Southern Africa’s Oil and Gas Opportunity

Recent discoveries of major gas and oil deposits in southern Africa could dramatically improve the prospects for southern African countries—reducing imports, driving economic growth, and lowering CO$_2$ levels in power generation.
Scattered pockets of natural gas off the coasts of South Africa and Mozambique were all that southern African countries seemed to offer in terms of oil and gas resources. That changed in 2010 and 2011, when a potential 500 trillion cubic feet of gas was identified across Mozambique and South Africa, along with 11 billion barrels of oil in Namibia. Together, these countries’ gas reserves equal those of Canada or Venezuela.

These discoveries could transform the southern Africa region. In this paper we examine some of the economics of oil and gas in the region, consider their possible impact, and offer recommendations for handling these resources.

The scope of our study is South Africa and its neighboring countries, since they form a large, connected economy with the potential for significant local use and beneficiation of hydrocarbon resources rather than simple export.  

New Discoveries

The highest-profile recent discoveries are in Mozambique, where estimates of offshore gas reserves range from 50 to 100 trillion cubic feet (tcf) in depths of 1,000 to 3,000 meters (about 3,200 to 9,800 feet).

The largest potential reserves are in South Africa’s shale beds beneath the Karoo region, estimated by the U.S. Energy Information Administration to exceed 400 tcf. These reserves may now be extracted in an economically viable manner, thanks to hydraulic fracturing techniques.

In addition to gas, oil deposits amounting to an estimated 11 billion barrels were found off the coast of Namibia in mid-2012. This discovery has spurred further exploration along the west coast of South Africa in the Orange River basin, an extension of the Namibian fields (see figure 1).

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**Figure 1**

**Recent developments in Southern African oil and gas**

- Several offshore gas finds made in the Rovuma basin since 2010
- Offshore oil reserves found in 11 prospects off the coast of Namibia in 2011
- Coal-bed methane discovered in the Kalahari Karoo basin in 2006
- New licenses awarded in 2012 for oil and gas exploration in the Orange River basin
- Production in the Mossel Bay area has declined over the past years
- South Africa’s moratorium on shale gas exploration in the Karoo basin lifted in 2012

Source: A.T. Kearney analysis

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1 Beneficiation is local processing to add value to raw materials in the country or region where they are extracted.
Yet the full potential of oil and gas in the region remains uncertain for three reasons. First, most fields are in the early-exploration phase; the estimated volumes are technically recoverable resources, not proven reserves. Second, gas and oil sources have relatively high extraction costs: They’re either deepwater sources, such as those off Mozambique, or unconventional gas sources, such as Karoo’s shale gas and Botswana’s coal-based methane. Third, new areas are opening for exploration promising even greater volumes, for instance the southern extensions of the fields off the coast of Namibia and the coal bed methane deposits in Botswana (see sidebar: Skills as Critical Enablers).

Southern Africa’s Energy Outlook

Southern Africa’s economy is based on coal, and is short of liquid fuels. In 2011, South Africa imported 130 million barrels of crude oil. This high import volume exposes South Africa to both political and supply risk. The country’s primary source of crude oil is Iran, followed by Saudi Arabia, Nigeria, and Angola. In June 2012 sanctions against Iran led to the cancellation of all imports from the country and a rapid search for alternative sources.

South Africa’s total refining capacity is 250 million barrels per year, or about 700,000 barrels per day. Of the daily total refining capacity, 500,000 barrels is crude oil and 195,000 barrels coal-to-liquid synthetic fuel. So with total consumption at about 24.5 billion liters (6.5 billion gallons) of fuel annually—mainly petrol and kerosene—there is a 7 percent shortfall of 1.5 billion liters (nearly 400 million gallons) of fuel per year, accounting for South Africa’s need to import refined products.

Against this backdrop there have been a series of fuel shortages due to refinery-maintenance issues. The most significant event was in January 2012 when several planned and unplanned refinery shutdowns combined with problems at the Single Buoy Mooring facility off Durban to cause widespread fuel shortages. Also, South Africa’s refineries are old, an average of 43 years old, and need increasing levels of maintenance—and in some cases, significant

Skills as Critical Enablers

Taking advantage of the opportunities presented by natural-gas discoveries will require skilled engineers and managers along the entire value chain from exploration to tertiary manufacturing.

Southern Africa has a serious shortage of skilled engineers. An October 2012 report by Britain’s Royal Academy of Engineering determined the extent of the shortage in a survey of decision makers in the region. Eighty-six percent of respondents reported engineering-skills shortages, with more than 50 percent describing them as significant or severe.

The immediate solution is to import engineers from other countries, a natural choice for global oil-and-gas companies running offshore exploration operations. However, for companies interested in ensuring a stable local presence and for governments wanting to develop their populations’ skills, importing talent is only a short-term fix to start development.

The region’s governments, companies, and educational institutions must work together to develop a skilled, local work force for the oil-and-gas industry. Companies must invest in the education and development of engineering and management staff, and governments have the opportunity to use the build-up of complex engineering operations to ensure a transfer of skills to their respective populations.

Establishing staffing and skills-development strategies that contribute both to operational performance and to social and industrial development is the key to success for all parties.

upgrades—to keep them operational, efficient, and in line with environmental standards. With fuel prices regulated, funds for making those upgrades are limited.

Further, South Africa’s general energy environment is constrained. Electricity utility Eskom operates with a very narrow reserve margin—about 17 percent, and much lower when affected by maintenance—and depends on diesel generation to cover peak demand.\(^3\) Two open cycle gas turbines (OCGTs) running on gasified diesel started on 11 August 2012. They consume an estimated 220 million liters (nearly 60 million gallons) annually—about 2.5 percent of South Africa’s total diesel consumption.\(^4\)

**Recent discoveries could transform the southern Africa region, yet the full potential of oil and gas in the region remains uncertain.**

Southern Africa has abundant and cheap sources of coal, making it still the primary energy source; it provides 85 percent of Eskom’s total generation. The region’s coal-fired power fleet is the cheapest option for producing power and at current coal production, reserves could last at least a century.

However, coal dependency for generating electricity and for conversion to liquid fuels makes South Africa one of the most CO\(_2\)-intensive countries in the world. Were South Africa part of the European Emissions Trading Scheme (ETS), the Sasol Secunda plant would be the single largest CO\(_2\)-emitting site.

**The Potential: Generation**

Gas is a low-cost, flexible power source. It can provide generation primarily above the base load in peak-demand periods. Replacing expensive diesel generation during these hours would also contribute to reducing the cost of electricity generation for Eskom and mitigate price rises for consumers (see figure 2 on page 5).

Coal is expected to maintain a high position in the southern African energy mix. The South African Department of Energy’s Integrated Resource Plan expects a coal share of 46 percent in 2030, with OCGTs expected to contribute about 8 percent of the mix. If gas were increased to 25 percent and based on combined cycle turbines, the coal share could be reduced to a third of total generation capacity.

Gas generation also plays a role in enabling the build-up of renewable energy sources. Wind and solar units experience down periods when they cannot generate due to intermittent loss of wind or when clouds block the sun. Since these periods are unpredictable, there is a need for short-term generation sources to cover loss of output; gas turbines with start-up times of

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\(^3\) Source: Eskom annual reports

\(^4\) Source: Malusi Gigaba, Minister of Public Enterprises, in a report to parliament
between 10 and 30 minutes are ideal to meet this need. The more southern African countries develop renewable energies, the greater will be their need.

Finally, since gas generates only about half the CO$_2$ emissions of coal and two-thirds those of oil-fired power facilities, increasing the gas share would significantly lower South Africa’s overall CO$_2$ emissions (see sidebar: The U.S. Shale Gas Experience).

The Potential: Liquid Fuels

Namibian oil is the simplest source of newly discovered liquid fuels. When in production it will provide a local, relatively secure additional source of crude oil for the region. Reduced reliance upon the Middle East and Angola would substantially improve the security of crude-oil supply to South African refineries. The proximity will also reduce freight costs and provide more flexibility in scheduling supplies and managing stocks.

The U.S. Shale Gas Experience

The impact of shale gas on the U.S. economy is evidence of the potential effects it could have on southern African economies, particularly South Africa’s. The rapid ramp-up of shale-gas production has reduced U.S. gas prices from a peak of $13 per thousand cubic feet in 2008, to a low of $2 in mid-2012, with levels around $3.50 at the end of 2012. This low pricing has opened up close to $200 billion in investments, taking advantage of lower input costs. These investments cross the value chain from GTL plants through pipelines and petrochemicals to end products such as fertilizer and manufactured goods.\(^5\)

\(^5\) Source: A.T. Kearney North American gas study. Planned projects include 20 MMT Cracker capacity ($40 billion); 50 GW of power generation ($75 billion); 6,000 miles of gas pipelines ($20 billion); 5 tcf of LNG capacity ($50 billion).
Gas is a more complex source, requiring conversion from gas to liquid. With PetroSA’s Mossel Bay gas-to-liquids (GTL) plant operating at 60 percent of capacity, according to the company’s annual report, there is immediate potential to increase the utilization of existing assets. PetroSA’s plan to extend its operations to the F-O gas field should bring capacity back up to 100 percent.\(^6\)

The large gas sources in and around southern Africa offer the possibility of increasing GTL refining capacities to further address South Africa’s short position. An additional GTL plant would enable South Africa to close the shortage of liquid fuels. We will consider the full feasibility of this option below.

The Potential: Chemicals

The chemicals industry is a critical part of South Africa’s economy. The industry’s $23 billion in annual revenues contribute more than 5 percent to the gross domestic product (GDP), accounting for approximately 25 percent of all manufacturing activity.\(^7\) Despite its local importance, the industry’s poor access to local feedstock and remoteness from major developed markets are fundamental weaknesses.

Gas is a low-cost, flexible power source that can provide generation primarily above the base load in peak-demand periods.

South Africa’s current feedstock sources are Sasol’s coal-to-liquids Secunda plant and imports from the Middle East and Far East. Chemicals margins are declining and Sasol in particular is suffering as a result of cheaper imports. Its competitive position was weakened further with the removal of import duties on polymers in January 2012. This has deepened a strategic shift in the South African chemicals industry to one that focuses more on higher-value chemicals products, greater customer service, and innovation.

The new hydrocarbon sources have the potential to transform this landscape. Local sources would secure low-cost supplies of feedstock for southern African chemicals companies, reducing their reliance on imports and improving profitability. This would open up new possibilities for manufacturing further down the value chain.

This leads to a fundamental question: Where should the chemicals feedstock come from? Today the major production operations are around the Secunda plant in Sasolburg and the six other refineries. The new feedstock sources are off the western and eastern coasts and in the Karoo.

There are a number of possible answers. While using Namibian oil could allow expansion of the existing refineries, potentially building new capacity, Namibian oil is a relatively small source and offers few cost advantages over existing crude oil sources. Further, due to overcapacity in

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\(^6\) The F-O gas field is 40 kilometers southeast of PetroSA’s F-A production platform and will be developed as an extension of the existing infrastructure.

\(^7\) Monetary figure is in U.S. dollars. Source: Statistics South Africa.
Europe and the United States, refining margins are falling worldwide (see figure 3). Adding southern African conventional refining capacity would expose the market even more to the dynamics that are making refining unattractive in most regions.

The opportunity, then, is first to take advantage of offshore gas and, ultimately, shale gas. With gas trading at about half the price of oil on a recoverable-energy basis, achievable margins are significantly greater (see figure 4).

Figure 3
Refining margins are falling worldwide

Figure 4
Gas and coal prices are less than half that of oil

This means that southern Africa’s energy infrastructure would have to be developed to use gas rather than oil. The way to do this is to add GTL refining capacity in South Africa. One option would be for PetroSA, the country’s national oil company, to convert its planned Mthombo refinery project from a conventional refinery to a GTL plant. Rather than adding more conventional capacity in an unattractive refining market, this would give PetroSA a leading position in a market where margins are potentially more attractive.

However, this would leave PetroSA exposed to changes in the energy landscape and “unhedged” should the oil-gas gap narrow. It would also constrain competition.

Another option could be for a local player or group of players already active in southern Africa to construct a plant. This would result in downstream integration, foster competition, and provide balance across a number of suppliers and sources.

Constraints, Solutions

The development of southern African oil-and-gas solutions is subject to several constraints, one of which is location. Mozambique gas is several hundred miles from the major consuming regions in South Africa. Either more pipelines would have to be built down to Natal, the Eastern Cape, and Gauteng, or gas could be brought into South Africa using a liquefied natural gas (LNG) terminal.

An LNG terminal solution would give flexibility to address the related constraint of supply stability. In the event that supply is interrupted from a principal source, a pipeline leaves no room for alternatives. LNG, by contrast, would allow South Africa to import from whatever low-cost supplier it could find. This also reduces the need for South Africa to become politically dependent on its neighbors.

There is a time factor involved in the location constraint. Immediate supplies of gas are available on the coasts of South Africa, either from Mozambique or from PetroSA’s Mossel Bay fields. The largest supply, however, is unconventional shale gas from Karoo in the west. The best solution would be to build capacity to offer maximum flexibility around the two sources—and Mossel Bay looks ideal.

Implications

The South African government has the opportunity to use oil and gas discoveries to boost its economic and social development. Low-cost energy and feedstock sources have the potential to give South Africa the same cost advantages in manufacturing enjoyed by other hydrocarbon-rich nations. In the short term, such sources also could alleviate the shortfall in electricity generation and facilitate development of renewable energy sources.
To capitalize on these opportunities, South Africa must support the development of gas as a low-cost energy source and a feedstock source for chemicals beneficiation. It should work with Eskom and other potential electricity providers to explore options for gas generation around the Southern Africa Power Pool. Finally, as owner of PetroSA and sponsor of the Mthombo refinery project, the government should consider redesigning the plant as a GTL facility.

Mozambique’s government has more direct opportunities to capitalize on the gas found off its shores. Supplies are already set for export, with Anadarko and ENI preparing two LNG liquefaction facilities. However, the real development opportunity for Mozambique is the potential for bringing gas onshore—first for energy generation and second, for liquid fuels and chemicals manufacturing. The imperative for the government is to make sure it explores all possible opportunities and puts in place policy and investment frameworks needed to promote that development.

The discoveries around the coast of Southern Africa present major opportunities for South Africa, Mozambique, and Namibia

With their aging assets, refiners and retailers are at some risk from new developments. They will find it difficult to compete with new large-scale, efficient refining facilities, whether GTL or crude oil-based. They should first explore options for partnerships in emerging projects to exploit gas supplies. Secondly, they should concentrate on maximizing the performance of their legacy assets. Thirdly, they should focus on commercial positioning around sources of potential cost advantage, crude oil from Namibia, new-build refineries, or a GTL plant.

Chemical companies have the most to win from the exploitation of gas in the region. With a looming worldwide oversupply of chemical capacity, only regions with a source of local, low-cost feedstock will stay competitive. Southern African gas offers that opportunity. Chemical firms must advocate the immediate exploitation of offshore natural gas and opportunities to access it as feedstock, whether in ethane from pipelines, LNG deliveries, or a GTL plant.

Over the longer term, the Karoo shale-gas basin offers the greatest, albeit least well-defined, opportunity. Chemical companies must treat this undeveloped area as an option that has the potential to increase greatly in value over time. Right now they must ensure that the opportunity is fully recognized and developed. As the chemical composition and economics become clearer, chemical firms must take increasingly concrete steps to work with the companies developing the basin to access its gas as feedstock. Finally, they must work with governments and their customers to identify manufacturing opportunities and assist in investing to realize them.
A Range of Options and Opportunities

The discoveries around the coast of Southern Africa present major opportunities for South Africa, Mozambique, and Namibia—from reducing the cost and carbon intensity of power generation, to creating a supply of chemical feedstock to drive manufacturing development.

The challenge is for those involved to find the best way to take advantage of these opportunities. There are no simple paths to combining the locations, production timing, logistics, and market opportunities. However, those governments and companies that create and develop a range of options will most likely benefit from long-term development—the kind that can transform the southern African economy.

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