Fracking in South Africa: In search of a strategy for the DBSA

'If you see a bandwagon, it's too late' – Jimmy Goldsmith

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1. Background

Fracking has become controversial across the world as the environmental debates clash with energy concerns. The discussions appear to be irreconcilable currently, but in a country with energy constraints, it is necessary to find a comfortable middle ground that takes into account the environmental concerns but ensures a sustainable energy supply in the country. Approximately 90% of South Africa's energy comes from coal sources, which produces significant carbon emissions. It is speculated that by developing just one 10th of South Africa's estimated resources the economy would be boosted by R200 billion a year and create 700 000 jobs.[1]

The energy sector in South Africa contributes about 15% to the country's Gross Domestic Product (GDP). In 2010, the Integrated Resource Plan (IRP) defined the potential energy mix for South Africa up to 2013. It aims to reduce carbon emissions; reduce new technology uncertainties; regulates water usage; ensures localization and job creation; promotes southern African regional development and integration; and, endeavours to build a security of supply. The energy mix by 2030[2] would include the following contributions from various energy sources:

- Coal at 15%
- Nuclear 23%
- Renewable energy 42%[3]

The estimated installed capacity in South Africa is 39440 MW with Eskom controlling 36340 Mw, 2500 MW and 800 MW under municipal and private sector control respectively.[4] Retrospective view

In 2010, 90% of electricity generated in South Africa came from coal, followed by nuclear and hydro at 5% and 4.5% respectively. Petroleum products, natural gas and other renewables (solar, wind, biomass, bagasse and landfill gas) collectively contributed less than 0.5% towards total installed capacity.

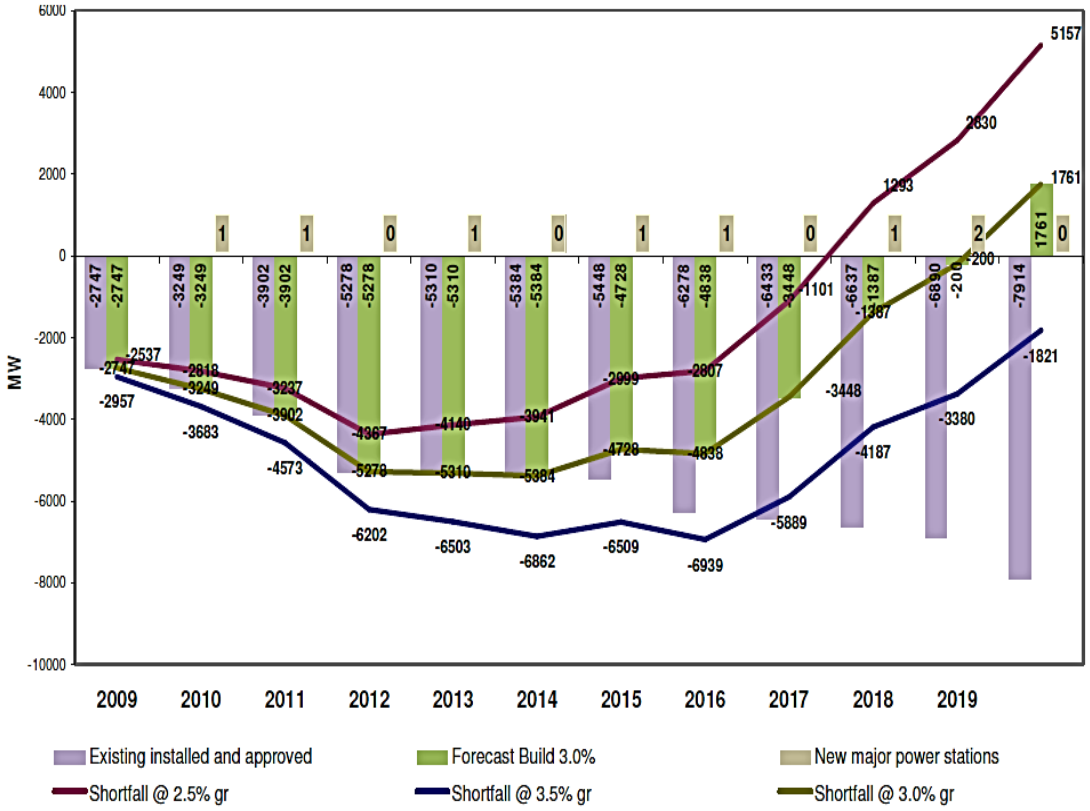
South Africa's coal industry emits 3.97 kg of CO_2 per USD[5] which makes it the largest African contributor to greenhouse gasses. The country cannot reduce its reliance on coal-fired power in the short run because it has invested significant capital in coal-based electricity generation. South Africa exports 26.2% of its coal while the rest contributes to total primary energy requirements. 92.8% of its electricity is generated by Eskom with only 7.2% being generated by the Independent Power Producers (IPPs), while Sasol produces 30% of the country's total liquid fuel requirements from coal. South Africa's coal-fired power stations, Medupi and Kusile will eventually contribute to the energy mix but they are in Mpumalanga, which comes with

[1] http://uk.reuters.com/article/2013/10/10/safrica-fracking-idUKL6N0I02BI20131010 (accessed 10 November 2013). The Energy Year Book 2011/12 notes that 77% of South Africa's primary energy needs are provided by coal. http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/yearbook/2011/13_Energy.pdf (accessed 10 November 2013)
[2] Integrated Resource Plan 2010
[3] http://www.info.gov.za/aboutsa/energy.htm (accessed 10 November 2013)
[4] Econometrix 2012, p21
[5] Energy Sustainability Index 2012 (World Energy Council)

transmission costs. The Waterberg offers new opportunities but water limitations in that area have a bearing on the levels of expected yield and production.

Figure 1 depicts the synthesis of available information related to energy supply and demand from 2009 to 2019 in South Africa, which roughly corresponds with the period of exploration for shale gas in the Karoo.

Figure 1: Electricity Shortfall in South Africa



Source: Econometrix 2012, p.24

It is for this reason that the energy mix in South Africa remains an important debate, even though the Minister of Finance claims that South Africa will have 'adequate power' within the next two years[6] as Kusile, Medupi and Ingula come online. This briefing paper looks at the shale gas debates and explores the opportunities for the DBSA in that industry.

2. Objectives

The objective of this report is to:

- Provide a comprehensive and analytical study of the legislative and regulatory frameworks of the energy sector in South Africa.

[6] Minister Pravin Gordhan, response to parliamentary questions, 11 March 2014. http://www.fin24.com/Economy/Call-to-privatise-electricity-management-20140311

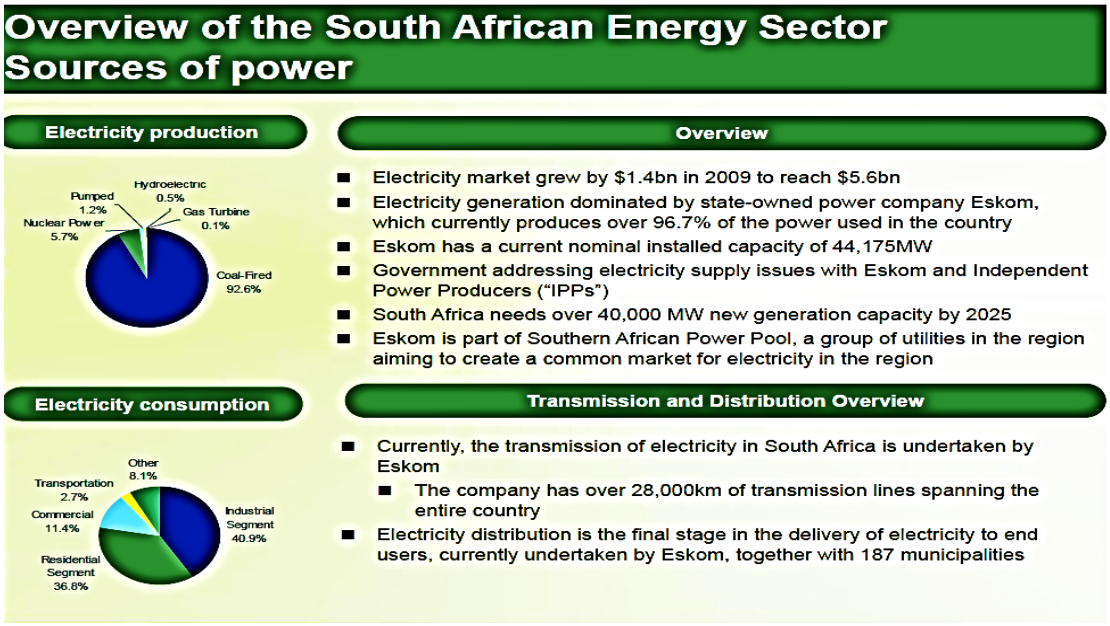
- Analyse the policy landscape governing new technology like fracking
- Identify companies involved in the exploratory phase and those that have expressed interest.
- Identify potential investment opportunities in the fracking industry
- Identify potential partnerships and strategies for the industry
- Define a strategy for the DBSA's involvement in the fracking industry.

This briefing looks at the current sources of energy and mix, the proposed sources of energy as per official documents and evaluates the role that fracking would play in the energy strategy in South Africa. Finally, it determines a possible strategy for the DBSA to work in the energy sector particularly in the areas of energy generation and transmission.

3. Energy policies in South Africa[7]

The Department of Energy is the line department for the oversight and regulation of the energy sector in South Africa. A number of policies have been introduced in the post-1994 period that will be annotated in this section, to provide an overview of the legislative and regulatory framework that exists in South Africa.

Figure 2: Current sources of power in South Africa



Source: http://www.usea.org/sites/default/files/event-file/497/South_Africa_Country_Presentation.pdf

3.1 Renewable Energy White Paper 2003[8]

The then-Department of Minerals and Energy (DME) set a target of 10 000 GWh of energy to be produced from renewable resources (biomass, wind, solar and small-scale hydro) by 2013.

[7] http://www.usea.org/sites/default/files/event-file/497/South_Africa_Country_Presentation.pdf
[8] http://www.energy.gov.za/files/policies/whitepaper_renewables_2003.pdf

Achieving the target will:

- Add about 2,667 MW new renewable energy capacity with a net impact on GDP as high as R1 071 billion per annum
- Create additional government revenue of R299 million
- Stimulate additional income that will flow to low-income households by as much as R128 million, creating over 20 000 new jobs; and,
- Contribute to water savings of 16.5 million kilolitres, which translates into a R26.6 million saving.

The White Paper was supported by the decisions made at the World Summit on Sustainable Development (WSSD) in 2002, which advocated for renewable energy generation in South Africa.

3.2 Energy Efficiency Strategy 2005[9]

This document was produced to highlight the need for energy efficiency in South Africa and emanates from the White paper on Energy Policy (1998). Changes within communities and businesses were the focal points for the reduction of energy demand, particularly from the industrial and mining sectors that account for more than two-thirds of national electricity consumption. The Energy Efficiency Strategy links energy sector development with national socio-economic development plans. The Strategy sets a national target for energy efficiency improvement of 12% by 2015.

The Strategy has eight goals that cut across the areas of social, environmental and economic sustainability:

- Improve the health of the nation
- Job creation
- Alleviate energy poverty
- Reduce environmental pollution
- Reduce $C0_2$ emissions
- Improve industrial competitiveness
- Enhance energy security
- Reduce the necessity for additional power generation capacity.

The Kyoto Protocol also fed into the Strategy by creating a moral imperative for South Africa to reduce its greenhouse gasses by 2012 as it was not required by law to do so as a developing country. The DME established the Designated National Authority to process Clean Development Mechanism projects to achieve a lower national carbon footprint.

South Africa has committed to international standards and protocols to reduce carbon emissions and to adjust its energy mix to reflect this 'green' approach. The Energy Efficiency Strategy and subsequent policies and frameworks are evidence of that commitment.

[9] http://www.energy.gov.za/files/esources/electricity/ee_strategy_05.pdf

3.3 National Energy Act, 2008 and the Regulations on Energy Savings Allowance 2011

The National Energy Act of 2008 'ensures that diverse energy resources are available, in sustainable quantities, and at affordable prices'[10]. According to this Act, the minister has to develop and review the Integrated Energy Plan on an annual basis, which would deal with a range of social and economic issues related to the provision of affordable, secure energy and take into account other sectors in the economy that rely on energy supply.

The Regulations on Energy Savings Allowance 2011 provides the framework that oversees one of the incentives introduced into the sector to encourage affordability and incentives to be energy efficient.

3.4 New Generation Capacity Regulations 2006[11]

Two iterations of the original Regulations were passed in 2009 and 2011. The 2011 Regulations make provision for the Independent Power Producers and Power Purchase Agreements. The objectives of the regulations include the facilitation planning for the establishment of new generation capacity; the regulation of entry by a buyer and a generator into a PPA, minimum standards or requirements for PPAs; full cost recovery and the provision of a framework for implementation of an IPP procurement programme. The Regulations exclude new generation capacity derived from nuclear power technology.

3.5 An Integrated Resource Plan 2010 – 2030[12]

The final iteration of the 2010[13] Integrated Resource Plan was made available in March 2011. The Policy-Adjusted IRP included a Revised Balanced Scenario (RBS) for the period 2010 to 2030. The Policy-Adjusted IRP report sets out the energy mix as follows (including 10 GW committed coal):

- Nuclear fleet of 9.6 GW
- Coal 6.3 GW
- Renewables 17.8 GW
- Other generation sources 8.9 GW

Since the 2011 report, the updated report has included the contributions of Independent Power Producers (3 725 MW), which is broadly aligned to the Renewable Energy generation in the IRP 2010 – 2030.

The IRP recommends that the nuclear decision can be delayed until after 2025 due to alternative options such as hydro and potential shale gas. Regional projects will also come on line in Mozambique and Zambia and potentially Grand Inga in the DRC, which might provide cheaper energy for South Africa. Also, the IPPs will improve their contributions to the grid over the subsequent annual rounds. The IRP acknowledges that there will be constraints until 2016

[10] Naitonal Energy Act, 2008 (Act No.34 of 2008), Republic of South Africa

[11] http://www.energy.gov.za/files/irp_frame.html

[12] http://www.doe-irp.co.za/content/IRP2010_updatea.pdf

[13] http://www.energy.gov.za/IRP/irp%20files/IRP2010_2030_Final_Report_20110325.pdf

but there are few alternative options in the short-term except to increase energy efficiency and demand side response, and improve the use of existing generation resources.

3.6 National Gas Act 2001[14] and the Gas Amendment Bill 2013[15]

The National Gas Act was instituted to 'promote the orderly development of the piped gas industry; to establish a national regulatory framework; to establish a National Gas Regulator' and to provide a framework for all related matters. The Gas Energy Regulator is separate from the Energy Regulator due to the projected size of the potential gas finds in South Africa.

The Gas Act did not include new technologies such as hydraulic fracturing (fracking) therefore the Gas Amendment Bill of 2013 was introduced to provide, among others, for new development and changing technologies in the gas sector, facilitate infrastructure development and investment and provide for public private cooperation.

The national framework for the development of the gas sector includes the Natural Gas Treaty with Sasol, the Natural Gas Regulations regarding the Mandatory blending of biofuels with Petrol and Diesel and the Gas Infrastructure Plan. None of these additional frameworks take into consideration the nascent shale gas industry.

3.7 Mineral and Petroleum Resources Development Act (2002), the Amendment Act (2008), the Proposed Technical Regulations for Petroleum Exploration and Exploitation (2013) and the Mineral and Petroleum Resources Amendment Act 2013

The *Mineral Act of 2002* was instituted to make provision for equitable access to and sustainable development of the national's mineral and petroleum resources. Environmental protections were written into the Act to ensure that the development of minerals and resources would not be at the expense of South Africa's environment. Local and rural communities would also be protected and developed under the Act and benefit from mining activities.

The *Amendment Act of 2008* was introduced to make the Minister of Minerals and Energy the responsible authority for implementing environmental matters in terms of the National Environmental Management Act 1998 (NEMA) and to align the Act with NEMA.

The *Proposed Technical Regulations for Petroleum Exploration and Exploitation (2013)* were particularly important in relation to Hydraulic Fracturing (fracking) and prescribe good international practices and standards for the industry. Again, environmental protection is important in the development of this sector, including the fracking sub-sector. The Regulations provide guidelines for water use and water conservation; the protection of the Square Kilometer Array Telescope (SKA) and the immediate area around it to ensure clarity of the telescope; suitable waste management; and air management.

Two clauses in the *Mineral and Petroleum Resources Amendment Act* have created much controversy in the approval process. The Amendment Act will entitle the government to set the regulations shaping exploitation of SA's mineral resources and nascent oil and gas industry. will provide the government with 20% free carry interest on any new exploration and finds in the industry. A free carry interest is the portion of production that goes to the state as a form of tax

[14] http://www.energy.gov.za/files/policies/act_gas_48of2001_national_2002.pdf
[15] http://www.energy.gov.za/files/policies/The-Gas-Amendment-Bill.pdf

without it putting up any financing for the exploration phase. This has been referred to as an 'exploration' tax in other contexts, such as Mozambique. The Bill also carries a 26% Black Economic Empowerment requirement, which set a total hurdle of 46%. The second clause is related to the state's access to participation up to 30% at market related prices.[16]

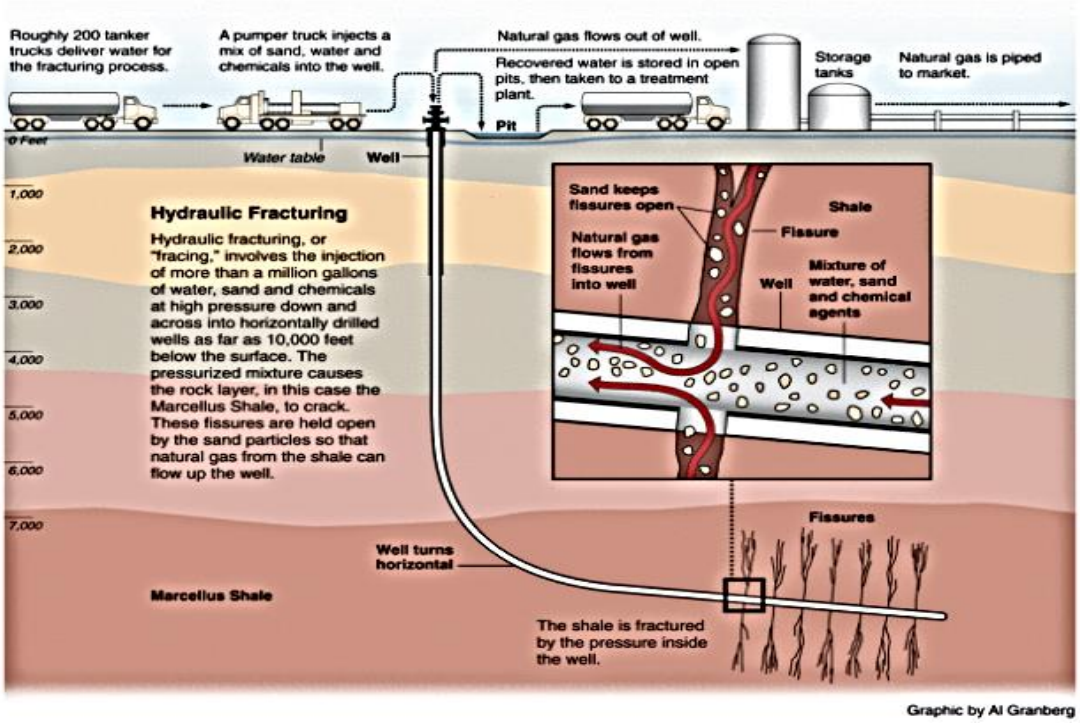
4. Hydraulic Fracturing (Fracking)

4.1 History of fracking

Fracking was discovered in the US and is surrounded by much controversy despite its potential to improve the self-sustainability of countries in relation to their dependency on oil and gas imports. It is also a source of renewable energy, albeit it limited, which makes it attractive to the 'green' energy supporters. However, the environmental concerns place the industry in the balance because of the use of excessive water, toxic chemicals and related pollution fears.

The process of fracking involves the breaking up of deep rock using significant quantities of water, sand and chemicals under high pressure, which cracks the rock and release gas that is then captured and piped to the surface and energy generation plants. It was first used in the US in the 1940s to reuse almost-depleted oil wells and gained traction in the early 1980s due to horizontal drilling in oil production processes. In the 1990s, a new process known as horizontal slickwater hydraulic fracturing was pioneered that uses more water and chemicals than the original process.[17]

Figure 3: A quick guide to fracking



Source: www.karoospace.co.za/lowdown-on-fracking-in-the-karoo/

[16] http://www.bdlive.co.za/business/mining/2013/11/06/still-concerns-over-mineral-amendment-bill

[17] www.karoospace.co.za/lowdown-on-fracking-in-the-karoo/

Large-scale shale gas production in the US only started in 2000 when it became a commercially viable enterprise in the Barnett Shale in north-central Texas. Shale gas production spread to Haynesville, Marcellus, Woodford and Eagle Ford shales. US shale gas production increased from 0.3 TFC in 2000 to 9.6 TFC in 2012 or to 40% of US dry natural gas production.

4.2 International debates

There are positives and negatives to fracking. For example, fracking has expanded in the US and as a result, their carbon emissions have been reduced. However, the dangers of the practice itself and of toxic water destroying the environment are evident in the environmental arguments against fracking. For example, 6 million to 25 million litres of water are used in a single well process with up to 20 tons of chemicals and sand. The toxic water rises to the surface with the waste water and care needs to be taken to remove it without causing damage to the environment.

Argentina's fracking industry has been fraught with tensions between the industry leaders and civil society. In a recent IHS report, Laurence Allen shares that more than 30 municipalities in Argentina have prohibited fracking, mostly due to pressure from civil society anti-fracking groups. In the La Rioja province, Canadian company Osisko Mining Corporation's contract was cancelled where a long-term campaign resulted in court challenges.

The anti-fracking movement has gained momentum globally and local protestors have used social media and global anti-fracking networks. Allen argues that '(a)ctivists are likely to use the effects of fracking on water resources to show that their opposition is based on not only potential environmental degradation and health concerns but also possible negative economic consequences for agriculture'[18]. The mobilisation of the indigenous people in Argentina could be seen to be replicated in the Karoo with the anti-fracking stance of the Khoisan. If a country is a signatory to the International Labour Organisation Convention 169, which guarantees the rights of indigenous people to be consulted on the development of their traditional lands, the mining companies have to obtain the buy-in from those groups.

5. South Africa and the fracking debates

In August 2013, the US Energy Information Administration (USEIA) downgraded South Africa's potential shale gas reserves from 485 Trillion Cubic Feet (5th largest in the world) to 390 TCF (8th in the world) because of 'geologic complexity caused by igneous intrusions', which resulted in a 15% reduction of the potential area from 70,800 square miles to 60,180 square miles.[19] In March 2014, the Petro Agency South Africa (PetroSA) further downgraded the estimates to 40 TCF but the project will still be viable.[20]

Energy from shale gas production has been explored in the post-2010 period therefore has not been factored into the energy equation for South Africa, as per the IRP. Total energy demand in South Africa will increase at an average annual rate of 2% from 5 500 Petajoules of energy to

[18] Laurence Allen, 2014. 'Argentina: Can anti-fracking activism derail the development of unconventional energy'. IHS Country Risk.
[19] http://www.eia.gov/analysis/studies/worldshalegas/
[20] Paul Vecchiatto, 5 March 2014. 'Energy sector set for big opportunities', *Business Day*, Late Final, p4. Mossgas was declared a viable proposition with a deposit of 1 TCF.

8246 PJs by 2050. Simply put, South Africa needs over 40 000 MW of new generation capacity by 2025.

In a 2013 report, Business Monitor International (BMI) argues that shale gas regulations will provide 'clarity for investors seeking to tap South Africa's shale gas potential'[21]. They argue that legislation alone will not attract investors because of the 'unappealing incentive structure' proposed by the Minerals and petroleum Development Amendment Bill.

The South African debate has followed the same lines of argument. The main legislation guiding the exploitation of hydrocarbon resources is the Mineral and Petroleum Resources development Act (the MPRDA) and the National Environmental Management Act (NEMA) do not include fracking in their frameworks. In fact, the decision to allow fracking has not been reached yet, which leaves an opportunity to look at the potential fracking has for easing the energy supply constraints in South Africa.

A Technical Cooperation Permit allows companies to undertake the first stage of exploration. Applications to convert these TCPs to exploration permits were initially halted by a moratorium that was meant to end in 2012. This was lifted and then reimposed in 2013, in order for government to find out more about the fracking industry.

The following companies have been granted exploration rights:

- Royal Dutch Shell – 90 000 square kilometer area from Bedford to Sutherland
- Falcon Oil & Gas – 30 000 km^2 for gas, half the size of the Kruger Park that includes the mohair centre of Jansenville, Aberdeen, Rietbron, Merweville and Leeu Gamka;
- Sunset Energy or Bundu – 35 000 km^2 including Pearston and areas around Graaf-Reinet.

They comprise an area as big as the entire Eastern Cape. In addition to these companies, a consortium of Sasol, Chesapeake Energy and Statoil ASA has applied to explore 80 000 km^2 which includes a large portion of KwaZulu Natal and most of the Free State. Anglo Coal (50 000 km^2) has also been added to the list confirmed by the US Energy Information Administration (EIA). The Econometrix report[22] confirms that the area for exploration includes five of the nine provinces, mainly the Western Cape, Eastern Cape, the Northern Cape, the Free State and KwaZulu Natal.

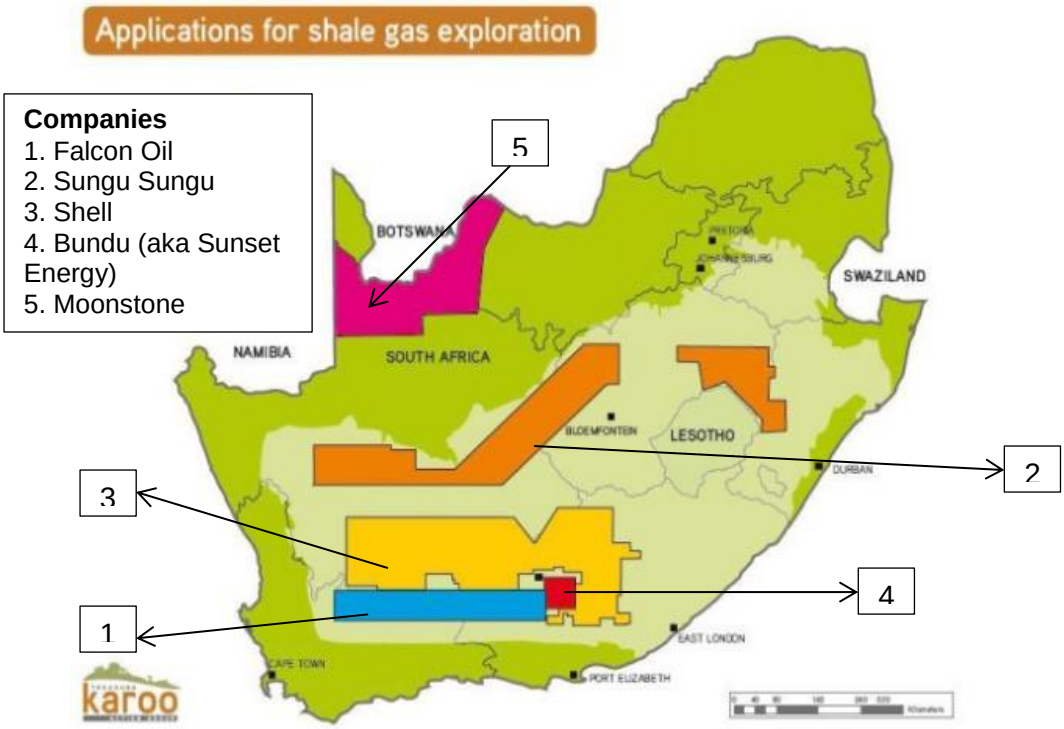
Sasol, Statoil and Chesapeake Energy (South Africa-Norway-US) were interested in South Africa's shale gas potential in 2009 but a moratorium halted the allocation of exploration and drilling licenses. The ban was lifted in 2012 and Royal Dutch Shell took the lead in announcing its intentions to invest in shale. Chevron (US) entered into an agreement with US Falcon Oil & Gas for exploration rights. Anglo American is also involved while smaller companies include Bundu Oil & Gas (Australian based in South Africa), Sungu Sungu (South African empowerment group based in Johannesburg) and Moonstone (unknown).

Some reports claim there are more than twenty companies interested in the fracking industry in the Karoo but the interest of the companies listed above is publicly known. For South Africa, this

[21] BMI, October 2013. 'Shale Gas a Long Term Hope'.
[22] http://cer.org.za/wp-content/uploads/2012/06/Econometrix-KSG-Report-February-2012.pdf

is only the exploration phase, once viable gas reserves have been confirmed, the upstream industries will need to be developed. This matter will be explored in more detail in Section 7.

Figure 4: Potential Fracking Areas in the Karoo Basin



Source: Adapted from www.karoospace.co.za/lowdown-on-fracking-in-the-karoo/

5.1 Shale gas reports

This section highlights two key reports that were generated to understand the cost/benefit analysis of developing the shale gas industry in South Africa. Many others exist but these were highlighted for their potential to influence policy at the national level.

Shale Gas Extraction Report (National Treasury)

The National Treasury report examines the potential benefits of gas to produce electricity and liquid fuels and provides a summary of potential environmental difficulties.[23] They do argue that shale gas production could take the pressure off the nuclear programme or the demand for a new coal-fired plant.

Table 1: Main Study Findings

	Electricity generation	Synfuels production
Production	2418 MW	34 000 bpd
Capital cost for plant and well construction	R18.83 bn	R25.94 bn
Product selling price	R632.40/MWh	R6.00/l*
NPV at 10%	R72.82 bn	R51.37 bn
IRR	39.6%	25.8%

[23] National Treasury National Capital Projects Unit, September 2012, 'Shale Gas Extraction'.

Job creation		
- Construction	2 210	5 500
- Permanent	153	850
- Shale gas extraction	1 000	1 000

*Source: National Treasury Report 2012. *Basic fuel price of R6.00/l, the selling price is equivalent to crude oil at $100/bbl and R/$=8.00.*

The calculations are based on a 30 year period where the wells will be drilled continuously and maintenance of 1 714 wells. They argue that limited government funding is required as the private sector will cover the costs incurred, however, government would provide a source of water if there is insufficient ground water. The infrastructure needs for fracking will be discussed under the Section 6.

The recommendations of the National Treasury report include the following:

- Shale gas production needs to be considered as an energy source considering the limitations of the current energy sources in South Africa but the report does concede that an 8 – 10 year exploration period can be expected before the industry comes online.
- Surveys should be conducted to determine the viability of the reserves in the Karoo and to guide the decision on whether it is a viable option for development. Monitoring environmental protection processes would be key in this sector.
- The volume of water available would need to be determined before and during the exploration process.
- Mitigation frameworks need to be established to minimize the potential environmental impact of the industry. International standards should be used as a guide to determine the acceptable parameters of the impact on the environment. A designated authority, local communities and interest groups should be involved in the decision-making process.
- A transparent and well-communicated process should be instituted to get community and public buy-in to the project.

National Treasury does not want to close the debate with a definitive answer but cautions that these recommendations need to be met for fracking to be given the green light and for the industry to contribute to the energy mix in South Africa.

Karoo Shale Gas Report (Econometrix)

The Econometrix report presents 'clear insight into the economic opportunities that *may exist if a large gas find can properly be identified* in the Southern Karoo' [emphasis added].[24] Economist Tony Twine and a team of researchers developed a model that presents two scenarios for shale gas production, which shows the following gains: an annual economic impact of more than R80bn to R200bn to GDP; an additional R35 500m and R90 000 million to government revenues; and, creation of 300 000 to 700 000 permanent jobs per year across the 25-year lifespan of the project.[25] The model was based on conservative estimates of South Africa's shale gas reserves ranging from 20 TCF and 50 TCF over 25 production years.

The Econometrix report identifies six main opportunity areas for natural gas in the South African context:

[24] http://cer.org.za/wp-content/uploads/2012/06/Econometrix-KSG-Report-February-2012.pdf
[25] Ibid., see also http://www.moneyweb.co.za/moneyweb-south-africa/tony-twines-legacy

- Exports of the gas;
- Use of the gas as an industrial commercial and domestic energy source;
- Generation of electricity;
- Use as an automotive fuel;
- Conversion to liquid fuels; and,
- Energy feedstock for fertilizer production.

A critique against Tony Twine's analysis argues that the job losses from agriculture and tourism were not factored into his model and neither were the costs from income lost from pollution and health problems caused by fracking.[26]

5.2 Policy delays[27]

- 21 April 2011, South African government passed a moratorium suspending all applications for gas exploration. The Department of Minerals and Resources aims to carry out further investigations into the pros and cons of fracking.
- 18 August 2011, Minister Shabangu extended the moratorium to allow for public consultation on fracking
- 7 September 2012, the moratorium was lifted to allow companies who had applied for rights to explore in their respective areas.
- In October 2013, the Energy Minister Susan Shabangu announced new technical regulations for fracking, which include the protection of wild life and the environment. Shell and other explorers estimate that shale gas may generate R1 trillion of sales in 30 years. The Centre for Environmental Rights (CER), a Cape Town-based research group argues that the proposed fracking regulations are 'inadequate and flawed'[28] and proposed minimum requirements for safe fracking[29].
- 13 February 2014, Minister Shabangu asked the oil and gas industry for comment on a proposed two-year extension of the moratorium on new applications for fracking and onshore and offshore exploration rights.
- The Minister has promised to release the regulations before May 7, 2014 (as of 12 March, no decision has been made as yet).

5.3 Opposition to fracking

The main opposition to fracking comes from the environmentalists, the Karoo community itself and academics who argue against the projected benefits of the industry to the Karoo specifically and South Africa in general.

The Karoo community and others have started a Treasure the Karoo Action Group (TKAG) where resources have been raised and allocated for legal interventions, public outreach and research. The TKAG team has compiled a comprehensive response to the Shell Environmental

[26] www.karoospace.co.za/lowdown-on-fracking-in-the-karoo/
[27] http://www.un-earthed.com/generalinformation/ and http://www.bdlive.co.za/business/mining/2014/02/13/shabangu-wants-two-year-delay-on-fracking
[28] http://www.news24.com/Columnists/AndreasSpath/SAs-new-fracking-regulations-are-flawed-20131224
[29] http://cer.org.za/wp-content/uploads/2013/12/CER-Minimum-Requirements-for-Regulation-of-Env-Impacts-of-Fracking-Dec-2013.pdf

Management Report and has had some success in controlling Shell's advertisements in the media about the benefits of fracking.[30]

The farmers in the district have also been vocal opponents to the fracking initiatives. Much debate in this lobbying group revolves around the benefits of farming to the Karoo and the positioning of iconic South African agriculture products, for example, the Karoo supplies 30% of South Africa's red meat and 30% of its wool[31], on the international market. The essence of this debate is the source of the supply of water that could potentially be redirected from farming to fracking and the fears of the fallout this would produce for the farming community and for the water-scarce Karoo region. Shell has suggested that the water could be piped or shipped in from the sea, waste water or from deep wells in the Karoo.

Every well is fracked up to 18 times during the production phase, typically within five years, using up to 20 million litres of water each time. Shell has said that they will build hazardous waste facilities during the exploration and production phases. There have been reports of hazardous water in the US resulting from nearby fracking[32]; human stories which make fracking highly controversial and an emotional debate.

6. Fracking: a loss-making enterprise?

President Obama and Prime Minister Cameron have endorsed fracking but there are problems with the concept of shale as a secure energy source and that extend beyond environmental concerns. BHP Billiton wrote down US$2.8 bn in 2012 on assets it acquired for US$4.8 bn for shale and cut production costs in the Eagle Ford oil and gas formation in south Texas by 30% recently.[33] BP wrote of $1 bn on shale in July 2012 and Encana lost almost $2 bn on shale gas assets in recent years. Terry Smith argues that one of the new concepts is the energy return on energy investment, which is the ratio of the amount of energy generated from a source to the amount of energy used to obtain that energy.[34] He asserts that the US oil production industry had an EROEI of 100:1 in the 10930s and currently that is at 11:1. Shale oil ratio is 5:1, which means that the costs of production far outweigh the economic gains.

It is argued that shale gas has a very short lifespan, that wells are depleted alarmingly quickly and that the average life of a shale gas well is less than seven years. In April 2013, Shell acknowledged that shale gas is expensive to mine and as a result electricity from the gas will be costly. This statement should be placed within the context of the cost of shale gas in relation to the cost of alternative sources of energy, including the environmental and social costs as well as the financial cost of production. On that basis, shale is cheaper than nuclear but has a shorter lifespan. It should be regarded as one of many sources of energy available to the South African energy market. With the advent of renewables on the market and shale's long lead-in time to reach production stage, it appears that the latter source might not be as viable as it was first thought. But, in light of South Africa's energy crisis, every option needs to be developed.

[30] David Fig, 2012, Fracking and the Democratic Deficit in South Africa', see also http://www.cornell-landproject.org/download/landgrab2012papers/Fig.pdf
[31] www.karoospace.co.za/lowdown-on-fracking-in-the-karoo/
[32] List of the Harmed http://pennsylvaniaallianceforcleanwaterandair.wordpress.com/the-list/
[33] Ed Crooks, March 4, 2014. 'BHP Chief warns of shale gas reliance', Financial Times online.
[34] Terry Smith, February 7, 2014. 'Shale: miracle, revolution or bandwagon?', Financial Times online.

McKinsey's recently released *Reverse the Curse* report argues that the costs of resource exploration and production should be outweighed by the benefits to the community in order to make it a viable investment opportunity.

7. Potential investment opportunities

McKinsey Global Institute released a report titled, '*Reverse the curse: Maximising the potential of resource-driven economies*' (December 2013)[35], which provides an analytical framework for assessing the contribution of resource-based industries to development across six dimensions. This section examines those dimensions in narrative detail to determine where the opportunities lie for the DBSA.

7.1 Fiscal contribution

According to the EIA, South Africa has the 8th largest shale deposit in the world at 485 TCF. Even if the deposit is only 30 TCF could produce an economic windfall of R1 trillion ($115 billion).[36] The Econometrix report has downgraded this even further in their conservative projections of shale deposits from 20 TFC to 50 TFC. Gideon Steyl, University of the Free State Professor of Natural and Agricultural Sciences explained that 24 TCF resource will power 20 GW of combined cycle gas turbines, generating about 130 000 GWh of electricity of a 20 year period.[37] Shale gas could also be used for domestic energy consumption and chemical feedstock production, which will boost economic development in the country.

Econometrix estimates that if 5% of South Africa's deposits are recoverable, it will add more than R80 bn or 3.3% a year to the gross domestic product per year. Government revenue will increase by R35 bn a year.[38]

The Econometrix report ran two scenarios based on two conservative assumptions of resources (see table 2). The assumption in Scenario A is that

Table 2: Test scenario summary of macro-economic model output[39]

Scenario label	**A**	**B**
Upstream Production		
Resource assumption TCF	20	50
Production years	25	25
Project value added Rm	759 612	2 142 212
Project employment – man years	1 377 495	3 885 241
Maximum employment	67 278	189 758

35 http://www.mckinsey.com/insights/energy_resources_materials/reverse_the_curse_maximizing_the_potential_of_resource_driven_economies

36

37 http://deloitteblog.co.za/2013/08/07/a-fracking-boost-for-the-south-african-economy/

38 Ibid.

39 This table presents outputs that are closer to the adjusted deposit figures released by PetroSA in March 2014 (see footnote 14)

Downstream production		
Project value added Rm	1 246 535	2 872 904
Project employment – man years	5 951 114	13 715 606
Maximum employment	288 539	664 999
Combined upstream and downstream		
Project value added Rm	2 006 046	5 015 116
Project employment – man years	7 328 608	17 600 846
Maximum employment	355 817	854 757

Source: Econometrix Report 2012

The risk in shale gas is that the gas reserves may be less than expected to replace the nuclear programme. Shale gas will also only come on line in 2020 therefore Kusile, Medupi and Ingula will be viable operations by then. The lifespan of the wells will also determine the levels of economic benefit as wells in the US have declined significantly in terms of their production rates.

7.2 Job creation and skill building

A National Treasury study identified the following jobs in the shale gas process:

Table 3: Shale gas related employment opportunities

Activity	Employment
Construction and operation of a power plant	2210 temporary jobs
Well pad development	50
Drilling	120
Completions and fracking	30
Operators	1-3
57 wells a year	X 5 permanent teams = 1 000 opportunities
1 714 wells over 30 years	

Source: National Treasury, 2012

A 2012 IHS study on the potential for the American shale gas industry boosting job creation has indicated that the jobs created 'tend to be high quality and high paying, given the technologically innovative nature of unconventional oil and gas activity...[and are paid more than their peers] in manufacturing, whole sale trade and education'.[40] As South Africa lacks the experience, expertise, infrastructure or regulation required in the gas industry to conduct fracking successfully, the skills and technology will have to be imported. This analysis does not bode well for the potential of job creation through the shale industry.

The Econometrix report argues that 700 000 jobs will be created over a 50 year period based on downstream and upstream industry demands. There is no clear job creation formula for the industry as it depends on the levels of skills that exist in the economy at the time of development of the sector. The initial phases will largely be highly-skilled with low inputs from unskilled labour; this period is usually the first 5 – 10 years of the project. The subsequent phases are based on the findings of gas, ranging from a conservative deposit of 20 TCF and a bigger deposit of 50 TCF.

One caution expressed in the job creation calculations is that the assessments do not factor in the potential loss of jobs in other sectors, for example, agriculture and agribusiness. There is an assumption that tourism will increase in the Karoo due to the SKA and to fracking, but this

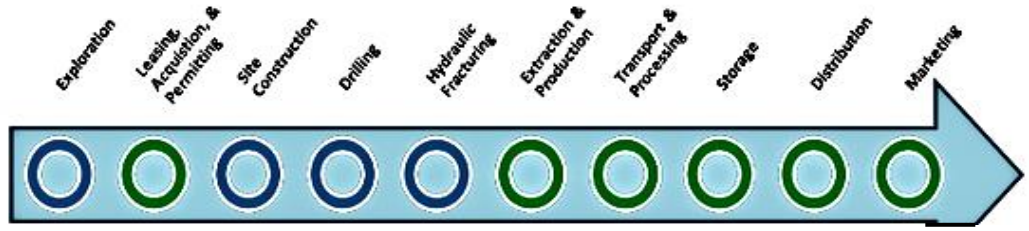
[40] http://marcelluscoalition.org/2012/10/new-ihs-study-american-shale-gas-boosting-job-creation/

cannot be confirmed. Employment transfer is particularly important in the Karoo where the agriculture and related businesses contribute to the local economy. The industry does offer employment opportunities in a region where unemployment is approximately 90% and where most people live on social grants.

7.3 Infrastructure investment

The shale gas industry will operate from zero to production-ready within 10 years, according to the Econometrix report. Figure XXXX below depicts the value chain of the Marcellus development located in Pennsylvania, US.

Figure 5: The Marcellus Shale Supply Chain[41]



Source: Marcellus Drilling News

The infrastructure investment required for this nascent industry is substantial but should also include investments needed in road, transmission lines, social infrastructure for workers, and other related infrastructure for value addition industries in the region. The National Treasury Report estimates that between 4 000 – 7 000 truckloads of material will need to be transported to establish a well pad, with the result that already poor road infrastructure in the Karoo will be further decimated. They do suggest that up to 32 wells could be drilled on a single well pad to reduce the traffic, noise and dust. South Africa also lacks a wide-reaching gas-pipeline infrastructure and does not have any rigs that can undertake hydraulic fracturing in the Karoo. Road and rail infrastructure would need to be rehabilitated to take the increased traffic volumes on the transport routes.

The **upstream** investment will be significant where R104 bn is required to generate 9600 MW from a gas reserve of 13 TCF. Construction and production costs for power stations, transmission lines and end-user units will contribute to the overall cost of developing the gas industry in South Africa. The industry would also need to provide infrastructure for waste water containers and other infrastructure related to protecting the environment.

Midstream investment could be in the water, chemicals and sand for the fracking mix that could later be used in the production of fertilisers. Water will need to be transported via truck or temporary pipes to the fracking sites in the Karoo because the area is water scarce. Other midstream industires would include water storage tanks, diesel fuel for the water pumps, lining and fencing the water pits, pipelines to transport the water, mobile wastewater treatment tanks.

The **downstream** investment could be limited if all the gas is exported, which would only require transmission to the holding areas or to the ports. Processing of the natural gas to extract natural gas liquids (ethane, propane and butane) could provide an entire value chain on its own. Storage also provides a separate value chain that could be exploited. Liquid Natural Gas

[41] http://www.slideshare.net/MarcellusDN/understanding-the-marcellus-shale-supply-chain

facilities could be designed to convert methane to diesel, as being done by Sasol in Lake Charles, Los Angeles where 1 BCF of gas is being converted to 48 000 bbls of diesel fuel by 2018.[42]

It has also been argued that, in the US, natural gas has the 'potential to displace petroleum in the transport and industrial sectors'[43], which means that natural gas infrastructure will need to be worked into the economic infrastructure across South Africa. In Johannesburg, taxis are being fitted with liquid gas to reduce reliance on petrol.[44] The Converted Natural Gas industry will continue to grow as more South African vehicles convert to gas engines; this market has not been explored sufficiently.

The downstream demand will increase and more households and users realise the value of gas, but this would require a policy change to promote gas infrastructure and gas use as well as an educated public.

7.4 Social and community benefits

The jury is out on social and community benefits because there has been opposition to fracking in the Karoo from the communities themselves. Shell has met with the communities and has failed to convince them of the benefits related to shale gas production. Communities around the world have opposed fracking with success in many instances, and even led to a full ban in parts of Argentina and in all of France. If the Minister gives the go-ahead for actual fracking without considering the community's opposition or discomfort with the industry, it could result in delays in court as the community attempts to reverse the decision. The anti-fracking front has been characterised as white and from large business in the Karoo region. Other than the KhoiSan group in the region, black communities have seen the nascent industry as a job creation opportunity. However, this might change if the 'true story'[45] about fracking is explained.

7.5 Environmental preservation

The Minerals and Energy Amendment Act has incorporated NEMA into its framework, which makes the industry responsible for upholding environmental management guidelines as set out in NEMA. Professor Gerrit van Tonder, from the Institute for Ground Water Studies at the University of the Free State, argues that the rock formations in the Karoo make water contamination a very real threat because 'the underground water in the Karoo basin flowed upwards' in 'pathways' that could carry the chemicals used in fracking[46]. Other threats listed by the anti-fracking constituency include health issues and earthquakes. The level of comfort with information depends on which side of the fracking debate one leans towards. Environmental studies can only be sufficiently conducted once the deposits are confirmed and once the longevity of the wells is determined. Until such time, the environmental debate will be ideological and will need government oversight and regulation to ensure that any eventuality is accounted for.

[42] http://www.frackusa.com/fracnews-upstream-midstream-downstream/
[43] Tommy Inglesby, Rob Jenks, Scott Nyquist, Dickon Pinner, 2012. 'Shale gas and tight oil: Framing the opportunities and risks'. McKinsey & Company.
[44] http://www.bdlive.co.za/business/energy/2014/03/13/converted-taxis-first-in-line-at-sas-first-natural-gas-filling-station
[45] http://thinkafricapress.com/south-africa/wanna-frack-pressure-rises-south-africa-debate-over-natural-gas-exploration
[46] http://www.timeslive.co.za/scitech/2012/06/01/karoo-fracking-could-cause-water-disaster

7.6 Shareholder communication

The fracking companies have engaged with communities frequently but without much success as the two parties are poles apart in their view of the fracking industry. The Ministry of Mineral Resources has communicated their support of the industry via the media and has communicated their decisions related to the process of granting rights to explore with communities in the Karoo. By law, government has to communicate the legal process that leads to a bill becoming a law or an amendment to a law being passed.

Jonathan Deal established the Treasure Karoo Action Group (TKGA) that is anti-fracking. He sees their opposition to fracking as part of a global movement against fracking. 'Were South Africa to fall to shale gas mining, I believed that it would be a strategic blow to those opposing shale gas mining globally. It's got the potential to be a strategic domino in a series of dominoes.'[47]

The Southern Cape Land Committee is a local non-governmental organization that has worked with communities and land rights in the region. They raise issues related to the 'skewed land ownership in the Karoo' and how fracking could worsen that relationship; the conversion of recreation and agricultural land for fracking; limited meaningful job creation; and, the risks to natural resources.

The Karoo Shale Gas Community Forum represents the groups in the Karoo supporting shale gas development because it will bring economic development and jobs to the region. The Forum asks the industry and government to: 'conduct the necessary research; require environmental impact assessments and environmental management plans; and be sure to hold gas-drilling companies responsible for any unintended harm that their operation might cause'[48].

Government departments and the private sector have not communicated sufficiently with civil society organization and the communities in these areas. There appears to be a gap in knowledge and information between those who back the fracking industry and those who are against. The communication process needs to be improved, particularly as government moves towards a final decision on fracking in the Karoo.

8. Partnerships and strategies for the DBSA

This study is timely as the moratorium on exploratory fracking was lifted for the early entry firms and exploration and assessments of the deposit of shale gas has started in the Karoo. The DBSA would need to know who the stakeholders are on either side of the debate and develop a strategy to engage with those parties prior to investing in the field. As green energy takes root in the Bank, it is also important to be informed about an alternative source of energy, which could be brought into the country's energy mix thereby reducing our reliance on coal and reducing supply side constraints.

The DBSA's entry into the fracking value chain could be at various levels:

[47] http://thinkafricapress.com/south-africa/wanna-frack-pressure-rises-south-africa-debate-over-natural-gas-exploration

[48] http://www.wecanchange.co.za/Editors/Articles/tabid/55/itemid/638/amid/376/shale-gas-fracking-for-africa.aspx

- **Upstream** – transport (road, rail, ports) infrastructure delivery; financing investments in rigs (export credit opportunity with Export Credit Agencies); temporary water pipelines for bulk water transport to the sites; power plants at site or further downstream; conversion plants at the site of drilling; related supply chain industries to provide machinery to the industry. The Independent Power Pool model could be utlised in this context to provide power to the fracking companies in the Karoo and the southern Cape.

- **Midstream** – investing in chemical and sand industries to provide resources to the fracking chemical companies. The delivery and logistics systems will also provide opportunities for investments in this regard. Construction and operations of wastewater management systems would provide opportunities for investment for the DBSA.

- **Downstream** – processing plants; conversion plants; and, manufacturing in the energy sector could provide investment opportunities.

The DBSA would need to be made aware of the full value chain in South Africa for it to take full advantage of the opportunities.

9. Conclusion

Shale gas reserve could be a 'transformational opportunity'[49] for South Africa and for those that rely on it for their livelihood. This demands a proper assessment of the reserve because confirmed shale gas deposits could contribute significantly to economic development across a spectrum of industries. The cost of extracting shale gas from the Karoo would be outweighed by the benefits to the South African economy in terms of potential jobs and industrial development.

10. Recommendations

- Follow the developments at national level closely to determine the outcome of the parliamentary and ministerial processes related to exploration and drilling rights as per the legal frameworks.
- Identify the players in the fracking industry at all levels of the value chain and market the potential role of the DBSA in providing finance to them.
- Monitor and analyse the proponents and antagonists in the debate and determine how the debate is developing. Monitor especially any legal contestation of the decisions.
- Keep fracking on the radar as it could contribute to the energy mix in the long run, if approved, and reduce South Africa's carbon footprint.
- Monitor new developments in the fracking sector.

[49] Econometrix report, 2012, p.48. See also Brian Kantor, 2011. 'Natural gas: Economic development vs status quo' http://www.zaeconomist.com/sa-economy/natural-gas-economic-development-vs-the-status-quo/