POTENTIAL ECONOMIC BENEFITS OF SHALE GAS DEVELOPMENT IN THE KAROO

Overview, key findings and conclusions

Econometrix

About this report

This report has been produced by Econometrix (Pty) Ltd, based on its in-depth study of the potential economic benefits of shale gas development in the Karoo. This included significant desk research and building a sophisticated economic impact model. This report provides a high level summary of the principal findings of the work; Econometrix's final report and appendices contain all the detailed evidence in support of this summary and are available as separate standalone documents.

Econometrix (Pty) Ltd

Econometrix is South Africa's largest independent macro-economic consultancy based in Johannesburg. Econometrix is privately owned and therefore totally independent of any official organisation or pressure groups. Econometrix – which has a successful track record of close to 30 years - is committed to on-going research and analysis of economic fundamentals thereby ensuring a sound basis for future business decisions. These services are provided through a range of complementary products and to more than 150 South African and international organisations.

Our approach is to empower our clients with quality decision support intelligence and assistance regarding the economic and financial environment, and assist them in their strategic and financial planning processes. Our in-depth analysis of economic fundamentals aims to assist our clients in commanding the economic environment and in identifying opportunities and risks.

Key findings and conclusions

In conducting the study, we reviewed publicly available documents on shale gas, economic data from Statistics South Africa, government policy papers, relevant consultancy studies, information from the US Energy Information Administration, and numerous other sources, as referenced in the main body of their report. An economic impact model was then built to estimate the likely impact of shale gas extraction on the South African economy (including effects on GDP, employment and government revenues). A number of GDP growth scenarios were examined for the South African economy; the 'mid'-growth GDP scenario acts as the backdrop to the gas scenario modelling.

Exploration will be required to assess the possible presence, distribution and magnitude of shale gas in the Karoo. Currently a volumetric range up to some 500 Trillion Cubic Feet ("TCF") is quoted by the US Energy Information Administration ("EIA") as possible resources in place (equivalent to the Marcellus Shale of the United States).

For this report, the two main scenarios reported are based on plausible assumptions of the successful extraction of shale gas totalling 20 TCF and 50 TCF during a 25 year period – the expected lifetime of an initial first phase shale gas development.

Our principal conclusions follow:

- There has been and remains a sustained energy deficit in South Africa; high quality coal is exported to raise revenues yet oil, gas, and electricity are imported to meet domestic energy needs. If the South African economy is to grow in future, energy demand will continue to increase, thereby **exacerbating the energy deficit which is likely to continue for the foreseeable future**.
- In the early stages of shale gas exploration projects, economic benefits tend to be localised, arising from specialist-skilled on-site test activity together with related and supporting services. **Should the exploration be successful, longer term effects are realised, generating permanent and sustainable jobs, increased government revenues and positive effects on GDP.** Real world examples include Barnett Shale in the US – to date this project has generated 710,319 man-years of employment to the US. (http://www.fortworthchamber.com/BarnettShaleStudy11.pdf)
- The Econometrix modelling indicates that for the two scenarios of shale gas production of 20 TCF and 50 TCF in the Karoo basin, there would be **an annual economic impact** (at constant 2010 prices) **of more than R80,000m to R200,600m to GDP (around 3.3% and 9.6% respectively of total 2010 GDP. Coal mining value added during 2010 equated to 1.8% of total GDP), around R35,500m to R90,000m to government revenues and generate around 300,000 to 700,000 permanent jobs,** for a period of 25 years (the development cycle of the project).
- These are significant benefits in terms of additional income and jobs for the people of South Africa. Large scale development of shale gas may also help **ease the energy deficit, making it cheaper for South Africa to grow in future, reducing imports of gas and electricity**. Consumers may benefit from more reliable and affordable energy.
- Producers will too benefit from lower energy prices which will have knock-on effects on related downstream sectors, making domestic goods and services and exports cheaper. The **improvement in competitiveness and security of supply may enhance South Africa's appeal as a location for investment,** encouraging entrepreneurial activity and rejuvenated manufacturing, improving its status in the world economy; **the successful development of shale gas could be a 'game-changer'.** Alternative opportunities of this order may be difficult to secure.
- This contrasts with the current prognosis where the energy deficit continues to mount and risks becoming a constraint on economic growth.

1. Introduction

1.1 This summary report contains an overview, key findings and conclusions of a detailed report and supporting appendices produced by Econometrix (Pty) Ltd, entitled "Karoo Shale Gas Report". The study examines the potential economic impact of the successful development of the shale gas resource found in the Karoo basin in South Africa.

1.2 The detailed assessment of the potential economic impact is based on a review of publicly available documents on shale gas, economic data from Statistics South Africa, government policy papers, relevant consultancy studies, information from the US Energy Information Administration, and numerous other sources, as referenced in the main body of its report.

1.3 Shale gas, put simply, is natural gas (composed mainly of methane) that is present in shale formations (finely grained sedimentary rocks). Shale gas has wide-ranging industrial and commercial uses as well as being suitable for electricity generation for domestic and non-domestic use.

1.4 The exploration, discovery and subsequent commercial development of shale gas have the potential to deliver significant economic benefits both locally (i.e. within the region where the gas is extracted) and across the national economy as the benefits ripple through the various supply chains, benefiting producers, consumers and government – in essence society as a whole. Indeed, benefits may transcend borders depending on the degree of economic and labour market integration.

1.5 Globally, shale gas extraction has grown significantly during the past decade; although most of the extraction to date has taken place in the US. For example, shale gas production in the US grew from 0.39 trillion cubic feet ("TCF") in 2000 to 4.87 TCF by 2010, equivalent to 23% of total US natural gas production. The US Energy Information Administration ("EIA") now forecasts that shale gas will account for 47% of US gas production by 2035.

1.6 Shale gas exploration is now occurring in numerous other countries including the UK, Germany, Hungary, Austria, Romania, Poland, the Ukraine, Canada, Australia, as well as in China and Latin America. In 2011 the EIA published a report on shale gas resources in 32 countries.[1] According to the EIA, countries where shale gas development is likely to be most attractive are those that are highly dependent upon natural gas imports, have at least some gas production infrastructure, and where estimated shale gas resources are substantial relative to current gas consumption.

[1] "World Shale Gas Resources: an Initial Assessment of 14 Regions outside the United States", EIA, April 2011.

1.7 South Africa fits into this category alongside a number of other countries such as France, Poland, Turkey, Ukraine, Morocco, and Chile. The EIA also notes that South Africa's shale gas resources may have added attraction because they could be used as feedstock for its existing gas-to-liquids (GTL) and coal-to-liquids (CTL) plants.

1.8 South Africa's economy is heavily reliant on its energy sector. It has faced a sustained and significant domestic energy deficit since the end of the Second World War. Around 67% of oil consumption is imported, and 65% of its natural gas consumption is imported from Mozambique. While 88% of urban people have access to electricity, only 55% of people living in rural areas have access; around 10 million people in total do not have access to electricity. Demand continues to increase and localised black-outs occur.

1.9 Other things being equal, South Africa's energy deficit looks set to increase if its economy is to grow and sustain higher levels of wealth and employment. South Africa's energy demand is set to double, potentially triple by 2050. South Africa will increasingly need to import yet more energy (oil, gas and electricity) as it continues to export high value (quality) coal.[2] South Africa is an electricity intensive country and more than 90% of its electricity is produced by coal.[3] Indeed, according to the IEA, the share of coal in South Africa's total primary energy supply ("TPES") in 2009 was around 68%.[4] Others included oil (16.9%), nuclear (2.3%), bio fuels and waste (9.8%) and natural gas (2.6%).

1.10 In 2009, South Africa produced just 0.09 TCF of natural gas and consumed 0.17 TCF yet according to EIA, the technically recoverable shale gas resource for South Africa, located in the Karoo basin, is estimated at 485 TCF. According to the National Planning Commission's National Development Plan:

"Exploitation of a 24 TCF resource will power about 20 gigawatts (GW) of combined cycle gas turbines, generating about 130,000 GW-hours of electricity per year. This is more than half of current production."[5]

1.11 Shale gas development could therefore be a 'game changer' for the South African economy.

[2] While exports of coal were around 26% by quantity, they represented 51% by value (source: DMR/ Prevost, 2010).
[3] See http://www.npconline.co.za/medialib/downloads/home/NPC%20National%20Development%20Plan%20Vision%202030%20-lo-res.pdf
[4] See http://www.iea.org/stats/pdf_graphs/ZATPESPI.pdf. Data exclude electricity trade.
[5] See page 143 of the National Development Plan.

2. Potential benefits of successful shale gas development

2.1 In the early stages of shale gas projects, during the exploration phase, economic benefits tend to be localised, arising from on-site test activity together with related and supporting services such as catering and accommodation. The requirements of shale gas exploration are relatively specialised in terms of labour, capital equipment and specialist suppliers. Although capital intensive, it has a broad supply chain. Jobs supported tend to include trucking, steel fabrication, aggregates, heavy equipment manufacturing, retailers, hotels and restaurants.

2.2 Should the exploration lead to successful commercial production, there is a longer run impact, comprising much larger and widespread economic benefits such as:

- **GDP** effects – there is an enhanced stimulus to demand from the exploitation activity that ripples out across the economy and in principle leads to higher GDP levels for a prolonged period of time (15-25 years, potentially longer) assuming that this does not substitute alternative investments and other economic opportunities.
- **Government revenue** effects – these arise from increased taxes from GDP and employment in addition to any tax royalties derived directly from exploration – these allow additional public expenditure (which may include growth-enhancing investments) or the reduction of other forms of taxation.
- **Employment** effects – studies have found that the shale gas industry tends to have high employment multipliers – for every one direct job created, a further three are created owing to ripple-down effects.[6] Once production is commercialised, the employment will persist for as long as commercialisation takes place.[7]
- **Spillover or catalytic** effects such as:
  - those arising directly from the investment, often from overseas, such as the transfer of know-how and training of the labour force;
  - an industry location effect (from new suppliers locating close to the gas resource);
  - less reliance on energy imports with benefits in terms of the balance of payments and security of supply (reduced risk of supply disruption, less vulnerability to price spikes);
  - consumer benefits arising directly from lower energy prices and indirectly from reductions in prices of other goods and services;
  - industries that are energy intensive will benefit from lower input prices, thus enabling a wide range of goods and services to be produced more quickly; and

[6] See "The Economic Contributions of Shale Gas in the United States", IHS CERA, December 2011.
[7] The studies do not distinguish between local employment and expat employment.

- producer benefits arising from lower energy prices, including positive downstream effects on related sectors such as petro-chemicals and pharmaceuticals, together with price-competitiveness effects leading to cheaper export prices.

2.3 These latter effects are very difficult to quantify and for the purpose of the study the focus is on the direct and indirect measurable benefits in respect of GDP, employment and government revenues.

2.4 Publicly available economic impact studies suggest that the economic effects can be substantial. For example:

- A Perryman Group report estimates that Barnett Shale in the US accounts for 8.1% of the regional output or $8.2 billion per annum and that around 38.5 percent of the region's economic growth since 2001 stems from Barnett Shale activity.[8] The report concludes that: "the Barnett Shale's effects are now larger than other, long-time sources of economic success … about 5 percent higher than that of aircraft manufacturing, 10 percent larger than air transportation (including Dallas Love Field, Dallas/Fort Worth International Airport, and Fort Worth Alliance Airport), and 83 percent larger than motor vehicles (manufacturing)."
- A study by IHS Global Insight prepared for an American natural-gas trade body reported that shale gas contributed more than $76 billion to GDP in 2010. It projects that capital spending in American shale gas would amount to $1.9 trillion between 2010 and 2035, and will increase GDP via multiplier effects. The GDP effects are expected to total $118 billion in 2015 and $231 billion by 2035 (a tripling of 2010 numbers).[9]
- The IHS Global Insight study also demonstrated that in the US, shale gas production supported more than 600,000 jobs in 2010 and forecast that employment supported will increase to almost 870,000 by 2015 and that shale gas will support 1.6m jobs by 2035.
- According to Regeneris Consulting, and based on its modelling of the potential benefits of successful shale gas exploitation in Lancashire in the UK; "Commercial shale gas extraction would, in our opinion, represent the single largest job creation project across Lancashire in the next 10 years."[10]

2.5 Clearly the above findings are a function of the specific circumstances of each region; nevertheless they provide useful indications of the potential importance of successful shale gas development.

2.6 We also observe that in the US, President Obama endorsed the benefits of shale gas development in his State of the Union speech:

[8] See "Drilling for Dollars: An Assessment of the Ongoing and Expanding Economic Impact of Activity in the Barnett Shale on Fort Worth and the Surrounding Area", The Perryman Group, Waco, Texas, March 2008.
[9] See "The Economic Contributions of Shale Gas in the United States", IHS CERA, December 2011.
[10] See: http://www.cuadrillaresources.com/cms/wp-content/uploads/2011/09/Executive-Summary-Economic-Impact-of-Shale-Gas-14-Sept.pdf

"We have a supply of natural gas that can last America nearly 100 years, and my administration will take every possible action to safely develop this energy. … Experts believe this will support more than 600,000 jobs by the end of the decade."

3. Potential shale gas development in South Africa

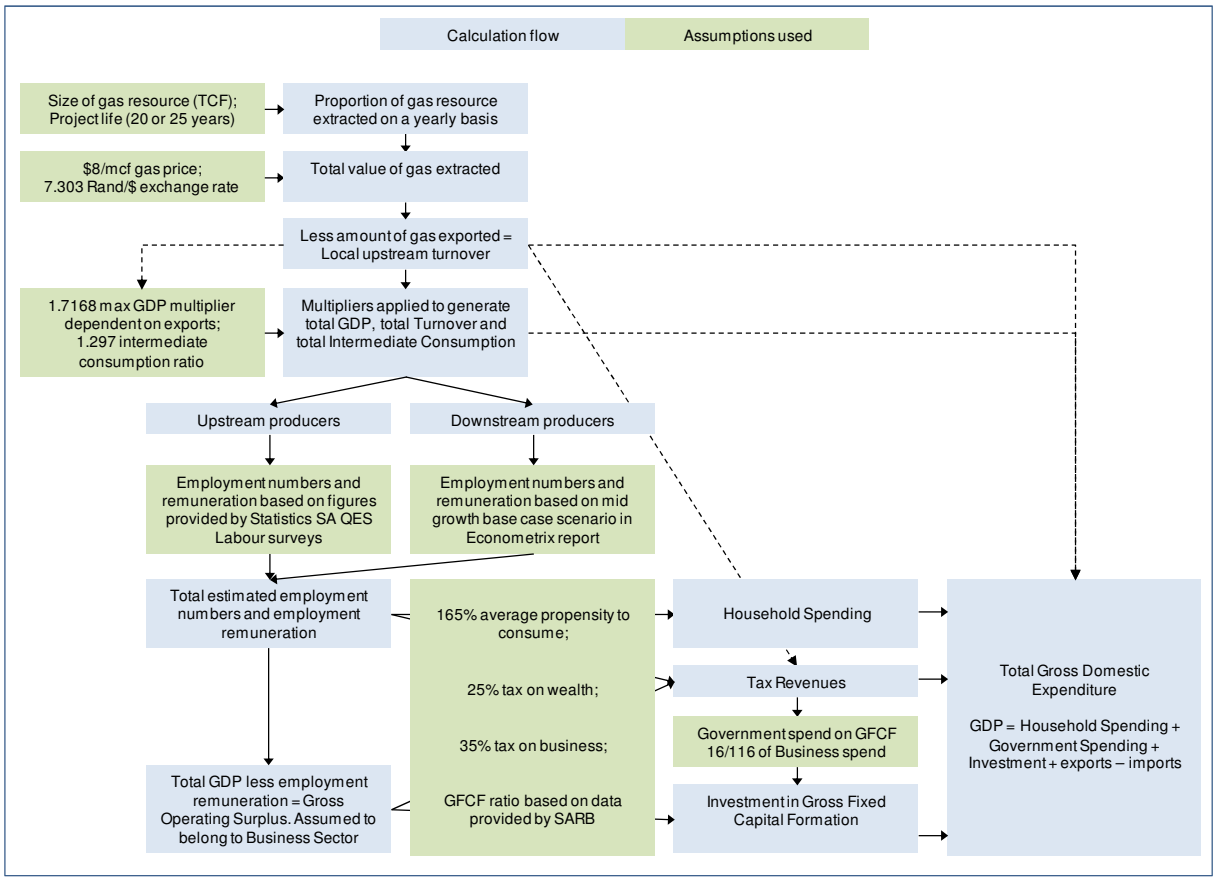
3.1 To estimate the potential impact of successful shale gas development on the South African economy, an economic impact model based on historic economic and energy data and using methods informed by previous economic impact studies was built by Econometrix.[11] The model can be used to prepare estimates for a range of production volumes: in this summary we report two scenarios – one project with total extraction of 20 TCF and the other with total extraction of 50 TCF, with both projects lasting 25 years.[12] These represent around 4% and 10% respectively of the EIA estimate of the total recoverable resource.

3.2 The model calculates each year the volume of gas extracted and its value based on assumed energy prices and exchange rates. Both US dollar and South African rand values are generated (all values are at constant 2010 prices i.e. they exclude inflation). Multipliers are applied to the value of the gas to generate the impact on GDP. Upstream and downstream production effects are distinguished and the resulting employment and government revenue effects are calculated.[13]

3.3 The model and the derivation of exogenous assumption values are described in appendices to the main Econometrix report; Figure 1 provides a schematic summarising the principal assumptions and activity/revenue flows.

[11] As most of the benefits during the exploration and discovery phase tend not to lead to significant multiplier effects across the whole economy, we have focused on the economic impact following successful extraction of the resource.
[12] We assume a 5 year 'ramp-up' period before production reaches 'mature' levels and a five year 'run-out' period once the mature production phase has ended.
[13] Upstream activities are those involved in extracting the gas from the ground, ending at the extraction gate or outlet flange). Downstream activities comprise all distribution and further value adding activity.

Figure 1: Summary of shale gas economic impact model



4. Results – the potential economic benefits of successful shale gas development in South Africa

4.1 Table 1 contains a summary of the principal economic effects arising from the two extraction scenarios.

Table 1: Main economic effects of shale gas projects

	Scenario A	Scenario B
Resource TCF	20	50
Total project turnover Rm	4,031,773	9,520,268
Average annual turnover Rm	161,271	380,811
Total project value added Rm	2,006,046	5,015,116
Average annual value added Rm	80,242	200,605
Total project government revenue Rm	886,808	2,223,494
Average annual government revenue Rm	35,472	88,940
Total project employment - man years	7,328,608	17,600,846
Average annual employment	293,144	704,034

Source: Econometrix shale gas financial model

4.2 It can be seen that in Scenario A, if just 4% (20 TCF) of the technically recoverable shale gas resource is extracted, more than R80,000m average annual value added is generated through multiplier effects. In tandem, more than R35,000m government revenue is raised each year, and around 300,000 jobs are supported. As the shale gas projects are long term, these benefits are expected to be realised for periods of around 25 years in line with the development cycle of the project.

4.3 Should Scenario B (50 TCF) be realised, the benefits increase in line with the gas resource produced. While still at just 10% of the estimated shale gas resource, under this scenario annual employment exceeds 700,000, annual value added exceeds R200,000m and government revenues tend towards R90,000m. Total value added lies between 3.3% and 9.6% of total South African GDP at 2010 levels, or between 1.1% and 2.8% of projected 2035 GDP levels. In terms of employment, the modelled values represent between 2.7% and 6.5% of 2010's measured employment level, or between 0.98% and 2.4% of the projected level of employment given sustained 4.5% pa growth in GDP to 2035. Average government revenue equates to between 4.6% and 11.8% of 2010's level, or between 1.5% and 3.9% of projected 2035 government revenue levels.

4.4 The above provides a summary of the economic benefits in quantitative terms at the macro level. At the micro level, such benefits may include industry attraction effects, as businesses establish themselves close to new areas of economic activity, and encourage the establishment of new small and medium enterprises ("SMEs") and the expansion of existing ones.

5. Concluding remarks

5.1 There are significant technical and commercial uncertainties attached to the exploration and subsequent discovery, production and commercialisation of the shale gas reserves in the Karoo. Nevertheless, the modelling suggests that, if the development is successful, there is the potential for significant economic benefit in terms of income and jobs for the people of South Africa.

5.2 Additionally, large scale development of shale gas may help ease the energy deficit, making it cheaper for South Africa to grow in future, reducing imports of gas and electricity. Consumers may benefit from more reliable and affordable energy.

5.3 Producers will too benefit from lower energy prices which will have knock-on effects on related downstream sectors, making domestic goods and services and exports cheaper. The improvement in competitiveness and security of supply may enhance South Africa's appeal as a location for investment, encouraging entrepreneurial activity and rejuvenated manufacturing, improving its status in the world economy; the successful development of shale gas could be a 'game-changer'. Alternative opportunities of this order may be difficult to secure.

5.4 This contrasts with the current prognosis where the energy deficit continues to mount and risks becoming a constraint on economic growth.