CHAMBER OF MINES
of South Africa

COAL STRATEGY **2018**

NATIONAL COAL STRATEGY FOR SOUTH AFRICA

PUTTING SOUTH AFRICA FIRST

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CONTENTS

EXECUTIVE SUMMARY

The Chamber of Mines Coal Leadership Forum, consisting of coal executives, commissioned a report to determine what needs to be done to increase the profile of the coal mining industry in the face of seemingly ineluctable negative public opinion around the use of coal in industrial processes. Negative views on coal and its impact on the environment have resulted in a precipitous decline in the use of coal by the major economies of the world. Because of coal's contribution to greenhouse gas (GHG) emissions, many jurisdictions including South Africa, have put in place strict environmental laws which have affected demand for coal.

The report draws attention to the three industries and sectors that will be adversely affected by the implementation and enforcement of strict environmental laws in South Africa. They are: the electricity sector; the liquid fuels manufacture sector; and the basic iron and steel industry. Together, these three sectors account for more than 80% of domestic coal demand in terms of value and approximately 70% in terms of volumes.

The use of coal in the electricity sector is the cheapest baseload power generation technology. This is supported by the Department of Energy's Integrated Resource Plan (IRP 2016) which shows that the levelised cost of electricity (LCOE) across the various coal technologies, is lower than renewables. If battery technology for renewables is taken into account, the LCOE increases significantly.

When it comes to emissions arising from coal powered generation, new technologies such as high efficiency, low emissions (HELE) and carbon capture storage (CCS) emissions and other pollutants are reduced quite drastically. Japan and China have employed the HELE technology to great success. The essence of the coal industry's argument in respect of which electricity generation technologies should form part of the country's energy mix, is that the final decision should be based on the 'least cost option'.

For the other two industries that are major users of coal, namely liquid fuels manufacture and basic iron and steel, it is likely that CCS could help reduce carbon emissions for now. However, this technology is currently not a commercially viable option for most industries.

The report also considers the export sector. Data presented in the report shows that there has been a total shift from European

markets to Asia and that contrary to popular belief that China is South Africa's chief export market, it turns out that India accounts for almost half of the country's total exports in terms of volumes. The Chamber's view points towards India continuing on this trajectory, not least because the country seems to have institutionally patronised the coal resource through the Ministry of Coal.

To better understand the relevance of the coal industry in South Africa the report presents data on employment (direct and indirect), production, productivity, the cost structure of the industry, profitability and investment. Among other things, the report shows that:

- indirectly, the coal industry is responsible for creating and sustaining over 170,000 jobs outside the industry;
- for most of the period between 1980 and 2015, increased labour productivity accounted for an increase in coal production (in volumes);
- transport and storage costs account for more than 50% of total industry costs (excluding value add);
- as a share of total GDP value add, compensation of employees outpaced net operating surplus/profits for most years between 1995-2015; and
- coal export prices is the leading indicator for net investment. In other words, a sustained increase in export prices is soon followed by higher net investment.

The latter may not seem to be important when considering that in terms of volumes, exports account for about 30% of total sales. Yet in terms of value, exports make up approximately 45% of total earnings.

The report culminates with the presentation of domestic constraints including issues and factors that are likely to result in reduced demand for, and supply of coal. The constraints are instrumental in developing the four scenarios (2016-2050) outlined below:

- **Scenario 1: Coal extinguisher (-1%) –** In this scenario, total coal demand declines annually by an average of 1%. The main assumption is that nuclear power and renewables have supplanted coal as the main primary energy source. Environmental and water regulations stifle coal use.
- **Scenario 2: Trudge along (1%) –** An important assumption in this scenario is that growth in total coal demand remains positive, but is lower than the 2.3% average growth experienced between 1980 and 2016. The key assumptions underpinning this scenario are that carbon tax is introduced and that access to land for mining purposes becomes a contentious issue. This is balanced by the fact that renewable technologies lose political support and that the development of battery technology occurs at a slow pace.
- **Scenario 3: Status quo (2.3%) –** Between 1980 and 2015, growth in coal production averaged 2.3%. This scenario assumes that clean coal technologies gain ground while everything else remains the same. For example, there is no carbon tax and Eskom's procurement policy does not change.
- **Scenario 4: Firelighter (5%) –** This scenario assumes a major leap in clean coal technologies and an increase in export demand leading to increased investment. Government policy is also assumed to be supportive of the industry.

Corresponding to each scenario, actions that need to be taken by stakeholders to either mitigate the impact or take advantage of the opportunities presented by each future, are included.

1. BACKGROUND

Coal is currently the most important energy source in the world after oil. It is also one of the cheapest and most abundant energy carriers. Before the discovery of coal in the 16th century in England, peat was used particularly in the Netherlands where it brought about the Dutch Golden age – a period of economic prosperity. The amount of energy present in peat is very small compared to coal and as such the discovery of coal resulted in it becoming the most abundant energy source. In England, the steep price of firewood, which had been a major energy source until then, hastened the shift to coal. The industrial revolution in Britain was spurred by the discovery of cheap coal energy, starting with its use in the mining sector, then the transport sector, later for industrial processes, and then for the generation of electricity. As an electricity source, coal power and the steam engine were first used to pump water out of coal mines.

As an enabler, coal power resulted in the introduction of a number of new materials such as synthetic abrasives, chlorine, aluminium, stainless steel, and tungsten. These in turn opened the way for innovations such as high speed grinders, chlorinated water, PVC, incandescent lamps, X-rays, and the aircraft industry.

Coal's share in the global energy mix has steadily soared. Even as the global economy suffered one of the most notable energy price shocks, coal has remained resilient. In 1973, the share of coal in the global energy mix was 24.5%, the equivalent of around 3Mt, while oil was 46.2%. By 2014, coal's share had increased to 28.6% (or around 8 Mt) while oil's share had declined significantly to 31.3%.

In modern times, coal power has played an important role in improving the welfare of communities across the globe. In China, for example, coal power has managed to lift millions of people out of electricity poverty. To date, out of a population of 1.3 billion people there are only a mere 3 million people who do not have access to electricity in China.

Coal as an energy source faces a number of challenges not least among them the fact that, as a major contributor to GHG emissions, coal is responsible for environmental degradation. At an international level, governments have developed and rectified legislation to cut down the use of coal in electricity generation. As a result, environmentally-friendly technologies are subsidised with the hope that soon they will replace coal in the process of generating electricity. In countries such as the US, the UK and Germany, coal power has declined significantly having been replaced by nuclear power and renewables.

FACTS ABOUT THE COAL RESOURCE IN SOUTH AFRICA:

- South Africa is endowed with an estimated 30 billion tonnes of coal representing 3.5% of the world's coal resources.
- The country produces 3.3% of the world's annual coal production.
- 83% of coal produced in the country is mined in Mpumalanga with the residual produced in Limpopo, KwaZulu-Natal, and the Free State. Coal reserves are dwindling in Mpumalanga and mining is shifting to the Waterberg region.
- South Africa is a net exporter of coal and exports amount to 6% of total global exports. This ranks South Africa as the 6th largest coal-exporting nation in the world.
- In 2016, South Africa produced 253.1Mt of coal of which 181.4Mt were sold internally with a value of R61.5 billion while 68.9Mt, worth R50.5 billion, were exported.
- The Richards Bay Coal Terminal (RBCT) serves as the primary export port and has a dedicated coal railway.
- Coal provides 82% of the power generated by state-owned power utility Eskom.
- Eskom operates 16 power stations and is building two more that will come on stream by 2021.
- Sasol mines some 40Mt of coal a year for gasification and conversion into liquid fuels.

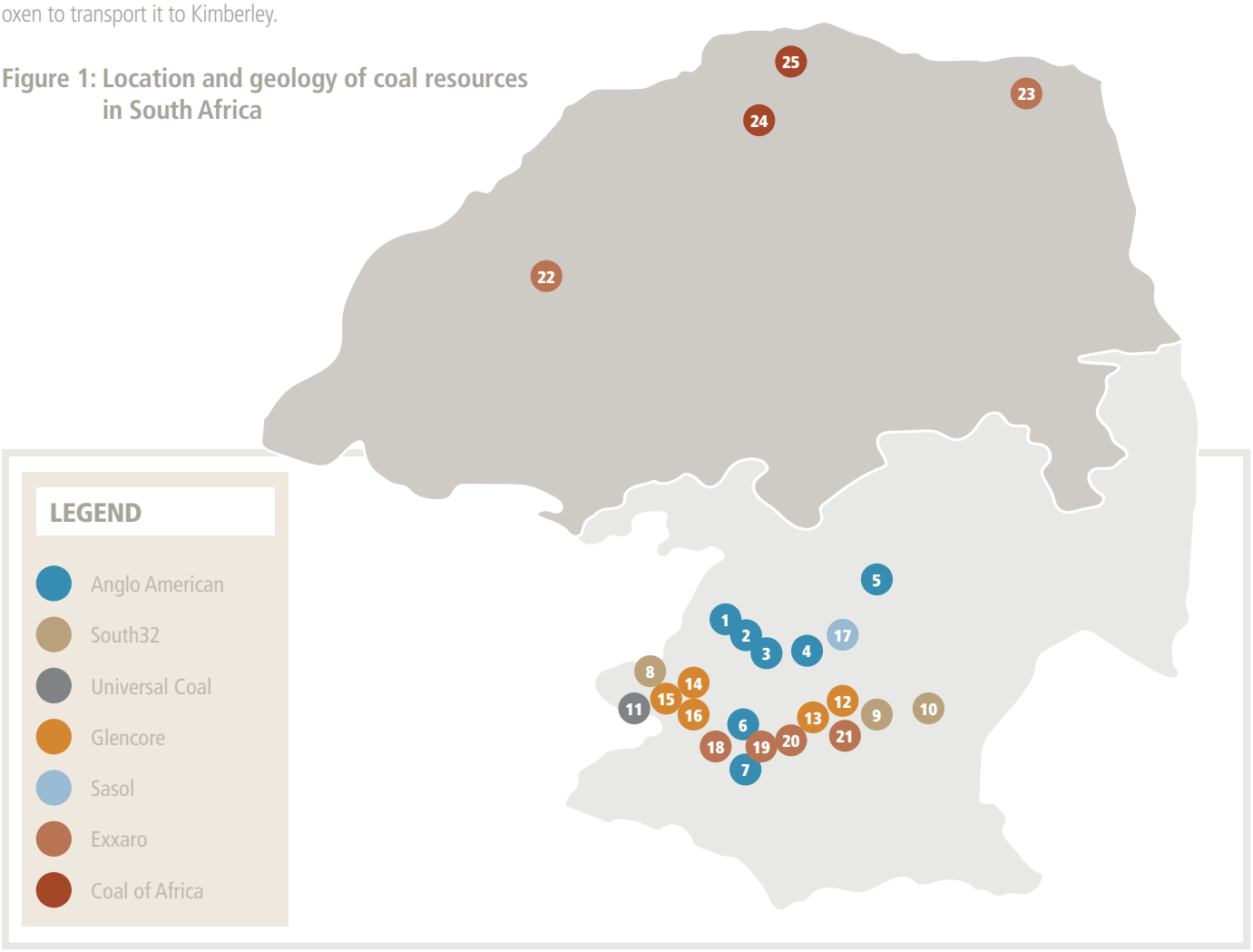
The South African government, too, has ratified the Paris Agreement, which entered into force on 4 November 2016, signalling that government is committed to addressing the challenge of climate change. Government through the Department of Energy (DoE) intends reducing the share of coal-generated power in the country's electricity mix from 82% in 2016 to 31% in 2050 as outlined in the Integrated Resource Plan (IRP) 2016.

However, coal and nuclear power will continue to play an important role in the economy as the IRP 2016 adds an additional 6.3GW of electricity to existing generation consumption levels which will have come from coal-fired power plants.

In South Africa, the discovery of coal dates back to 1879 when George William Stow, on his second attempt after an unsuccessful prospecting bid in the area around Bethlehem (Free State), found commercially viable deposits in the Transvaal. Without adequate transport infrastructure, the Orange Free State Government, which had commissioned Stow, decided not to develop the find. However, Stow and his colleagues developed the coal find and used wagons pulled by oxen to transport it to Kimberley.

The map below illustrates the geographic locations where most of South Africa's coal deposits are located – mainly in Mpumalanga and Limpopo. Coal can also be found in Kwa-Zulu Natal and the Free State provinces. South African mines make use of open-cast and underground mining. Figure 1 also presents the main coal mining companies across the industry.

Figure 1: Location and geology of coal resources in South Africa



Source: Chamber of Mines

COAL HAS THREE MAJOR USES:

ELECTRICITY GENERATION:

As a source of energy, the global share of coal used in electricity generation has risen slightly from 38.3% (2,348.2TWh) in 1973 to 40.8% (9,716.9TWh) in 2014.

In spite of environmental concerns and legislation restricting the use of coal in electricity generation and industrial processes, coal continues to be an important energy source across the globe.

Table 1: World fuel shares of total primary energy supply (%)

	1973	2014
Coal	24.5	28.6
Biofuels and waste	10.5	10.3
Natural gas	16.0	21.2
Oil	46.2	31.3
Nuclear	0.9	4.8
Hydro	1.8	2.4
Other	0.1	1.4

Source: International Energy Agency, 2016

Table 2: World fuel shares of electricity generation (%)

	1973	2014
Coal	38.3	40.8
Natural gas	12.1	21.6
Oil	24.8	4.3
Nuclear	3.3	10.6
Hydro	20.9	16.4
Other	0.6	6.3

Source: International Energy Agency, 2016

INDUSTRIAL PROCESSES:

Many industries use coal and coal by-products. The cement/concrete and paper industries burn large amounts of coal to produce heat. Coal is also used in the steel industry. Steel plants use coking coal in their furnaces to process iron ore into iron to make steel. The high temperatures created by burning coke give steel the strength and flexibility needed for infrastructure projects such as bridges and buildings, the automobile sector and others.

MANUFACTURE OF GAS AND LIQUID FUELS:

Coal can be turned into gases and liquids (synthetic fuels) which are used as fuels or processed into chemicals to make other products. The fuels are made by heating coal in large vessels. These fuels produce fewer air pollutants when burned than burning coal directly.

1.1 SUMMARY

This section highlights the importance of coal in the economy. It has drawn attention to the three industries that will be adversely affected by the implementation and enforcement of strict environmental laws in South Africa. They are: the electricity sector; liquid fuels manufacture; and basic iron and steel industry. Together these three industries account for more than 80% of domestic coal demand in terms of value and approximately 70% in terms of volumes.

2. THE MARKETS FOR SOUTH AFRICAN COAL: OVERVIEW

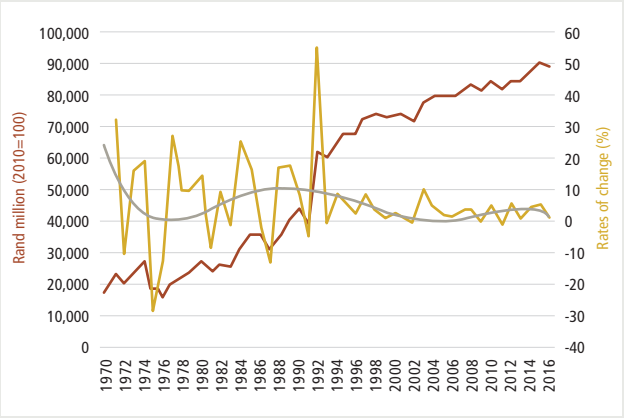
This section presents historical trends in coal production, domestic and export markets and prices. The starting point of most of the data is 1970, before the oil price shock of 1973, and runs to 2016.

The domestic and export markets for South African coal have developed over time, each with their own dynamics. In 2016, South Africa exported 28% (68.9Mt) of its coal by volume and sold 72% domestically. By value, exports were worth R50.5 billion (45% of the total) and domestic sales R61.5 billion (55%).

Globally prices are determined by demand and supply and, unlike other energy markets such as oil, the market is not organised into cartels. The benchmark price for domestically-consumed coal is set by Eskom.

As an abundant resource relative to other energy carriers, coal is more affordable. Figure 4 charts the price of coal and natural gas per one million British Thermal Units from 2000 to 2015.

Figure 2: Coal mining production

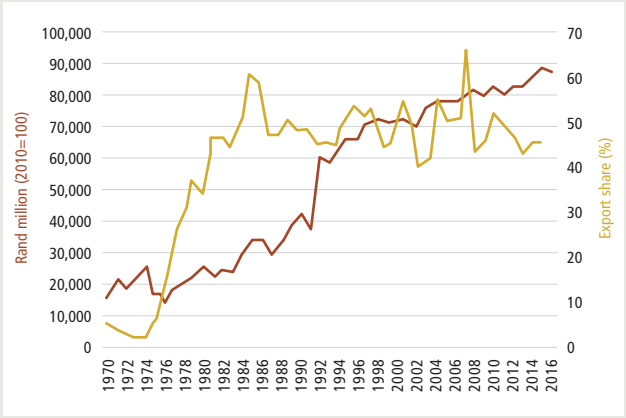


Sources: StatsSA, DMR, Quantec, 2016

Coal mining production grew by 1.2% between 2000 and 2016, to reach a level of R118 billion in 2016. This represents value add of R72 billion or 24% of the mining sector.

Importantly, coal mining production was not seriously affected by the commodity cycle downturn, with fairly stable growth since 2000 reaching a peak in 2015.

Figure 3: Coal mining production and export share



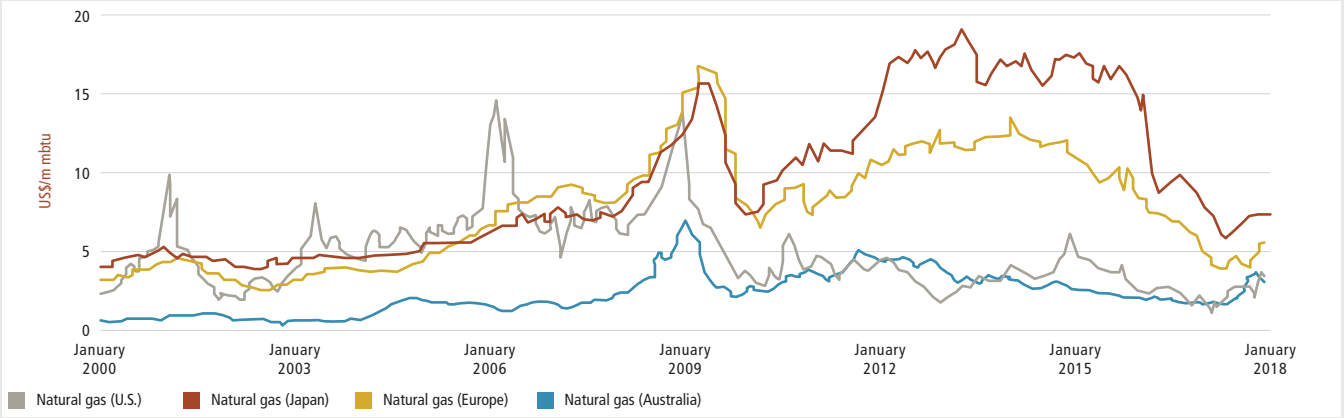
Sources: StatsSA, DMR, Quantec, 2016

The export market for coal has been a major driver for the South African coal mining sector.

The share of exports rose rapidly during the 70s reaching a peak in 1985, and again in 2008.

Export price trends and the continual weakening exchange rate had a large impact on coal mining in South Africa.

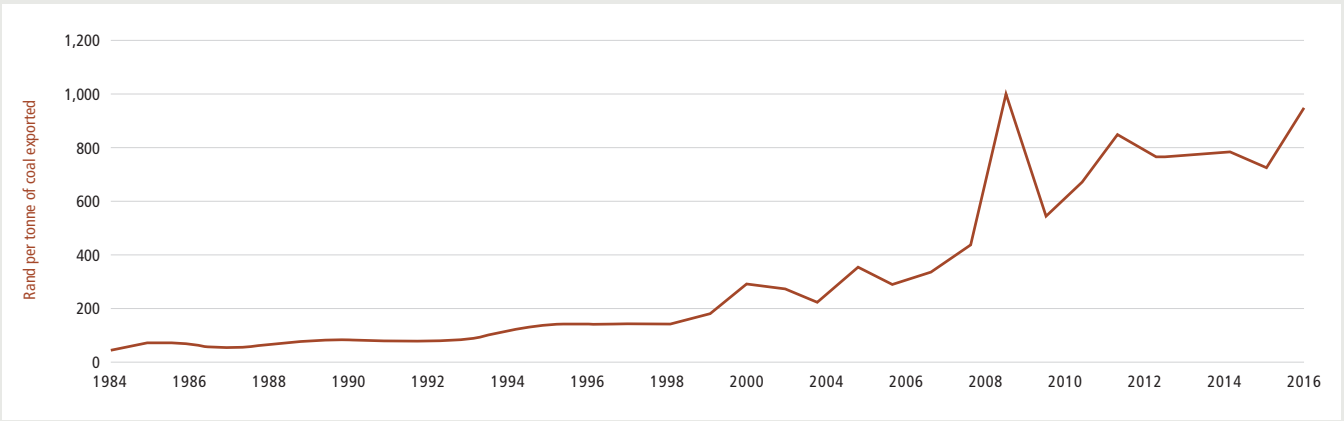
Figure 4: Coal and natural gas prices



Source: World Bank Commodity Markets Outlook

The rand price per tonne of coal sold at Richards Bay over time is outlined below.

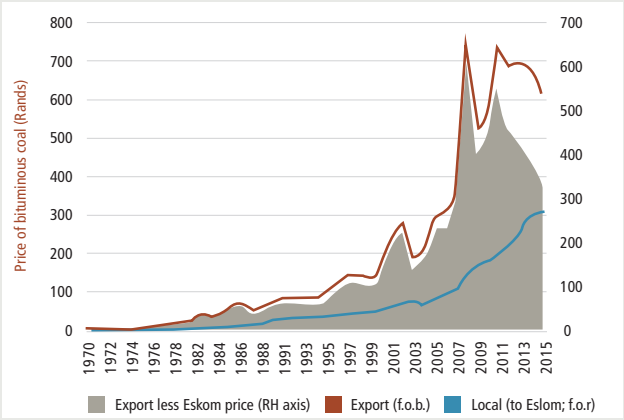
Figure 5: Rand coal prices per tonne at Richards Bay



Source: World Bank Commodity Markets Outlook

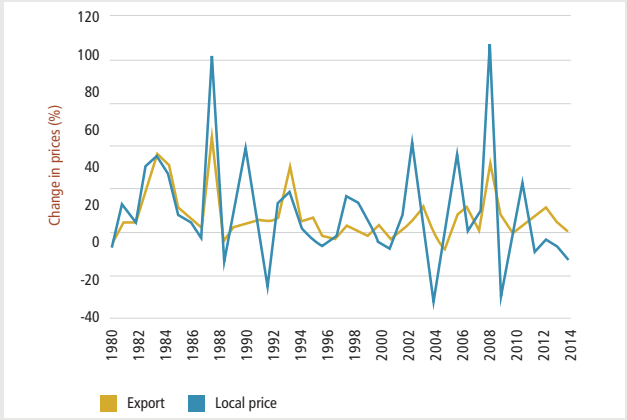
The domestic price of coal is mainly determined by Eskom and historically it has always been lower than the export price. Figure 6 compares the local and export prices of coal while figure 7 illustrates that the price offered by Eskom is less volatile compared to the export price.

Figure 6: Price of bituminous coal in South Africa



Source: Department of Energy Price Report

Figure 7: Change in coal price (%)



Source: Department of Energy Price Report

Between 1971 and 2015, export prices grew by an average of 15.3% per year compared to 13.6% for local sales; between 1990 and 2015 export prices increased annually by 11.9% while local sales recorded increased by 11.2%; and between 2005 and 2015, coal export prices increased by 13.8% while prices for local sales increased by 12.1%.

The biggest increase in export prices was an increase of 105% to R735.64/Mt recorded in 2008. In the same year, local prices increased by only 42.3% to R150.7/Mt

In 2016, for the first time since 1970, the local price reached 50% of the export price. The historical average (1970-2015) is 35.2%.

2.1 SUMMARY

The export market is important for South African coal. Since the early 1980s, exports earnings have averaged 40% of total sales.

3. GLOBAL DYNAMICS – RESERVES, PRODUCTION, CONSUMPTION, AND IMPLICATIONS FOR SOUTH AFRICAN COAL EXPORTS

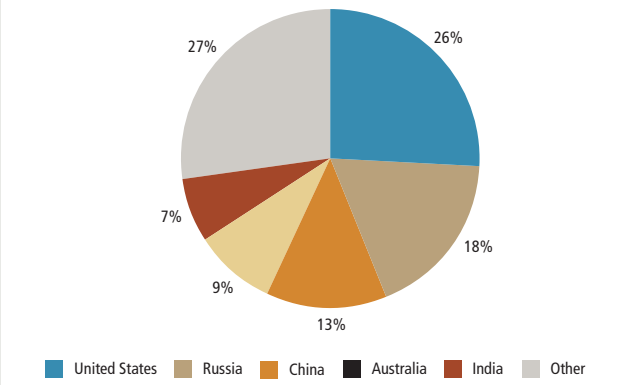
Five questions are of concern to us in this section. What is the extent of the coal resource globally? Which countries are the major producers and consumers of coal? What is the future of coal consumption globally? What are South Africa's export markets and what are the future consumption levels going forward in those markets? What factors are behind the rise and decline of coal consumption in some of South Africa's export markets?

The International Energy Agency (IEA) estimates that the world's recoverable coal reserves are 888.9 billion tonnes (IEA, 2016). Globally five countries have nearly 73% of the world's recoverable coal reserves.

Ranked third in terms of coal resource endowments, China is by far the world's leading producer of coal, which is used mainly in power generation. It is followed by the US, which in recent years has closed hundreds of coal mines for a number of reasons. Chief among these is an aging fleet of coal power plants and the country's international commitments to curb GHG emissions.

China is also the leading consumer of coal and has had to rely on imports to satisfy its coal requirements. The US on the other hand is self-reliant on coal and government policy under the Obama administration was directed at the country weaning itself off of coal dependency in power generation. India is the second largest consumer of coal, which it also uses predominantly to generate electricity.

Figure 8: Global recoverable coal reserves in 2016 (%)



Source: IEA

Table 3 : Coal balances (top 10 producers and consumers)

World ranking	Production (million metric tonnes of oil equivalent)								
	1981	1990	2000	2005	2010	2012	2013	2014	2015
World	1,863	2,274	2,326	3,034	3,628	3,930	3,986	3,898	3,830
1 China	311	540	707	1,242	1,665	1,874	1,895	1,864	1,827
2 US	463	566	570	580	551	518	501	508	455
3 India	64	106	152	190	252	255	255	271	284
4 Australia	65	109	167	206	241	250	268	287	275
5 Indonesia	0	7	47	94	169	237	276	282	241
6 Russia	n/a	186	121	136	151	168	173	177	184
7 South Africa	75	100	127	138	144	147	145	148	143
8 Colombia	3	13	25	39	48	58	56	58	56
9 Poland	103	100	72	69	55	58	56	58	56
10 Kazakhstan	n/a	57	32	37	47	52	51	49	46

World ranking	Consumption (million metric tonnes of oil equivalent)								
World	1,836	2,243	2,379	131	3,634	3,814	3,891	3,911	3,840
1 China	303	526	701	1,318	1,743	1,923	1,964	1,949	1,920
2 India	64	110	164	211	293	330	356	389	407
3 US	407	483	569	574	525	438	455	454	396
4 Japan	65	78	95	114	116	116	121	119	119
5 Russia	n/a	182	106	95	91	98	91	88	89
6 South Africa	51	67	75	80	93	88	89	90	85
7 South Korea	15	24	43	55	76	81	82	85	84
8 Indonesia	0	3	13	24	39	53	58	70	80
9 Germany	144	132	85	81	77	80	83	79	78
10 Poland	91	78	56	55	55	51	53	49	50

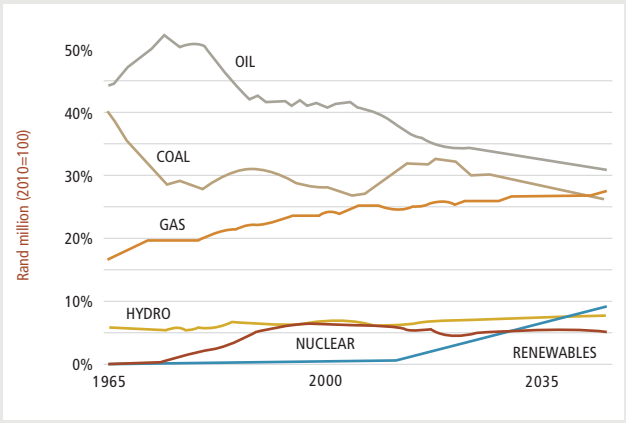
Source: IEA

Of the 10 major global consumers of coal, China and India are net importers. Their combined consumption is more than the sum of the other eight countries on the list (Table 3). Other top 10 net importers of coal are Japan, South Korea, Taiwan, Germany, Turkey, UK, Malaysia, and Thailand.

3.1 THE FUTURE OF COAL CONSUMPTION GLOBALLY

The IEA predicts that demand for coal for power generation will decline from 41% in 2014 to 37% in 2021. Figure 8 provides consumption forecasts of primary energy sources going forward. Coal and oil are projected to decline, with the latter dropping significantly.

Figure 9: World sources of primary energy



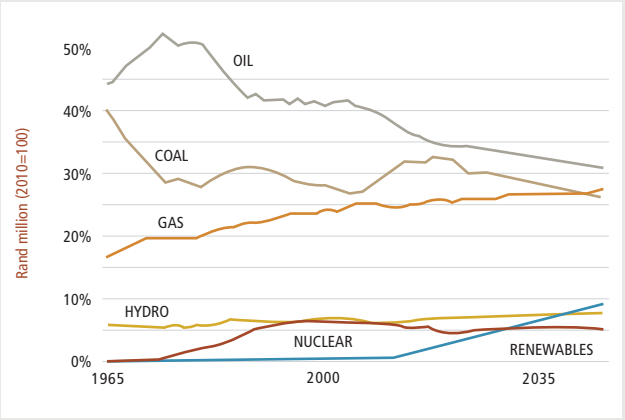
*Source: BP Energy Outlook 2016; *Includes biofuels*

3.2 CURRENT EXPORTS OF SOUTH AFRICAN COAL

Historically, South Africa exports about 30% of total domestic coal production. In 2016, this was equivalent to 69Mt. On the other hand, export sales have traditionally accounted for between 40 – 45% of total coal sales, highlighting the importance of the export market. Total exports were valued at R50.5 billion in 2016 of a total sales figure of R112 billion. Coal is therefore an important foreign exchange earner.

Most South African coal exports are destined for India, which takes up about 45% of coal export volumes. India started to become an important market for South African coal in 2007 when sales volumes suddenly went up from 3% (2006) of total exports to 13%.

Figure 10: Exports of coal by volume and value



Source: DMR

South Africa's traditional coal export market used to be Europe, in particular the Netherlands, Belgium, and the UK. After 2000 this changed when the Kyoto Protocol, which sought to enforce the mandatory reduction of GHG emissions. The Kyoto Protocol was adopted in 1997 but it was not until 2005 that countries, mainly those in Europe, took practical steps to implement the Protocol. European countries started reducing coal imports from then.

Table 4 shows the outcome as follows:

- While the Netherlands consumed more than 20% of South Africa's coal export volumes, in 2011 this went down to approximately 5%. Except for 2013 and 2014, the trend points to the Netherlands having drastically reduced its coal imports from South Africa.
- The UK reduction appears sudden, from 17% in 2004 it has averaged 1% since 2009.
- France, Spain, Denmark, Germany have had similar reductions in coal imports.
- Italy seems to be holding up, but the trend also indicates a decline.
- China, which used to import a significant amount of South African coal, has taken drastic measures to reduce CO_2 emissions. For that reason China, has been closing some coal mines and restricting operating days of state mines from 330 to 276 per annum.

Table 4: Major South African coal export markets (% share of total coal export earnings)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mozambique	2	2	2	2	1	2	2	4	3	2	2	1	1
China	0	0	0	0	0	1	9	18	16	16	4	0	0
Taiwan	2	0	0	1	0	3	4	5	6	8	2	2	1
South Korea	0	0	0	0	1	1	3	5	2	0	0	0	4
India	1	5	3	13	13	29	33	24	29	27	37	42	45
Pakistan	0	0	0	2	1	2	2	1	1	3	5	5	7
Malaysia	0	0	0	1	3	2	4	4	4	3	2	1	2
Israel	10	7	6	6	6	7	5	4	7	4	3	4	2
Turkey	2	2	4	2	2	2	3	4	4	4	5	6	3
UAE	0	0	0	1	1	1	3	2	3	3	3	2	3
Denmark	2	2	4	3	2	1	1	2	1	0	1	0	1
France	5	7	6	4	4	3	2	2	1	2	1	1	1
Italy	10	8	7	8	7	7	4	5	5	3	2	5	4
Netherlands	24	22	25	23	19	14	5	4	5	10	14	3	4
Spain	13	12	12	14	10	8	4	3	3	3	4	3	1
UK	17	16	13	6	6	1	1	1	1	1	1	0	0
Germany	2	1	1	1	1	1	1	2	0	0	0	0	0
Growth in export earnings (5, year on year)	16.3	31.6	1.2	13.8	63.6	-8.7	13.1	35.2	1.1	2.2	2.3	-4.6	8.7

Source: South African Revenue Service (SARS) and Quantec Easydata

3.3 FUTURE DEMAND FOR SOUTH AFRICAN COAL EXPORTS

India, currently South Africa's biggest coal export market, has agreed to voluntarily reduce the GHG emissions intensity of its GDP by 20% to 25% from 2005 to 2020. Thus far, this has not affected South African coal exports to the country, which have grown to almost half our total coal exports in revenue terms.

Indications are that India's coal demand will continue to increase in the foreseeable future for several reasons:

- Electricity supply in India has still not kept up with growth in demand;
- India's electricity market is dominated by coal, which accounts for more than 75% of total electricity generation. India is the world's third largest coal energy user after China and the US;
- India's Ministry of Coal is the custodian of coal resources in the country. This institutionalisation of coal could ensure the resource's use into the future. India also has a Ministry of Power, a Ministry of Petroleum and Natural Gas, a Ministry of New and Renewable Energy, and a Department of Atomic Energy.

Export growth markets seem to be in Asia, in countries such as India, Pakistan, Malaysia, Taiwan, and Bangladesh, not all of which are included in table 4.

South Korea seems to present potential for further export growth for South African coal. This opportunity needs further investigation to ascertain the potential that this market presents.

There is no scope for further growth in Europe (more precisely countries in the European Union) because of environmental laws.

While there is potential in Sub-Saharan Africa for export growth because of electricity shortages, the dearth of investment and investment finance is unlikely to increase appetite for coal.

An export risk factor, other than environmental laws, is technology. South Africa's current and potential export markets are on a big push to build HELE power generation plants.

This technology requires high quality coal, with which some of the country's competitors such as Australia are endowed.

Table 5: HELE power generation plants across Asia

	In operation	Planned or under construction
China	579	575
India	49	395
Vietnam	2	57
Japan	44	52
South Korea	38	18
Taiwan	1	9
Philippines	0	1
Indonesia	3	32

Source: Minerals Council of Australia

3.4 SUMMARY

This section presented data that indicated that there has been a total shift from European markets to Asia; and that contrary to popular belief that China is South Africa's chief export market, it turns out that India accounts for almost half of South Africa's total exports in terms of volumes. The Chamber's view points to India continuing on this trajectory, not least because the country seems to have institutionally patronised the coal resource through the Ministry of Coal.

Between 2010 and 2014, China used to be South Africa's second most important coal export market, after which there was a precipitous decline. During 2015 and 2016, exports to China have decreased to less than 1% of total exports. The sudden decline could be partly attributed to China adopting new, less polluting technologies in its coal power plants such as HELE.

India is South Africa's leading export market and, as things stand, it appears that this will continue into the foreseeable future. Perhaps no other country has patronised coal as an energy resource as much as India has by having established the Ministry of Coal.

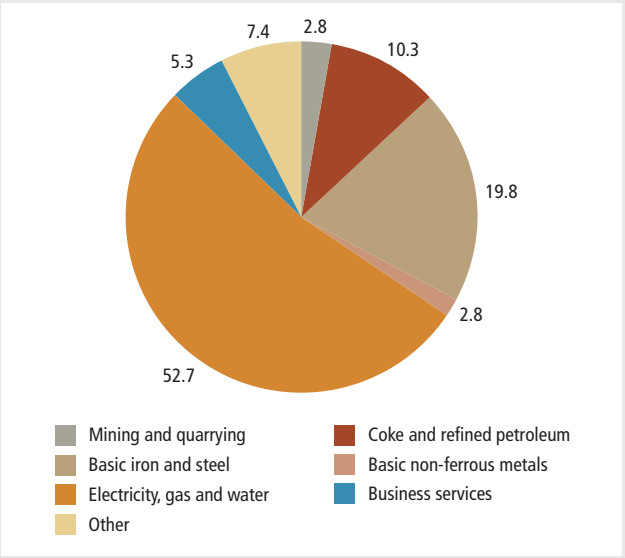
European countries used to import a significant amount of South African coal as a share of total exports. However, strict environmental laws have resulted in a significant decline in the use of coal. Italy, the Netherlands, the UK, and Spain used to be the country's major export markets. While stricter environmental laws in some export markets present one risk factor, the other risk factor relates to the type of coal that South Africa exports. Most HELE coal power plants make use of higher grade coal.

4. DRIVERS OF THE DOMESTIC DEMAND FOR COAL IN SOUTH AFRICA

What industries are the main drivers of domestic demand for coal? How elastic is the demand for coal in relation to the coal price? Which sectors are price sensitive? As government enforces environmental laws in the form of a carbon tax, are there viable coal substitutes that could warrant a shift from coal?

The domestic demand for coal in the country is depicted in figure 11. Local coal is mainly of the bituminous type and about 4% of coal demand is satisfied by coking coal imports worth an estimated R4 billion. The largest share of demand in terms of value originates from electricity (53%), then the basic iron and steel sector (20%), followed by the synthetic fuel and chemical industries (10%).

Figure 11: South African coal intermediary demand from industries 2015



Sources: StatsSA, Quantec, 2015

4.1 FUTURE DOMESTIC COAL DEMAND

4.1.1 Electricity

Cheap input costs are necessary to ensure efficient production resulting in economic growth and development. Electricity is a major input in the production process and improves society's welfare if it is accessible and affordable. It is worth noting that the Golden Age in the Netherlands and the Industrial Revolution in Britain were both brought about by cheap energy sources.

Affordable, reliable and easily accessible energy is at the core of economic growth and development. For that reason, the drive to develop new electricity technologies should be based on these three pillars, which can be fundamentally summed up as the 'least cost options'.

Currently, coal power is among the cheapest baseload options, a fact that is acknowledged by the IRP 2016. Tables 6 and 7 present the various technologies' LCOE. Not only does coal present the cheapest baseload option, it does so even at the inclusion of CO_2 curbing technologies such as CCS, fluidised bed combustion (FBC), and integrated gasification combined cycle (IGCC).

Table 6: Load factor and LCOE of the base load and mid-merit technologies

	Base load					Mid-merit		
	Coal PF	Coal FBC	Coal pulverised with CCS	Coal IGCC	Nuclear (DOE)	CCGT	Internal combustion engine (ICE) 2MW	Internal combustion engine (ICE) 10MW
Typical load factor (%)	86	86	86	86	90	36	36	36
Levelised cost of electricity (LCOE; R/MWh)	862.50	888.54	1,514.35	1,292.85	970.85	1,183.22	1,615.55	1,620.39

Source: Department of Energy (IRP 2016)

Table 7: Load factor and LCOE of renewable technologies

	Renewables									
	Wind	PV, Crystalline silicon fixed tilt	PV, Crystalline silicon fixed tracking	Con-centrated PV	CSP through 3 hours storage	CSP through 6 hours storage	CSP through 9 hours storage	CSP tower 3 hours storage	CSP tower 6 hours	CSP tower 9 hours
Typical load factor (%)	36	24	22	22	32	40	44	34	42	48
Levelised cost of electricity (LCOE; R/MWh)	805.30	931.24	1,087.65	2,425.81	2,887.56	2,796.32	3,065.50	2,585.85	2,379.06	2,335.93

Source: Department of Energy (IRP 2016)

Eskom operates 16 coal power plants making it the single most important consumer of coal in the country. In 2015, the utility used 114.8Mt of coal.

The IRP 2016 presents two electricity demand forecasts. One is a less energy intensity forecast where energy demand grows by an average of 2.17% to 2050. The other is a low energy growth rate of 1.31% to 2050.

The eventual choice of energy mix between nuclear, coal and renewables will have a further impact on coal demand. More importantly, under the base case scenario of the Department of Energy's IRP 2016, the share of coal emanating from electricity generation is set to decline to around 31%.

Table 8: South African fuel shares of electricity generation (%)

	2016	2050
Coal	81.78	31.6
Natural gas	1.37	6.96
Solar PV	0.96	6.55
Nuclear	5.57	30.1
Wind	1.84	18.09
Other (e.g. hydro)	8.48	6.7

Source: Department of Energy (IRP 2016)

Eskom sources 51% of its coal from Anglo Thermal Coal, South32, Exxaro and Glencore using a cost-plus agreement. As a state-owned corporation, Eskom is at the centre of government's 'radical economic transformation' programme, whereby the state seeks to procure coal from majority-owned black mines. As such the utility is currently in the process of ascertaining whether to continue with this cost-plus procurement model. At the moment it is unclear whether Eskom will transfer this model to firms that are 51% black-owned or if it will discard it altogether in favour of an arms-length procurement model for all its suppliers.

Eskom has argued that coal remains the cheapest base load energy carrier in power generation. At the same time, the Department of Energy, as the custodian of policy in the sector, has signalled its intention to reduce coal use in power generation.

The revised IRP 2016 indicates that among the base load technologies, coal remains the cheapest.

For example, depending on the coal technology, the LCOE ranges from R862.5/MWh to R1,514.35/MWh (with carbon capture storage). Nuclear's LCOE is R970.81/MWh. The typical load factor for a coal power plant is 86% while nuclear's load factor is 90%.

On the other hand, the other technologies based on natural gas, such as CCGT, have a LCOE ranging from R1,183.22/MWh to R1,620.39/MWh. These technologies are only mid-merit and have a typical load factor of 36%.

The LCOE for renewable technologies ranges from R805.30/MWh for wind to R2,887.56/MWh for CSP (with 3 hours storage).

New technologies, such as HELE, designed to improve efficiency and curb carbon emissions, are already in place in Japan, China and Australia. Developed by Japan in 1993 and ranked the cleanest technology currently in use for coal power plants, HELE is responsible for the significant decline in carbon emissions in Asia. In 2015, for example, the use of HELE in China reduced carbon emissions by 434t, equivalent to the annual carbon emissions produced by India.

Over the next 10 years, Eskom will close four coal power stations – Hendrina, Camden, Komati, Kriel, and Grootvlei – which collectively represent 8,800MW of installed capacity. This will result in the loss of approximately 30,000 jobs.

4.1.2 Manufacture of liquid fuels and in chemical processes

Sasol uses coal to manufacture liquid fuels and coal is also used in other chemical processes such as cement. Sasol is vertically integrated with the corporation sourcing coal from its own mines.

The industries involved include the petroleum, chemicals rubber and plastics industries which acquired R7.9 billion worth of coal, representing 11.52% of total goods sold by the coal industry while the metals, machinery and equipment industry purchased R15.4 billion worth of coal, representing 22.4% of products sold by the coal industry.

4.1.3 Basic iron and steel sector

In terms of value, coal inputs into the basic iron and steel industry made up about R13.6 billion or 9.3% in 2015. While the share is comparable to the 9.3% recorded five years ago in value terms, the 2015 figure is some R4 billion higher than the R9 billion recorded in 2010. As a share of total input costs, coal ranks among the top three most important inputs in the basic iron and steel sector. The international price has plummeted to the lowest since the 2007/08 financial crisis from $500 a tonne to around $280 a tonne. This represents a drop of approximately 45% since 2015. The implication for the coal industry is a reduction demand. The short-term relief, for now, is that coking coal – one of the key inputs in the production of steel – has also declined significantly.

Other than the price effect, the domestic basic iron and steel industry is affected by cheaper imports. As a relief, the South African government introduced, among other measures, designated fabricated structural steel with 100% local content for procurement and a 10% import tariff which will likely sustain coal demand.

It seems likely that CCS could help reduce carbon emissions across the liquid fuels manufacture and basic iron and steel industries. However, CCS is not a commercially-viable technology to employ at the moment.

4.2 THE PRICE FACTOR

It is important to examine the impact of a price change, particularly an increase in price, on the demand for coal.

Electricity: Currently Eskom applies a cost-plus model in procuring over 50% of its coal. This means Eskom directly invests in coal operations which allows it to procure coal on a cost-plus basis. This model effectively benchmarks the extent to which other market players can sell coal to the utility. Because the price of coal is controlled by Eskom, it is difficult to determine the extent to which a price increase would affect Eskom as the cost-plus model means Eskom is virtually vertically integrated.

Manufacturing of liquid fuel and chemical processes: Sasol is vertically integrated and sources its coal from its own coal mines. The market price of coal is therefore not a factor. However, other chemical firms buy coal at market prices. It is likely that an increase in price, such as one caused by the introduction of a carbon tax, could drive chemical firms to replace coal with substitutes. Anecdotal evidence shows that firms in the cement industry are looking for substitutes for coal as the carbon tax is likely to cost millions annually.

Basic iron and steel sector: The industry is highly affected by price changes as it procures coal from the market and is influenced by demand and supply, particularly in the case of coking coal, which is mostly imported.

4.3 SUMMARY

The use of coal in the electricity sector is the cheapest baseload power generation technology. This is supported by the Department of Energy's IRP 2016 which shows that the LCOE across the various coal technologies is lower than renewables. If battery technology for renewables is taken into account, the LCOE increases significantly.

When it comes to emissions arising from coal power generation, new technologies such as HELE and CCS reduce emissions and other pollutants quite drastically. For example, Japan and China have employed the HELE technology to great success. The essence of the argument with regards to which electricity generation technologies should form part of the country's energy mix is that the final decision should be based on the least cost option.

It seems likely that CCS could help reduce carbon emissions across the liquid fuels manufacture and basic iron and steel industries. However, CCS is not a commercially-viable technology to employ at the moment.

5. SOUTH AFRICAN COAL MINING DYNAMICS

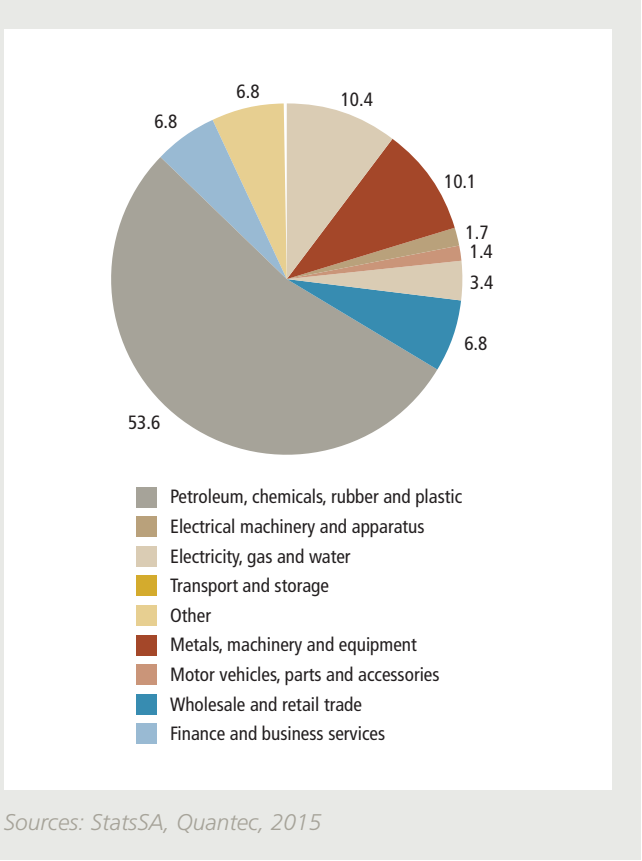
How important is the coal industry in the South African economy? Is the industry capital or labour intensive? What is the industry's cost and structure? As a share of GDP value add, what is the proportion of compensation to labour and profit? What drives investment in the industry?

There are a number of economic indicators that point to the relevance of the coal industry to the South Africa economy. These include the number of people employed (directly and indirectly) and the amount of money spent on goods and services.

In 2016, the coal industry employed 77,506 people, representing 17% of total employment in the mining sector. These employees earned R21 billion in wages and salaries. In the same year, the coal industry spent R60 billion on the procurement of goods and services, most of it locally. This contributed to creating and maintaining jobs in other industries. Indirectly, the coal industry created 173,093 jobs mainly in the transport and storage sector where almost 120,000 jobs were created representing 69% of all indirect jobs created by the coal industry. This highlights the importance of the coal sector in supporting the transport industry.

The pie chart and table below show the backward linkages into supply sectors and employment created in the process.

Figure 12: Intermediary demand/backward linkages of the coal industry into the economy



Sources: StatsSA, Quantec, 2015

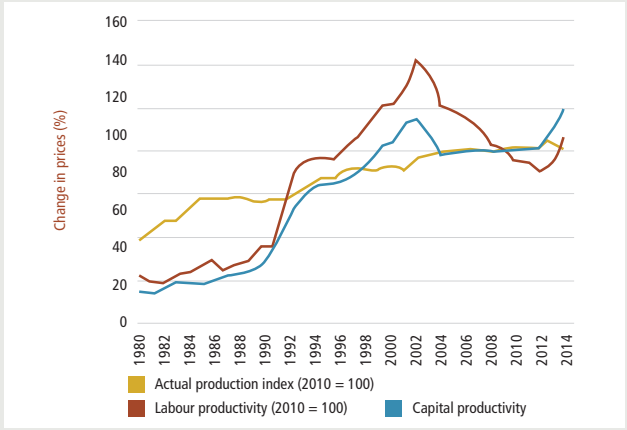
Table 9: Jobs created by the coal industry in the rest of the economy (2015)

Primary Industries	1,953
Agriculture, forestry and fisheries	181
Mining and quarrying	1,772
Secondary industries	48,779
Manufacturing	42,701
Petroleum, chemical, rubber, plastics	16,881
Electricity	5,073
Tertiary industries	154,064
Transport and storage	119,558
Other	34,506
Total	222,892
Less imported element	49,799
Net jobs created	173,093

Source: Chamber of Mines

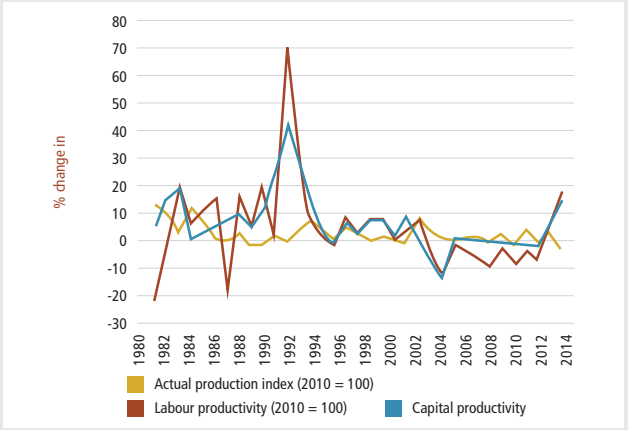
The mining sector is capital intensive. If gross operating surplus is used to represent the share of capital in the production process, the data reveals that the share of capital has historically accounted for almost 60% in mining. Despite this phenomenon, output growth in the coal sector has mainly been accounted for by increased labour productivity. In 2010, this trend changed as labour productivity declined.

Figure 13: Coal production and productivity



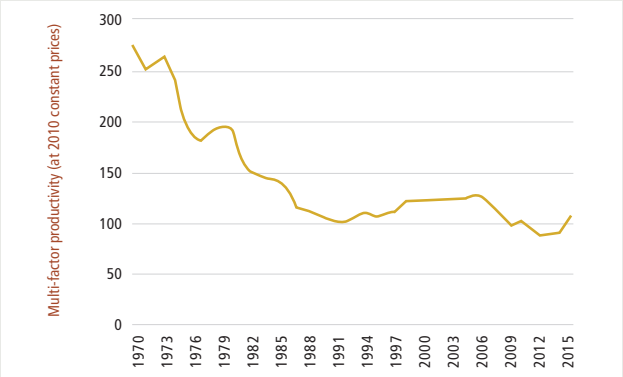
Sources: Quantec and StatsSA

Figure 14: Change in production and productivity



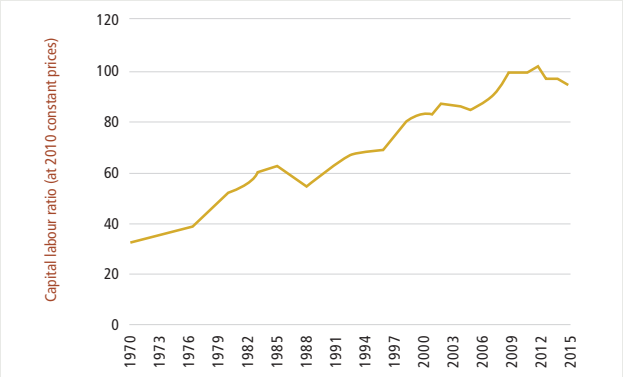
Sources: StatsSA, Quantec, 2015

Figure 15 : Multi-factor productivity (at 2010 constant prices)



Sources: Quantec and StatsSA

Figure 16: Capital-labour ratio (at 2010 constant prices)

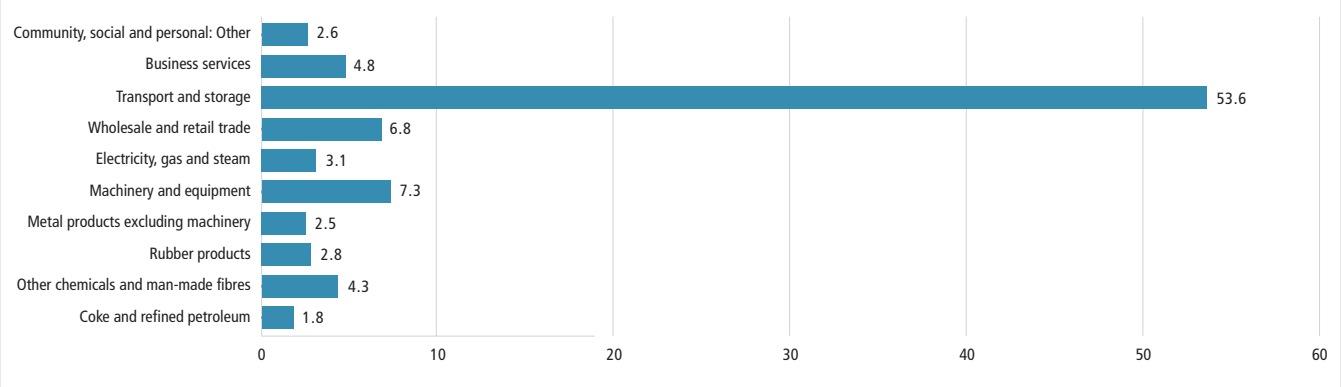


Sources: StatsSA, Quantec, 2015

5.1 COST STRUCTURE OF THE COAL INDUSTRY

The coal industry spends 7.3% of total input costs on machinery and equipment and 6.8% on wholesale and retail which includes general purchases.

Figure 17: Input cost structure of the coal industry (% share of total inputs including value add)



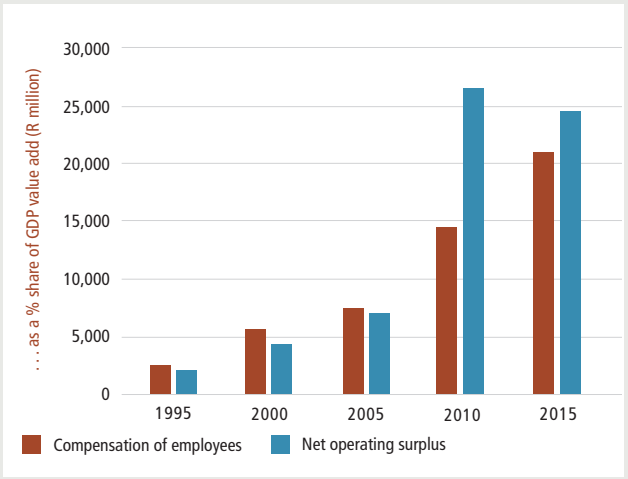
Sources: Quantec and StatsSA

The industry spends 7.3% of total input costs on machinery & equipment and 6.8% on wholesale & retail which includes general purchases.

5.2 PROFITABILITY

In terms of profitability, net operating surplus has been increasing rapidly between 1995 and 2015. Compensation of employees increased at the same pace as net operating surplus.

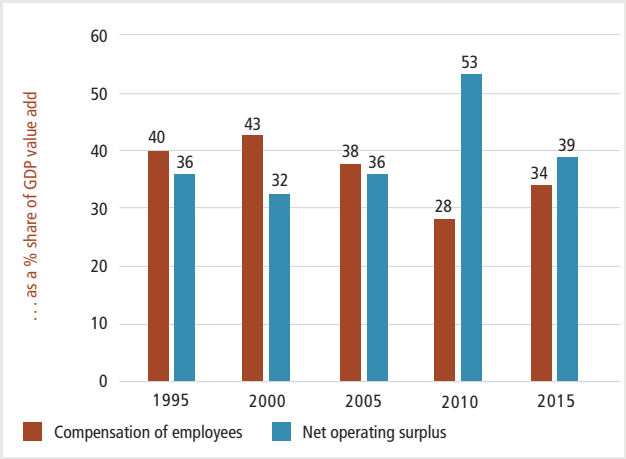
Figure 18: Compensation of employees and net operating surplus (R million)



Sources: Quantec and StatsSA

In 1995, 2000, and 2005 compensation of employees took a bigger share of total GDP value add while net operating surplus (profits) were higher in 2010 and 2015. The vertiginous increase in 2010 can be explained by improved production and increased prices after the 2007/08 financial crisis.

Figure 19: Compensation of employees and net operating surplus (% share of GDP value added)



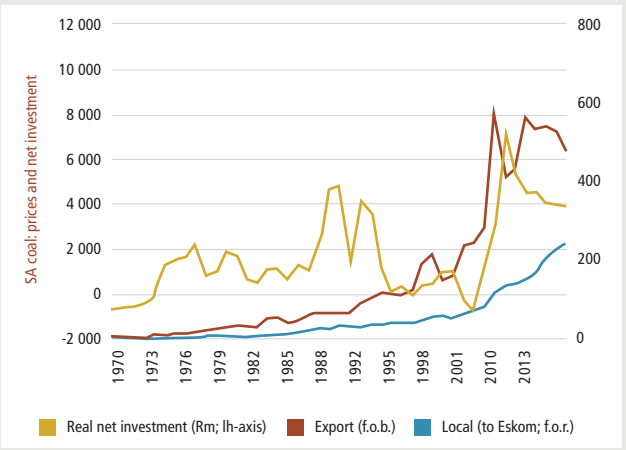
Sources: Quantec and StatsSA

5.3 WHAT DRIVES INVESTMENT?

There are a number of factors that drive the investment levels in a country and in an industry. In the context of this section we only consider market factors; namely the domestic and export prices.

Figure 20 depicts the relationship between prices – local and international – and net investment. Pre-1994 there seemed to be a disconnect between prices and net investment, which is understandable because this was a period during which South Africa was sanctioned from trading internationally. After 1994 there seems to be a significant correlation between international prices and net investment even though Eskom consumed more than 60% of the country's total coal production.

Figure 20: SA coal – prices and net investment



Sources: Department of Energy, Price Report, 2016; Quantec

Eskom's coal consumption does not seem to influence net investment even though it buys most of the country's coal output. Sasol, which consumes approximately 30% of the country's coal is vertically integrated, which means it operates its own mines and therefore has very little impact on the domestic price of coal.

The correlation between the export (international) price and net investment in coal is an important one because it tells us that even as Eskom presents certainty by engaging in long-term or offtake agreements with coal companies, this arrangement does not necessarily incentivise firms to invest more in order to increase production.

5.4 SUMMARY

To better understand the relevance of the coal industry in South Africa we presented data on employment (direct and indirect), production, productivity, the cost structure of the industry, profitability, and investment. Amongst other things, we showed

that: i) while in 2016 over 77,000 people were employed in the coal industry, indirectly the coal industry is responsible for creating and sustaining of over 170,000 jobs outside of the industry; ii) for most of the period between 1980 and 2015 increased labour productivity accounted for the increase in coal production (in volumes); iii) transport and storage costs account for more than 50% of total industry costs (excl. value add); iv) as a share of total GDP value add compensation of employees outpaced net operating surplus/profits for most years between 1995 – 2015; and, v) coal export prices is the leading indicator for net investment. In other words, a sustained increase in export prices is soon followed by higher net investment.

6. CONSTRAINTS TO THE GROWTH OF THE COAL INDUSTRY

The following factors – in order of importance – are listed as being the major reasons that will result in the stagnation, and later shrinking of the coal industry.

6.1 POLICY AND REGULATORY FACTORS

Environmental policies and regulations aimed at reducing the country's carbon emissions are welcome but must take into account South Africa's developmental exigencies – in terms of affordable and reliable power and energy security – viz-a-vis that of South Africa's global trade and investment competitors.

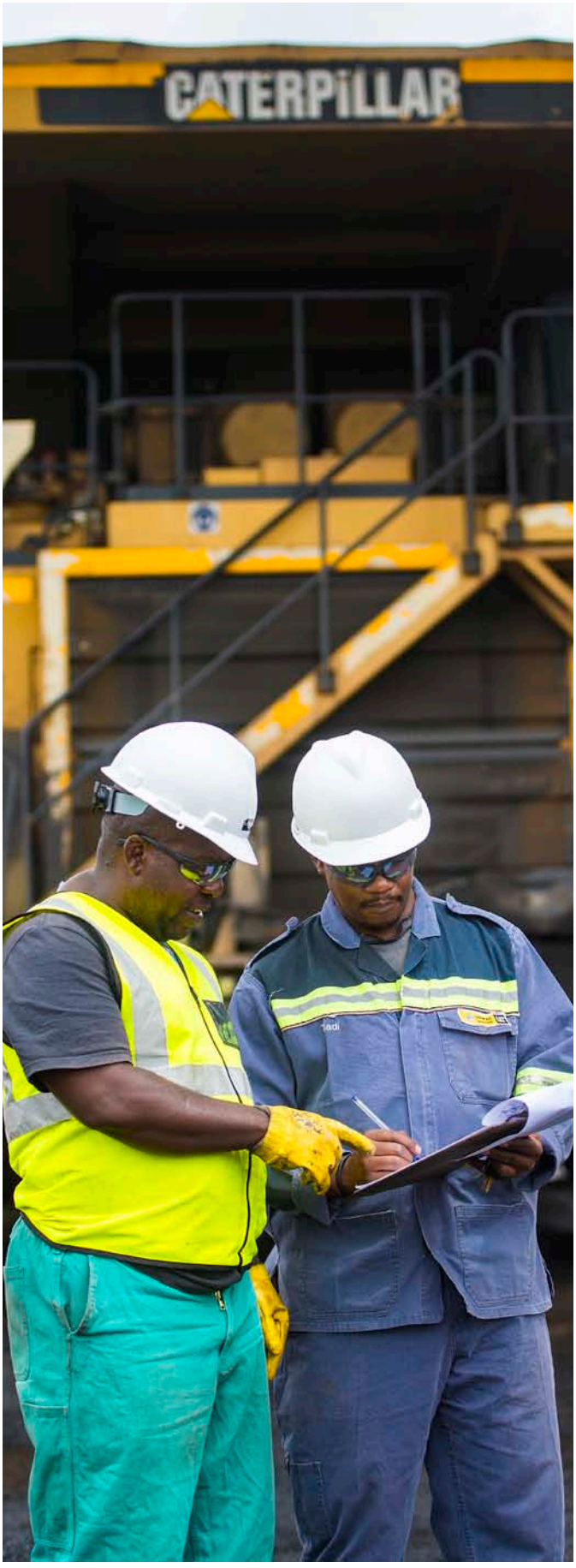
The Carbon Tax Policy Paper (2013) proposes a carbon tax of R120 per tonne of CO_2-eq above the tax-free threshold. This will affect all coal users and reduce competitiveness of South Africa's producers.

South Africa currently has limited alternative solutions for reasonably priced power other than coal (especially base load power generation). Coal can and should remain part of the energy mix, as is recognised in the IRP 2010 and IRP 2016.

Classifying coal (and iron ore) as strategic minerals in order to ensure that the minerals are available to support the country's development indicates government's role as the custodian of the country's natural resources. The intention, of course, is not to convey a message that the country is not open to foreign direct investment and that it operates under economic dirigisme.

6.2 ACCESS TO CAPITAL

The enacting of environmental laws in major jurisdictions around the world has seen less and less credit being extended to the construction of coal power plants. The World Bank and the International Monetary Fund have been loath to lend funds to utilities and governments that want to build coal power plants.



Eskom is one example. In most cases this has curtailed the production of coal.

6.3 INADEQUATE INFRASTRUCTURE

The lack of rail and water infrastructure are the main challenges in the development of new coal mines in the Greater Waterberg area and is currently limiting investment in coal mining in the area.

Transnet has responded positively to the rail infrastructure backlog and in 2018 the state-owned company is looking at investing in a 6 million tonnes of coal a year capacity on the rail line from Lephalale in the Waterberg to Richards Bay. Transnet is seeking to double that to 12 million tonnes a year by 2020. It intends expanding the line to beyond 24 million tonnes capacity a year in later phases.

Water remains a major challenge in terms of scarcity and pollution. South Africa is a water scarce country. Throughout the entire value chain, the industry makes use of water. In South Africa, water scarcity is compounded by the lack of investment in water infrastructure such as dams and canals.

6.4 TECHNOLOGY

Coal technology is the cheapest among electricity-generating technologies. In China, coal's HELE technology is five times cheaper than renewables. In recent times, new technological solutions have emerged such as HELE coal technologies which result in a reduction in CO_2 emissions of between 2 – 3% for every 1% improvement in efficiency of a conventional pulverised coal combustion plant.

Other technological solutions include the use of efficient coal technologies to beneficiate discarded coal resources for power generation, which also reduces environmental degradation. Further-out technological solutions include underground coal gasification (UCG) and carbon capture CCS. As the economy transitions to a greener energy future, the industry believes that this could be done in a way and within a timeframe that can potentially enhance, instead of eroding, the competitiveness of the South African economy.

6.5 LAND ACCESS

Mining in general competes with other sectors such as agriculture and manufacturing for land use. In some jurisdictions, agriculture is prioritised, whilst in others certain land portions are strictly designated for agricultural/industrial use. Internationally, evidence suggests that these sectors can and do co-exist providing back-and-forth catalysts for the development and sustainability of communities.

6.6 SUMMARY

There is no doubt that these factors threaten the viability of the industry as an enabler of economic growth and development. If these risks are not addressed or their impacts not mitigated they threaten the long-term growth and development of the economy including the livelihood of tens of thousands of people who directly and indirectly depend on the coal industry. There are also opportunities to be exploited.

While new technologies are always disruptive and shake the foundations of normalcy and convention, the transition should be well managed and proper safeguard measures must be taken. Similar measures should be adopted in the transition to clean energy sources. The transition should be pragmatic and should not penalise or even subsidise the nascent technologies at the expense of conventional ones as this would create market and price distortions.

In view of the foregoing, various scenarios have been developed to help industry players, policy makers, organised labour, and communities that depend on coal to better plan their future, taking into account the various risks outlined in this document.

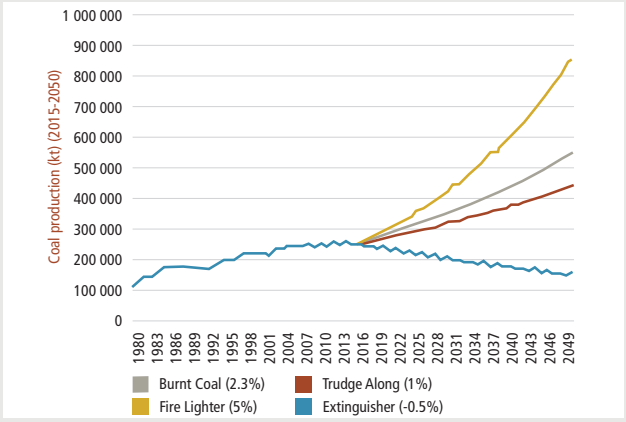
7. SCENARIOS

The purpose of the scenarios presented here is to help decision makers to explore a range of possible futures for South African coal, to consider how those futures might emerge, and to develop strategies that are both focused and flexible.

Each scenario includes assumptions relating to the five key uncertainties, and a narrative describing a plausible future for the South African coal industry. It is unlikely that any of the scenarios will play out exactly as presented. The value of this exercise is in the planning and anticipation of the possible scenarios. The emphasis is on the responses of the various role players to the events – or events similar to – the scenarios presented below.

While GDP growth is used as a major indicator determining economic performance of the various industries, for the purposes of the current analysis, coal production is used to develop the scenarios. This is because GDP is an indirect measure of the performance of industries while coal production presents the real events occurring in the coal industry. This in no way suggests that coal production is delinked from economic performance or vice versa.

Table 21: South African coal production scenarios



Sources: Department of Energy, Price Report, 2016; Quantec

Developing a strategic response to each of these scenarios will provide stakeholders involved in the production of coal with the best opportunity for success in the face of any outcome.

7.1 SCENARIO 1: COAL EXTINGUISHER (-0.5%)

This scenario describes a future in which the coal industry is disenfranchised to the point of near obsolescence. This scenario comes to life under the following assumptions:

- Public opinion ensures that the use of coal falls out of favour.
- Environmental and water regulations stifle coal use.
- Access to capital is severely limited.
- Renewable energy technologies improve to the point of offering baseload, in particular CSP technologies.
- Coal is designated to be a strategic mineral.
- Battery technology for renewable energy makes a quantum leap.
- Export markets for coal collapse as India resorts to nuclear technology.
- Natural gas presents an alternative for baseload.
- Karoo shale gas deposits are exploited and are a boon for the economy.
- The problem of water scarcity escalates and no new infrastructure is developed.

In this scenario, nuclear power and renewable technology have supplanted coal as the country's primary energy source while shale gas tags along close behind. With coal use having declined by two-thirds of current national consumption levels, producers look beyond South African borders for markets only to discover there is an over-supply of coal. Coal prices collapse endangering the continued survival of many producers. Under this scenario, coal mining communities suffer the most as people lose jobs and companies close. This causes not just economic and social strife, but political stability is at risk as supplier industries for the coal industry collapse and jobs are shed.

Stakeholder responses

Under this scenario, subsidies have ensured that the renewables industry surpassed coal use in power generation. Since renewables are capital intensive, with no proper and well-implemented localisation strategy, the loss of jobs in the coal industry has not been accompanied by equal or more jobs created in the renewables industry. In the process, the transportation sector, including state-owned Transnet, are the net losers.

In this scenario, coal is declared to be a 'strategic mineral' and major private assets in the industry are sold to a state-owned company. The sector loses its lustre and investment takes a dive. Most coal mine operations are forced to close which means that tens of thousands of people lose their livelihoods.

Tax revenue shrinks even as government introduces a renewable energy tax/levy. To cover the shortfall, government raises taxes on corporate and personal income. Tax increases are also effected on value added tax.

7.2 SCENARIO 2 – TRUDGE ALONG (1%)

Under a mixed bag of positive and negative developments, this scenario entails an average growth of 1% in total coal production. Underpinning this scenario are the following assumptions:

- Carbon tax is introduced across the board.
- Land access becomes a contentious issue.
- Trade taxes are effected on goods produced using coal power.
- Eskom continues its policy of cost-plus contracts in the coal industry thus maintaining certainty.
- The necessary infrastructure in the Greater Waterberg is developed including road, rail, and water.
- Renewable technologies do not develop at the rate they should as oil prices remain stagnant to the point of collapsing to levels averaging $30-$40/barrel as oil companies invest in increased output and new deposits are discovered and developed.
- Nuclear power becomes expensive and the state procures only a few reactors, which represent half the 9.6GW initially intended to be sourced.

In this scenario, South Africa has taken a cautious yet pragmatic view on coal use. While wanting to abide by its international commitments to reduce GHG emissions by way of introducing the carbon tax, for example, the use of coal for baseload power is not overtly criticised.

Stakeholder responses

This scenario, even though lukewarm to the coal industry, manifests some positives which the industry can build on. The key to this outcome, which prevents coal from taking a dive, is the maintenance of Eskom coal cost-plus contracts.

Table 10: Actual and scenario-based outcomes

	Actual outcome	Status quo	Firelighter (5%)	Trudge along (1%)	Extinguisher (-0.5%)
	1980-2016	2017-2050	2017-2050	2017-2050	2017-2050
Production - annual average growth rate (%)	2,3	2,3	5	1	-0,5
Total coal produced (tonnes)	7,793,400	15,242,405	20,269,060	13,718,142	7,993,450
Value of coal produced (R):	1,243,223,848,097				
Domestic average price of R290,14/Mt		4,422,431,483	5,795,632,737	3,894,949,203	2,233,987,169
Export average price of R840,99/Mt		44,525,643,603	16,799,025,213	11,289,768,146	4,475,359,721
Domestic price (average R/Mt)	70	290	290	290	290
Export price (average R/Mt)	205	841	841	841	841
Starting employment	128,149	77,189	77,189	77,189	77,189
Ending employment	77,189 (in 2016)	147,914 (in 2050)	230,326 (in 2050)	119,011 (in 2050)	39,019 (in 2050)

7.3 SCENARIO 3 – STATUS QUO (2.3%)

This is effectively the status quo scenario in which coal is an indispensable power source. The following assumptions form the foundation of this scenario:

- Clean coal technologies are faster and cheaper to install and retrofit.
- Coal is the fuel of lowest risk (including environmental hazards) and provides the highest return.

In this scenario, Eskom continues with its policy of procuring coal by means of cost-plus agreements. Even as it does arms-length contracts with some producers, these offer certainty as Eskom commits to offtake agreements. Internationally, renewables have underperformed as they can be intermittent. Coal use makes a major comeback with coal technologies becoming cleaner and less polluting.

Stakeholder response

Government is more consultative and transparent in policy design, formulation, and implementation. Multi-year wage agreements are the order of the day and they foster an atmosphere of certainty among private players and labour.

7.4 SCENARIO 4 – FIRELIGHTER (5%)

This scenario explores a future in which coal is an indispensable power source. The foundation of this scenario makes the following assumptions:

- There is a major leap in coal technology such as HELE and CCS while battery technology for renewables as a baseload solution moves slowly.
- Coal is the fuel of lowest risk (including environmental hazards) and provides the highest return.
- Export demand increases significantly as enabling infrastructure is developed.
- A shift in public opinion to other economic, social and political issues tends to favour coal.
- Government policy and regulation supports the coal industry and a balanced approach on transformation is adopted.
- Mutual understanding on the part of labour and the coal industry, which is based on respect, trust and sincere consultation is in place.

In this scenario, South Africa's economy is growing at a higher rate of above 3% per year and coal production increases. The government, through state-owned Transnet, expands railway infrastructure in the Greater Waterberg area. Transnet's project pipeline related to railway infrastructure is set to expand to 24 million tonnes a year. Beyond this capacity a new line would be needed. This assumption also relies on the fact that water resource infrastructure is developed in the area.

Stakeholder response

In this scenario, coal producers will increase production while government policy supports further investment in the sector. Eskom and the coal industry would have reached a progressive compromise where – in the absence of cost-plus contracts – the utility is prepared to pay competitive domestic coal prices.

Eskom is in a position to agree to offtake agreements with coal producers across the board, which would bring certainty and allow for future investment in the industry. The result is that more people are employed in the sector.

Table 11: Summary of scenarios

Scenarios	Drivers	Constraints	Action
Coal extinguisher (-0.5%) [CSIR scenario for low GDP growth rate of 2%]	**Domestic drivers:** • Electricity • Liquid fuels manufacture and chemicals process **External drivers:** • Exports	**Domestic drivers:** • Environmental laws strictly applied • Renewable technologies offer baseload electricity • Battery technology for renewable energy makes a quantum leap **External drivers:** • India and other South East Asian countries wean themselves off of coal	**Domestic drivers:** • The Chamber engages with National Treasury and the Department of Environmental Affairs (DEA) on the implication of strict environmental laws **External drivers:** • Explore other potential markets in Africa where universal electrification is still a long way off
Trudge along (1%) [CSIR scenario for high GDP growth rate of 2%]	**Domestic drivers:** • Electricity • Liquid fuels manufacture and chemicals process **External drivers:** • Exports	**Domestic drivers:** • Carbon tax is introduced and applied across the board • Eskom continues its policy of cost-plus contracts in the coal industry and prioritising of procurement from majority-owned BBBEE firms **External drivers:** • Domestic cost escalation	**Domestic drivers:** • The Chamber engages with National Treasury on the application of carbon tax in the mining sector. In some instances it may prove to be double taxation **External drivers:** • Labour, government and the Chamber to find and maintain ways to arrest cost increases
Status quo (2.3%) [CSIR scenario for moderate GDP growth rate of 3%]	**Domestic drivers:** • Electricity • Liquid fuels manufacture and chemicals process **External drivers:** • Exports	**Domestic drivers:** • Uncertainty continues as Eskom continues with its policy of procuring coal by means of cost-plus agreements. Even as it does arms-length contracts with some producers, these offer certainty as Eskom commits to offtake agreements. **External drivers:** • Domestic cost escalation	**Domestic drivers:** • Eskom should provide certainty on coal purchases **External drivers:** • Labour, government and the Chamber to find and maintain ways to arrest cost increases
Firelighter (5%) [CSIR scenario for high GDP growth rate of 3.7%]	**Domestic drivers:** • Electricity • Liquid fuels manufacture and chemicals process **External drivers:** • Exports	**Domestic drivers:** • There is a major leap in clean coal technology while battery technology for renewables as a baseload solution moves slowly **External drivers:** • Export demand increases significantly for markets such as India, South Korea • Expansion and development of enabling infrastructure such as water, rail, and port infrastructure	**Domestic drivers:** • Producers through Coaltech, Mintek and other institutions continue to invest in R&D for clean coal technologies for electricity generation and liquid fuels manufacture. **External drivers:** • Domestic infrastructure (rail and water) maintained through sustained investments by Transnet and the RBCT

8. IMPLEMENTATION

Table12: The implementation of the strategy is outlined in the table below.

Theme	Objective/opportunity	Risk (if not addressed)	Custodian
Electricity	• To use the least cost option in electricity generation	• If least cost option is not employed in selecting generating technologies South Africa's global competitiveness will be eroded • Reduction in employment in industries that depend on coal	• Chamber of Mines to discuss the matter with the DoE
Manufacture of liquid fuels and chemical process	• Coal is key to South Africa's energy security • To maintain and improve the competitiveness of South African industries	• The manufacturing of liquid fuel by Sasol in South Africa adds to the country's energy security; an introduction of the carbon tax will drastically reduce Sasol's competitiveness and undermine energy security. Sasol's break-even point is somewhere in the region of $85/barrel much higher than most international producers and local refiners • The cement industry stands to shrink with the introduction of a carbon tax and lose market share from imports from countries such as Pakistan	• Chamber of Mines to deliberate with the DoE • Chamber of Mines has already made inputs to the Carbon Tax Policy (2013) highlighting some of the dangers with the pending introduction of the carbon tax policy
Exports	• To expand export infrastructure • Explore potential bilateral trade agreements with potential export markets	• Exports are essential in bringing foreign exchange into the country, which South Africa uses to import, among other things, raw materials and foreign technology, and also to service public and private external debt	• Transnet • National Treasury, DTI, and DIRCO
GHG emissions	• To reduce GHG emissions by employing the latest technologies available	GHG emissions are a negative externality and result in reduced societal welfare	• All Chamber of Mines members and users of coal • Chamber of Mines to engage DEA and National Treasury on the consequences of CO_2 tax

NOTES

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