

The gas equation



*An analysis of the
potential of the natural
gas industry in South
Africa*

June 2012



pwc

Contents

<i>Foreword</i>	2
<i>Acknowledgements</i>	3
<i>Abbreviations</i>	4
<i>Introduction</i>	5
<i>Research approach</i>	5
<i>Analytical framework</i>	6
<i>Summary of findings</i>	7
<i>Market analysis</i>	9
<i>Natural gas supply and the bargaining power of suppliers</i>	9
<i>Natural gas demand and the bargaining power of buyers</i>	15
<i>Threats of new entrants and barriers</i>	21
<i>Pressure from substitute products</i>	26
<i>Rivalry</i>	29
<i>Conclusions</i>	31
<i>References</i>	32
<i>PwC's energy industry expertise</i>	34
<i>Contacts</i>	35



Foreword

While debate about hydraulic fracturing for shale gas in the Karoo continues to grab the media spotlight, the broader discourse about the role of gas in South Africa's energy mix needs to continue. With this in mind, this analysis investigates the current state of the natural gas industry in South Africa and evaluates the potential for its future development.

In carrying out the research, we aimed to determine whether:

- There is significant interest in exploring for and/or developing a local natural gas industry in South Africa;
- It will be profitable for energy companies to engage in exploration and production (E&P) activities;
- It will be profitable for energy companies to engage in gas import and distribution activities;
- There will be wider environmental benefits for the country if that increased gas use displace some elements of coal-fired energy generation;
- The South African economy will benefit from gas developments through increased energy security; and
- Increased availability of natural gas will enable South Africa to maintain its leading position in the gas-to-liquids sector.

Research approach

The project research began with an appraisal of the global natural gas industry by means of a review of analyst reports, research papers and media reports. This was followed up with an assessment of the legal, regulatory and energy planning landscape in South Africa. This research provided a contextual understanding of the industry, which was brought to bear in interviews held with selected participants in the local natural gas industry.

Limitations

Statistics and estimates used in this report have been obtained from industry analyst reports and other information available in the public domain and have not been independently verified.

Conclusion

We believe that South Africa stands at the dawn of a new energy era, driven by domestic, regional and global developments. These developments have the significant potential to transform the local energy landscape and regional economy.

I trust you will find this report to be informative and look forward to receiving any feedback you may wish to share.

A handwritten signature in black ink, appearing to read "Chris Bredenhann".

Chris Bredenhann
Southern Africa Energy Leader
Cape Town

June 2012

Acknowledgements

PwC would like to express its gratitude to executives from a number of organisations who shared their views and insights during the development of this research report:

- Dynamic Energy – An independent consulting firm specialising in the energy sector with a specific focus on natural gas;
- Forest Exploration International (South Africa) – An international independent exploration and production company and operator of the Ibhubesi gas field;
- Gigajoule South Africa – A South African energy company focussed on establishing natural gas operations in South Africa in addition to natural gas operations in Mozambique;
- i-Gas – A state-owned enterprise focussed on promoting the development of the piped gas industry in South Africa. i-Gas is a co-owner of the natural gas pipeline supplying natural gas from Mozambique to Sasol;
- The National Energy Regulator of South Africa (NERSA) – The gas regulator in terms of the Gas Act, NERSA is responsible for licensing gas transmission, distribution and trading activities and facilities;
- Sasol Gas – A subsidiary of Sasol Limited, a multinational petrochemical company based in South Africa, and co-owner and operator of gas fields in Mozambique, a natural gas pipeline from Mozambique to South Africa, and synfuel and GTL plants;
- Shell South Africa – A subsidiary of Royal Dutch Shell plc, a major international oil company with plans to explore for natural gas onshore and offshore in South Africa;
- The Petroleum Agency of South Africa (Pasa) – The regulating authority responsible for promoting, regulating and licensing upstream exploration and production activities in South Africa; and
- The Petroleum Oil and Gas Exploration Company of South Africa (PetroSA) – The national oil company of South Africa and operator of a 36 000 bpd GTL plant in Mossel Bay.



Abbreviations

Bbl	Barrels
Bcm	Billion cubic metres
CCGT	Combined cycle gas turbine
CCS	Carbon capture and storage
CSP	Concentrated solar power
CNG	Compressed natural gas
DoE	Department of Energy
E & P	Exploration and production
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
FSRU	Floating storage and regasification unit
GDP	Gross domestic product
GJ	Gigajoule
GHG	Greenhouse gas
GTL	Gas to liquids
IEA	International Energy Agency
IPP	Independent power producer
IRP2	Integrated Resource Plan second iteration
JOA	Joint operating agreement
LNG	Liquid natural gas
MMscf	Million standard cubic feet
MMBtu	Million British thermal units
Mmbbl	Million barrels
NERSA	National Energy Regulator of South Africa
NG	Natural gas
NGV	Natural gas vehicle
OCGT	Open cycle gas turbine
Pasa	Petroleum Agency of South Africa
PESTEL	Political, economic, social, technological, environment and legal
PPA	Power purchase agreement
PV	Photovoltaic
Rompco	Republic of Mozambique Pipeline Investment Company
SANAS	South African National Accreditation System
scf	Standard cubic feet
SWOT	Strengths, weaknesses, opportunities, threats
tcf	Trillion cubic feet
tcm	Trillion cubic metres
TCP	Technical cooperation permit
WEC	World Energy Council
WTI	West Texas Intermediate

Introduction

Natural gas currently makes up only 3% of the total primary energy mix in South Africa, but this is expected to grow to around 10% over the next decade.¹ This low contribution and expected growth rate, together with recent local and international developments in the natural gas market provided the motivation for this study.

The aforementioned developments include the potential for domestic and regional gas supplies, recent large shale gas developments globally, environmental demands and the need to reduce CO₂ emissions.

As South Africa continues to face an energy crisis, the potential of natural gas to play a role in addressing the energy needs of the country warrants investigation. The International Energy Agency (IEA) points out that proven global natural gas reserves continue to increase and have doubled since 1980.²

Research approach

The analysis contained in this study is based on a study of the global natural gas industry, including a review of analyst reports, research papers and media articles. This, together with an investigation of legal, regulatory and energy planning issues in South Africa provided an understanding of the industry, which was used to inform interviews with selected participants in the local natural gas industry, including regulators, national and multinational gas companies.



1 Peters, 2010

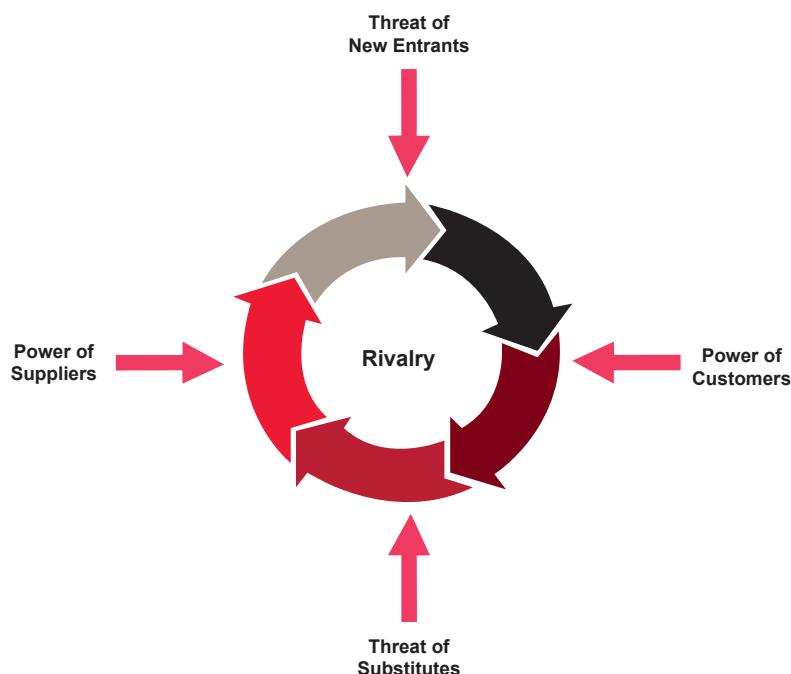
2 World Energy Outlook 2009

Analytical framework

This study uses the Porter's five forces model as a framework to understand the gas industry in South Africa. Consideration has also been given to the wider economic, political and regulatory environment to enhance the analysis of the dynamics and drivers of the industry.

Examining an industry using Porter's five forces framework is a widely used approach that helps to illustrate the dynamics at work and gives insight into the attractiveness of an industry. It has been argued that, when taken together, the five forces determine long-term profitability and competition within an industry.³

Figure 1: Porter's five competitive forces



Source: Adapted from Porter, 1998

The combined effect of the five forces determines how dynamic, competitive and stable an industry is. This usually provides useful information to aid companies in developing their strategies.

In the South African context, the natural gas industry is still at a very early stage of development with limited competition. All industry participants are therefore impacted similarly by changes in the industry, and a five forces analysis on the industry as a whole is therefore deemed to be appropriate to develop an industry analysis.

An industry can be defined in terms of the relationship between the value of the product being offered, the intensity of competition and the bargaining power that producers have relative to their suppliers.⁴

3 Arons and Waalewijn, 1999; Aktouf, 2004; Speed, 1989; Narayanan and Fahey, 2005

4 Grant, 2009

Summary of findings

This analysis finds that there is significant interest in exploring for and/or developing a natural gas industry in South Africa. This finding is based on the extent of actual and proposed on- and offshore exploration activity, the number of licence applications being submitted to the gas regulator, and the specific energy needs of South Africa.

A Porter's five-forces analysis highlights the dynamics at play with respect to each competitive force and their relative impact on the development of the industry. The results are summarised in Figure 2 below:

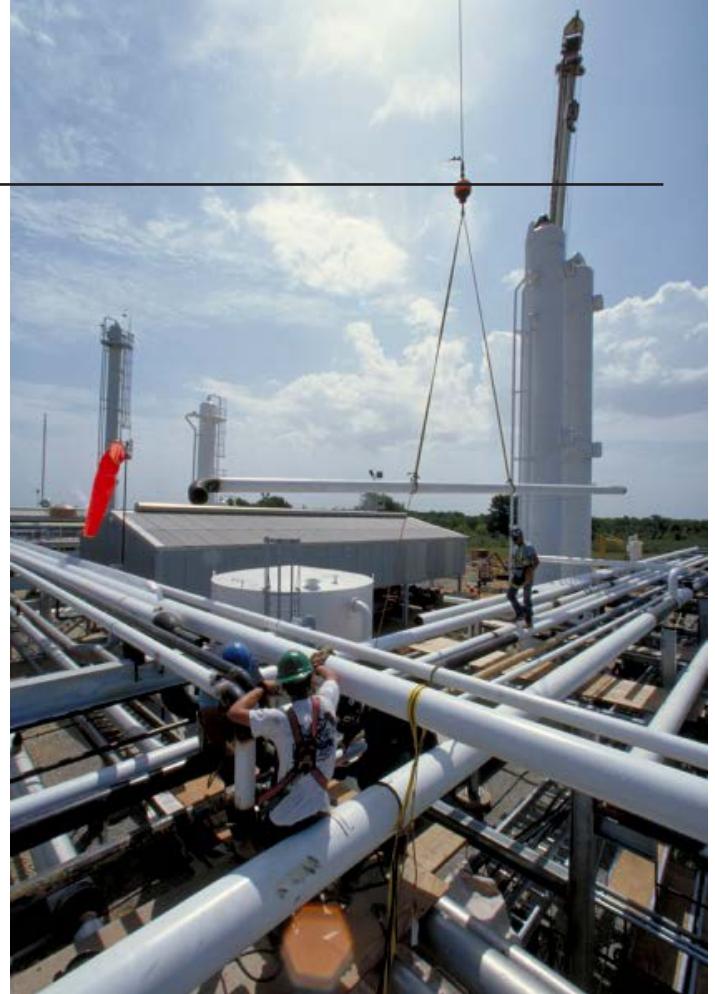


Figure 2: Competitive forces in the South African natural gas industry



* + or - indicates a factor that increases or decreases the attractiveness of the industry.

The overall conclusion of the analysis is that the local natural gas industry is relatively unattractive for new market entrants, with existing players having entrenched their position.

However, the research also highlights the fact that the global natural gas market is developing at a fast pace as demand for cleaner hydrocarbon fuels increases. Proven and probable global natural gas reserves are believed to have the potential to provide for the energy needs of the world for the next 250 years.

While South Africa does not have significant proven reserves, the potential for significant indigenous natural gas reserves being found remains a possibility. Significant proven indigenous gas reserves would have a disruptive effect on the industry, potentially upsetting the strong position of the current players, and open up the industry to more competition.

The drive for renewable energy in South Africa and the need to reduce greenhouse gas (GHG) emissions work together to establish demand for natural gas. Furthermore, South Africa's leading position in the GTL market underscores the importance of natural gas to South Africa.

But the industry faces a dilemma. In order to develop, large anchor customers using significant gas volumes are required. Indigenous reserves must still be proven and this can only be achieved with significant capital outlay. Exploration and production (E&P) companies are, however, unwilling to commit to this without demand commitments, and the potential anchor customers that could create this demand are unwilling to commit until reserves are proven.

There are significant barriers to entry, including a lack of infrastructure, high capital costs, significant environmental concerns relating to shale gas exploration and the lack of a credible and constructive industry development programme supported by the Government. With the will and commitment from all industry players, these barriers can no doubt be overcome.

The introduction of more natural gas into the energy mix in South Africa could lead to a reduction in GHG emissions. Natural gas has also been proven to cost less than nuclear energy as well as all types of renewable energy technology currently available.

The dominance of coal in the South African energy mix and relative low cost of coal will, however, prevent natural gas from taking a larger share of the total energy mix.

Market analysis

This market analysis follows the structure of Porter's five-forces model. The analysis of the forces also considers the legal and regulatory aspects at play, and where applicable, commentary is also included on the political landscape.

Natural gas supply and the bargaining power of suppliers

In a typical five forces model a supplier's power is understood to potentially have significant influence on the industry, as suppliers can influence price increases, product quality and availability. Porter (1998) suggests that suppliers' bargaining power can also be influenced by:

- The number of suppliers in the market;
- The availability of substitutes;
- The importance of the supplier's product to the market or industry; and
- The forward integration potential available to the supplier group.

Supply-side market analysis

For a natural gas market to develop in South Africa, certainty of supply is required. Investors will not be willing to commit to capital projects, while industrial, commercial and domestic customers will not be willing to convert to gas-fired infrastructure unless they have security of supply.

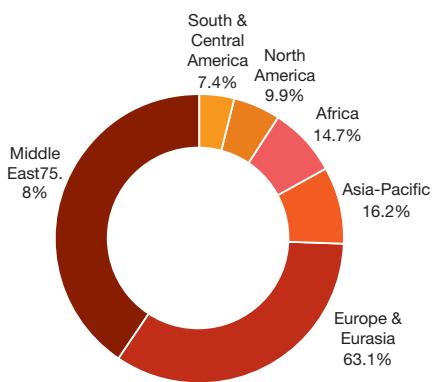
The South African energy landscape is dominated by coal and South Africa does not have any significant proven reserves of indigenous natural gas. According to Business Monitor International, South Africa had proven natural gas reserves of 0,7tcf (20bcm) in 2011.⁵ These reserves are relatively insignificant in the global context, when compared to proven global natural gas reserves of 6 621,2tcf (187,49tcm).⁶



5 BMI, 2012

6 BP, 2011

Figure 3: Proved reserves at end 2010 (tcm)



Source: BP Statistical Review of World Energy, 2011.

The global proven conventional natural gas reserves are equivalent to more than 120 years of current global consumption.⁷ These proven reserves exclude the large potential reserves that may be discovered and developed from unconventional sources such as shale gas. The IEA is of the view that unconventional gas may be the key to expanding the long-term role of gas in the global energy mix.

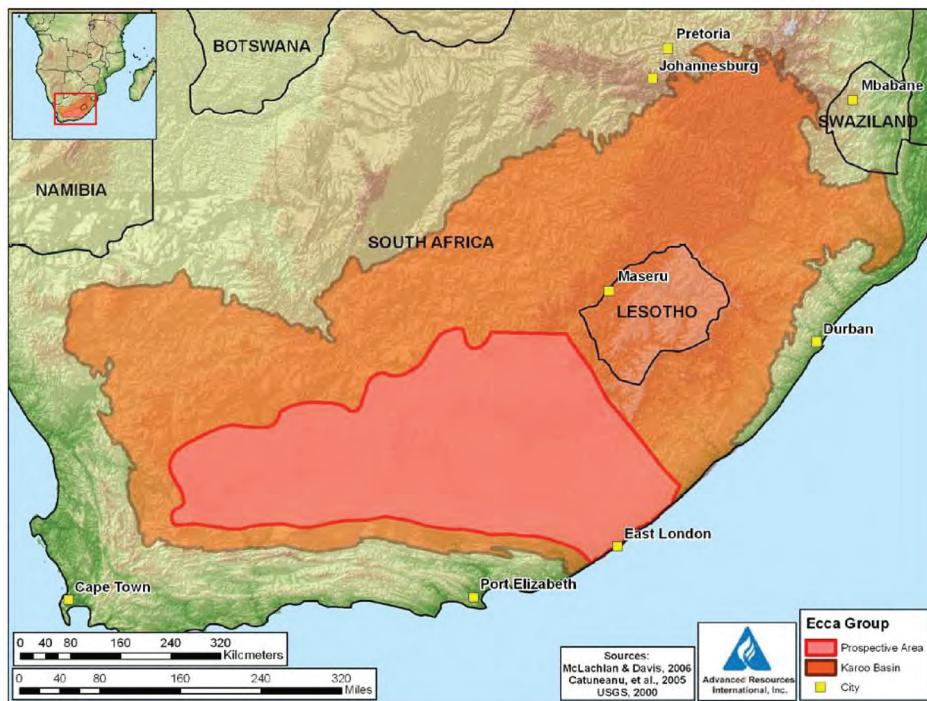
The World Economic Forum's Energy Vision Update 2011 estimates that with the inclusion of unconventional gas, the world's recoverable natural gas reserves are equivalent to more than 250 years of production at current rates.⁸

The bargaining power of suppliers in the South African context is severely constrained by the lack of proven indigenous reserves. This leads to a stalemate, where E&P companies are not willing to invest more in exploration activities to prove reserves, and where potential buyers are not willing to invest in the required infrastructure (pipelines, conversion to gas-fired energy devices, power stations, etc.) before more reserves are proven. A shift towards a stronger bargaining position for suppliers requires significant reserves to be proven, or certainty that imported gas can be supplied on a reliable basis.

Onshore indigenous reserves

There is significant, albeit unproven, potential for indigenous natural gas reserves, mostly in the form of shale gas in the onshore Karoo Basin. A study by the US Energy Information Agency (EIA) on world shale resources outside of the United States concludes that there may be as much as 1,834 tcf risked gas in place and 485 tcf recoverable reserves of shale gas in the Karoo Basin.⁹

Figure 4: Potential shale reserves



Source: EIA

These volume estimates place South Africa in fifth position in terms of shale gas reserves outside of the United States.

The basis for this estimate is a desk-top study of the geological formations and drawing conclusions on the potential reserves based on the geology and experience with the exploration of shale gas in the United States.

7 IEA, 2011

8 WEF, 2011

9 EIA, 2011

Opponents of shale gas development in South Africa have expressed doubts about the extent of the recoverable reserves. The Petroleum Agency of South Africa (Pasa) was unable to confirm the EIA reserve estimate, preferring rather to refer to the shale gas play as a multi-tcf opportunity. The true extent of the reserves can only be proven through further technical studies and the drilling of wells to prove that there is gas in place and that it can be viably extracted.

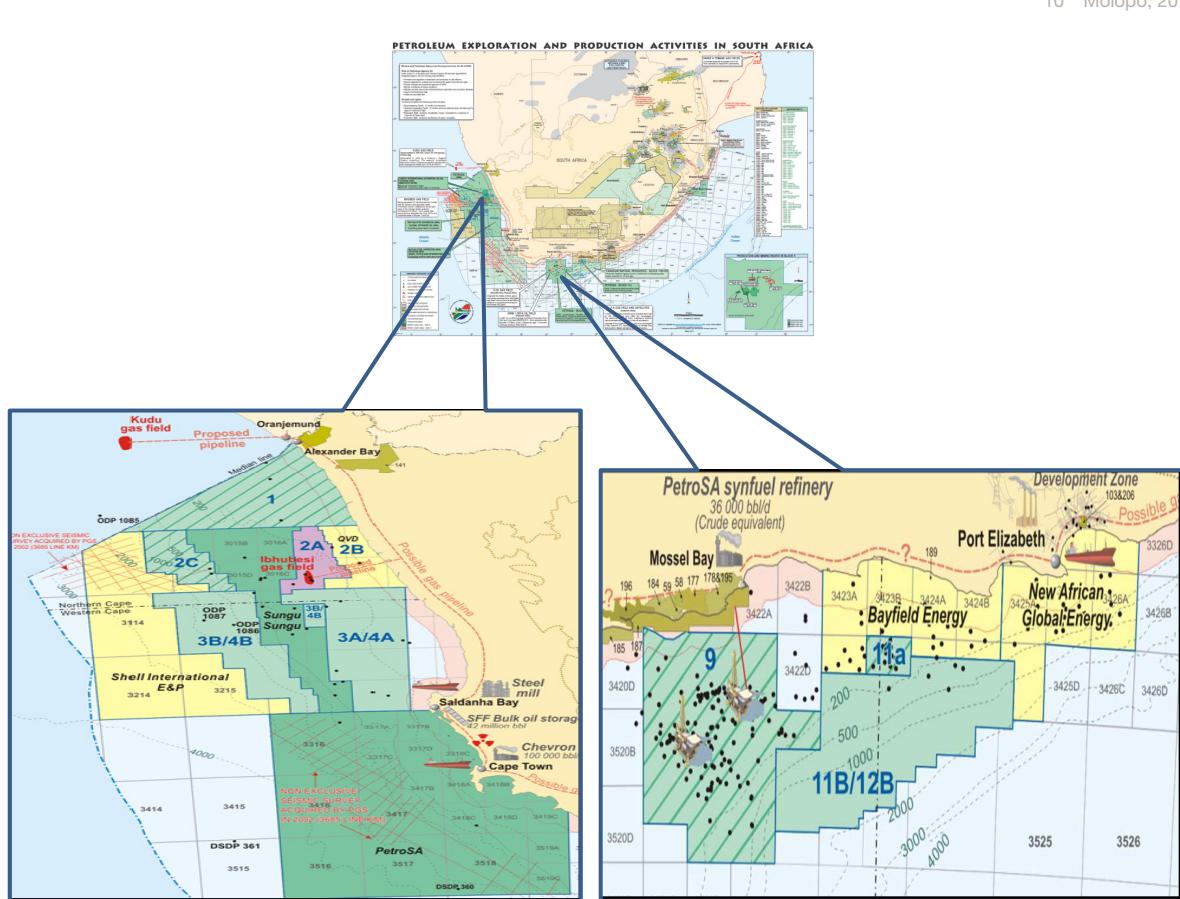
While the recoverable reserves estimate of 485tcf can be disputed, the fact remains that this more than likely represents the single biggest potential natural gas reserve in South Africa. To put this into perspective, the PetroSA MossGas GTL plant was developed on the basis of proven reserves of 1tcf. In this context, even with conservative reserve estimates, shale gas could transform the South African energy industry.

Offshore indigenous reserves

Figure 5 provides an overview of offshore exploration activity under way, with exploration activity taking place in Block 2A (Forest Exploration International), Block 3 (BHP Billiton), Block 9 (PetroSA), Block 11 (Canadian Natural Resources) and Block 11A (PetroSA).

Figure 5: Petroleum exploration and production activities

Highland Exploration and Production, a subsidiary of Australia's Molopo Energy Limited has been awarded a production right for their Virginia Gas Field, where methane resulting from gold exploration activities is produced. An application for a distribution licence has been submitted to NERSA and an agreement has been reached with NOVO Energy for the initial sale of 600 000scf/d of gas as compressed natural gas (CNG).¹⁰



Source: Pasa, 2011

The Ibhubesi gas field is located in Block 2A. A production right has been granted on this block. Forest Exploration International (Forest) who owned 53,2%, and acted as operator recently sold their stake to African International Energy. PetroSA owns 24%, and Anschutz owns the remaining 22,8%.¹¹ Eight wells have been drilled in this block and, according to Pasa, it is a field with multi-tcf potential.

To date this gas has been stranded due to insufficient demand for gas and a lack of infrastructure. However, Forest has indicated that it plans to commercialise the gas through the construction of a pipeline from the field to the shore to enable the supply of gas to a 750MW CCGT power plant.

The field is capable of producing 225MMscf/day, which is equal to 30-40% of the energy used in the Western Cape. The field has not been fully developed and requires further exploration and development activity to prove the reserve estimate with more certainty. The field will be developed in four phases, and will consist of 99 wells, costing US\$3-4 billion.

PetroSA owns the only producing indigenous offshore gas field. This field is located in Block 9 in the Bredasdorp basin and provides feedstock for their GTL plant. This field is nearly depleted, resulting in the GTL plant being operated below capacity. Further field development in this block is being undertaken to secure feedstock for the GTL plant.

CBM developments in neighbouring Botswana may provide additional gas resources for South Africa. Estimates of 15tcf are mentioned for the CBM potential in Botswana. However, this play remains unproven and a significant amount of work must still be done before this can be proven and commercialised.

The Kudu gas field off the Namibian coast is significantly further developed. This field, owned by Namcor, Gazprom, Tullow and PetroSA, was discovered 30 years ago. The gas reserves, estimated to be in the region of 1,8tcf, have been stranded due to a lack of demand and infrastructure to commercialise the gas. The field is located 170km offshore and has the potential to supply gas for the generation of 800MW of power for 20 years.¹⁵

Imported natural gas supply

Foreign sources of natural gas are dealt with in two parts, being current imports of natural gas and potential imports in the form of liquid natural gas (LNG) or piped gas.

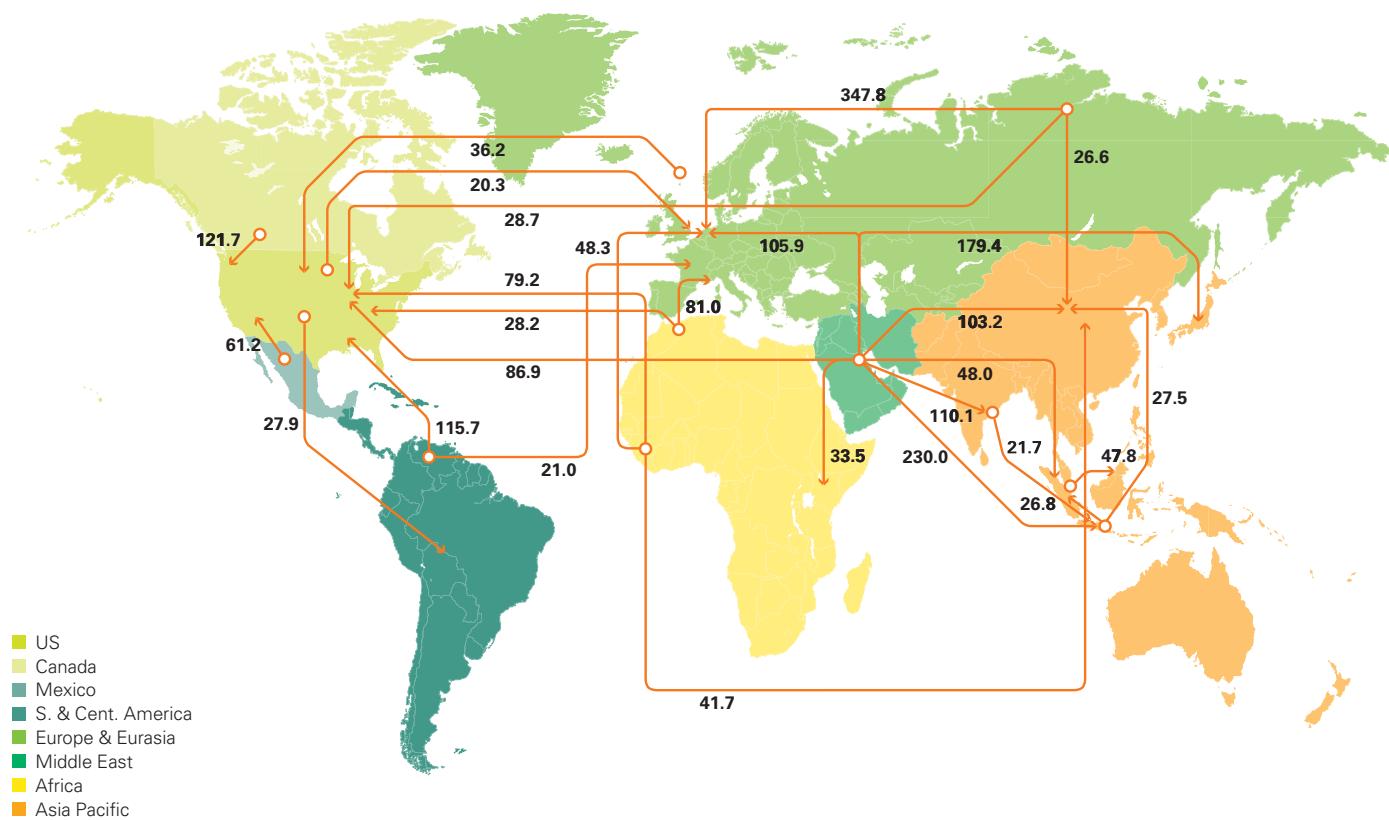
Currently natural gas is imported into South Africa by Sasol Gas via an 865-km pipeline from the Temane and Pande gas fields in Mozambique. Reserves are estimated around 2,6tcf.¹² The pipeline has a capacity of 240 million gigajoules (GJ) per annum. Sasol imported approximately 123 million GJ into South Africa during 2010.¹³ Approximately 120 million GJ is used annually by Sasol in the GTL and chemicals plant in Secunda, while the balance is distributed to commercial and industrial customers via a pipeline network covering more than 2 000km in the Free State, Gauteng, Mpumalanga and KwaZulu-Natal.¹⁴ In terms of the Gas Act (2001), Sasol is the primary gas supplier and distributor until 2014 for certain identified distribution areas.

11 Pasa, 2011
12 World Bank, 2008
13 Sasol, 2011
14 Sasol, 2011
15 XYX Today, 2010

Recent significant discoveries in Mozambique and Tanzania add to the potential sources of natural gas. South Africa should therefore investigate the potential for diversifying its energy mix to include natural gas. It is a policy decision to diversify the energy mix, and the Government has indicated that gas should play a larger role. This means that alternatives for gas supply should be investigated, which also brings LNG into consideration.

A global natural gas market has been enabled by the development of LNG technology and gas is a globally traded commodity. Figure 6 describes the major natural gas trade flows:

Figure 6: Major trade movements (Bcm)



Source: BP Statistical Review of World Energy 2010

Figure 6 clearly shows that South Africa is not on any traditional LNG trading route. The growth in the LNG market, coupled with the exponential shale gas growth in the United States, does, however, mean that capacity is available and that trade routings should not necessarily be a barrier.

The closest source of LNG to South Africa is the Gulf of Guinea, and there are LNG developments in Angola (Soyo) which could also provide another regional supply source. The extent of recent natural gas reserves proven in Mozambique creates prospects for even closer regional supply sources. South Africa is also much closer to Qatar, a major LNG supplier, than the countries in the North Atlantic.¹⁶ Furthermore, significant CBM developments in Australia may also provide a new supply source of LNG for South Africa. Various investigations into the viability of importing LNG to South Africa have been conducted. These include:

- Importing LNG as feedstock for the PetroSA GTL plant;
- Importing LNG at Saldanha on the West Coast for electricity generation and to supply natural gas to the industries in the Western Cape; and
- Importing LNG at Coega in the Eastern Cape for the Coega Industrial Development Zone and power generation.

According to the Electric Power Research Institute (EPRI), the current LNG market is a buyers' market with large volumes of excess supply since 2008 as a result of the global recession slowing down demand growth.¹⁷ The decline in conventional natural gas production in the United States led to the creation of significant LNG demand, which was met through LNG developments around the world.

With the unexpected shale gas developments in the United States, LNG demand disappeared virtually overnight, leaving excess supply capacity for which the LNG operators have to find a market. High oil prices have also resulted in expectations that gas prices will remain high and, as a result, developers have been willing to invest in LNG projects, further increasing supply.

There have also been expectations of significant LNG demand growth from India and China, which have not materialised. In the case of China, this is as a result of insufficient regasification capacity, and not actual demand. This near-term excess supply results in lower prices.

Increased LNG demand is also seen from Japan following the 2011 tsunami.

Oil and gas prices have traditionally been coupled, with gas trading at a constant differential to oil. In the period from 1996 to 2005, West Texas Intermediate (WTI) crude traded at a differential of around US\$1 per MMBtu against the Henry Hub gas price. During 2010, WTI crude traded at about US\$9 per MMBtu higher than the Henry Hub gas price.

European spot and contract gas prices have also been trading well below oil equivalent levels. It has been argued that diverging production costs are driving the price spread. Shale gas developments in the United States have led to a long-term cost curve for natural gas at US\$4-5 per MMBtu, while the cost of oil is constantly increasing as conventional oil reserves are depleted.¹⁸

The lower prices potentially support the case for importing LNG as an alternative energy source in the diversified energy mix for South Africa. Research conducted for this report confirms that there are a number of parties willing to invest in the infrastructure required to import LNG, and the demand analysis dealt with later in this report confirms the viability of this.

Conclusion

Future gas supply may potentially not be constrained, but at present sufficient supply may be a problem. This improves the bargaining power of suppliers, as buyers have fewer choices. The availability of substitutes, however, weakens the bargaining power of gas suppliers.

The demand for natural gas, dealt with in the next section, is also not of such a nature that it would place suppliers in a strong bargaining position. Forward integration in the industry is certainly a possibility and this will strengthen the bargaining power of suppliers.

The bargaining power of suppliers is increased when there are fewer suppliers and buyers' choices are limited. There are currently relatively few suppliers in the local natural gas market, with Sasol Gas currently dominating the market. This situation may change, however, given the number of domestic natural gas projects being considered or planned, and the potential for increased LNG imports.

17 EPRI, 2010
18 Abadie et al, 2011

Natural gas demand and the bargaining power of buyers

Under the right conditions, buyers can have significant power to drive down prices, demand higher quality products and play different suppliers off against each other. Factors that could increase the bargaining power of buyers include:

- When they buy significant volumes;
- When the product is a significant part of the buyer's costs or purchases;
- The products being bought are standard within the industry;
- Switching costs are low;
- Potential for backwards integration exists; and
- The buyer has full information about supply, demand and costs.¹⁹

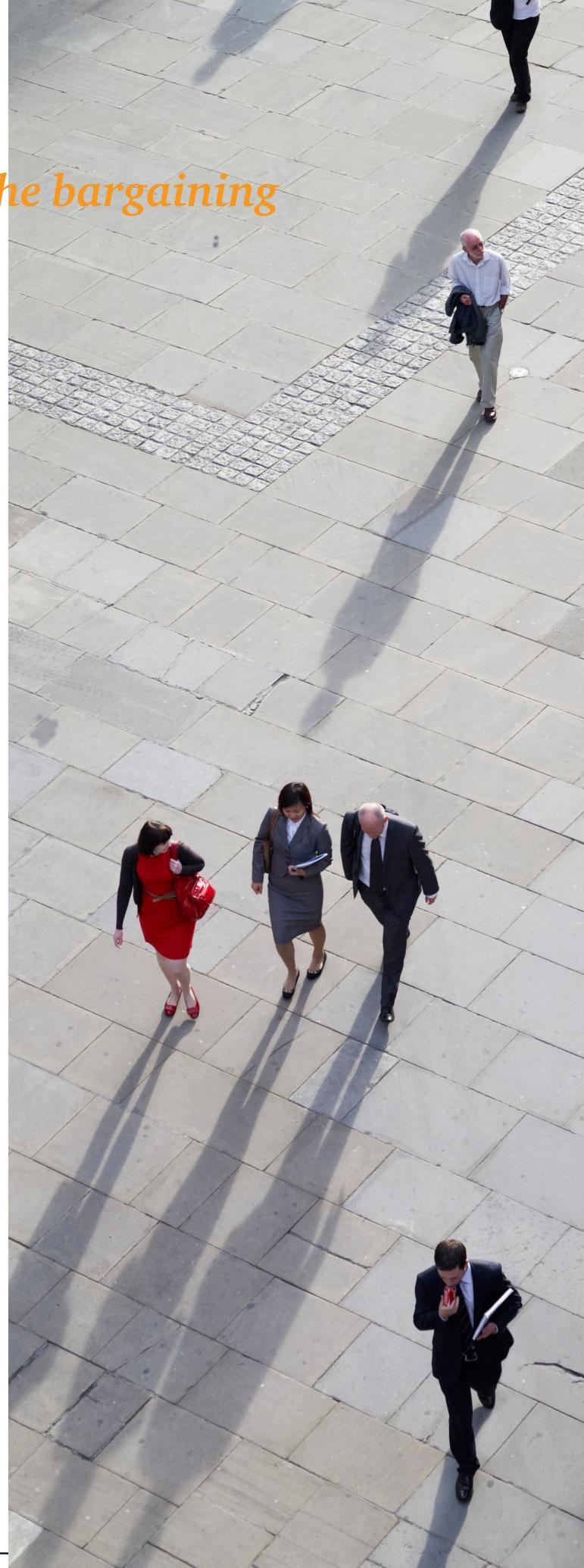
Demand-side market analysis

Natural gas accounts for a very small portion of the energy demand in South Africa (3% versus 21% globally).²⁰ The Government has, however, stated its objective to reduce emission levels and to increase the use of natural gas as a substitute for coal is seen as one way of achieving this.²¹

Drivers of gas demand

The IEA argues that the expansion of gas use is dependent on the interaction between economic and environmental factors and policy decisions.²³ This is particularly relevant to the South African situation, where it is clear that in the absence of a price for CO₂, coal will remain a cheaper option than natural gas for generating electricity. Other benefits of using natural gas are obviously ignored if the price factor is the only issue being considered. These benefits include energy diversification, flexibility and backup, as well as a reduction in GHG emissions.

Table 1 shows the IEA view on the principal drivers of natural gas demand by sector. It provides a useful framework that can be applied to the South African situation to establish a view on the potential demand for natural gas. The level of economic activity in South Africa and expected growth rates are factors that are expected to increase demand in the power generation, industry and transport sectors.



19 Porter, 1998

20 IEA, 2011

21 Peters, 2010

22 IEA, 2011

23 IEA, 2011

Table 1: Principal drivers of natural gas demand by sector

	Economic activity	Competitiveness	Environmental impact	Technology	Access/infrastructure	Government policies
Power generation	(+/-)* Industrial output and household income levels, which rise and fall with economic activity, are strong determinants of electricity demand.	(+/-) Gas-fired generation is sensitive to changes in relative fuel prices and CO ₂ prices; (+) Short lead times for construction; low capital costs.	(+) Less emissions intensive than other fossil fuels (local pollution/climate); (+) Increase flexibility of the system with more renewable capacity.	(+) Best available CCGTs have a sizeable efficiency advantage over coal-fired plants; an electric vehicle breakthrough could raise electricity needs	Not significant in most regions as power plants are typically built close to major infrastructure	(+/-) Regulation of CO ₂ emissions; (+) Policy uncertainty favours gas-fired plants to reduce risk; (-) Support for renewable and nuclear power.
Buildings	(+/-) Household income levels strongly correlate with residential space and water heating needs.	(+/-) Changes in relative fuel prices could cause switching in the long term.	(+) Gas-fired boilers produce fewer emissions than most fossil-fuel based alternatives.	(-) Potential to raise average boiler efficiency by replacing old stock.	(+) Construction of gas distribution networks enables potential end-users to connect to supply.	(-) Standards, subsidies and labels to promote higher efficiency buildings and equipment.
Industry	(+/-) Industrial output strongly correlates with gas demand for process heat and steam-raising.	(+) Gas is usually the preferred fuel for new equipment; (-) High gas prices encourage use of more efficient boilers.	(+) Reduced impact of gas use on air quality compared to other fossil-fuels; (+) No need for management of waste products.	(-) Potential to raise boiler efficiency by installing new units; (-) Increased use of combined heat and power (CHP) plants.	Not significant in most regions as factories are typically built close to major infrastructure.	(+) Government-subsidised gas pricing to protect domestic industry; (-) Efficiency standards for industry equipment.
Transport	Not significant because penetration of natural gas vehicles (NGVs) is small.	(+) Payback period for purchasing an NGV shortens with higher oil prices.	(+) In road transport, gas is less emissions intensive than oil and able to improve local air quality.	(+) Potential to improve gas storage technology to extend NGV range.	(+) NGVs require large network of refuelling stations; (+) Pipeline gas transport raises power needs in compressors.	(+) Policies promoting use of NGVs (personal and fleets) to improve energy security and/or air quality.
Other	(+/-) Demand for gas for feedstock use is closely tied to industrial production and GDP.	(+/-) Petrochemicals feedstock demand is very sensitive to price of gas relative to naphtha.	Relatively insensitive.	(+) Technical advances in GTL or other technologies could greatly boost use of stranded gas.	Not significant in most regions as industries using feedstocks are typically built close to major infrastructure	(+) Policies to support domestic industries that utilise natural gas inputs (fertilisers, GTL and petrochemicals).

* (+/-) Indicates drivers with the potential to cause either higher or lower gas demands; (+) for drivers that can raise demand; (-) for drivers that can lower demand.

Source: IEA, 2011

Current demand

Current demand for natural gas in South Africa is mainly for the GTL and chemicals industries, where PetroSA, Sasol and some industrial users are the major players. PetroSA produced 7.31mmbbl in 2009/10, down 28% on the previous year due to field depletion.²⁴

Sasol Gas imports natural gas from Mozambique and utilises most of this in its own chemical and GTL facilities. Sasol has exclusive rights to the transmission and distribution network for gas imported from Mozambique for 10 years until 2014. It has more than 500 industrial customers and gas traders, but also satisfies the demand from the following local gas distributors:

- Egoli Gas, operating in and around Johannesburg, servicing 7 500 industrial and residential customers;
- Spring Lights Gas, operating in KwaZulu-Natal, servicing industrial customers; and
- Novo Energy, operating in Gauteng, supplying commercial and residential customers.

The domestic gas market is therefore mainly made up of GTL plants and industrial users, and the lack of an extensive transmission and distribution network is seen to be a significant barrier to increasing the demand from commercial and residential customers.

While the existing GTL industry creates demand, the lack of indigenous gas makes the further development of this segment of the market difficult. The PetroSA south coast gas field has been producing since 1983 and is virtually at the end of its life. This has resulted in a significant reduction in operations at the MossGas GTL plant and an effort to secure alternative feedstock sources. One of these alternatives is the further exploration of the F-O field, with probable reserves estimated at 7tcf.

In addition, PetroSA considered importing LNG to use as feedstock for the GTL plant, but due to volume, cost, contract duration and other constraints, this project did not proceed. PetroSA subsequently terminated the LNG project on the basis of a business case review that concluded that the project would result in a significant loss to the company.²⁵ Alternatives to liquid fuels do exist and, on balance, it would be more appropriate to utilise imported LNG for other projects, including power generation. Significant volumes of local shale gas would change this situation.

The South African economy is energy constrained, and initiatives being taken to address this include building two new coal-fired power stations and a significant drive to develop the renewable energy industry. This is expanded on in the Integrated Resource Plan 2010 (IRP2) released by the Department of Energy. The IRP2 also makes provision for gas-fired power generation, which provides the most likely source of demand for gas in South Africa.

IRP2 provides for 711MW of combined cycle gas turbine (CCGT) capacity to be developed in 2019-2021. A further 1 659MW of gas-fired CCGT generation capacity is provided for in the 2028 to 2030 period, bringing the total gas-fired power generation capacity up to 2 370MW.

Various studies have been conducted in the Western Cape to justify the use of gas-fired power stations. Forest has recognised the single biggest demand driver for gas in South Africa will be gas-fired power generation. As a result, in an effort to commercialise the gas reserves in the Ibhubesi field, Forest proposed a 750MW CCGT power station to be built on the West Coast, close to the field.

Such an initiative will have the advantage of reducing the Western Cape's dependence on electricity imported from the rest of the country. At present, approximately 2300MW is imported to the Western Cape. While the power is available for transmission to the Western Cape, there are transmission losses and power generation closer to its final demand location is more efficient.

Gigajoule Africa has existing operations in neighbouring Mozambique. It jointly owns Matola Gas Corporation with the Mozambican Government and operates more than 100km of transmission and distribution pipelines. The company has been actively pursuing opportunities in South Africa and has made an unsuccessful licence application to NERSA for the supply of natural gas to the Western Cape. Gigajoule proposed the introduction of what it termed a "virtual pipeline" system, making use of centralised compressed natural gas facilities from where gas could be distributed to industry and households. It has successfully introduced this technology in Mozambique and believes that it offers significant opportunity for South Africa. Gigajoule further supplies CNG for public transportation purposes in Mozambique and has CNG vehicle refilling points.²⁶

24 PetroSA, 2010

25 PetroSA, 2010

26 Gigajoule, 2011

Gigajoule believes that there is a market for natural gas in South Africa, sourced on the international LNG market, in supplying Eskom and independent power producers initially. However, once an anchor customer can be secured, further demand will develop, focussed on industrial, commercial, residential and public transportation users. This can be achieved through CNG technology until such time as a comprehensive transmission and distribution network can be established.

In the absence of the development of the Ibhubesi gas field, or any of the other indigenous gas plays referred to earlier, South Africa will have to rely on imported LNG for the gas-fired power generation anticipated in the IRP 2010.

The concept of gas-fired power generation acting as an anchor customer to provide demand in the large volumes required to make LNG projects viable, is similar to the position in China. Both countries rely heavily on coal as a primary energy source and natural gas makes up only around 3% of the total energy mix. Lessons could therefore be learned from China.

China is in the initial stages of developing its natural gas markets. Large cities, including Shanghai and Guangdong, are in need of natural gas, but there is a complete lack of a natural gas pipeline network, similar to South Africa. Critics argue that the demand from these cities alone would not consume the volumes of natural gas that would make LNG projects viable.²⁷ It has been suggested that the urban pipeline network would gradually be formed once large industrial gas users (such as power producers) provide the basis for the creation of the natural gas industry. The same argument can be applied to the South African scenario, where, once gas is available, infrastructure development could be motivated.

One of the projects that Gigajoule has been motivating is the conversion of the Ankerlig power station in the Western Cape to CCGT. This project would have a capital cost of between R4B and R7B (US\$570m and US\$1B). The current configuration of Ankerlig consist of nine 150MW (1350MW in total) OCGT units running on diesel. The plant has an efficiency of 32.7% and is utilised less than 6% per year. A conversion to gas-fired CCGT will increase the output to 2 070MW, allowing it to operate at 51% efficiency, which could be utilised 47% of the year.

Gas for the CCGT configuration would be sourced from the global LNG market and supplied to an offshore submerged receiving terminal, which would consist of a demountable buoy, flexible marine riser and a floating storage and regasification unit (FSRU). This configuration and technologies would result in savings over conventional LNG infrastructure requirements for onshore regasification and storage.²⁸

Eskom has already completed the environmental impact assessment for the CCGT conversion, as in its initial design this conversion was anticipated.²⁹

Gigajoule estimates that the conversion of Ankerlig would result in a price of R0.70/kWh, which compares very favourably with any other form of new generating capacity under consideration in South Africa.

The Ankerlig CCGT project would also provide the anchor customer necessary to make the investment in the required infrastructure feasible, and would act as the trigger for the construction of additional pipeline infrastructure that could supply industry and households in the Western Cape with gas.

Forest believes that there is no demand uncertainty with respect to natural gas, but that concerns revolve around supply uncertainty. From this perspective, this could be overcome through LNG imports, which could act as the trigger for the development of the required distribution and transmission infrastructure, until such time as indigenous gas supplies have been developed. Once this infrastructure is in place, industrial, commercial and domestic users may be more willing to consider converting to gas-fired energy sources.

When considering demand for natural gas, it is also important to look at industrial development nodes, as this is more than likely where the biggest demand for energy will be. It would be appropriate to conclude that natural gas demand opportunities are located in the Western Cape, KwaZulu-Natal, Gauteng and the Eastern Cape. Gauteng and KwaZulu-Natal already have gas supplies and there is unsatisfied demand, essentially as a result of a supply shortfall and distribution network constraints.

27 Li and Bai, 2009

28 Gigajoule, 2011

29 Eskom, 2011

Ankerlig in the Western Cape, as well as major industrial players (ArcelorMittal, Namaqua Sands and Rare Metal Industries to name a few) provide sources of demand. In the Eastern Cape, the Coega industrial development zone has been established. This is the location for PetroSA's proposed 400 000bpd crude oil refinery and a number of other energy-intensive industries. Eskom and i-Gas have proposed the establishment of LNG import facilities at Coega to supply a 2 400MW CCGT power plant, and other industries in the region.³⁰

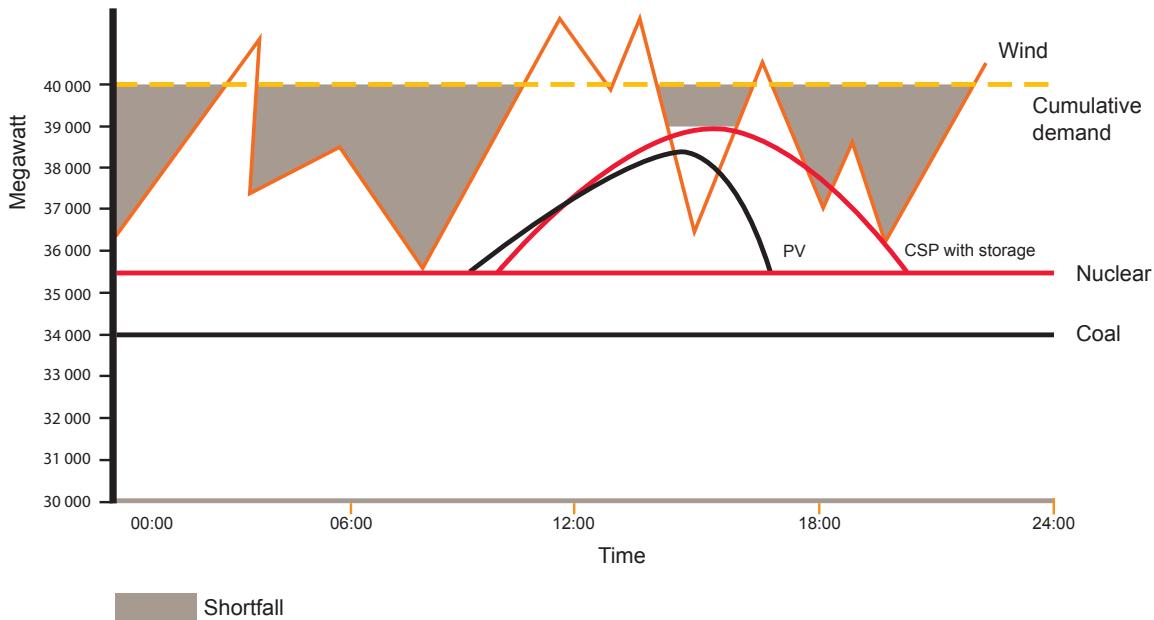
The large proportion of renewable energy in the IRP 2010 also creates a demand for natural gas. Due to the nature of renewable energy technologies and sources (variable wind and sun), there are security of supply concerns. While coal and nuclear provide base load capacity, natural gas is able to fill the gaps created by this variability, as demonstrated in Figure 7.

The demand for natural gas will also be influenced by carbon constraints. It is becoming more and more difficult to obtain funding for coal-fired power stations due to the high levels of associated GHG emissions. This will more than likely lead to increased demand for natural gas and renewable energy.

Implications of higher global gas reserves

The WEC expects that large shale gas reserves will result in lower gas prices, supporting the international trend to use more natural gas for power generation.³¹ Greater reserves and lower prices may also lead to wholesale shifts away from oil to gas, including in the transportation sector, using CNG. While GTL is not the most economic application for LNG at current prices, lower gas prices may make GTL more viable.

Figure 7: Renewable energy and natural gas



Source: PwC

30 Lochner et al, 2006
31 WEC, 2010

Conclusion

The bargaining power of buyers in the existing market in South Africa is reduced by the strong position of suppliers, where Sasol dominates the market. Buyers wishing to engage in large-scale natural gas projects that require significant volumes will, however, be able to use these volumes in their negotiations to increase their bargaining power.

International alternatives and issues around security of supply, as well as renewable energy, strengthen buyers' bargaining power. However, switching costs, together with security of supply concerns may act as a deterrent to investment and switching.

Suppliers of natural gas will therefore need to be competitive if they wish to convert users to natural gas. Given the regulatory environment and pricing mechanisms prescribed and regulated by NERSA, buyers have full information about supply, demand and costs, increasing their bargaining power.

Overall, while buyers currently have low bargaining power, the introduction of additional supply and new infrastructure would improve the bargaining power of future buyers.



Threats of new entrants and barriers

The ability for new players to enter a specific market depends to a large extent on the barriers to entry. Porter identified seven major barriers to entry:

- Economies of scale – new entrants are required to enter the market at a certain minimum scale to enable them to produce or operate at competitive levels;
- Product differentiation or brand identification and customer loyalty;
- Capital requirements for entry;
- Switching costs;
- Access to distribution channels;
- Cost disadvantages independent of scale – established players already have a favourable position due to factors such as subsidies, technology and preferential treatment; and
- Government policy in the form of regulations and licensing requirements.³²



Energy Outlook lists the following above-ground barriers to shale gas development:

- Access to the gas resources on a basis that is acceptable to local communities;
- Availability of land for installations;
- Availability of water in the required quantities for use in fracturing operations;
- Increased use of local infrastructure such as roads;
- Access ways for pipelines;
- Lack of facilities to treat waste water;
- Access to capital to sustain ongoing drilling operations;
- Environmental compliance issues; and
- Lack of existing pipeline infrastructure.

If the barriers associated with the supply of natural gas can be overcome, then the lack of infrastructure (import facilities, regasification terminals, transmission, distribution networks, gas-fired industrial equipment) must still be addressed. South Africa has approximately 3 300km of transmission and distribution pipelines, serving a small part of the country. The industrial development centres in the Western and Eastern Cape are completely unserviced by gas pipeline infrastructure.

The South African economy is energy intensive as a result of the type of industries that are operated here (mining, aluminium smelters, steel industry) and relies extensively on electricity as a source of energy. Industry has not invested in gas-fired equipment because of the lack of supply and there will be switching costs if they move to natural gas. Switching costs will not only be the direct equipment conversion costs, but security of supply concerns in the initial stages of industry establishment,, which will add to the perceived opportunity costs associated with switching.

Market analysis of barriers to entry

There are significant barriers to the development of a natural gas industry in South Africa. Some of these barriers can be overcome, while others may prevent the industry from developing.

While South Africa has negligible proven indigenous natural gas reserves, this can be overcome by importing natural gas, either via pipeline (as is the case with Mozambique) or shipping in LNG. The barriers associated with LNG, and using imported gas as the basis for establishing the industry, is that the country would be exposed to both commodity and exchange rate risks.

The development of indigenous gas supplies in the short to medium term will be focussed on the Ibhubesi gas field, PetroSA's F-O field development, the Molopo methane play and the shale gas potential in the onshore Karoo Basin. There are barriers surrounding the Ibhubesi and shale gas plays, but the PetroSA and Molopo projects have the required funding, approval and momentum.

The barriers associated with the Ibhubesi gas field are found in two main areas:

- Further investment is required to firm up the reserve's estimates for the Ibhubesi field. This investment is difficult to justify without certainty of a market for the gas. This market has previously been identified as a CCGT power station to be operated by an independent power producer (IPP) that has been able to successfully negotiate a power purchase agreement (PPA); and
- The IPP/PPA process is complex, with a significant level of regulatory uncertainty associated with it. Some of the industry participants interviewed in this analysis argue that there are uncertainties associated with the roles of the various players, and even to an extent, rivalry between NERSA and the Department of Energy.

There are various barriers to the development of shale gas in South Africa. Environmental concerns associated with the exploration and extraction of shale gas is the most high-profile of all the barriers. This relates largely to the process of hydraulic fracturing (fracking) that is used to release natural gas from deep shale formations.

The fracking process utilises chemicals and large quantities of water. Water is a scarce resource in South Africa and the exact composition of the chemicals used in the process is not known. As a result there are concerns around the potential for contaminating groundwater. Public opposition to hydraulic fracturing, both locally and internationally, led to a moratorium being placed on further shale gas exploration in 2011.³³ The 2009 World

³³ Pasa, 2011

A key barrier, not related to infrastructure or reserves, is simply the lack of a credible and constructive industry development plan for natural gas. The South African Government recognises that only about 3% of primary energy is provided by natural gas and that in a carbon constrained environment, natural gas can contribute to the solution.

The Government has stated that it is supportive of increasing the share of natural gas in the total energy mix.³⁴ However, this is not supported by any form of incentives, tax breaks or industry support or development plans.

The Gas Act (Act No. 48 of 2001) is aimed at encouraging the development of the gas industry in South Africa. Section 2 of the Act describes its objectives to:

- a. promote the efficient, effective, sustainable and orderly development and operation of gas transmission, storage, distribution, liquefaction and regasification facilities and the provision of efficient, effective and sustainable gas transmission, storage, distribution, liquefaction, regasification and trading services;*
- b. facilitate investment in the gas industry;*
- c. promote the development of competitive markets for gas and gas services*
- d. promote access to gas in an affordable and safe manner.³⁵*

The Gas Act was based on international norms and practices found in economies with developed gas industries where normal market forces will take their course to ensure that the market develops. The risks associated with investing in the industry (security of supply, regulatory barriers, potential lack of demand, etc.) means that this is not happening locally.

Government should therefore take the lead and encourage investment in the sector. The lack of visible development plans or support mechanisms raises the question of whether the Government sees natural gas as a viable alternative to the cheap and abundant coal reserves.

South Africa operates a mineral ownership regime that sees the mineral resources of the country belonging to the state, and not the landowner. This is different to the position in, for example the United States, where landowners (with exceptions in certain states) also own the mineral rights. This leads to an incentive for land owners to allow exploration and production activities on their land. This is believed to have contributed to the fast growth of the shale gas industry in the United States. The same incentive for landowners does not exist in South Africa, resulting in a further barrier to development.

Arguments in favour of natural gas include the fact that it is the cleanest-burning hydrocarbon, and as a result less polluting than other hydrocarbons such as oil and coal.³⁶ There are, however, increasing concerns that methane, which forms the major part of natural gas, is a greenhouse gas with a far larger global warming impact on the atmosphere than CO₂.³⁷

Methane is released into the atmosphere during production, and a full life cycle assessment of the entire natural gas process from exploration through to final consumption should be considered in order to understand its total environmental impact.

Figure 8 demonstrates that over its full life cycle natural gas used for electricity generation produces fewer GHG emissions than coal, when compared to traditional coal technologies.

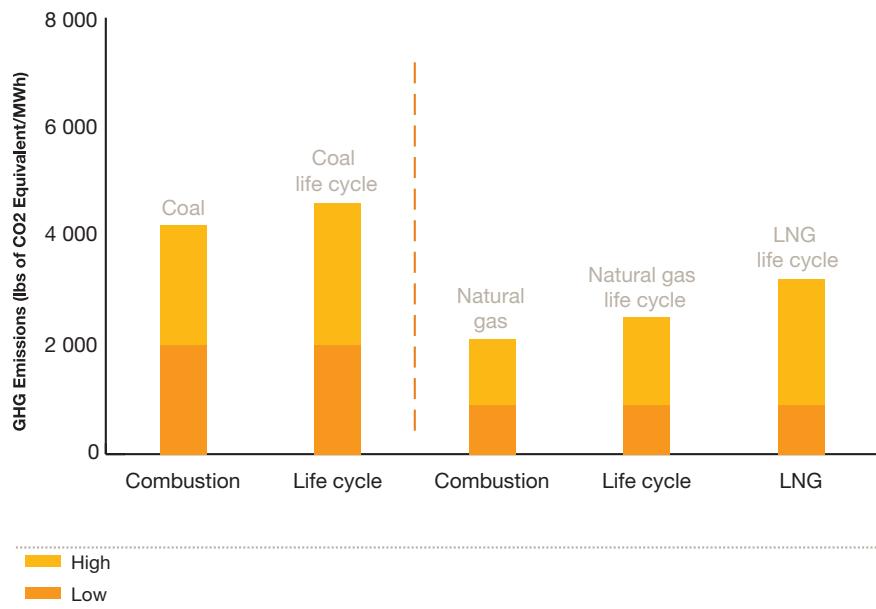
34 Peters, 2010

35 Gas Act, 2001

36 Golder Associates, 2011

37 IEA, 2011

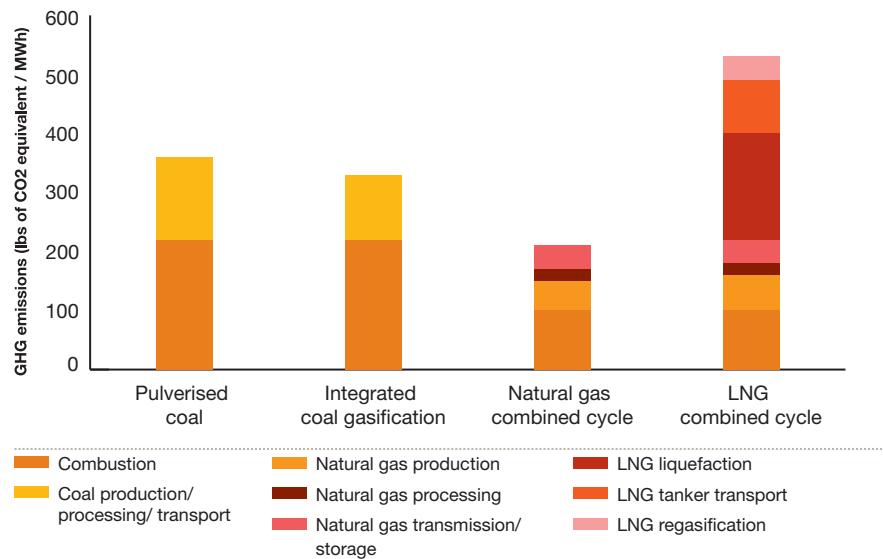
Figure 8: Life cycle analysis: Coal vs natural gas



Source: Jaramillo et al, 2007

Using newer technologies, including carbon capture and storage (CCS), a different picture emerges, especially with respect to LNG:

Figure 9: Lifecycle analysis: Coal vs natural gas using CCS



Source: Jaramillo et al, 200

These conclusions are supported by various studies, including the National Energy Technology Laboratory³⁸, the National Renewable Energy Laboratory³⁹, and The Centre for Liquefied Natural Gas.⁴⁰

In a CO₂ constrained economy, it can be concluded that for power generation, preference should be given to locally produced natural gas as it produces less GHG than both LNG-fed power plants and coal. GHG emissions is, however, not the only consideration, and capital cost, construction lead times, fuel costs, total cost per kWh and energy diversification must also be considered.

38 Skone et al, 2010

39 Spath and Mann, 2000

40 Pace, 2009

The review of the barriers to entry also investigated the licensing regime in South Africa as well as the ability of the South African oil and gas field services industry to support the development of a natural gas industry locally. In both instances none of the industry participants interviewed identified these factors as barriers.

The licensing regime was identified by some commentators as potentially encouraging speculative applications for gas licenses. NERSA, as the industry regulator, does, however, give careful consideration to all applications to prevent speculative applications that may result in sterilising the market and preventing other players from entering. This is demonstrated by its decision not to issue licences to Gigajoule and Unigas where it was argued that the lack of supply contracts, a lack of contractually committed customers, generic gas specifications and uncertainties related to the capital structures influenced the regulator's decision.⁴¹

Potential reserves alone cannot be seen as a barrier, given the reserves' potential explained earlier in this report. The industry participants interviewed were all of the view that although the oilfield services industry was not as developed as in established oil and gas provinces, local skills and capacity did exist, and could be developed reasonably quickly as and when required.



Conclusion

There are definite barriers to entry, which entrench the position of incumbent operators in the industry. Since the scale of operations that is required to support the development of the industry is large, so too is the need for natural gas projects to be anchored by large power projects. Furthermore, the lack of infrastructure and the capital required to put this in place acts as a significant barrier to entry.

The legal and regulatory environment, although designed to be supportive of industry development, does not achieve this objective, and actually seems to be encouraging a speculative approach to market entry, which could be harmful to the development of the industry.



Pressure from substitute products

Substitute products place a limit on the profitability of an industry, as in a monopolistic environment where there are no alternatives, the supplier has the ability to demand a premium for its product. Substitutes give customers choices and place suppliers under pressure.⁴² In the context of this analysis, natural gas has many substitutes as an energy source, including electricity generated from coal, industrial heating powered by fuel oil and refined petroleum products produced from crude oil.

Market analysis of substitutes

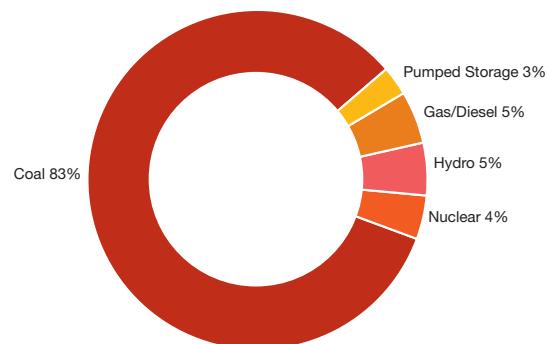
The introduction of a new element in the energy mix will only be successful if it can be demonstrated that it has benefits over the existing elements. These benefits may take the form of price, security of supply, carbon footprint, capital cost, construction lead times and energy efficiency.

Globally, natural gas is recognised as a viable substitute for oil. In the United States it is reported that the substitution of oil by natural gas is largely complete.⁴³ This substitution has been driven by the diverging price spread between oil and gas, which resulted from a relatively flat cost curve for natural gas production and rising production costs for oil as conventional, easy oil reserves are decreasing. More oil-gas substitution outside the United States is possible, but the pace of this will be driven by the pace of gas network development.⁴⁴ The current price competitiveness of natural gas can be seen to be accelerating infrastructure development.

The IRP2 makes provision for CCGT of 711MW to be introduced from 2019 to 2021, on the assumption that the Kusile and Medupi coal-fired power stations currently under construction will be completed on schedule by 2016. If there were to be delays with this, natural gas-fired CCGT may become a viable substitute in the short term to make up for the shortfall in energy demand, given the relative short lead times associated with the construction of CCGT power stations.

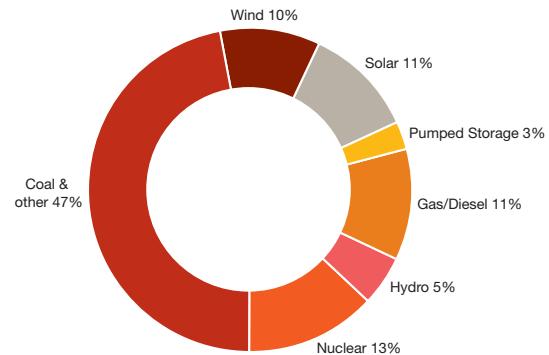
The IRP2 makes further provision for a significant increase in renewable energy in the South African energy mix.

Figure 10: Total generating capacity in 2010 (44 GW)



Source: Department of Energy, 2011

Figure 11: Proposed total generating capacity in 2030 (89 GW)



Source: Department of Energy, 2011

43 Abadie et al, 2011
44 Abadie et al, 2011

From point of view of levelised cost of electricity, gas-fired CCGT would provide the cheapest form of energy for South Africa.

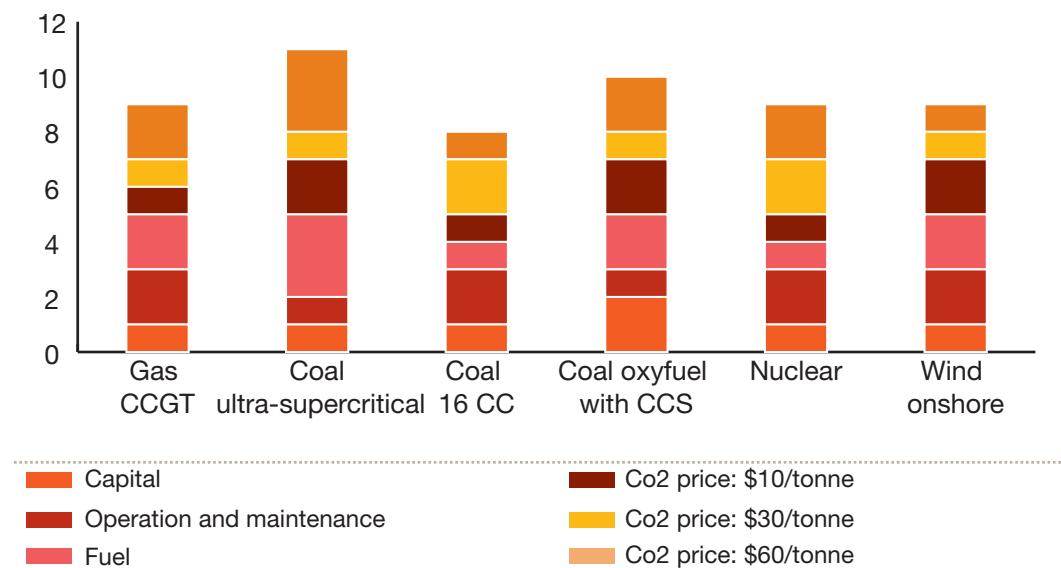
Table 2: Electricity cost per technology

	Pulverised coal	OCGT	CCGT	Nuclear	Wind	Solar – parabolic trough (9-hr storage)	Solar – CSP
Total plant cost per kW (ZAR)	16 880	3 955	5 780	28 290	16 930	50 910	37 225
Lead time (years)	5	2	3	6	3	4	2
Fuel cost per GJ (ZAR)	15	42.1	42.1	6.25	0	0	0
Economic life (years)	30	30	30	60	20	30	25
Levelised cost of electricity (LCOE) (ZAR/MWh)	553	1 397	460	737	657-1 052	2 025	2 299

Source: EPRI, 2010

The IEA World Energy Outlook 2009 further supports these conclusions, as demonstrated in Figure 12

Figure 12: Long-run marginal cost of generation for gas-fired CCGT power plants compared with other technologies and fuels in OECD countries in 2015-2020



Source: IEA, 2009

Once an anchor demand for natural gas can be established, it can act as a substitute for various other energy sources, including in public transportation, industrial and commercial enterprises, and even domestic applications. However, the key barriers such as supply, lack of infrastructure and switching cost must be removed before this could happen.

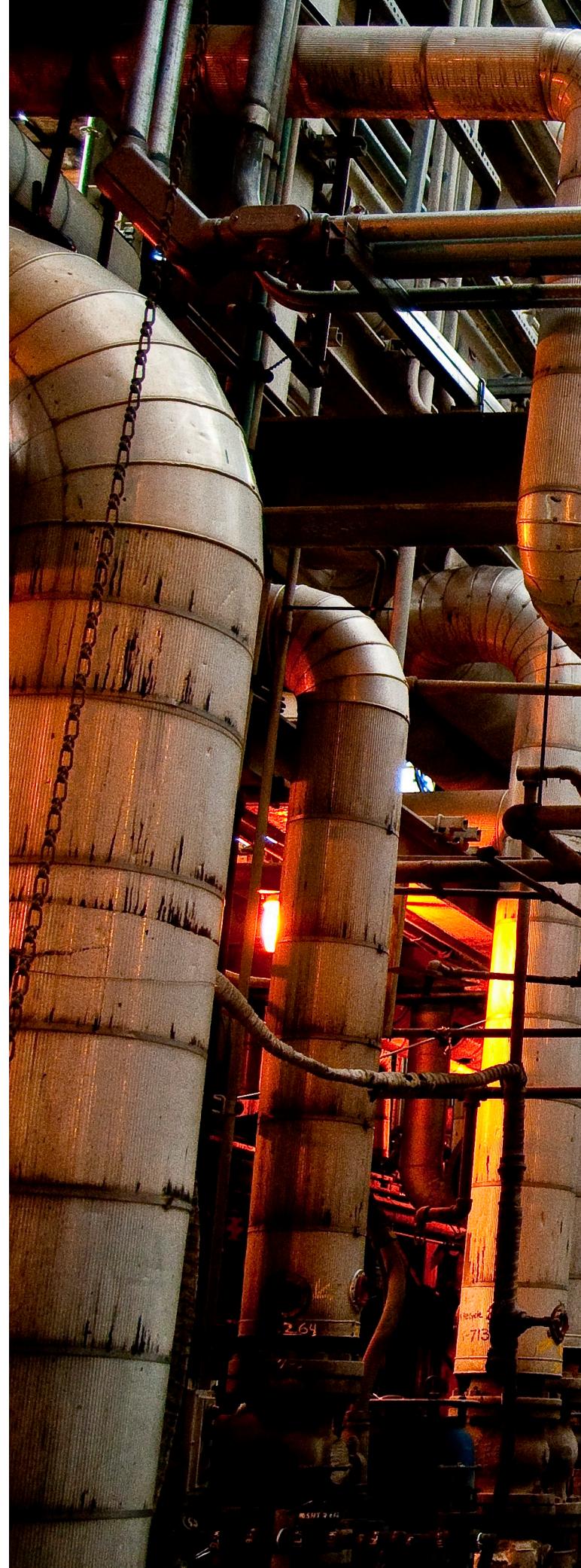
Conclusion

While natural gas can be seen to be more environmentally friendly and economically competitive than other hydrocarbon-based energy sources, there are a number of substitutes in which committed capital projects are also already under way. This, combined with the barriers listed earlier, leads to the conclusion that pressure from substitute products will have a negative impact on the development of the local natural gas industry.

Rivalry

Competitive rivalry refers to the way in which organisations within an industry interact with each other. Factors influencing this include:

- Industry concentration, or the extent to which the industry is dominated by one or a few entities;
- Industry maturity and rate of growth – rapid growth and extensive competition is present in a new industry, while an industry heading to the end of its life cycle may see less competition. Rapid industry growth leads to fierce competition;
- Exit barriers or exit costs – in some industries with high entry costs, it is also more difficult to exit due to high exit costs;
- Diversity of competitors – if industry participants take on the same challenges in different ways, then there tends to be less competition between the participants;
- Brand equity – when the market recognises and attaches value to a brand, then that brand owner will have a competitive advantage;
- Fixed cost per value added – capital-intensive industries are more difficult to enter for competitors, and as a result these industries are generally less competitive;
- Switching costs – if it is easy for customers to switch between suppliers, the industry tends to be more competitive; and
- Intermittent over-capacity leads to falling prices, resulting in some participants exiting the industry and reducing competition.



Market analysis of the extent of competitive rivalry

Given that the natural gas industry is immature and not significant in South Africa, there is not a significant amount of rivalry within the industry. This can mainly be attributed to the lack of indigenous supply and the dominant position that Sasol has in the local market. This position is protected through the Gas Act, which gives Sasol exclusivity for the importation of natural gas from Mozambique until 2014.

Rompco (Republic of Mozambique Pipeline Investment Company), a subsidiary of Sasol with a 25% minority stake held by i-Gas, operates the gas pipeline between Mozambique and South Africa. Section 36 of the Gas Act makes specific mention of the Mozambique Gas Pipeline Agreement entered into between the Minister of Energy, the Minister of Trade and Industry and Sasol Limited with respect to the importation of natural gas by pipeline from Mozambique to South Africa.

This agreement was reached before the Gas Act was enacted and Sasol was attempting to protect itself from adverse conditions that may have been included in the Gas Act. In terms of the agreement, Sasol obtained 10-year exclusivity from the date of the first import on the import and distribution of natural gas from Mozambique.⁴⁵ In addition, mandatory third-party access to the pipeline was only allowed for greenfield and brownfield customers that consume a quantity of gas in excess of specified minimums.

Because there is insufficient competition in the market, NERSA sets minimum and maximum prices to protect customers. This is a further admission that the level of rivalry in the industry is low.

Given the limited number of players in the market, and the dominant position of Sasol, there is currently very little gas-on-gas competition.

Another factor impacting rivalry is the capital intensity of the natural gas industry. Significant capital investment is required to build pipelines and other gas processing facilities. In order to promote competition, the regulatory framework makes provision for third-party access to uncommitted capacity in existing infrastructure. In the current South African context, this is of academic value only as there is no uncommitted capacity and therefore very limited rivalry.

Competition in the onshore shale gas play is also fairly limited, partly due to the extensive size of the exploration blocks that have been created. In 2011 there were only five major shale gas developers holding exploration blocks under TCPs:

- Royal Dutch Shell (185 000 km²);
- Falcon Oil and Gas (30 000 km²);
- Sasol / Chesapeake / Statoil (88 000 km²);
- Sunset Energy (4 600 km²); and
- Anglo Coal (50 000 km²)⁴⁶

Conclusion

It could be argued that the abovementioned factors contribute to the lack of competition, and if competition were to be encouraged, more players would be encouraged to enter the industry. The fact that there are 67 TCP or production licence permits issued or under consideration for onshore exploration and production activities point to an industry in its early stages of development. The entry of a number of potential rivals could create more competition and reduce the current high level of industry concentration.

Once gas reserves are proven and comprehensive infrastructure is established, more rivalry will develop, and the possibility of switching between suppliers may even become a reality. While the impact of rivalry in the natural gas industry in South Africa is neutral at present, it should become more positive as the industry grows and more market entrants appear.

45 DoE, 2001
46 EIA, 2011

Conclusions

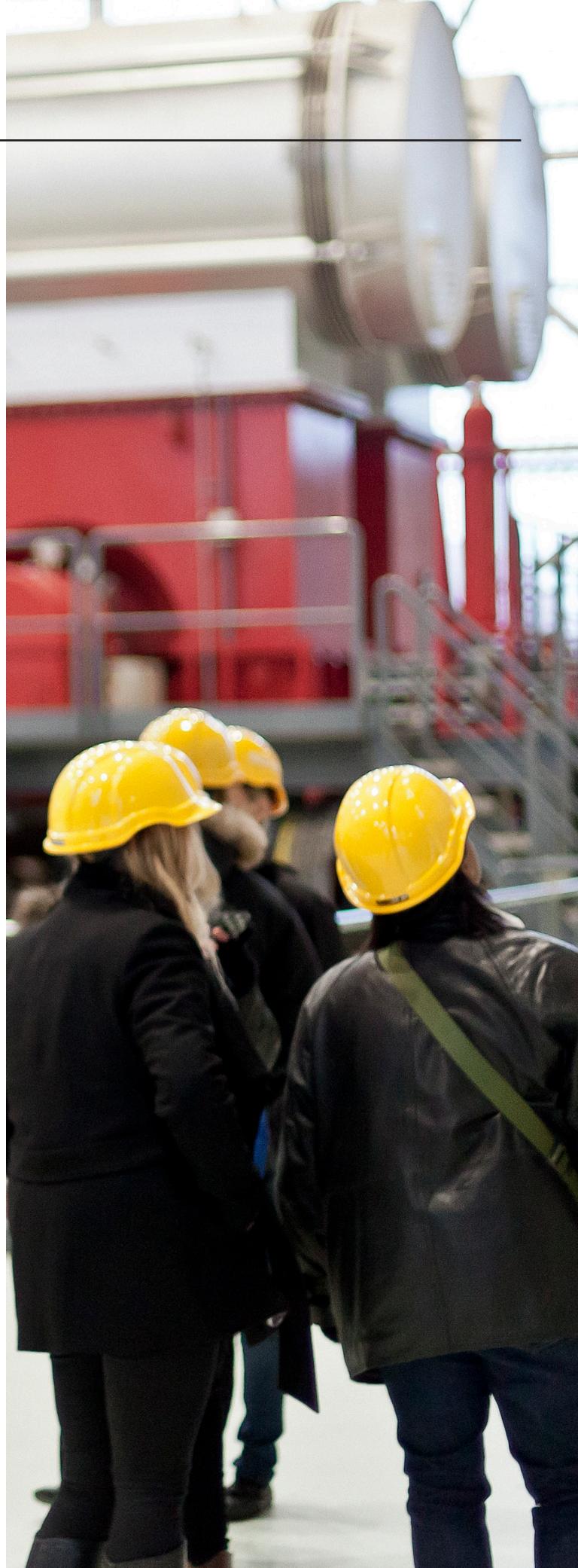
The number of licence applications and proposed exploration activities in progress at present confirms that there is much interest in the natural gas industry. Whether or not this interest can be converted into profitable operations for these participants is still subject to debate, as a number of the proposed exploration projects require further confirmation that economically recoverable reserves exist.

Analysis of recent licence application decisions further highlights financial uncertainties, and points to the need for further work to confirm financial feasibility. It should be noted, however, that the existing operations of Sasol and PetroSA are profitable.

This report confirms the environmental benefits of natural gas over coal as well as its competitiveness from a cost point of view. The Government's introduction of a formal renewable energy policy was also shown to create opportunities for natural gas and to provide additional security of supply.

PetroSA's continuing exploration for gas is an acknowledgment of the importance of natural gas to its own future sustainability and the country's reputation as a leader in the GTL field.

Nevertheless, South Africa faces a significant number of barriers to the development of the industry. Although unproven, there appears to be significant natural gas potential, which, with the right incentives and further pressure to reduce GHG emissions, will make it possible for natural gas to make up a larger share of the total energy mix in South Africa.



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