

# SA coal resources and reserves, a present-day outlook

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The reassessment of coal reserves has become a matter of urgency and has come as a result of the present situation of the industry, in the context of globalized coal economies, as well as new mining legislation and the advantages and difficulties of domestic coal suppliers. The de Jager report concerning coal reserves, released twenty years ago, can no longer be used as an estimate for accurately forecasting South Africa's future coal production. The new reserve and resource study will promote the diversification of energy sources and provide a clearer view of the future of coal mining in the country. With plans to increase South Africa's coal export capacity to approximately 84 million tons by 2005, it is uncertain whether the country really has sufficient reserves to meet this expansion, as well as satisfy the projected increase in inland demand.

The face of South Africa's coal industry and by association, the economy of our coal-dependent country, are both set to change. This is mainly due to factors such as the demise of most of the large collieries over the last approximately twenty years, growing numbers of economic empowerment producers, the emergence of strong competition in the export market, the dawn of Clean Coal Technologies (CCTs) and the Kyoto Protocol.

The paper will attempt to dispel some of the current myths about coalfields and reserves and highlight potential areas of high quality coal reserves, available mainly to new entrants in the industry.

Keywords: Central Basin, Clean coal technologies, Coal combustion, Coal exports, Coalfields, coalLink, Coal reserves, Coal resources, Coal processing, Colliery, Economic empowerment, Discards, Fluidized bed combustion, Low-ash coal, Metallurgical coal, Power generation, Pulverized fuel, Reserve blocks, Richards Bay Coal Terminal, Run-of-mine production, Saleable production, SAMREC Code, South Dunes Coal Terminal, Steam coal, Synthetic fuels.

## Introduction

Coal is the most important energy source in South Africa, acting as the backbone of the metallurgical industry and main feedstock for the petrochemical industry. Inland coal prices are considered one of the lowest in the world. 70% of coal produced is used inland, mainly for the generation of electricity, synthetic fuels and other industrial uses. The remainder is exported and, in 2001, resulted in almost R17 billion revenue, the third largest, after platinum and gold. The mining industry is now slowly changing, given the mature age of the large producers and the potential incorporation of numerous small-scale, economic empowerment coal mines. With the introduction of Clean Coal Technologies (CCTs), coal usage is becoming also more environmentally friendly. The importance of coal for the future of South Africa's economy therefore looks set to stay.

As South Africa plans to increase its coal exports to about 84 million tons per annum by 2004, the country needs sufficient reserves to meet this expansion, as well as to satisfy the projected local demand. Last year, coal mining and beneficiation processes resulted in the generation of about 66 million tons of discards. Although generally of poor quality, due to the remaining carbon in them, these discards might be used as a future energy source. It is estimated that more than a billion tons of this material has already accumulated around coal mines, and that new projects in South Africa, such as fluidized bed boilers, could be used to take advantage of these discards.

It is envisaged that all coal gasification activities at Sasol in Sasolburg will be phased out by 2004, with only a small amount of coal being used for steam and power generation. The replacement of coal by natural gas as a feedstock for some Sasol plants may lead to an increase in the life span of Sasol's coal reserves.

Economic empowerment (EE) entrepreneurs are actively looking for reserves to open collieries, but remaining reserves are not easily accessible to newcomers due to the lack of information on them. One of the prerequisites for opening a new mine is that the product have a local market with, if at all possible, a second product for export. Coal reserves of the better qualities produced for exports and some local users, are not as abundant as they used to be. However, the Central Basin still contains enough mineable coals to last for a long time. Future collieries in this area will probably not be of the size of the present 'mega' mines, but, with careful husbandry of remaining reserves, many operations that are more successful could still be opened there.

## Current information on South Africa's coal reserves

As indicated earlier, the latest official coal resource and reserve figures were published by de Jager in 1983 and then discussed and reviewed by Bredell in 1987. The former study reported 58.4 billion tons and the latter 55.3 billion tons of recoverable coal reserves. Based on past and present South African coal production trends and statistics from the

Minerals Bureau, it is estimated that the volume exploited from when the de Jager report was compiled in 1982 until 2001, amounts to 4.7 billion tons of ROM coal. Subtracting this tonnage from Bredell's 39.1 billion tons of reserves, less previous reserves, now re-classified as resources in the light of the South African Mineral Resource Committee's (SAMREC) Code, the new coal reserve estimate by the end of 2001 comes to 34.4 billion tons or 62% of the previous amount. Given the present rate of output of approximately 297 Mt/a ROM, and expecting a 3% annual growth in production, we find that within 40 years, only 20% of these reserves will remain, most likely as unmineable coal left in the ground due to mining or geological constraints. An important fact to note is that coal reserves differ from coalfield to coalfield with regard to rank, type and quality. Once the Central Basin (Witbank, Highveld, Ermelo, North KwaZulu-Natal coalfields) reserves are mined-out, some of the best coal qualities for export and local use will end.

## The DME *in situ* reserves evaluation

### Sustainability to supply future demand

The overall quality of South Africa's reserves is of relatively low-grade with a high-ash content. To overcome this handicap, most coal processing technologies used are state of the art, geared to make efficient use of the low-grade coal reserves. Some of Eskom's and Sasol's coal-to-liquids and chemicals plants use mainly ROM coal as feedstock, while supply to the metallurgical local market, the industrial small boiler sector and some merchant or household markets are washed to improve quality. These markets comprise only about 10% of the total domestic 152 Mt/a consumption. The future demand for high-grade beneficiated coal on the South African domestic market is therefore limited and it is likely that sufficient reserves of low-grade quality would be available to supply the demand in the medium- to long-term. The main problem facing the country, however, is the sustainability of South African coal exports.

South Africa currently exports 30% of its annual saleable output of 223 Mt/a. This high-grade coal is obtained through intensive beneficiation of the relatively low-grade production. Uncertainty exists on the amount of suitable reserves amenable to processing that will sustain the current rate of South African exports. This reasoning is based on the reserve situation in the Witbank and Ermelo coalfields from which most exports originate. Some large export collieries have exhausted half of their reserves and there is limited availability of large blocks of coal reserves for future exports.

### National coal resources and reserves evaluation

South Africa's expected dependence on coal well into the near future gives rise to concern about the availability of significant amounts of economically extractable coal reserves for future use. It is therefore imperative that the national coal resource and reserve base be evaluated in order to assist Government in formulating an efficient energy policy with regard to future energy supply.

It is a Government's responsibility, as is the case worldwide, to re-evaluate the amount of coal available and store the information in a national coal resource/reserve database. The amount of coal that has already been mined out, as well as the rate at which future exploitation could take place, are by-products of this study.

South Africa, being one of the world's major producers, local users and exporters of coal, is largely reliant on coal for medium- to long-term economic development. For this

reason, it is essential that the potential of the country's remaining coal resources and reserves be evaluated in determining to what extent they can supply future demand from the various coal-consumption sectors, of which the coal export sector is the most important.

Since coal resource blocks belong mainly to private coal companies, the involvement of coal producers from the early stages is of paramount importance in the establishment of the National Inventory on Coal Resources and Reserves on a national level.

In light of the above, the Department of Minerals and Energy (DME) has initiated a three-phase process to re-evaluate the national coal resource/reserve status. The first two phases, now completed, are:

- *Phase 1*—The establishment of the relevant definitions and methodology based on an international standard for the *in situ* evaluation of coal resources; and
- *Phase 2*—The pilot scale testing of the methodology at two coal mines in the Highveld coalfield.

Government is concerned with the accuracy and variations characterizing some informal estimates seen published. According to the White Paper on Energy Policy of 1998, it is Government's responsibility to ensure that the country's coal resources and reserves are extracted and utilized to their optimal potential. This is only possible when accurate information on their full potential exists on a national level.

*Phase 3*—of the study will be the computation of an accurate estimate of the country's total coal resources and reserves, which will be known as the National Inventory of Coal Resources, and Reserves. This Inventory will also be based on the accepted South African reserve classification standard, described in the SAMREC code published in March 2000.

The scope of the work will comprise the following:

Using the DME methodology, under Phase 2, and the guidelines for reporting South African coal resources and reserves as developed by the South African Minerals Resource Committee, the following will be established on a national basis:

- Amount and qualities of the coal resource base (Reconnaissance, Inferred, Indicated and Measured Resources)
- Amount and qualities of the coal reserve base (Probable and Proved Reserves)
- Amount of coal expected to be sterilized
- Amount of coal already mined out
- Amount of discards expected to be generated in future (to be combined with the amount of discards already produced from the 'Discard Coal—National Inventory'—DME's GIS database currently in use.

National resources and reserves will also be calculated for each of the five main coal utilization sectors in South Africa classified according to the calorific value (CV) and ash content. The five main coal utilization sectors are:

- Export steam coal, Power Station Smalls (PSS) and export low-ash coal
- Utility combustion (electricity generation) and gasification
- Synthetic fuels
- Metallurgical coal; and
- Coal for general industrial use.

### Current local use and exports

During 2001, the consumption was: electricity generation—93 Mt/a; synthetic fuels—46 Mt; exports—69 Mt; and other local usage (comprising the metallurgical industry, household users and the industry's small users—16 Mt.

## Growth constraints

For the past three years, the local coal market has suffered the effect of local and international economic changes. One of the major users of steam coal, Eskom, has decreased its consumption and increased its stocks largely. Some of the local coal sources supplying the local market have decided to export, and the demand of small to medium industries has not always been met. Although the local and export demand for coal is growing, production has remained stagnant. Large producers have lost on average more than 1% output, whilst small mines have increased their production by some 600%. The balance is a slight increase on the saleable production for 2001 compared with 2000, but a decrease on the overall quality of the run-of-mine output. The past few years have also not produced any significant large new coal developments, apart from the Kriel South and Usutu projects.

Existing reserves are not easily accessible because of the lack of information about them. The National Coal Reserves Project could be used to obtain the information needed, if the results produced are available soon to fulfil the needs of this group. One of the prerequisites to open a new mine is that the product's quality is such that it has a local market with; if possible, a lighter fraction for exports. Coal exports are, for now only available to big producers, with some exceptions, given the constraints of quality and infrastructure required to access this market. With the creation of the South Dunes Coal Terminal (SDCT), at Richards Bay, this situation may change, if allocations given to independent mines are convenient to all, port costs are affordable and extra capacity is enough to accommodate all newcomers.

## Economic empowerment and coal mining

Economic empowerment (EE) has become the buzzword in and around the large mining houses over the past few years. There has been much talk, speculation and even some action with respect to the developing economic empowerment. The final realization of economic empowerment will now come as the *Mineral and Petroleum Resources Development Act* is implemented.

According to Jacinto Rocha, (DME), 'The whole aim of the policy and new legislation is to facilitate growth and provide new opportunities in the mining and minerals sector, also for current stakeholders. But obviously, to create real growth, current players will have to accept that the new legislation will also encourage new entrants, both foreign and local, and especially those from the previously disadvantaged sector of our community'.

This legislation will have a great impact on the junior coal-mining sector. Due to the underlying principle in the Bill of 'use it or lose it', many of the large mining concerns will be placed in the position of having to take inventory of their reserve base. Those reserves considered by them to be too small and/or uneconomical, will be prime targets for acquisition by the smaller mining concerns and thus definitely increase the growth of the small coal-mining sector. Another beneficial outcome of empowerment is that many of the larger coal-mining concerns will enter into partnership with junior mining companies, allowing the small mining partner access to resources (technical and financial) that would otherwise have been unavailable. This partnership will also ensure proper mineral resource management for the small mines.

As such, many new coal mines will be formed from the 'leftovers' of operating and defunct collieries. New entrants will need strong technical and economic support from government and the private sector in order to succeed in an environment where many others have failed.

There are currently two groups of EE companies. Those firmly established in the industry, with mines and reserves available and many others with potentially viable operations, but awaiting an opening to be able to export coal and boost their future profits. The establishment of the new export terminal, SDCT, will provide the opportunities for some. The Richards Bay Coal Terminal (RBCT) has also offered new entrants the possibility of using their facilities, when the EE companies can prove that the tonnages and coal qualities for export are available and transportable from mine to port at reasonable rates.

Because of a Coal Export Forum that took place at the DME, a committee was formed to facilitate coal exports for the EE group. The SDCT, RBCT, CoalLink, SpoorNet, The Port Authority (NPA), DME and Department of Public Enterprises are all part of this initiative.

A suggestion put forward during the Forum was that in order for EE companies to reinforce their economic position and become more acceptable as coal exporters, they should also become a group that will facilitate their coal's marketability.

## Port facility expansions

The long-awaited and desperately needed SDCT may now at last be constructed for the benefit of non-RBCT producers. However, the question remains as to whether there are enough reserves and demand to increase exports to 82 Mt/a or 84 Mt/a?

Due to new legislation on mining rights, South African mining companies with non-utilized or 'frozen' reserves will be given the choice to use or lose these reserves. This will hopefully occur in time for the country to access these reserves and utilize them before coal mining, as we know it, becomes outdated. In order to facilitate this, the DME and other significant parties will create the mechanisms needed to make information concerning unused reserves available to industry's new entrants.

## CCTs and the environment

The focus of Clean Coal Technologies is the basic science of coal combustion. The specific objectives are to encourage, support and promote research and development that will lead to an improved understanding and characterization of conventional combustion processes; develop techniques that control and reduce solids, liquid and gaseous emissions associated with combustion processes; improve operating efficiency; and identify methods for the effective utilization of combustion by-products.

South Africa is an energy intensive country, with a high reliance on electricity and primary energy resources such as coal and imported oil. Coal currently provides about 77% of South Africa's primary energy needs, and over 90% of electricity in this country is coal-derived. In the local power generating industry, the predominant coal-based technology is pulverized fuel (pf) combustion.

Clean Coal Science, which incorporates clean coal technologies as developed by the industrialized countries, will become available to South Africa once we become a signatory to the IEA Clean Coal Sciences Agreement (CCS).

## The new technologies

Clean Coal Technologies (CCTs) are defined as 'technologies designed to enhance both the efficiency and the environmental acceptability of coal extraction, preparation and use'. These technologies reduce emissions

and waste and increase the amount of energy obtained from coal.

A relatively new technology that presents interesting opportunities for South Africa is Fluidized Bed Combustion (FBC), which allows the burning of fuels that may be problematic for conventional pf combustion. The technology is considered matured worldwide, but there are no commercial power generating FBC plants in South Africa at present.

FBC fuels can accommodate high levels of ash, hence enabling the technology to offer opportunities for a wide variety of fuel resources. Such a fuel is available in South Africa in the form of large reserves of discard coal. Now it represents an environmental and technical challenge to the South African industry, and offers an opportunity for power generation using FBC technology.

### **CCT's challenges in South Africa**

Further deliberation is needed when considering the future implementation of power generating options in South Africa. These include the impact of the application of the Kyoto Protocol by our trading partners, the suitability of local fuels and conditions, the increasing of the amount of technology options, the training of South African engineers and scientists, the development of a technological support infrastructure within South Africa and joint venture partnering between technology suppliers and users.

### **CCT's benefits for South Africa**

Clean Coal Technologies have already proved to be the best solution for enhancing the living environment of developed countries. With their acceptance and implementation in South Africa, the following benefits can be derived: removal and use of more than a billion tons of coal discards; increased availability of agricultural land in Mpumalanga; increased fuel efficiency in power generation (from 36% to 60%); partial or total removal of CO<sub>2</sub> and SO<sub>x</sub> emissions; recovery of uneconomical coal reserves (using UCG); compliance with the Kyoto Protocol; and free access to information of the CCS Agreement projects.

### **Conclusions**

Analysing the present coal reserve situation and looking back at the achievements of an industry that managed to change the perception of people that coal was the "Cinderella" among commodities and that positioned coal at the centre of industrial and commercial development in this country, we must conclude that for coal, this is only the end of another development phase. With the aid of new technologies and the present openness of this country to an influx of coal combustion research, especially from groups such as the IEA Agreement of Clean Coal Science, coal is a sunrise industry in South Africa.

Although coal reserves of the better qualities that are mined for exports and for some local users are obviously not as abundant as they were. The Central Basin still contains enough mineable coal to last for a long time. Future collieries in this area will probably not be the size of the present 'mega' mines, but with careful husbandry of remaining reserves, many operations that are more successful could still be initiated. The mineability of coal in other areas of the country, such as the remainder of the Waterberg coalfield, others in Northern Province, as well as the Free State coalfields, is a question that only time and advances in coal mining technology will be able to answer.

The South African coal industry is rapidly approaching a stage of stagnation, mainly due to a lack of re-investment by the main producers. Our industry has therefore recently

not been able to raise its production. On the contrary, we are steadily decreasing output and exports. Reserve blocks earmarked for expansions of collieries are therefore left for future development.

As the world energy industry changes to cleaner fuel sources that future is, however, uncertain. In the light of the new Bill, unused coal reserves should be made available to new entrepreneurs. The main coal producers have made a commitment to economic empowerment. I believe that the greatest remaining coal potential for the small-to medium-sized producer remains in the Witbank and Highveld coalfields.

The year 2020 is the 'target' date by when we will know if the local coal industry will survive or not. Around this time, most of the large collieries with an output of more than 10 Million tons per year will close down or their reserves will be near exhaustion. If by then the industry has not been re-structured to generate more small mines with lesser output, it will be too late.

South Africa and the rest of the world are now starting to accept and implement clean coal technologies. In order to make coal acceptable as an energy source, and simultaneously ensure it is more environmentally friendly through reduced emissions, it is imperative to use new technologies. The answers for the future of South Africa's coal industry are: better mining, better beneficiation and better utilization. All of this is possible provided the industry makes the right decisions and follows the right goals.

### **Summary**

The South African coal industry faces many technical, economic, social and environmental challenges. These will all need to receive equal and adequate attention when considering new mining ventures.

As the traditional, big coal mines cease operations; increasingly smaller mines with smaller profit margins will open. These will, with any luck, be able to replace the production capacity lost by the demise of the larger mines.

It is generally accepted that, in South Africa, coal will form the basis of most of the local power generating capacity for many years to come.

Technology options are increasing due to the significant global investment in coal research and development. International pressure on environmental performance will continue to increase too.

As power generating excess capacity is reduced by a growing economy, decisions on new plants will be required. There will be significant interest from international suppliers and investors in the opportunities that arise, with increased environmental vigilance.

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