Presented by: Sicelo Xulu
Director: Engineering Services
City Power

Topic: Challenges of providing energy infrastructure in a big City (CoJ case study)
What business are we in?

We are in the business of buying electricity from a source and selling it to electricity customers.
## Network Key Statistics

<table>
<thead>
<tr>
<th>Substations (Total: 268)</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Intake Substations</td>
<td>6</td>
</tr>
<tr>
<td>Eskom intake Substations</td>
<td>39</td>
</tr>
<tr>
<td>Major Substations</td>
<td>62</td>
</tr>
<tr>
<td>Satellite Substation</td>
<td>161</td>
</tr>
<tr>
<td>Major Transformers</td>
<td>293</td>
</tr>
<tr>
<td>Load Centers</td>
<td>17,633</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overhead/Underground network</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead: &gt;20kV</td>
<td>822km</td>
</tr>
<tr>
<td>Overhead: &lt;20kV</td>
<td>1,034km</td>
</tr>
<tr>
<td>Underground: &gt;20kV</td>
<td>216km</td>
</tr>
<tr>
<td>Underground: &lt;20kV</td>
<td>6,270km</td>
</tr>
<tr>
<td>Total</td>
<td>8,342km</td>
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</tbody>
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### Customer Type

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Power Users</td>
<td>279,937</td>
</tr>
<tr>
<td>Large Power Users</td>
<td>4,885</td>
</tr>
<tr>
<td>Top Customers</td>
<td>18,892</td>
</tr>
<tr>
<td>Prepayment</td>
<td>60,691</td>
</tr>
<tr>
<td><strong>Total Customer Base (Approx)</strong></td>
<td><strong>364,405</strong></td>
</tr>
</tbody>
</table>
Urban Development (Historic Growth)

1890

1950

2007

There is a need to expand Electricity infrastructure to support this growth!

Source: Net group presentation (modified)
Eradication of 180 informal settlement

5-YEAR PLAN TO Wipe Off Squatter Camps

GONE BY 2014: Informal settlements such as this one in Tembisa, Ekurhuleni, will disappear after fathers to formalise and develop shanty towns into fruit-bowl settlements.

Katie Henson

THERE will be no squatter camps in the city of Johannesburg after five years. Johannesburg’s mayor Amos Masondo says.

The five-year plan is already underway to legalise, upgrade and formalise all such settlements by 2014.

Masondo confirmed yesterday that this was in line with the millennium development plan to eradicate all informal settlements by 2014.

Settlements should be structured in a way that will allow for the provision of basic infrastructure, including water, electricity, roads and services including refuse removal, mobile clinics, libraries and ambulances.

“Future settlement growth should be properly structured and development of future non-authorised settlements must be contained,” Masondo said.

Executive director of City of Johannesburg’s department of development, planning, and urban management, and housing Philip Harrison said: “The aim is to bring a level of security of tenure to residents of informal settlements so that they are encouraged to invest in their properties.”

Harrison admitted that not 100 percent of shacks would be eradicated by 2014.

He added that the aim was to also encourage people to take ownership of their properties because their settlement would be legal.

Harrison said this would help stop the mushrooming of shacks because people would be incentivised for looking after their properties and stop others from erecting illegal shacks.

Harrison said residents in hazardous locations would be moved.

Of Johannesburg’s 180 informal settlements, 73 have been earmarked as upgrading projects, 17 as relocation projects, 20 as regularisation projects, 23 as already linked to housing programmes and 47 not yet linked to programmes or projects.

Currently, 35 percent of Johannesburg’s citizens fall in the informal category which equates to about 200,000 households.
City Power consists of six (6) essentially independent transmission systems Johannesburg, Randburg, Roodepoort, Sandton, Midrand and Johannesburg South.

There are also a few minor independent load points such as Alexandra, Dainfern, Lenasia, Modderfontein and Vlakfontein.

When City Power was formed in 2000/1:

- The technical designs and features of the various systems were often diverse and the systems had little interconnection.

- The network had reached its theoretical life expectancy (equipment older than 30 years).

- Little or no maintenance at all had been done over the years – hence high number of outages.
During 2003/4: Development of the three (3) to five (5) year infrastructure rolling plan

- Detailed Audits were conducted in order to ascertain the condition of the Network infrastructure.

- Network master plans were also developed to ascertain short and medium term capacity requirements.

- Root cause analysis for Technical and non-Technical losses were conducted and revenue protection and generation projects identified.

- Electrification master plans were developed in consultation with Housing department to ascertain the electrification backlog.

- From the above exercise the five year infrastructure rolling plan to address the load growth, Electrification and refurbishment needs was developed and put in place.

This infrastructure plan is revised and updated annually.
1. Overloaded infrastructure identified and prioritized

2. Short, Medium and Long Term capacity plans developed (based on new township developments, de-densification programmes and sub-division applications)

3. Alignment and prioritization electrification to the Housing programme (RDP and Mixed development)
Capital Investments (Past 7 years)

Capital Expenditure (7YRS)

Introduction of Comprehensive NDP

City of JHB Response – increase in CAPEX allocation

<table>
<thead>
<tr>
<th>Previous 2 Fin Yrs</th>
<th>2004/5</th>
<th>2005/6</th>
<th>2006/7</th>
<th>2007/8</th>
<th>2008/9</th>
<th>Total CAPEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Expenditure</td>
<td>612,045</td>
<td>472,712</td>
<td>765,559</td>
<td>865,025</td>
<td>1,034,909</td>
<td>4,813,715</td>
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<tr>
<td>Budget</td>
<td>612,045</td>
<td>441,196</td>
<td>704,409</td>
<td>877,320</td>
<td>1,034,923</td>
<td>4,734,043</td>
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</tbody>
</table>
The following benefits have been realised over the past 4 to 5 years, in areas where investments have been made:

- Over 15000 customers have been added into the electrical network infrastructure in response to new township developments and sub-division applications (combination of customers < 56kVA and >56kVA)

- Over 60 000 previously disadvantaged (RDP houses) have been electrified, in response to the universal access to electricity targets (in partnership with DoE)

- Significant reduction in unplanned outages for both HV and MV levels

- Additional infrastructure has been constructed and commissioned to cater for short to medium developments

- Significant investment has been made into SAP, SCADA, Protection, GIS, network data improvement and work management solution (WMS)

- Additional 140MW has been introduced into the network through refurbishment of GAS turbines – in response to load shedding threat

- ISO 14001 (Environmental Management System) and the OHSAS 18001 (Health and Safety Management System) accreditation - now going for ISO 9001, 2008 (QMS)
Benefits vs. Investment: Capacity constraints: 2006 vs. 2009 upgrade programme...
Other than access to electricity and provision of street lighting the following benefits have been observed after the implementation of these projects. These programmes have positively contributed towards poverty alleviation, the following small business have emerged in the townships:

- Establishment of “Spaza” shops
- Back yard mechanics
- Informal restaurants
- Employment of local community during project execution (EPWP)
- Community Phones (Cell C, Vodacom and MTN)
- Improvement of pedestrian and vehicular safety, where we have installed public lighting
- More service being rolled out due to access to electricity e.g. Clinics, Waterborne sewerages, schools etc.
But what are the challenges of providing Energy infrastructure in a big City?

- Introduction of *environmental protection laws*, which led to the EIA processes conducted in infrastructure projects.

- Challenges on finding the best *service corridors* (due to lack of open space OR available space competing with *low cost housing developments*).

- Escalation in the *cost* of acquiring *land* and *material* (especially long lead item).

- Inadequate *resources* i.e. funding, personnel etc.

- Integrating *new technology* with the *old technology* without compromising *network integrity* (to ensure standardisation and harmonisation).

- Striking a balance in *supporting new developments* vs. *capacity constraints/shortages*.

- Service delivery protest.

- Retention of critical skills to ensure continuity.
Challenges going forward…

- Find a balance between satisfying the ever increasing development requirements (Additional capacity for new township development and rezoning application) and energy savings/reduction requirements - PCP

- Continue to reduce the average age of installed equipment to an acceptable technical useful lives (Refurbishment Programmes)

- Meeting the 2010 FIFA requirements and associated capacity/development requirements and operational plans

- Meeting electrification targets by 2012 /14

- Continue to build electricity infrastructure to support major projects e.g. Gauntrain, BRT’s etc.
Challenges going forward…Funding requirements

Firstly, I must start by commending the City of Johannesburg with its CAPEX allocation over the past 4 to 5 years towards the strengthening of electricity infrastructure around Johannesburg.

Over **R4.8billion** has been invested into the electrical infrastructure over the past 4 to 5 years and a further **R825million** has been allocated for this financial year i.e. 2009/10.

However there is still a huge challenge ahead of us, the average age of our HV, MV and LV infrastructure is still in excess of 30 years which implies that much of the networks have theoretically exceeded their technical lifespan and will require intensive refurbishment and or replacement in the short to medium term.

Our current backlog is in the order of **R6.8billion**, densification, subdivisions and new development are also placing an increasing demand on these networks which necessitates the upgrading and extension of these networks.

A **20 year master plan is currently being revised** and the indication is that an amount of **R7.3billion will be required**; most of the expenditure will have to be incurred over the first 8 years.
The budget application to the council/budget panel must be supported by detailed infrastructure plan (not high level wish list).

Forward planning and strategic sourcing of long lead items is also critical.

Coordination of plans amongst critical role players is of paramount importance i.e.

- Alignment with Growth and Development Strategy (GDS),
- Spatial Development Framework (SDF),
- Eskom: additional capacity applications,
- Timeous engagement with developers and commenting towards township development approval process (at the town planning level)
Secure service corridors and land parcels for substation at town planning approval stage (including the EIA)

Establishment of the Programme and Project Management office with well defined process (e.g. NACVC)

Municipalities must pursue alternative sources of funding within the MFMA limitations (e.g. PPP, Project Finance, Grant Funding etc.) to support their infrastructure plans

Introduction of alternative energy sources into the Grid

Aggressive implementation of Demand Side Management (DSM) measures, the pilot stage must come to end.
Some of completed Infrastructure Projects

“Improving the management of our electricity resources”
Cydna Substation:
Transformer and Switchgear Installation

- **NEW 45 MVA TRANSFORMER**
- **NEW 11kV SWITCHGEAR**
- **NEW CONTROL PANELS**
- **OLD EXISTING 6,6kV PANELS**
Rosebank, Roosevelt and Wemmer Substations
New Transformer Installation

OLD EXISTING 30 MVA TRANSFORMER

NEW 45 MVA TRANSFORMER
Beyers Substation
Switchgear and Power Transformers

NEW 88kV JUNCTION YARD

NEW 11kV SWITCHBAY
Sentraal and Roodetown Substations Protection and Scada Control Panels Upgrading

OLD CONTROL PANEL FOR SENTRAAL SUBSTATION
Florida / Florida North
33kV Cable Installation

33kV CABLE EXCAVATION AND SAFETY BARRICADING DURING CONSTRUCTION
John Ware Substation: 88/20kv Transformer Installation

NEW TRANSFORMER PLINTHS

OLD EXISTING 88/20kV 3x SINGLE PHASE TRANSFORMER UNITS

NEWLY REFURBISHED TRANSFORMER INSTALLED
Fordsburg: 275kv Switchgear Installation

**Delivered** 275kV CB'S and VT'S

**New** 220V DC Battery Set

**Old Existing** 275kV Bus Section CB’S

**Installed** 275kV CB’S and Isolators

TRFR 3
Lenasia

OLD LV LINES

NEWLY INSTALLED PUBLIC LIGHTS WITH UNDERGROUND CABLES

OLD SWITCHGEAR

NEW SWITCHGEAR AT ELDORADO PARK SWS
Roodepoort

A-TYPE MSS’S WITHOUT SWITCHGEAR

COMPACT SWITCHGEAR INSTALLED
OLD SWITCHGEAR: UNSAFE TO OPERATE & UNRELIABLE

NEW SWITCHGEAR INSTALLED OUTSIDE THE CHAMBER
Bryanston temporary substation was commissioned in December 2006, this substation will alleviate the supply shortage in Bryanston. Other related projects of conversion from 66kV to 11kV are ongoing in the area.
NEWLY INSTALLED PUBLIC LIGHTING AT LARROCHELLE & OVERHEAD NETWORK UNDERGROUND
LEHAE HOUSES BEFORE ELECTRIFICATION

LEHAE HOUSES WITH ELECTRICITY
Tshepisong

TSHEPISONG HOUSES WITHOUT ELECTRICITY

TSHEPISONG HOUSEHOLDS ELECTRIFIED
Cleveland Substation (Transformer Replacement)

new transformer
Cleveland Substation
(Replacement of the Transformer)

MV Terminations
Cleveland Substation
(Replacement of the Transformer)

New Transformer
Central substation
(Replacement of the transformer)

The wall was broken in order to replace the old transformer.
Central substation
(Replacement of the transformer)

New transformer is being racked in
Central substation
(Replacement of the transformer)

New transformer is being racked in
THANK YOU