electricity

For Net-Zero Electricity, Figure 3-4-13 shows the ratio balance of Number of Homes and PV within in 100,000 m2. PV area of 22%, 780 Homes will balance solar + battery power and household power consumption.

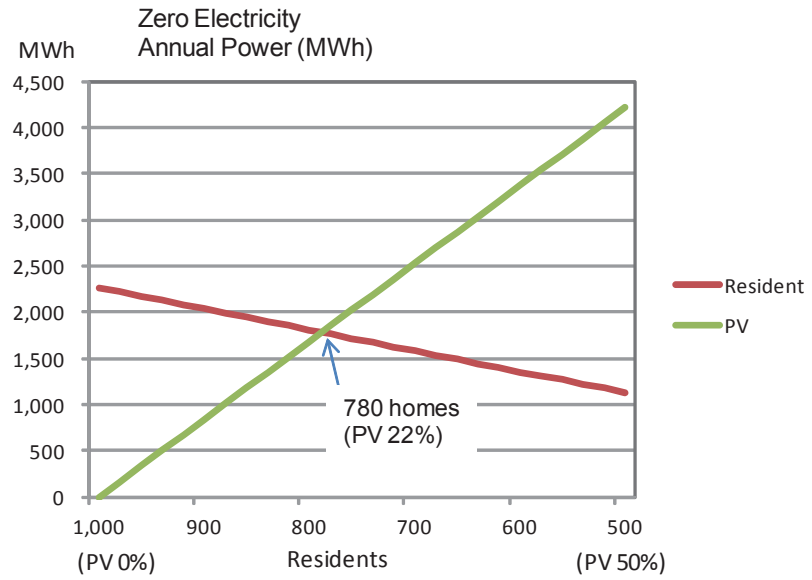


Figure 3-4-13 Power balance

Figure 3-4-14 shows Power Curve of based on hourly average. There are no peak in the night time and power from grid will always be under 120 KW/h. So peak power are be reduced to 1/3.

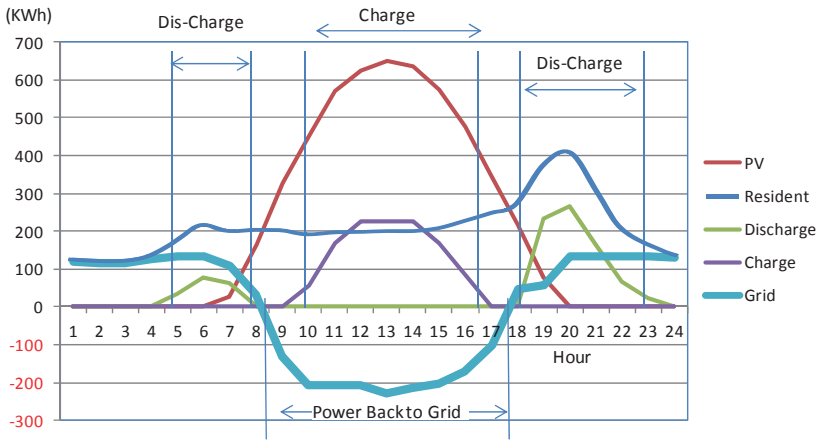


Figure 3-4-14 Power Curve for average day

Figure 3-4-15 shows the basic Layout block of PV and Households. In this study, each block of PV are separated by 2m aisle to make room for maintenance such as cleaning, replacing a bad panel. House area are assumed to place 6.5m x 6.5m 2story high home, which in Japan are so

called 25 Tsubo housing, which are targeted for low cost.

Figure 3-4-16 shows example of total layout in 100,000 area of Net-Zero Electricity.

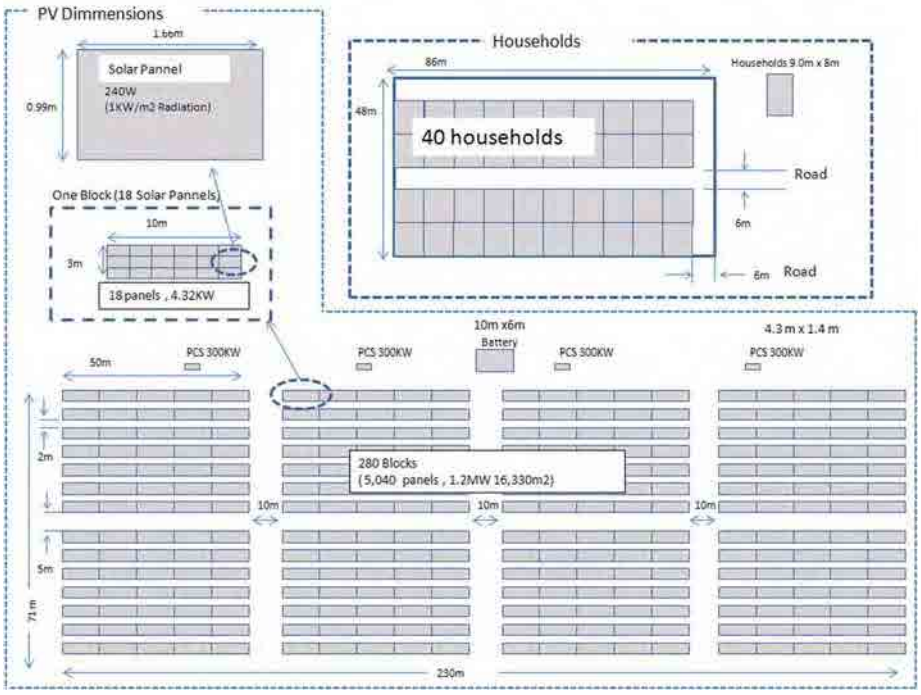


Figure 3-4-15 Basic Layout Blocks of PV and Housings

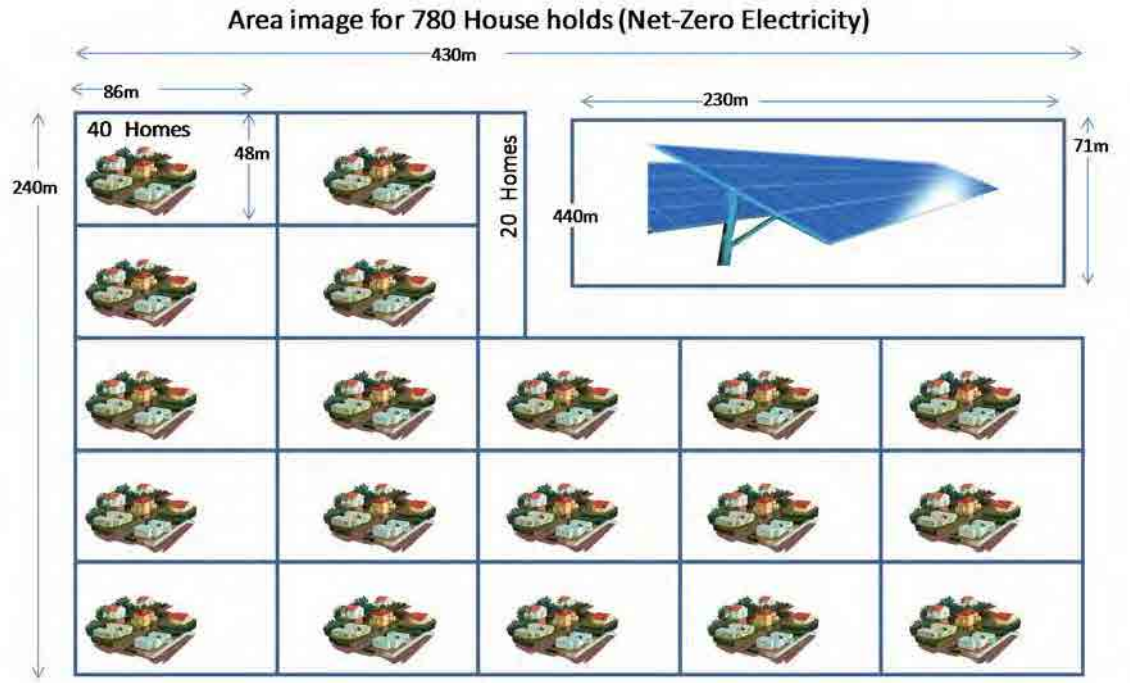


Figure 3-4-16 Layout example of PV and Residential Blocks

c. Peak Cut Scenario

For peak cut, zero electricity are used on night peak time. Zero Electricity in night peak of 2hours (19:00 to 20:00), 4hours (18:00 to 21:00), 6hours (17:00 to 22:00) are considered. Figure 3-4-17 shows the number of homes depending on peak cut hours of 2, 4 and 6 hours and demand curve of peak cut for 2hours.(18:00 to 20:00)

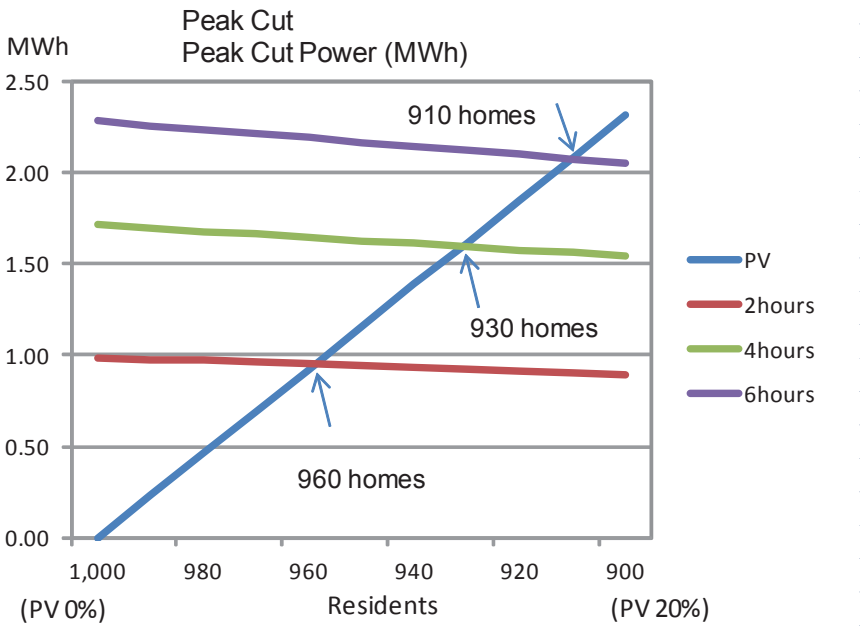


Figure 3-4-17 Number of homes for Peak Cut 2 to 6 hours

Figure 3-4-18 shows the demand curve of Peak cut 2hours. As the demand curve of the GRID and Discharge shows, during 18:00 to 20:00 power from discharge battery are used instead of power from the GRID.

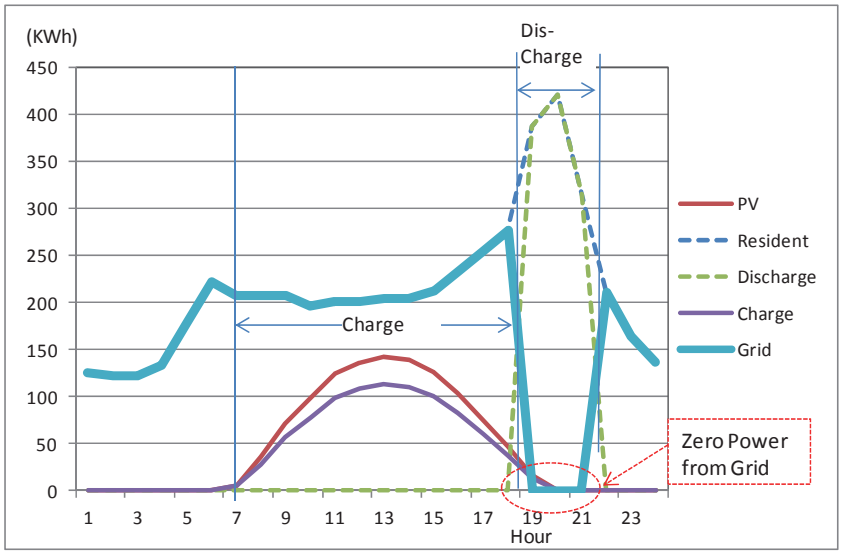


Figure 3-4-18 Demand Curve for Peak Cut 2 to 6 hours

d. Summary of Zero Electricity and Peak Cut for Residential Development

Table 3-4-7 shows Summary for Zero Electricity, Peak Cut of 2,4,6 hours. ,

Table 3-4-7 Summary of each scenario

Theme	Zero Electricity	Peak Cut		
		2hours	4hours	6hours
PV KW	1,000	182	318	409
PV Area (m^2)	22,704	4,128	7,224	9,288
PV area (%)	22%	4%	7%	9%
Home Area (m^2)	80,496	99,072	95,976	93,912
Homes	780	960	930	910
Batt Capacity (KWh) (60% usage)	1,667	1,581	2,819	3,459
Batt Power (KW)	464	571	553	541
GRID Balance (MW/year)	0	1,879	1,566	1,357

(4) Net-Zero electricity by wind power and battery

Wind turbine can be used as similar concept as PV for Net-Zero Electricity.

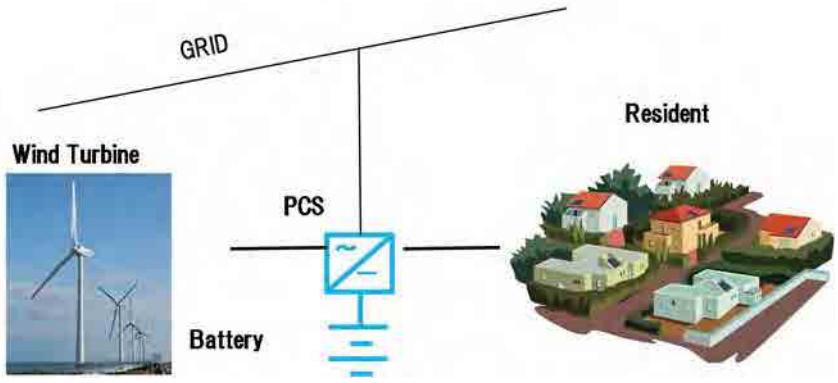


Figure 3-4-19 Overview of Net-Zero Electricity by Wind Turbine

Wind data near Cape Town was used. Due to wind cutting noise from blade, it is not suitable to construct large wind turbine in residential area. So for this case, analysis are made per households. Number of households which Wind Turbine can support should be calculated by dividing the annual power generation of wind turbine by average house hold annual power consumption. Battery utilization and 60%, Battery Charge loss 10%, Discharge loss 10%, PCS loss 5% was used.(same as PV solution on Section 3.4-(3)

In this case, wind turbine can produce power in the night time, and can power half the power for the evening demand peak time, requirement for battery capacity is 756Wh, in capacity, 421W in peak power. Figure 3-4-20 shows the per home power curve.

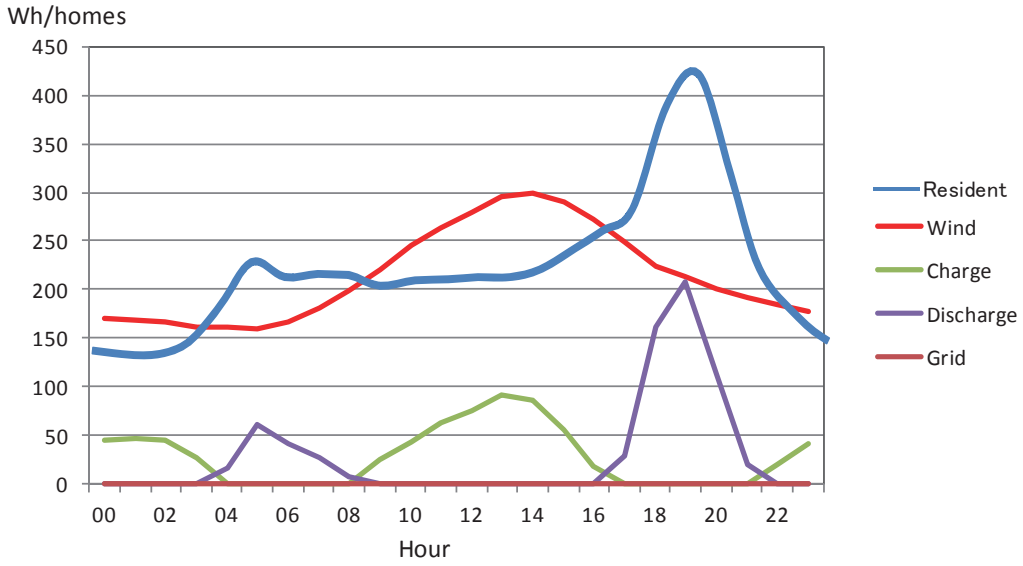


Figure 3-4-20 Power curve per home

Table 3-4-8 shows Hourly Monthly wind speed of Cape Town. Column Average was used for hourly wind power of the day.

Table 3-4-8 Monthly hourly Wind Speed

Hour	01	02	03	04	05	06	07	08	09	10	11	12	Average
00	5.3	4.7	3.9	3.8	3.4	3.2	3.3	3.4	3.5	4.0	4.6	4.9	4.0
01	5.2	4.6	3.9	3.7	3.3	3.5	3.4	3.5	3.5	3.9	4.5	4.8	4.0
02	5.1	4.7	3.8	3.7	3.4	3.3	3.3	3.7	3.4	3.9	4.3	4.6	3.9
03	4.8	4.4	3.7	3.5	3.3	3.4	3.1	3.5	3.4	3.8	4.2	4.3	3.8
04	4.6	4.4	3.7	3.6	3.3	3.4	3.4	3.7	3.3	3.7	4.0	4.2	3.8
05	4.6	4.4	3.6	3.4	3.2	3.4	3.3	3.7	3.3	3.7	4.2	4.6	3.8
06	5.0	4.6	3.6	3.3	3.3	3.2	3.2	3.6	3.3	3.9	4.8	5.0	3.9
07	5.4	5.1	4.3	3.7	3.3	3.4	3.2	3.8	4.0	4.5	5.2	5.3	4.3
08	5.7	5.4	4.8	4.2	3.8	3.7	3.6	4.2	4.7	5.1	5.6	5.7	4.7
09	6.2	5.9	5.3	4.7	4.3	4.1	4.1	4.7	5.1	5.6	6.1	6.3	5.2
10	7.0	6.6	6.0	5.2	4.7	4.5	4.6	5.2	5.4	6.1	7.0	7.0	5.8
11	7.6	7.0	6.5	5.6	5.1	4.9	4.9	5.3	5.9	6.7	7.5	7.5	6.2
12	8.2	7.6	7.0	6.0	5.4	5.2	4.9	5.6	6.2	7.0	8.0	8.0	6.6
13	8.7	8.3	7.6	6.2	5.7	5.4	5.2	5.8	6.4	7.4	8.2	8.5	7.0
14	9.0	8.5	7.6	6.4	5.6	5.3	5.1	5.8	6.5	7.6	8.4	8.6	7.1
15	8.9	8.6	7.4	6.1	5.1	4.9	4.6	5.6	6.4	7.4	8.2	8.5	6.8
16	8.8	8.3	7.1	5.7	4.7	4.3	4.0	5.0	5.8	7.0	8.0	8.3	6.4
17	8.4	7.7	6.4	5.1	4.2	3.9	3.7	4.2	5.1	6.1	7.3	7.9	5.9
18	7.5	6.9	5.8	4.7	3.8	3.7	3.4	4.0	4.6	5.7	6.4	6.9	5.3
19	7.0	6.5	5.5	4.4	3.8	3.6	3.3	3.7	4.4	5.3	5.9	6.5	5.0
20	6.4	6.1	5.2	4.1	3.6	3.7	3.3	3.8	4.1	4.9	5.6	6.1	4.7
21	6.1	5.7	5.0	4.0	3.5	3.5	3.3	3.7	3.8	4.6	5.3	5.8	4.5
22	5.9	5.4	4.6	3.8	3.4	3.4	3.4	3.6	3.9	4.4	4.9	5.6	4.3
23	5.6	5.1	4.4	3.9	3.5	3.3	3.3	3.6	3.6	4.2	4.8	5.3	4.2
Average	**6.6**	**6.1**	**5.3**	**4.5**	**4.0**	**3.9**	**3.8**	**4.3**	**4.6**	**5.3**	**6.0**	**6.3**	**5.1**

(5) Large Scale Wind Farm for Costal Area

Around EThekwini and Cape Town, faced to ocean, so called blow-up wind can be expected as Figure 3-4-21. From the point of effective usage of blow-up wind, the downwind type wind turbine in Figure 3-4-22 might be recommended. The downwind type can catch the normal

component of the blow-up wind. The expected output increasing due to blow-up wind is 7%. Figure 3-4-23 shows a position relationship between wind turbine and stream lines of blow-up wind. The downwind type can catch the normal component of the blow-up wind. Figure 3-4-24 shows overview of the downwind type wind turbine. The diameter of the blade and the hub height is 80m and 80m, respectively.

Figure 3-4-21 Example of blow-up wind potentially place

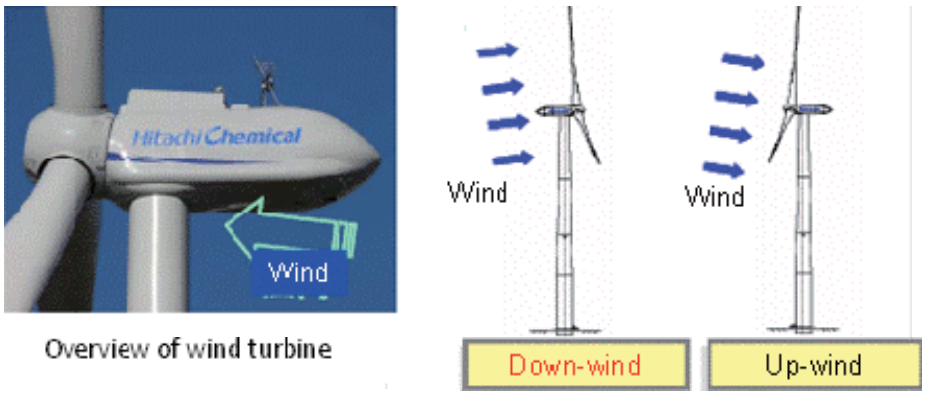
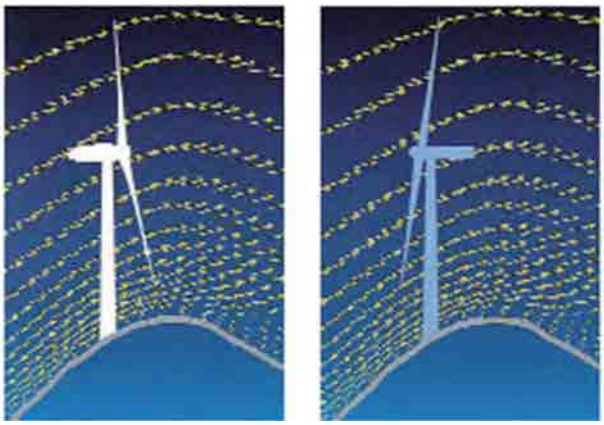


Figure 3-4-22 Nation's Largest down-wind type wind turbines (2MW)



Down Wind Type UP Wind Type

Figure 3-4-23 Position relationship between Wind turbine and stream lines of blow-up wind

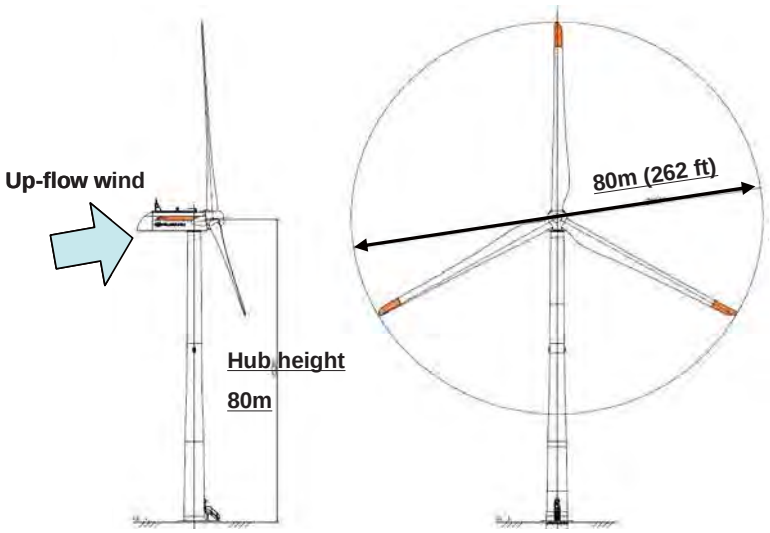


Figure 3-4-24 Overview of blow-up wind type wind turbine

To mitigate the output variations due to wind power, the energy storage system should be required as shown is Figure 3-4-25.

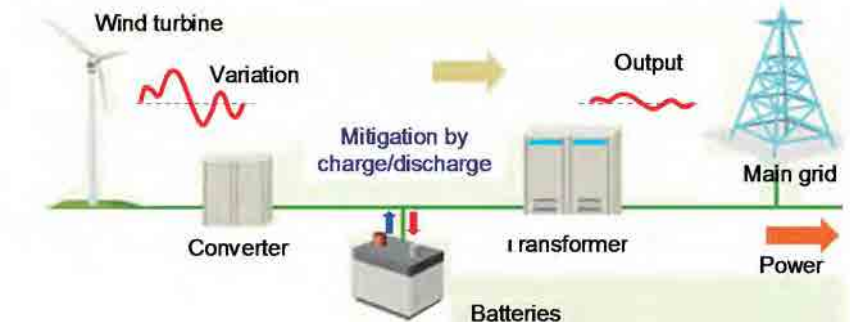


Figure 3-4-25 Fundamental systems of wind power with secondary battery

With charging and discharging of secondary battery systems, the magnitude of the output variations would be required. Table 3-4-9 and Figure 3-4-26 indicate the specifications and overview of the lead acid battery.

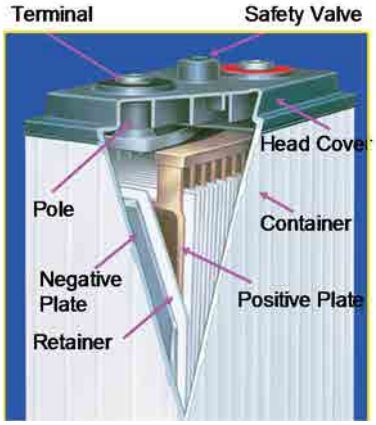


Figure 3-4-26 Fundamental structure of lead acid battery

Table 3-4-9 Specifications of Lead acid battery

Specifications		LL1500W-S
Voltage		8V
Battery Capacity (10hr)		1500Ah
Energy Capacity		12kW
Installation		Horizontal
Dimensions	Heights	506mm
	Widths	473mm
	Depths	799mm
Weights(4 cells)		485kg
Expected life time (under 25℃)		17 years
SOC range		30-90%

On the specifications, especially, the expected life time is top-levels compared with other type batteries. The advantages of lead battery are operation under room temperature and long life time. On the other hand, the low energy density and the heavy weight are disadvantages. Especially, the heavy weight will require strong foundation.

Figure 3-4-27 Demonstration wind park at Nishime (Akita, Japan)

Figure 3-4-27 shows overview of a demonstration wind turbine with lead battery system at Nishime, Akita prefecture, Japan. To mitigate the output variations, 96 cells of lead acid batteries were applied. The total battery weight is 12t. Figure 3-4-28 shows the results of mitigation of output variations by charge and discharge of lead battery. On the actual output of

the wind turbine, the frequent variations are superimposed on the average output. On the other hand, the smoothing effect of output with lead battery was confirmed. Figure 3-4-29 shows the nation's largest wind park with 10MWh battery at Goshogawara, Aomori prefecture, Japan. On this system, a wide installation area was required. The total weight of batteries is 420t.

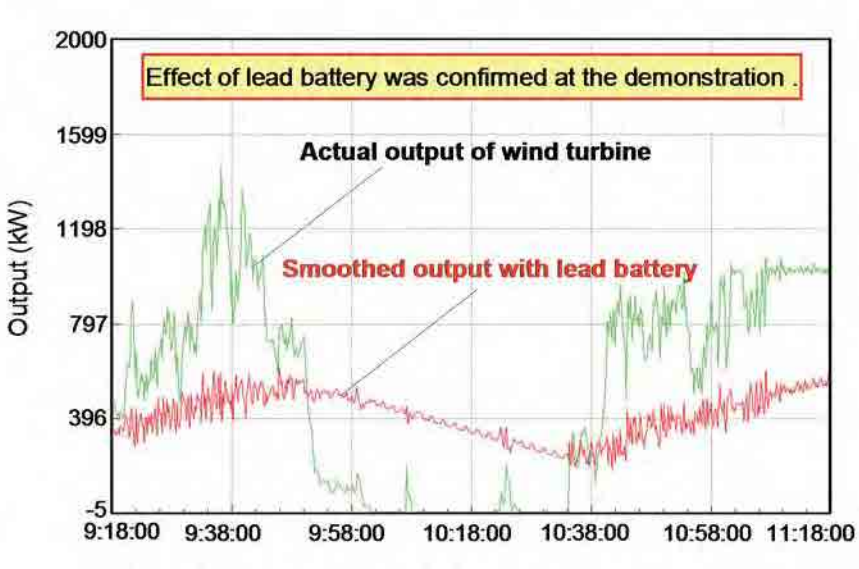


Figure 3-4-28 Results of demonstration wind farm

＜Specifications＞
- Purpose ＝ Smoothign o output
- Capacity of wind park ＝ 15.4MW (2MW × 8)
- Battery capacity ＝ 10.4MWh (LL1500W × 3456cells)
- Installation area＝ 30m × 18m=540m^2
- Weight ＝ 420t

Figure 3-4-29 Demonstration wind park at Goshogawara (Aomori,Japan)

(6) UPS Battery for sudden power outage

Sudden power outage (black out) to the industrial sector may lead to big amount of Loss Cost. For example, power failure during air brush painting of a automobile manufacturing will lead to nozzle clogged, uneven painting.

Having a generator as a backup during the blackout are common countermeasure for blackout.

However, in the event of power failure, power interruption remain until diesel engine ramp up to maximum power. This interrupt time still affects painting process. Sometime, due to poor maintenance, backup generator may take longer time to start up, which leads to increase of Loss Cost. On line UPS (Power Conditioning Systems) system are effective to fill the gap on this kind of interruption. Figure 3-4-30 shows example of UPS controller.

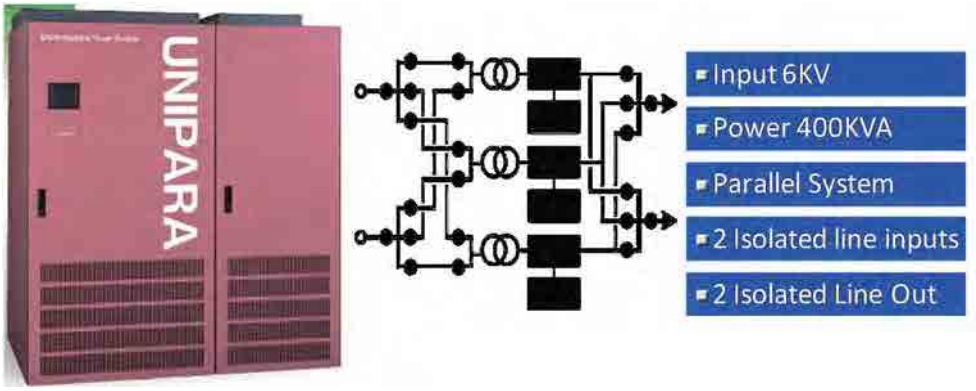


Figure 3-4-30 Example of Large Size UPS Controller

(7) Underground substation to avoid ash flow of wild fire

When strong wind blows during wild fire, smoke with ashes fallen to the substation leads to power outage due to short circuit. Having a substation in underground can be a countermeasure from the wild fire ash falls. Underground substation can be made near the high demand area in the urban area, which will enhance the efficiency of the grid. Figure 3-4-31 shows example of Gas insulated switch used in indoors.

Figure 3-4-31 Example of GAS insulated switch used in indoors

3.4.1.2 Measures and Solutions for Each City

Though most of the measures previously mentioned can be adopted in any area, Table 3-4-10 are examples of adopting solution to each cities.

Table 3-4-10 Specific Measures and Solutions for Each City (Electric Power)

City	Major Issues	Specific Measure or Solution
Johannesburg	Electrification for near urban rural area developments	Allocating power from mine sector LL Cable , GAP Cable for local transmission line Zero Electricity PV system
EThekwini	Sudden Power Outage Electrification for rural areas	LL Cable , GAP Cable for main transmission line UPS for Manufacturing Underground Substation
Cape Town	Sudden Power Outage Protection of Tourism Resource	Clean Energy for Tourism resource protection Wind Power system

(1) Johannesburg

According to Johannesburg city's "Joburg 2040 Growth and Development Strategy", eradication of poverty is one of the top priorities. It describes current issues as follows:

-16% of households lack municipal sanitation

-15% do not receive municipal electricity

-3.6% do not have water supplies

-Unemployment is at 30%, up from 27% three years ago

-Some 116 827 families live in informal settlements

-Some 108 000 families live in illegal backyard dwellings

-There are some 4 500 homeless "street people"

City of Johannesburg have a plan to build 200,000 homes for the poor within the next 10 years. Currently two major plan for housing is proceeding. Lufhereng Project (24,000 homes) and Malibongwe Ridge Project (5,500 homes)

The electricity required for Lufhereng Project 24,000 households is estimated to be 54GWh per year, with demand peak of 12MW. Allocating this power may be possible if Dornkop can achieve power reduction of 26%. For the 200,000 households, it requires all four mine near Johannesburg to have 26% power reduction. Figure 3-4-32 shows the location of mine and Transmission line.

a. Enhancing the transmission line

Main Transmission Line near Dornkop and Lufhereng are 275KV, which can carry 273MVA (approx 218MW). 12MW increase from Lufhereng will not be immediate impact on Capacity. For 200,000 homes increase for the future projects, peak demand will be 103MW. For this case, increasing the transmission capacity and substation enhance are required. In this case, GAP Cable may be better solution compared to making new route, because new route requires

environmental survey, new land acquisition. LL Cable may be used if the sag increase is considered.

b. Net-Zero Electricity resident

If the mines cannot achieve 26% reduction due to expansion, new mines, than PV + Battery to self supply the electricity should be considered (described in section 3.4.(3)). PV have no emission of CO2 or exhaust, it can be installed near the residential area without any environment concerns.

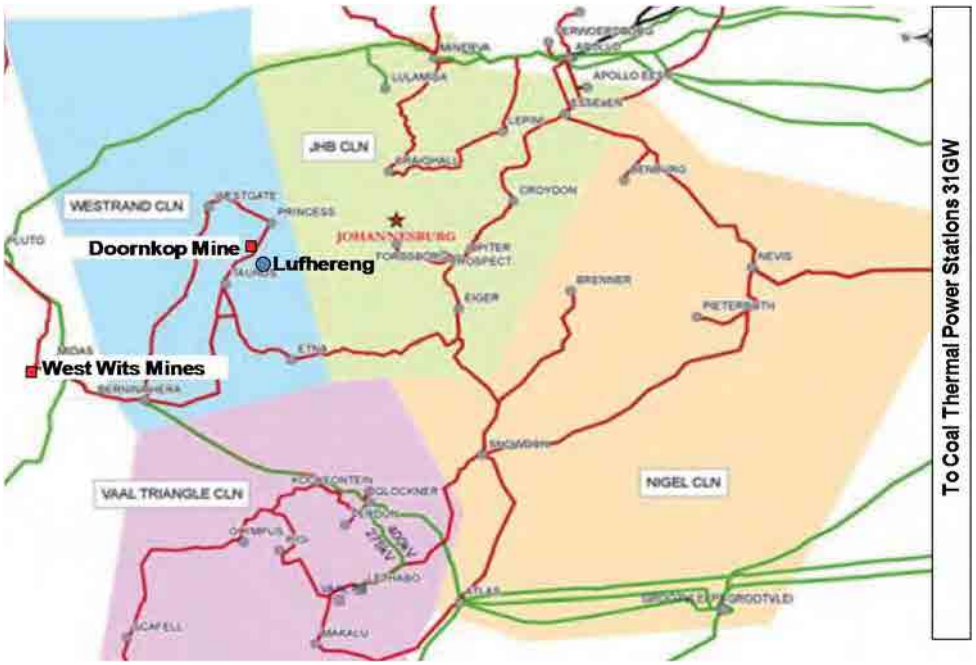


Figure 3-4-32 Mines near Lufhereng[4]

(2) EThekwini

GDP of manufacturing sector in the Kwazulu-natal Province where EThekwini is located, is the second highest in South Africa. Table 3-4-11 shows the GDP of manufacturing of each province. One of the major industries near EThekwini is auto industry, led by Toyota. In our survey, Toyota said that sudden power outage during the operation hour are fatal for their operation.

[4] http://www.eskom.co.za/Whatweredoing/TransmissionDevelopmentPlan/Documents/TransDevPlanBrochure2013-2022.pdf

Table 3-4-11 GDP comparison between Provinces[5]

Province	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Western Cape	33 207	36 176	38 733	39 984	44 782	50 334	48 176	50 745	49 416	50 227
Eastern Cape	17 780	19 154	20 111	21 803	23 745	27 130	25 891	27 358	26 391	26 863
Northern Cape	980	1 021	1 107	1 156	1 020	1 555	1 283	1 608	1 178	771
Free State	9 063	9 644	9 898	11 172	12 081	13 152	13 494	13 961	12 871	12 859
KwaZulu-Natal	47 700	51 876	55 027	58 496	65 401	72 240	71 081	73 828	72 932	74 108
North West	5 736	6 686	6 677	7 165	8 070	7 693	8 569	8 951	8 204	7 411
Gauteng	89 759	98 065	105 281	110 496	123 338	138 618	135 073	139 599	137 216	139 087
Mpumalanga	16 629	17 984	18 719	20 512	22 244	24 632	23 422	24 079	24 231	24 973
Limpopo	3 062	3 360	3 547	3 718	3 757	5 270	4 713	5 423	5 201	4 685
Value added at basic prices	**223 917**	**243 967**	**259 101**	**274 502**	**304 438**	**340 623**	**331 703**	**345 554**	**337 639**	**340 983**

a. Enhancing Transmission Line

Kwazulu-natal consumes 6784MW during peak hours, however Kwazulu-natal only have a 1000MW pumped hydro, else must rely on Coal Thermal from nearby Province. So EThekwini area are vulnerable to transmission failures on other province power from the main transmission lines. Replacing the current transmission line with high capacity GAP Cable adds more flexibility for power re-routing in the event of transmission line failure. LL Cable may also be used if the sag increase is considered.

b. UPS Power Supply

On the manufacturing industry side such as auto manufacture, having an online UPS battery backup can minimize the effect to the power failure.

c. Underground Substation

Underground substation will be effective for power outage from Substation failure due to ash fall of wild fire.

(3) Cape Town

After the Sanctions era ended in 1990's tourist arrivals to South Africa grow from sub 1 Million in 1980's to near 10 Million on 2009. Figure 3-4-33 shows the tourism growth from 1967 to 2009.

2013 Economic Growth Strategy issued by the Cape Town government says the importance of natural environment as "It is often stated that Cape Town's number one asset is its natural environment, particularly its beaches, its iconic Table and Cape Peninsula and the unique Cape floral kingdom." And the Cape Town was elected as "Top Holiday destination for the Year" for 2014 from New York Times and Guardian.

Western Cape province which Cape Town Located only uses Gas Turbine generator for peak demand period, which contributes carbon reduction on Cape Town. The province also have a Nuclear Power Plant which also contributes for carbon reduction. Reducing the Carbon

[5] http://beta2.statssa.gov.za/publications/P0441/P04413rdQuarter2013.pdf

footprint have clean image to the tourists which can contribute to tourism sector.

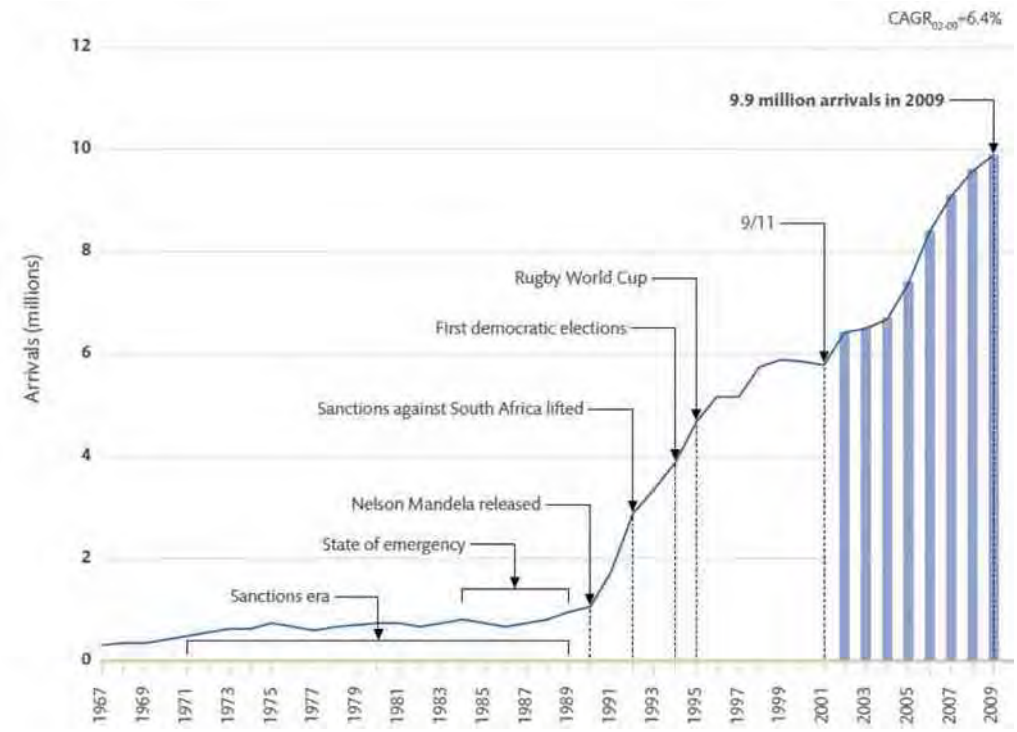


Figure 3-4-33 Growth of Tourist in South Africa[6]

a. Wind Turbine for Clean image.

Wind Turbine has a good image for public for carbon reduction. It will also contribute to reduce the operation of Gas Turbines.

b. Enhancing the transmission line

Power demand of which Western Cape can produce is 2600MW which is half of total demand of Western Cape 5,100MW. Rest of the power are transmitted from 1,000km away from Coal Thermal Power plants in North East region. Due to long transmission line, they are volatile to Transmission line failure. Using high capacity GAP Cable on the transmission line are effective for re-routing power line to secondary route in case of primary line transmission line failure. LL Cable will be effective to save power from loss of long transmission line also. Power saving from 3phase line of 1,000Km will be 104GWh per year(50% utilization of normal cable).

c. Underground substations

Climate of Western cape is dry in summer seasons, wild fire occurs near cape town. Underground Substation is also effective in Cape Town to prevent power outage from ash falls.

[6] http://www.southafrica.net/uploads/legacy/1/333747/SA%2520Tourism%2520Annual%2520Report%25202009-10.pdf&sa=U&ei=rEiDU6mBEIyPlQXe3oDgDQ&ved=0CB4QFjAA&usg=AFQjCNGxOIs8MFYL7pGjikx5lvdiLJ2VDQ

3.4.2 Energy and Environmental Planning

3.4.2.1 Formulation of Measures or Solutions

The issues pertaining to energy and environmental planning as faced by Johannesburg, Cape Town and eThekwini have been discussed in section 2.8. Common issues among all three cities include deficiencies in energy infrastructure planning, the lack of local authority over energy and environmental planning of their own jurisdiction, and various obstacles in renewable energy projects implementation. Underutilization of local resources, need for alternative water resources and underutilization of energy and environmental data are among few of the other challenges. To address these topics, specific strategies have been formulated based on the key aspects below:

(1) Natural energy utilization

Natural energy such as solar heat and natural daylight shall be utilized to reduce the environmental burden and improve the energy efficiency of urban development. Passive energy systems should be considered before active technologies are implemented.

(2) Local resources utilization

Effective utilization of local resources such as sugarcane bagasse and storm water can improve the energy efficiency, lessen the environmental burden, reduce waste generation, improve air quality, and alleviate the impact of natural hazards within a region.

(3) Energy and environmental management

Energy and environmental conservation cannot be achieved without proper management of the installed technologies and systems, as well as continuous strategic planning process. An environmentally-friendly urban development will only be made sustainable through the involvement of all stakeholders.

(4) Comprehensive policy planning

Good policymaking and development planning shall be based on clearly defined, time-bound, and measurable facts. Intelligent and versatile use of energy and environmental statistics can lead to effective policies and result in sustainable urban development.

3.4.2.2 Specific Measures or Solutions

(1) Energy and environmental planning for Affordable Housing

A decentralized energy network, or micro-grid, should be implemented within Affordable Housing complexes. The network should consist of on-site power and heat generation (solar water heating and photovoltaic power) and energy storage system (storage batteries), and should be operated in conjunction with energy-reduction measures through guideline and management

(see Figure 3-4-34).

Such decentralized energy network could decrease area-wide energy use, reduce load on central power stations and provide stable power during emergencies. The independent energy system reduces the area's reliance on the grid thus increasing its energy security.

a. Solar water heating and photovoltaic power systems

Solar energy should be harnessed to provide power and heat for the community. A solar water heater should be installed on roof of individual residential units and supply hot water for the residents. PV panels should be installed in the open space in the complex to create a mega solar power plant. The power generated from PV plant should first serve the power needs within the community. The excess power should be delivered via power network to the local power grid owned by Eskom or other local power company.

b. Energy efficiency guideline and area energy management

There shall be an energy management plan in place, which includes an energy efficiency guideline and a management body, to ensure that the community energy system is properly operated and maintained. The energy efficiency guideline provides the energy usage rules and energy-saving recommendations for the residents. The energy planning and management including operation and maintenance of the solar water heating and PV systems should be run by a council organized by and consisting of the members of the community. The council would provide job training to residents to undertake duties like maintaining PV panels and solar water heaters; these residents would receive a steady income for their service.

To ensure the stability of the power micro-grid and balance between supply and demand, a monthly maximum allowable electricity use limit (Figure 3-4-35) for each residential unit should be included in the move-in conditions of residents. There should be a penalty system for exceeding the allowable limit, e.g., extra electricity charge, electricity cut-off etc. Such system could ensure area-wide energy reduction through collaborative efforts.

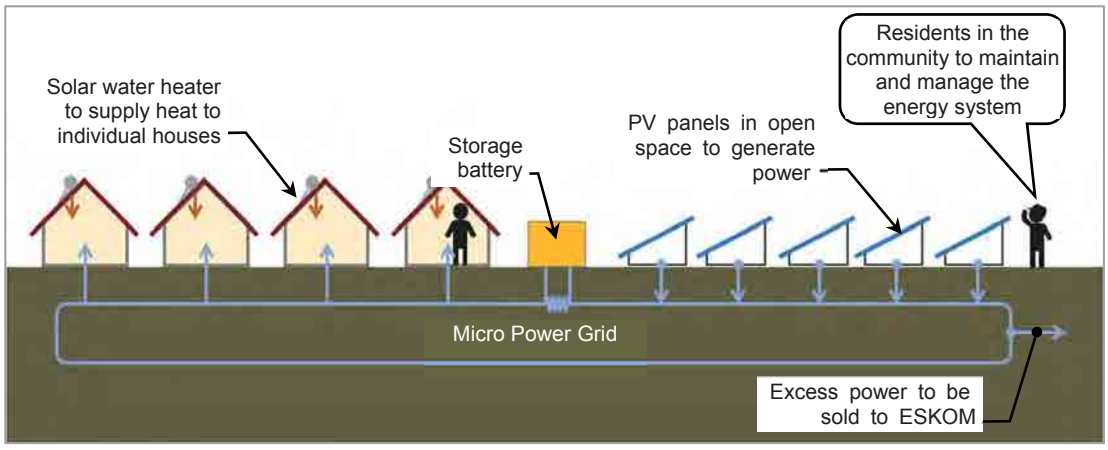


Figure 3-4-34 Energy network system for Affordable Housing complex

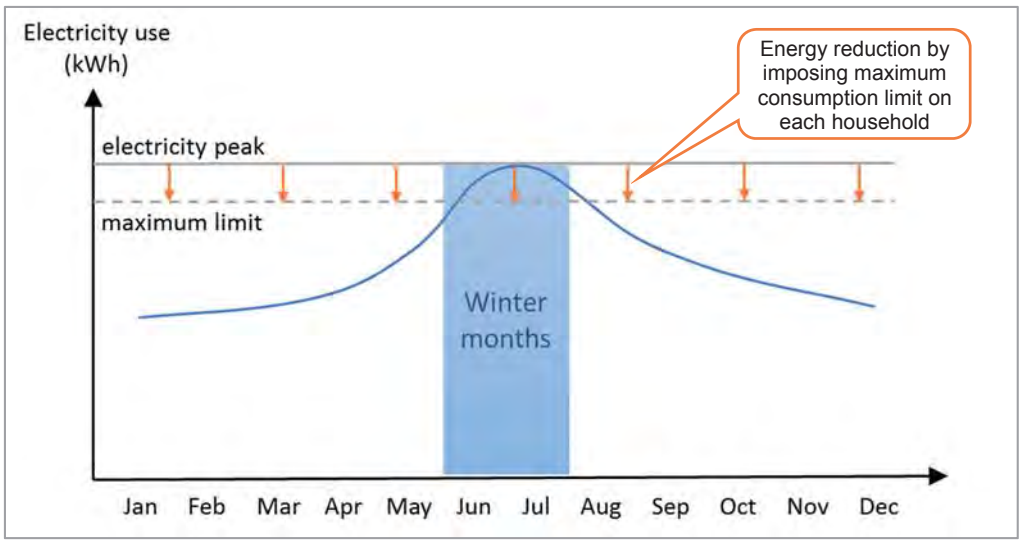
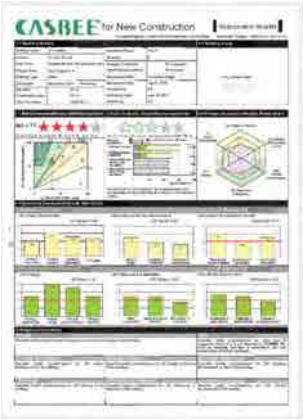


Figure 3-4-35 Projected electricity usage trend for Affordable Housing complex

BOX. CASBEE as energy efficiency guideline in Japan



Comprehensive Assessment System for Built Environment Efficiency (CASBEE) is a building performance assessment method developed jointly by industry, government and academia in Japan in 2001. CASBEE addresses four assessment areas including 'energy efficiency'. One of the assessment indicator, "LR1: Energy", outlines the measures that could reduce the environmental load of a building, such as reduction of building thermal load, natural energy utilization, energy efficiency in building service systems and efficient building operations.

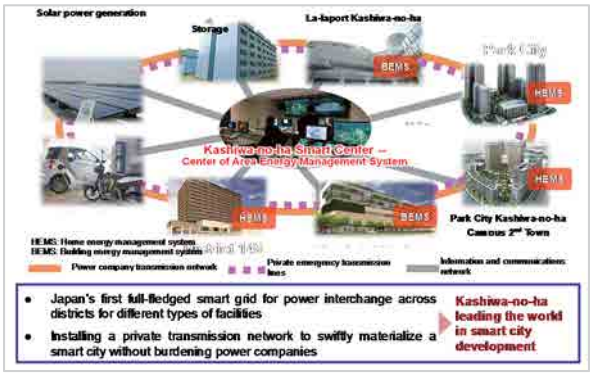
Currently, a total of 24 prefectural or city governments have adopted a policy that requires owners of large-scale building to submit building environmental plans according to the guidelines of CASBEE.

Source: Japan Sustainable Building Consortium. "CASBEE for New Construction"

BOX. Smart Grid of Kashiwa-no-ha Campus City, Japan

The Kashiwa-no-ha Campus City is a 273ha development area located 25 kilometers from central Tokyo. The development, consisting of residences, schools, commercial facilities, etc., has multiple renewable energy resources (solar power, wind power) and energy storage systems.

To optimize the energy network, a Smart Grid system was formed with an Area Energy Management System that monitors energy consumption, provides visualized information to users to encourage energy-conscious operation and performs demand-response control of the district's energy usage.



Source: Nikken Sekkei Research Institute (NSRI)

(2) Water resources utilization

With widespread water shortages throughout South Africa, locally available water sources should be explored and utilized as much as possible. For example, abundant underground water is collected in old mines in the Johannesburg area. Storm water runoff which regularly causes flooding during rainy season could be captured and stored in flood control reservoirs (water storage ponds) and used. Greywater, after biological treatment processes, could be re-used. The recycled water from these sources could be combined into a single recycled water system that supply water for landscape irrigation and indoor toilet flushing (see Figure 3-4-36). The benefits from this system would include reduced central water supply, reduced energy use and chemical pollution from treatment, and alleviating flooding due to rainstorms.

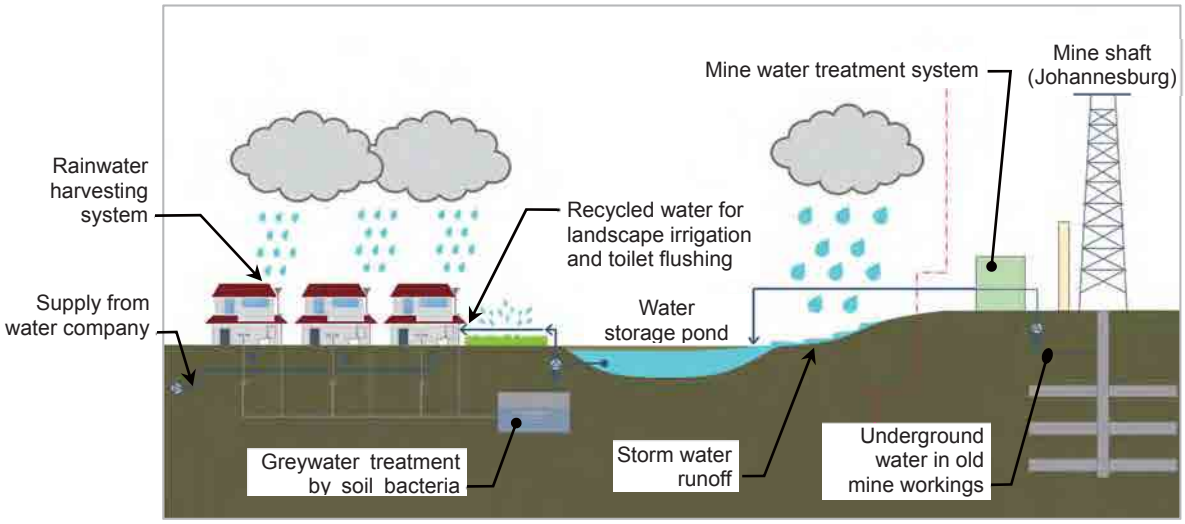


Figure 3-4-36 Recycled water system for Affordable Housing complex

(3) Passive and active design strategies for commercial facilities

Commercial buildings in general consume more energy than residential buildings and therefore have higher potentials for energy reduction. Energy reductions for commercial facilities (shopping centers, office buildings etc.) could be achieved through a combination of passive and active building design strategies, such as those shown in Figure 3-4-37.

The energy efficiency of buildings could be further enhanced with proper energy management, which involves both the building owner and building tenants. BEMS should be installed to monitor the supply and demand side of energy use, and each lease space shall be installed with a smart meter. The tenants lease agreement shall contain a provision that requires the tenants to abide by energy-reduction measures and pre-determined energy consumption limits.

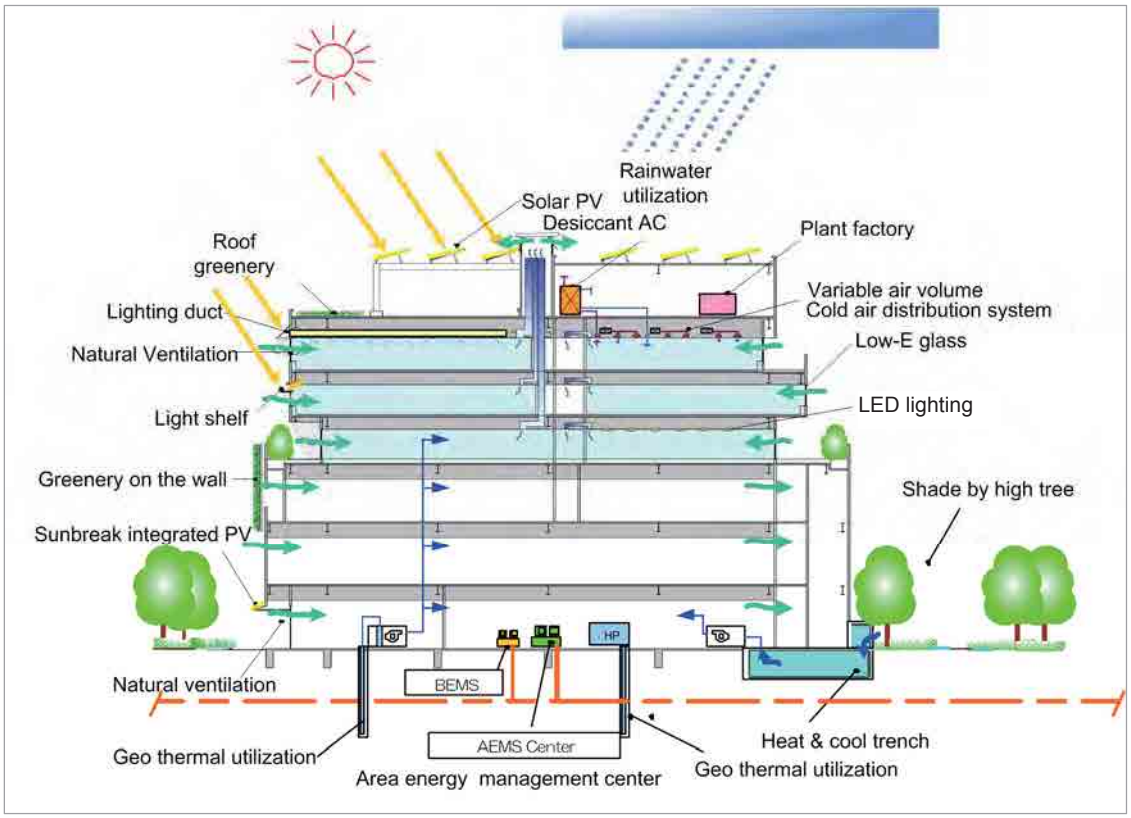
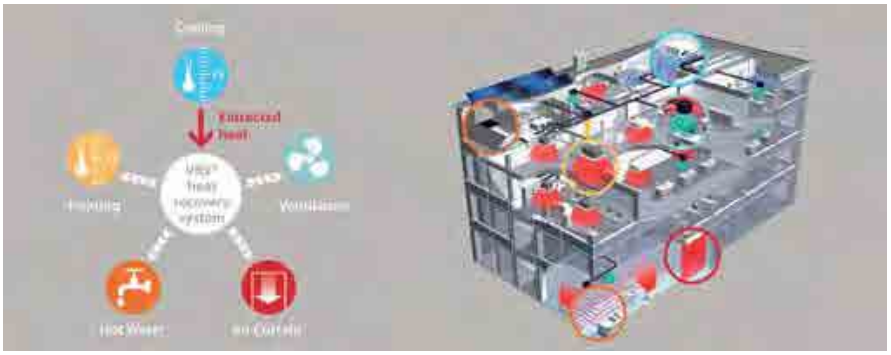


Figure 3-4-37 Passive and active design strategies for commercial buildings

BOX. High efficiency multi-split air conditioning system

The Daikin VRV system is a multi-split type air condition system for commercial buildings that uses variable refrigerant flow control to provide users with the ability to maintain individual zone control in each room and floor of a building. Daikin VRV heat recovery type system allows simultaneous operation of heating and cooling in a building with optimum energy efficiency.



Source: http://www.daikinafrica.com

BOX. Hotel Verde of Cape Town – the first carbon neutral hotel in Africa

Hotel Verde is the first hotel in Africa that has been designed and constructed to achieve 100% carbon neutrality. The hotel has achieve energy self-sufficiency by installing photovoltaic panels and wind turbines to generate electricity and a geothermal heat pump system that serve the heating and cooling needs of the hotel. Other sustainable features of Hotel Verde include: concrete slabs comprising recycled materials, a "living wall" made up entirely of plants, a greywater recycling system, and occupancy sensors for lighting.

Geothermal system piping & wind turbines

Source: JICA study team

(4) Passive and active design strategies for residential facilities

Energy consumption is much higher for middle- and high-income households, and therefore provide more opportunities for energy efficiency interventions.

Due to the mild climate of all three cities, indoor thermal comfort is highly achievable by passive design, which can reduce or eliminate energy use, improve the comfort and quality of the interior environment, and reduce energy consumption associated with the active systems, i.e., heating, cooling, and lighting. The passive an active design strategies shown in Figure 3-4-38 could be employed in upper- or middle-class residential homes.

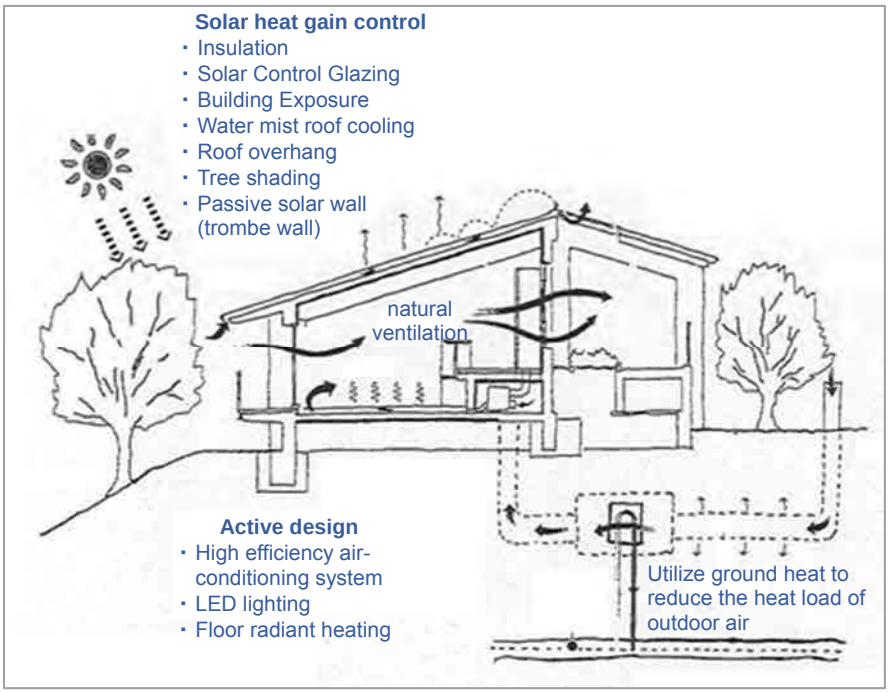
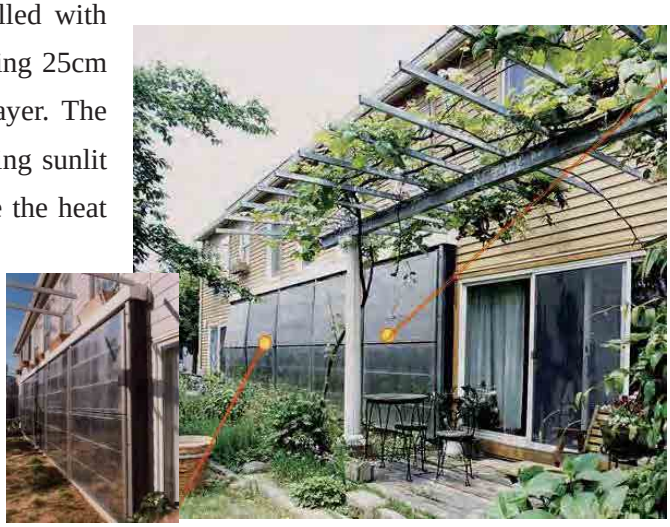


Figure 3-4-38 Passive and active design strategies for residential buildings

BOX. Trombe wall design for a private home (Aichi Prefecture, Japan)

The Okamoto residence was installed with south-facing trombe walls comprising 25cm concrete wall and glass external layer. The trombe wall could absorb heat during sunlit hours of winter then slowly release the heat over night.



Source: http://www.chiryuheater.jp/okm/

(5) Biomass energy from sugarcane

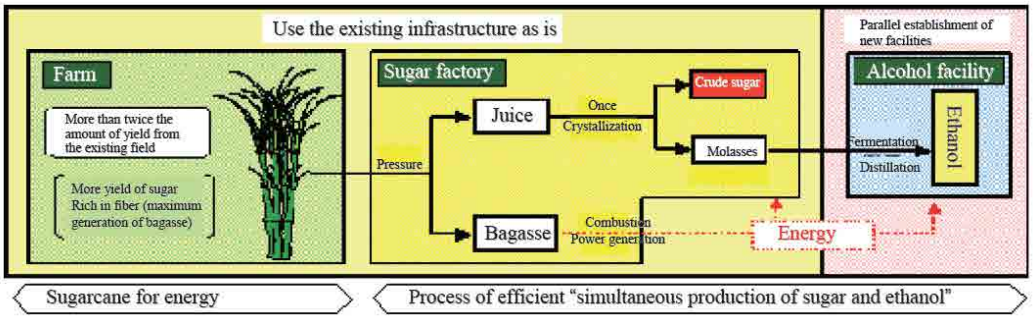
The South African sugar sector is one of the world's leading producers of sugar and countrywide there are nearly 30,000 sugar cane growers predominantly in the KwaZulu-Natal province[1]. Examining an agriculture map would find that the Durban metropolitan area is surrounded by sugar cane plantations along the Indian Ocean coastal belt[2].

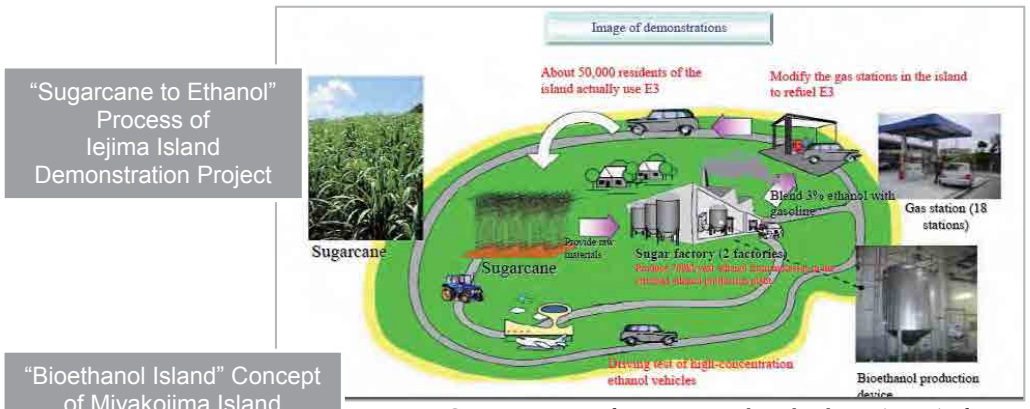
The molasses after sugarcane crystallization and the sugarcane bagasse could be converted into useful energy such as bioethanol and electricity through fermentation and thermal combustion processes. The electricity produced may be sold to ESKOM; the residue from fermenting molasses and the ashes from burning bagasse may be used to produce fertilizers. The proposed cascade system (as demonstrated in the demonstration projects in Okinawa below) allows for "resource circulation" and the full use of sugarcane lifecycle.

It is however critical that the technologies used for this purpose include first a farming technique that produce high biomass sugarcane crops to prevent competition with food crops.

BOX. Sugarcane to bioethanol demonstration projects (Okinawa Prefecture)

Bioethanol was efficiently produced from sugarcane crops in two demonstration projects in Iejima Island and Miyakojima Island of Okinawa Prefecture undertaken by the Japanese government. E-3 gasoline was produced from the sugar cane molasses and bagasse.





Source: Ministry of Economy, Trade and Industry (METI) of Japan.

[1] GCIS Republic of South Africa. South Africa Yearbook 2012/13.
[2] iied (2007). Biofuels trade and sustainable development: An analysis of South African.

(6) Energy and environmental data utilization for policy and development planning

Existing energy and environmental data could be further utilized by using a data management and analysis system that could capture, manage, analyze and present the data in an intelligent way. This system, combined with Geographic Information System (GIS) tools, will create 3-D graphics so that essential statistics (energy use density, access to electricity, water use density, air pollutant emissions, waste etc.) of different areas (city center, suburb, rural etc.) within the city could be projected on a map and therefore provides for easy visualization. With further incorporation of socioeconomic data (population density and growth, health level, education level, employment rate, income level, crime rate, etc.), this tool can help the city with diagnosing the vulnerable areas or sectors and determining the priority site for spatial development and infrastructure needs under budget constraint.

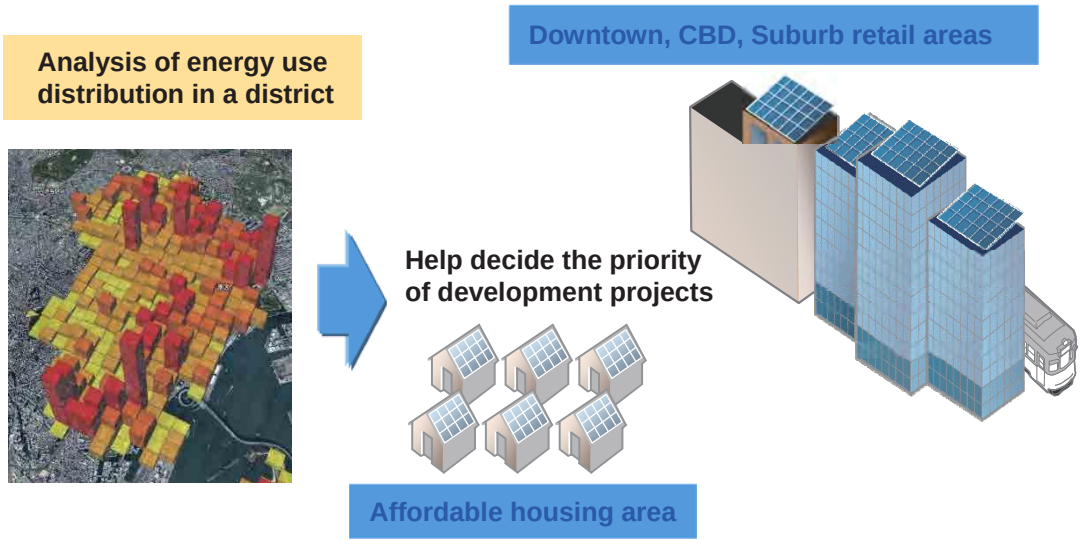
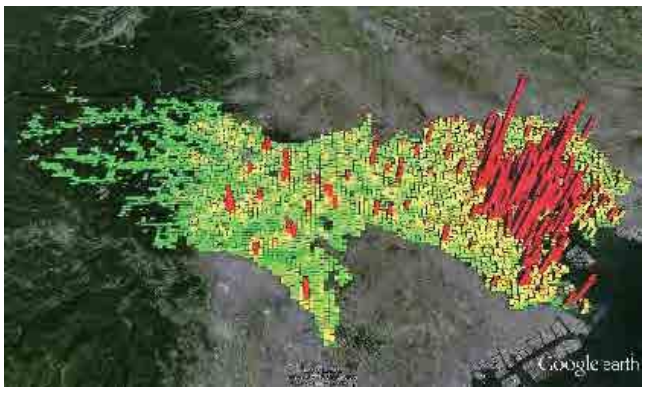


Figure 3-4-39 Energy density map for Johannesburg City

BOX. 3-D Visualization of Energy use density map of Tokyo

The figure shows a 3-D map that has been created to illustrate and compare the energy use density of different areas within Tokyo metropolitan area.



Source: Nikken Sekkei Research Institute (NSRI)

3.4.2.3 Measures or Solutions for Each City

The proposed strategies and solutions for enhancing the future energy and environmental planning of the three metropolitan areas have been described in the previous sections. The specific strategies or solutions recommended for each city are summarized in Table 3-4-12 below.

Table 3-4-12 Specific Measures and Solutions for Each City

	Intention of Measure or Solution	Specific Measure or Solution
Three cities	- Natural energy utilization - Local resources utilization - Energy and environmental management	- Energy and environmental planning for Affordable Housing - Water resources utilization - Passive and active design strategies for commercial facilities
Johannesburg	- Comprehensive policy planning	- Efficient energy and environmental data utilization
Cape Town	- Energy efficiency - Natural energy utilization	- Passive and active design strategies for residential facilities
eThekwini	- Local resources utilization	- Biomass energy from sugarcane bagasse

3.5 ICT Planning

3.5.1 Measures or Solutions for ICT infrastructure development

a) Effective deployment of fixed wireless access technology

As mentioned in Section 2.9, effectively providing broadband services in the last miles to the end users is the key to achieve sufficient ICT environment that contributes to further development of South African cities. However, as South African cities has stood behind fibred broadband infrastructure development, extension of existing fibre network directly to the premises would require excessive amount of investment and construction period. Therefore, utilization of fixed wireless access (FWA) technologies would have a considerable potential to reduce the initial roll-out and operation and maintenance cost, simultaneously enabling cities to quick development in order to meet growing connection needs. In order to accelerate the installation of such a system, it would be important for government to dedicate certain spectrum to such FWA so that operators does not need to apply and wait for radio licenses.

BOX. Wireless broadband product

This product needs no license in Japan, energy saving, quick installation and cost effective through the life cycle of the product and was deployed as emergency telecommunication infrastructure after the Great East Japan earthquake in 2011

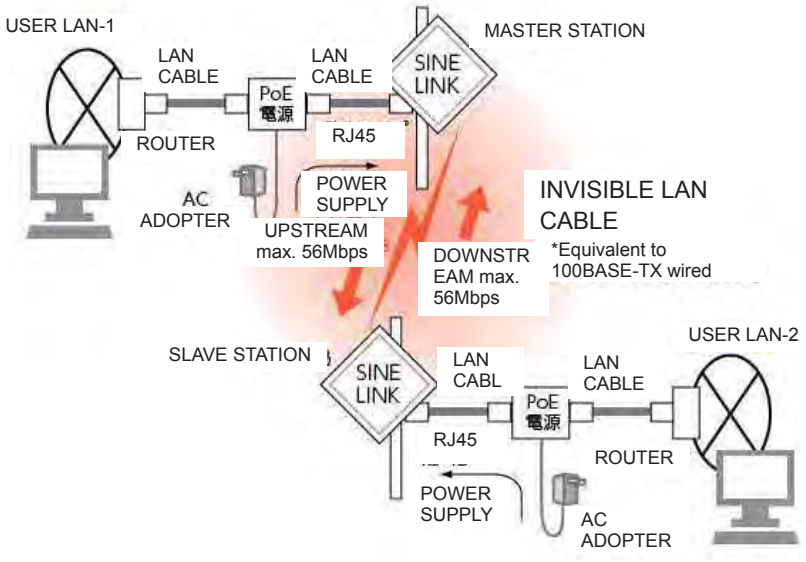


Figure 3-5-1 System overview of wireless broadband system[1]

[1] SINELINK 25
http://www.hitachi.co.jp/area/tohoku/portal/interview/revival/contents/__icsFiles/afieldfile/2012/03/23/KOKUSAI_leaflet.pdf

b) Improvement of data and infrastructure security to ensure continuity for businesses

As the development of broadband infrastructure progresses in South Africa, governments, enterprises, citizens and visitors will become more dependent on ICT, such as cloud services, to sustain their everyday activities in cities. Therefore, when South African cities consider sustainable development, it is critical to be prepared for the future risks on ICT infrastructure's continuity by having possible counter measures to prevent or respond to these risks. Especially, when cities try to attract foreign investments for their economic growth it is important to provide robust ICT infrastructure to sustain enterprises' business continuity and resilience. Therefore, local governments should have the abilities of sustaining the security of important data and services for local enterprises' business operations by developing data back-up infrastructures, simultaneously considering the correlation between the cost, value of data and recovery time. For example, three major cities could develop mutual data back-up system to improve data security synergistically.

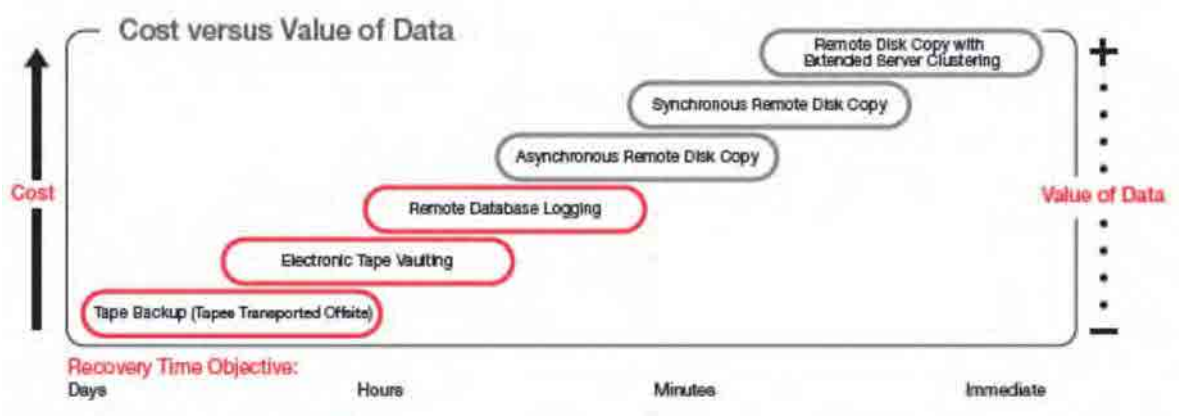


Figure 3-5-2 Correlation between recovery time, cost and value of data

3.5.2 Measures or Solutions for ICT application

a) Development of comprehensive urban management system

Considerable amount of public expense is being spent on the operation and maintenance of infrastructure. By enhancing cross-sector management of urban infrastructure, city can minimize unnecessary investment and running cost. As public participation in sustainable urban development has become a key to realize socially cohesive living environment for the next generations, bidirectional and real-time communication between citizens and city managers needs to be established to promote productive collaborations between demand and managerial sides.

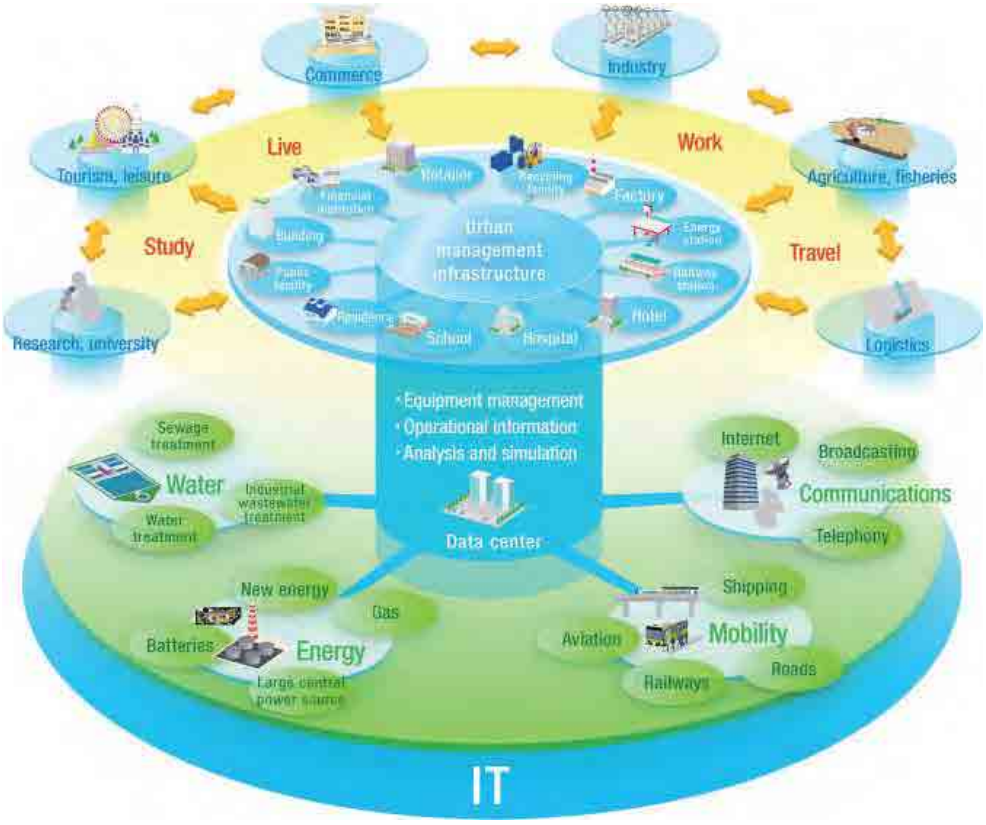


Figure 3-5-3 Concept model of Smart City management system[2]

b) Improvement of safety and security level by ICT based surveillance system

While South African cities have been planning TOD to achieve sustainable growth of cities, safety and security situation in the areas around public transport hubs has been discouraging the people's use of them. Therefore, TOD would be effectively promoted in parallel with the improvement of safety and security by the ICT empowered surveillance system that can synergistically interoperates with physical security services.

Insecurity of urban environment has negative impacts not only on the transport sectors by preventing people to use public transport to travel but also adversely effects the South African tourism industries which has been a strong economic driver for the country.

Urban security system should therefore be improved to the sufficient level to bring down the crime rate, for example, by introducing facial recognition program which can be built into the broadband infrastructure.

2 ICT Underpinning Smart Cities, Hitachi, http://www.hitachi.com/products/smartcity/vision/concept/it.html, accessed 2014 May 26th

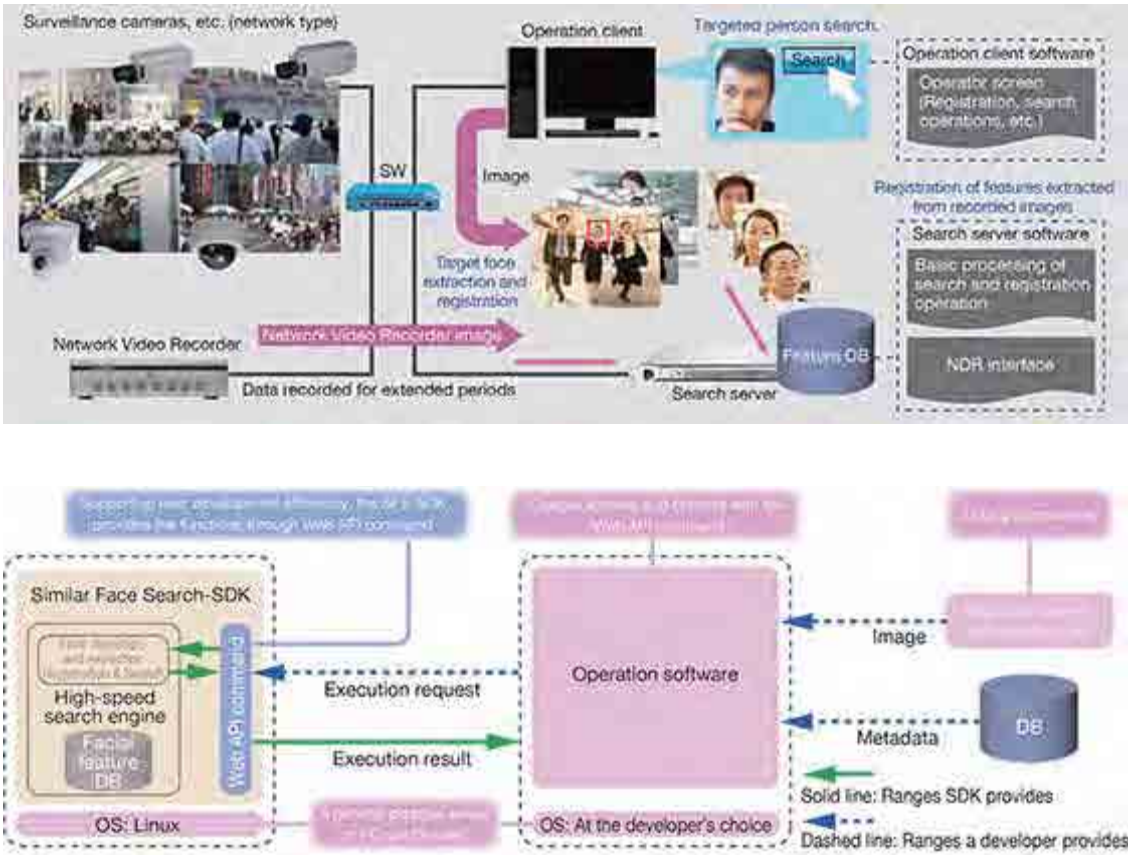


Figure 3-5-4 System overview of ICT based surveillance system[3]

c) Deployment of remote technologies for education and skill development

Construction of affordable housing should be promoted together with the development of education and skill training services in the community to give equal opportunities and consequently reduce the unemployment rate of people who live in low-income communities. .

Building physical facilities for education and training always requires larger amount of investment compared to the introduction of ICT empowered remote learning system. By effectively utilizing e-learning solutions, cities could cut expenses on the initial investment for the development of education and skill training environment and also the operational cost for labors.

3 Similar face searching system, Hitachi, http://www.hitachi-kokusai.co.jp/global/products/camera/network/sfs.html, accessed 2014 May 26th

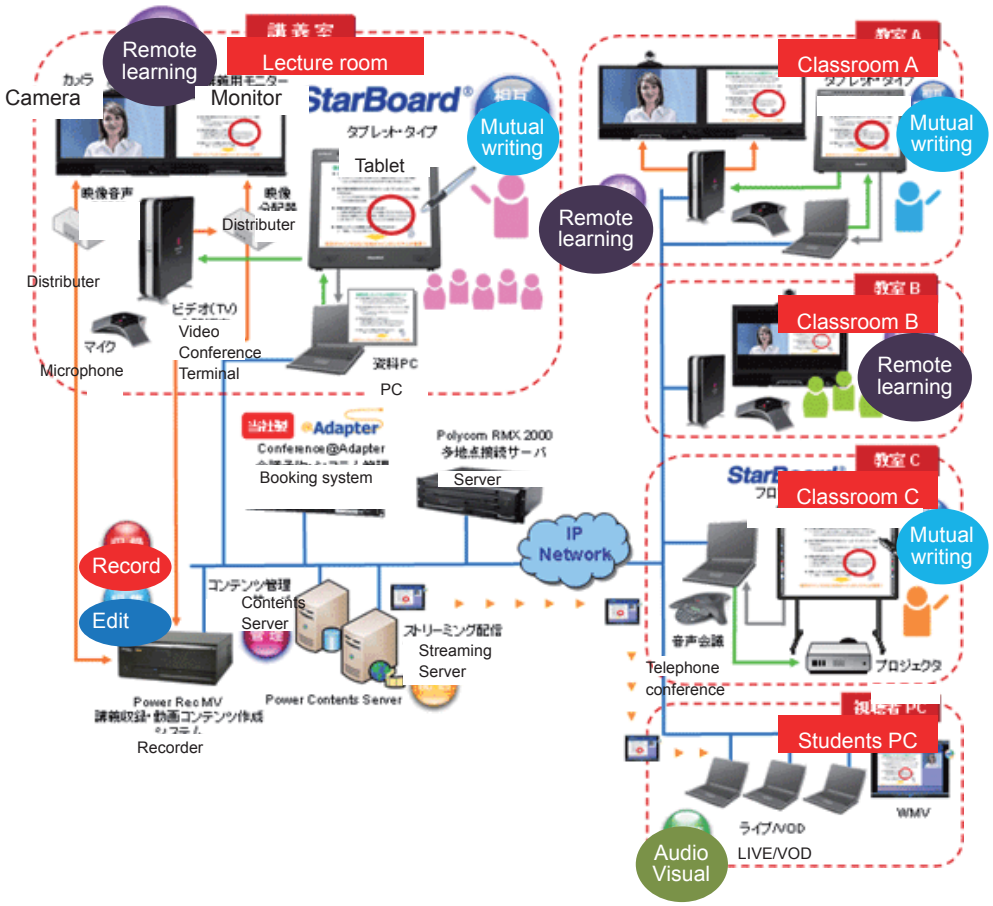


Figure 3-5-5 System overview of remote learning system[4]

[4] Interactive whiteboard, Hitachi, http://eu.hitachi-solutions.com/en/products/index.php, accessed 2014 may 26th

3.5.3 Formulation of Measures or Solutions

Table 3-5-1 Directions for proposed measures or solutions in ICT planning

	Intension of Measure or Solution	Specific Measure or Solution
Three cities	(ICT Infrastructure development) -Efficient infrastructure development in sparsely spread urban areas - Achievement of equal ICT accessibility	(ICT Infrastructure development) -Effective deployment of wireless broadband technologies to last-mile connections
	-Development of stable and reliable infrastructure to attract foreign enterprises and visitors -Introduction of local data centre business to boost economy	-Development of mutual data back up system among three major cities to improve BCP
	(ICT Application) -Improvement of compartmentalized management structure and introduction of cross-sectional management	(ICT Application) -Development of comprehensive urban management system
	-Improvement of safety and security around the public transport nodes	-Introduction of ICT empowered surveillance system (Facial recognition)
	-Improvement of quality of life for lower-income residents and enrichment of educational and medical services	-Utilization of remote service technology for education and medication

4. COMPREHENSIVE SOLUTIONS FOR PILOT PROJECTS

4.1 Overview of each area

In Chapter 2, current status and issues in each metropolitan municipality have been described and in Chapter 3, directions and solutions to solve those issues by utilizing technologies or know-how of Japanese enterprises have been proposed. The proposed measures are intended to address a specific issue, but in actual situation, other cases can be considered such that one solution can address several issues and combination of several measures can achieve greater effectiveness.

In order to demonstrate how several measures could be utilized in combination, in this chapter, comprehensive solutions are shown at pilot projects in each metropolitan municipality. When selecting pilot projects, it is considered important that the projects are managed by local government to solve its urban issues and challenges. Objective of this comprehensive solutions is to show our total image/idea by combining each solution stated in chapter 3 and to support implementation of existing strategies or plans by local government.

The selection criteria for pilot projects are described below. Overview of the pilot projects is given in the next page.

Concepts for selection of pilot projects

a) Highly significant urban policies that are actively promoted by administration
b) Appropriate land size (approximately from 10 to 1,000 ha) for utilizing technologies and expertise by Japanese companies (As for suburban type projects, since development shall be implemented step by step, one part of development size shall be less than 1,000ha)
c) Integration of multiple functions
d) Connection with traffic hubs of public transit
e) Japanese businesses are either already present or planning to open in the area

+

- Selection of urban type projects (redevelopment of existing urban areas) and suburban type projects (new developments) in each metropolitan area

Figure 4-1-1 Concepts for selection of pilot projects

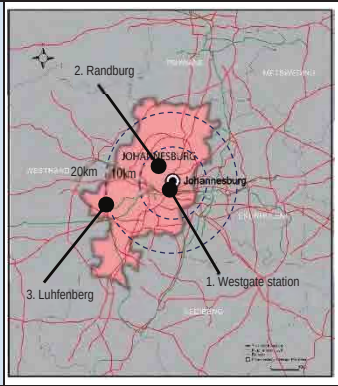
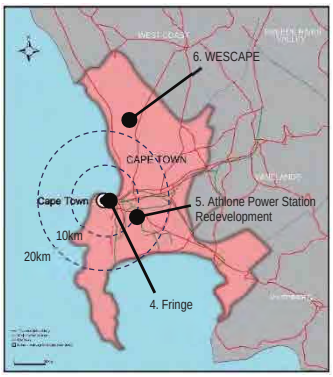
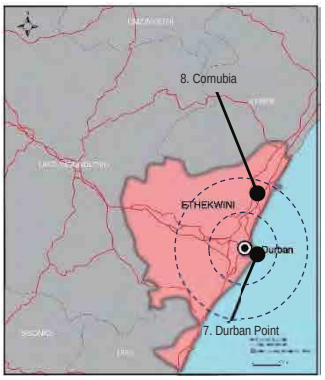
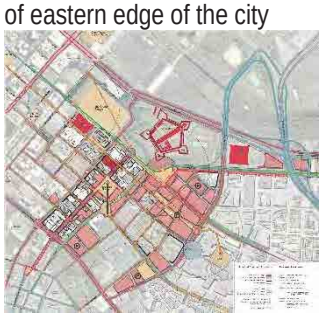
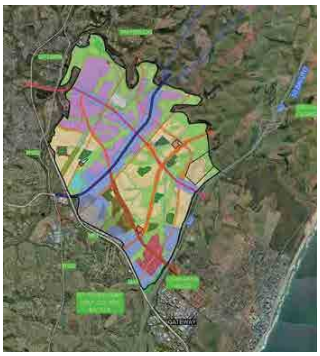
Based on the selection criteria a)-e) above, selected pilot projects are stated in Table 4-1-1. Each pilot project was first picked up by the JICA study team during the 1st domestic study and confirmed through discussion with local government during the 1st field study.

Table 4-1-1 Overview of selection of pilot projects

Projects		a)	b)	c)	d)	e)
Johannesburg	Westgate station	●	●	●	●	−
	Randburg CBD	●	●	●	●	−
	Lufhereng	●	●	●	●	●
Cape Town	The Fringe	●	●	●	●	−
	Athlone Power Station	●	●	●	▲ *2	−
	WESCAPE	▲ *1	●	●	●	−
eThekwini	Durban Point	●	●	●	▲ *2	−
	Cornubia	●	●	●	●	−

*1: WESCAPE is mainly developed by a consortium of private companies (CommuniTgrow). The city of Cape Town is supporting this project according to interview with CommunitTgrow.
*2: Currently there is no plan of introducing public transport station(s) inside of or adjacent to the site

Table 4-1-2 Overview of pilot projects

	Johannesburg	Cape Town	eThekwini
Location			
CBD type	1. Westgate station (94.5ha) Introduced as TOD project managed by JDA  2. Randburg CBD (251ha) Introduced as TOD project managed by JDA 	4. The Fringe (150ha) Introduced as redevelopment of eastern edge of the city  5. Athlone Power Station Redevelopment (36ha) Introduced as Special Spatial intervention in BEPP 	7. Durban Point Waterfront (55ha) Introduced project managed by eThekwini Metropolitan Municipality 
Suburban type	3. Lufhereng (1,800ha) Applied Human Settlement Development Grant 	6. WESCAPE (3,100ha) Example of suburban new town project (No mentioned in SDF) 	8. Cornubia (1,200ha) Defined as Investment Opportunity Area in SDF 

4.2 Johannesburg

The locations of the pilot projects in the Johannesburg metropolitan area are shown below.

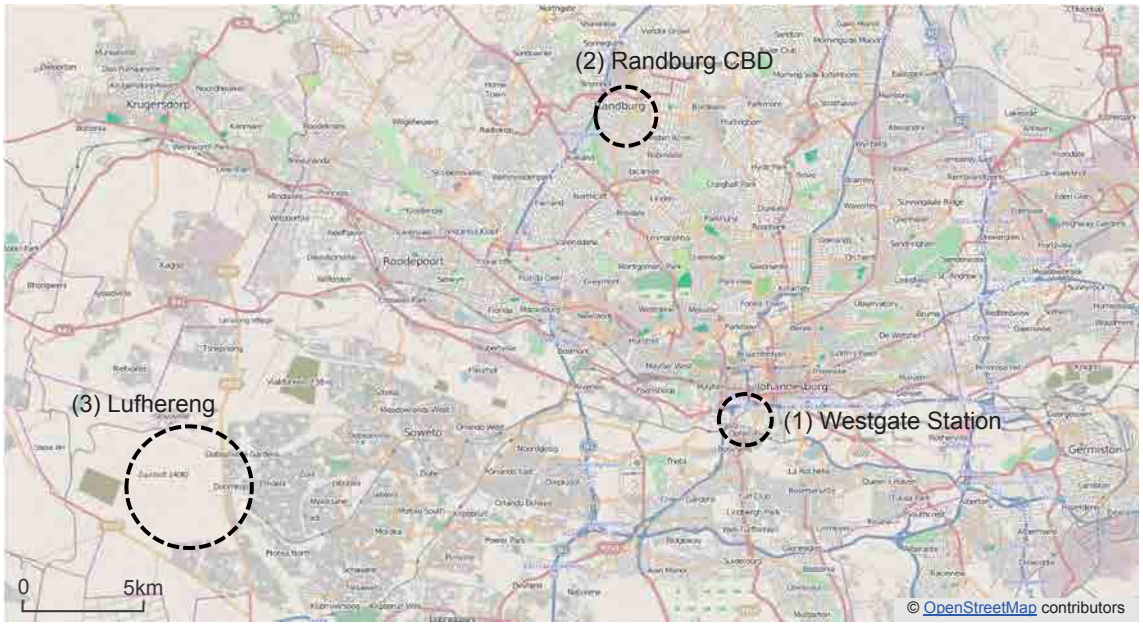


Figure 4-2-1 Locations of pilot projects in Johannesburg metropolitan area

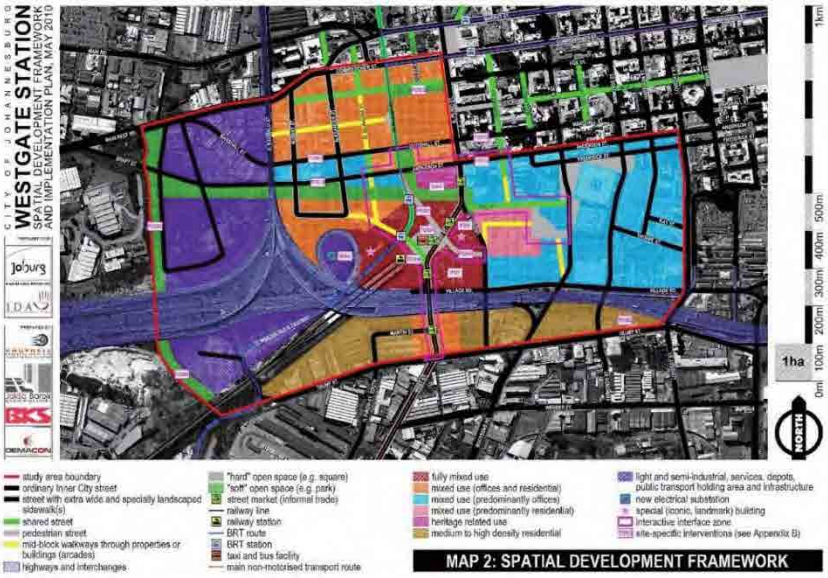
(1) Westgate Station Precinct

A. Basic information

The Westgate Station precinct lies at the south-west corner of Johannesburg inner city. The interchange includes the Westgate train station, owned and operated by PRASA, two Rea Vaya (Bus Rapid Transit) stations, a minibus taxi rank, and parking for Metrobus and privately owned national and cross-border buses.

B. Master plan

According to JICTTS Report 1 Final March 2010 (Volume 3 Annexures) by JDA, it is positioned as a Transit Oriented Node representative of the urban central area. A plaza space is planned in the railway station and BRT station vicinity as the center of the precinct, around which integrated functions including commercial businesses are zoned.



Source: City of Johannesburg

Figure 4-2-2 Master plan of Westgate station Precinct

C. Current status

- Public works are under way in front of the Westgate station. Since this area is going to be a square according to the master plan, it seems the land was being leveled to create an open space for the square.
- Two new BRT stations have already been completed and placed in service. Ticket gates of BRT stations could accept IC cards. The BRT stations and railway stations connect to each other.
- Warehouses and historical buildings, etc. are also located in/around the precinct.
- The area does not seem safe by the look of retail shops on the first floor and sidewalk, so safety improvement is an urgent issue.

Photo: JICA study team (as of April 2014)

Figure 4-2-3 Views around Westgate station

D. Proposal of Comprehensive Solutions

As stated above, City of Johannesburg considers this area a prominent TOD project and intends to create a safe and comfortable community around each station. In order to realize the city's goal, some of the most effective and proven solutions from Japan are proposed for this site. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts for this project are set as follows.

Table 4-2-1 Concept, proposed solutions and potential counterparts

Concept: Safe & Livable TOD
Creation of a safe and comfortable urban environment centered around the railway station and BRT stations

	1) Restructuring city blocks around the station Rearrange land ownership around the station and arrange public space including a station square by introducing land readjustment project.
	2) Incentive policy for private development Mitigate regulations (e.g. bonus FAR) associated with incentive policies for open space, pedestrian deck connected with station, affordable housing development, maintenance of historical buildings, etc.
	3) Joint development with station facilities Improve convenience around the station by combining commercial facilities and offices, etc. coupled with the railway station.
	4) Introduction of comprehensive IC card system Improve convenience around the station by making IC card system available not only for public transportation ride, but also for shopping in railway stations and surrounding commercial facilities and a security card for living accommodation.
	5) Introduction of smart navigator system Improve use of public transportation system by providing traffic related information such as optimized routes and measures to the destination.
	Potential counterparts Department of development planning Transport Department Johannesburg Development Agency, etc.
	6) Utilization of rainwater and greywater Reuse rainwater and greywater by introducing simple purification system within the facilities to reduce water use.
	7) Introduction of waste separation system Facilitate and sophisticate the intermediate treatment by introducing a waste separation system into the main facilities.
	Potential counterparts Department of Environment and Infrastructure Services Rand water, Johannesburg water, etc.
	8) Utilization of renewable and unharnessed energy Utilize solar energy by installing PV panels on building roof, etc.

9) Implementation of hybrid design in buildings

Introduce high-efficient equipment to high-energy-consuming facilities (e.g., shopping centers)

Achieve energy saving by means of hybrid design which effectively combines active systems (utilizing natural light and wind) and passive systems (high-efficiency equipment)

Potential counterparts
Department of Environment and Infrastructure Services
City Power, Eskom, etc.

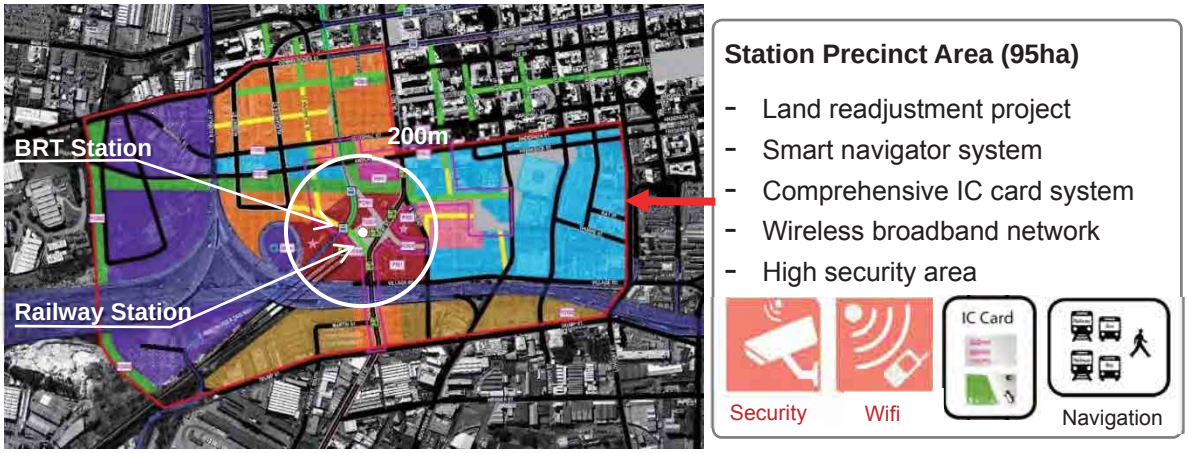
10) Provision of free Wi-fi area

Improve convenience by providing free Wi-fi area centering on the station facilities.

11) Provision of high security systems

Create a high-security area by deploying in the precinct security cameras with face recognition function.

Potential counterparts
Department of ICT, etc.



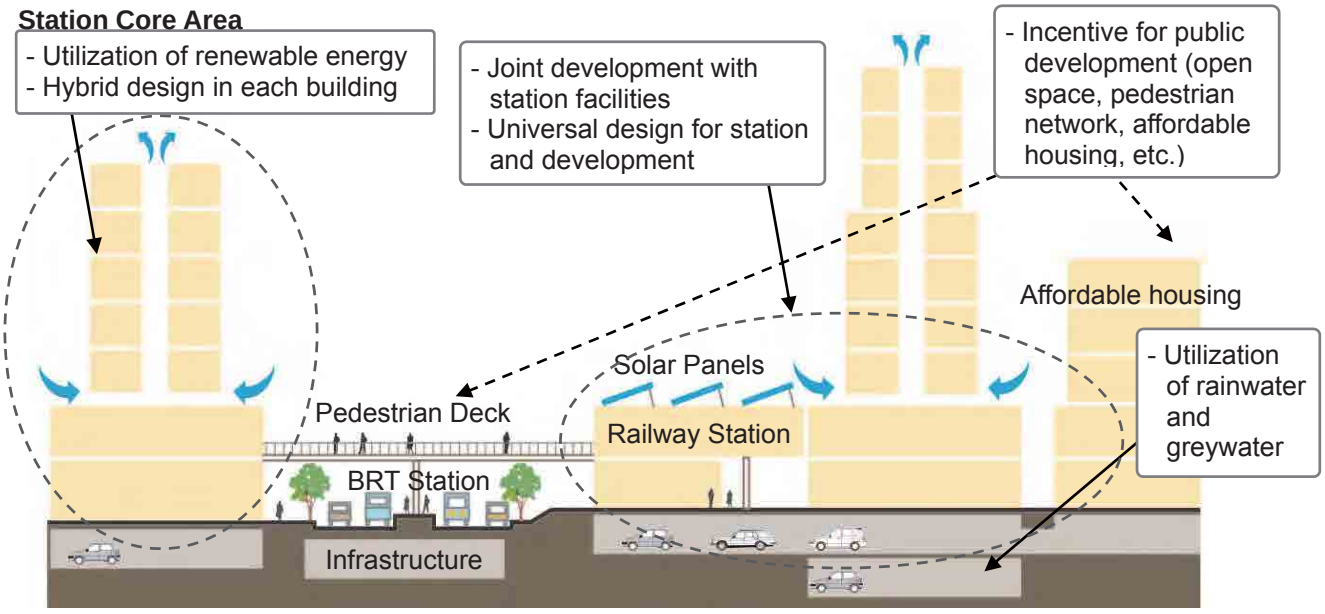


Figure 4-2-4 Environmental-friendly Urban Development of Westgate Station Precinct

(2) Randburg CBD

A. Basic information

Randburg CBD is a key Transit Oriented Development hub set to be developed as part of the Joburg GDS 2040. The Civic Precinct (9 ha) of Randburg CBD is located to the east of the CBD, between Selkirk, Jan Smuts and Bram Fischer.

B. Master plan

Randburg CBD is divided into four precincts: The Civic Precinct, The Retail Core Precinct, The Office Precinct and The Residential Precinct.

Four precincts were identified:

- The Civic Precinct, between Selkirk, Bram Fischer and Jan Smuts Roads. It has a unique shape, is highly visible and accessible and accommodates a variety of government functions.
- The Retail Core Precinct which focuses on the Hill Street Mall and its surroundings. It contains the highest concentration of retail activities and has large portions of vacant land in Council ownership that can be developed.
- The Office Precinct which stretches to the north and south of the Retail Core Precinct up to Surrey Avenue, which contains the highest concentration of office uses.
- The Residential Precinct west of Surrey Avenue, which accommodates the bulk of residential development.

Source: Johannesburg Development Agency (JDA)

Figure 4-2-5 Land use plan of Randburg CBD

The Civic Precinct is abutted by two important public transport routes and its three corners have been identified as landmark/ gateway positions. Also, a variety of land uses including medium to high density residential (as well as affordable housing options e.g. Social housing), offices, retail, entertainment, refreshment and recreational uses.

Source: Johannesburg Development Agency (JDA)

Figure 4-2-6 Development concept of Civic Precinct

C. Current status

- A shopping-oriented pedestrian mall has already been developed in the central part including Randburg Square with some retail stores, offices and housing integrated into the area.
- As for the triangle part on the east side (The Civic Precinct), most of the land are owned by the

administration and not many facilities have been built.

- The Civic Precinct and its vicinity still functions as a traffic hub, but it does not appear to be a safe place with its disordered atmosphere.

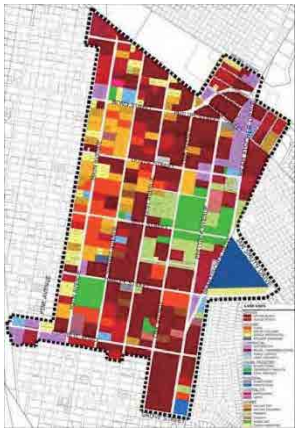


Figure 4-2-7 Current land use plan of Randburg CBD

Figure 4-2-8 Current land use plan of Civic Precinct

Source: Johannesburg Development Agency (JDA)

View along street (upper), Shopping mall (lower) Photo: JICA study team (as of April 2014)

Figure 4-2-9 Views around Randburg CBD

D. Proposal of Comprehensive Solutions

As stated above, City of Johannesburg considers this a prominent TOD project and intends to create safe and comfortable community around station. In order to realize the City's goal and create a livable core in the Randburg CBD, some of the most effective and proven solutions from Japan are proposed for this site. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts for this project are set as follows.

Table 4-2-2 Concept, proposed solutions and potential counterparts

Concept: Safety and Livable Core of Randburg CBD
Creation of a safe and bustling new CBD hub centering on BRT station

1) Incentive policy for private development
Mitigate regulations (e.g. bonus FAR) associated with incentive policies for open space, pedestrian deck connected with station, affordable housing development, maintenance of historical buildings, etc.

2) Joint development with station facilities
Improve convenience around the station by combining commercial facilities and offices, etc. coupled with the railway station.

3) Introduction of comprehensive IC card system
Improve convenience around the station by making IC card system available not only for public transportation ride, but also for shopping in railway stations and surrounding commercial facilities and a security card for living accommodation.

4) Introduction of smart navigator system
Improve use of public transportation system by providing traffic related information such as optimized routes and measures to the destination.

Potential counterparts
Department of Development Planning
Transport Department
Johannesburg Development Agency, etc.

5) Utilization of rainwater and greywater
Reuse rainwater and greywater by introducing simple purification system within the facilities to reduce water use.

6) Introduction of waste separation system
Facilitate and sophisticate the intermediate treatment by introducing a waste separation system into the main facilities.

Potential counterparts
Department of Environment and Infrastructure Services
Rand Water, Johannesburg Water, etc.

7) Utilization of renewable and unharnessed energy
Utilize solar energy by installing PV panels on building roof, etc.

8) Implementation of hybrid design in buildings
Introduce high-efficient equipment to high-energy-consuming facilities (e.g. shopping centers).
Achieve energy saving by means of hybrid design which effectively combines active systems (utilizing natural light and wind) and passive systems (high-efficiency equipment).

Potential counterparts
Department of Environment and Infrastructure Services
City Power, Eskom, etc.

9) Provision of free Wi-fi area
Improve convenience by providing free Wi-fi area centering on the station facilities.

10) Provision of high security systems

Create a high security area by deploying in the precinct security cameras with face recognition function.

Potential counterparts
Department of ICT, etc.

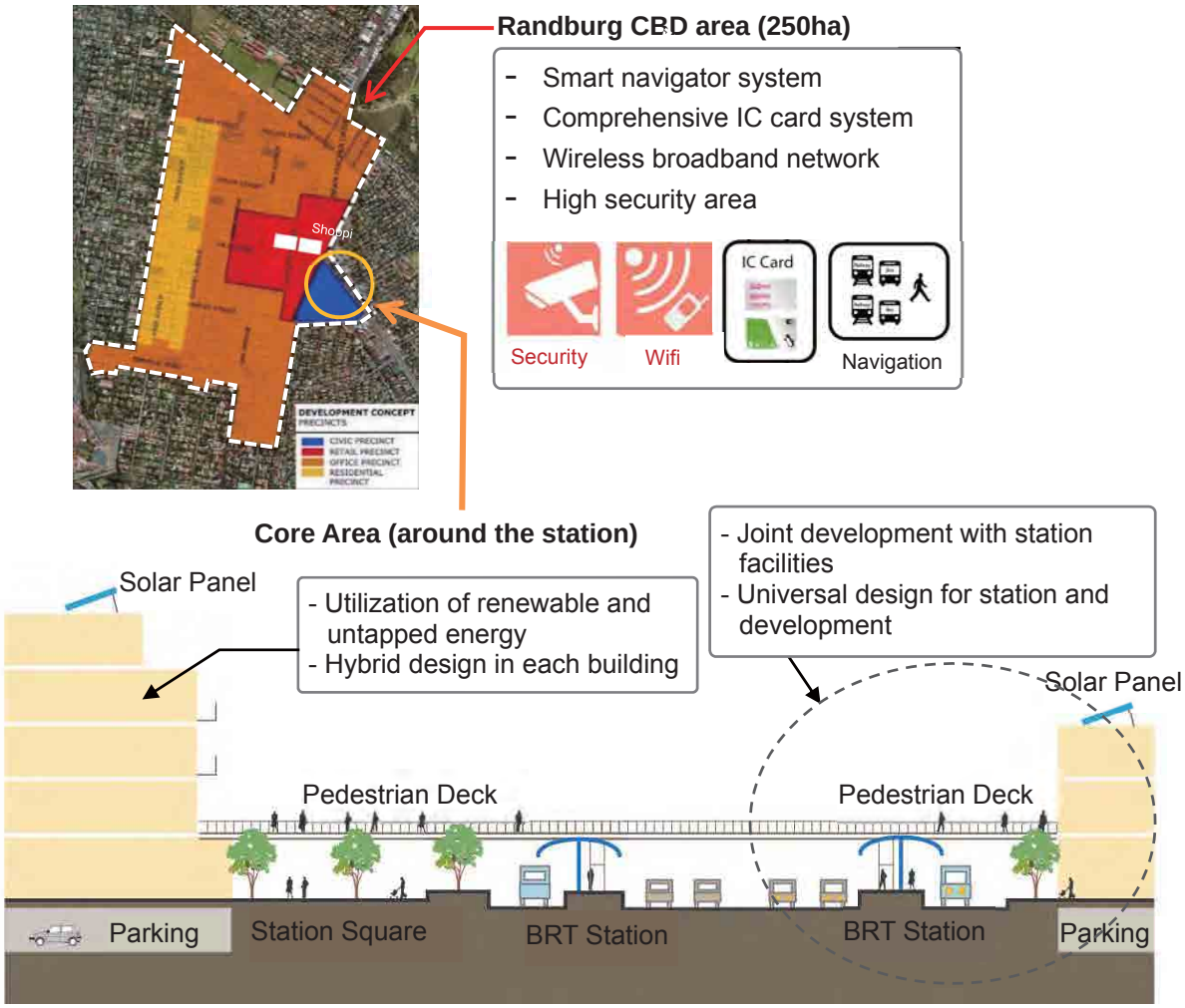


Figure 4-2-10 Environmental-friendly Urban Development of Randburg CBD

(3) Lufhereng

A. Basic information

The Lufhereng integrated urban development project is located directly to the west of Soweto, to the north of Protea Glen and to the south of Slovoville, forming a natural western extension of Soweto. The development has been planned to integrate physically, economically and socially with Soweto.

B. Master plan

The Lufhereng project is planned to include other land uses normally associated with a

sustainable urban environment such as social, institutional, commercial, municipal and public open space. Provision will be made for over 15 primary and secondary schools and over 60 community facilities, churches and creches.

Lufhereng Extension 1 & 2 Land Use Table

ZONING	LAND USE	TOTAL No. OF STANDS
RESIDENTIAL	RESIDENTIAL	476
	RESIDENTIAL	320
	RESIDENTIAL	669
	RESIDENTIAL	337
	[illegible]	320
	[illegible]	81
RESIDENTIAL 3	[illegible]	4
BUSINESS	[illegible]	10
	[illegible]	2
	[illegible]	1
COMMUNITY FACILITY	[illegible]	4
	PRIMARY SCHOOL	2
	[illegible]	1
	[illegible]	3
	CHURCH	8
INDUSTRIAL	RAILWAY LINE	1
MUNICIPAL	[illegible]	6
P.O.S	[illegible]	29
	SOCCER FIELD	1
TOTAL		2457

Source: City of Johannesburg

Figure 4-2-11 Land use plan of Lufhereng

C. Current status

Residential area

- The houses are detached and two-storied with solar heating system installed on the roof as a standard equipment.
- Although a green space is set aside for agriculture in each housing unit, it seems to be seldom used because water is scarce and the soil is not good for planting.
- Since electricity and water are in short supply, the project development, e.g., number of housing units, is planned based on the availability of electricity and water.
- BRT, which has a plan to connect to the central part of Johannesburg in the future, is scheduled to be established.
- Most of the residents were relocated from informal settlements in the central part of the city. Due partly to the free housing provision from the city, most residents are unemployed. Job creation for them is an urgent issue.

Surrounding areas

- Since in general water is scarce in this area and the soil has poor drainage, by building a water reservoir for the area storm water could be captured, stored and used by the community.
- There is a mine and soil dumping site located around the development area. Mining activities require large volume of water. Currently, the contaminated water from the mine is discharged to a river after being treated to a certain extent.

Photo: JICA study team (as of April 2014)

Figure 4-2-12 Views inside Lufhereng

D. Proposal of Comprehensive Solutions

As stated above, City of Johannesburg is developing this area as a new town for low income residents in suburban area, but is experiencing issues such as deficiency of energy and water, unemployment, etc. New town projects similar to Lufhereng are expected to be developed in the suburban areas in the future. To solve the previously mentioned issues and to realize self-sustaining community from the viewpoint of energy, food and long-term employment, some of the most effective and proven solutions from Japan are proposed for this site. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts for this project are set as follows.

Table 4-2-3 Concept, proposed solutions and potential counterparts

Concept: Compact and Self-sustaining community Creation of a compact and self-sustaining community in large-scale housing development	
	1) Provision of medium-density housing and securing open space Create open space by building medium-rise residential buildings. Create the core of a community such as a square and intensive agriculture farm land.
	Potential counterparts Department of development planning, etc.
	2) Utilization of rainwater and greywater Reuse rainwater and greywater by introducing simple purification system in the community or by installing a community pond to reduce water use.

3) Introduction of waste separation system

Facilitate and sophisticate the intermediate treatment by introducing a waste separation system at community level.

Potential counterparts
Department of environment and infrastructure services
Rand water, Johannesburg water, etc.

4) Introduction of highly-efficient inverter system

Promote energy savings at mining facilities, which consume large amounts of electricity, by introducing highly-efficient inverter system.

5) Introduction of GAP cable

Enhance transmission capacity of electricity by replacing the existing cables with GAP cable.

6) Promotion of solar heat utilization and implementation of micro-grid with photovoltaic power systems

Promote energy savings by connecting photovoltaic power systems installed on roof or in open space and storage batteries to establish a micro grid.
Install solar water heaters on the roof of all residential units.

7) Establishment of energy efficiency and management guidelines for energy management for the community (move-in conditions for residents)

Achieve community-wide energy savings by setting allowable electricity use limit (maximum power demand), and provide job training to residents to undertake duties like maintaining PV panels and solar water heaters.

Potential counterparts
- Department of Environment and Infrastructure Services
- City Power, Eskom, etc.

8) Provision of Wireless broad band

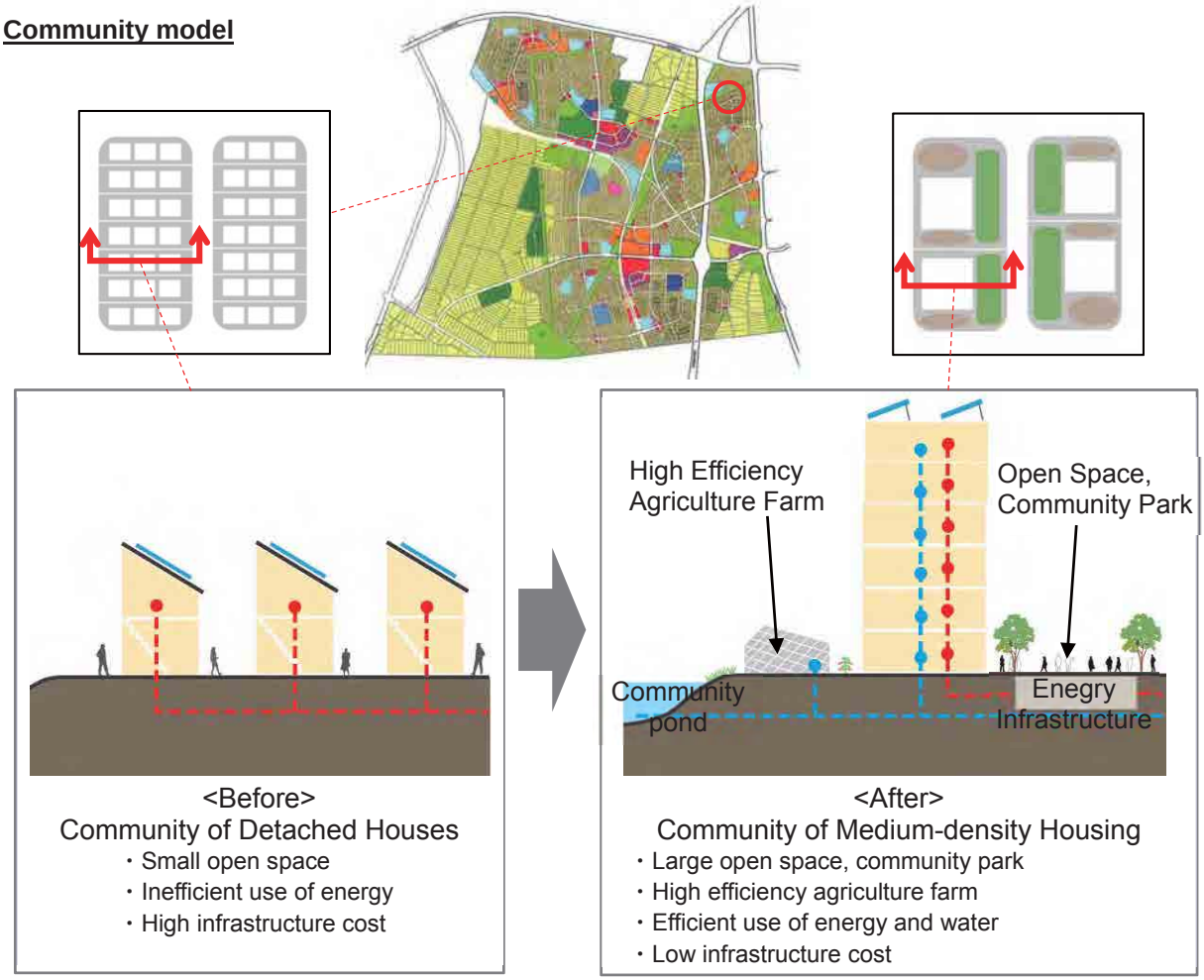
Create an easy-to-access wi-fi environment for everyone by providing wireless broad band as an alternative for optical fiber which requires high installation cost.

9) Remote education by utilizing ICT

Provide education and training for low-income residents in an effective manner by utilizing electronic blackboard (Starboard)

Potential counterparts
- Department of ICT, etc.

Community model



Wide area model (low energy and water recycle)

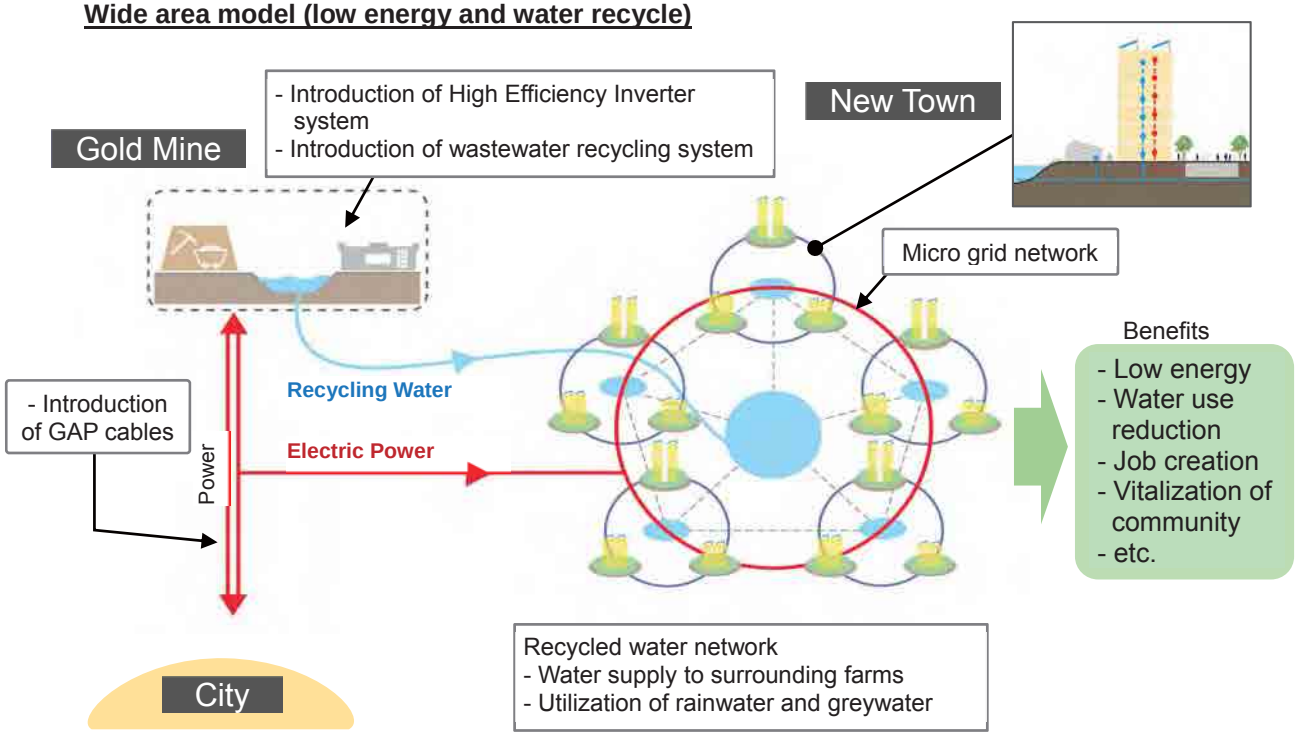


Figure 4-2-13 Environmental-friendly Urban Development of Lufhereng

4.3 Cape Town

The locations of the pilot projects in the Cape Town metropolitan area are shown below.

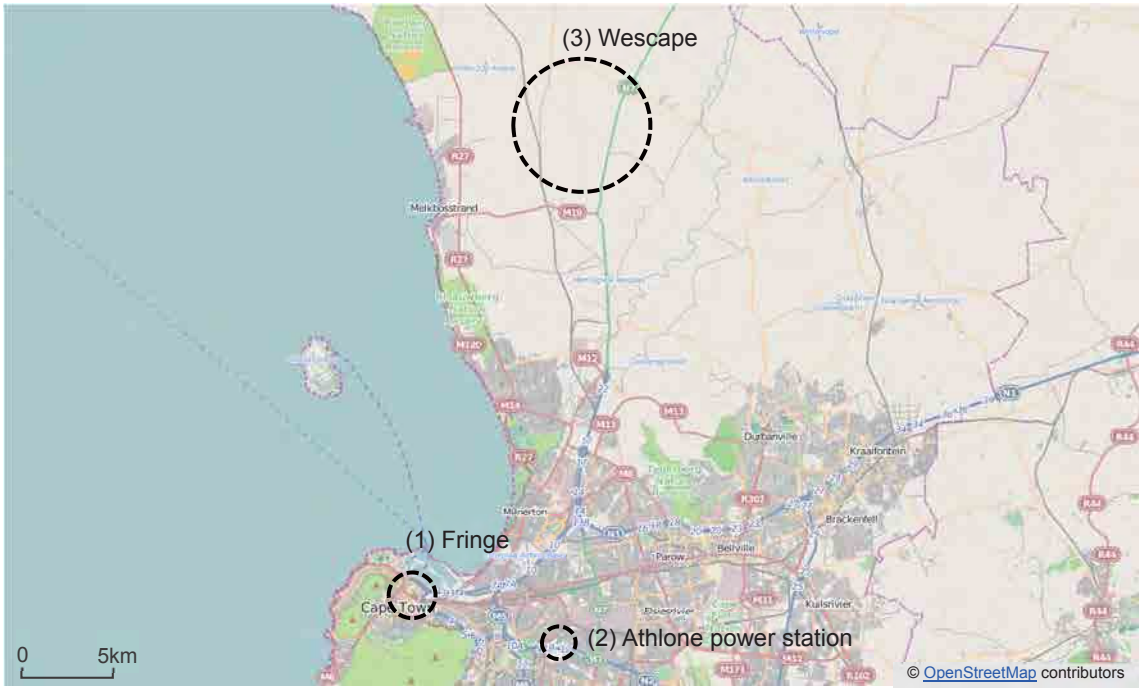


Figure 4-3-1 Locations of pilot projects in Cape Town metropolitan area

(1) The Fringe

A. Basic information

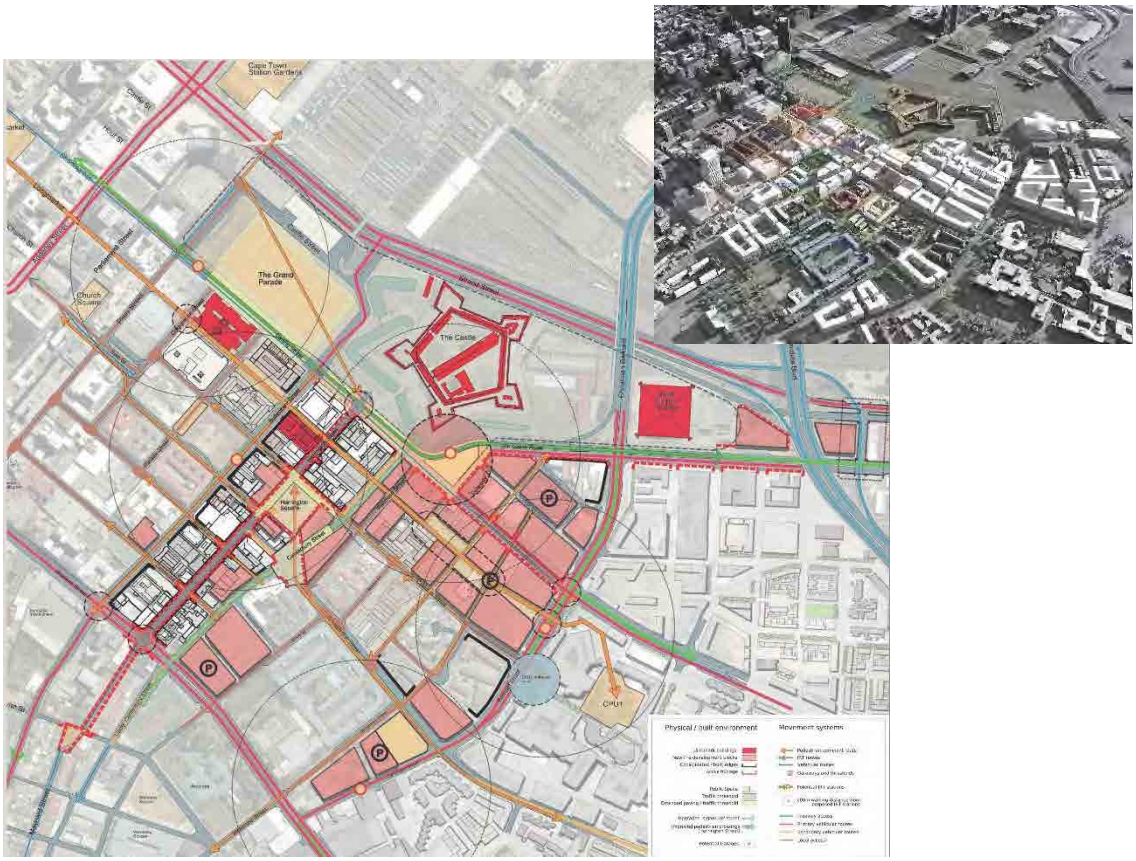
The Fringe, which is the innovation district as the design and informatics hub on the eastern edge of the city since 2007, is being planned as Africa's premier environment for design, media and ICT innovation, creativity and entrepreneurship. It is located between Roeland and Darling Streets, Buitenkant and Canterbury Streets, and connecting land to CPUT from Longmarket through to Tenant Street. The Fringe development is supported by the Western Cape Government's Department of Economic Development and Tourism through its Cape Catalyst Initiative.

B. Master plan

The Fringe Urban Design Framework is intended to have the status of development guidelines and is proposed to become part of the City of Cape Town's policy driven Land Use Management System, functioning alongside the Cape Town Spatial Development Framework (SDF) and the Central City Development Strategy (CCDS) and associated Development Guidelines for Land Use Management (DGLUM).

The extension to the Integrated Rapid Transit (IRT) will bring several routes through The Fringe.

The location of IRT routes and stops will be integrated with the distribution and articulation of public space. The framework proposes to retain the overall character of the area, in particular the architectural and spatial qualities of the core streets, and the grittiness of its scale and grain.



Source: The fringe homepage http://thefringe.org.za/

Figure 4-3-2 Urban Design Framework Plan of The Fringe

C. Current status

- It is located in the central area adjacent to the Cape Town railway station and castle ruins with the best access to the transportation. Cape Peninsular University of Technology (CPUT) is located on the east side of the precinct.
- However, there are many vacant lots and unused facilities in the precinct, implying the land use has not been effectively planned.
- The area appeared to be unpopular, with people sitting on sidewalks. It is necessary to develop a vitalization strategy for the community, including safety improvement in the whole area.

Photo: JICA study team (as of April 2014)

Figure 4-3-3 Views around The Fringe

D. Proposal of Comprehensive Solutions

As stated above, City of Cape Town considers this a prominent project to create safe, walkable and comfortable community in the center of the city. In order to realize the City's goal, some of the most effective and proven solutions from Japan are proposed for this site. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts for this project are set as follows.

Table 4-3-1 Concept, proposed solutions and potential counterparts

Concept: Creative and Walkable CBD

Creation of a university-linked creative environment where people can walk comfortably and safely

	1) Incentive policy for private development Mitigate regulations (e.g. bonus FAR) associated with incentive policies for open space, pedestrian deck connected with station, affordable housing development, maintenance of historical buildings, etc.
	2) Joint development with BRT terminal Improve convenience around the station by combining commercial facilities and offices, etc. Integrate with BRT terminal planned to be constructed in the precinct.
	3) Introduction of comprehensive IC card system Improve convenience around the station by making IC card system available not only for public transportation ride, but also for shopping in railway stations and surrounding commercial facilities and a security card for living accommodation.

	4) Introduction of smart navigator system Improve use of public transportation system by providing traffic related information such as optimized routes and measures to the destination. **Potential counterparts** Planning and Building Development Management Department MyCiti, etc.
	5) Utilization of rainwater and greywater Reuse rainwater and greywater by using simple purification system within the facilities to reduce water use. 6) Introduction of waste separation system Facilitate and sophisticate the intermediate treatment by installing a waste separation system in the main facilities. **Potential counterparts** Water and Sanitation Department Solid Waste Department, etc.
	7) Utilization of renewable and unharnessed energy Utilize solar energy by installing PV panels on building roof, etc. 8) Implementation of hybrid design in buildings Introduce high-efficient equipment to high-energy-consuming facilities (e.g. shopping centers) Achieve energy saving by means of hybrid design which effectively combines active systems (utilizing natural light and wind) and passive systems (high-efficiency equipment). **Potential counterparts** Environmental Resource Management Department, etc.
	9) Provision of free Wi-Fi area Improve convenience by providing free Wi-Fi area in the area 10) Provision of high security systems Create a high security area by deploying security cameras with face recognition function in the precinct. **Potential counterparts** Department of ICT, etc.

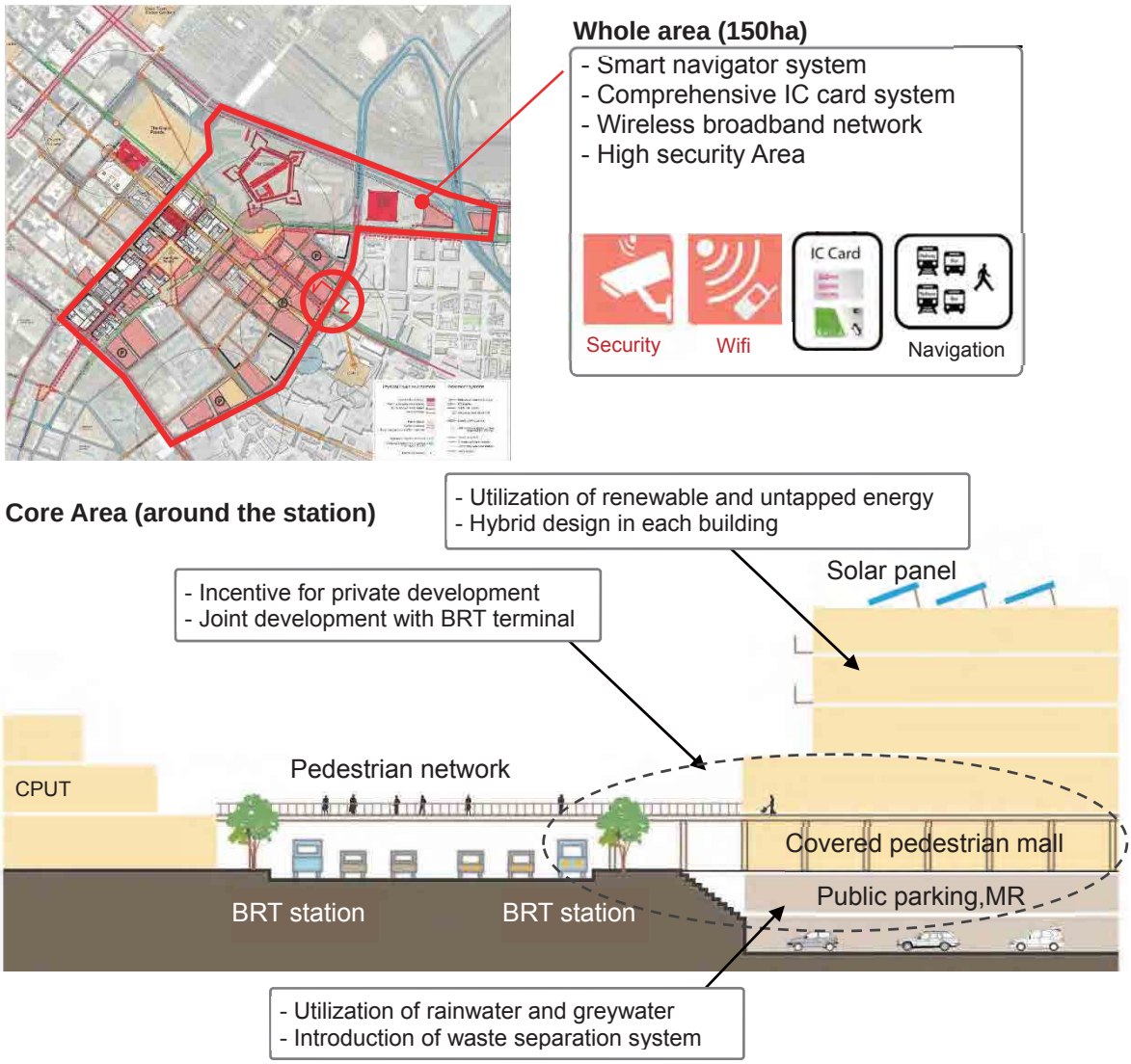


Figure 4-3-4 Environmental-friendly Urban Development of The Fringe

(2) Athlone Power Station

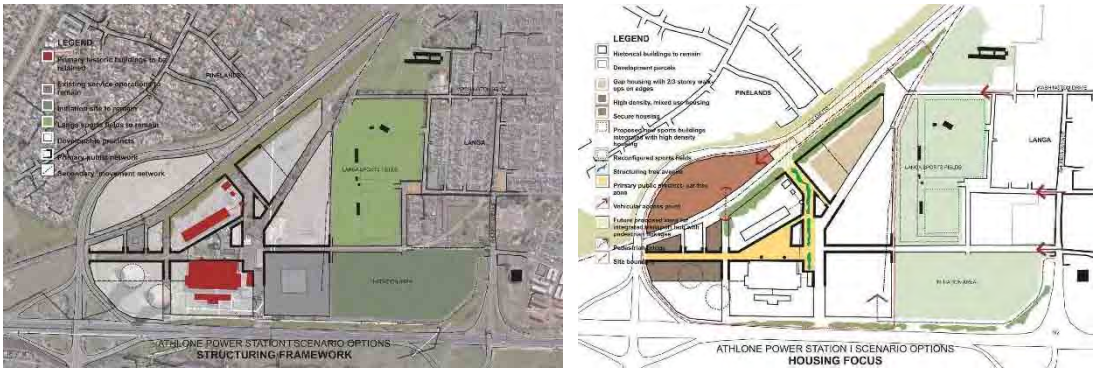
A. Basic information

The power station was commissioned in 1962 with 6 turbines with a nominal capacity of 180 megawatts, and operated by the City of Cape Town. In 2003, due to the age of the power station, facility upgrade would have been too costly and therefore operation was stopped. The Power Station was partially decommissioned in 2003 due to high generation and maintenance costs. No power has been generated on site since then, but the facility still houses equipment used for the transmission of electricity.

B. Master plan

The analysis of project by City of Cape Town identified a mixed-use development with the following land use breakdown as the preferred scenario: residential 22.2%, commercial or

business 30%, retail 12.3%, public institutions 21.5%, light industry 7.4%, and Athlone Refuse Transfer Station 6.6%. The historical red brick buildings are to be retained where possible for predominantly public usage, such as a cultural center. The land use breakdown is not final.



Source: City of Cape Town

Figure 4-3-5 Structuring framework and housing plan for redevelopment of Athlone Power Station

C. Current status

- The site is close to the airport and faces an expressway, providing high visibility and accessibility.
- Old power station facilities have remained and the area is now closed. Although the power station facility will be utilized as a historic property according to the development program, its development and operation program is considered a key issue.
- Inside the area, there is still a waste collecting station and some trains deliver waste to the northern area of the city.
- Township spreads eastern boundary of the area. The relationship with the surroundings is considered an issue.

Photo: JICA study team (as of April 2014)

Figure 4-3-6 Views around Athlone Power station

D. Proposal of Comprehensive Solutions

As stated above, City of Cape Town considers this an important project to create mixed use development by utilizing historical facilities (electric power plant). In order to realize the City's

goal and to realize self-sustaining community by introducing new energy-related solutions such as renewable energy, some of the most effective and proven solutions from Japan are proposed for this site. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts for this project are set as follows.

Table 4-3-2 Concept, proposed solutions and potential counterparts

Concept: Self-sustaining, mixed use development

Creation of a new self-sustaining, mixed use urban development on the site of a one-time power station by utilizing unharnessed and renewable energy

1) Incentive policy for private development

Mitigate regulations (e.g. bonus FAR) associated with incentive policies for open space, pedestrian deck connected with station, affordable housing development, maintenance of historical buildings, etc.

2) Introduction of comprehensive IC card system

Improve convenience around the station by making IC card system available not only for public transportation ride, but also for shopping in railway stations and surrounding commercial facilities and a security card for living accommodation.

Potential counterparts
Planning and Building Development Management Department
MyCiti, etc.

3) Utilization of rainwater and greywater

Reuse rainwater and greywater by using simple purification system within the facilities to reduce water use.

4) Introduction of waste separation system

Facilitate and sophisticate the intermediate treatment by installing a waste separation system in the main facilities.

Potential counterparts
Water and Sanitation Department
Solid Waste Department, etc.

5) Utilization of renewable and unharnessed energy

Utilize solar energy by installing PV panels on building roof or peripheral land. Create jobs for the surrounding township, including in maintenance of the system.

6) Implementation of hybrid design in buildings

Introduce high-efficient equipment to high-energy-consuming facilities (e.g. shopping centers)

Achieve energy saving by means of hybrid design which effectively combines active systems (utilizing natural light and wind) and passive systems (high-efficiency equipment).

Potential counterparts
Environmental Resource Management Department, etc.

7) Provision of free Wi-Fi area

Improve convenience by providing free Wi-Fi area in the precinct.

8) Provision of high security systems

Create a high security area by deploying security cameras with face recognition function in the precinct.

Potential counterparts
Department of ICT, etc.

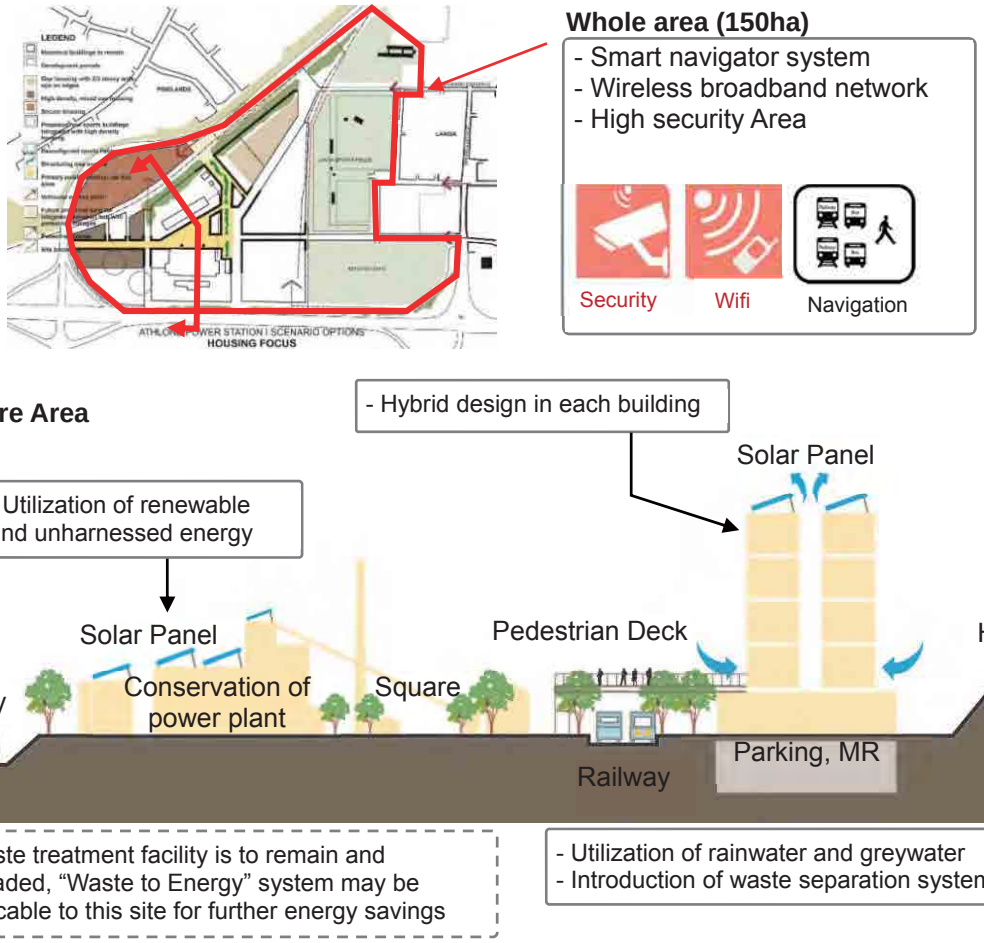


Figure 4-3-7 Environmental-friendly Urban Development of Athlone Power station

(3) WESCAPE

A. Basic information

WESCAPE is located northwest of Cape Town on the urban edge and along the West Coast Growth Corridor and will provide housings, educational and healthcare facilities, employment opportunities and community facilities and services.

B. Master plan

WESCAPE, which was developed based on the concepts of 'Ecologically friendly Green City' and 'Walkable urban design', consists of 200,000 homes, 400 educational facilities, 90 health / safety / community facilities, 600 public open spaces, and 1.7 million sq.m. of commercial lease

space. It is connected to the City of Cape Town Integrated Rapid Transport Bus Service.

Source: communiTgrow

Figure 4-3-8 Master plan of WESCAPE

C. Current status

- The site was vacant during our site visit in April of 2014. However, since it is located close to an expressway which is in the expansion and maintenance process, and will be served by a BRT system that connects to the city center in the near future, it has a high potential for traffic convenience.
- Since it is a large-scale development with a total site area of over 3,000ha, it would be difficult to develop the site all at once and therefore a phased development is necessary.
- Since electricity and water are generally in short supply, it would be necessary to develop specific plans that include technologies for reducing electricity and water consumption.

Photo: JICA study team (as of April 2014)

Figure 4-3-9 Views around Wescape

D. Proposal of Comprehensive Solutions

As stated above, this area is being developed by private companies and is supported by City of Cape Town. Currently it is experiencing issues such as deficiency of energy and water, and

disconnection from the city center. New town projects similar to Wescape are expected to be developed in the suburban areas in the future. To solve the previously mentioned issues and realize self-sustaining community from the viewpoint of energy and transportation, some of the most effective and proven solutions from Japan are proposed for this site.

The comprehensive solutions described below presents possible solutions for such suburban new town development with the aim of realizing a walkable and sustainable community around public transportation core such as BRT. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts in this project are set as follows.

Table 4-3-3 Concept, proposed solutions and potential counterparts

Concept: Walkable and Sustainable Community
Creation of a public transit-oriented, energy self-sufficient community which could be a model development in the suburbs of Cape Town

	1) Incentive policy for private development Mitigate regulations (e.g. bonus FAR) associated with incentive policies for open space, pedestrian deck connected with station, affordable housing development, maintenance of historical buildings, etc.
	2) Joint development with station facilities Improve convenience around the station by combining commercial facilities and offices, etc. coupled with the railway station.
	3) Introduction of comprehensive IC card system Improve convenience around the station by making IC card system available not only for public transportation ride, but also for shopping in railway stations and surrounding commercial facilities and a security card for living accommodation.
	4) Introduction of smart navigator system Improve use of public transportation system by providing traffic related information such as optimized routes and measures to the destination.
	Potential counterparts Planning and Building Development Management Department MyCiti, etc. CommuniTgrow
	5) Utilization of rainwater and greywater Reuse rainwater and greywater by using simple purification system within the facilities to reduce water use.
	6) Introduction of waste separation system Facilitate and sophisticate the intermediate treatment by installing a waste separation system in the main facilities.
	Potential counterparts Water and Sanitation Department Solid Waste Department, etc.
	7) Utilization of renewable and unharnessed energy

Utilize solar energy system by installing PV panels on building roof, etc.

8) Implementation of hybrid design in buildings

Introduce high-efficient equipment to high-energy-consuming facilities (e.g. shopping centers)

Achieve energy saving by means of hybrid design which effectively combines active systems (utilizing natural light and wind) and passive systems (high-efficiency equipment).

Potential counterparts
Environmental Resource Management Department, etc.

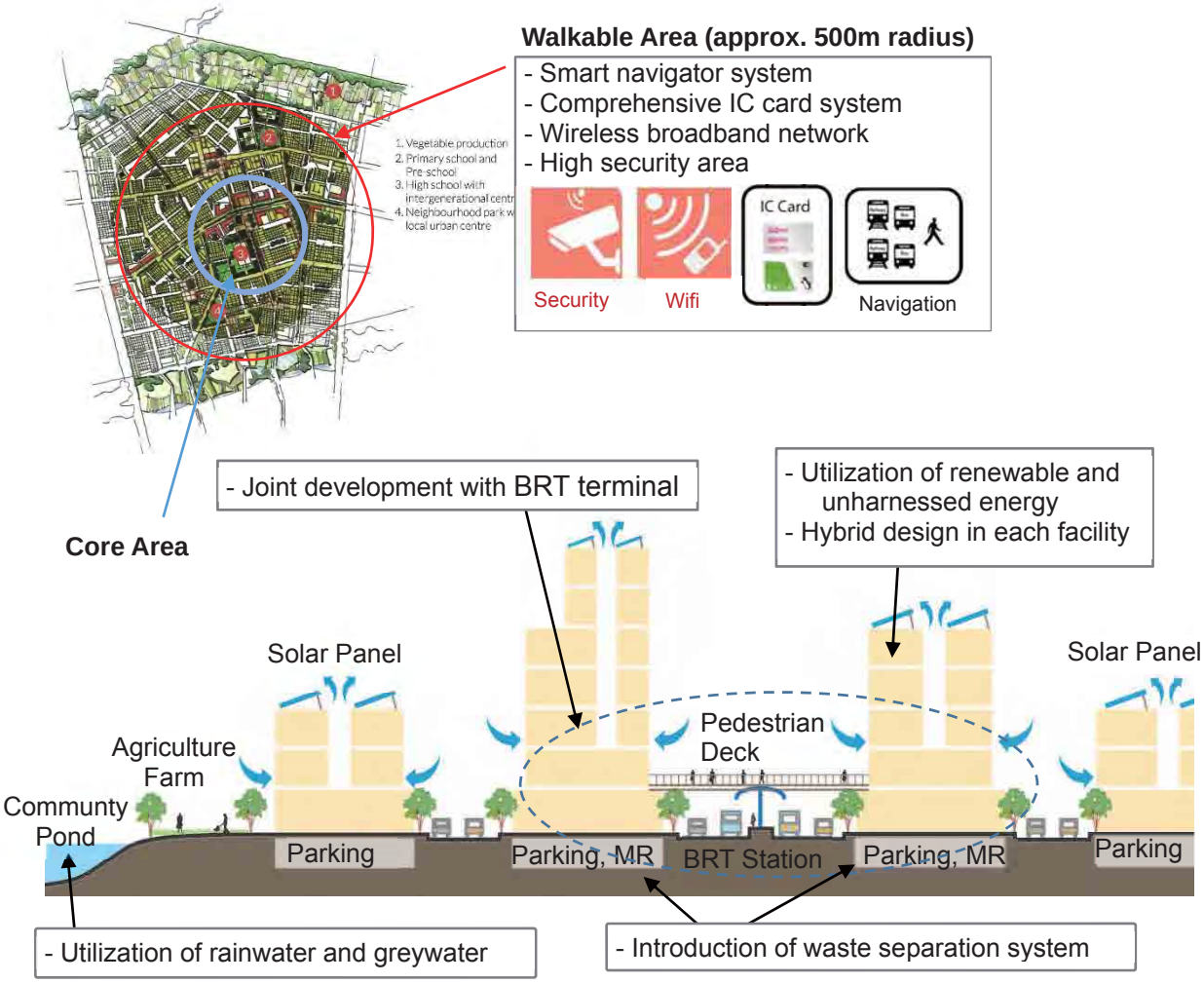
9) Provision of free Wi-Fi area

Improve convenience by providing free Wi-Fi area in the precinct.

10) Provision of high security systems

Create a high security area by deploying security cameras with face recognition function in the precinct.

Potential counterparts
Department of ICT, etc.



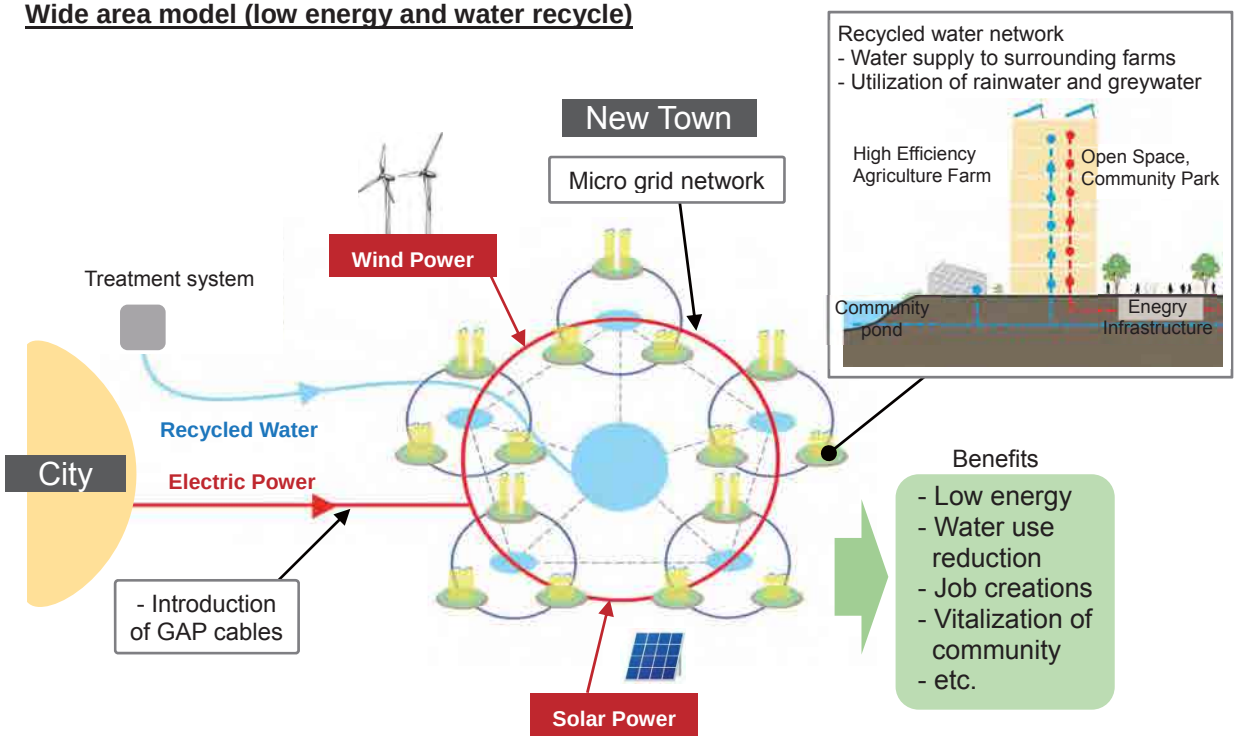


Figure 4-3-10 Environmental-friendly Urban Development of Newtown

4.4 eThekwini

The locations of the pilot projects in the eThekwini Metropolitan Municipality are shown below.

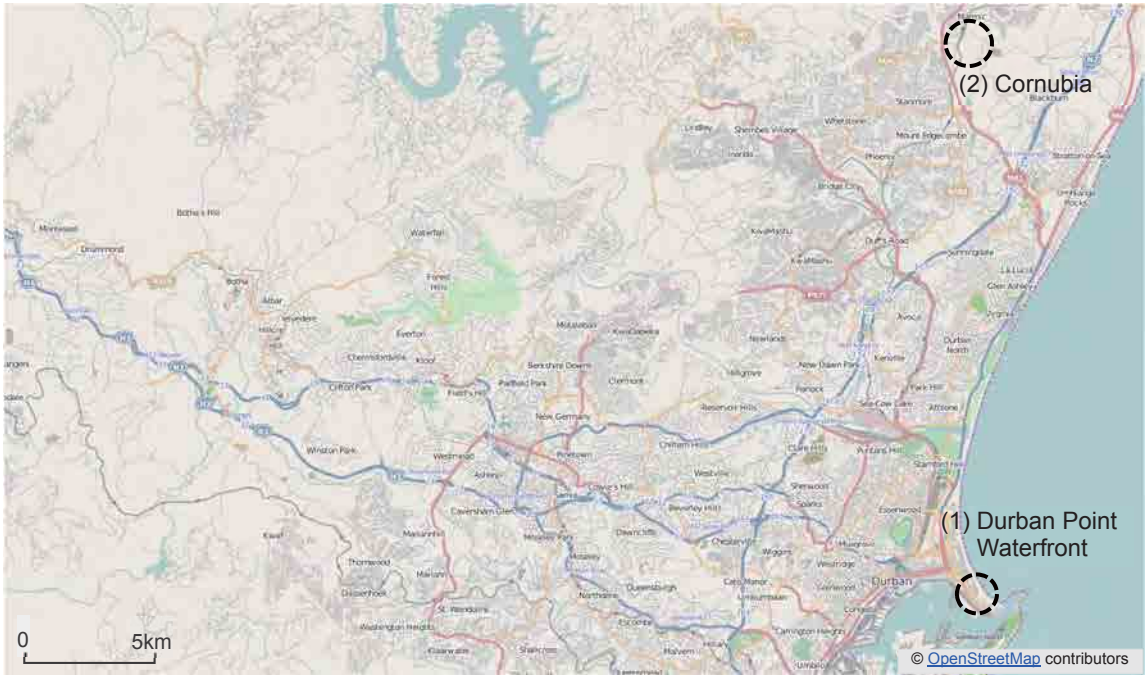


Figure 4-4-1 Locations of Pilot projects in eThekwini Metropolitan Municipality

(1) Durban point waterfront

A. Basic information

Durban point development was launched in 2003 as a marina project that includes retail, hotel and office real estate. As much as R1.8 billion has been committed towards investments in the development of infrastructure and building complexes. This excludes the R750 million costs for uShaka Marine World which opened May 2004.

B. Master plan

Many of the sites at Durban Point have a mixed-use zoning. Developers are encouraged to use the ground floor of buildings for uses such as retailing, entertainment and restaurants that can flow out onto the adjacent sidewalk space. Uses such as offices and residential on upper floors are encouraged to look out onto the public spaces below. In order to achieve as much of an urbane quality as possible, developers are encouraged to achieve maximum allowable height and bulk restrictions. Thus buildings of a minimum height of three to four storeys.

Source: Durban point waterfront

Figure 4-4-2 Land use of Durban Point Waterfront

C. Current status

- The site is located at the edge of a peninsula near the central part of Durban, and several houses have been already constructed.
- A comfortable urban environment has been created by drawing water into the precinct and providing a walkway near the water and a bridge with sophisticated design.
- It has an atmosphere of a community for higher income brackets.
- Since there is a college in the precinct, the presence of many students makes the city vibrant.

Photo: JICA study team (as of April 2014)

Figure 4-4-3 Views around Durban Point Waterfront

D. Proposal of Comprehensive Solutions

As stated above, this area has already been developed in some districts and popular for comparatively wealthy people. In this section, focusing on the future development districts in this area, some of the most effective and proven solutions from Japan are proposed for the realization of an advanced sustainable community. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts in this project are set as follows.

Table 4-4-1 Concept, proposed solutions and potential counterparts

Concept: Advanced Sustainable Community
Creation of an energy self-sustainable community with advanced technology which enhances the additional value of development as a high class community

	1) Utilization of rainwater and greywater Reuse rainwater and greywater by using simple purification system within the facilities to reduce water use.
	2) Introduction of waste separation system Facilitate and sophisticate the intermediate treatment by installing a waste separation system in the main facilities.
	Potential counterparts Umgeni Water, eThekwini Water and Sanitation Department of Solid Waste, etc.
	3) Utilization of renewable and unharnessed energy Utilize solar power system, etc. installed in peripheral land or on building roof.
	4) Implementation of hybrid design in buildings Achieve energy saving by means of hybrid design which effectively combines active systems (utilizing natural light and wind) and passive systems (high-efficiency equipment).
	Potential counterparts Environmental Planning and Climate Protection Department, etc.

5) Provision of free Wi-Fi area

Improve convenience by providing free Wi-Fi area in the precinct.

6) Provision of high security systems

Create a high security area by deploying security cameras with face recognition function in the precinct.

Potential counterparts
ICT department, etc.

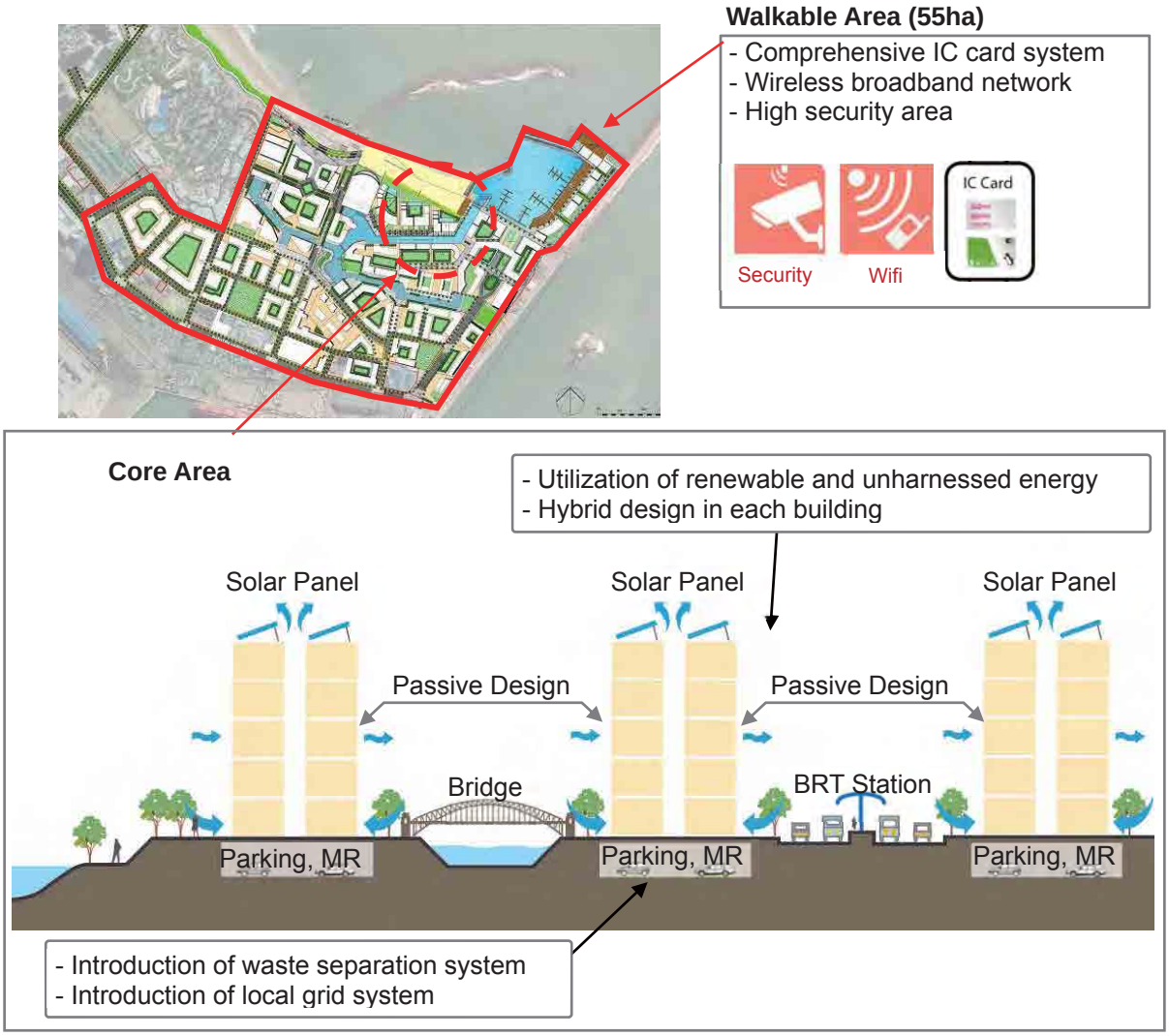


Figure 4-4-4 Environmental-friendly Urban Development of Durban Point Waterfront

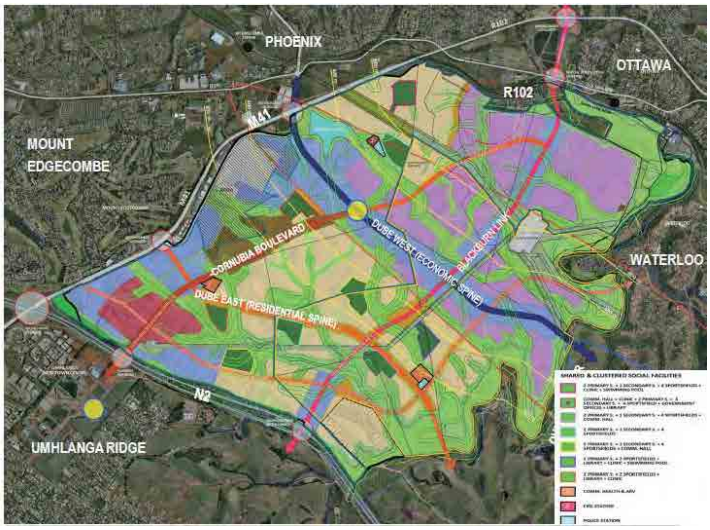
(2) Cornubia

A. Basic information

Cornubia is a mixed use and mixed income development, spanning over 20 years, in Umhlanga. Cornubia will be the home of the next major industrial area in the north, with approximately 80ha coming on to the market in 2012. This will be a key industrial development with linkages to the new international airport.

B. Master plan

The planning of Cornubia is based upon the principles of sustainable development with higher densities, a wide range and integration of income levels, employment and economic opportunities, substantial provision for schools, clinics and other social facilities, predicated on viable non-motorized and public transportation and extensive open spaces. The development is proposed to provide some 24,000 homes of which 15,000 are proposed for subsidized housing and the balance for a wide range of affordability levels.



750 ha developable land:
-24,000 residential units
(15,000 subsidized housing)
-80 ha industrial platform
-50 ha mixed used development
-400 ha rehabilitated open space

Source: eThekwini Municipality

Figure 4-4-5 Land use plan of Cornubia

C. Current status

- It is located on a hilly area about 20 km from the central part of eThekwini. Although the land development is still under way, part of the foundation and residential plots have already been placed in use.
- The rent for a house is targeted between 0 and 3,500R, and they are mostly Social Housing.
- In the residential district surveyed, two storied townhouse-like houses have been constructed around an open space like a block park. The floor area of each dwelling is seemingly about 30~40 m2.
- As for the opinion of the residents, it is livable, a mixture of different races, easy access to the city center (bus is available) and such. They are mostly positive opinions.

- Although the front of each dwelling unit was designed to be a farming space, it seems to be seldom used.

Photo: JICA study team (as of April 2014)

Figure 4-4-6 Views inside Cornubia

D. Proposal of Comprehensive Solutions

As stated above, local government is developing this area as new town for low income residents in the suburban area but is experiencing issues such as deficiency of energy, water, etc. New town projects similar to Cornubia are expected to be developed in the suburban areas in the future. To solve the previously mentioned issues and realize self-sustaining community from the viewpoint of energy and community creation, some of the most effective and proven solutions from Japan are proposed for this site. However, further communications with the relevant counterparts are necessary to study the feasibility of implementing these solutions individually or in combination.

The concept, proposed solutions and potential counterparts for this project are set as follows.

As stated above, in Cornubia, 1st phase of development is already under construction. According to discussion with the eThekwini Metropolitan Municipality, the comprehensive solutions as proposed below could be implemented in the 2nd phase of development. Since industrial zoning is planned inside of the area, more comprehensive systems could be incorporated for including not only residential, office and retail areas but also for industrial facilities in the future.

Table 4-4-2 Concept, proposed solutions and potential counterparts

Concept: Compact and Self-sustaining community Creation of a compact and self-sustaining community in a large-scale housing development

1) Provision of medium-density housing and open space

Create open space by building medium-rise social housing. Create the core of a community such as a square and an intensive farm land.

Potential counterparts

Development Planning, Environment & Management Unit
eThekwini Transport Authority, etc.

2) Utilization of rainwater and greywater

Reuse rainwater and greywater by using simple purification system in the community or by installing a community pond to contribute to water use reduction.

3) Introduction of waste separation system

Facilitate and sophisticate the intermediate treatment by installing a waste separation system at a community level.

Potential counterparts

Umgeni Water, eThekwini Water and Sanitation
Department of Solid Waste, etc.

4) Introduction of highly-efficient inverter system

Promote energy savings at electricity-guzzling mining facilities by introducing highly-efficient inverter system.

5) Introduction of GAP cable

It is possible to enhance transmission capacity of electricity by replacing the existing cable with GAP cable.

6) Promotion of solar heat utilization and implementation of micro-grid with photovoltaic power systems

Promote energy savings by connecting photovoltaic power systems installed on roof or in open space and storage batteries to establish a micro grid.
Install solar water heaters on the roof of all residential units.

7) Establishment of energy efficiency and management guidelines for energy management for the community (move-in conditions for residents)

Achieve community-wide energy savings by setting allowable electricity use limit (maximum power demand), and provide job training to residents to undertake duties like maintaining PV panels and solar water heaters.

Potential counterparts

Environmental Planning and Climate Protection Department, etc.

8) Provision of Wireless broad band

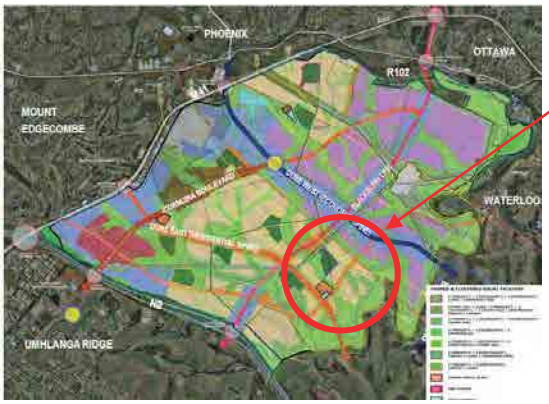
Create an easy-to-access Wi-Fi environment for everyone by providing wireless broad band as an alternative for optical fiber which requires high installation cost.

9) Remote education by utilizing ICT

Provide education and training for low-income residents in an effective manner by utilizing electronic blackboard (Starboard)

Potential counterparts

ICT department, etc.



Walkable Area (approx.. 500m radius)

- Micro-grid system
- Water recycling system
- Community-based waste sorting system
- Wireless broadband network
- High security area

Water Waste Security Wifi

<Before>
Community of Detached Houses
- Small open space
- Inefficient use of energy
- High infrastructure cost

High Efficiency Agriculture Farm
Open Space, Community Park
Community pond
Energy Infrastructure

<After>
Community of Medium-density Housing
- Large open space, community park
- High efficiency agriculture farm
- Efficient use of energy and water
- Low infrastructure cost

Wide area model (low energy and water recycling)

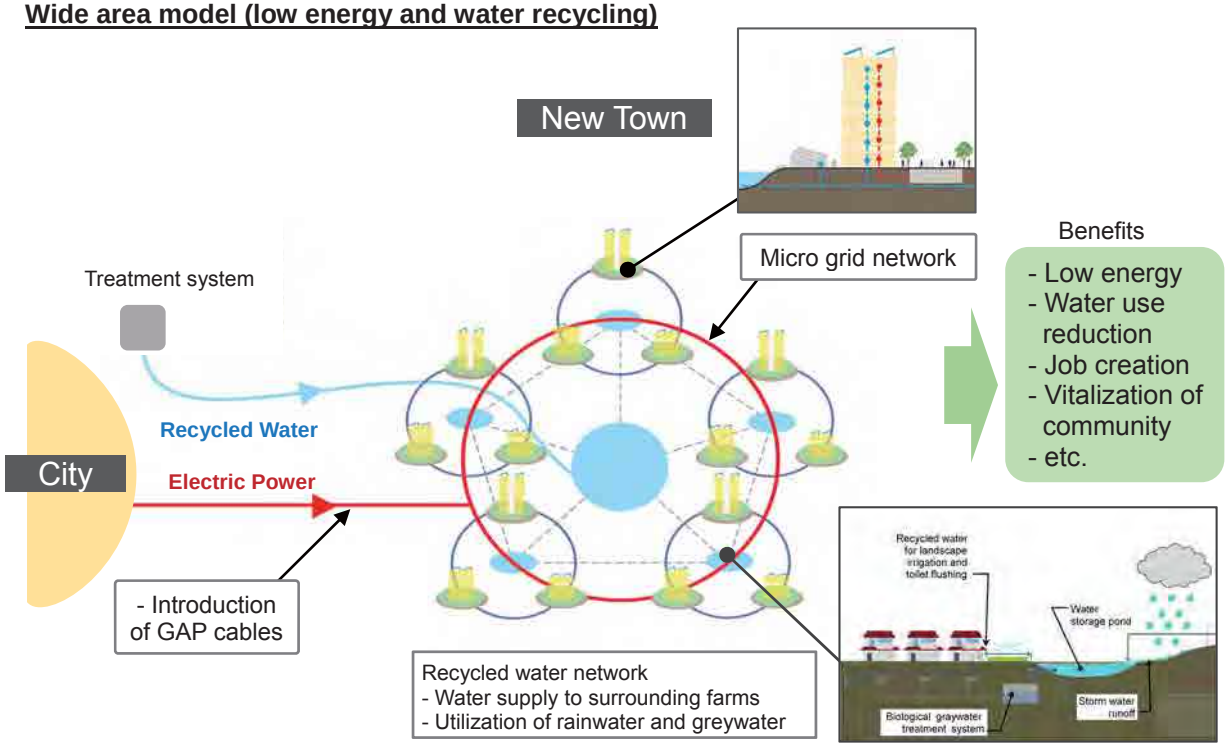
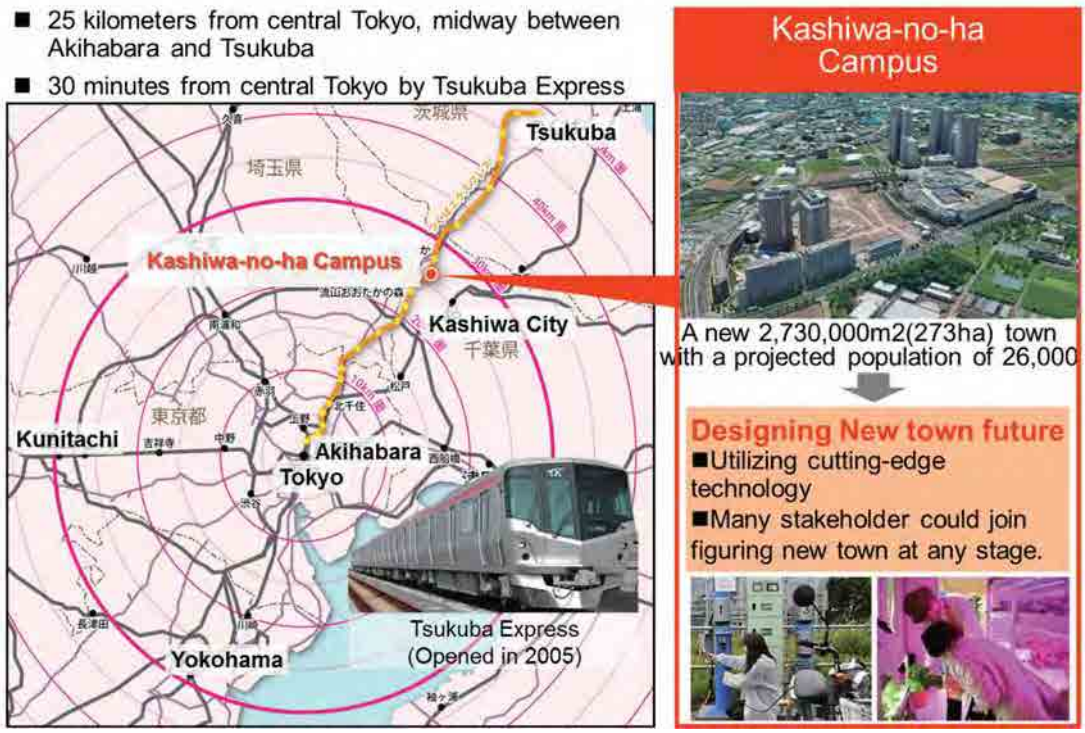
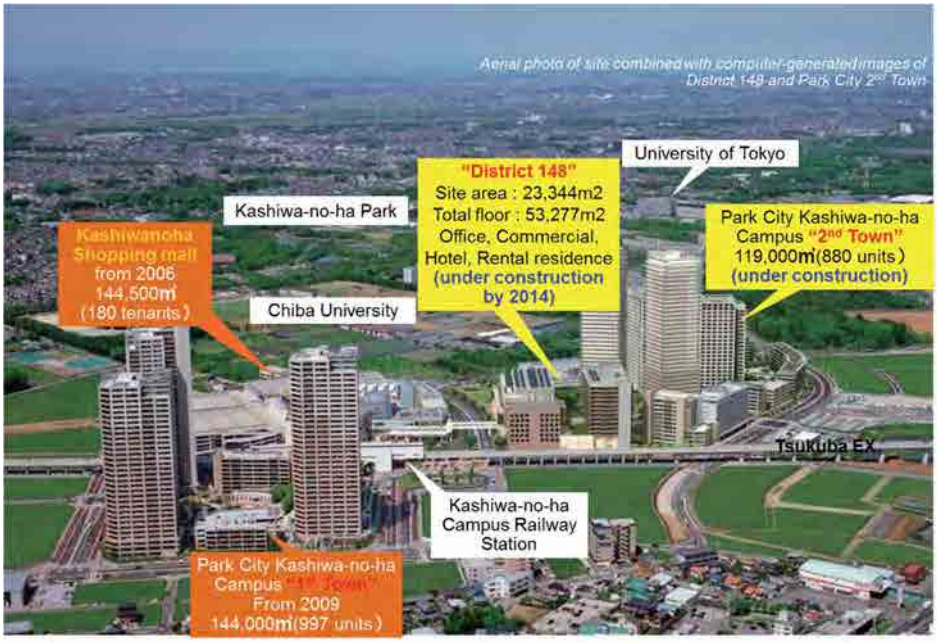


Figure 4-4-7 Environmental-friendly Urban Development of Cornubia

4.5 Case example of comprehensive solutions in Japan (Kashiwa-no-ha Smart City)

A case example of implementing comprehensive solutions for urban development in Japan is shown as follows. Kashiwa-no-ha Smart City is located approximately 25 km from the center of the Tokyo and is a mixed-use development around a newly developed railway station (TOD). Currently, a shopping mall, high-rise residential buildings, offices, a hospital and university facilities have been occupied, but the area is still under development.





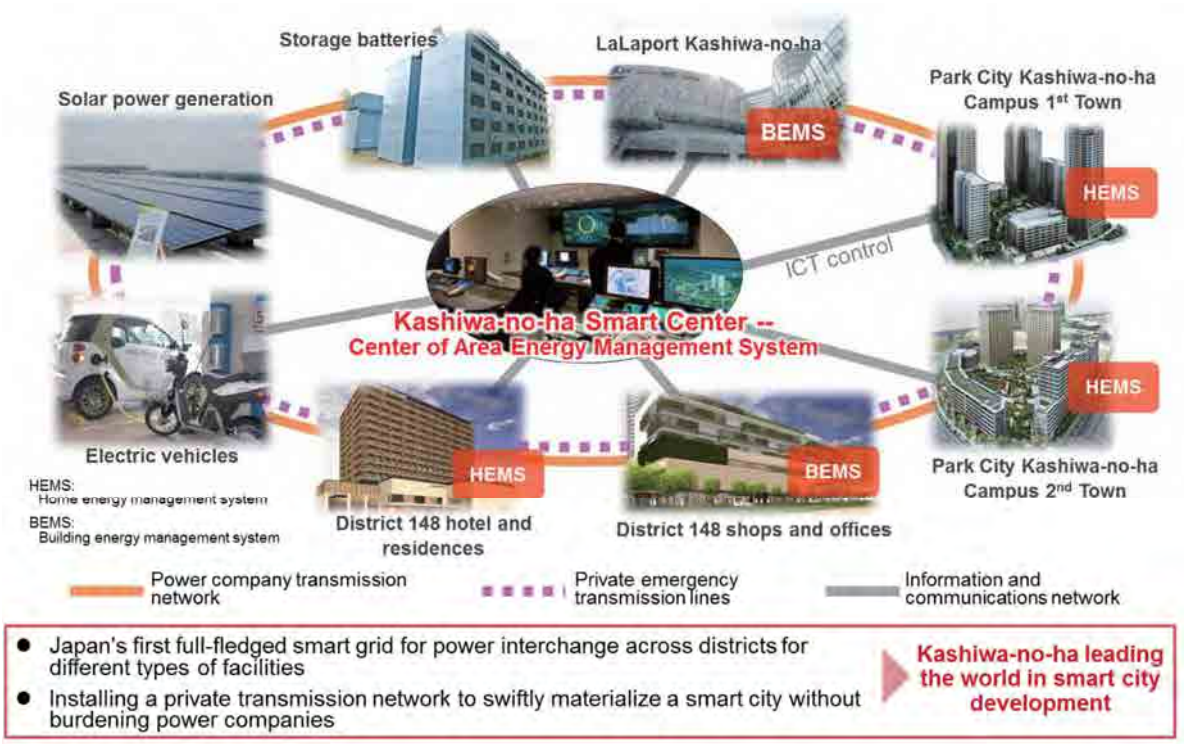
Source: JICA study team

Figure 4-5-1 Location and current view of Kashiwa-no-ha Smart City

Source: JICA study team

Figure 4-5-2 Characteristics of Kashiwa-no-ha Smart City

The advanced smart grid system at Kashiwa-no-ha connects the existing environmental technologies deployed individually to buildings and facilities via an area energy management system. Its other environmentally-friendly strategies include energy generation systems (solar and geothermal power systems), utilization of untapped energy sources such as waste heat and methane gas produced by food waste, and passive architectural designs that take advantage of the natural environment to reduce energy consumption.



Source: JICA study team

Figure 4-5-3 Overview of Area Energy Management System of Kashiwa-no-ha Smart City

5. FUTURE DIRECTION FOR IMPLEMENTATION

5.1 Method of financial support

5.1.1 Strategy Formulation and implementation

The following aspects have been considered in the formulation and implementation of strategies for the proposed measures described in Chapter 3:

- There are various development projects in public and private sectors but the financing schemes proposed in this study are intended for public-based projects and PPP projects.
- The financing schemes are intended for the projects that could not be profitable without subsidies or financing support.
- Target is such a project featured Japanese high value-added and total-solution technologies which provide positive effects (contribution to the local area, economic ripple effect etc.).
- The implementation authority of the environmentally-friendly urban development project is transferred to the local government.
- Sub-sovereign lending schemes are utilized through partnerships with financing institutions

5.1.2 Financing schemes in South Africa

(1) Financial support from central government

The South African government has established a scheme that allows fund transfer from the central government to the local government to supplement maintenance expenses of the public infrastructure. Examples of such fund transferring schemes are shown below.

a. Municipal Infrastructure Grant (MIG)

Characteristics:

Funding Institution	National Treasury & Department of Cooperative Governance and Traditional Affairs (CoGTA)
Funding amount	1,220million US US$ (Source: Revenue Division Act Gazette No.34258 2011.4.28)
Purpose	Provision basic services to all citizens. Eradication of Poverty. Creation of job opportunity.
Usage	Infrastructure for basic and essential services. Rehabilitation of existing infrastructure.
Conditions	Compliance with the existing IDP of the local government. Capital expenditure Applicable but Operation expenses excluded.

b. Equitable Share Grant

Characteristics:

Funding Institution	National Treasury & Department of Cooperative Governance and Traditional Affairs (CoGTA)
Funding amount	21million US$ (For Thembisile Hani Local Municipality in 2011)
Usage	Support of maintenance and operating expenses of public service of local government.
Conditions	Money given to each local government is determined of the Division of Revenue Act, by considering the poor population in the local governments.

(2) PPP (Public Private Partnership)

PPP is a business venture funded and operated through a partnership of government and private enterprise(s) to provide a government service. Mechanisms of PPP include PFI, designated manager system, and Design-Build-Operate (DBO).

The South African government developed the strategic framework of PPP in 1999, and the PFMA (Public Finance Management Act) that came into effect in April 2000 set out the national legislations on financial management including PPP-related schemes. Subsequently, a PPP agency is established in each state by the South African Ministry of Finance to support and undertake PPP implementation.

In general, the private sector proposes a project, but the government decides the project conditions based on market competition.

In South Africa, the social effect of an investment project is regarded as very important. In Japan and other countries, an investment project generally goes through the T-L-F-Link (technique, law, finance relations), but in the case of South Africa, the social development link is emphasized in addition to these three elements.

Source: South African National Treasury PPP Unit, http://www.ppp.gov.za/

Example: PPP project in transportation sector

The Gau Train project is the only example of PPP project in the railroad sector so far. The total project cost was approximately 26 billion rand (including foreign currency conversion in 2004, parking maintenance costs or bus vehicle costs), of which 87% are grants from the Gauteng province, 2% are borne by Bombela, 11% are loan from banks. Bombela, which carries out the design, construction, service, maintenance and partial financing, of the Gau Train project through a 20-year concession contract with Gauteng province, bears the full construction and technical risks of the project. The design, construction, operation, and maintenance are sub-contracted to other companies. The operation and maintenance service was consigned to RATP Dev under a 15-year contract.

(3) Municipal Finance Management Act

The National Treasury has played a pivotal role in the introduction of financial management reforms in local government since 1996.The cornerstone of the reform initiative has been implemented through the Municipal Finance Management Act (MFMA), which became effective in July 2004 and supported by the annual Division of Revenue Act. National Treasury's primary objective is to secure sound and sustainable management of the financial affairs of government, national, provincial and local, and to lead such policies and reforms. Local Government is required to report to the National Treasury about the balance in each sector, the expenditure ratio for investments in infrastructure and annual expenditure and revenue by MFMA. Furthermore, based on the middle - long term, required to make a budget and perform financial management. To enhance effectiveness of the MFMA, the National Treasury is supporting regulatory interventions, manuals, guidance, circulars, workshops, seminars, training and internship programmes with various municipalities.

It is necessary to fulfill the criteria and condition of the MFMA for investments in new infrastructure and external financing include Sub-sovereign loan.

(4) Lending programs of financial institutions

The existing financing scheme are summarized in the following table.

Table 5-1-1 Existing financing schemes

Sector	Existing financing scheme	department	target
Urban & Transportation Planning	- DBSA: The Green Fund	DBSA or Department of Environmental Affairs (DEA)	- Waste management and recycling - Public transport - Renewable energy, energy efficiency - Ecosystem management, etc.
Environment & Energy Planning	- World Bank: South African Cities Energy Efficiency and Renewable Energy Program	WB or Public-Private Infrastructure Advisory Facility	- Climate change - Urban services and housing for the poor - Establishing policy and regulatory frameworks, etc.
	- World Bank：Development Policy Loan (DPL)	WB or National Treasury	- Improved investment climate - Enhanced public financial management, governance, and anti-corruption efforts - Improved public service delivery, etc.
	- World Bank：Clean Technology Fund(CTF)	WB or Department of Environmental Affairs and Tourism	- Power Sector: renewable energy and highly efficient technologies to reduce carbon intensity - Transport Sector: efficiency and modal shifts - Energy Efficiency: buildings, industry, and agriculture, etc.
	- African Development Bank Group (AfDB): Lending program	Group Treasurer	- water, agriculture, health, biodiversity and ecosystems, and human settlements, etc.

	- DBSA: Renewable Energy Independent Power Producers Programme (REIPPP)	Investment banking division group	- Renewable energy (solar wind, etc.)
	- DBSA: The Green Fund	ditto	ditto
Water & Waste Planning	- AfDB: Lending program	ditto	ditto
	- DBSA: The Green Fund	ditto	ditto
ICT Planning	- DBSA: The Green Fund	ditto	ditto

5.1.3 Proposed financing schemes for project implementation

(1) Current type schemes of project implementation

It is assumed that a project would fall under one of the following three cases:

- Case1: The public sector provides the funding and the private sector offers the service
- Case2: The private sector performs construction and administration with its own funding and collects a service payment from users. It also receives the shortfall from the public sector for the service provided.
- Case3: The private sector performs construction and administrative services with its own fund, collecting service payments from users. No financial support from the public sector.

Table 5-1-2 Types of project implementation schemes

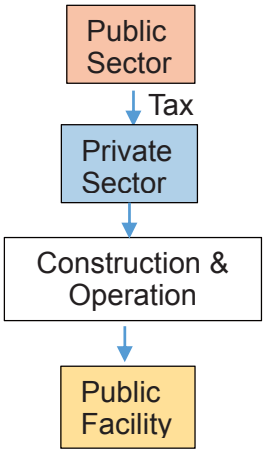
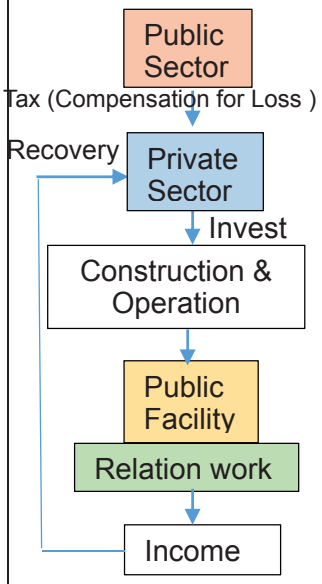
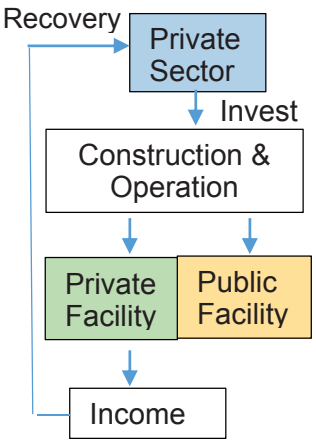
case	Case1	Case2	Case3
	public works	PPP	PPP (private works)
Characteristics	Deferred payment by public sector. Public sector provides 100% of funding.	Private Sector invest in public facilities and public sector supports with tax.	Private sector invests in private & public facilities. No funding from public sector.
Project scheme Flow			

Table 5-1-3 shows the proposed scheme which is applicable to each measures. It is assumed that Case 1 is for the project having implication of public work, Case 2 for the project in operation receiving subsidies and Case 3 for the highly profitable project.

Table 5-1-3 Applicable project implementation schemes

			Case1	Case2	Case3
			public works	PPP	PPP (private works)
Urban. Transportation Planning		① Joint development with station facilities	★	★	
		② Creating a shopping mall at Ekinaka (in-station) and Ekiue (above-station)		★	★
		③ Comprehensive IC card system		★	★
		④ Smart nagivator system		★	★
		⑤ Middle densification of social / affordable housing	★	★	
		⑥ Land readjustment project	★	★	
		⑦ Incentive policy for private development			★
Water & Waste	Water Planning	① Purification of mine wastewater by membrane treatment, and desalination treatment of seawater	★		
		② Water management system which utilizes smart mete	★	★	
		③ Pipeline investigation and correction system	★	★	
		④ Prevalence of sanitary treatment	★	★	
		⑤ Greywater system which utilizes rainwater (mini-reservoir)	★	★	
	Waste Planning	⑥ Waste separation system by separation machine	★	★	
		⑦ Mature compost production facilities	★	★	
		⑧ Waste energy recovery facilities		★	★
		⑨ Highly-efficient incinerator		★	★
		⑩ Waste separation and reuse system in community	★	★	
Energy & Environment	Electric Power Planning	① Highly-efficient inverter system (energy conservation in mines)	★		
		② GAP cable (enhancement of transmission capacity)	★		
		③ Underground substation equipment (countermeasure against ash fall from wildfire)		★	
		④ Rechargeable battery system (portable)		★	
		⑤ Local grid which combines solar and wind power generation		★	★
	Energy and Environmental Planning	⑧ Energy and environmental data utilization for policy and development planning	★		
		⑦ Hybrid Design (combination of passive and active system)		★	★
		⑥ Using sugar cane as biomass		★	★
		⑨ Utilization of water resources		★	★
		⑩ Utilizing solar energy		★	★
		⑪ Guidelines for energy saving in community		★	
ICT Planning		① Wireless broadband (replacement for light fiber)		★	★
		② Security camera (with face recognition function)		★	★
		③ Remote education (electronic blackboard: starboard)	★	★	
		④ Smart City infrastructure (cross-departmental urban control system)		★	★
		⑥ Data backup system in an emergency	★	★	★

Source: JICA Study Team

(2) Financing schemes for measures in each sector

For implementation of the proposed measures and projects described in Chapter 3, existing investment and financing schemes could be applied as proposed below.

Generally, when private enterprise consider financing schemes, the Bank's decision will have consequences. As the project risk is higher, Bank take account of the payback risk and tends to reduce Debt amount, increasing Equity of necessity. Therefore, it is useful to utilize financing schemes mentioned table 5-1-3 as a part of Debt when private enterprise conducting investing projects in South Africa.

Table 5-1-4 Financing schemes for proposed projects

Category	Potential financing schemes	Example
Urban and Transportation	-"The Green Fund (Green cities and Town)" by DBSA	"Land readjustment project", "Mixed use development around the station", etc.
Water & Waste	-Lending program offered by AfDB - "The Green Fund (Environmental and natural resource management)" by DBSA	"Greywater recycling and rainwater harvesting system", "Waste separation and reuse system", etc.
Energy & Environment	-"South African Cities Energy Efficiency and Renewable Energy Program" by World Bank - "The Green Fund (Environmental and natural resource management, Low Carbon economy)" by DBSA	"Highly-efficient inverter system", "Local grid combining solar and wind power generation", etc.
	-Renewable Energy Independent Power Producers Programme (REIPPP) by DBSA	"Water resources recycle", "Solar energy farm", etc.
ICT	-"The Green Fund (Environmental and natural resource management, Green cities and Town)" by DBSA	"Wireless broadband", "security camera system", etc.

Source: JICA Study Team

5.2 Support for Implementation from Japan

(1) Financial Schemes by Japan's Financial Institutions

The basic financial schemes available in South Africa indicated in the previous section would not sufficiently make up for the limited government funds for the implementation of the projects and programs for environmentally-friendly urban development recommended in the study. In the developing countries, while there is a variety of development needs, sometimes happen that not only government but also local public organizations are investing their money in business relating to social and economic development. The government of Japan is considering in the future direct-investment for Sub-sovereign Loan, together with consolidation of organization in JICA.

(2) Technical Support from JICA

In order to implement the recommended projects and programs, the establishment of relevant institutional and regulatory frameworks and the building of capacity for operation and maintenance are needed. For those purposes, JICA's technical assistance schemes could be utilized, which would be provided based on Japan's extensive experiences and latest technologies for environmentally-friendly urban development. The table below shows the items which could obtain the technical support from JICA for the proposed directions and measures for environmentally-friendly urban development in Chapter 3. Since the policies and master plans related to environmentally-friendly urban development is considered to have already been formulated in South Africa, the items for technical support indicated in the table are focused on preparation of manuals and guidelines and establishment of regulatory frameworks.

Table 5-2-1 Potential Items for Technical Support from JICA

Category	Potential Items for Technical Support from JICA
Urban & Transportation Planning	- Support for preparation of an urban planning manual on TOD (creating a compact city surrounding the station), including standards for intermodal facilities, urban planning criteria for station area, etc. - Support for preparation of standards for energy saving measures for an affordable house and affordable housing area. - Support for establishment of a regulatory framework and implementation manual for the land readjustment method.
Water & Waste	- Support for preparation of an implementation manual for community level waste segregation and reuse system.
Energy & Environment	- Support for preparation of a manual for utilization of energy and environmental data for policy and planning formulation. - Support for preparation of an energy saving guideline.

Source: JICA Study Team