A Brief Analysis Of The Envisaged Impact Of Gas On Coal

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ABSTRACT

Sasol is on the cusp of a project to develop natural gas reserves in Mozambique. The gas will be transported to South African markets via a 895 km transmission pipeline. By deferring the construction of a new mine at Sasolburg, and by supplementing some of its coal-based growth at Secunda with natural gas, Sasol can contribute to a base-load for the project. Third party customers will also be converted from synthetic gas to natural gas.

South Africa is still a predominantly coal-based economy and is expected to remain so even after the introduction of natural gas. In the paper the energy consumption profile of South Africa is investigated to establish the extent of the effect of natural gas.

INTRODUCTION

Many years after the first discovery of natural gas in Mozambique, this resource is about to be developed for the first time. The Government of Mozambique, ENH (Empresa Nacional Hidrocarbonetos, the national oil company) and Sasol have reached a series of historic agreements that will allow the first step towards the development of a significant natural gas industry in Southern Africa.

On 26 October 2000, Sasol Limited signed three major agreements with the government of Mozambique and ENH. In broad terms, the agreements provide for the joint development of the Pande and Temane gas fields, the further appraisal and exploration within the fields and the piping of the gas to customers in Mozambique and South Africa. These agreements are a pivotal step towards the development of a significant natural gas industry in Southern Africa.

By committing its plants and markets to taking natural gas, Sasol has enabled a project whose value is expected to exceed $1 billion. Upon fulfilment of certain conditions, construction can start on a pipeline to bring gas to South Africa. If all goes as planned, the first gas should reach Secunda by the first quarter of 2004, thereby inaugurating a new chapter in the energy history of Southern Africa.

HISTORY

Gas was discovered in Mozambique in 1962, when Gulf Oil found gas in the Pande Field. During the same time, Sasol had already started to develop a pipeline distribution network using the coal-based gas it manufactured in the Sasolburg plant. By 1970, the potential for Mozambican gas in Southern Africa was becoming apparent. In a prophetic precursor to the current project, the then managing director of Sasol's gas distribution company, Frans Coetzee, wrote to his colleagues: "I believe that natural gas can profitably be brought from Mozambique to South Africa".

However, years of regional conflict, civil war and political differences prevented the gas from being utilised for the benefit of Southern Africa. It is only now, thirty years later, with the prevailing political climate and focus on peace and development in Mozambique, that the linking of the two countries by natural gas pipeline is imminent.

FIELD DEVELOPMENT

Sasol Petroleum International has drilled five wells in the Temane area, proving this reservoir to be a substantial addition to Mozambique's overall gas resources. The Temane reservoir has a significantly higher pressure than Pande and will therefore be focused on first. Gas will be gathered from 18 wells in the Temane field and later on, from a further 15 wells in the Pande field, giving a total of 33 gas production wells, phased in over the life of the combined fields. From there, the gas will be cleaned and compressed in a central processing facility before being delivered to the inlet flange of the transmission pipeline for transportation to downstream customers.

MOZAMBIQUE TO SOUTH AFRICA PIPELINE

A study has established the feasibility of a new transmission line for the supply of natural gas from the Temane and Pande gas fields in Mozambique to South African markets. The recommended option consists of a new 895 km 26" high-pressure steel transmission pipeline, without initial intermediate compression. The pipeline will be able to transport 120MGJ/a, increasing to 240MGJ/a with midpoint and quarterpoint compression.

For safety and maintenance purposes, the pipeline will be buried about one metre below the surface. While some environmental impact is unavoidable, care will be taken to minimise the impact of construction operations. Sasol has also undertaken to rehabilitate the pipeline corridor after construction, so that there will be few visible surface signs that the soil has been disturbed. The pressure in the pipeline will be at about 125 bar at the inlet of the pipeline.

The Mozambican route portion (approximately 551km long) runs within a corridor starting at the gathering point of the Temane Gas Fields near Vilanculos. The corridor crosses the Limpopo River within a few kilometres of the Maccaretane barrage near the towns of Maccaratane and Chokwe, crosses the Incomati river and continues to the border near the town of Ressano Garcia. The South African portion (approximately 344km long) continues from the border town of Komatipoort, via Kaapmuiden, Badplaas and Bethal, to the Secunda petrochemical complex, where it will link up to the existing Sasol Gas distribution network.

The construction of the pipeline both in Mozambique and South Africa will be carried out by an EPC contractor. It is envisaged that the contractor will be appointed during the second half of 2001.

SOUTH AFRICAN ENERGY MARKET

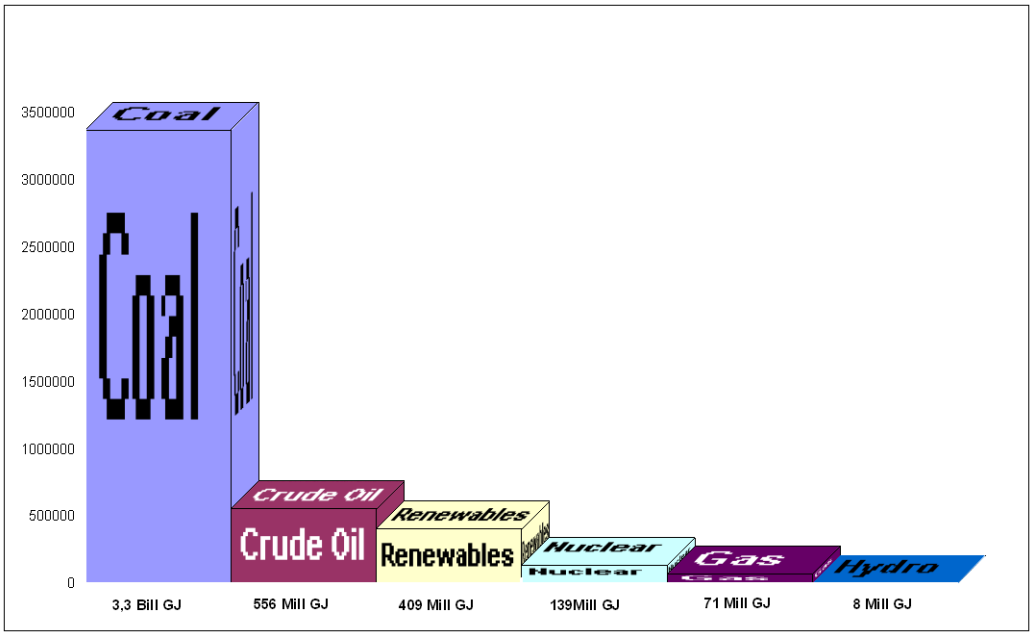
South Africa is one of the few coal-based economies in the world. The extensive use of coal is due to its wide-scale availability and low cost. Coal resources are widely dispersed and there are enough independent coal producers to ensure healthy coal-on-coal competition with coal prices at the level of marginal cost. Scarcity and limited competition in some countries allow coal prices to rise to near the level of competing fuels. This is not the case in South Africa and is thus a crucial point when considering the future price and supply of natural gas, as coal will be the main competing fuel.

Annual coal consumption in South Africa is estimated at some 220 million tonnes, of which about 70 million tonnes is exported, 96 million tonnes is consumed by Eskom for power generation, and 47 million tonnes is used by Sasol as petrochemical feedstock. The balance is used for general industrial and domestic usage.

According to industry analysts, South Africa's coal reserves, most located in Mpumalanga and in northern KwaZulu-Natal, have been estimated to be between 60 billion and 100 billion tonnes, enough to maintain current levels of domestic use and exports through much of the twenty-first century. The coal occurs in seams which are often less than one hundred meters below the surface, and hence it is relatively easy and inexpensive to mine. This abundance, coupled with low cost, make it difficult to replace coal with gas on a financial basis alone.

Figure 1 indicates the overwhelming presence of coal on the South African energy scene. Of the total consumption of some 4,4 billion GJ/a, coal constitutes some 77%. It is this heavy reliance on coal rather than the environmental benefits that may be the major driver of gas as a stakeholder in South Africa's energy economy. This is one of the reasons why Government has committed itself to the development of a South African gas industry in terms of a Gas Bill that is expected to be tabled in Parliament in the April 2001 session. The dominance of coal is indicative both of the extremely heavy reliance by the South African economy on a single source of energy, as well as the fact that any new source of energy will have to compete with this type of fuel. This competition can take the form either of competing for new growth in the market, or of dislodging already established business. When taking conversion cost into account, the latter option is of relatively low interest, except where a supplier can offer sufficiently long-term security of supply so that the benefits of natural gas, such as environmental and utility of use, become major considerations.

Figure 1 – Makeup of South African Energy Market



Another consequence of the large, low-priced coal resource is an abundance of relatively low cost, power generation plants. The average price of electricity to industrial users in the Gauteng area is about R27/GJ. South Africa has surplus power generation capacity at this stage. It is forecast that the current installed capacity will be sufficient to meet electricity demand up to the year 2005-2010.

While South Africa's coal resources are abundant, there are virtually no oil and very limited gas resources. Natural gas is one of the most under-utilised energy carriers in Southern Africa. Compared to the international average of 20% of energy usage, South Africa only uses a measly

2%. While this can be attributed to abundant reserves, long term technological and environmental trends indicate a trend toward the convenience of clean-burning fuels. Building a pipeline will stimulate exploration of the potential gas reserves in Mozambique, which may result in more natural gas being available for gas market development.

Further afield, indications are that gas can be found in commercial quantities off the West Coast of South Africa and Namibia. Should markets be found to support the development of these gas fields together with the associated transportation infrastructure, these gas fields may be developed within the medium term future.

In other economies, the introduction of natural gas has typically generated significantly more demand than originally anticipated on a pure cost per Gigajoule comparison. Environmental pressures, as well as the technological advantages obtainable through using natural gas, have contributed to the "dash for gas" phenomenon seen in the United Kingdom. Being a developing country, South Africa is less subject to the strictures of the Kyoto Protocol than the developed nations of North America and Europe. However, it would be short-sighted to continue with unmitigated emissions at the expense of the environment. It is therefore foreseen that in addition to the move to gas for environmental reasons, major coal consumers in South Africa will increasingly pay attention to their emissions.

The implications of diversification of feedstock are the biggest advantage that natural gas has as a potential energy supplier.

GAS AND COAL

Natural gas is formed through the decomposition of organic material trapped below the earth's surface. Contrary to other fossil fuels such as coal and oil, natural gas burns cleanly and produces mostly water vapour and carbon dioxide as by-products. The gas is made up of simple hydrocarbons such as methane, ethane, propane and butane. The advantage of natural gas comes from the burning properties of the main constituent, namely methane, which is a colourless, odourless gas that combusts easily with a pale, slightly luminous flame. It is a clean, convenient, cost-effective and efficient fuel used in the manufacturing of many different products, including steel, non-ferrous metal, building bricks, sheet and moulded glass, foundry products, fibreglass, chemicals, food products and paint. Applications of pipeline gas include heat treatment, forging, melting and casting, paint drying, galvanising, baking and steam generation.

A further advantage, especially with regard to the Mozambican gas, is that it is a sweet gas with low levels of impurities such as hydrogen sulphide. This means further environmental benefits.

Unlike other coal, and for that matter oil, gas by its very nature is not easily handled. In the absence of a well-developed pipeline network linking a number of gas producers with gas consumers, such as is the case in South Africa, gas is not easily transported or traded. These factors inhibit the development of a gas market, and in South Africa have contributed to restraining natural gas as a competitive fuel.

There are a number of ways of transporting gas, including the liquefaction of natural gas into LNG, which allows it to be transported safely by ship and by road. Other alternatives include compressing the gas into a smaller volume. This option is, however, limited by the wall thickness and hence weight of pressurised containers. The most common way of transporting natural gas is the one proposed by Sasol, namely a transmission pipeline. A pipeline, however, has a number of characteristics that make it very different from other transportation modes. It is capital intensive, requiring a substantial investment upfront. This investment buys years of reliable transportation, provided the pipeline is adequately maintained. A pipeline is also captive to a market, and cannot be easily adapted to other destinations. This last characteristic determines that gas purchase and transportation contracts are often concluded on a take-or-pay and ship-or-

pay. It also dictates that a significant amount of security has to be developed to ensure that sufficient gas reserves will be available to repay loans and reward equity investors in the transmission pipeline and the gas field. A corollary to this is that the market also needs to be able to demonstrate a similar degree of certainty of off-take, as lenders and investors require reassurance that adequate cash flow will be forthcoming.

The heat value of gas is commonly measured in Gigajoules, which is abbreviated as GJ. Burning forty kilograms of coal will release the same amount of heat as is contained in one Gigajoule of natural gas. The proposed project will therefore deliver the heat equivalent of some 5 million tonnes of coal every year, equivalent to the output of a large coal mine. Should the pipeline be brought up to its full capacity, this output will double to some 10 million tonnes of coal-equivalent per annum. However, when viewed against the backdrop of the huge resources of coal still available in South Africa, even this increased volume hardly threatens to supplant coal as the dominant energy carrier. At full capacity, the pipeline will carry the coal-equivalent of five percent of annual coal consumption, and only two and a half percent at the outset.

BASE LOAD

The pipeline gas market in South Africa compared to international norms is still in its infancy. Substantial growth, both targeted and associated, is expected with the introduction of natural gas. Sasol, as a major consumer and supplier of energy in Southern Africa, has evaluated the viability of bringing natural gas from Mozambique to South Africa. This evaluation has clearly indicated that the success of such a gas venture is entirely dependent on a large, instantaneous base load which is necessary to justify the substantial investment required for field development and construction of a long transmission pipeline. Feasibility studies show that an anchor market of 120 MGJ/a at a competitive delivered price at Secunda is necessary to support investment in such a project. This anchor market must be aggregated from a variety of consumers.

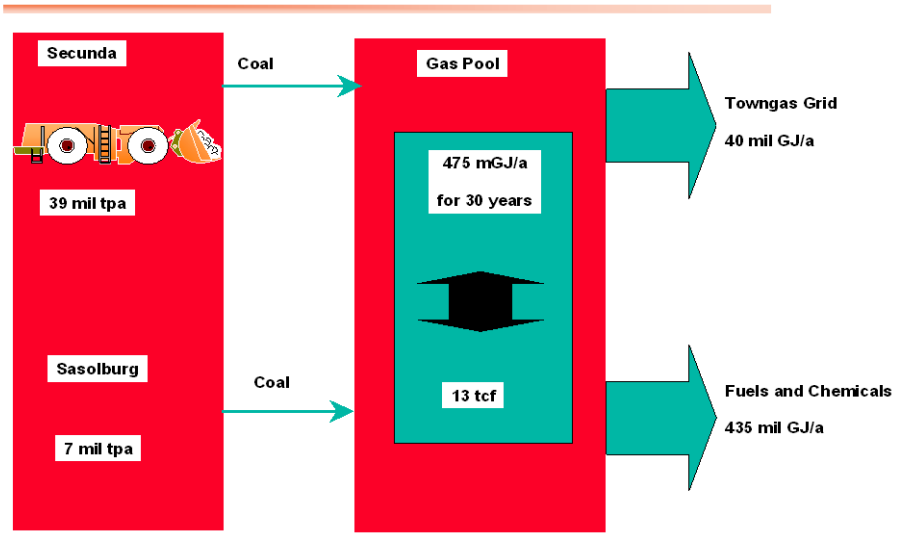
With the underground operations of the Sigma colliery at the Sasolburg Petrochemical complex nearing the end of its economic life, a window of opportunity arose to grow the base-load required for a viable project. Through the conversion of the SCI petrochemical complex in Sasolburg to take gas, the cost of a mine will be saved and environmental benefits realised. As part of its desire to bring natural gas from Mozambique to markets in South Africa, Sasol is willing to convert a part of its coal-based market to natural gas. Furthermore, some of the growth at Sasol Synthetic Fuels in Secunda that would have been coal-based, can now be supported by natural gas. Sasol can achieve this by delaying investments in proposed new coalmines and instead using gas as feedstock.

Sasol will commit to an instantaneous 80 MGJ/a offtake of natural gas from Mozambique. Sasol can achieve further volume growth to 120 MGJ/a over four years by investments in market expansion ventures. Some of this volume growth will be in the high value market segment, where natural gas will offer distinct advantages to entice users to convert. However, in order to build the necessary volume, it is also necessary to consider the low value market where natural gas will compete directly with the cheaper forms of energy such as coal. It is intended to restrict the volume of this market to the minimum.

Sasol is one of a few companies, if not the only one, in this region that can provide the instantaneous base load necessary for this venture.

The current pipeline gas market which Sasol has developed over the past 30 years can also be converted from synthetic gas to natural gas to assist in establishing a natural gas base load. As can be seen from the accompanying illustration, Sasol has substantial expertise in managing the production, beneficiation and marketing of hydrocarbons. Its current coal consumption is equivalent to managing a gas reserve of 13 trillion cubic feet (TCF).

Figure 2 – Sasol manages a 13 TCF equivalent energy pool



As a synthetic fuel and petrochemical producer, Sasol is virtually entirely dependent on an efficient coal-mining operation. The mining activities currently focus on six areas; Wonderwater strip mine in Sasolburg, Bosjesspruit, Brandspruit, Middelbult, Twistdraai, and Syferfontein in Secunda - Mpumalanga province. At present, it produces and consumes some 475MGJ/a of coal-equivalent energy. It is apparent that even with the pipeline at its full capacity of 240MGJ/a, coal cannot be dislodged from its position as Sasol's predominant feedstock source.

A VISION FOR NATURAL GAS

The proposed pipeline from Mozambique to South Africa to provide gas for the South African market is the first step to the development of a natural gas industry that would span borders and deliver clean and cost-effective energy to the entire sub-region. As regional trade and interdependence increase, a stable environment will be created in which economic growth can be fostered.

The Mozambique to South Africa Gas Project will supply gas to markets in Maputo, Mpumalanga and areas currently served by the Sasol gas distribution network. This could be an important stimulus for industrial developments in Mozambique, including securing a stable source of supply for the Maputo Iron and Steel Project through generating sufficient economies of scale.

This vision holds substantial promise for the future of natural gas in Southern Africa. With sufficient reserves to initiate natural gas development in Mozambique, the appropriate regulatory and fiscal framework, and a strong partnership between the Government of Mozambique and Sasol this vision will become a reality. Further afield, the development of the Kudu Field offshore off Namibia as well as other West Coast sources may result in gas being piped to Cape Town, while coal-bed methane from the Waterberg may yet become another feedstock into a Southern African gas transmission grid.

THE FUTURE

It would indeed be short-sighted to believe that coal will forever be the dominant energy carrier. However, the abundance of coal, together with the diversity of products produced from it, will secure its future in South Africa as a dominant energy carrier for many years ahead. Natural gas will be a strategic complement to the suite of energy carriers available to consumers and will enable South Africa to stay abreast of technological developments. Over the longer term, and as environmental pressures mount, natural gas may be expected to mount a sterner challenge to coal, provided that the necessary reserves can be found to support the demand. By reducing its dependence on coal, South Africa will ensure the security of supply and mutual existence of coal and gas well into the 21st century.

Author's Curriculum Vitae

André de Ruyter has been working on the Mozambique to South Africa Natural Gas Project since 1998. Prior to that, he worked for Sasol in establishing Sasol's coal exports from its Twistdraai Colliery. He holds an LLB from Unisa and an MBA from Nijenrode University, as well as a BA and a BLC from the University of Pretoria.