South African Residential and Commercial Gas
Unfolding scenarios
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Although gas has been globally accepted as an important source of energy, its usage for this purpose in the South African economy is still small compared to other mid-income countries. Until now, the use of gas in South Africa has been largely limited to applications in the industrial market. There are two types of gas for consideration in the local market: the natural gas imported from Mozambique for petrochemicals production and liquid petroleum gas (LP gas), which is produced as a by-product of crude and coal to liquids (CTL) refining processes.

South Africa has enjoyed a period of accelerated economic growth post the apartheid era accompanied by historically low electricity prices to lure foreign direct investment. The delay of investment in new generation capacity since the 1970s and 1980s to support the country’s economic growth has resulted in demand for power being disturbingly close to supply. Due to the tight supply, the local energy sector has experienced a dynamic shift over the last three years, which has seen end users experience more than a 30% price increase during the period to help the national power utility finance the construction of its new generation capacity.

The local electricity supply chain consists of three parts, as illustrated on the diagram. These are the generation of electricity from power stations, transmission via power lines and distribution to end users.
Most commercial and residential end users do not purchase power from the national power utility. They purchase the power from local municipalities who have been subject to a 25% average price increase from the power utility in the last three years and add a further 10% increase when they distribute power to end users. Similar price increases can be expected over the next two years as the power utility tries to bridge the gap between supply and demand from 2010 to 2013 and again from 2018 and 2020, as illustrated below.

As a result of these developments, end users of power in both the commercial and residential sectors of the South African economy are turning to gas as an alternative source of energy. Over the past 12 months, businesses and property developers in the high-income sector have started to leverage existing infrastructure by implementing gas-to-power and gas-to-heat technologies respectively to counter the effects of high price tariffs and uncertainties in security of energy supply. The current realities in each of these sectors are as follows:

**Residential dynamics**

- **Rising electricity prices**: This has encouraged many households to switch to alternative sources of energy such as LP gas and solar.
- **Limited distribution infrastructure**: Adoption of LP gas in the residential market is, however, limited by its current distribution structure. The cylinder distribution model has historically made LP gas far more expensive than electricity, and consumers have always viewed the usage of cylindered LP gas as an energy source that is unsafe and not as easily accessible as electricity.

**Commercial dynamics**

- **Increases in electricity prices**: Most South African commercial users of electricity are not direct customers of the power utility and thus experience a more-than-25% price increase when municipalities distribute power to them.
- **Security of supply**: Commercial entities regard security of energy supply as a critical business risk. In the absence of significant new generation capacity coming online in the next 18 months, South African companies are making a concerted effort to ensure adequate energy supply to their operations through co-generation or energy-efficient demand side management programmes.
- **On-site gas-powered generation is a reality**: A major telecommunications company has proven the gas-to-power model through tri-generation (electricity, heating and cooling) in the commercial space while recent industrial activity boasts the announcement by a major petrochemicals company to build a gas engine plant in the Free State that will generate 140 MW of power by the end of 2012.

**Bottom line**

- Residential and commercial users face energy constraints with many of them exposed to price increases of 30% or more in a very tight electricity reserve margin environment. These realities are driving the demand for gas and other solutions of alternative energy, a market trend that Deloitte believes will gain more traction over time.
Property developers for high-income housing are establishing localised micro-gas utilities

Reticulated LP gas is driven by property developers in the high-income housing sector (houses priced at 120,000 USD and above) who go on to sell the gas as to new homeowners through self-established micro-gas utilities. The use of LP gas can substitute up to 70% of the household energy requirements for cooking, water heating and space heating for high-income housing. This means that a property developer only has to provide the balance of energy requirements through electricity for each unit, thus resulting in 70% electricity equivalent saving per household. Furthermore, property developers are taking advantage of the relatively lower reticulation installation costs at construction phase. The retrofit option would be more expensive, as households would have to replace their existing electricity appliances with gas appliances.

Reticulated LP gas is affordable

The economic rationale for households to switch to LP gas is clear, as illustrated by the energy cost comparison between reticulated LP gas, cylinder LP gas and electricity. In addition to the added benefit of convenient gas supply, the reticulated distribution model makes the gas more affordable for households, as illustrated in the energy cost comparison diagram. The figure below is representative of typical cost savings for a high-income housing scenario.

The Waterfall Country Estate development situated north of Johannesburg is an example of a high-profile LP gas reticulation initiative where a property developer has partnered with a prominent gas supplier to distribute LP gas to more than 2,000 homes in the first phase of construction. This is the first LP gas project of this nature in Johannesburg, which more property developers are expected to adopt as energy prices continue to rise. The market within Johannesburg suburbs alone (i.e. new property developments for high-income housing) is estimated at 10–15 MW of electricity equivalent a year.

The reticulated distribution of gas to the household market (high-income) is not a new phenomenon in Johannesburg. The urban natural gas network in the greater Johannesburg area currently operated by Egoli Gas has provided the platform for reticulated gas distribution, but the growth in this market has been largely limited by cheap electricity, which as a result led to the lack of infrastructural investment required to extend the existing pipeline network. Through LP gas produced at local refineries, localised reticulation networks can be established to grow the use of gas by households to satisfy their cooking and heating needs.
The growth for localised micro-reticulation networks lies in the affordable-housing sector

The majority of current and all future housing stock resides in the affordable-housing sector (houses priced at 30,000 to 80,000 USD and above). With more than 400,000 units in the pipeline over the next 5 to 10 years nationally, the affordable housing sector is a key market for the growth of localised LP gas reticulation systems. A typical layout of a reticulated LP gas distribution network in the affordable housing sector is illustrated below.

The feasibility of a gas reticulation model in the affordable housing sector is yet to be proven and will certainly require a pilot to demonstrate its viability. Alignment between policy makers, gas industry, construction industry and the local governments will be crucial to develop this market.

Bottom line

The establishment of localised gas networks is an efficient and sustainable approach to adoption of LP gas in the residential market. To ensure sustainability on a wider scale, the involvement of key energy stakeholders such as regulators, state-owned energy enterprises and large oil companies is crucial to facilitate the rapid development of reticulated gas distribution networks in both the high-income and affordable-housing sectors. Property developers with a broader entrepreneurial mindset will continue to drive the development of this industry for high-income housing in the short term while affordable housing will require a concerted effort from all key stakeholders.
Commercial energy users are implementing gas-to-power solutions

Commercial municipal electricity customers are starting to generate their own power from natural gas. The technology that makes this possible is tri-generation, which is the simultaneous production of power, heat and cooling from one source of fuel input – natural gas in this case. The tri-generation system is unique in the sense that it not only generates electricity, but also uses exhaust gases of the process for cooling purposes. This allows for efficiencies of more than 80% compared to efficiencies ranging between 35 and 42% from conventional gas-to-power generators.

Africa’s largest mobile network operator was the first company to unveil its 2 MW tri-generation plant to power a new building that houses a data centre and a test switch centre at its head office campus in Johannesburg. The tri-generation plant is powered by natural gas, which is piped over 800 km from Sasol’s Mozambique gas fields to the urban gas network operated by Egoli Gas in Johannesburg, and then to the company’s office. There are three primary reasons that have led to the company embarking on this milestone: to mitigate the effects of rising electricity prices, to ensure security of energy supply and to reduce the organisation’s carbon footprint.

One of the big-four banks in South Africa generates 11.2 MW of electricity from natural gas supplied via the Egoli Gas network at its headquarters in Johannesburg. The power generated from gas is mostly used during business hours when demand for electricity peaks in the Central Business District. The system installed by the bank at its headquarters is, however, not tri-generation, but there are plans to convert it to tri-generation to achieve efficiencies and minimise running costs. The conventional gas-to-power system will, however, also become competitive to electricity with time as prices of electricity increase.

The company’s decision to introduce the gas-to-power system at its headquarters was largely driven by power supply disruptions experienced in the country between 2007 and 2008.

Gas-to-power solutions are becoming more competitive

Following the mobile network operator’s success, other commercial players are beginning to consider tri-generation as a viable means of alternative energy supply. As these commercial entities strive to achieve efficiencies through cost optimisation to increase shareholder value, more companies will adopt on-site gas-to-power generation systems such as tri-generation, as the price of electricity supplied by municipalities exceeds that of power produced through tri-generation or conventional means, as illustrated by the energy cost comparison diagram.

3. Natural gas: The Commercial Sector response

![Energy Cost Comparison Diagram](source: Deloitte Research)
The existing market potential is through the current urban natural gas network

The current gas network (1,200km) in the greater Johannesburg area covers major commercial and small-scale industrial sites. These users of energy have the opportunity to connect to the existing network and generate power on-site to either substitute or supplement their energy demands. It is envisaged that about 150 to 200 MW of electricity can be generated by gas-to-power switching through the existing urban gas network in the short term. This 200 MW threshold is mainly due to the availability of natural gas supply and the investment requirement to expand the existing network to the northern suburbs of Johannesburg.

Breaking the gas supply constraint is key to future growth

The infrastructural capacity constraints with respect to the existing pipeline network will be addressed by the market as the price of gas becomes more competitive than that of electricity. Current market trends show that commercial and small-scale industrial users of power can generate up to 12 MW of power from gas, and if the natural gas supply constraint can be broken through imports or other means, more commercial entities can do this on an intelligent grid. The net effect is a new “virtual utility” that will sell power to other users over the network, as illustrated below.
4. Issues of strategic importance in the gas sector

Gas supply
“The majority of current and future supplies of natural gas imports from Mozambique are committed to petrochemicals production”

“The supply of LP gas is limited by the lack of infrastructural investment by key industry players over the years, and this has led to inadequate storage capacity at local refineries”

Gas infrastructure
“Investment in import facilities is pivotal to unlocking the gas supply constraint and creating a sustainable gas industry throughout the country”

“The infrastructure created from the establishment of localised micro-gas utilities by property developers will alleviate the storage capacity inadequacies for LP gas”

Regulatory impact
“A policy enabler such as the use of Demand Side Management rebates can help to accelerate the development of the local gas industry within the residential and commercial spheres”

“Policing of regulated LP gas prices by the Department of Energy and other interventions by the government will ensure further adoption of LP gas usage by households”

Social dynamics
“The lack of knowledge associated with the benefits that can be derived from gas-to-power solutions still persists”

“Misleading public perceptions that gas is unsafe for household applications still exist, especially amongst low-income groups of the population”
5. Unfolding scenarios

The potential future scenarios for consideration in the South African gas industry are as follows:

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Pure Market Scenario</th>
<th>Holistic Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No major involvement from gas suppliers, regulators or customers</td>
<td>• Break the gas supply constraint</td>
<td>The holistic scenario is similar to Scenario 2 with further intervention in the way of:</td>
</tr>
<tr>
<td>• An “as is” state continues to shape future activities in the local gas industry.</td>
<td>• LNG and LP gas supply significantly increased at the coast and in-land region</td>
<td>• Strong regulatory support</td>
</tr>
<tr>
<td></td>
<td>• Gas industry invests significantly in infrastructure</td>
<td>• Strong support from state-owned energy enterprises</td>
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| Outcomes                                                                                                                                               |                                                                                      |                                                                                                                                                                    |
| • The industry will generate an estimated 150 – 200 MW electricity through on-site gas-to-power generation over the next five years without any intervention from a major energy player. | • An aggressive approach by industry players will unlock a further 1,000 MW through gas-to-power solutions or through the use of gas as a direct source of heat. | • Through enabling policy, the entire gas market will respond quickly and achieve in excess of 3,000 MW in the longer term. |
| • Property developers in the high-income housing sector will continue to establish micro-gas utilities at new developments, albeit at a slower rate.    |                                                                                        |                                                                                                                                                                    |

**Bottom line**

Through government support and industry participation, an entirely new economically viable gas industry can be created, de-risking the country’s energy mix and creating new jobs and opportunities within the broader South African economy in the longer term.

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**Market adoption**

- High Regulatory support
- Gas supply constraint broken
- 2.5 GW
- 0.5 GW
- Commercial gas-to-power
- Residential gas reticulation

Source: Deloitte Research
Papi is deployed to the Strategy & Innovation Business within Deloitte Consulting and has experience in strategic business development in the Oil & Gas, mining and power sectors in South Africa. He has experience in working to develop significant new growth opportunities in these sectors. This includes playing a key leadership role in the commercialisation of a gas business for commercial and residential applications for an international oil company.

Papi Melamu  
Lead: Strategy & Innovation  
Tel: +27 11 806 5400  
Email: pmelamu@deloitte.co.za

Contact information

Anton Botes  
Director: Oil & Gas Leader for Deloitte Africa  
Deloitte Southern Africa  
Tel: +27 12 482 0020  
Email: abotes@deloitte.co.za

Eugene de Klerk  
Director: Oil & Gas Leader for Strategy and Innovation  
Deloitte Southern Africa  
Tel: +27 11 806 5400  
Email: edeklerk@deloitte.co.za

Shamal Sivasanker  
Director: Power Solutions Leader for Strategy and Innovation  
Deloitte Southern Africa  
Tel: +27 11 806 5400  
Email: ssivasanker@deloitte.co.za

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