Smart Metering implementation programme
“From concept to reality”

24th AMEU Technical Convention 2013, Supporting SA infrastructure and Service Delivery objectives,
6 – 9 October 2013

Presented by: SICELO XULU, Managing Director of City Power
• Introductory remarks
  – State of Electricity industry in Africa
  – Urbanisation trends in the city of Johannesburg
• City Power at a Glance
• Programme Problem Statement
• Programme Overview
• Programme’s Strategic Placement
• Programme Benefits
• Programme Success Factors
• Programme Impact on City Power
• Chosen Technology Benefits
• Chosen Suppliers Credentials
• Solution components
• Meter to Goal Contribution
• Highlights of Progress to date
• Current Challenges
• Key Milestones for Quarter

“Good work ……. but I think we need just a little more detail right here”
My advise...avoid taking pictures at substations....

The connected Mr. Xulu
STATE OF THE ELECTRICITY INDUSTRY IN AFRICA
• By 2030, most people in Africa will be living in and around cities.

• According to the latest Stats SA report, South Africa is already close to 60% urbanized.

* Source: WUP 2009
Size of power sector in Africa

Power generation imbalance within the continent

<table>
<thead>
<tr>
<th>Region</th>
<th>MW</th>
<th>percent</th>
<th>GWh</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Africa</td>
<td>9,498</td>
<td>10.01</td>
<td>21,190</td>
<td>6.26</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>50,007</td>
<td>52.70</td>
<td>197,481</td>
<td>58.34</td>
</tr>
<tr>
<td>North Africa</td>
<td>28,905</td>
<td>30.46</td>
<td>101,688</td>
<td>30.04</td>
</tr>
<tr>
<td>East Africa</td>
<td>2,875</td>
<td>3.64</td>
<td>7,696</td>
<td>2.27</td>
</tr>
<tr>
<td>Central Africa</td>
<td>3,454</td>
<td>3.64</td>
<td>7,696</td>
<td>2.27</td>
</tr>
<tr>
<td>Totals</td>
<td>94,898</td>
<td>100</td>
<td>338,485</td>
<td>100</td>
</tr>
</tbody>
</table>

- Total power generated by sub-Saharan region (excl. South Africa) is equivalent to Argentina's.
- South Africa alone has close to 50% generating capacity of the entire continent.
- South Africa and north African countries hold more than 80% generation of the continent.

* Mkhwanazi 2010
Electricity reliability

Power interruption per customer per year

* * *

Average number of days of supply interruption per year (2000 – 2005)

<table>
<thead>
<tr>
<th>Country</th>
<th>Days of Interruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eritrea</td>
<td>93.9</td>
</tr>
<tr>
<td>Mali</td>
<td>10.5</td>
</tr>
<tr>
<td>Tanzania</td>
<td>60.6</td>
</tr>
<tr>
<td>Kenya</td>
<td>83.6</td>
</tr>
<tr>
<td>Senegal</td>
<td>26.1</td>
</tr>
<tr>
<td>Uganda</td>
<td>70.8</td>
</tr>
<tr>
<td>Madagascar</td>
<td>78.0</td>
</tr>
<tr>
<td>South Africa</td>
<td>5.5</td>
</tr>
<tr>
<td>Zambia</td>
<td>30.0</td>
</tr>
</tbody>
</table>

- **Reliability of supply** - On average, African enterprises experience 56 days of power interruptions per year.
- **Low access and insufficient capacity** – only 24% of the population of sub-Saharan region have access to electricity.
- **Low economic growth** – On average, the cost to the GDP of all interruption is 2.1%.

* Wangwengwende and Wamukonya 2007
URBANISATION TRENDS IN THE CITY OF JOHANNESBURG
• 84.6% of the CoJ population are born in SA. There was a general increase in international migration into Johannesburg - total international migration increased by approximately 9.8% since 2001.

• Majority of the international migrants are from SADC 7.5% in 2011 up from 1.7% in 2001
City of Johannesburg

- City of Johannesburg is experiencing rapid population growth;
- Population grew by 20.5% between 2001 and 2007 and by 14% between 2007 and 2011;
- Over the ten year period from 2001 to 2011, COJ Population increased by 37%;

* 2011 South African Census
The CoJ population is predominantly young ‘Youth Bulge’. This is a result of mainly migration from other parts of the country as young people migrate for jobs.
Growth of households

City of Johannesburg

- City of Johannesburg Households increased by 10.9% between 2001 & 2007 and by 23.2% over ten years;
- The households’ formation is greater than the population growth in the City;
- In 2011, 36.2% were female headed households down from 38.3% in 2001;

* 2011 South African Census

PROPRIETARY & CONFIDENTIAL
• Vision: World Class Electricity Utility
• MOE: City of Johannesburg is the single shareholder of City Power
• Number of customers: Over 460,000
  • LPU: 1%
  • Prepaid: 62%
  • Conventional Business/Domestic: 37%
• Revenue: R13.2bn
• Employees: 1,700
• Only utility in Africa that has three ISO accreditations (9000, 14001 and 18001)
• Non-technical losses account for over 10% of the overall power purchased from Eskom
• Income collection and usage data are not streamlined with available technologies
• Processes are manual and paper based leading to reduced performance

• Data has overtime become ‘corrupted’ leading to increased frustration of our customers
• Criminal elements pray on victims using City Power as a method to gain entry to homes
• The grid is not ready for effective management
• Consumers are limited by lack of information available to them
• Cost and demand increases require efficient use of current supply
<table>
<thead>
<tr>
<th>Proposed Solution: Split Pre-paid solution &lt; 1000kwh/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convert customers to split prepaid meters with bidirectional communication</td>
</tr>
<tr>
<td>• Installation of independent load management controllers.</td>
</tr>
<tr>
<td>• Installation of protective structures</td>
</tr>
<tr>
<td>• Install remote meter monitoring systems <strong>STARTED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed Solution: Smart Meters Domestic Customers, &gt; 1000kwh/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convert to smart meters (with load management, ToU functionality and ability to be on pre-payment or conventional metering with fraud detection capability)</td>
</tr>
<tr>
<td>• Bi-directional metering infrastructure</td>
</tr>
<tr>
<td>• <strong>STARTED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed Solution: Smart Meters Large Power Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Convert to smart meters</td>
</tr>
<tr>
<td>• Perform technical audit on metering accuracy</td>
</tr>
<tr>
<td>• Time of Use tariff</td>
</tr>
<tr>
<td>• Power conservation scheme through pricing signal</td>
</tr>
<tr>
<td>• <strong>STARTED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed Solution: Technical Data completeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Audit all stands in areas where supply is provided</td>
</tr>
<tr>
<td>• Locate all meters with GPS coordinates.</td>
</tr>
<tr>
<td>• Possible joint operation with other entities</td>
</tr>
<tr>
<td>• Communication campaigns</td>
</tr>
<tr>
<td>• <strong>STARTED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed Solution: Confirmation of Losses and direct cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Installing stats meters at all of our substation incomers, feeder board and switching stations</td>
</tr>
<tr>
<td>• Installing bulk metering for intake points as check meters</td>
</tr>
<tr>
<td>• Installation of Capacitor banks</td>
</tr>
<tr>
<td>• <strong>STARTED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed Solution: Establishment of dedicated team to manage metering</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Establishment of Energy Management back office</td>
</tr>
<tr>
<td>• Establishment of revenue protection response team (to deal with bypass/faulty meters etc.)</td>
</tr>
<tr>
<td>• Introduction of energy champions to provide energy service to Large Power Users</td>
</tr>
<tr>
<td>• <strong>STARTED</strong></td>
</tr>
</tbody>
</table>
• Projects, phases and activities include:
  – Legacy Systems Replacement (immediate requirement)
  – Production Systems Implementation
  – Business Trials for mass roll out
  – Data Clean Up
  – Customer support & Information Management Improvement
  – Systems Integration
  – Mass Roll Out
  – Programme Close-Out

... empowering leaders to manage energy resources for a sustainable future
PROGRAMME BENEFITS – CITY POWER

• Improved customer service
  – Accurate meter reading, reduced call handling,
  – on-demand data access,
  – leading to proactive grid monitoring and support

• Distribution Operations
  – Reduced outage repair times
  – Reduced false outage dispatches
  – Direct communication to customers in home devices
  – Energy supply management

• Revenue Enhancement
  – Time of use billing
  – Remote disconnections, accurate usage forecasting,
  – reduced ‘missed readings’, reduced annual failure rate
  – Decreased direct meter-reading labour and contractual expense, supervisory labour expense, vehicles, equipment and other miscellaneous materials, customer support costs, and others
  – Accurate usage data as well as potential energy theft analysis, reduced non-reads

• Foundation to Smart Grid Portfolio
PROGRAMME BENEFITS

• Societal & Customer Benefits Anticipated
  – Reduced outages due to voluntary participation in load management
  – Avoided new capacity capital costs and related end user fees due to decreased peak demand (load management)
  – Reduced environmental impact (decreased demand – related pollutants, reduced vehicle omissions – meter reading)
  – Reduced criminal activity by imposters posing as City Power representatives
  – City Power can focus on other areas of the business to improve the overall business proposition
  – eCommerce and data analysis services
PROGRAMME SUCCESS FACTORS

- Improved customer relations
- Improved operational environment
- Improved access and management of resources (incl. financial)
- Programme and strategic alignment
- Human resource development
- Improved information management
**PROGRAMME IMPACT ON CITY POWER**

- **Capability Impact**
  - Meter Reading
  - Meter Data Management
  - Meter Data Provision to Customers
  - Billing & Back Office
  - Customer Service / Call Centre
  - Contract Management
  - Reporting
  - Commissioning of new Meters

- **‘Business as Usual’ Impact**
  - Business Process Impact
  - System / Equipment / Technology Impacts
  - Staffing Impacts
Smart Meter Realisation Project
‘Nerve Centre’ for automatic meter reading
CHOSEN TECHNOLOGY BENEFITS

MDC's based on standards can be included in architecture.

'Future Proof' Meters

Multiple Communication Options

Automated Data Collection failure resolution

Interoperable Modular Upgradable
CHosen Suppliers Credentials

Consortium Members Background Includes;

- Oldest Electrical Contracting Company In South Africa
- HDI Empower Electrical Contractors
- Global Technology Company & world leading provider of energy and water management solutions for utilities
- Experience and expertise include; commercial, industrial, HV and LV reticulation, township reticulation, fibre optic installations, live line installations, smart metering, wind and solar EPC and substation and transformer installations.
- Market Leaders with High Value placed on social responsibility
SOLUTION COMPONENTS

SMIP Solution Components

End User Environment

LPU / Large Commercial Environment

Wide Area Network (WAN)
GPRS / PLC / WIFI
End user Portal
LPU Meter

LPU / Large Commercial Environment

Backend System Environment

Manual
Meter Reads

Programme Solution Set

Meter Data Management
Multiple Meter Data Collection
Field Deployment
Audit Systems
GIS
EA Bus
and Others

Interface / Integration points

Existing Systems

Some of the ways automated data collection from meters support the business in achievement of organisational goals.
HIGHLIGHTS OF PROGRESS


• Business Analysis and workshops, Business Solution Design (BSD), Technical Architecture Design (TAD), Setup and Configured development, test, interim and production hardware / operating systems and solution components

• 9350 meters loaded onto the IEE MDM, 1925 domestic meters installed, Just under 20,000 Domestic Meters audited, 6489 LPU AMR conversions of registers / meters were audited, 4582 LPU AMR conversions of registers / meters completed

• Design of system architecture, Installation of server to manage integration, Interim Integration between some systems, Interim work order and commissioning sheet creation for domestic meter installations

• Setup of warehouse, Deployment of field deployment systems, deployment of 2x MDC’s, Preproduction smart meters installed, LPU meters - Domestic Meters and Deployment equipment delivered

• Setup of training facilities, Training of installers, warehouse manager, administrative resources

• Implementation planning framework developed, Documentation of implementation processes, Use cases for business trials developed
CURRENT CHALLENGES

- Poor data quality
- Prepaid customer information limited
- Out-dated customer information
- Dependency on 3rd parties data (CoJ)
- Slow data update processes
- Slow response times from business resources
- Resistance to change (internal and external)
- Access to customers premises
- Poor perception of the utility by customers
- Deteriorated ‘on-field’ environment
- Extremely manual processes within the utility
- Limited documented processes
- Poor customer support services (call centres)
KEY MILESTONES FOR NEXT QUARTER

- Transition IEE MDM Operations to City Power and move from Delivery to Support
- AG response Plan Close Out
- Business Trials
  - Complete field trials for customer experience
  - Final sign-off of field and back-office systems prior to roll out
  - Completion of business trials prior to mass roll out
  - Additional Analysis workshops (business & technical) and phase 1 of production systems integration
- Communication and Awareness
  - Awareness campaign
  - Improved communication management structures
  - Improved customer support centre
- Final planning for mass roll out
  - Completion of meter audits
  - Business Sign-Off mass roll out implementation plan, Updated SMIP toolkit
- City Wide Roll Out Begins
Proposed Solution: Split Pre-paid solution < 1000kwh/month

- Convert customers to split prepaid meters with bidirectional communication
- Installation of independent load management controllers.
- Installation of protective structures
- Install remote meter monitoring systems
City Power Revenue Enhancement Project

PROJECT OVERVIEW & DELIVERABLES

Three year project from May 2012 to April 2015

Landis+Gyr to provide City Power with a total revenue enhancement solution for their current prepayment installed base.

This will be achieved by remotely monitoring the complete City Power prepayment installed base from a central control centre and providing innovative ways to manage and react to fraudulent activity and fault reporting.

Deliverables

- SupTalk communications controller system
- 1,800 Remote Access Terminals (RAT’s)
- 1,800 ZMD405.B2 check meters
- 80,000 plus PLC2 split prepayment meters
- SupTalk development for Total Solution
- 3 year SupTalk Maintenance Agreement
- 3 year Project Management for the above
City Power Revenue Enhancement Project
RAT dashboard – Far East Bank

- RAT Groups
  - Alexandra - Far East Bank
  - Alexandra - East Bank
  - Alexandra

- RAT Filter
  - No Filter

- Meter Filter
  - Tampered

- Changes filters...

- Include inactive RATs

- Refresh

- RATs Status
  - All RATs: 19/30
  - FAR EAST BANK - MINI SUB - N 739 - ALL AFRICAN GAMES STREET: 14/30
  - FAR EAST BANK - MINI SUB 08 - STAND 1754 - SOUTH AFRICAN BLVD: 24/30
  - FAR EAST BANK - MINI SUB 11 - STAND 180: 25/30
  - FAR EAST BANK - MINI SUB 01460 - STAND 7610: 19/30
  - FAR EAST BANK - MINI SUB 7 46 - STAND 1729 - SOUTH AFRICAN BLVD: > 30/30

- Meter Alarms
  - 0/0

- Status
  - All OK
  - Pending update
  - Refreshing
  - Unacknowledged
  - Lost comms?
  - Status unknown
  - Large RATs

- Alarms
  - No alarms
  - Alarms present
  - Unacknowledged alarms
  - No recent status

- Far East Bank

- RAT Groups
  - Alexandra - Far East Bank
  - Alexandra - East Bank
  - Alexandra

- RAT Filter
  - No Filter

- Meter Filter
  - Tampered

- Changes filters...

- Include inactive RATs

- Refresh

- RATs Status
  - All RATs: 24/30
  - FAR EAST BANK - MINI SUB 01460 - STAND 7610: 24/30
  - FAR EAST BANK - MINI SUB 7 46 - STAND 1729 - SOUTH AFRICAN BLVD: > 30/30

- Meter Alarms
  - 0/0

- Status
  - All OK
  - Pending update
  - Refreshing
  - Unacknowledged
  - Lost comms?
  - Status unknown
  - Large RATs

- Alarms
  - No alarms
  - Alarms present
  - Unacknowledged alarms
  - No recent status

- Far East Bank
City Power Revenue Enhancement Project
Good meter consumption graph
City Power Revenue Enhancement Project
Tampered meter consumption graph
REVENUE ENHANCEMENT SOLUTION, Meter selection
REVENUE ENHANCEMENT SOLUTION, Meter tampering

Only one meter not Tampered
REVENUE ENHANCEMENT SOLUTION, Protective Structures
CONCLUSION

• Despite the challenges, we are pushing the organisation into a well needed change

• The programme has made good progress in 8 months

• The programme is continuing at a fast pace and we are continuing to expedite delivery

• All stakeholders need to get on-board early

• The programme is aligned to the smart city strategy

• The City is becoming a sustainable energy hub
Looking back, 10 years from now, this will be seen as a forward-thinking decision that will have saved City Power money and provided significant value to its customers.