South African Gas Master Plan Consultation Document

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Appendices

Appendix A : Exploration and Production Activities and Rights Holder

Appendix B : Natural Gas Licensees

Appendix C : Natural Gas Pipeline Infrastructure

Abbreviations

AAIE	Portuguese acronym for High Authority for the Extraction Industry
ANPG	Angola National Petroleum and Gas Agency
ARENA	Portuguese acronym for Energy Regulatory Authority
BERA	Botswana Energy Regulatory Authority
BOT	Build-Operate-Transfer
BOOT	Build-Own-Operate-Transfer
CBM	Coal Bed Methane
CNG	Compressed Natural Gas
CTL	Coal-to-Liquid
DNG	Delta Natural Gas
E&P	Exploration and Production
EC	Eastern Cape
ENH	Empresa Nacional de Hidrocarbonetos
EPC	Engineering, Procurement and Construction
EWURA	Energy and Water Utilities Regulatory Authority
FS	Free State
FET	Further Education and Training
FID	Final Investment Decision
FSRU	Floating, Storage and Regasification Unit

GDP	Gross Domestic Product
GP	Gauteng Province
GTL	Gas-to-Liquid
GTW	Gas-to-Wire
IEP	Integrated Energy Plan
IGUA-SA	Industrial Gas Users Association – South
INP	Institute of National Petroleum
IOC	International Oil Companies
IRP	Integrated Resource Plan
KZN	KwaZulu-Natal
LNG	Liquefied Natural Gas
LEAP	Long-range Energy Alternatives Planning
LP	Limpopo
LPG	Liquefied Petroleum Gas
MP	Mpumalanga
MPRDA	Mineral and Petroleum Resources Development Act
NDP	National Development Plan
NERSA	National Energy Regulator of South Africa
NG	Natural Gas
NGC	Natural Gas Compression
PASA	Petroleum Agency SA

PPA	Petroleum Production Agreement
PSA	Production Sharing Agreement
PURA	Petroleum Upstream Regulatory Authority
RFO	Residual Fuel Oil
SA	South Africa
SAB	South African Breweries
SABOA	South African Bus Operators Association
SADC	Southern Africa Development Community
SEA	Strategic Environmental Assessment
SEPI	Sasol Exploration and Production International
SPA	Sales and Purchase Agreement
SSA	Sub-Saharan Africa
TPDC	Tanzania Petroleum Development Corporation
TRT	Tshwane Rapid Transit
US	United States
VAT	Value-Added Tax
WC	Western Cape
ZERA	Zimbabwe Energy Regulatory Authority

Conversion Factors

Natural Gas & LNG	To convert					
	Billion cubic meters NG	Billion cubic feet NG	Million tonnes oil equivalent	Million tonnes LNG	Million tonnes LNG	Million barrels oil equivalent
From	**Multiply by**					
1 billion cubic meters NG	1.000	35.315	0.860	0.735	34.121	5.883
1 billion cubic feet NG	0.028	1.000	0.024	0.021	0.966	0.167
1 million tonnes oil equivalent	1.163	41.071	1.000	0.855	39.682	6.842
1 million tonnes LNG	1.360	48.028	1.169	1.000	46.405	8.001
1 trillion British thermal units	0.029	1.035	0.025	0.022	1.000	0.172
1 million barrels oil equivalent	0.170	6.003	0.146	0.125	5.800	1.000

1. Introduction

1.1. Background

The National Development Plan (NDP) envisions that by 2030 South Africa will have an energy sector that promotes economic growth and development through adequate investment in energy infrastructure.

At just 2.6 % of the country's total energy mix, South Africa's natural gas market is small, but with all its inherent benefits, it has the potential to completely change the economy by stimulating economic growth and development, stability, and job creation.

The meaningful addition of natural gas to the country's energy mix will rejuvenate an overburdened, out-dated energy infrastructure and reduce cyclical energy shortfalls. Perhaps even more importantly, it will stimulate the economy by allowing business and industry to lower their energy and operational spend while also creating significant numbers of new jobs and skills development opportunities.

Considering that nearly 90 % of South Africa's existing natural gas demand is supplied by a single entity, namely Sasol Gas, the associated economic and employment risks of limited supply options, development and sourcing of alternative natural gas resources are high. It is imperative to ensure economic and employment stability within the natural gas sector by introducing more suppliers.

Southern Africa's gas potential has been revealed by major discoveries that, when developed, widen options for greater regional energy trade. South Africa's unconventional gas potential remains to be quantified but raises the prospect of possible domestic production in the longer term. Globally the natural gas industry has moved into a supply surplus, favouring a larger role for gas as a clean fossil fuel in many countries' energy policies.

A challenge in developing the gas sector is to bring gas demand and supply on stream at the same time and spread geographically to stimulate broader localized demand through South Africa. Without such localized gas demand, it is difficult to develop distributed gas supply and without such distributed gas supply it is difficult to develop localized gas demand. One way of breaking this impasse is to create significant "anchor" gas demand through the development of a gas-to-power programme. In pursuit of adding generating capacity, lowering carbon emissions, enhancing energy security and supporting industrial development, South Africa has taken the first steps in a gas-to-power programme to be executed under the Integrated Resource Plan 2019, aiming to increase the national energy mix natural gas contribution from 2.6 % to 15.7 % by 2030.

1.2. Document Objective

The objective of the consultation document is to establish baseline information for the natural gas sector in South Africa and to outline the Gas Master Plan roadmap. Such baseline information includes an overview of the gas value chain and regulatory framework. The Gas Master Plan document, once developed, will provide a roadmap for taking strategic, political and institutional decisions which will guide industry investment planning and coordinated implementation.

2. Natural Gas as Energy Source

Natural gas is an abundant and integral part of the world's energy supply, accounting for nearly 24 % of 2018's global primary energy consumed [7]. When burned, natural gas is one of the cleanest and most powerful forms of energy available. Considering that only 2.6 % of South Africa's primary energy needs are currently sourced from natural gas and Government's international climate change and carbon reduction commitment, exploitation of natural gas will play an integral part of South Africa's future energy mix diversification.

Natural gas is a fossil fuel naturally occurring as a gaseous mixture of light hydrocarbons in sedimentary rocks. Though it primarily consists of methane, there are other hydrocarbons that contribute to the makeup of natural gas and after natural gas is refined, those individual hydrocarbons can be used as various sources of energy.

Natural gas can be contained in a variety of different types of deposits that must be accessed if the natural gas is to be used. Natural gas has been extracted from conventional natural gas deposits for a long time, while the unconventional resources are resources that are being extracted using newly developed techniques.

Conventional resources are "pockets" of gas contained within relatively porous rock and are the most easily mined. Conventional gas has been extracted for many years and is the cheapest to extract, yielding the largest returns. While newer technologies like hydraulic fracturing has allowed for more expansive access to these deposits, they can be mined without its use.

Unconventional resources are made up of natural gas resources which are not readily available as conventional natural gas and have only been explored and extracted as energy resources in the last couple of decades. These unconventional resources consist of the following proven types of resources:

- *Coal bed methane* is natural gas consisting mostly of methane, which is trapped inside coal seams. This is extracted while the coal is being mined, as diminishing the pressure in the coal seam allows the gas to flow out of the seam and into a wellbore, where it is extracted.

- *Shale gas* is natural gas found inside a fine-grained sedimentary rock called shale. Shale is porous, but it is non-permeable, which means the gas cannot flow through it. Shale gas requires the use of hydraulic fracturing for extraction.

- *Biogenic gas* is formed at shallow depths and low temperatures by anaerobic bacterial decomposition of sedimentary organic matter. Biogenic gas consists almost entirely of methane and is unrelated to the processes that form oil.

- *Landfill gas* is a natural by-product of the decomposition of organic material in landfills. When municipal solid waste is first deposited in a landfill, it undergoes an aerobic decomposition stage and within one year, methane-producing bacteria begin to decompose the waste and generate methane. Instead of escaping into the air, landfill gas can be captured, converted and used as a renewable energy source, generating revenue and creating jobs in the community.

- *Biogas* is a type of biofuel that is naturally produced from the decomposition of organic waste, such as municipal wastewater and solid waste, industrial wastewater and agricultural waste. Anaerobic digestion is a natural form of waste-to-energy that uses the process of fermentation to break down organic matter. Biogas is known as an environmentally friendly energy source, alleviating the global waste epidemic and reliance on fossil fuel for energy.

Landfill gas and biogas are not classified as natural gas reserves but can be used as an energy source for gas, electricity, heat and transportation due to the high content of methane.

3. South African Gas Sector

The gas industry encompasses a range of different activities and processes which jointly contribute to the transformation of underlying resources into useable end-products valued by industrial and private customers.

The physical workflow architecture for the natural gas business is built around a capital-intensive asset base. The assets of each of the three principal business segments are held by exploration and production (E&P) companies (upstream), gas transmission providers (midstream) and local distribution companies (downstream). Figure 3-1 depicts a typical natural gas business value chain.

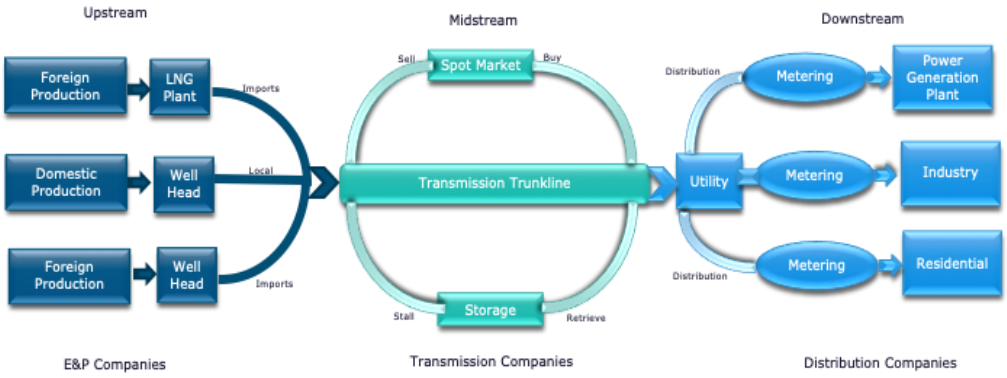


Figure 3-1: Gas Value Chain: Natural Gas Business

The value/business chain is divided into upstream, midstream and downstream components. The upstream sector of the value chain contains the exploration and production section of gas fields. The processes and activities involved in the upstream sector are exploration, field development and production operations. The midstream sector of the value chain is focused around transportation, processing and storage of natural gas, while the downstream sector involves distribution of natural gas to the end market. The current South African natural gas value chain is depicted in Figure 3-2.

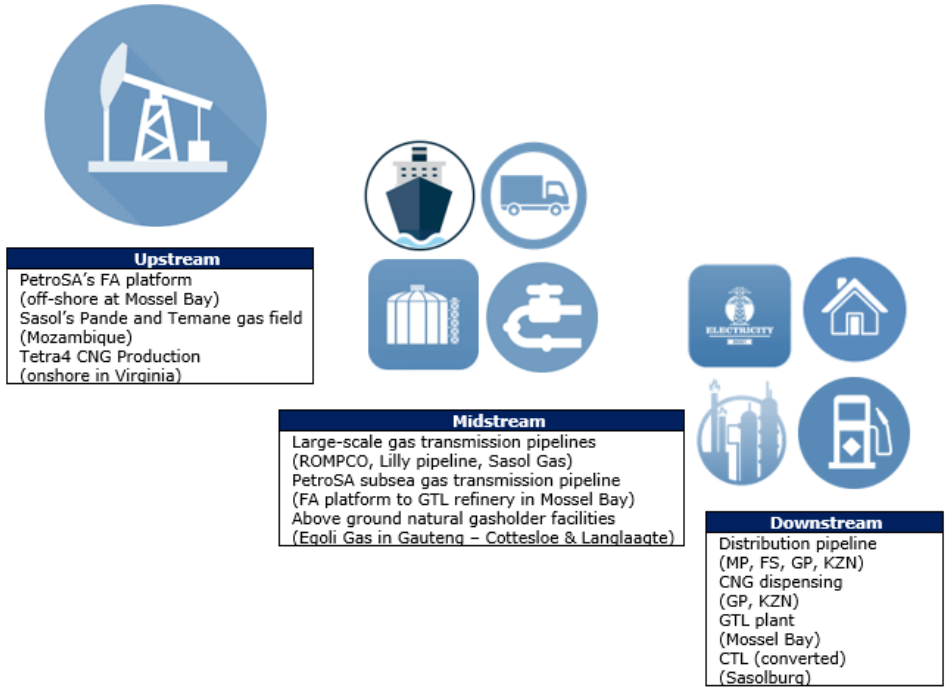


Figure 3-2: South African Natural Gas Value Chain

3.1. Upstream Gas Sector

PetroSA, Sasol Exploration and Production International (SEPI) and Tetra4 are the E&P companies currently involved in the upstream gas business sector.

The national natural gas demand is predominantly met through importation of natural gas from Sasol's Pande and Temane gas fields located in Mozambique. PetroSA has an indigenously produced offshore gas supply to the Gas-to-Liquid (GTL) plant located in Mossel Bay and Tetra4 is supplying natural gas extracted and compressed in Virginia to their customer, Megabus.

PetroSA's current indigenous offshore gas reserve is estimated to be depleted by 2029, while Sasol's Pande and Temane gas supply to South Africa is expected to decline by September 2023 if additional investments to extend the production plateau are not approved by the two governments [59] [12] [60].

3.2. Midstream Gas Sector

PetroSA has a transmission line leading from the FA platform to the GTL refinery in Mossel Bay.

There are transmission pipelines distributing natural gas from Mozambique via the ROMPCO supply line, running from Secunda to Gauteng and finally down to Durban via Transnet's Lilly pipeline.

Sasol Gas is the only transmission company functioning within the midstream gas business sector in South Africa, since PetroSA's gas transmission is for own use.

The ROMPCO pipeline is a free access transmission pipeline, connecting South Africa to Mozambique. This transmission infrastructure presents a corridor opportunity for anyone who has secured natural gas in Mozambique and is willing to pay transport charges. Empresa Nacional de Hidrocarbonetos (ENH) recently signed an agreement with ROMPCO to supply and sell 0.002 tcf natural gas annually in South Africa, starting September 2019.

At present, above ground natural gasholder facilities are the only type of natural gas storage in South Africa. Egoli Gas' main storage-station is located at Cottesloe, with three larger gasholders capable of storing around 0.00000001 tcf of natural gas. Secondary smaller storage facilities, with seven high-pressure gas vessels, are situated at Langlaagte.

3.3. Downstream Gas Sector

South Africa currently has one purpose-built GTL refinery situated in Mossel Bay, with a design capacity of 45,000 bbl/day. The GTL refinery operation is currently limited to one reformer and one synthol train mode because of the declining gas reserves.

The Sasol Secunda and Sasolburg Coal-to-Liquid (CTL) facilities were adapted to accept natural gas as feedstock. The Sasolburg facility was eventually converted to only run on natural gas.

The following distribution companies form part of the national downstream gas sector:

- **Sasol Gas**, supplying natural gas to approximately 320 clients in MP, FS, GP and KZN via traditional pipelines;
- **Spring Lights Gas**, supplying natural gas to approximately 23 clients in KZN via traditional and virtual pipelines;
- **Novo Energy and NGV Gas**, supplying natural gas to approximately 669 vehicles in GP;
- **Virtual Gas Network**, supplying four industrial users in GP;
- **Reatile Gastrade**, supplying natural gas to clients in GP an KZN via traditional gas pipelines;
- **Tetra4**, supplying CNG to CNG converted busses operated by Megabus in FS; and
- **Egoli Gas**, supplying approximately 7,500 residential and commercial clients in GP.

Competition within the downstream gas business sector may not be levelled, since Sasol Gas has a competitive advantage, being the only supplier of gas, exhibiting a price advantage over other traders. Appendix B contains the list of National Energy Regulator of South Africa (NERSA) - approved natural gas licensees [41].

3.4. Gas Sector Prices and Tariffs

The Gas Act (48/2001) makes a clear distinction between gas prices (charge for a gas molecule) and gas tariffs (charge for network or gas service). Gas charges in South Africa comprise of both prices and tariffs. Figure 3-3 illustrates the composition of the total charges for piped-gas in South Africa [27].

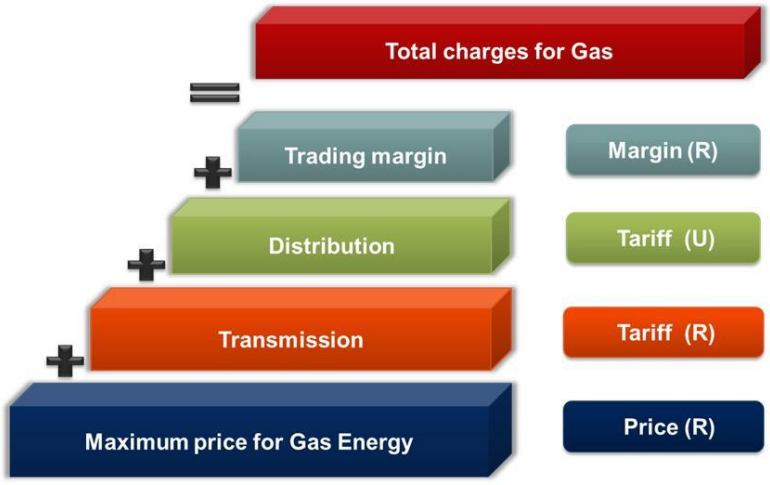


Figure 3-3: South African Piped-Gas Total Charge Composition

Table 3-1 contains the latest NERSA approved tariffs for transmission. Only Sasol Gas charges both transmission and distribution tariffs (including for the use of Transnet's Lilly Pipeline) [43] [40].

Table 3-1: Transmission Tariffs

Licensee		R/GJ
Sasol Gas	Zone 1 – Gauteng	6.01
	Zone 2 – Secunda-Middleburg	19.43
	Zone 3 – KwaZulu-Natal	6.25
ROMPCO	GTA 1	13.67
	GTA 2	11.56
	GTA 3	49.87
Transnet	Transnet Lilly Pipeline	6.34

NERSA is guided by piped-gas regulations when monitoring and approving piped-gas trading margins. The regulations provide that gas prices must enable the licensee to recover all efficient and prudently incurred investment and operational costs and make a profit commensurate with its risk. Table 3-2 presents a summary of the current and most recent trading margin application by Sasol Gas approved by NERSA [43].

Table 3-2: Sasol Gas Trading Margins

	Current R/GJ	1 July'19 – 30 June'20 R/GJ	1 July'20 – 30 June'21 R/GJ
Supply to end customer	*5.99*	*7.60*	*8.24*
Supply to traders	4.49	3.80	4.12

The methodology to approve maximum prices for piped-gas in South Africa makes provision for the gas trader to recover the transmission and distribution tariffs. Figure 3-4 summarises the maximum total charges for piped-gas to end customers for each of the current licensees [43].

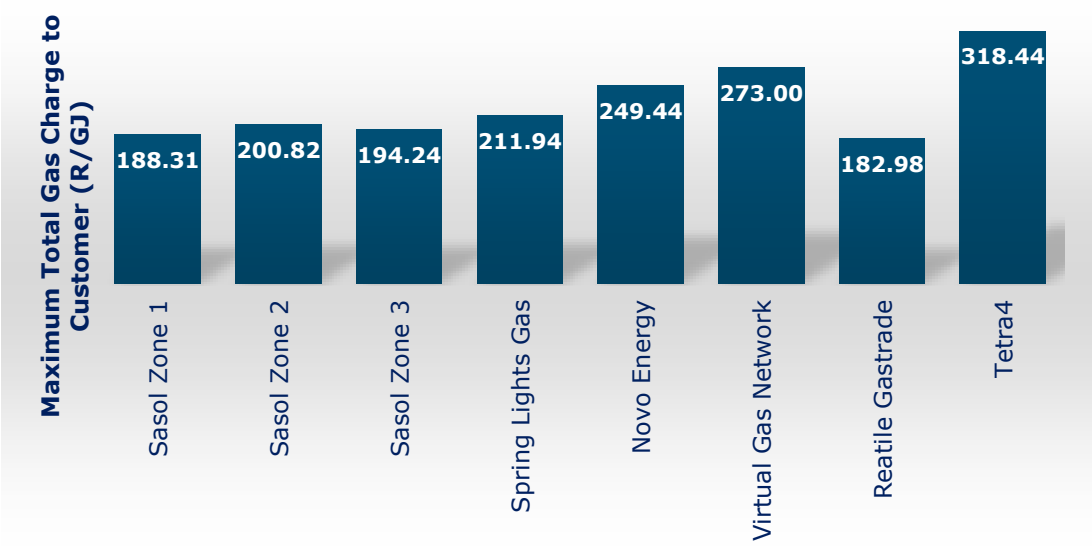


Figure 3-4: Maximum Total Gas Charges to End Customers by Licensee

4. Gas Supply and Production

4.1. Domestic Gas Reserves and Resources

Ten countries hold more than two-thirds of the world's total proven natural gas reserves according to the latest publications by US EIA, OPEC and BP. Although South Africa does not currently feature on any of the published proven natural gas reserve lists, the country has the potential to rank amongst the top 30 countries, provided the initial gas estimates, specifically unconventional natural gas reserves, hold true [7][18][46].

South Africa has several natural gas opportunities for local natural gas production, either from conventional (onshore/offshore) or unconventional (shale gas/coal bed methane) sources. Refer to Figure 4-1 for a simplified graphical representation of the domestic gas fields and their quantified reserve volumes. A map indicating the locations of these reserves and ongoing exploration activities along with the list of current exploration rights holders are available in Appendix A [50].

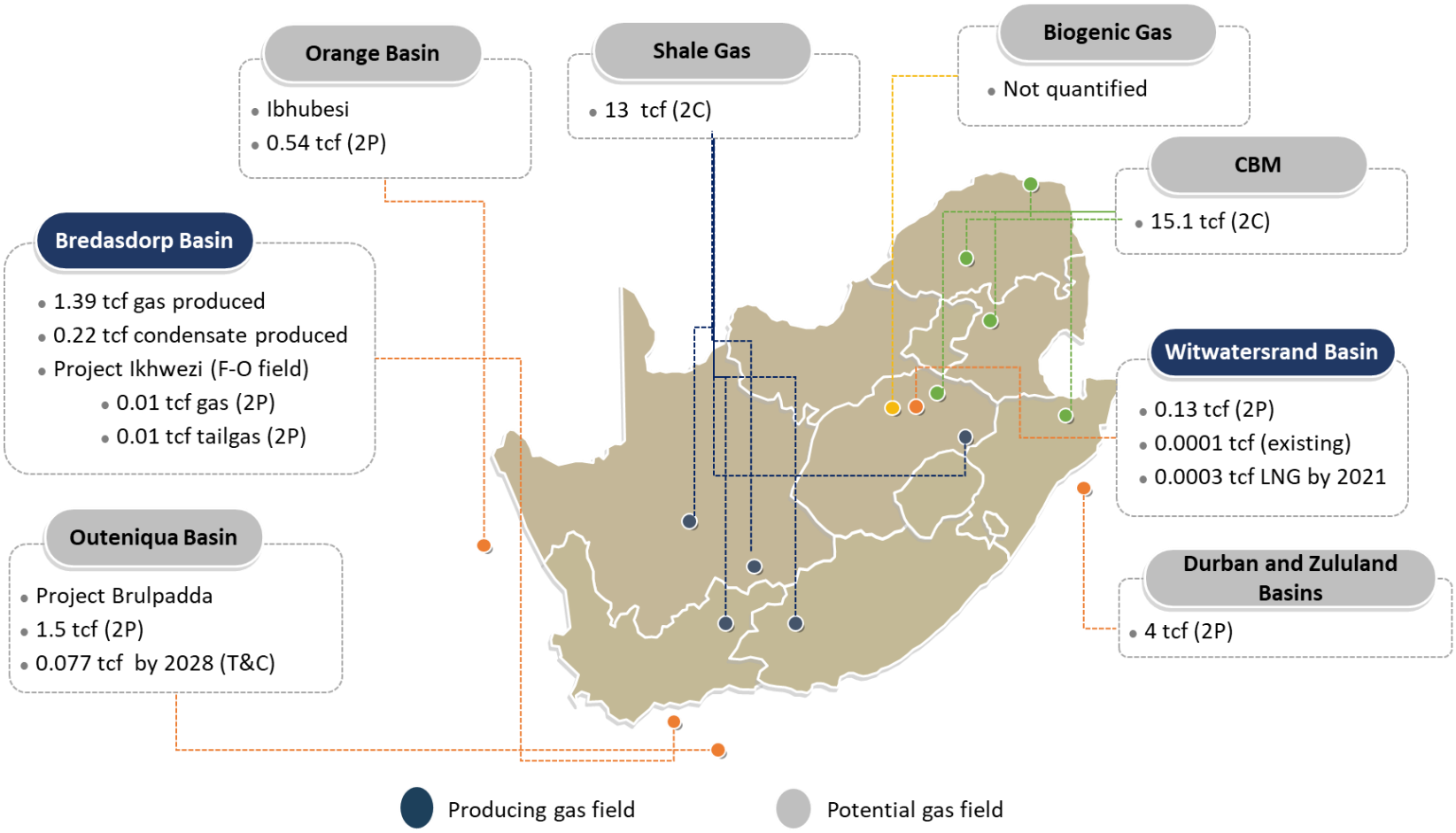


Figure 4-1: Domestic Gas Reserves

4.1.1. Orange Basin

The Orange Basin forms part of the Southwest African Coastal Basin, which lies offshore Namibia and western South Africa.

Ibhubesi is the most significant play in the South African portion of the Orange Basin to date. Independently certified gas reserves have been certified at 0.54 tcf (2P), with the best estimate perspectivity certified to be close to 8 tcf of gas. Ibhubesi Gas Projects were in negotiations with Eskom for the provision of gas to the existing Ankerlig Power Station, the DoE Independent Power Producer procurement program, as well as other major industrial users [58].

It is suggested that the Kudu-type play extends southwards into the South African portion of the Orange Basin, with the play currently being explored by companies with concessions over the northern and central parts of the Orange Basin.

4.1.2. Bredasdorp Basin

Petro SA has secured nearly 1.39 tcf gas and 0.22 tcf condensate feedstock for the GTL refinery from the F-A and Satellites, E-M, South Coast Gas and F-O gas fields [55].

Project Ikhwezi forms part of PetroSA's plan to secure additional reserves to sustain the Mossel Bay GTL refinery. Project Ikhwezi was expected to yield 0.24 tcf of gas though five wells [51]. The production volume recorded, from December 2013 until 31 March 2019, was 0.05 tcf, through three wells from the F-O gas field. The remaining F-O gas field reserve is estimated at 0.01 tcf (2P) and 0.01 tcf (2P) contingent resources (tailgas). The reserve is expected to sustain GTL operations until end-2029, but there remain further undeveloped contingent resources available in the F-O field [12].

4.1.3. Outeniqua Basin

Total and its partners announced early February 2019 that a significant gas condensate discovery had been made in Block 11B/12B, 175 km off the southern coast. The Brulpadda project's reserve is estimated at approximately 6 tcf of gas and condensate. Geophysical estimates have suggested a potential gas reserve in the range of 1.9 tcf, of which around 1.5 tcf (2P) can be recovered [48].

The experts estimated that, over a 20-year production period, with an average annual production of 0.077 tcf, the Brulpadda field could produce about 1.3 GW of baseload power in a 50% efficiency gas-to-power plant or if the resource were to be used for the production of diesel, it could produce around 21,000 bbl/d of fuel over a 20-year life [19]. The most probable use for the gas would be to serve as feedstock to PetroSA's GTL plant, due to proximity to existing infrastructure from the FA platform to Mossel Bay. The Brulpadda field could substitute the GTL plant's current waning gas reserve, preventing the plant from shutting down and the associated loss of jobs and infrastructure in South Africa.

The current timeline, subject to approval by partners and government, aims to obtain 2D/3D surveying between 2019 and 2020 and up to four exploration and appraisal wells drilled between 2020 and 2022 [26]. Production is only expected between 2027 and 2028, if the project reaches FID.

4.1.4. Witwatersrand Basin

The biogenic gas resource probable recoverable volume has been estimated at 0.13 tcf (2P), with associated helium reserves valued at 0.003 tcf. Tetra4, a subsidiary of Renergen, has reserved the rights to develop the onshore gas field situated near the town of Virginia, in the Free State province.

Given the unusual nature of this unconventional play, commercial exploitation of biogenic gas has become a reality with business opportunities for compressed natural gas (CNG) and liquefied natural gas (LNG) production, power generation supply and helium for industrial applications.

Renergen gas recently signed an offtake agreement with Anheuser-Busch InBev (AB InBev), subsidiary of South African Breweries (SAB) for the supply of LNG to power its delivery trucks. The company plans to commence full field development within two years but are still lagging the original targets for first gas and are currently raising funds for future developments. Renergen is targeting daily flow rates of 0.0017 tcf by 2022 and estimates that this will require 66 producing wells. There are 18 existing wells, of which 13 are considered suitable for use initially, with the remaining either located too far from the planned six pipeline locations or with lower flow rates.

EPCM Bonisana, a subsidiary of EPCM Holdings, will be responsible for building the gas gathering system connecting the gas wells for the project. The gas gathering system is a critical component to the project as it will reticulate all the gas to a centralised point for processing before the LNG and helium is moved to customers. The project will be developed over two phases, the first being the reticulation of the existing 12 wells, along with several new wells to be drilled in the coming months. This will result in the production of around 0.0003 tcf of LNG starting in 2021 [28].

4.1.5. Durban and Zululand Basins

The offshore Durban and Zululand Basins became of interest to the oil and gas industry following large discoveries along the eastern margin of Africa, most notably in Tanzania and Mozambique. The Petroleum Agency's gas-in-place prospective evaluation is estimated at 4 tcf [49].

Eni South Africa BV (Eni), and Sasol Africa Limited (Sasol) hold an Exploration Right off the East Coast of South Africa and are in the process of obtaining final approval for conducting an exploration drilling programme in Block ER236 (12/3/236) to assess the commercial viability of the hydrocarbon reservoir for future development. The drilling program and time schedule proposed by Eni is to drill at least one exploration well within the northern or southern areas of

interest between November 2019 and March 2020. If the first exploration well shows a hydrocarbon discovery, up to two exploration drilling wells at different locations and up to three appraisal wells will follow [21].

4.1.6. Unconventional

4.1.6.1 Shale Gas

The southern Main Karoo Basin is the most prospective area for shale gas in South Africa. Exploration right applications have been received from Shell International, Falcon Oil and Gas, in partnership with Chevron and Bundu Gas. The shale as resource in the Karoo Basin is unknown, due to the scarcity of relevant geoscientific data, but the preliminary estimate of the technically recoverable resource is speculated to be 30 tcf (2C) [1] [48].

A major investment in infrastructure of this remote and arid region of South Africa will be required to ensure economic viability. These reserves have not reached commercial extraction, and their economic viability is still to be confirmed.

4.1.6.2 Coal Bed Methane

There is great interest in the coal bed methane (CBM) potential of South Africa's Ecca Group coal deposits in the north-eastern Main Karoo Basin. The most significant exploration work conducted in the northern Karoo Basin has occurred in Lephalale, Mopane and Ermelo coalfields.

Lephalale Basin is the country's most promising target for CBM exploration at present. Anglo Thermal Coal has reported a technically recoverable reserve of 1 tcf, with the Petroleum Agency's gas-in-place evaluation estimated at 4 tcf (2C) [48].

Springbok Flats Basin is largely untested, and the Petroleum Agency's gas-in-place estimation is in the order of 2 tcf (2C) [48].

Mopane Sub-Basin, in the *Soutpansberg Basin*, is considered favourable for the occurrence of CBM, similar to the successfully developed Lephalale Basin. The Petroleum Agency's gas-in-place estimation is in the order of 1.2 tcf (2C). The exploration license is held by Sunbird (74 %) and Umbono (26 %), with newly drilled data suggesting a resource potential of 1.9 tcf [48].

Tshipise-Pafuri Sub-Basin, in the *Soutpansberg Basin*, is also considered favourable for the occurrence of CBM. The Petroleum Agency's gas-in-place estimation is in the order of 1.6 tcf (2C) [48].

Tuli Basin is considered favourable for the occurrence of CBM and the Petroleum Agency's gas-in-place estimation is in the order of 1.4 tcf (2C) [48].

Ermelo Coalfields comprises of Amersfoort Gas Project, which is the most promising target for CBM production, since the area is nearby existing coal-based energy and power generation

infrastructure and within proximity to major industrial, mining and manufacturing areas. Afro Energy has drilled 21 exploration core holes and prospective resources are estimated to be approximately 2.4 tcf (2C) of gas-in-place [48].

Highveld Coalfields is considered favourable for the occurrence of CBM and based on the Petroleum Agency's evaluation, could potentially host gas-in-place resources in order of 2.5 tcf (2C) [48].

4.1.6.3 Biogenic Gas

Gas encountered within the coal-bearing Karoo strata in the region is believed to have migrated from the underlying Witwatersrand Basin, which is biogenic in origin and is thus constantly replenished. Given the unusual nature of this unconventional biogenic play, the volume of technically recoverable gas resource has not yet been quantified.

4.2. Regional Gas Reserves and Resources

Four of the largest potential natural gas producing countries in Africa, namely Zimbabwe, Mozambique, Namibia and Botswana, are neighbouring South Africa. Due to the proximity, sourcing from these countries would be ideal. South Africa also has the opportunity for regional supply from Angola and Tanzania. Figure 4-2 presents a graphical illustration of the geographical locations of the potential South African Development Community (SADC) natural gas supply countries.

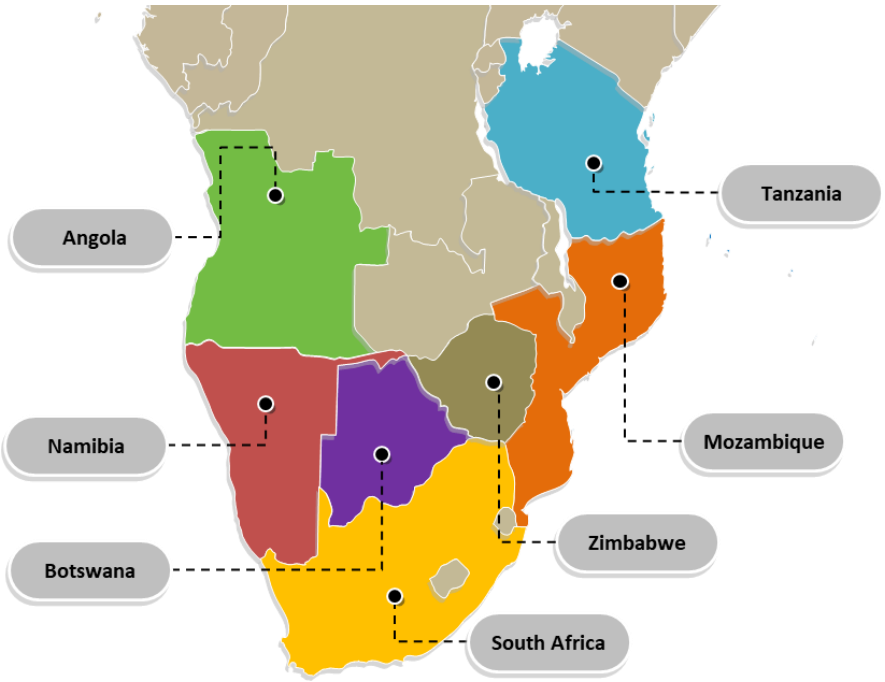


Figure 4-2: SADC Regional Gas Supply Options

4.2.1. Angola

The Angola LNG project, situated in Soyo in the Zaire district, became operational in early 2013. The project is the result of a partnership between Sonangol, Chevron, BP, ENI and Total, to collect, process and launch 0.25 tcf of LNG in the global market annually. The facility utilizes associated gas resources, primarily from shallow-water fields, for LNG production. The facility is currently restricted to produce below 0.25 tcf per annum and more wells are required to ensure stable, long-term production rates [35].

Angola LNG has signed an offtake multi-year agreement with Vitol and Glencore for the supply of LNG. Agreements have also been reached with Germany's RWE to deliver LNG products [22]. According to Oil Review Africa, Angola has been selling all its LNG through competitive tenders in the global spot market.

4.2.2. Botswana

Botswana discovered CBM reserves in the Lesedi region. The Lesedi CBM project has an independently certified contingent gas resource of 3.2 tcf. The concessionaire Tlou Energy places the commercial proven reserves at 0.15 tcf and commercial possible reserves at 0.26 tcf. Drilling contractor has spudded its first well named Lesedi 3P in October 2018. The well is planned to be drilled to a proposed total depth of 580 m and production start-up is targeted to commence in 2019. The wells will be operational for an extended period to dewater and lower the pressure in the coal seam to achieve gas flow. Initial 100 MW CBM-to-power projects, includes offtake agreements with Botswana Power Corporation. Further discussions for other offtake agreements are currently underway [65].

4.2.3. Mozambique

Mozambique has the largest gas discoveries among the focus countries. It already produces gas from its Pande and Temane fields, has discovered large volumes of offshore gas (approximately 180 tcf, concentrated in the Rovuma basin), and has an unquantified onshore potential (e.g. CBM prospects in Tete). Combining all the recoverable reserves (onshore, offshore and CBM), Mozambique could supply as much as 3.9 tcf annually by 2030.

Given Atlantic Basin competition, South Africa may not be the first market of choice for Mozambique's LNG. Even if a substantial part of these volumes would be initially reserved for export through LNG, vast potential remains for regional supply. South Africa is Mozambique's neighbour and has an established and deep trading relationship, and significant existing investment by South Africa into Mozambique [61].

South Africa has purchased natural gas from Mozambique, through Sasol Gas, since 2004. The project served as a milestone in Southern African energy and infrastructure development, initiating a much-needed broadening of the energy supply mix in the region and impacting positively on both the Mozambican and South African economies. The development provided an

anchor offtake to facilitate development of gas fields in Mozambique, which in turn stimulated the development of South African and Mozambican gas markets.

The Petroleum Production Agreement (PPA) resulted in expansion of South Africa's industrial sector, with the existing industrial companies combined economic contribution amounting to more than R 150 billion per annum, providing employment for over 46,000 South Africans [29]. The Pande and Temane gas field reserves are declining and the imminent gas supply shortage could be catastrophic for South Africa's economy and labour force.

A Production Sharing Agreement (PSA) licence is set to bring about the next wave of development, supporting the Mozambican Government's drivers for in-country monetisation, energy security, further industrialisation and skills development. Unfortunately, Sasol's negotiation with the Mozambican Government for the PSA seems to be at a deadlock, emphasising a potential lack in security of gas supply to South Africa.

The Golfinho project in Mozambique has been provided a loan facility of approximately 1 billion USD by Standard Bank, underwritten by the Export Credit Insurance Corporation of South Africa and a similar loan facility is expected for the Rovuma LNG project. These Mozambican projects thus offer significant opportunities for South African industrial players to ramp up their capacity and supply a wide variety of value-added products into these projects [63].

Wood-Mackenzie estimates the total recoverable Rovuma reserves at approximately 120 tcf. Relatively small offshore reserves were also found at the Njika and Buzi fields, totalling nearly 1.3 tcf of recoverable reserves.

An early development plan is underway for a 2,600 km gas pipeline from the Rovuma Basin in northern Mozambique to Gauteng, South Africa. A cooperation agreement has been signed between ENH, Profin Consulting, SacOil and China Petroleum Pipeline Bureau. The consortium's next task is to conduct a feasibility study to determine the possible economic benefits for the project and these results will determine the future steps for the project [34].

The Anadarko-operated Mozambique LNG project will be Mozambique's first onshore LNG development. The total recoverable reserves are estimated at 63 tcf, although none of the fields are currently producing. Initially consisting of two LNG trains, with a total annual capacity of 0.58 tcf, which can be expanded to 2.44 tcf per annum. Final Investment Decision (FID) was announced in June 2019 and production is expected by 2024.

The partners in the Mozambique Rovuma Venture submitted the development plan to the government for the first phase of the Rovuma LNG project, which will produce, liquefy and market natural gas from the Mamba fields located in the Area 4 block offshore Mozambique. The plan details the proposed design and construction of two LNG trains which will each produce 0.37 tcf per annum [44]. FID is expected by 2019 and production is anticipated by 2024.

The Coral South project is the first LNG project in Mozambique, led by ENI, to exploit the huge reserves of Area Four in the Rovuma Basin through the first worldwide ultra-deep floating LNG plant. Area Four comprises a total recoverable gas reserve of 58.2 tcf, with 17.6 tcf currently estimated to be commercially recoverable. The production capacity is 0.17 tcf, for 25 years, starting 2022.

In addition to these recent offshore discoveries, Mozambique is already producing gas from its onshore Pande and Temane fields, with the remaining recoverable reserves estimated at 2.3 tcf. Production is also expected to come online from the adjacent Inhassoro PSA, which has recoverable reserves of 0.4 tcf (100 % owned by Sasol). All three fields feed the ROMPCO pipeline to Secunda.

Mozambique is expected to have unconventional gas potential from its CBM resources in the Tete region. These reserves are still unquantified and would likely be more economically challenging to develop compared to the country's conventional gas reserves.

4.2.4. Namibia

The Kudu gas field, situated offshore southern Namibia, have proven and probable recoverable reserves estimated at more than 3.3 tcf [52]. Transporting gas by pipeline from the Kudu gas field in Namibia to the East Coast region has proven to be commercially challenging, with various studies on the technical and commercial viability proving marginal results. More importantly, the government of Namibia have indicated a preference to use natural gas for indigenous requirements rather than for exportation to South Africa. Although Kudu was discovered in 1974 it has not been developed and if Kudu comes online by 2030, Namibia's annual gas supply potential is estimated at approximately 0.04 tcf.

4.2.5. Tanzania

Tanzania's natural gas reserve is estimated at 57.5 tcf. Currently, the natural gas extracted is for domestic use rather than exportation.

Tanzania expects a consortium of internal oil companies to start building a long-delayed LNG project in 2022. Equinor, alongside Royal Dutch Shell, Exxon Mobil and Ophir Energy and Pavilion Energy, plan to build the onshore LNG plant in the Lindi region. The project will have a capacity of 0.49 tcf LNG annually. Construction is expected to commence in 2022 and will be concluded in 2028 [53].

4.2.6. Zimbabwe

Invictus Energy raised prospects of natural gas in Mzarabani and Msasa, which could result in Zimbabwe joining countries in the SADC region as leading natural gas producers. The Mzarabani Prospect's natural gas reserve was independently estimated at 9.25 tcf by Getech Group Plc, with the net mean recoverable conventional potential estimated at 6.5 tcf. Invictus has

committed to drill an exploration well by 2020 provided funding is secured. In addition, the Msasa Prospect is estimated to contain 1.05 tcf on a total gross mean unrisked basis [32] [45].

South Africa is one of the potential off-takers earmarked for the natural gas reserve, in addition to Zambia.

CBM reserves were discovered in the Lupane-Lubimbi area a few decades ago, but commercial exploitation has not taken off. The reserve is estimated at over 0.02 tcf. Exploration and pilot production have since been conducted and results indicate that the resource can be exploited commercially [3].

The gas fields remain undeveloped and the prospective resource relates to undiscovered accumulations which have both a risk of discovery and a risk of development.

4.3. Global Gas Reserves and Resources

According to the BP Statistical Review of World Energy, the total global proven natural gas reserves at the end of 2018 was nearly 6,952 tcf, with the distribution of global reserves shown in Figure 4-3 [7]. Figure 4-5 displays the global potential LNG supply projects, with expected FIDs between 2019 and 2023 [5].

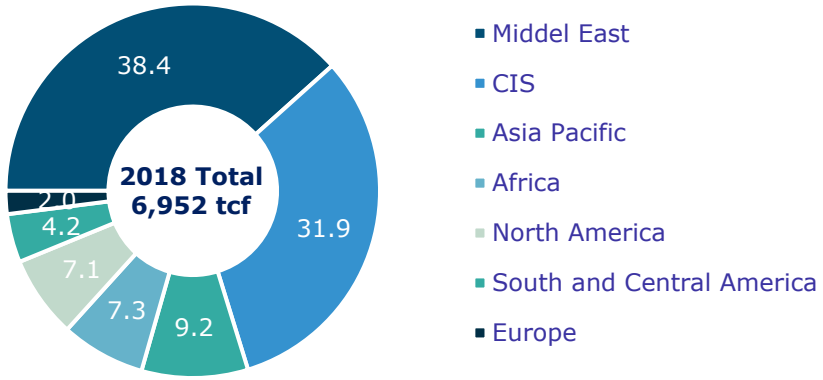


Figure 4-3: Global Natural Gas Proven Reserve Percentage Distribution

The highest ranking global natural gas exporters for 2018 are depicted in Figure 4-4 [7]. The LNG supply capacity, above the structural demand growth in 2019, amounts to 0.78 tcf per annum, to be potentially leveraged [5].

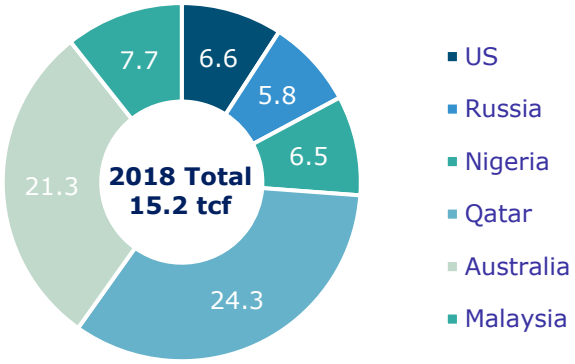


Figure 4-4: Global Natural Gas Exporters Percentage Distribution

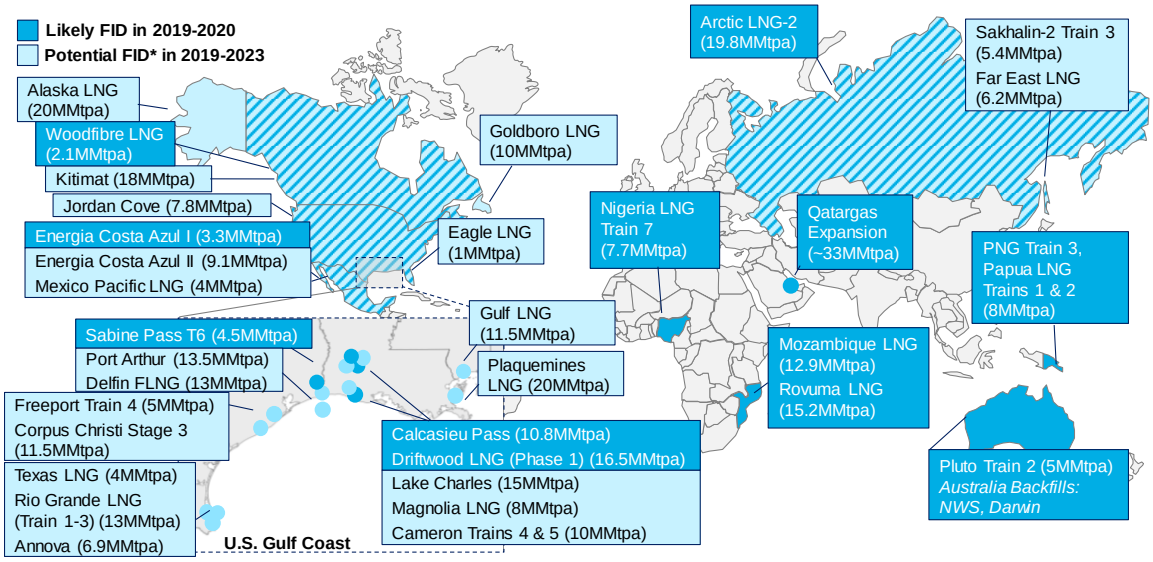


Figure 4-5: Potential LNG Supply Project FIDs in 2019-2023

The major natural gas trade movements, either through inter-regional pipelines or LNG industries, are indicated in Figure 4-6 [7].

North America and Europe are the dominant piped gas markets, while major suppliers, such as Australia and Nigeria, connect with key Asian markets through the LNG industry.

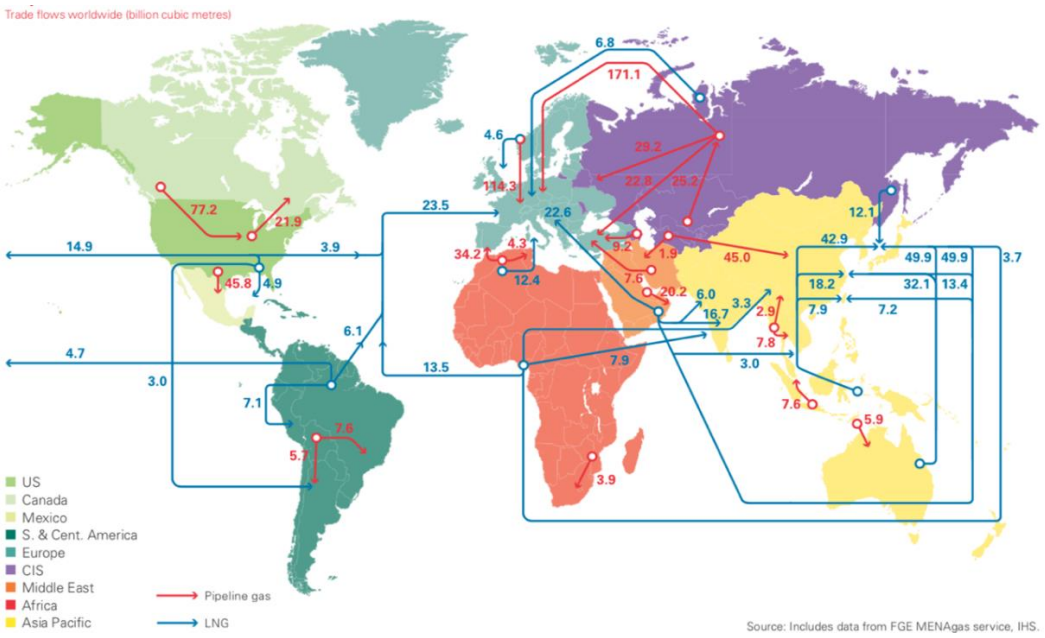


Figure 4-6: 2018 Major Natural Gas Trade Movement

4.3.1. BRICS Countries

4.3.1.1 Brazil

At the end of 2018 Brazil had 13.4 tcf of proven natural gas reserves. The country produced 0.9 tcf in 2018, but consumed 1.27 tcf, indicating a net deficit of natural gas available, with inter-regional trade accounting for the remaining 0.37 tcf. Although Brazil exports LNG, the country's exporting capacity decreased significantly over the past few years, accounting for only 0.004 tcf in 2018 [7].

Gas consumption in Brazil's power sector is volatile and highly dependent on the availability of hydropower. The prolonged drought has caused an increase in Brazil's power sector's gas demand and consumption is foreseen to outpace production despite the large potential from major gas fields. Brazil is expected to be net importer until the end of the next decade, with the change in pace of production from 2025 providing the potential for Brazil to enter the following decade as a net exporter of natural gas.

4.3.1.2 Russia

Russia increased their natural gas production by 1.2 tcf during 2018 and has 1,375 tcf of proven natural gas reserves. The country produced 23.6 tcf in 2018 and consumed 16.1 tcf, indicating a net surplus of natural gas available. Russia exported 8.75 tcf in 2018 via inter-regional trade, with 0.88 tcf dispatched as LNG [7].

Russia remains a major power in global politics. Geopolitical risks remain prevalent and care should be taken to not fall victim to the contemporary "geopolitical chess" game played by the major powers on the continent.

4.3.1.3 India

India has 45.5 tcf of proven natural gas reserves. The country produced 0.97 tcf in 2018 but consumed 2.05 tcf, indicating a net deficit of natural gas available, with inter-regional LNG trade accounting for the remaining 1.08 tcf [7]. As a net importer of natural gas, it is highly improbable to obtain gas supply from India.

4.3.1.4 China

China has 214.4 tcf of proven natural gas reserves and accounted for nearly half of the global increase in natural gas imports (0.74 tcf) during 2018, showing an above-average growth in natural gas consumption of 17.7% (1.52 tcf). The country produced 5.70 tcf in 2018 but consumed 9.99 tcf, indicating a net deficit of natural gas available, with inter-regional trade accounting for the remaining 4.28 tcf [7]. China's increase in natural gas consumption is driven by continuous economic growth and strong policy support to curb air pollution ("Blue Skies" policy). Similar to India, China is a net importer of gas, with a growing gas demand, emphasizing the improbability of China functioning as a future gas supplier.

4.3.2. Non-BRICS Countries

4.3.2.1 Australia

At the end of 2018 Australia had 84.4 tcf of proven natural gas reserves. The country produced 4.59 tcf in 2018 and consumed 1.46 tcf, indicating a net surplus of natural gas available. Australia exported 3.24 tcf in 2018 via LNG terminals and was rated the second largest global LNG exporter [7].

4.3.2.2 Malaysia

At the end of 2018 Malaysia had 84.5 tcf of proven natural gas reserves. The country produced 2.56 tcf in 2018 and exported 1.17 tcf in 2018 via LNG terminals [7].

4.3.2.3 Nigeria

At the end of 2018 Nigeria had 188.8 tcf of proven natural gas reserves. The country produced 1.74 tcf in 2018 and exported 0.98 tcf in 2018 via LNG terminals [7]. Nigeria LNG has plans to increase annual LNG production capacity to approximately 1.46 tcf [31].

4.3.2.4 Qatar

Qatar is the world's largest LNG exporter and recorded 872.1 tcf of proven natural gas reserves by the end of 2018. The country produced 6.20 tcf in 2018 and consumed 1.48 tcf, indicating a net surplus of natural gas available. Qatar exported 3.70 tcf in 2018 via LNG terminals [7].

4.3.2.5 Saudi Arabia

Saudi Arabia has 208.1 tcf of proven natural gas reserves and produced 3.96 tcf in 2018. All the natural gas produced during 2018 was used to meet the region's local demand, despite a 2.6 % annual production growth rate being reported [7].

Saudi Arabia plans to become a major gas exporter within a decade and announced that it will invest US$150 billion to enable it to export 0.11 tcf gas annually by 2030 [24].

4.3.2.6 United States

The United States (US) accounted for almost 40 % of the global demand growth in 2018 and recorded over 45 % increase in natural gas production. At the end of 2018 the US had 419.8 tcf of proven natural gas reserves. The country produced 29.4 tcf in 2018 and consumed 28.9 tcf, indicating a net surplus of natural gas available. The US exported 2.39 tcf in 2018 via inter-regional pipelines and 1.00 tcf was dispatched via LNG terminals [7].

4.3.2.7 Portfolio Suppliers

Natural gas delivered by means of LNG could also be sourced from international portfolio suppliers. These companies hold a portfolio of supplies either as operator or owner throughout the world and typically include International Oil Companies (IOC's) such as Chevron, Shell, BG, BP, StatoilHydro, ExxonMobil, Total and others. In most cases such IOC's will internally decide from where it will supply volumes in order to optimize the LNG shipping fleet operations and production capabilities from the various LNG plants or option supplies. One of the advantages of international portfolio suppliers is the security of supplies; should LNG tonnage not be available from one of the supplier's plants it could secure supplies from another plant with additional LNG tonnage.

5. Gas Utilisation Options

Global demand for natural gas is forecast to increase at an average rate of 1.6 % over the next 4 years, with emerging Asian markets as the main engine for demand [31]. Global natural gas consumption growth has been primarily driven by changes in patterns of economic activity, energy intensity and energy substitution.

Globally, the gas industry sector is set to replace power generation as the main driver of growth, with natural gas being used not only as energy source for processes, but also as feedstock for

chemicals, including fertilisers in emerging economies and feedstock for petrochemicals. Natural gas use in transportation is also expected to grow strongly by 3.3 % per annum predominantly within long-distance road haulage and marine, while gas demand in residential and commercial sectors will benefit from the ongoing coal-to-gas switch [6] [30]. Residential and commercial demand will also be driven by the desire to switch from electricity to more a reliable form of energy, such as natural gas.

The utilisation options for natural gas in South Africa are thus power generation, industrial co-generation, CNG vehicles, petrochemical synthesis, residential/commercial heating and future exportation.

It is anticipated that the power and industry sectors will initially account for nearly 95 % of the gas market (57 % power sector and 37 % industry sector), since these are the most prominent sectors forming part of the existing demand base, with transport making up the remainder of the market. Although transport could contribute a sizeable volume in future, it remains small relative to the existing gas landscape and is unlikely to anchor gas development.

5.1. Power Sector

More than 90 % of South Africa's electricity is generated from coal and it is anticipated to remain the main fuel source for power generation.

Power generation has been clearly identified as the priority sector for gas utilisation in the draft IEP and IRP 2019, aiming to increase the national energy mix's natural gas contribution from 2.6 % to 15.7 % by 2030 [14] [15]. The existing Open Cycle Gas Turbine (OCGT) peaking plants present an ideal opportunity for conversion to natural gas, with the potential to realize substantial savings of more than 30 %.

Nationally, there are six OCGT plants currently utilising diesel as fuel source. These OCGT plants, with a combined installed capacity of nearly 4 GW, could be powered by natural gas and potentially be converted to closed cycle operations, presenting both a cheaper and cleaner source of energy with potentially higher energy output.

Further opportunities exist in converting mothballed coal fired power plants to run on natural gas. This opportunity will save substantial time and capital expenditure when compared with building new generation facilities and present the opportunity of recovering previously lost jobs when facilities were closed.

The power sector presents an immediate source of secure and growing natural gas demand, with attractive margins at low-risk as existing OCGT plants are ready to convert to Combined Cycle Gas Turbine (CCGT) plants, in addition to new gas-based thermal plants at various stages of development.

The benefit of prioritising gas for power generation provides for large and concentrated volume of offtake, making the development of gas transmission infrastructure easier and more financially viable.

To ensure the gas-to-power sector's development can keep pace with demand and incentivize necessary investment, the regulatory framework to ensure financial viability exists for all parties, is paramount. This applies to both the electricity as well as the gas sector. Cost reflective tariff and pricing, institutional and regulatory certainty, and ensuring gas security of supply will be the main features acting as gas-to-power demand drivers.

Power generation represents one of the most economically attractive, low-risk and urgent demand sectors for natural gas supplies. The financial viability of the sector must be secured in order to incentivize supply and new investment.

5.2. Non-Power Sectors

5.2.1. Industrial Sector

Low-risk industrial use is attractive because it can be expanded in an incremental fashion, primarily to supply domestic demand.

Low pressure pipelines can be established in industrial areas to supply natural gas to factories for heat in industrial processes. In these circumstances, gas will compete with other fuel sources, notably Residual Fuel Oil (RFO) and Liquefied Petroleum Gas (LPG). Where infrastructure for pipeline gas can be provided to allow the cost differential to RFO and LPG to be sufficiently attractive to incentivize switching, industrial heating uses may present an additional source of low-risk incremental demand for natural gas. Industrial usage has appeared most successful where it has grown in incremental fashion rather than via focus on select 'champion' industries through proactive industrial policy. Textile, cement, steel, paper and fertilizer production facilities provide notable supplementary low-risk demand in a market where economic rationale for gas usage is the main driver.

For natural gas to become attractive, it would have to offer a cost advantage over LPG, after accounting for the significant capital required to establish urban distribution networks. Depending on the loads, this demand may be met through an offtake from gas transportation lines (for large offtakes) or local gas distribution networks or via combined heat and power supplying a district heating network.

5.2.2. Transport Sector

Natural gas can be used in a pressurized state, known as Compressed Natural Gas (CNG), for transportation as an alternative to petrol and diesel fuels. CNG use has proved popular in several markets where the cost of standard fuel options is high, which is particularly true among urban taxi and bus transportation fleets.

The main constraints to CNG vehicle use are the absence of infrastructure (including both compressors, which require reliable electricity supply, and a network of fueling stations); the capital cost of converting vehicles; poorer performance of vehicles; uncertainty over the future gas-oil price spread; and large storage space requirements. Targeting the conversion of dedicated fleets, rather than a general conversion of all vehicles on a voluntary basis, helps reduce the impact of all these challenges, particularly by allowing for localized refueling infrastructure to be developed.

CNG for transportation could be incrementally rolled-out in other provinces, with the benefit of releasing LPG and oil products for other uses. Risks would be minimized by making CNG available in the first instance for dedicated taxis and goods transport fleets, with vehicles tuned to operate efficiently on CNG.

Infrastructure, high capital costs and storage issues present barriers which may be addressed by concentrating on dedicated fleets in specific areas and providing financial support for conversion cost, possibly recouped through taxation on the CNG supply.

5.2.3. Residential/Commercial Sector

Residential and commercial demand for gas through distribution networks is commonly accepted to require space heating demand due to cold climate conditions in order to be economically viable. In the absence of such demand in South Africa and with the widespread use of LPG for cooking, this is not recommended as a priority utilisation area for natural gas.

Residential and commercial distribution networks are seen either as uneconomic or long-term options.

5.2.4. Export Sector

If and when supplies from domestic gas production are able to sufficiently meet local demand, exports might present an option. Such gas exports would likely be in the form of Liquefied Natural Gas (LNG) and would require a liquefaction facility and an export terminal.

Once domestic demand is adequately met, particularly for electricity generation, and sufficient gas becomes available to justify the construction of an LNG liquefaction facility and export terminal. Alternatively, it could be more beneficial to export electricity or any other commodity in high demand instead of gas. The final choice will be based on the expected margin to be gained; the level of risk associated with an investment, and the potential wider economic benefits.

6. Gas Demand

6.1. Existing Gas Demand

The current natural gas consumption in South Africa is 0.15 tcf, with an average annual growth rate of 1.6 % over the past decade. Approximately 2.6 % of South Africa's primary energy needs are sourced from natural gas [7].

6.1.1. Gas Importation

Sasol Gas imports approximately 0.14 tcf of natural gas into South Africa annually via the ROMPCO pipeline, of which 0.10 tcf of natural gas is for internal use.

6.1.2. Gas Domestic Production

PetroSA's GTL refinery in Mossel Bay consumes nearly 0.014 tcf of natural gas annually, supplied from their FA platform.

Tetra4's existing CNG plant in Virginia, can produce up to 0.0001 tcf annually from one well, to its customer, Megabus.

The Sasol Secunda plant produces close to 0.018 tcf methane rich gas annually, which along with the remainder of imported natural gas from the ROMPCO pipeline, is sold to external clients.

6.2. Gas Demand Forecasting

Demand planning has two traditional approaches, namely top-down (purely economic drivers considered) and bottom-up (purely relying on the projected population numbers). Since cost-drivers do not play the most important role in developing economies and cannot take informal sector energy needs into account in the top-down approach, and the bottom-up approach cannot take energy shortages and development subsidies into account, neither the top-down nor the bottom-up demand planning tools will suffice for developing regions such as Sub-Saharan Africa.

The Long-range Energy Alternatives Planning (LEAP) modelling tool allows for the combination of both the top-down and the bottom-up assessment tools, therefore allowing an assessment of the total system inputs for a developing region.

Two development scenarios for Sub-Saharan Africa (SSA) were considered [47]:

- **Reference Scenario**, which is the expected natural gas demand under the **Business As Usual Scenario** with the main purpose of enabling quantification of all existing policies. The reference scenario is associated with an economic development that will follow past trends, a continuation of development of technology and science progress, a smooth development of urbanisation and industrialisation, and a gradual development of the transport sector with population growth rate, urbanisation, and income progress. The

natural gas demand in 2040 is forecast to reach nearly 1.38 tcf in SSA, with an average annual growth rate of 6.5 %; and

- **Accelerated Energy Access (AEA) Scenario**, which assumes a significant improvement in energy access. This scenario models the African Development Bank's Energy New Deal for Africa that targets universal access by 2025 in Africa. Natural gas consumption is forecast to reach 11.89 tcf in 2040, with an initial average annual growth rate of 22 % for SSA until 2025, followed by 0.5 % thereafter. This scenario illustrates the most ambitious approach, but this rate has not yet been met.

Overall, natural gas demand under each scenario is predicted to increase steadily until 2040, but at different growth rates. The natural gas demand forecasts are graphically depicted in Figure 6-1 [47].

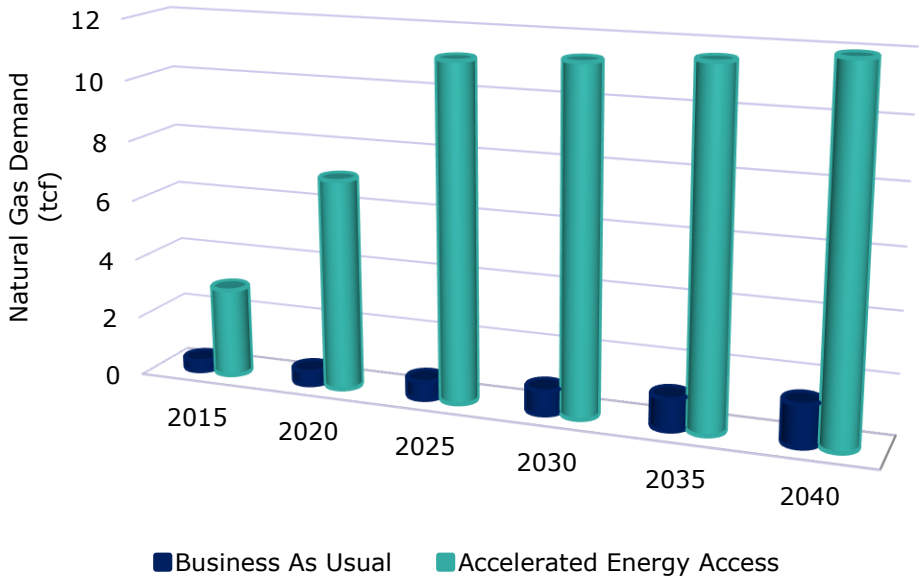


Figure 6-1: SSA Natural Gas LEAP Forecast

The Business As Usual and Accelerated Energy Access scenarios represent alternative development pathways and is indicative of the lower and upper limits of future natural gas demand in SSA, respectively.

6.3. Future Gas Demand from Power Sector

To meet the National Development Plan for South Africa by reducing the power generation's dependency on conventional coal, more gas-to-power facilities must be developed [14] [39]. To enable this development, the natural gas distribution network will have to be upgraded to meet the demand where it is needed.

Distribution pipelines (most economical option from source to consumers) to the following gas-to-power generation facilities are required [15]:

- Avon OCGT (KZN);
- Dedisa OCGT (EC);
- Ankerlig (WC);
- Gourikwa (WC);
- Acacia (WC); and
- Port Rex (EC).

Gas could play a crucial role in moving South Africa towards transactive energy, where utilities move towards customer centric demand, in that grids become less passive and deterministic, and more active and stochastic, as it has features which are flexible and modular enabling a decentralised system. The following coal-fired power stations are reaching end of life cycle before 2030 and distribution pipelines to facilitate partial or complete conversion to natural gas are required [15]:

- Arnot Power Plant (MP);
- Camden Power Plant (MP);
- Grootvlei Power Plant (MP);
- Hendrina Power Plant (MP);
- Kendal Power Plant (MP); and
- Kriel Power Plant (MP).

The opportunity associated with partially or completely converting mothballed coal fired power plants will save substantial time and capital expenditure when compared with building new generation facilities and present the opportunity of recovering and/or preventing associated job losses.

The City of Tshwane is also planning to revive plans to lease and upgrade its two power stations:

- Rooiwal Power Plant (GP); and
- Pretoria West Power Plant (GP)

with the aim of transforming the feedstock usage from anthracite (a grade of coal that is more profitable to export) to natural gas [33].

6.4. Future Gas Demand from Non-Power Sectors

6.4.1. Petroleum Sector

South Africa has a sizeable capital stock and management capacity to produce fuel from gas. Unfortunately, South Africa is a net importer of petroleum products, indicating a lack of local production capacity or efficiency. PetroSA's purpose-built GTL refinery, with a design capacity

of 45,000 bbl/day, is currently limited to one reformer and one synthol train mode because of the declining gas reserves.

The national petroleum demand for 2018 was approximately 27,800 ML, with South Africa currently producing 5% of its petroleum products from gas, 35% from coal and 50% from local crude oil refineries (which relies on imported crude oil), as illustrated in Figure 6-2 [9] [16].

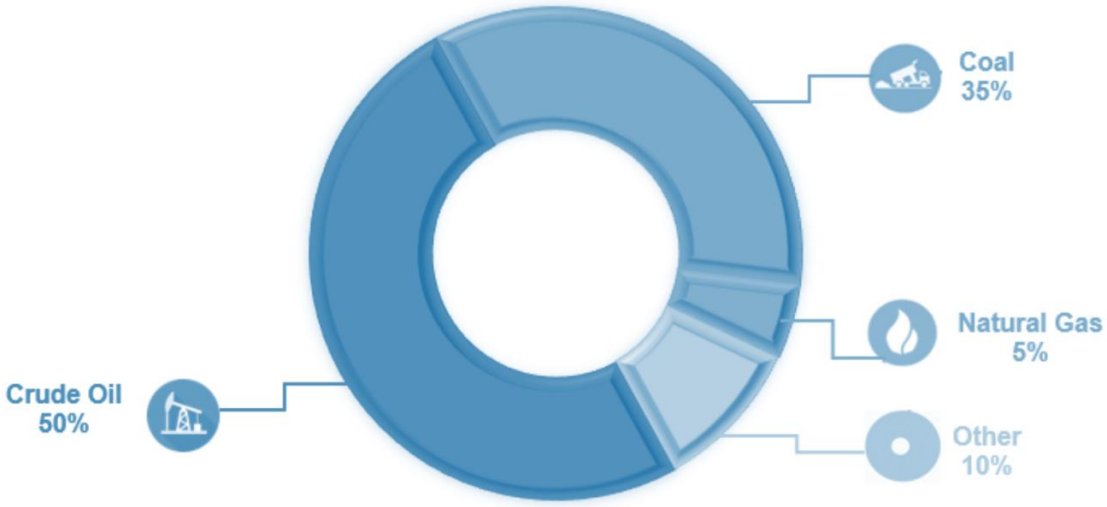


Figure 6-2: South Africa's Petroleum Product Resources

6.4.2. Transport Sector

South Africa has been in the backend of the global revolution to find a cleaner, environmentally friendlier, and mostly, a more economical source of fuel in the public transport sector.

Gas is a cheaper and cleaner alternative to traditional fuels of diesel and petrol and its availability in South Africa will not only provide a cheaper, more cost-effective fuel alternative, the additional environmental benefits will also impact the country's economic future.

Focusing on public transport fleets will allow for refueling from the same station since these fleets run circular routes.

6.4.2.1 Taxi Industry

The taxi industry is the most important part of South Africa's public transport system. The taxi industry employs more than 600,000 people and transports over 15 million commuters per day, according to the taxi council. Commuter utilization of taxis, as their daily mode of transport, has increased by 25 % over the past five year period, representing 75 % of all public transport. Taxis are the backbone of South Africa's public transport, and critical for lower-income groups to commute to work, to consider job opportunities and to link people with services.

There are approximately 250,000 minibus taxis currently doing business in South Africa, consuming close to 3 billion litres of fuel annually [56]. Most of these taxis are operating in Gauteng, followed by KwaZulu-Natal, Mpumalanga and the Western Cape. Faced with rising petrol prices which lead to fare hikes for millions of commuters, the multibillion-rand taxi industry is looking at gas as an alternative source of fuel.

A pilot study conducted by CNG Holdings, regarding the potential fuel cost saving associated with the conversion, documented a fuel cost saving of nearly 44 % [62].

The initial capital expenditure is recovered in lower fuel prices, with savings ranging between 24 % - 44 % depending on the route operating conditions, level of petrol displacement and efficiency. To date, over 1,200 taxis have been successfully converted in South Africa, leaving a huge portion of the transport industry to be leveraged.

6.4.2.2 Bus Industry

According to the South African Bus Operators Association (SABOA), there is approximately 25,000 busses in South Africa, of which 19,000 are involved in public transport. These busses travel collectively nearly 1.4 billion kilometres annually, consuming close to 506 million litres of diesel. The bus industry provides direct employment for approximately 34,200 people throughout the country, with nearly 171,000 people indirectly dependent on the industry for their livelihood [4] [37] [57].

The City of Johannesburg was one of the first cities in Sub-Saharan Africa to run a fleet on CNG converted busses and have 180 dual-fuel CNG operated busses. The City of Tshwane's Tshwane Rapid Transit (TRT) system now boasts a fleet of 80 busses that are dedicated natural gas busses. Megabus, a Unitrans subsidiary, has 10 CNG buses operational in their Free State fleet.

A pilot study conducted by Cape Advanced Engineering indicated a 19.2 % reduction in the fuel operating cost for a dual-fuel bus (71 % diesel substitution) compared to a standard diesel-operated bus, in addition to increased engine life expectancy and maintenance cycles [8].

6.4.3. Industrial Sector

The South African Industrial Gas Users Association's (IGUA-SA) members consume approximately 0.04 tcf annually. IGUA-SA current members are ArcelorMittal, Consol, Mondi, PFG Building Glass, Ceramic Industries, Tronox, Columbus Stainless, South32, ABInBev, Lanxess and Illovo. These industrial companies combined economic contribution amounts to more than R 150 billion per annum, providing employment for over 46,000 South Africans. An additional 0.007 tcf is consumed by smaller enterprises, households, hospitals and the transport sector annually [29].

There is an existing disconnect between stable natural gas supply and the growing demand for gas. The industrial sector consumes approximately 0.04 tcf annually but has an actual gas

demand of 0.11 tcf [29]. There is an established market within the industrial sector with 0.07 tcf demand to be leveraged annually.

7. Gas Infrastructure

7.1. Existing Infrastructure and Short-Term Plans

7.1.1. Transmission Network

Natural gas at present is almost entirely transported to customers via transmission, distribution and reticulation pipelines, as depicted in Figure 7-1. Appendix C contains maps depicting the provincial natural gas pipeline infrastructure [42].

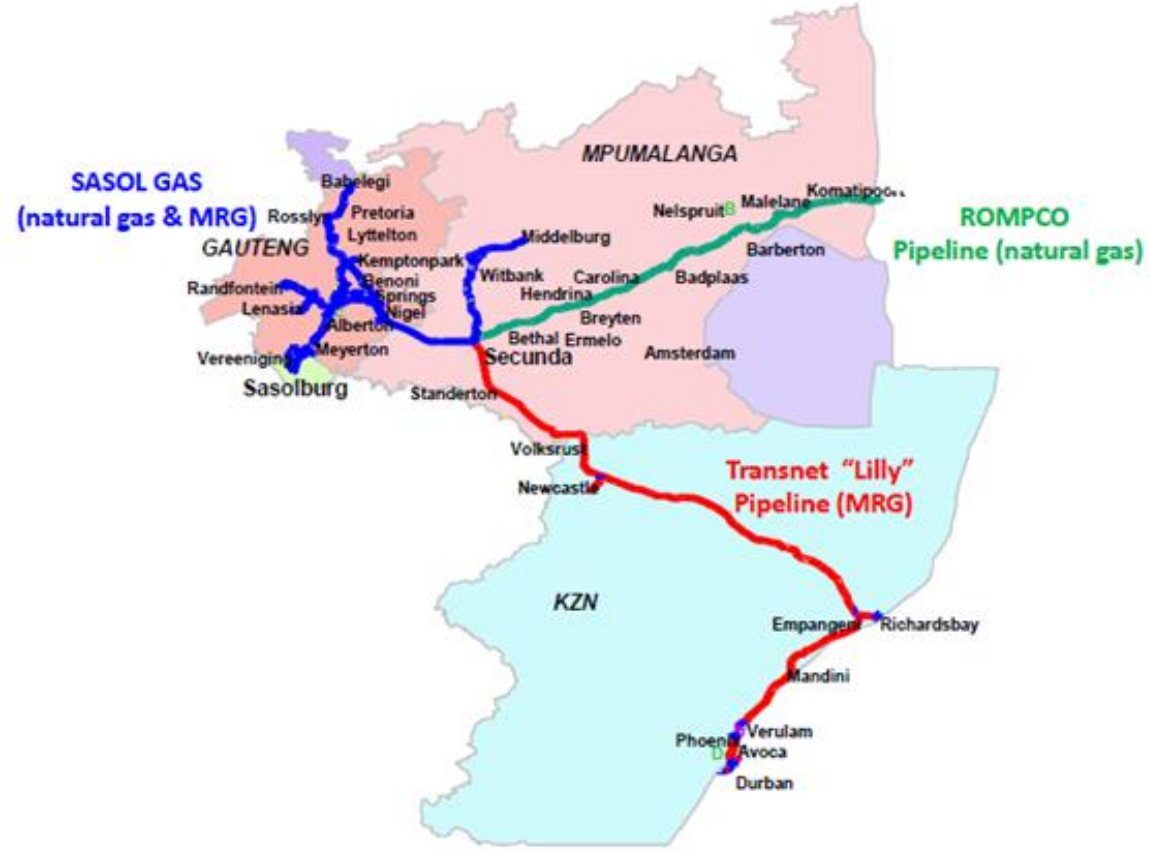


Figure 7-1: Main Natural Gas Transmission and Distribution Pipelines

The main natural gas transmission pipelines are:

- ±1,350 km transmission pipeline network owned and operated by Sasol Gas;
- 865 km transmission pipeline from Mozambique to Secunda owned by ROMPCO;

- 573 km Lilly transmission pipeline owned by Transnet running from Secunda to Durban; and
- ±100 km pipeline owned by PetroSA for the transmission of gas for own use to GTL plant in Mossel Bay.

The ROMPCO pipeline was recently upgraded to 0.19 tcf annual capacity. Sasol Gas has an annual transmission capacity of nearly 0.13 tcf of natural gas and 0.03 tcf of methane rich gas.

7.1.2. Distribution Network

7.1.2.1 Sasol Gas Owned Network

Sasol Gas has distribution pipelines from Secunda that connects Pretoria, Johannesburg, and Sasolburg, as well as a distribution network that links off the Transnet gas transmission pipeline to customers in KZN.

Gauteng's inland distribution network is fed from Secunda at a pressure of 4,500 kPa. The network is operated at a pressure of 3,350 kPa and lower. The distribution network has an annual capacity of 0.07 tcf. These pipelines supply the various low-pressure distribution areas as well as some direct customers. Where these lines enter the various distribution areas, a pressure reduction station reduces the pressure to 625 kPa.

Mpumalanga's distribution network received methane-rich gas produced and supplied by Sasol Synfuels. The distribution network supplies the Secunda-Witbank-Middelburg pipeline. The normal maximum operating pressure for this pipeline is 3,000 kPa and the annual capacity of this distribution network is 0.01 tcf.

KwaZulu-Natal's distribution network receives the same methane-rich gas supplied to Mpumalanga's distribution network, via Transnet's Lilly pipeline. The operating pressure of the pipeline is 5,300 kPa, with a maximum operating pressure of 5,900 kPa, and an annual network capacity of 0.02 tcf.

7.1.2.2 Spring Lights Gas Owned Network

Spring Lights Gas (SLG) provides industry with methane rich gas through an extensive pipeline network directly from the Lilly pipeline in KZN. SLG has recently expanded into supplying CNG to clients who are not connected to the piped gas network, via virtual pipelines, with Hulamin being their first large client. SLG has obtained a trading license for Gauteng and will be expanding their operations into the province.

7.1.2.3 CNG Holdings Gas Network

CNG Holdings, subsidiary NGV Gas, has a CNG public filling station at Langlaagte, Johannesburg, as well as an in-house filling station at the City of Tshwane's Braamfontein depot [11]. CNG Holdings also established a mobile CNG filling station to refuel the City of Tshwane's CNG rapid

transit buses and is constructing a permanent CNG filling station at the bus depot. CNG Holdings also has a mother station, with the capacity to compress 0.002 tcf annually, adjacent to the Sasol and Egoli Metering Stations, as well as retrofit filling stations in Dobsonville, Soweto.

7.1.2.4 Novo Energy Gas Network

Novo Energy has launched its large-scale Natural Gas Compression (NGC) facility at the Highveld Industrial Park in eMalahleni, Mpumalanga [36]. The eMalahleni NGC facility is Novo's thirteenth and largest facility, with established facilities in the greater Johannesburg area.

7.1.2.5 Tetra4 Gas Network

Tetra4 supplies, installs and maintains fuel storage and dispensing equipment at "client-owned depots" to make natural gas more accessible to the transport industry. Tetra4 currently supplies ten dedicated natural gas buses to a company in Virginia, in addition to a major South African conglomerate with CNG for 15 heavy-duty trucks in the form of diesel dual fuel.

7.1.2.6 Delta Natural Gas Energy Network

In 2018, Delta Natural Gas (DNG) Energy broke ground on the first of a planned 400 LNG refueling stations around South Africa. DNG Energy is establishing the refueling stations at taxi ranks and existing fuel stations serving the taxi and trucking industries [20].

DNG Energy's LNG barge, the DNG Genesis, is under construction at Southern African Shipyards in Durban's Bayhead. The barge is expected to be completed by the end of 2019. The company has a floating storage terminal and the idea is that LNG from exporting countries will be stored at the terminal and then offloaded onto the Durban-made barge which "as the work horse" will operate in Southern Africa waters, transporting energy to customers in South African and the member states of SADC [2].

7.1.3. Reticulation Network

7.1.3.1 Egoli Gas Owned Network

Egoli Gas has a 1,200 km high pressure gas reticulation network and another 2,000 km low pressure gas reticulation network within the greater Johannesburg Metropolitan area. The high-pressure line is operated at 20 kPa and forms the backbone of the system, while the low-pressure line feeds domestic demand at 3 kPa.

8. Regulatory Framework

The Natural Gas Regulatory Framework establishes policies for the monetisation of natural gas (both associated and non-associated gas) in existing and new concessions.

This section offers an overview of the key legislation and regulatory structure governing the natural gas sector in South Africa and potential regional supply countries.

8.1. South Africa Regulatory Overview

South Africa has the most developed regulatory framework for downstream gas in Southern Africa.

8.1.1. Established Regulatory Framework

The South African White Paper on Energy Policy (1998) states that the government is committed to the development of the gas industry.

The Gas Act (48/2001) provides regulatory framework for the construction and operation of gas transmission, storage, distribution, liquefaction and re-gasification facilities, as well as gas trade.

The Mineral and Petroleum Resources Development Act (28/2002) and the International Trade and Administration Act (71/2002) act as frameworks for gas regulation in South Africa.

The National Environmental Management Act (107/1999) provides the legislative environmental management in South Africa, defining principles for decision-making on matters affecting the environment. Under the National Environmental Management Act (107/1998) companies are required to make financial provision for the rehabilitation and management of potential negative environmental impacts. Exploration and production activities cannot commence without environmental authorization granted in terms of the National Environmental Management Act (107/1999), prior to the granting of which an environmental impact assessment investigating the potential impact of the proposed activity must be conducted.

The Draft Gas Amendment Bill (2020) is supportive and facilitative of investment in development of integrated energy projects, including gas-to-power projects. The Bill will largely introduce a mechanism that allows the Minister of Mineral Resources and Energy to direct the development of new gas infrastructure including pipelines, storage and regasification facilities for imported liquefied natural gas. The Bill will also encompass the midstream elements of the gas value chain, while upstream oil and gas legislation, responsible for regulating the exploration and production of oil and gas, is under development.

The import of natural gas is regulated primarily by the International Trade Administration Act (71/2002). A permit is required in order to import petroleum gas and other gaseous hydrocarbons. Bearing in mind that South Africa does not currently export natural gas, there is currently no legislated position on the export of natural gas. Furthermore, the Gas Act requires an owner of an operation involving the importation of gas to register with the Regulator.

8.1.2. Gas Regulator

Gas regulatory functions are performed by the National Energy Regulator of South Africa (NERSA). NERSA regulates the electricity, piped-gas and petroleum pipeline industries, in addition to being the competent licensing authority under the Petroleum Pipelines Act (60/2003) and the Gas Act (48/2001).

NERSA is mandated to monitor and approve piped-gas transmission and storage facilities but is not mandated to regulate distribution tariffs and licensees can set the tariff without having to comply with a particular tariff methodology or approach. Sasol Gas is the only licensee operating in the distribution network and does submit distribution tariffs to NERSA in its periodic applications for price and tariff approvals.

8.1.3. Domestic Gas Policies

The principal legislation governing the exploration and production of natural gas is the Mineral and Petroleum Resources Development Act (28/2002).

Petroleum resources belong to the nation while the State, via the Minister of Mineral Resources and Energy acts as the custodian thereof, with the responsibility of regulating and promoting petroleum development in South Africa. The Minister of Mineral Resources and Energy is empowered to grant or refuse applications for reconnaissance permits, technical cooperation permits, exploration rights and production rights and may initiate "licensing rounds".

The Petroleum Agency of South Africa (PASA) is responsible for promoting and regulating exploration for, and exploitation and production of petroleum. In general, it performs an advisory and administrative role which includes receiving, evaluating and making recommendations to the Minister of Mineral Resources and Energy on applications for petroleum permits and rights and monitoring compliance with permits and rights.

NERSA has the mandate to set the maximum prices for gas distributors, and all classes of customers, where there is inadequate competition in the gas industry.

8.1.4. Enablers

The fiscal regime that applies to the upstream gas industry in South Africa consist primarily of corporate income tax and royalties. The Tenth Schedule to the Income Tax Act (58/1962) deals with the taxation of upstream exploration and production activities and has favourable tax provisions for gas companies. A gas company may deduct all expenditures and losses incurred with respect to exploration and post-exploration. A further deduction is permitted over and above the expenditure incurred, which includes 100 % of all capital expenditures incurred in respect of exploration activities and 50 % of all capital expenditures incurred in respect of post-exploration activities. As a result, a gas company may recognize a total deduction equal to

200 % and 150 % of its capital expenditures related to exploration and post-exploration, respectively.

The Mineral and Petroleum Resources Royalty Act (28/2008) provides for the imposition of a royalty on the "transfer" of mineral resources extracted from within South Africa.

Royalties are payable when mineral resources extracted from within South Africa are "transferred", which includes the disposal or consumption thereof. Royalties are calculated in terms of a particular formula and the maximum royalty percentage is capped at 5% for refined mineral resources and 7% for unrefined mineral resources.

The Carbon Tax Act (15/2019) aims to provide for the imposition of a tax on the carbon dioxide (CO_2) equivalent of greenhouse gas emissions and provides significant tax-free emission allowances.

8.1.5. Established Bilateral Agreements

South African government signed a bilateral investment treaty (1997) and a cross-border gas trade agreement (2001) with Mozambique. A bi-national gas commission was also established to oversee gas movement between Mozambique and South Africa.

To facilitate trade of natural gas between Namibia and South Africa, a bilateral trade agreement was signed in 2003.

A Cooperation Agreement was signed between the Government of the Republic of South Africa and the Government of the Republic of Angola in the field of Petroleum.

The bilateral trade agreement between South Africa and Zimbabwe was terminated on 20 November 2018 and the two countries are now trading under SADC Free Trade Area. Both countries are participating in Tripartite Free Trade Area and African Continental Free Trade Area negotiations.

8.1.6. Legislative Gaps, Overlaps and Barriers

Even though South Africa has one of the most regulated natural gas sectors, legislation still contains weak enforcement mandates.

The Petroleum Agency of South Africa regulates gas exploration, production and prices. Reconnaissance, exploration and production rights are all controlled by the Mineral and Petroleum Resources Development Act (28/2002). Gas production and importation is registered at NERSA in terms of the Gas Act (48/2001) and Piped Gas regulations were promulgated to set out process and procedure to enhance the Gas Act (48/2001). Local Government (municipal governance), in conjunction with gas sector players, are responsible for reticulation of gas, but NERSA monitors the gas prices. As a result of several regulating bodies playing a part in the

administration and management of activities in the gas sector, potential overlapping mandates could be created, resulting in confusion to society and players in the gas market.

Environmental legislation is of particular importance, however adherence to environmental regulations (National Environmental Management Act (107/1998): Environmental Impact Assessment Regulations) can form a barrier to entry as the requirements are time consuming and expensive to fully comply, including additional municipal and national authorisation requirements based on the Spatial Planning and Land Use Management Act (16/2013).

Limited natural gas supply sources and the nature of economic regulation in the gas sector, resulted in insufficient competition within South Africa's gas business sector. Regulators and competition authorities focus on specific types of arrangements based on the Competition Act (89/1998) but lack facilitation of entry and promotion of effective rivalry within the gas business chain to create a landscape for competition to work more effectively.

8.2. Angola Regulatory Overview

The gas sector in Angola is primarily governed by the Ministry of Petroleum, which is responsible for the co-ordination, supervision and control of the activities of the gas sector and the definition of its policies and guidelines.

8.2.1. Established Upstream Regulatory Framework

The statutory framework for the exploration and production of oil and natural gas reserves is mainly encompassed in the Petroleum Act (10/04), in addition to the Taxation of Petroleum Activities Act (13/04), the Angolan Oil and Gas Foreign Exchange Act for the Oil Industry Act (2/12), the Petroleum Customs Act (11/04) and the Presidential Decree No. 211/15. Angola has three presidential decrees related to the governance and regulation of its oil & gas sector: Presidential Decree No. 5/18 establishing the framework for the exploration activities of the Development Areas; Presidential Decree No. 6/18 regulating the development of marginal fields and Presidential Decree No. 7/18 regulating the prospection, research, evaluation, development, production and sale of natural gas.

8.2.2. Gas Regulator

The Angola National Petroleum and Gas Agency, (ANPG) the newly appointed independent regulator. ANPG will be acting as Angola’s national concessionaire for hydrocarbon licenses and be in charge of regulating the industry and implementing government policy.

8.2.3. Domestic Gas Policies

Under the Constitution of Angola, the state is the owner of all national resources within the jurisdiction of Angola, and the Petroleum Activity Law (10/04) sets out that government’s right to explore, develop, exploit, produce, process, refine and market petroleum.

The Ministry of Mineral Resources and Petroleum oversees the exploration and production of oil and natural gas, and the Ministry of Environment oversees project's environmental licensing.

The law does not distinguish between conventional and unconventional gas fields, both onshore and offshore. Both operations will require an association (commercial company, consortium contract or production-sharing contract) with the National Concessionaire.

There are no specific rules that apply to cross-border sales or deliveries of natural gas. These activities are regulated by contract between the parties, but an export permit, issued by the Ministry of Commerce, will be required to export natural gas.

The Oil & Gas Distribution and Commercialisation Law (28/11) sets out that a retail price regulation mechanism be established to ensure that consumer costs are minimised and to take into account the difference between the various types of energy sources considering their value chain.

8.2.4. Enablers

The new Marginal Fields terms offer incentives which include a 50% cut in Royalty and Income Tax for small deep-water developments.

According to Act 11/04, Article 8, the exportation of petroleum produced in each concession, either in its natural state or after having been processed, is exempt from duties and general customs service fees.

8.2.5. Established Bilateral Agreements

A Cooperation Agreement was signed between the Government of the Republic of South Africa and the Government of the Republic of Angola in the field of Petroleum.

8.3. Botswana Regulatory Overview

Botswana has the least developed regulatory environment of the focus countries. It only recently established an energy regulator as a corporate body that is primarily responsible for economic regulation of the country's energy supply sector.

8.3.1. Established Upstream Regulatory Framework

Botswana's upstream gas regulations are mainly addressed by the Mines and Minerals Act (17/1999), although the act was developed for hard minerals and found to be less capable of dealing with gas or CBM.

8.3.2. Gas Regulator

The Botswana Energy Regulatory Authority (BERA) is primarily responsible for economic regulation of the country's energy supply sector (predominantly downstream), in addition to gas regulations.

8.3.3. Domestic Gas Policies

No explicit policies are defined, and the gas regulatory sphere has not been advanced due to the absence of a gas association.

8.3.4. Enablers

Botswana does not have direct incentives for gas development in the country.

8.3.5. Established Bilateral Agreements

There are no established cross-border gas trade agreements between Botswana and South Africa.

8.4. Mozambique Regulatory Overview

Mozambique recently developed an updated regulatory framework, primarily focused on increasing Mozambique's share of gas development benefits.

8.4.1. Established Upstream Regulatory Framework

The Petroleum Law (21/2014) and Decree no. 48/2018 establishes the general framework applicable to all oil and gas operations and determines the rules for granting of rights to petroleum operations.

The Petroleum Operations Regulation (Decree no. 34/2015) is a development of the Petroleum Law principles and general rules to allow for comprehensive and coordinated supervision.

The Petroleum Production Tax Law (27/2014) establishes the specific tax regime for petroleum operations.

The Petroleum Production Tax Regulation (Decree no. 32/2015) sets forth the rules that apply to the calculation and payment of Petroleum Production Tax and tax benefits in connection with petroleum operations.

The Rules on Import, Export, Distribution and Transport (Decree no. 45/2012) establishes the legal framework that applies to downstream operations.

The Regulation of Employment of Foreign Citizens in the Petroleum and Mining Sector (Decree no. 63/11) establishes the legal regime that applies to national and foreign employers in the petroleum and mining industries.

The Environmental Regulation for Petroleum Operations (Decree no. 56/2010) sets out the requirements to be satisfied in order to perform operations and prevent environmental disasters.

The Strategy for Concession of Areas for Petroleum Operations (Resolution no. 27/2009) establishes the legal regime to guide the concession on the appraisal and production rights.

The Mega-Projects Law (15/2011) governs public-private partnerships, large-scale projects and business concessions.

The Mega-Projects Law Regulation (Decree no. 16/2012) determines the applicable procedures for the contracting, implementing and monitoring of public-private partnerships, large-scale projects and business concessions ventures.

The Small Scale Projects Regulation (Decree no. 69/2013) sets out the applicable procedures for the contracting, implementing and monitoring of public-private partnerships, large-scale projects and business concessions ventures below MZN5 million.

The legal framework is supplemented by concession contracts that specify rights and duties of the concessionaire and the Government.

These provide guidelines predominantly for upstream development of gas fields. Other mining concession responsibilities are handled by MIREME/NAMI under the terms of the Mining Law (20/2014).

The New Petroleum Law (21/2014) and Petroleum Production Tax Law (27/2014) focus on increasing Mozambique's share of benefits, resulting in less favorable terms for investors.

Rovuma Basin Area 1 and 4 which remain subject to the Decree Law (2/2014), under the grandfathering clause, with new laws only affecting new concessions.

8.4.2. Gas Regulator

A new energy regulator, ARENE, was established in 2017, primarily focused on the downstream gas regulatory framework. ARENE regulates distribution, transport, storage and sale of natural gas at pressure equal or less than 16 bar, including the issuing and managing of concessions and licences.

Mozambique's National Petroleum Institute (INP) is responsible for managing exploration, production and transport concessions for petroleum products, which might be overlapping slightly with ARENE's responsibilities.

The High Authority for the Extraction Industry (AAIE) are envisioned in the Petroleum Law, but its roles and responsibilities are still being defined.

8.4.3. Domestic Gas Policies

The New Petroleum Law (21/2014) provides clarity regarding certain domestic issues, such as domestic gas obligation clauses, which stipulated 25%+ to be agreed per concession, however overall domestic policies do not provide clarity regarding terms of sale set by government.

All natural gas sales are done through state-owned oil company, Empresa Nacional de Hidrocarbonetos (ENH).

8.4.4. Enablers

Gas projects are normally subject to 6 % royalty rate, but can be reduced on an agreement basis, up to 2 % for the first 10 years.

8.4.5. Established Bilateral Agreements

Mozambique has previously signed bilateral investment agreement for cross-border trade with South Africa in 2001. The agreement includes extraction of natural gas from Mozambique and construction of cross-border transmission pipelines.

8.5. Namibia Regulatory Overview

Namibia's upstream gas regulations were noted as "most attractive" in the Africa Global Petroleum Survey's Policy Perception Index and Africa Business Insight, offering various incentives for gas companies.

8.5.1. Established Upstream Regulatory Framework

The gas regulatory framework is predominantly guided by the Petroleum Exploration and Production Act (2/1991) and the Petroleum Products and Energy Act (14/1993).

Other legislation to be considered include the Water Act (54/1956), Environmental Management Act (7/2007) and the Prevention and Combating of Pollution of the Sea by Oil Act (6/1981).

8.5.2. Gas Regulator

No dedicated gas regulator has been established. Gas regulatory functions are performed by the Petroleum Commissioner and the Chief Inspector of Petroleum Affairs under the governance of the Minister of Mines and Energy.

8.5.3. Domestic Gas Policies

Downstream gas industry is self-regulated, with downstream gas regulations related to the distribution or transportation of natural gas, LNG facilities or domestic gas prices, to be established.

The Income Tax Act (24/1981) and the Petroleum Taxation Act (3/1991) deals with administrative provisions. Petroleum tax is paid annually for the benefit of the State Revenue Fund in respect of taxable income received by or accrued to or in favour of any person from a licence area in connection with exploration and production operations. The tax rate is 35 % with an additional profit tax payable on a sliding scale of between 15 % and 25 %. Activities relating to downstream activities are not considered to be petroleum activities and are taxed under the Income Tax Act (24/1981).

The Gas Bill has been under development and has not yet been adopted, but it is anticipated to bring clarity to downstream gas regulation.

8.5.4. Enablers

Namibia offers gas investors VAT waiver incentives and low royalties (5% across board).

8.5.5. Established Bilateral Agreements

The Petroleum Exploration and Production Act (2/1991) makes no provision for cross-border trade of natural gas. A gas-trade agreement was signed in 2003 between South Africa and Namibia to facilitate gas trade between the countries.

8.6. Tanzania Regulatory Overview

The current institutional structure of the oil and natural gas industry is the challenging factor in Tanzania.

8.6.1. Established Upstream Regulatory Framework

The two key government entities involved in the upstream industry are the Ministry of Energy and Minerals and the Tanzania Petroleum Development Corporation (TPDC).

The Petroleum Act (21/2015) is the principal legislation governing oil and gas exploration and production. It governs the import, export, transformation, storage and wholesale and retail distribution of petroleum and petroleum products in a liberalised market.

Apart from the Petroleum Act (21/2015) there are other pieces of legislation that are relevant or apply to oil and gas exploration and production, of which the most important are the Oil and Gas Revenue Management Act (22/2015) and the Extractive Industries Act (23/2015).

8.6.2. Gas Regulator

The Petroleum Upstream Regulatory Authority (PURA) and Energy and Water Utilities Regulatory Authority (EWURA) are the authorities that regulate the extraction of gas. The two authorities fall under the Ministry of Energy and Minerals, the parent ministry, which is responsible for oil and gas, among other matters.

The Government of Tanzania, through the Minister for Energy and Minerals grants licences to the TPDC. The TPDC holds the licence and enters into a Production Sharing Agreement (PSA) with private developers to undertake exploration, development and production activities.

8.6.3. Domestic Gas Policies

The Petroleum Act (21/2015) provides that a development licence must impose a duty on the registered holder to supply petroleum to meet the local needs of Tanzania.

Revenue generated by an investor is subject to 30% income tax under the Income Tax Act (11/2004) and an investor must also pay a royalty when he obtains petroleum from the development area, with a royalty of 12.5% payable for onshore and shelf production, and a 75% royalty payable for offshore production.

8.6.4. Enablers

Tanzania does not have direct incentives for gas development in the country.

8.6.5. Established Bilateral Agreements

There are no established cross-border gas trade agreements between Tanzania and South Africa.

8.7. Zimbabwe Regulatory Overview

The Ministry of Energy and Power Development has overall responsibility for energy issues and its mandate includes policy formulation, performance monitoring and regulation of the energy sector.

8.7.1. Established Upstream Regulatory Framework

Current energy policies and legislation do not focus on the upstream sector. Exploration for energy minerals has been undertaken by potential investors under special mining grants in accordance with the Mines and Minerals Act [Chapter 21:05].

8.7.2. Gas Regulator

The Zimbabwe Energy Regulatory Authority (ZERA) is a statutory body established with the primary function of regulating the energy sector. Functions include the regulation of the procurement, production, transportation, transmission, distribution, importation and exportation of energy derived from any energy source. The agency seeks to create an enabling environment for competition and the Energy Regulatory Act [Chapter 13:23] confers upon ZERA the authority to license any and all players and to regulate and approve tariffs.

8.7.3. Domestic Gas Policies

The Pipelines Act [Chapter 13:08] is designed to facilitate public-private partnerships for pipeline development on a build-operate-transfer (BOT) or build-own-operate-transfer (BOOT) basis.

The Environmental Management Act [Chapter 20:27] makes provision for sustainable management of natural resources, protecting the environment and preventing pollution and environmental degradation. The act mandates the undertaking of an Environmental Impact Assessment before energy related project implementations.

The major acts governing investment and business registration in Zimbabwe include the Companies Act [Chapter 24:03], Competition Act [Chapter 14:28], Zimbabwe Investment Authority Act [Chapter 14:30], Labour Amendment Act (5/2015), Deeds Registries Act [Chapter 20:05] and the Indigenization and Economic Empowerment Act [Chapter 14:33].

8.7.4. Enablers

Fiscal incentives in the form of corporate tax for BOT and BOOT arrangements include 0 % for the first five years and 15 % for the subsequent five years.

8.7.5. Established Bilateral Agreements

The bilateral trade agreement between South Africa and Zimbabwe was terminated on 20 November 2018 and the two countries are now trading under SADC Free Trade Area. Both countries are participating in Tripartite Free Trade Area and African Continental Free Trade Area negotiations.

9. Gas Master Plan Roadmap

Natural gas will play a very important role in South Africa in the future and as the country's dependency on natural gas grows, the domestic infrastructure will need to be developed. The roadmap sets out a high-level agenda for gas sector reforms.

9.1. National PESTEL Analysis

The PESTEL analysis is a tool used for environmental and market analysis and furthermore used to support strategic decision making.

The PESTEL analysis aims to address all the political, economic, social, technological, environmental and legal factors, as illustrated in Figure 9-1. The PESTEL dimensions were researched as part of the macro-economic analysis to establish the current dimensions that could impact national natural gas development.

The main objective of the PESTEL analysis was to assess South Africa's business environment relating to the global market and to provide a structure for investigating and analysing the external marketing environment. South Africa is considered to be one of the most powerful countries in Africa and plays a considerable role in the African economy and politics.

9.1.1. Political Factors

Under the Copenhagen Accord, South Africa committed to reduce emissions below BAU by 34% in 2020, and by 42% in 2025.

The government is currently both promoting and supporting the development of the gas market in South Africa, with the Integrated Resource Plan (IRP 2019), setting out a new direction in energy sector planning, which includes increased adoption of natural gas. Eskom's ongoing financial solvency and plant reliability issues continue to expose the country's future to unreliable and unsecure energy supply. Urgent decisions on structural changes are required in order to address security of energy supply.

The government's current state of support has enablers as discussed in Section 8.1.4 which will aid in the development of the natural gas market in South Africa.

International political relationships and agreements will impact the global collaboration, creating possible joint ventures across borders and comprehensive collaboration efforts in the industry, including, among other, production, technical services, distribution, sourcing, etc.

There are no signs of policy-driven emissions reductions in the near future for emissions-intensive subsectors as steel production and mining in context of the ongoing economic stagnation in South Africa.

South Africa has several natural gas opportunities for local natural gas production, either from conventional (onshore/offshore) or unconventional (shale gas/coal bed methane) sources. The presence of significant amount of gas reserves in a country can increase corruption, which is one of the side effects known globally as the "resource curse", presenting a potential barrier for foreign gas companies to invest.

The South African political environment is often clouded by mismanagement, political intolerance, popular protest and violence, which could slow down natural gas development.

9.1.2. Economic Factors

Political stability and policy certainty are a pre-requisite for any country's economic growth. In South Africa, political stability can ignite economic growth and generate much-needed employment, especially for the millions of young people who are neither in education nor employment.

The South African economy grew by 1.3% in 2017 and 0.8 % in 2018. The World Bank projects 2019 growth at 1.3 %, accelerating further to 1.7 % in 2020. Given population growth, gross domestic product (GDP) per capita has been close to nil since 2014, leaving little room to reduce poverty. Implementation of prudent macroeconomic policies together with structural reforms to raise potential growth and lower the cost structure of the economy remains urgent.

Investment prospects will continue to be limited in the absence of structural reforms and the escalation of trade tensions could have further negative impacts.

The private sector is currently held back in its long-term investment in gas infrastructure due to regulatory uncertainty surrounding the continuance of relative tax benefit of natural gas fuels, which are VAT-ed, and conventional fuels, which are subject to fuel taxes. High upfront investments costs also provide an obstacle as private-sector finance is difficult to obtain in practice.

A weak economy will cause new corporations to be cautious when thinking of expanding business into South Africa. It also makes it more difficult for businesses within South Africa to branch out.

Strengthening investment, including foreign direct investment (FDI), will be critical to propel growth and create jobs. The development and expansion of the gas market in South Africa will attract various new industries and generate numerous new opportunities. These new industries and opportunities will stimulate economic growth through foreign investments, job creations, etc.

Standard & Poor's credit rating for South Africa stands at BB- with stable outlook. Moody's credit rating for South Africa was last set at Ba2 with a negative outlook. Fitch's credit rating for South Africa was last reported at BB- with negative outlook.

The Centre for Risk Analysis report notes a risk for further currency weakness, which means that South Africa may yet drift into a stagflationary environment, defined as persistent high inflation combined with high unemployment and stagnant demand in a country's economy. The results of the Quarterly Labour Force Survey for the second quarter of 2019, released by

Statistics South Africa, indicate that the official unemployment rate increased by 1.4 % to 29 % compared to the first quarter of 2019.

The annual inflation rate in South Africa fell to 4 % in July 2019, well below market expectations of 4.4 % and the mid-point of the Reserve Bank's target range of 3 % to 6 %. The projections for 2020 and 2021 remain unchanged at 5.1 % and 4.6 %, respectively. Inflation rate in South Africa averaged 8.99 % from 1968 until 2019, reaching an all-time high of 20.70 % in January of 1986 and a record low of 0.20 % in January of 2004.

South Africa is currently more dominant in the midstream to downstream sectors of the gas value chain. Total's latest Brulpadda discoveries off the southern Cape coast, Renergen's exploration activities in Virginia and the southern Karoo Basin's shale gas create the opportunity for South Africa to move into the upstream sector of the gas value chain. The shift into the upstream sector will have a significant economic benefit for the country, since most costs in the value chain are within the upstream sector due to the high capital expenditure associated with exploration and production activities.

Treasury could also benefit from using natural gas as transport fuel, as these could be locally produced as opposed to conventional fuels which are imported at the marginal level (or manufactured from imported crude oil, which represents 90 % of their manufactured value). The transport sector conversion would present a significant increase in local economic activity, with associated forex savings and the generation of more local taxes.

9.1.3. Social Factors

The development of the gas sector will enable social upliftment on a national level. The following factors will form part of the social upliftment:

- Job creation;
- Skills development (skilled and semi-skilled);
- Training and education opportunities (partnerships with FET's and training colleges);
- Poverty eradication and crime reduction (increase wages, etc.); and
- Improved quality of life.

The expansion of the gas market will lead to an increase in local market opportunities, where companies and individuals providing services and products are created and/or are able to upscale, and eventually even export their services or products. This creates a multiplier effect which comes about because injections of new demand for services and products into the circular flow of income stimulate further rounds of spending. The multiplier effect includes both direct opportunities and indirect (spin-off) opportunities.

The depleted rand currency and high unemployment could stifle the rising interest in entrepreneurship.

Globally, there has been an increasing awareness and focus on more environmentally friendly fuels, like natural gas, which is considered the cleanest fuel among fossil fuels.

9.1.4. Technological Factors

The development of the gas market will drive technology and innovation within South Africa's energy sector. The technology solutions and innovations will result, from among other, research and development, skill transfers and collaborations with technology and innovation leaders. These technological and innovative solutions will provide additional opportunities and increase South Africa's energy sector's competitiveness within the African market.

The main barriers that the gas industry faces in adopting a new technology are:

- Uncertainty over returns;
- Skill shortages;
- Development cost;
- Uncertainty over the time to get to market;
- Insufficient funding;
- Uncertainty over gas prices; and
- Stringent regulations.

9.1.5. Environmental Factors

The entire gas value chain, from exploration to final use, affects both people and animals, as well as the earth's plants, soil, air and water. The exploration, processing, and transportation of natural gas can potentially impact the environment negatively through disturbance of land and ecosystems, groundwater contamination, gas emissions, waste management, spills, excessive energy and water usage, and so forth. The negative environmental aspects challenge the industry's social license to operate which hinges on safety, minimum environmental impact, and maximum economic benefits.

However, natural gas is a cleaner fuel source compared to its alternatives. The development of natural gas will therefore reduce pollution and improve the general society's health conditions.

9.1.6. Legal Factors

Minerals and Petroleum Resource Development Act (28/2002) governs the acquisition, use and disposal of mineral rights and entrenches state power and control over the mineral and petroleum resources of the country.

South Africa encourages Foreign Direct Investment, although there are some restrictions on foreign shareholders.

B-BEE is a government initiative to promote economic transformation in order to enable meaningful participation in the economy by black people. Essentially, the practical working of

broad-based BEE (B-BBEE) requires a business to ensure that it measures its broad-based BEE empowerment status based on the Amended Codes of Good Practice. Unrelated mining activities is required to adhere to the BBBEE regulation and BBBEE influences the ownership, management control, skills development, enterprise and supplier development, as well as the socio-economic development subsections of the business.

The aim of the National Environmental Management Act (107/1998) is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for co-ordinating environmental functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith.

The aim of the Occupational Health and Safety Amendment Act (181/1993) is to provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.

The introduction of natural gas into South Africa's mainstream energy supply is an important step in the fulfilment of one of the major objectives of the White Paper on Energy Policy. The Gas Act (48/2001) aims to promote the orderly development of the piped gas industry, establish a national regulatory framework and establish a National Gas Regulator as the custodian and enforcer of the national regulatory framework.

The National Energy Regulator Act (40/2004) combines the non-technical aspects of the Electricity Regulation Act (4/2006), Gas Act (48/2001) and Petroleum Pipelines Act (60/2003) and repeals these provisions from the three Acts and establishes a National Energy Regulator to administer all three Acts and related legal instruments (regulations, levies).

After the establishment of the National Energy Regulator, the Department of Mineral Resources and Energy has promulgated the Piped Gas Regulations (2007) to promote the orderly development of the piped gas industry. A national Gas Master Plan is under development. Its objective is to provide the government with a blueprint for the development of infrastructure for future gas market developments. It is the Department of Mineral Resources and Energy's intention to coordinate natural gas infrastructure development within South Africa via this plan.

The South African natural gas regulatory overview is provided in Section 8.1.

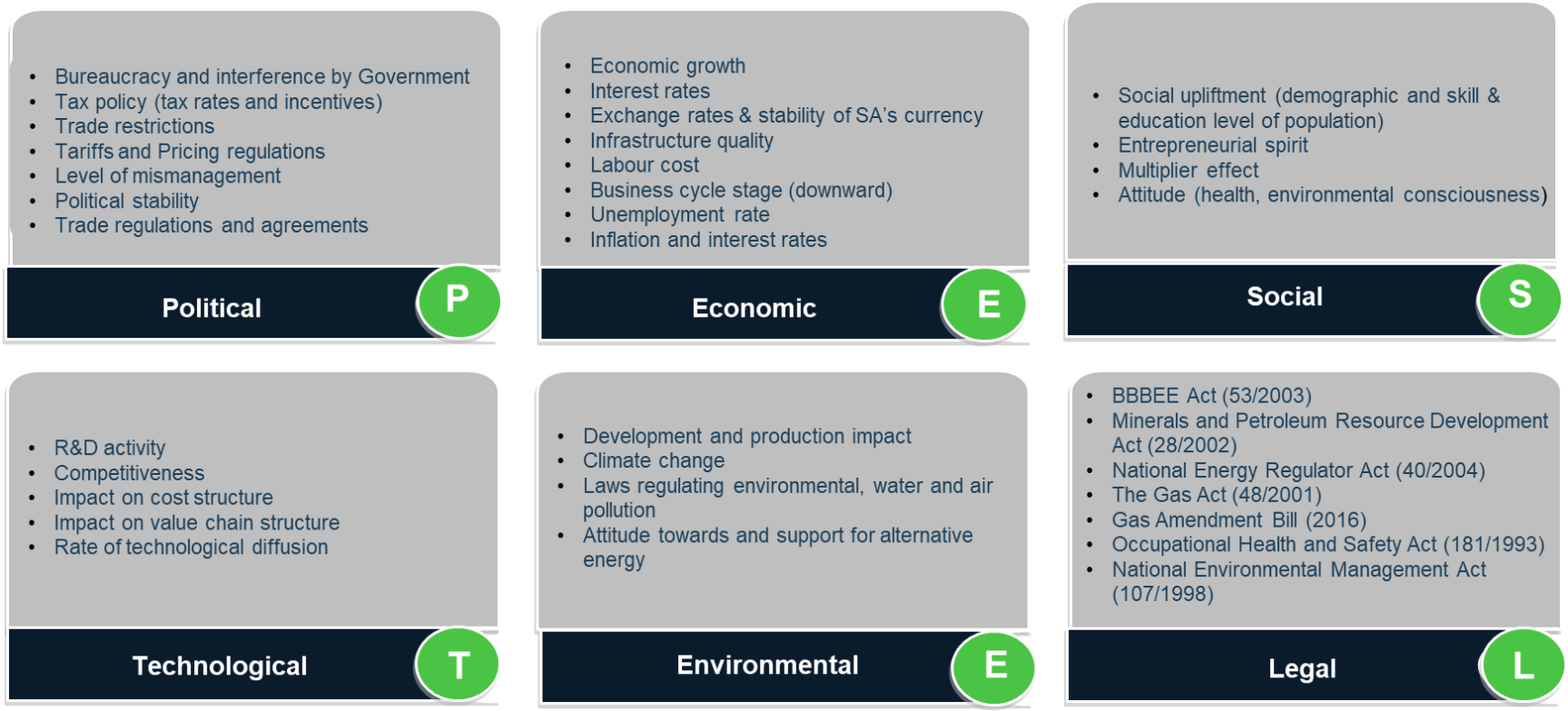


Figure 9-1: PESTEL Analysis' Dimension

9.2. National SWOT Analysis

A SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats) for the national development of natural gas was undertaken to assess associated internal and external attributes, as illustrated in Figure 9-2.

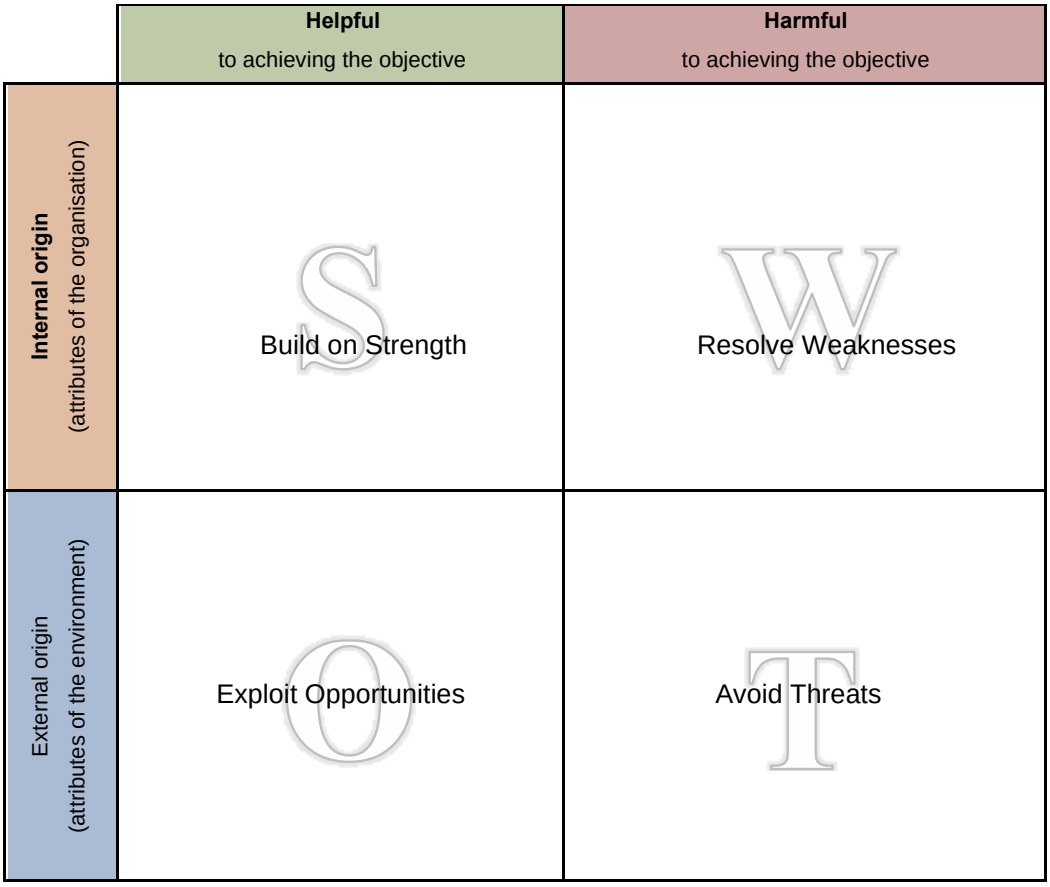


Figure 9-2: SWOT Analysis' Dimensions

The purpose of this SWOT analysis is to:

- Identify the opportunities and threats facing national natural gas development as a result of the situations, trends and events highlighted but not limited in the macro-environment; and
- Identify the country's strengths and weaknesses that have strategic implications in the context of the current and future conditions in the macro-environment.

SWOT analysis in Table 9-1 identifies the trends, events and strategic implications in the current and future conditions considering the macro-environment.

Table 9-1: National Gas Value Chain SWOT Analysis

Strengths	• Multiple indigenous reserves available. • Existing gas infrastructure available in proximity to Mozambique and Tanzania. • Gas Import - Significant regional gas discoveries (established trade agreements) • Political support from SA government as a whole and Operation Phakisa ocean economy for the gas market development.
Weaknesses	• Minimal gas infrastructure and distribution channels. • Economies of scale – To enable competitive pricing a minimum scale of new entries are required. • Recoverability of proven indigenous reserves. • Government policy – regulations and licensing requirements. • Pricing uncertainty. • Regulatory uncertainty. • Lead time to supply. • Small pool of highly skilled local gas experts – especially in the short-term. • Lack of CNG usage in heavy duty public road transport, e.g. buses.
Opportunities	• Gas market development and expansion will attract new industries (decarbonisation). • The gas market will stimulate national and regional growth, economic development, and social upliftment. • Job creation, skills development, diversity of workforce and improved living conditions through the development of the gas market. • Improve the energy security, national self-reliance and the energy diversity mix in SA. • LNG exporting services to East and West Coast of African market. • Cleaner fuel alternative - Reduction of air pollution and health effects.
Threats	• Large upfront capital requirements for new gas markets or converting existing operations. • Switching costs to convert existing markets. • Limited local availability. • Intense competition from traditional fuel sources. • Political uncertainty, monopolies, corruption and fraud.

9.3. Gas Balance

9.3.1. Role of Gas in National Development

The National Development Plan (NDP) identifies natural gas as a viable alternative to coal. The NDP further provides as one of the infrastructure priorities the construction of infrastructure to import LNG and increasing exploration to find domestic gas feedstock. Conventional and unconventional natural gas should play a more prominent role in South Africa's future energy mix, both in the electricity sector and in the liquid fuel sector [39].

In support of the vision for the South Africa gas programme, the Department of Mineral Resources and Energy has started developing, through its Independent Power Producer Office (IPPO), a gas-to-power IPP procurement programme. This programme will serve as an anchor for the gas market infrastructure development in South Africa.

The introduction of large-scale gas in the South African economy will lower the country's carbon emissions, not just from electricity generation but also from the energy sector, including the transport sector.

The economy of South Africa can capture real benefit from developing natural gas resources, generating employment (directly and indirectly), increasing GDP (directly and indirectly), increasing foreign direct investments and with potential future exports, increase the inflow of foreign currency, stemming both from the extraction and utilization of natural gas.

9.3.2. Gas Allocation Guiding Principles

Prioritization of gas allocation and gas-related infrastructure investments should be guided by a fixed criterion.

9.3.2.1 Project Priorities

Projects focused on gas-to-power and gas-to-liquid conversions should initially be given a higher priority than others, due to the large volume of natural gas these facilities will require.

In addition to the gas conversion projects, supplying gas to industry should also be prioritized to service the existing unmet industrial gas demand and the expected depletion from 2025.

However, this prioritization should be a general guideline, as market conditions may change over time and should not deter promoters of projects from submitting project proposals that will generate other products.

9.3.2.2 Gas Price

The price of natural gas for domestic consumption should encourage its competitive use for transportation, industrial co-generation and commercial heating. The pricing regime must

ensure that the price reflects efficient business operations, allowing for a fair return on investment, ensuring stability in order to promote efficient consumption of natural gas in the economy and encourage further investment to satisfy future demand. Switching from other forms of primary energy to natural gas should offer reduction in input cost for gas consumers.

9.3.2.3 Gas Quantity

The volume of gas should be sufficient either by itself or in combination with other developers to support construction of gas infrastructure to the proposed facility.

Variations in gas demand and supply, periodically or extended, affect the pace of infrastructure investment. Stability of supply, which includes supply quality, reliability and price, is pivotal to competitiveness and overall project prosperity. Balancing supply and demand should be one of the main considerations for infrastructure planning and investment.

Development of the Gas Master Plan should include supply options, demand forecast, infrastructure development, gas prices, and economic impact as minimum output variables.

9.3.2.4 Project Development Timeframe

Prioritization should be given to projects that can be constructed and come into operation as soon as gas is made available, in addition to projects utilizing domestic natural gas reserves. Development risk analyses and management plans should be considered to determine timeframe confidence levels.

9.3.2.5 Project Location

Prioritization should be given to projects located near population centres to maximize the potential for local labour and growth in surrounding support industries. Project locations allowing for common use of facilities, eliminating duplication of investments should be prioritized to ensure a competing edge in the global market.

9.4. Gas Economics

9.4.1. Mode of Transport

Traditionally, natural gas has been transported safely, reliably and economically via pipelines, however not all new gas reserves are conveniently located as attention shifts to more isolated large gas reserves.

Several solutions for exploiting gas reserves are available, as depicted in Figure 9-3. Some of the solutions are fully commercial and mature technologies, while other are still in the research and development phase.

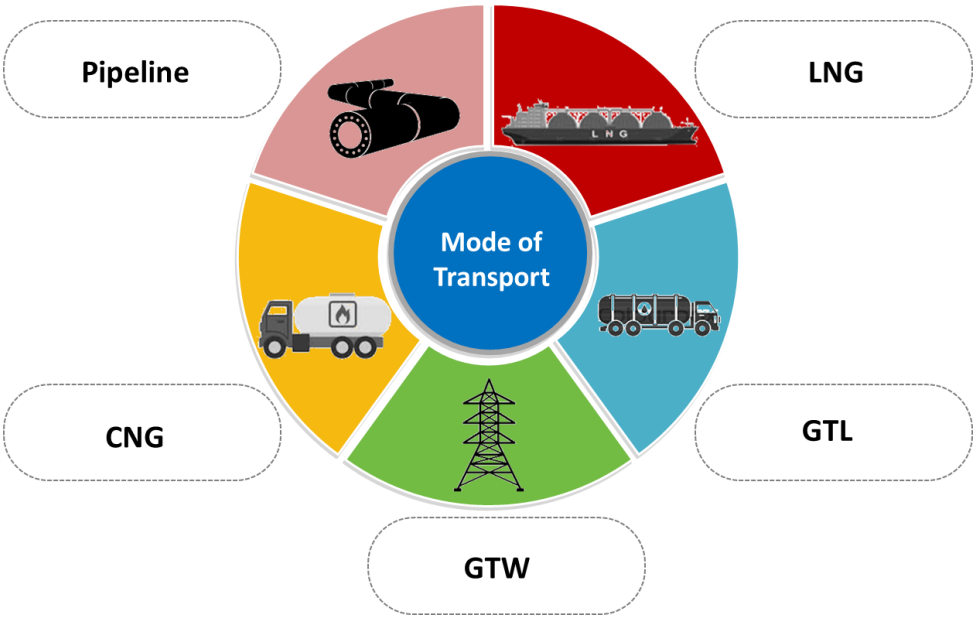


Figure 9-3: Methods of Moving Natural Gas to Market

Transport costs drive the price of natural gas due to the distance between source of supply and market. The economical mode of transportation of natural gas from source to market is predominantly dependent on the volume and distance, as illustrated in Figure 9-4 [38].

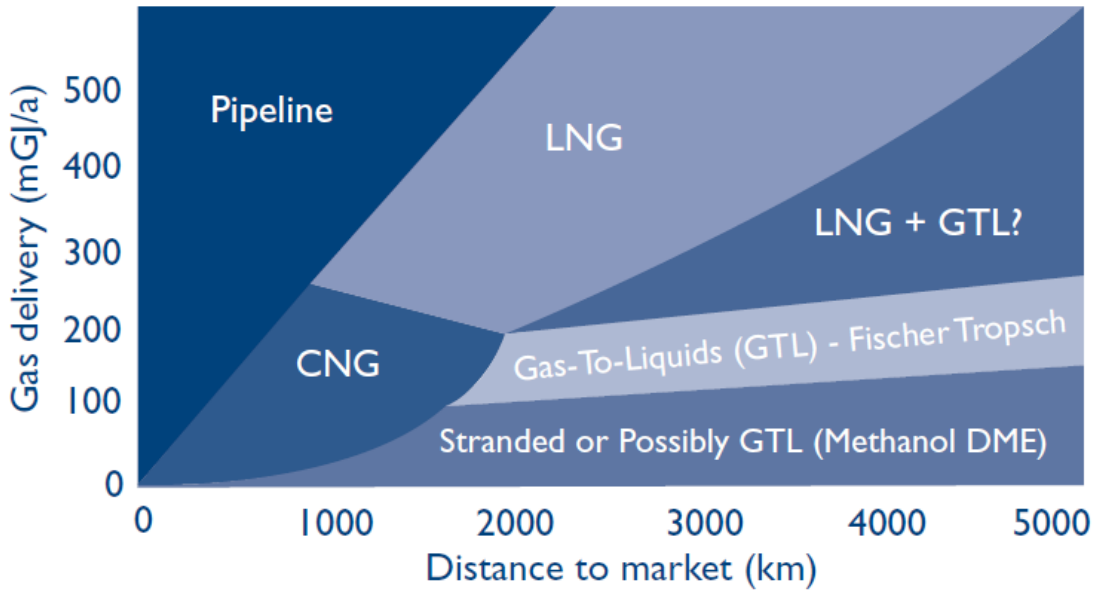


Figure 9-4: Natural Gas Transport - Volume vs. Distance

9.4.1.1 Pipelines

Pipelines are a very convenient method of transport. Once the pipeline diameter has been selected, the quantity of gas that can be delivered is fixed by the operating pressure, although an increase in quantity can be achieved through the addition of compressors along the line, as well as extra pipelines in the form of loops. The installation costs of pipelines are largely dependent on the distance, with cost being nearly proportional to distance. Transporting costs by pipeline are viable for distances up to 3,000 km, as a rule of thumb.

9.4.1.2 LNG

LNG is becoming a major gas export method worldwide. Cooling natural gas to -162 °C turns the gas into a liquid and reduces its volume by 600 times. LNG is easy and economical to ship when high volumes are required, and the reserve is in excess of 2,000 km from the market. LNG transported by maritime transport is received by a primary LNG terminal, which can be onshore or a floating storage and regasification unit (FSRU). LNG transport offers economics, flexibility and security of supply advantages, specifically for long-distance transport. LNG economics differ from piped gas due to the material costs involved in liquefaction, shipping and regasification.

9.4.1.3 CNG

Natural gas can be transported in containers at high pressure. These CNG systems make transport possible either for stranded gas or for smaller quantities of associated gas. CNG transport systems are more flexible and can cope with variable gas supplies.

9.4.1.4 Gas-to-Wire (GTW)

Where the transported gas's destination is fuel for electricity generation, the opportunity exists to generate electricity at the source and transport by cable to the destination.

9.4.1.5 Gas-to-Liquid (GTL)

In GTL transport processes, the natural gas is converted to a liquid, such as syncrude methanol, ammonia, etc. and transported in a suitable tanker to the appropriate markets.

9.4.2. Trade Viability

Table 9-2 and Table 9-3 consider the most viable options for natural gas trade, either via natural gas pipelines or LNG importation, for Southern African Development Community (SADC) countries and Non-SADC countries respectively. The viability is based on the prices, supply and production statuses and new developments.

Table 9-2: Natural Gas Trade Viability – SADC Countries

Country		Advantage / Disadvantage	Viability	Mode of Transport
SADC Countries	Angola	• Restricted production • Majority committed volumes • Cooperation Agreement	Viable (unfavourable)	LNG
	Botswana	• Close proximity • Proven commercial reserves in the short-term • Initial gas already allocated (100 MW CBM-to-power project)	Viable (unfavourable)	Pipeline
	Mozambique	• Close proximity • Uncommitted volumes • Large gas discoveries and projects under development • Bilateral trade agreements • Existing pipeline infrastructure (ROMPCO)	Viable	Pipeline LNG
	Namibia	• Close proximity • Large gas discoveries • Undeveloped gas fields • Bilateral trade agreements • Preference for local gas allocation • Marginal economic and commercial transport viability results	Viable (unfavourable)	Pipeline
	Tanzania	• Close proximity • Uncommitted volumes • Large gas discoveries and projects under development • Current gas extracted allocated for domestic use	Viable	LNG

Table 9-3: Natural Gas Trade Viability - Non-SADC Countries

Country		Advantage / Disadvantage	Viability	Mode of Transport
Non-SADC Countries	Australia	• 2nd Largest global LNG exporter • Predominantly serve the Asia Pacific region • Proximity to South Africa	Viable	LNG
	Malaysia	• Large export volumes • Predominantly serve the Asia Pacific region • Existing LNG trade corridor does not pass by SA's coastline	Viable (unfavourable)	LNG
	Nigeria	• Close proximity • Short-term LNG export capacity increase projects • Existing LNG trade corridor passing by SA's coastline	Viable	LNG
	Portfolio Suppliers	• Vast reserves/resources • Security of supply	Viable	LNG
	Qatar	• Largest global LNG exporter • Established long-term SPAs	Viable	LNG
	Russia	• Increased production • Have vast proven reserves • Geopolitical risks	Viable	LNG
	US	• Large export volumes • 45 % Natural gas production increase recorded in 2018 • Existing LNG trade corridor passing by SA's coastline	Viable	LNG

9.4.3. Supply and Demand Scenarios

South Africa will need to complement demand from the power sector with industry and transport demand to result in volumes required for scale.

Varying timelines between demand, supply and trade infrastructure development will require complementary outcomes to bridge the timeline gap.

Three supply sources of natural gas are available to South Africa:

- Piped natural gas from neighbouring countries;
- Imported LNG; and
- Domestic natural gas, either from conventional or unconventional reserves.

Piped gas is higher credit risk compared to LNG and needs to be competitive for both the seller and the buyer considering the alternative of importing LNG [61].

Initial gas demand and the development of a gas market will likely be stimulated by LNG-based gas supply, creating larger anchor demand that would trigger investments into additional gas infrastructure. Following this, related investments into indigenous conventional (offshore) and unconventional (onshore) gas explorations will occur, supplemented with increasing volumes of imported piped gas.

Mozambique presents a clear opportunity for gas trade given volumes and proximity. Various infrastructure options could possibly make trade feasible with the most likely infrastructure options being pipeline and LNG.

Uncommitted transmission pipeline capacity could potentially be utilized for tie-ins from reserves to gas markets within the area. Utilizing existing available infrastructure will not only minimize the upfront capital outlay required but also reduce social and environmental impacts.

9.4.3.1 Power Sector

Figure 9-5 depicts the location of identified power stations (coal-fired power stations reaching end of life cycle before 2030 and gas-fired power stations) in relation to existing gas transmission infrastructure and potential regional suppliers [23].

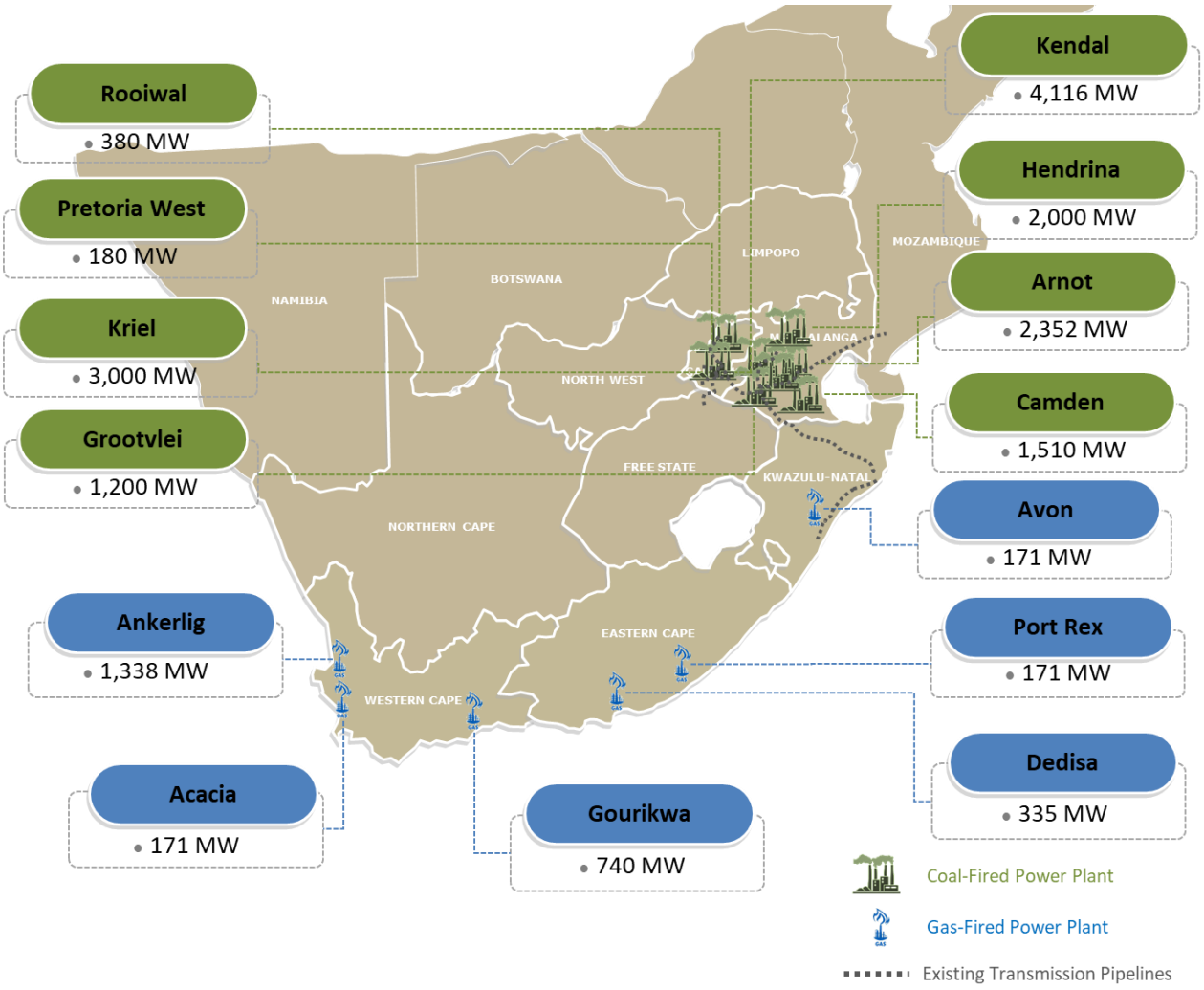


Figure 9-5: Power Sector Supply and Demand Map

9.4.3.1.1 Coal-Fired Power Stations

Most of the earmarked coal-fired power stations are located in Mpumalanga. According to NERSA, the last reported uncommitted capacity in the Secunda-Witbank-Middelburg transmission pipeline was nearly 0.0053 tcf and the ROMPCO pipeline has 0.014 tcf uncommitted capacity in the Mozambique-Secunda transmission pipeline [54] [40].

Supplying the coal-fired power stations with natural gas sourced from Mozambique, connecting to the existing ROMPCO and Sasol pipelines, presents as the most feasible short-term supply opportunity. Alternatively, LNG imported at the Port of Richards Bay could supply the coal-fired power stations either via South Africa's existing "heavy haul" coal railway network, connecting the Port of Richards Bay to the coal mining areas in Mpumalanga, or by reversing Transnet's Lilly pipeline's flow direction and connecting to the existing infrastructure in the immediate area.

Even though Botswana is in proximity to the coal-fired power stations, the uncertainty regarding CBM volumes and the initial available gas volumes will likely be too small to justify initial pipeline infrastructure development investments.

Zimbabwe's proximity to the coal-fired power stations in Mpumalanga presents an opportunity for potential supply either through a new build pipeline or utilizing the twin existing Harare-Beira pipeline route to tie into the ROMPCO pipeline. The gas fields remain undeveloped and the prospective resource relates to undiscovered accumulations which have both a risk of discovery and a risk of development.

9.4.3.1.2 Gas-Fired Power Stations

Transnet's Lilly Pipeline provides access to natural gas both northwards to Gauteng, as well as southwards to Durban, with a maximum capacity of 0.02 tcf. The uncommitted capacity of the Lilly Pipeline is 0.004 tcf and the forecasted Lilly pipeline utilisation is summarised in Figure 9-6 [67] [66].

Figure 9-6: Transnet's Lilly Pipeline Utilization Forecast

Transnet's Lilly Pipeline passes by the Avon Peaking Power Plant in KwaZulu-Natal and the potential exists to utilize the Lilly Pipeline. Additional gas will have to be secured and introduced into the pipeline in the KwaZulu-Natal region, since the transmission pipeline capacity is already constraint in the Secunda-New Castle section. Richards Bay is the closest South African port to Mozambique, which is in the process of unlocking its substantial offshore gas reserves [10].

Coega embodies an optimal geographic location to support gas markets both to the east and west coasts and offers a strong integrated logistics corridor for the delivery of gas to the hinterland. LNG importation at Coega and subsequent pipeline distribution could potentially service the gas-to-power generation facilities in the Eastern and Western Cape.

Natural gas supply from Namibia to the Cape region is unlikely, despite the Kudu gas field's potential, since it remains unclear whether the Kudu gas field will be developed given the current funding uncertainties.

Importing LNG into the west coast of the Western Cape, specifically Saldanha Bay, could potentially supply Ankerlig and Acacia power generation facilities, serving as key gas customers in the area [13] [69].

9.4.3.2 Non-Power Sector

LNG could potentially be a more suitable option to fulfil pockets of demand along the coastal areas before the needed scale is reached to support a pipeline. A common approach to LNG importation infrastructure could be considered, whereby all three potential ports (Richards Bay, Coega and Saldanha Bay) receive natural gas over time, but with different transmission and distribution infrastructure requirements. A phased approach to ports development will benefit infrastructure investment in the medium to long term.

Once import terminals and anchor gas customers (gas-to-power generation facilities) are in place, there could be potential to extend the gas distribution network to serve energy users in some of the key industrial nodes. The network could subsequently be extended further to provide gas as an alternative energy source to households and in transport applications. Until pipeline infrastructure is expanded, natural gas transportation by way of rail and truck can be considered.

9.4.4. Potential Natural Gas Corridors

In 2014, the South African government announced Operation Phakisa in order to stimulate the country's blue economy and create an enabling environment to give industry the comfort to invest in this capital-intensive sector.

The aim of the Strategic Environmental Assessment (SEA) for the development of a gas pipeline network for South Africa is to identify and pre-assess environmental sensitivities within suitable gas routing corridors. It is envisaged that the development and operation of a gas pipeline infrastructure would follow a streamlined environmental authorization process or would be exempt from environmental authorization within the corridors identified through the SEA process.

The natural gas corridors included in SEA, with the exception of the Shale Gas corridor, is depicted in Figure 9-7. Gas infrastructure development within these identified corridors should be considered to avoid development delay resulting from environmental authorizations.

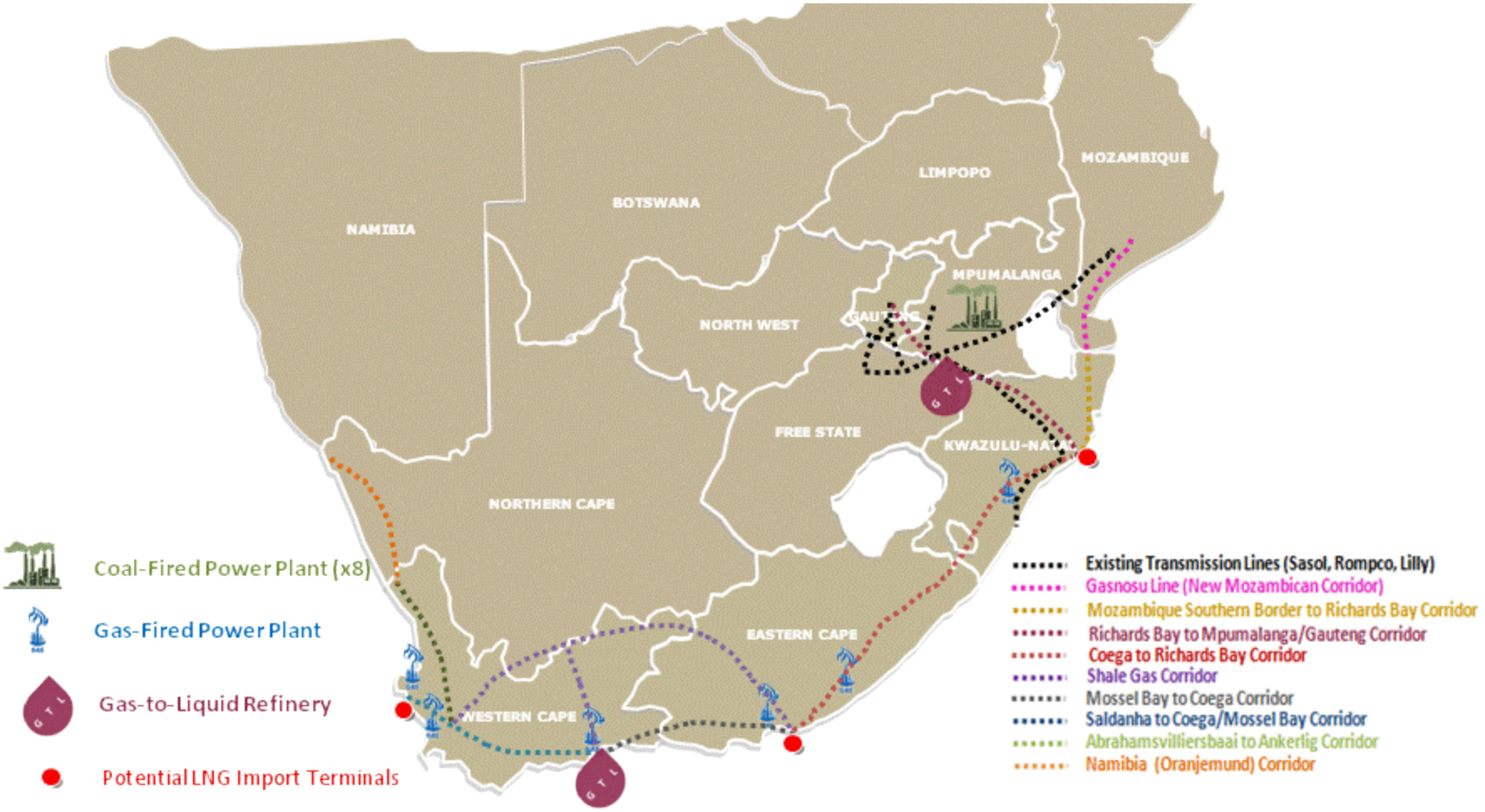


Figure 9-7: Potential Natural Gas Corridors

9.4.5. Natural Gas Trading Hubs

Henry Hub is an important market clearing pricing concept because it is based on actual supply and demand of natural gas as a stand-alone commodity. Gas producers can rely on Henry Hub as a source of natural gas spot pricing due to its large trading volume, clear pricing transparency and high liquidity.

Other natural gas markets, like Europe, have fragmented hub pricing points. This means natural gas prices are often indexed to crude oil, which can have very different supply and demand factors affecting its price. Asian natural gas markets are even more fragmented and have no defined hub pricing point, although Singapore would like to serve this regional role. Consequently, all Asian natural gas prices are either indexed to crude oil or linked to Henry Hub. The expansion of the LNG trade is likely to encourage greater price convergence between the regional prices. Some global gas producers, like Qatar and Australia prefer to base the pricing mechanism of their natural gas deliveries on spot prices rather than indexing to the price of oil.

The Henry Hub pricing for natural gas for the past decade is summarised in Figure 9-8 [68].

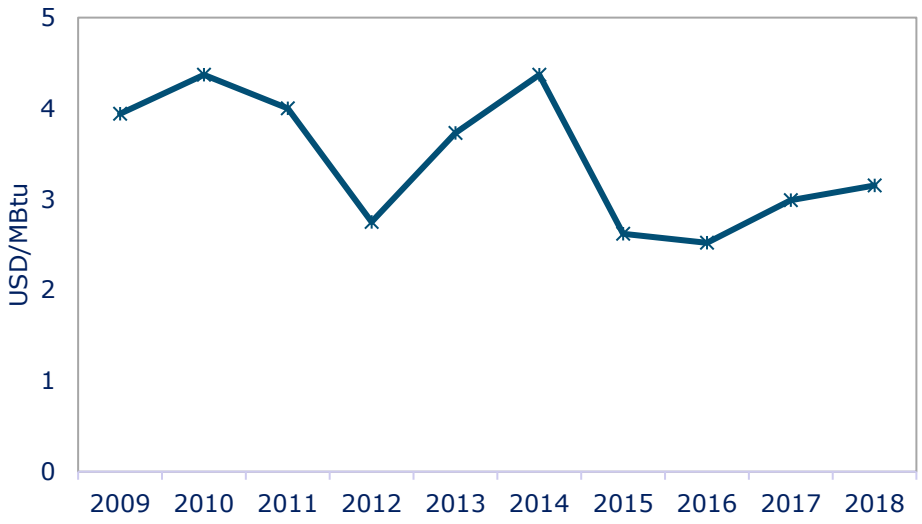


Figure 9-8: Henry Hub Natural Gas Spot Price

9.4.6. LNG Landed Cost

The producing domestic gas fields in South Africa are either for own-use (Petro SA's Ikhwezi project) or have signed take-off agreements (Tetra4's Virginia gas field). Potential domestic gas fields are expected to start production earliest 2028, with the Brulpadda gas field presenting the most bankable supply option.

Importation of natural gas presents the only immediate option to meet South Africa's short-term natural gas demand. Regionally, importation of natural gas via pipelines could be feasible while monetization in South Africa will require the development of LNG import facilities.

LNG landed price refers to the price that is received at the regasification terminal and are determined by a netback price for a producer at a defined location. Approximately 80 % of the landed cost relates to upstream costs in the supply chain, with shipping costs varying depending on the distance between source and destination market. The location of South Africa relative to the gas trading markets suggests that the Asian and European markers will be the most relevant markets for future LNG pricing in South Africa. Figure 9-9 shows the estimated world LNG landed prices [25].

Figure 9-9: World LNG Estimated Landed Prices – October 2019

According to Standard Bank commercial observations, there are no limitations on South Africa buying LNG on commercial terms and the limited shipping distances from Mozambique, Angola and Nigeria will aid in securing good landed prices. Since South Africa's high demand period is the opposite season to the Northern Hemisphere's winter peak, South Africa could make competitive LNG purchases and take risks on spot pricing [61].

The anticipated landed LNG pricing from the United States is estimated at US$6.50/MMBtu, while the LNG secured from Mozambique is expected to cost around US$7.07/MMBtu, with associated regasification cost estimated at US$0.60/MMBtu [61].

10. References

1. Gas Strategies Group. (2017, Dec). South Africa chases gas dreams. *South Africa chases gas dreams*.

2. Africa Oil + Gas Report. (2019, March 27). *LNG Barge Under Construction in Durban, South Africa*. Retrieved from https://africaoilgasreport.com/2019/03/maritime-services/lng-barge-under-construction-in-durban-south-africa/

3. allAfrica. (2019, January 31). *Zimbabwe: R55 Billion for Lupane Gas*. Retrieved from https://allafrica.com/stories/201901310143.html

4. Arrive Alive. (2019, September 5). *Public Transport*. Retrieved from https://www.arrivealive.co.za/Public-Transport

5. Bloomberg NEF. (2019). *Global LNG Outlook 2019-23.*

6. BP. (2019). *BP Energy Outlook 2019 Edition.*

7. BP Statistical Review of World Energy. (2019). *BP.* Retrieved from BP: https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf

8. Cape Advanced Engineering. (2014). *The Use of Compressed Gas in Public Transport in South Africa.*

9. Cision PR Newswire. (2018). *Petroleum Industry in South Africa 2018: State of Industry, Influencing Factors & Competition.* The South African Petroleum Industry in South Africa.

10. Club of Mozambique. (2019, September 3). *South Africas Plans for an LNG Hub at Richards Bay*. Retrieved from https://clubofmozambique.com/news/south-africas-plans-for-an-lng-hub-at-richards-bay-141012/

11. CNG Holdings. (n.d.). Retrieved August 17, 2019, from http://www.cngholdings.co.za/sa-gets-first-natural-gas-filling-station/

12. De Lange, A. (2019, 08 27). Geologist - PetroSA Gas Reserve Volumes. (I. Botha, Interviewer)

13. Deloitte. (2015). *The socio-economic impact of importing LNG into the West Coast of the Western Cape.*

14. Department of Energy. (2016). *Integrated Energy Plan.*

15. Department of Energy. (2019). *Draft Integrated Resource Plan 2018.*

16. Department of Energy. (2019, April 26). *Energy Statistics.* Retrieved August 15, 2019, from energy.gov.za/files/media/media_SAVolumes.html

17. Department of Trade and Industry. (2018). *Gas Industrialisation Strategy.*

18. EIA. (2019, October 31). *Internation Energy Statistics: Proved Reserves of Natural Gas 2018*. Retrieved from https://www.eia.gov/beta/international/rankings/#?prodact=3-6&cy=2018

19. Engineering News. (2019, April 12). *Brulpadda field unlikely to support a globally competitive chemicals industry, more exploration needed – experts*. (Creamer Media) Retrieved from https://www.engineeringnews.co.za/article/brulpadda-field-unlikely-to-support-a-globally-competitive-chemicals-industry-more-exploration-needed-experts-2019-04-12/rep_id:4136

20. Engineering News. (2019, April 26). *Firm plans to deploy 400 natural-gas refuelling sites across SA*. (Creamer Media) Retrieved from https://www.engineeringnews.co.za/print-version/gas-led-energy-transition-starts-with-transport-2019-04-26

21. ERM. (2018). *Exploration Drilling within Block ER236, off the East Coast of South Africa: Final Environmental Impact Assessment.*

22. ESI Africa. (2017, Sep). *Glencore inks multi-year deal for LNG supply.* Retrieved from ESI Africa: https://www.esi-africa.com/glencore-inks-multi-year-deal-lng-supply/

23. Eskom. (2019, September 9). *Power Stations.* Retrieved from http://www.eskom.co.za/Whatweredoing/ElectricityGeneration/PowerStations/Peaking/Pages.aspx

24. Eursia Review. (2019, March 1). Retrieved from https://www.eurasiareview.com/01032019-saudi-gas-export-plans-shine-new-light-on-efforts-to-isolate-iran-analysis/

25. Federal Energy Regulatory Commission. (2019, September 9). *National Natural Gas Market Overview: World LNG Landed Prices.* Retrieved from Market Oversight: https://www.ferc.gov/market-oversight/mkt-gas/overview/ngas-ovr-lng-wld-pr-est.pdf

26. Fin24. (2019, June 13). *Total at sample analysis phase of exploration at recent gas find*. Retrieved from https://www.fin24.com/Companies/Mining/total-at-sample-analysis-phase-of-exploration-at-recent-gas-find-20190613

27. G:ENESIS. (2015). *An assessment of the adequacy of competition in the South African pipe-gas industry.*

28. Gasworld. (2019, August 15). *Exclusive: Renergen discusses Virginia Gas Project.* Retrieved from https://www.gasworld.com/exclusive-renergen-discusses-virginia-gas-project/2017654.article

29. IGUA-SA. (2019). *Gas Energy - The Next Energy Challenge.*

30. International Energy Agency. (2019). *Gas 2018 - Analysis and Forecast to 2023.*

31. International Gas Union. (2019). *2019 World LNG Report.* 2019.

32. Invictus Energy Limited. (2019). *SG 4571 - Cabora Bassa Project Overview Conventional Oil and Gas Exploration Zimbabwe.*

33. IOL. (2019, April 9). *Plan to Upgrade Tshwane Coal-Fired Power Stations*.

34. Kiganda, A. (2018, Aug). *Construction of gas pipeline linking South Africa and Mozambique gains hope.* Retrieved from Construction Review Online: https://constructionreviewonline.com/2016/03/construction-gas-pipeline-linking-south-africa-mozambique/

35. MacauHub. (2018). *Angola LNG produces below-installed capacity*. Retrieved from MacauHub: https://macauhub.com.mo/2018/09/10/pt-angola-lng-produz-abaixo-da-capacidade-instalada/

36. MechChem Africa. (2019, June 19). *https://www.crown.co.za/latest-news/mechchem-africa-latest-news/10041-novo-energy-launches-state-of-the-art-natural-gas-compression-station*. Retrieved from https://www.crown.co.za/latest-news/mechchem-africa-latest-news/10041-novo-energy-launches-state-of-the-art-natural-gas-compression-station

37. Megabus. (2016). *SA Bus Industry Stats.* Retrieved from https://www.megabus.co.za/sa-bus-industry-stats/

38. Mokhatab, S., Mak, J. Y., Valappil, J. V., & Wood, D. A. (2014). *Handbook of Liquefied Natural Gas.* Elsevier.

39. National Planning Commission. (2012). *National Development Plan 2030.*

40. NERSA. (2017). *Piped-Gas Regulation Brochure (GAR).*

41. NERSA. (2019). Natural Gas Licensees.

42. NERSA. (2019). Natural Gas Transmission and Distribution Pipeline Maps.

43. NERSA. (2019, March 27). *Reason for Decision on the 2018/19 Determination of Inadequate Competition in the Piped-Gas Industry in terms of Section 21(1) of the Gas Act.*

44. Offshore Energy Today. (2018, Jul). *ExxonMobil, Eni file development plan for Rovuma project offshore Mozambique*. Retrieved from OffshoreEnergyToday.com:

https://www.offshoreenergytoday.com/exxonmobil-eni-file-development-plan-for-rovuma-project-offshore-mozambique/

45. Oil Review Africa. (2019, July 3). *Invictus Energy's Mzarabani Oil and Gas Prospects up in Zimbabwe*. Retrieved from http://www.oilreviewafrica.com/downstream/downstream/invictus-energy-s-mzarabani-oil-and-gas-prospects-up-in-zimbabwe

46. OPEC. (2019, October 31). *Data Download: Table 9.1: World proven natural gas reserves by country.* Retrieved from https://asb.opec.org/index.php/data-download

47. Ouedraogo, N. S. (2017). Africa energy future: Alternative scenarios and their implications for sustainable development strategies. *Energy Policy 106*, 467 - 471.

48. PASA. (2019, July 26). *Petroleum Geology Resources.* Retrieved from Petroleum Agency SA: http://www.petroleumagencysa.com/index.php/24-petroleum-geology-resources

49. Petroleum Agency SA. (2012). *Oil and Gas Reserves in South Africa.*

50. Petroleum Agency SA. (2019, January 16). *Exploration Activities Map.* Retrieved from https://www.petroleumagencysa.com/index.php/maps

51. PetroSA. (2016). *Presentation on the 2014/2015 Impairment Report Presented to the Portfolio Committee on Energy.*

52. Reuters. (2018). *Namibia to Pare Back Kudu Gas-to-Power Project*. Retrieved from Engineering News: http://www.engineeringnews.co.za/article/namibia-to-pare-back-kudu-gas-to-power-project-2018-04-30/rep_id:4136

53. Reuters. (2019, May 28). *Tanzania LNG.* Retrieved from Tanzania says construction of LNG plant to start in 2022.

54. ROMPCO. (2017). *ROMPCO Uncommitted Capacity to SA.*

55. Ross, L. (2019, September 5). Reservoir Engineer - PetroSA Gas Fields. (I. Botha, Interviewer)

56. SA Taxi. (2018). *Business Overview.*

57. SABOA. (2019, September 5). *SABOA Profile.* Retrieved from https://www.saboa.co.za/index_htm_files/SABOA%20%20Profile%20Sept%202018.pdf

58. SAOGA. (2017). *SunBird Energy.* Retrieved 2018, from SAOGA: http://www.saoga.org.za/directory/member-details/3606

59. Sasol Limited. (2018). *Form 20-F.*

60. Smit, J. (2019, September 10). Manager Gas Value Chain - Sasol Gas Business Chain. (I. Botha, Interviewer)

61. Standard Bank. (2019). *Mozambique - Gas Supplier to the World?*

62. The Citizen. (2019, 08 20). Taxi Industry Turns to Gas as High Petrol Prices Bite.

63. The Department of Trade and Industry South Africa. (2018). *Gas Industrialisation Strategy 2018.*

64. The World Bank. (2019, August 29). *The World Bank in South Africa*. Retrieved from https://www.worldbank.org/en/country/southafrica/overview#1

65. Tlou Energy. (2019, July 25). *Lesedi CBM Project*. Retrieved from https://tlouenergy.com/lesedi-cbm-project

66. Transnet. (2016). *LTPF Chapter 6.*

67. Transnet. (2018). *TPL Gas Transmission Uncommited Capacity Report 2017/2018.*

68. U.S. Energy Information Administration. (n.d.). *Henry Hub Natural Gas Spot Price.* Retrieved August 16, 2019, from eia.gov/dnav/ng/hist/rngwhhdm.htm

69. Western Cape Government. (2019). *Improving Energy Resilience During Power Shortages.*

Appendix A: Exploration and Production Activities and Rights Holder

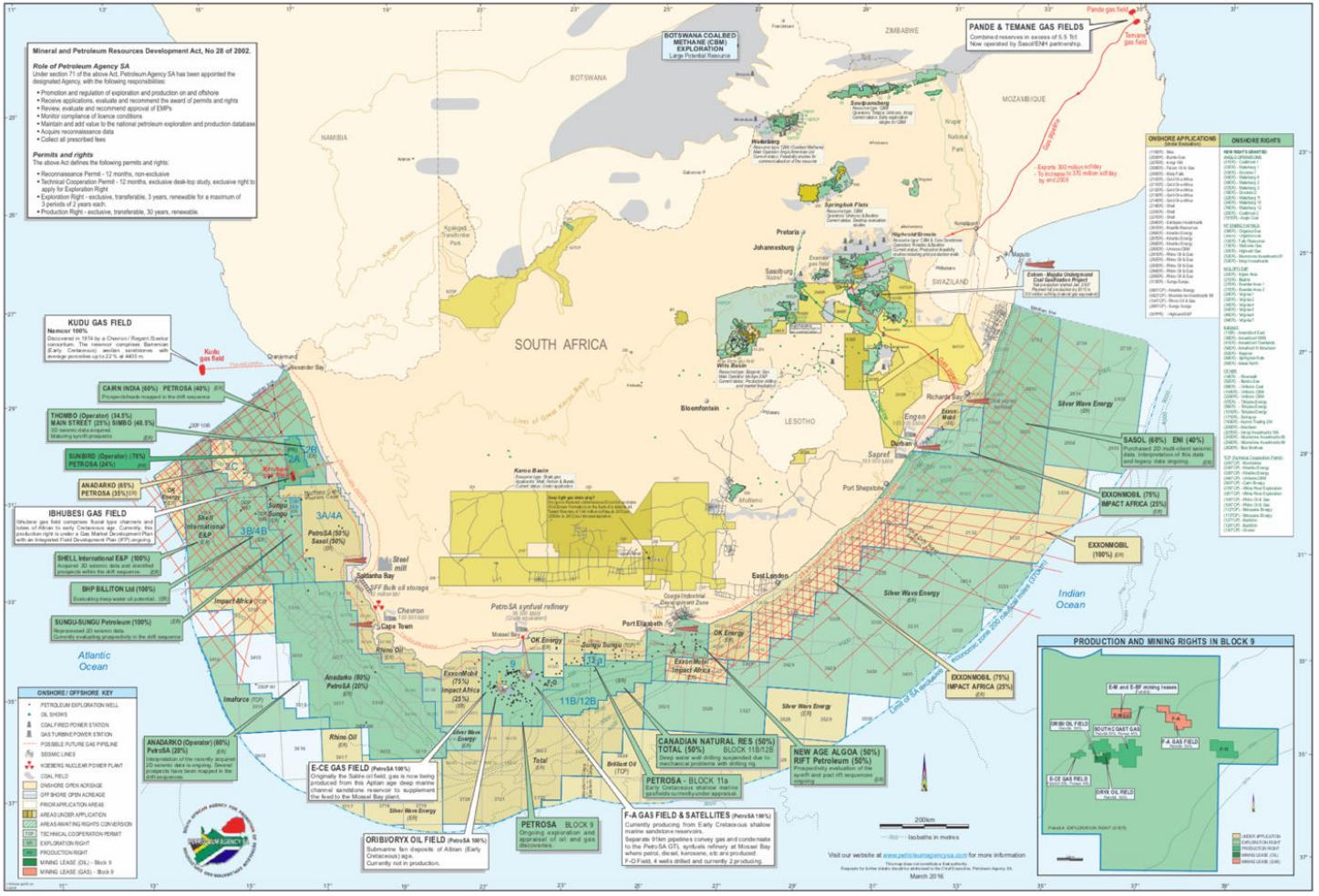


Figure A - 1: Petroleum Exploration and Production Activities in South Africa

Table A - 1: Onshore Natural Gas

Rights Holder	Area	Type of Petroleum
Inert Gas Industries	Heilbron, FS	Natural Gas
Tetra4 (Pty) Ltd	Evander, MP Virginia, FS FS	CBM Natural Gas Petroleum
Afro Energy (Pty) Ltd	Amersfoort NWS, MP Waterberg, LP	CBM
Umbono	Soutpansberg, LP	Natural Gas
Anglo	Waterberg, LP	CBM
Booi Brothers	Mutale & Malamulele, LP	Natural Gas
Maarifa Resources (Pty) Ltd	Weltevreden, NW	Petroleum

Table A - 2: Offshore Natural Gas

Rights Holder	Area	Type of Petroleum
PetroSA	Block 9 & 11A Block 5/6 & 7	Oil, Gas & Condensate Oil, Gas & Condensate
Thombo Petroleum, Main Street, Simbo & Africa Energy	Block 2B	Oil & Gas
ExxonMobil, Impact Africa Ltd & Statoil	Zululand Basin	Oil & Gas
NewAge & Rift	Algoa Gamtoos	Oil & Gas
CNR & Total	Block 11B/12B	Oil & Gas
Sungu	Mid-Orange Basin	Oil & Gas
Sasol & Eni	East Coast KZN	Petroleum
Silverwave Energy Pte	Blocks 2834, 2835 & other	Petroleum & Gas
Total E&P South Africa (Pty) Ltd	Outeniqua Basin	Petroleum & Gas
OK Energy Limited & Statoil	Eastern Algoa Basin	Natural Gas
Impact Africa Ltd	Transkei Margin Algoa Basin	Natural Gas
ExxonMobil E&P South Africa Ltd & Statoil	Deep Water Durban Basin	Natural Gas

Appendix B:
Natural Gas Licensees

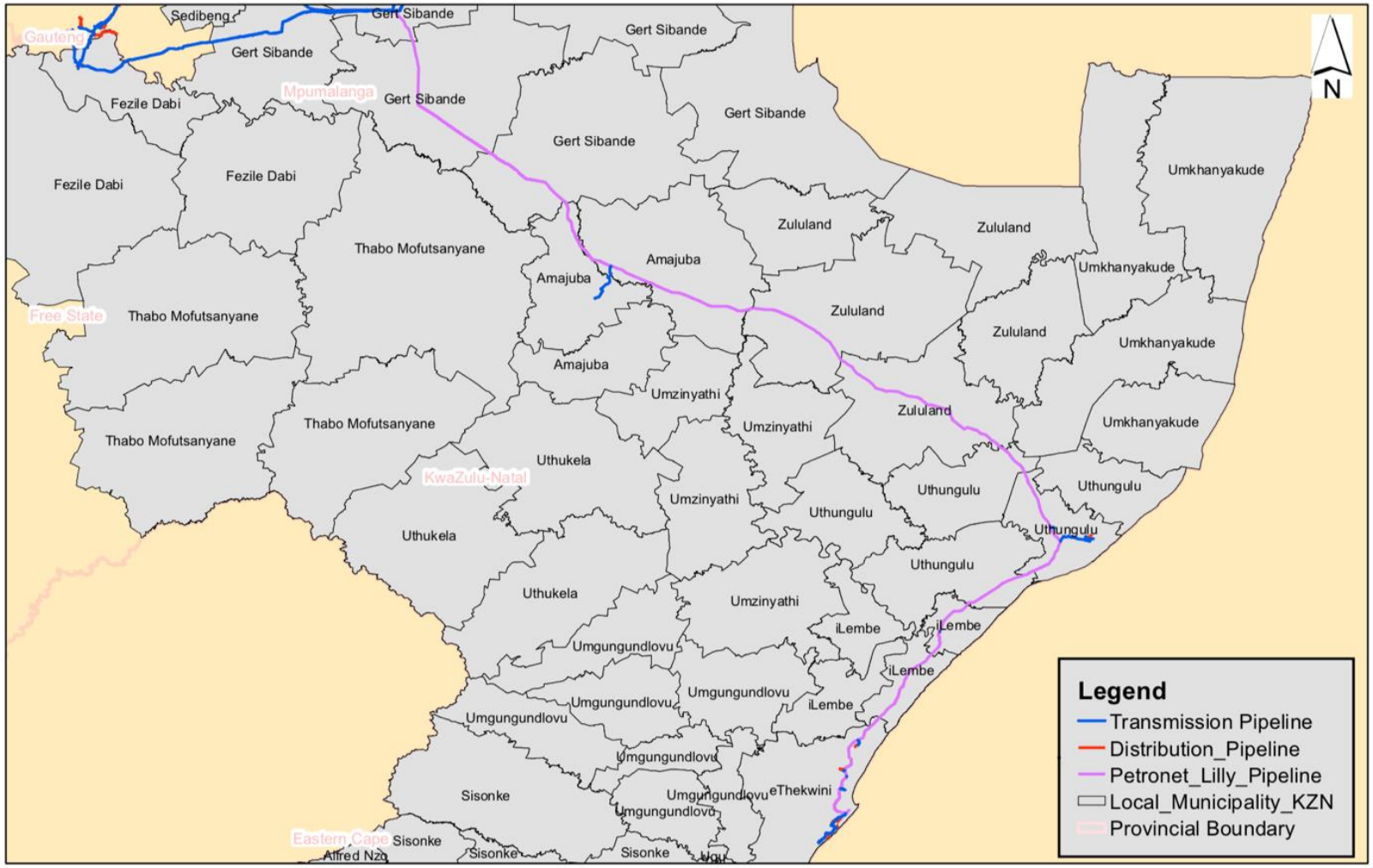
Table B - 1: Natural Gas Licensees

Type	Status	Holder
Transmission Licence	Approved	Sasol Gas
		Transnet
		ROMPCO
		Reatile Gas
		SAB
		Zemvelo
		Phambili
		PFG (Pty) Ltd
		Nampak
	Under Consideration	Ceramic Industries
Distribution Licence	Approved	Columbus Steel
		Sasol Gas
Trading Licence	Approved	Sasol Gas
		NOVO Energy
		Tetra4
		VGN
		NGV
		SLG CNG

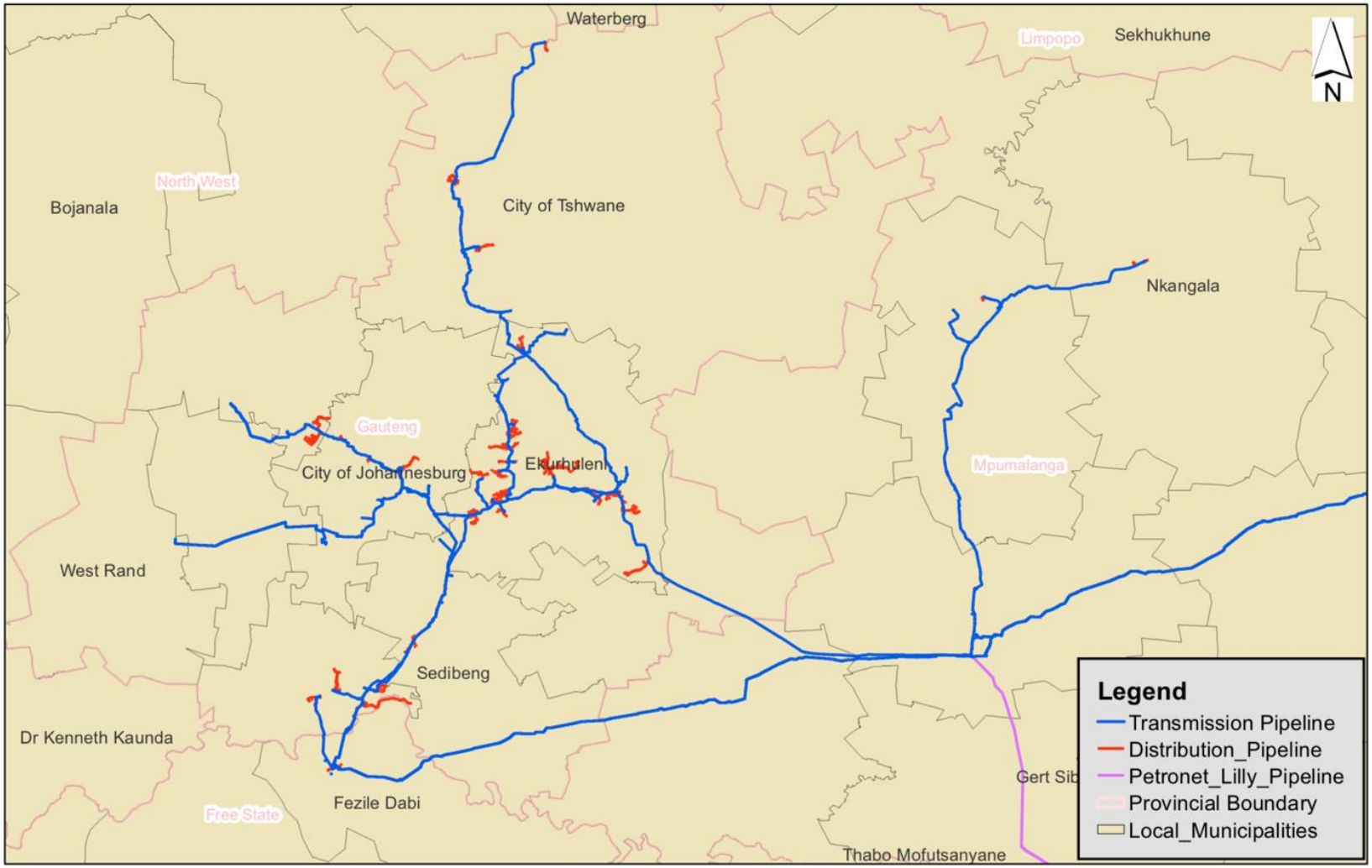
Type	Status	Holder
		Spring Lights Gas
		Egoli Gas
	Under Consideration	ILIZA Gas
		Kwande Gas

Appendix C:
Natural Gas Pipeline Infrastructure

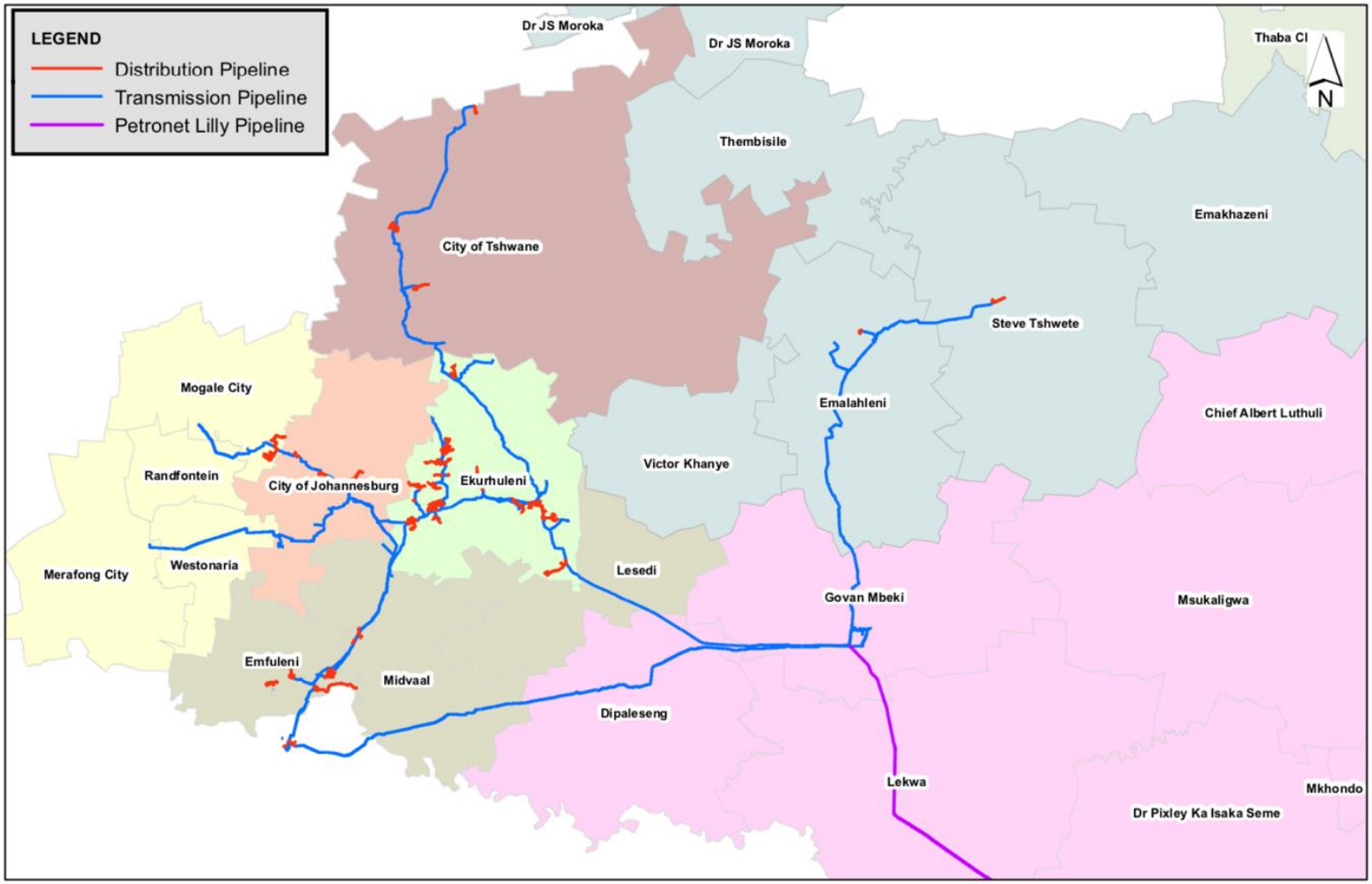
TRANSMISSION GAS PIPELINE- KZN

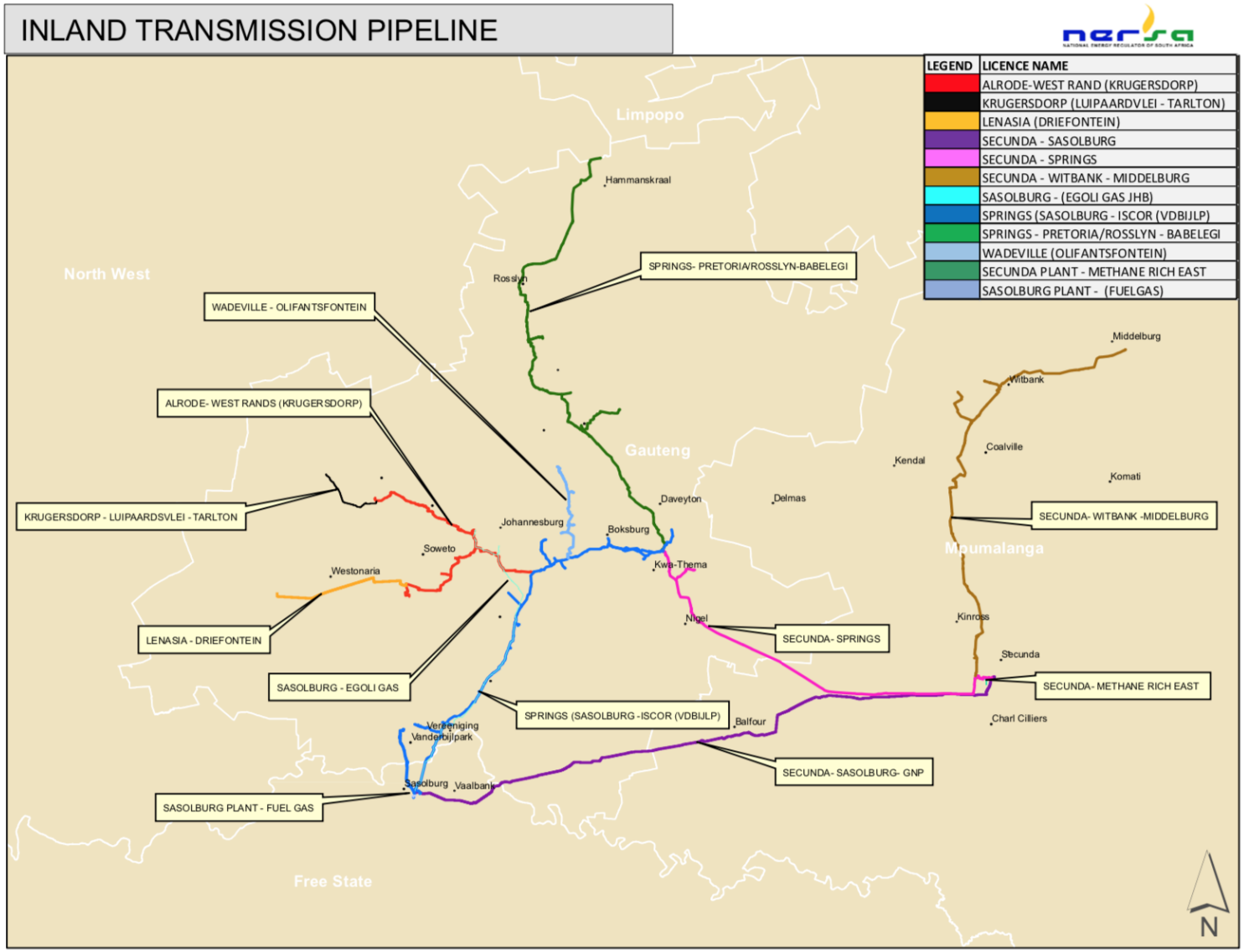


DISTRIBUTION GAS PIPELINE- INLAND



MUNICIPAL OVERVIEW- INLAND GAS PIPELINE




INLAND TRANSMISSION PIPELINE
LEGEND
LICENCE NAME
ALRODE-WEST RAND (KRUGERSDORP)
KRUGERSDORP (LUIPAARDVLEI - TARLTON)
LENASIA (DRIEFONTEIN)
SECUNDA - SASOLBURG
SECUNDA - SPRINGS
SECUNDA - WITBANK - MIDDELBURG
SASOLBURG - (EGOLI GAS JHB)
SPRINGS (SASOLBURG - ISCOR (VDBIJLP)
SPRINGS - PRETORIA/ROSSLYN - BABELEGI
WADEVILLE (OLIFANTSFONTEIN)
SECUNDA PLANT - METHANE RICH EAST
SASOLBURG PLANT - (FUELGAS)
Limpopo
North West
Gauteng
Mpumalanga
Free State
Hammanskraal
Rosslyn
Middelburg
Witbank
Coalville
Kendal
Komati
Daveyton
Delmas
Johannesburg
Boksburg
Soweto
Westonaria
Kwa-Thema
Nigel
Kinross
Secunda
Charl Cilliers
Balfour
Vereeniging
Vanderbijlpark
Sasolburg
Vaalbank
WADEVILLE - OLIFANTSFONTEIN
SPRINGS- PRETORIA/ROSSLYN-BABELEGI
ALRODE- WEST RANDS (KRUGERSDORP)
KRUGERSDORP - LUIPAARDSVLEI - TARLTON
SECUNDA- WITBANK -MIDDELBURG
LENASIA - DRIEFONTEIN
SECUNDA- SPRINGS
SASOLBURG - EGOLI GAS
SECUNDA- METHANE RICH EAST
SPRINGS (SASOLBURG -ISCOR (VDBIJLP)
SECUNDA- SASOLBURG- GNP
SASOLBURG PLANT - FUEL GAS
N