National Accounts

Environmental Economic Accounts

Mineral Accounts for South Africa: 1980–2008

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List of abbreviations and acronyms

CEEPA	Centre for Environment and Economic Policy in Africa
DMR	Department of Mineral Resources (Department of Minerals and Energy prior to July 2009 (President's Minute No. 690 of 2009)
Eskom	Electricity Supply Commission of South Africa
GDP	Gross domestic product
GWh	Gigawatt hour
MPRDA	Minerals and Petroleum Resources Development Act
MPRRB	Minerals and Petroleum Resources Royalty Bill
NEMA	National Environmental Management Act
OECD	Organisation for Economic Co-operation and Development
PGM	Platinum group metals
R	South African Rand
RRR	Real rate of return
R/kg	Rand per kilogram
SAMI	South Africa's Mineral Industry
SARB	South African Reserve Bank
SARS	South African Revenue Service
SEEA	System of Integrated Environmental Economic Accounting
SBI	Sustainable Budget Index
SIC	Standard Industrial Classification of All Economic Activities
SDR	Social Discount Rate
Stats SA	Statistics South Africa
TJ	Terajoules
US$	United States Dollar
SNA	System of National Accounts
ZLED	Zero liquid effluent discharge

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Executive summary

South Africa's mineral wealth is found in diverse geological formations, some of which are unique and extensive by world standards. For the purpose of this document, some of the country's minerals include but are not limited to the list below:

- Gold – the unique and widespread Witwatersrand Basin yields 96% of South Africa's gold output.
- Platinum group metals (PGM), chrome and vanadium – these minerals occur in the Bushveld Igneous Complex in Mpumalanga, Limpopo and North West. More than half of the world's chrome and proven platinum reserves are in this deposit.
- Bituminous coal and anthracite seams occur in the Karoo Basin in Mpumalanga, KwaZulu-Natal, Free State, Limpopo and Eastern Cape.

South Africa, known throughout the world as a treasure trove, boasts an abundance of mineral resources, producing and owning a significant proportion of the world's mineral resources. In the fourth quarter of 2008 there were 521 000 employees in the mining and quarrying industry as a whole[1] with the majority of employment of 431 781 employees within the top three mining industries, namely gold, PGM and coal[2a]. Mining is South Africa's largest industry in the primary economic sector, followed by agriculture[2b].

South Africa's reserves of gold, PGM and coal commodities are regarded as globally the highest. Due to the small domestic market for most commodities, South Africa's mineral industry is export-oriented. South Africa ranked number four in the world for the production of gold and ranked number one in the world with highest proven gold reserves in 2008[2b]. South Africa ranked number one in the production (extraction) of PGM and number one with the highest PGM reserves in 2008[2b]. With regard to coal reserves, South Africa ranked number six and number seven in coal production (extraction) in 2008[2b]. Coal is one of the important export commodities because of its vast mineral resource base. South Africa is a leading world supplier of a range of minerals and mineral products of consistent high quality[2b]. The country's rich endowment of minerals has played a critical role in the evolution of the South African economy. For more than a century, South Africa's mineral industry, based mainly on gold, diamond, coal and recently PGM production (extraction), has made an important contribution to the national economy[2b]. The focus of this document is therefore on gold, PGM and coal. The country supplies about 80% of the world's PGM. The index of total mining production was 7,5% lower in 2008 compared with 2007. The 7,5% drop in annual mining production followed decreases of 0,9% in 2007 and 1,5% in 2006[3].

Gold

South Africa held its position as the world's largest gold producer for more than a century. China took over as number one in gold production in 2007. In 2008, South Africa ranked number four in the world. South African gold production (extraction) has steadily decreased from 675 tons in 1980 to 213 tons in 2008, which is a 68% decrease over a 28-year period. South Africa's gold production (extraction) year-on-year, shows a negative growth. Gold production (extraction) has decreased by 16% from 253 tons in 2007 to 213 tons in 2008. This decrease can be attributed to the energy supply challenges, the mining of lower-grade ore which was made economically viable by higher rand gold prices and the maintenance of infrastructure along with new safety procedures which involved the temporary closure of a shaft where a fatal incident had occurred in order to facilitate a safety audit[4]. However, the output (sales) has shown an increase over the years. The output (sales) revenue of gold was R38 036 million in 2007 and has increased by 21% to R45 992 in 2008.

Platinum group metals

PGM constitute a family of six chemically similar elements, which include platinum, palladium, rhodium, ruthenium, iridium and osmium. They are divided according to their densities into a heavier category that includes platinum, iridium and osmium, and a lighter group consisting of palladium, rhodium and ruthenium. South Africa's PGM production (extraction) has increased with 142% from 114 tons in 1980 to 276 tons in 2008. PGM production (extraction) decreased with 9% from 304 tons in 2007 to 276 tons in 2008. PGM export sales revenue in 2007 was R66 064 million and increased with 18% to R77 904 million in 2008. PGM output (sales) for 2008 amounted to R91 353 million.

Coal

In 2008, South African mines produced 252 million tons of coal, which constitutes an increase of 119% from 115 million tons in 1980. In 2007, coal production (extraction) was 248 million tons. Of the 2008 coal production (extraction), 197 million tons was sold domestically at a value of R30 120 million, with export sales totalling 58 million tons at a value of R42 388 million[2b]. South Africa has approximately 30 408 million tons of proven coal reserves, making it the sixth-largest holder of proven coal reserves in the world. South African mines produced about 252 million tons of coal in 2008, ranking the country number seven in the world for coal production (extraction)[2b]. In 2008/2009, coal met about 88% of South Africa's primary energy needs[4] compared to 67,3% in 2006 (refer to Table 16).

Key findings

South Africa's mineral industry, based mainly on gold, coal and recently PGM production (extraction), has made an important contribution to the national economy. Gold production (extraction) has steadily declined from 1980 to 2008. In 1980, the total production (extraction) was 675 tons, declining by 68% to 213 tons in 2008. With the decline in gold production (extraction) there was also a decline in the total volume sold. In 2008, the total volume sold for gold was 199 tons valued at R45 992 million. At this current extraction rate, proven gold reserves are estimated to last another 146 years from 2008. PGM showed a substantial increase in production (extraction) over the recorded period. In 1980, production (extraction) of PGM in South Africa was at 114 tons, maintaining a steady increase of 142% to 276 tons for 2008. The total volume sold also increased at a rate of 99% from 1980 to 2008. At the same rate of extraction as in 2008, proven PGM reserves will last for another 254 years. Coal production (extraction) has experienced an increase over the same period from 1980 to 2008. In 1980, coal production (extraction) was 115 million tons and in 2008 production (extraction) increased by 119% to 252 million tons. The total volume sold showed an increase of 126% from 113 million tons in 1980 to 255 million tons in 2008. The estimated number of years to depletion for proven coal reserves in 2008 was 121 years.

The output (sales) for gold increased from R10 395 million in 1980 to R45 992 million in 2008. Intermediate consumption increased from R1 454 million in 1980 to R20 709 million in 2008. PGM output (sales) showed a large increase from R851 million in 1980 to R91 353 million in 2008. From 2005 to 2006 there was a drastic increase of R26 993 million, and from 2007 to 2008 there was a sharp increase of R12 939 million leading to the output (sales) of R91 353 million in 2008. Intermediate consumption for PGM also showed a large increase from R128 million in 1980 to R5 237 million in 1997, and increased to R39 005 million in 2008. Coal output (sales) experienced a large increase from R1 497 million in 1980 to R72 508 million in 2008. Intermediate consumption of coal increased steadily from R507 million in 1980 to R25 455 million in 2008.

Gold mineral asset value for closing stock at the Social Discount Rate (SDR) of 3%, 5% and 11,7% for annual values showed a fluctuating trend that peaked in 1986 and began to decline through 1987 to 2002. The asset value for closing stock is negative for the period from 1995 to 2002. The closing stock began to recover in 2003 and 2004, with negative values in 2004 at 3%, 5% and 11,7%. Negative values were shown at 11,7% between 2005 to 2008 (see Annexure 1 for an explanation of the process of deriving at these social discount rates). The closing stock for PGM at 3%, 5% and 11,7% at annual values all showed an increasing trend from 1980. From 1990 to 1999 the annual asset values, closing stock at 3%, 5% and 11,7% for PGM started to show a declining trend. For the same period, the annual asset values, closing stock at 3% represented negative values for the years 1993 to 1999. From 2000 the closing stock for PGM showed a recovery trend up to 2008. The closing stock for coal for the period 1980 to 2008 has shown a positive trend for both annual and 5-year moving averages with only negative values in 1999, 2000, 2002 to 2004 at the discount rate of 11,7% for annual values.

With a decrease in the income component, less of the revenue from gold mining has to be invested to maintain a constant stream of income. With a decrease in the capital component, less of the revenue from mining can be consumed as current income. The reverse is true if there is and increase for the income or capital components.

The income component (X) for gold at a real rate of return (RRR)[a] of 11,7% fluctuated from 1980 to 2008. The income component in 1980 was R6 506 million, decreasing to negative R4 360 million in 2008. The capital component also showed a decrease from approximately R4 million to R0 million (refer to Table 13). The capital depreciation factor remained relatively unchanged from 1980 to 2008 at 0%. The results from gold suggest that South Africa has to invest a relatively small amount of the revenue from gold mining into substitute forms of capital.

The income component (X) for PGM at a RRR of 11,7% increased from 1980 to 2008. The income component in 1980 was R401 million, increasing to R15 962 million in 2008. The capital component remained unchanged at R0 million (refer to Table 14). The capital depreciation factor also remained unchanged at 0% in 2008. The results from PGM suggest that South Africa does not have to invest any of the revenue from PGM mining into substitute forms of capital.

The income component (X) for coal at a RRR of 11,7% increased from 1980 to 2008. The income component in 1980 was R220 million, increasing to R26 961 million in 2008. The capital component also remained stable at R0 million (refer to Table 15). The capital depreciation factor remained relatively unchanged at 0% for the 28-year period. The results from coal suggest that South Africa does not have to invest any of the revenue from coal mining into substitute forms of capital.

1. Introduction

South Africa has an abundance of mineral resources and produces a significant proportion of some of the world's minerals. As a result South Africa needs to account for these resources. The purpose of this discussion document is to present the updated mineral accounts for South Africa for the reference period 1980 to 2008. This is the fifth document for mineral accounts that Stats SA[b] has compiled. The previous mineral accounts document also presented the physical, monetary and resource rent accounts. The three main differentiating features for this mineral accounts discussion document is that there is a more in-depth analysis of the account, specifically regarding the results presented in the resource rent and monetary accounts. The mining industry has provided the impetus for the development of an extensive and efficient physical infrastructure and has contributed greatly to the establishment of the country's secondary industries. The results for the El-Serafy's Use-Cost method are presented in a table format where previously only the importance and methodologies were discussed. A geographical representation of the active mines in South Africa is included.

Section 3 presents the updated physical accounts for South Africa where the production (extraction) rate and years to depletion are shown. In section 4 the resource rent accounts are presented along with an in-depth analysis of the results. In section 5 the monetary accounts are presented where the monetary value of South Africa's proven gold, PGM and coal reserves are shown. The monetary accounts are drawn up with the assistance of the resource rent accounts. Section 6 focuses on the policy analysis of the mineral accounts, with the use of the El-Serafy's Use-Cost method. In section 7 a discussion follows on the concepts of sustainability and the approaches on how to measure sustainability. Section 8 discusses the linkages between minerals, energy and water.

[a] SDR is the same as RRR as shown in El-Serafy's Use-Cost formula.

[b] The first discussion document was published in September 2002, followed by a report in September 2004. The second and third discussion documents were published in December 2008 and March 2010 respectively.

Annexure 1 contains a detailed description of the methodologies used to compile the accounts and methods used to perform policy analysis for gold, PGM and coal in South Africa.

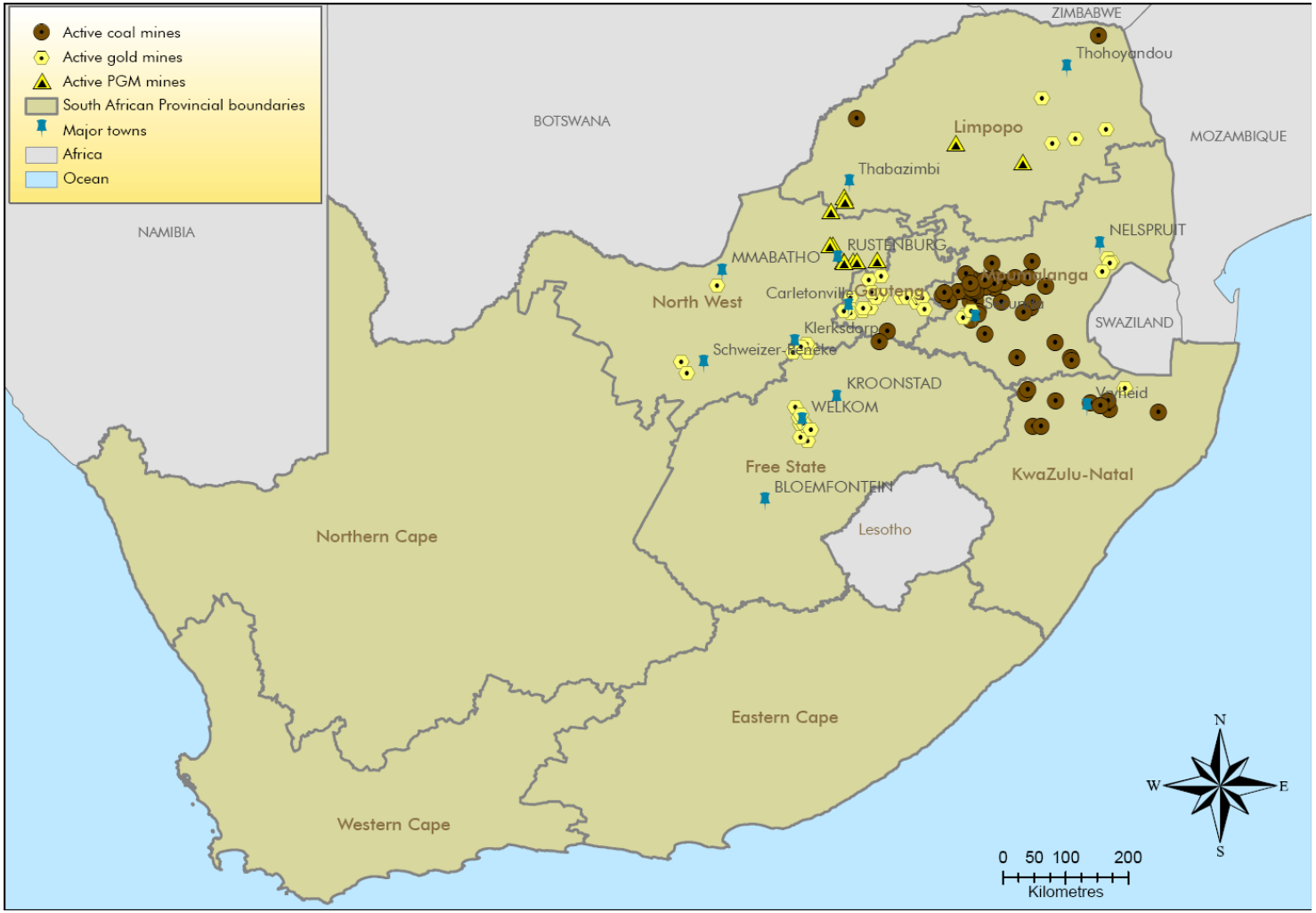
2. The importance of mineral accounts for South Africa

Mining continues to support and stimulate growth and development in the country. Mining companies contribute extensively to South Africa's tax base. Rail, road and port development is more often than not spurred on by the development of new and extended mining operations. New towns are established in mineral-rich areas and attract new investment into the economy. Therefore the importance of mining in South Africa cannot be overemphasised. The Republic of South Africa holds a major economic and physical presence on the African continent regarding mining[5]. Mining has been the mainstay of the economy for more than 100 years and has contributed significantly to the industrial development of the country. In the past 10 years, the development of export-oriented value-added processing aluminium, ferro-alloys, steel, and titanium industries has become an important component of the mineral economy of South Africa. The development of these value-added industries along with an expansion in coal exports and a recent sharp increase in PGM prices have helped compensate for the declining role of gold in the economy. Owing to the high cost of deep gold mining in South Africa and the decline in the world market price for gold, gold export earnings have dropped. In 2008, mining contributed 9,9% to the gross domestic product (GDP)[6] and the sector provided 521 000 employment opportunities to a large number of South African employees in the fourth quarter of 2008[1].

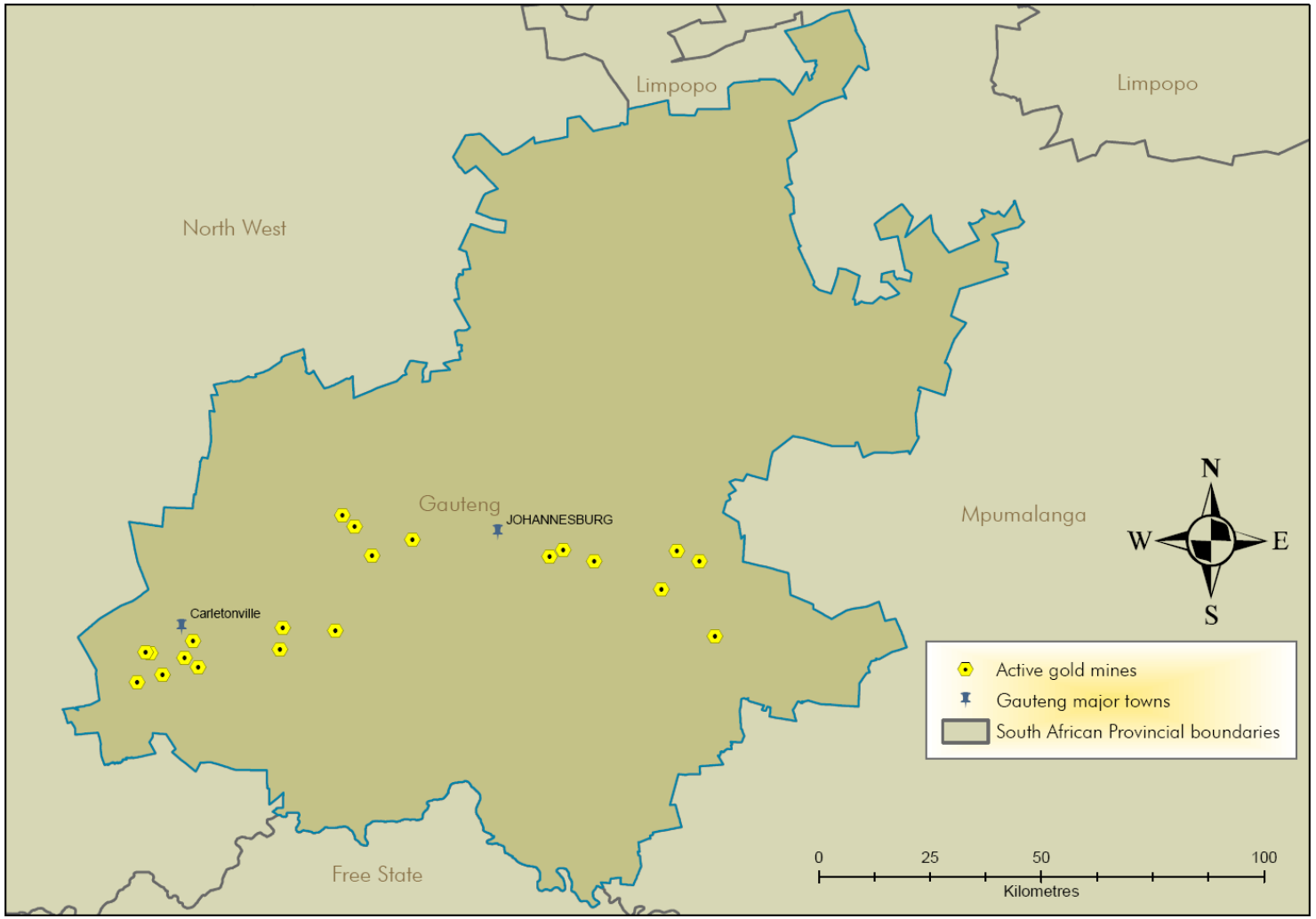
Some of the livelihoods and economies in South African mining towns are mostly, if not totally, reliant on the surrounding mines. Map 1 illustrates the geographical positions of active gold, PGM and coal mines in South Africa. The majority of mining activities occur in Gauteng, Free State, Mpumalanga, North West and KwaZulu-Natal. Map 2 illustrates the active gold mines in Gauteng, which houses most of the active gold mines in South Africa. Map 3 illustrates the active PGM mines in North West and Limpopo. Map 4 illustrates all the active coal mines in Mpumalanga where the majority of South African coal mines are located. From these geographical maps, it is possible to see all the towns that have developed due to the mining activities in the areas where mines are located.

Through mineral accounting it is possible to measure the sustainability of the resources which will be depleted, and provides the information to government about who has to ensure that there are sufficient jobs for the people that rely on the mining industry for employment. Some minerals, such as gold, are increasingly difficult to exploit due to the great depths from which the ore needs to be extracted and its fairly low-grade quality. If the resources are depleted or are no longer economically viable to extract, the mines could close down, resulting in job losses with no steady flow of income to the families of those who were previously employed by the mining industry. It becomes equally important to measure the physical volume of minerals that are left and to calculate the years to depletion to enable planning for the future and ensure the sustainability of not only the mining industry, but most importantly the sustainability of associated employment. This involves the necessity of calculating the resource rents produced through the mining activities and to calculate which percentage of these rents should be reinvested to maintain a constant stream of income (capital component) or the residual amount that can be consumed as current income (income component).

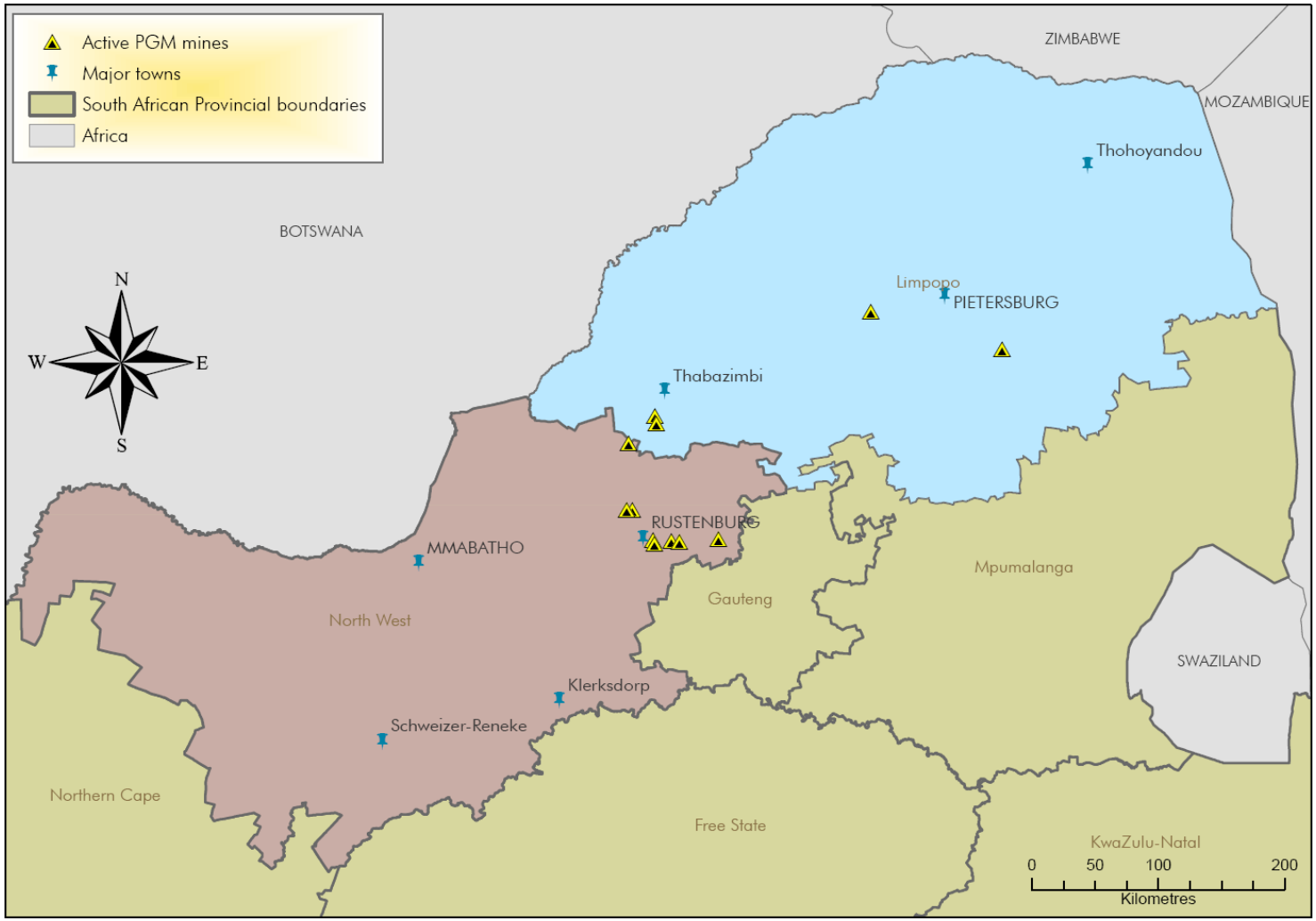
Map 1: Active gold, platinum group metals and coal mines in South Africa[7]



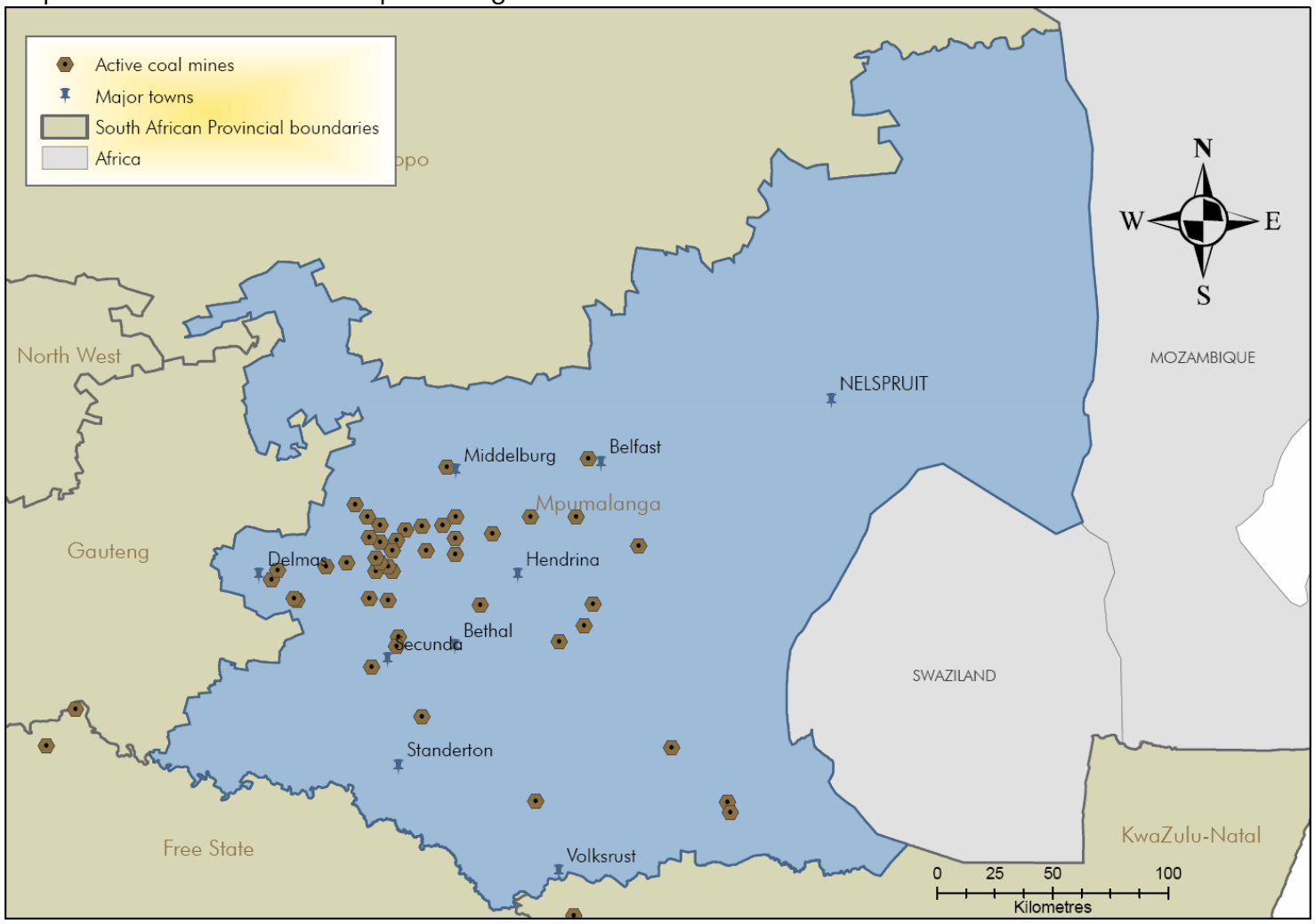
Map 2: Active gold mines in Gauteng[7]



Map 3: Active platinum group metals mines in North West and Limpopo[7]



Map 4: Active coal mines in Mpumalanga[7]



3. Physical accounts for the South African mining industry

Physical accounts provide information on mineral volume changes. This section presents the updated physical accounts for gold, PGM and coal for the reference period 1980 to 2008. The physical accounts consist of the following components: opening stock; production (extraction); closing stock (sub-soil assets); total volume sold; net change in inventories; closing stock (including inventories); and years to depletion of the particular mineral. These different components enable the monitoring of the physical volumes of mineral resources.

3.1 Gold

Comparing South African gold production (extraction) with other countries, South Africa was the world's second largest producer of gold in 2007 and has dropped to number four in 2008; number one being China, followed by the United States of America and Australia[2b]. Due to the small domestic market for most commodities, the South African mineral industry is export-oriented. South Africa has approximately 31 000 million tons of proven gold reserves, making it the largest holder of proven gold reserves in the world. Russia is ranked number two followed by Australia and Indonesia both ranking number three in gold reserves in the world[2b].

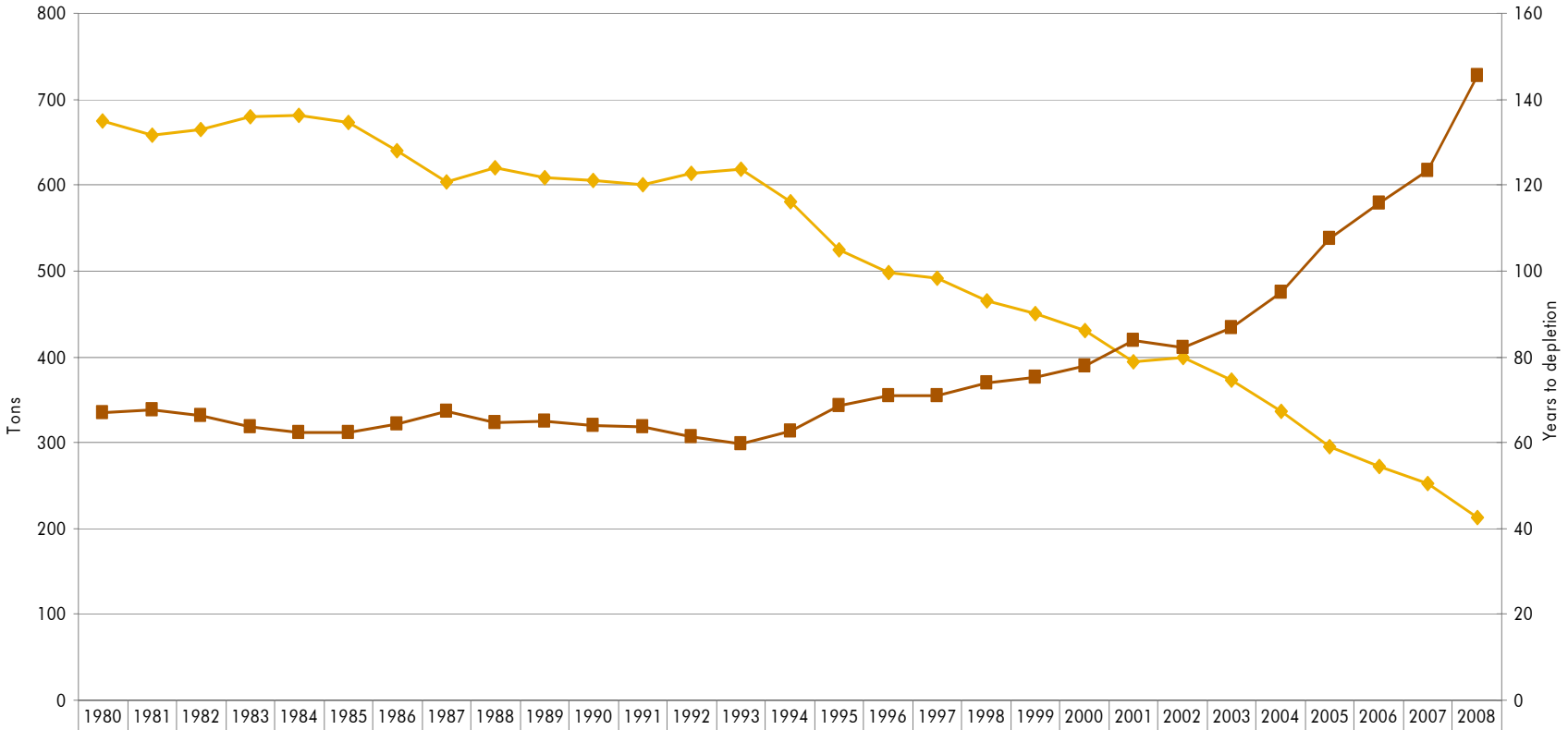
Physical accounts for gold are presented in Table 1. The trend that can be observed from Table 1 is the rate of production (extraction) of gold and how it has steadily declined over the period of observation 1980 to 2008. In 1980, the total production (extraction) was 675 tons declining by 68% to 213 tons in 2008. With the decline in production (extraction) there was also a similar decline of 71% in the total volume sold for gold over the same period from 675 tons to 199 tons. This has a direct effect on the years to depletion of gold which has steadily increased by 118% from 67 years in 1980 to 146 years left at the current extraction rate of 213 tons in 2008 (refer to Figure 1). South Africa's gold production (extraction) decreased by 16% from 253 tons in 2007 to 213 tons in 2008, resulting in the country dropping in production (extraction) ranking. This decrease can be attributed to the energy supply challenges, the mining of lower-grade ore which was made economically viable by higher rand gold prices, and the maintenance of infrastructure along with new safety procedures which involved the temporary closure of a shaft where a fatal incident had occurred in order to facilitate a safety audit[2b]. The country's output (sales) increased from R38 036 million in 2007 by 21% to R45 992 million in 2008, due to a 46% rise in the average rand price for the year, despite lower sales volumes. Employment in the gold mining sector rose slightly from 166 063 employees in 2007 to 166 421 employees in 2008, with total remuneration increasing by 10% in the same period[2a]. The mining and quarrying industry provided employment to 521 000 employees in the fourth quarter of 2008[1].

Table 1: Gold: physical accounts for South Africa, 1980–2008[2a, 2b]

Year	Opening stock*	Production* (extraction)	Discoveries	Other volume changes	Closing stock* (sub-soil assets)	Total volume sold	Net changes in inventories*	Closing stock* (including inventories)	Years to depletion*
	Tons								
1980	45 919	675	0	0	45 244	675	0	45 244	67
1981	45 244	658	0	0	44 586	661	-3	44 583	68
1982	44 586	664	0	0	43 922	662	2	43 924	66
1983	43 922	680	0	0	43 242	669	11	43 253	64
1984	43 242	682	0	0	42 560	685	-3	42 557	62
1985	42 560	673	0	0	41 887	677	-4	41 883	62
1986	41 887	640	0	0	41 247	642	-2	41 245	64
1987	41 247	604	0	0	40 643	602	2	40 645	67
1988	40 643	620	0	0	40 023	618	2	40 025	65
1989	40 023	608	0	0	39 415	606	2	39 417	65
1990	39 415	605	0	0	38 810	596	9	38 819	64
1991	38 810	601	0	0	38 209	601	0	38 209	64
1992	38 209	613	0	0	37 596	613	0	37 596	61
1993	37 596	619	0	0	36 977	619	0	36 977	60
1994	36 977	580	0	0	36 397	580	0	36 397	63
1995	36 397	524	0	0	35 873	524	0	35 873	68
1996	35 873	498	0	0	35 375	496	2	35 377	71
1997	35 375	491	0	0	34 884	508	-17	34 867	71
1998	34 884	465	0	0	34 419	465	0	34 419	74
1999	34 419	451	0	0	33 968	455	-4	33 964	75
2000	33 968	431	0	0	33 537	406	25	33 562	78
2001	33 537	395	0	0	33 142	387	8	33 150	84
2002	33 142	399	0	0	32 743	396	3	32 746	82
2003	32 743	373	0	0	32 370	376	-3	32 367	87
2004	32 370	337	0	0	32 033	347	-10	32 023	95
2005	32 033	295	0	0	31 738	270	25	31 763	108
2006	31 738	272	0	0	31 466	283	-11	31 455	116
2007	31 466	253	0	0	31 213	243	10	31 223	123
2008	31 213	213	0	0	31 000	199	14	31 014	146

Notes: Discoveries = 0 due to confidentiality in the mining industry; see Annexure 1: Methodological notes, for the definition of the variables.
*Where figures have been rounded, discrepancies may occur with totals.

Figure 1: Gold: production and years to depletion, 1980–2008[2a, 2b]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Production (extraction)	675	658	664	680	682	673	640	604	620	608	605	601	613	619	580	524	498	491	465	451	431	395	399	373	337	295	272	253	213
Years to depletion	67	68	66	64	62	62	64	67	65	65	64	64	61	60	63	68	71	71	74	75	78	84	82	87	95	108	116	123	146

3.2 Platinum group metals

PGM constitute a family of six chemically similar elements, which include platinum, palladium, rhodium, ruthenium, iridium and osmium. They are divided according to their densities into a heavier category, comprising platinum, iridium and osmium, and a lighter group, consisting of palladium, rhodium and ruthenium. South Africa's PGM production (extraction) decreased from 309 tons in 2006 to 304 tons in 2007 and 276 tons in 2008 (refer to Table 2). PGM output (sales) increased by about 17% in 2008 due to the mining companies increased investment in the PGM mining sector, in an attempt to increase production (extraction) for the expanding global market[5]. During mid 2008 there was a fall-off in demand and prices had materially impacted on the sector, with most companies cutting costs and capital expenditure in order to mitigate the impact of lower prices. Both domestic and export sales increased during 2008. PGM export sales revenue increased from R66 064 million in 2007 to R77 904 million in 2008[2b].

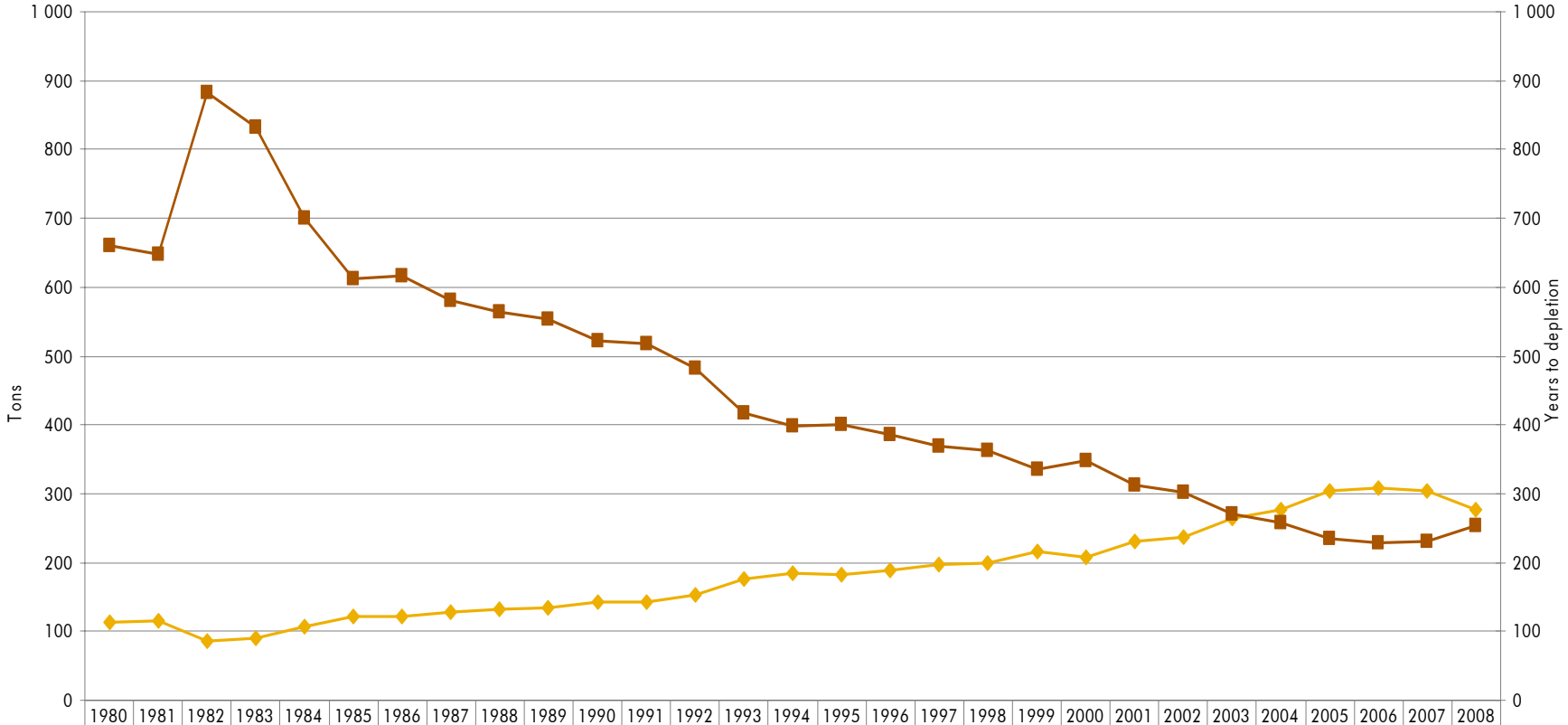
Unlike gold, PGM has experienced a substantial increase in production (extraction) from 1980 to 2007 and a decline of 9% in 2008. In 1980, production (extraction) of PGM in South Africa was at 114 tons; production (extraction) decreased in 1982 to 85 tons but showed a steady increase by 142% to 276 tons from 1980 to 2008 (refer to Table 2). The total volume sold has also experienced a similar trend and increased by 99% from 1980 to 2008. Figure 2 illustrates that the increase in production (extraction) has decreased the years to depletion. In 1980 South Africa was standing at 660 years to depletion; in 2008 it was at 254 years to depletion (refer to Table 2 and Figure 2).

Table 2: Platinum group metals: physical accounts for South Africa, 1980–2008[2a, 2b]

Year	Opening stock*	Production* (extraction)	Discoveries	Other volume changes	Closing stock* (sub-soil assets)	Total volume sold	Net changes in inventories*	Closing stock* (including inventories)	Years to depletion*
	Tons								
1980	75 339	114	0	0	75 225	112	2	75 227	660
1981	75 225	116	0	0	75 109	104	12	75 121	647
1982	75 109	85	0	0	75 024	98	-13	75 011	883
1983	75 024	90	0	0	74 934	104	-14	74 920	833
1984	74 934	107	0	0	74 827	113	-6	74 821	699
1985	74 827	122	0	0	74 705	118	4	74 709	612
1986	74 705	121	0	0	74 584	120	1	74 585	616
1987	74 584	128	0	0	74 456	130	-2	74 454	582
1988	74 456	132	0	0	74 324	131	1	74 325	563
1989	74 324	134	0	0	74 190	137	-3	74 187	554
1990	74 190	142	0	0	74 048	136	6	74 054	521
1991	74 048	143	0	0	73 905	141	2	73 907	517
1992	73 905	153	0	0	73 752	137	16	73 768	482
1993	73 752	176	0	0	73 576	154	22	73 598	418
1994	73 576	184	0	0	73 392	162	22	73 414	399
1995	73 392	183	0	0	73 209	175	8	73 217	400
1996	73 209	189	0	0	73 020	184	5	73 025	386
1997	73 020	197	0	0	72 823	187	10	72 833	370
1998	72 823	200	0	0	72 623	194	6	72 629	363
1999	72 623	216	0	0	72 407	199	17	72 424	335
2000	72 407	207	0	0	72 200	199	8	72 208	349
2001	72 200	230	0	0	71 970	193	37	72 007	313
2002	71 970	237	0	0	71 733	208	29	71 762	303
2003	71 733	265	0	0	71 468	241	24	71 492	270
2004	71 468	276	0	0	71 192	260	16	71 208	258
2005	71 192	303	0	0	70 889	259	44	70 933	234
2006	70 889	309	0	0	70 580	266	43	70 623	228
2007	70 580	304	0	0	70 276	258	46	70 322	231
2008	70 276	276	0	0	70 000	223	53	70 053	254

Notes: Discoveries = 0 due to confidentiality in the mining industry; see Annexure 1: Methodological notes, for the definition of the variables.
*Where figures have been rounded, discrepancies may occur with totals.

Figure 2: Platinum group metals: production and years to depletion, 1980–2008[2a, 2b]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Production (extraction)	114	116	85	90	107	122	121	128	132	134	142	143	153	176	184	183	189	197	200	216	207	230	237	265	276	303	309	304	276
Years to depletion	660	647	883	833	699	612	616	582	563	554	521	517	482	418	399	400	386	370	363	335	349	313	303	270	258	234	228	231	254

3.3 Coal

Following PGM and gold, coal is one of the most important sectors of the mineral economy of South Africa. South Africa in 2008 remained the seventh largest coal-producing country in the world and the fifth largest coal exporter[2b]. As production (extraction) and exports continues with an increasing trend from 1980 until 2008, the use of coal is still expected to keep increasing over the next few years. South Africa has approximately 30 408 million tons of proven coal reserves, making it the sixth largest holder of proven coal reserves in the world[2b]. The volumes of economically extractible reserves raise doubt as to whether the economy can continue for much longer to depend massively on coal without taking into consideration the environmental problems posed by its use[2b].

Coal represented 88% of national primary energy consumption for 2008/2009[4] compared to 67,3% in 2006 (refer to Table 16). Coal production (extraction) in South Africa has experienced an increase over the observation period of 1980 to 2008 (refer to Table 3 and Figure 3). In 1980, production (extraction) was 115 million tons, and in 2008 production (extraction) was 252 million tons, which represents an increase of 119%. The volume of total sales showed an increase of 126% from 113 million tons in 1980 to 255 million tons in 2008. An increase in production (extraction) has caused the years to depletion to decrease by 61% over the 28 years of reference. In 1980 there were 313 years to depletion and in 2008 there were only 121 years to depletion. Due to the extensive use of coal in the domestic economy, 28% of South Africa's production (extraction) is exported internationally, mainly through the Richards Bay Coal Terminal, making South Africa the fifth largest coal exporter in the world.

The increase in production (extraction) and total volume sold that is observed in the physical accounts for coal (refer to Table 3) were due to the increase in demand for coal as a source of producing electricity. Domestic sales increased from 183 million tons in 2007 to 197 million tons in 2008[2a]. Electricity is the driver for the domestic coal market, while the coal market is driven by exports in monetary terms. South Africa's saleable coal production (extraction) increased by less than 2% from 248 million tons in 2007 to 252 million tons in 2008 (refer to Table 3). In the first half of 2008, coal production (extraction) was flat on a year-on-year basis as a result of the heavy rains experienced in January. The increase in domestic coal sales was mostly as a result of the Electricity Supply Commission of South Africa (Eskom) procuring extra coal to replenish coal stock piles at key power stations[8]. Despite lower export volumes, the much higher export and domestic prices for coal resulted in a 64% increase in coal output (sales) from R44 166 million in 2007 to R72 508 million in 2008. Comparing with 2007, coal export sales increased by 73% to R42 388 million in 2008, while domestic sales increased by 53% to R30 120 million in 2008.

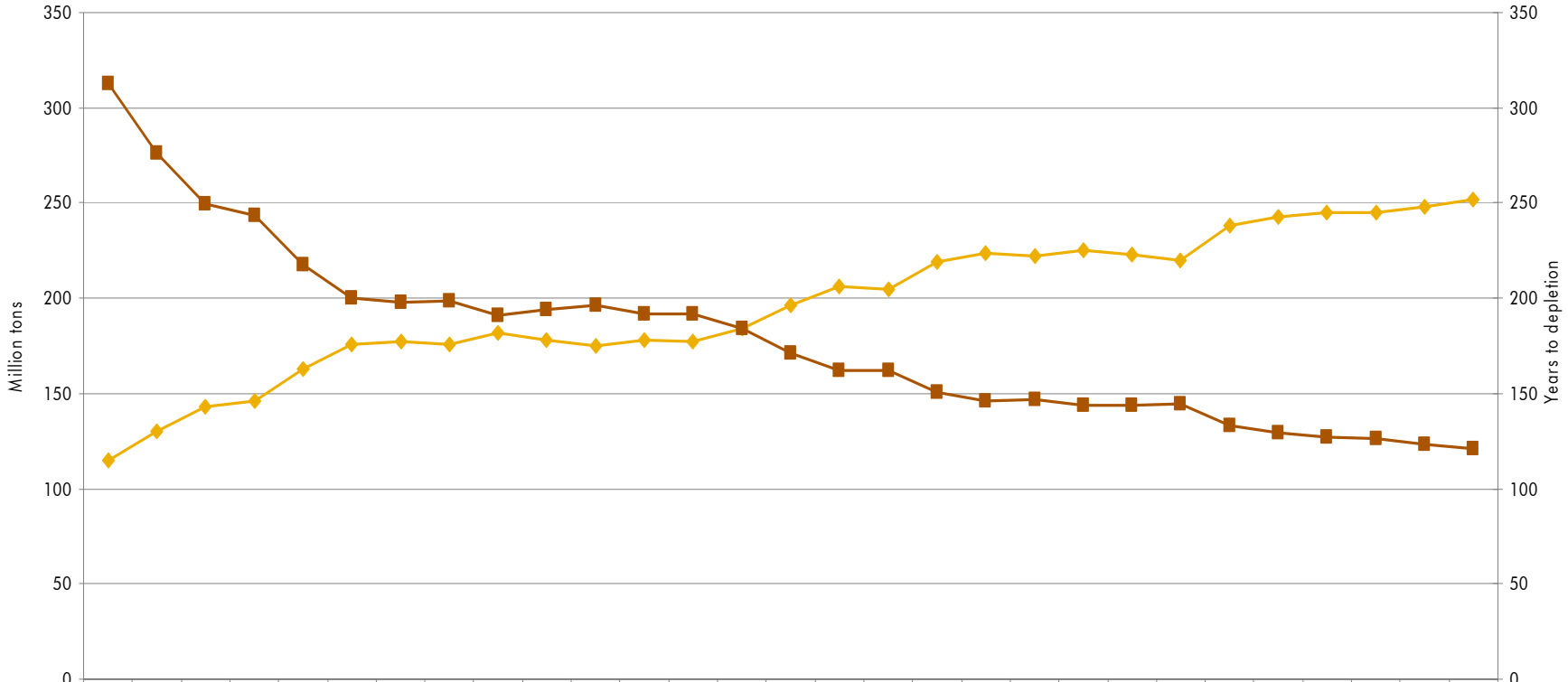
Coal is the most widely distributed energy fuel in the world. Slightly less than one-third or 29% of coal is located in North America, dominated by the United States, a little more than one-third or 34% in Eurasia, dominated by Russia to which one can add Ukraine, Kazakhstan and Serbia; and less than one-third or 31% in Asia-Oceania, where the reserves in China alone are equal to the sum of the reserves in India and Australia. Africa holds less than 5% of the total coal deposits, with the bulk of coal resources located in South Africa. The African coal producing countries are dominated by South Africa[9].

Table 3: Coal: physical accounts for South Africa, 1980–2008[2a, 2b]

Year	Opening stock*	Production* (extraction)	Discoveries	Other volume changes	Closing stock* (sub-soil assets)	Total volume sold	Net changes in inventories*	Closing stock* (including inventories)	Years to depletion*
	Million tons								
1980	36 119	115	0	0	36 004	113	2	36 006	313
1981	36 004	130	0	0	35 874	130	0	35 874	276
1982	35 874	143	0	0	35 731	140	3	35 734	250
1983	35 731	146	0	0	35 585	145	1	35 586	244
1984	35 585	163	0	0	35 422	161	2	35 424	217
1985	35 422	176	0	0	35 246	172	4	35 250	200
1986	35 246	177	0	0	35 069	174	3	35 072	198
1987	35 069	176	0	0	34 893	173	3	34 896	198
1988	34 893	182	0	0	34 711	184	-2	34 709	191
1989	34 711	178	0	0	34 533	180	-2	34 531	194
1990	34 533	175	0	0	34 358	185	-10	34 348	196
1991	34 358	178	0	0	34 180	182	-4	34 176	192
1992	34 180	177	0	0	34 003	179	-2	34 001	192
1993	34 003	184	0	0	33 819	184	0	33 819	184
1994	33 819	196	0	0	33 623	194	2	33 625	172
1995	33 623	206	0	0	33 417	206	0	33 417	162
1996	33 417	205	0	0	33 212	206	-1	33 211	162
1997	33 212	219	0	0	32 993	217	2	32 995	151
1998	32 993	224	0	0	32 769	224	0	32 769	146
1999	32 769	222	0	0	32 547	222	0	32 547	147
2000	32 547	225	0	0	32 322	225	0	32 322	144
2001	32 322	223	0	0	32 099	221	2	32 101	144
2002	32 099	220	0	0	31 879	227	-7	31 872	145
2003	31 879	238	0	0	31 641	240	-2	31 639	133
2004	31 641	243	0	0	31 398	247	-4	31 394	129
2005	31 398	245	0	0	31 153	245	0	31 153	127
2006	31 153	245	0	0	30 908	246	-1	30 907	126
2007	30 908	248	0	0	30 660	250	-2	30 658	124
2008	30 660	252	0	0	30 408	255	-3	30 405	121

Note: Discoveries = 0 due to confidentiality in the mining industry; see Annexure 1: Methodological notes, for the definition of the variables.
*Where figures have been rounded, discrepancies may occur with totals.

Figure 3: Coal: production and years to depletion, 1980–2008[2a, 2b]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Production (extraction)	115	130	143	146	163	176	177	176	182	178	175	178	177	184	196	206	205	219	224	222	225	223	220	238	243	245	245	248	252
Years to depletion	313	276	250	244	217	200	198	198	191	194	196	192	192	184	172	162	162	151	146	147	144	144	145	133	129	127	126	124	121

4. Resource rent accounts for the South African mining industry

Private enterprises are granted leases by government permitting them to extract mineral deposits over a specified period of time in return for the payment of rents. These payments are often described as royalties, but they are essentially rents that accrue to owners of the assets in return for putting them at the disposal of other institutions for specified periods of time. This section discusses resource rent calculations for South Africa's gold, PGM and coal industries (refer to Tables 4 to 6), how much rent should be collected by government and what should the resource rent be used for. The resource rent tables show output (sales), intermediate consumption, compensation of employees, unit rent, resource rent, and other calculations for the period 1980 to 2008. The Social Discount Rate (SDR) that is used in the resource rent calculation in this discussion document are 3%, 5% and 11,7%. Detailed discussions of the methods used to calculate the SDR at 11,7% are presented in Annexure 1, Section 2.1.

This discussion document attempts to analyse the mining industry in South Africa specific to each mineral, as well as to the relevant year in order to explain the negative resource rent values. Negative resource rent values may be an indication that during that specific period it was not economically viable for mines to sustain their production (extraction) rates. The output (sales) of the top three minerals (coal, PGM, and gold) accounted for R209 853 million in 2008[2b].

4.1 Gold

Table 4 presents the resource rent and other calculations for the period 1980 to 2008 at current prices. Figure 4 shows how gold output (sales), intermediate consumption and consumption of fixed capital follow a similar trend. Intermediate consumption increased steadily from R1 454 million in 1980 to R8 232 million in 1992 (refer to Figure 4). From 1993 intermediate consumption began to increase at a faster pace to R9 314 million. In 2002 there was a significant increase, where the intermediate consumption was R17 353 million, in 2005 a decline to R8 077 million, and steady increases in 2006 and 2007 to reach R20 709 million in 2008 (refer to Table 4).

Resource rents at 3%, 5% and 11,7% have all experienced a steady decrease for the years 1980 to 2008. The negative resource rents are present at 3%, 5% and 11,7% SDR from 1990 to 2008. Negative resource rents may be an indication that mining of gold has not been economically viable. One indicator may be the price of gold during the negative resource rent periods. As the price of gold decreases, it may become non-viable to mine the gold. The annual average gold price for the year 1993 was US$360 per ounce with the gold price dropping to a low of US$273 per ounce in 2001 and then recovering to US$872 per ounce in 2008[10].

Table 4: Gold: resource rent and other calculations for South Africa, 1980–2008[2a, 2b, 11, 12, 13]

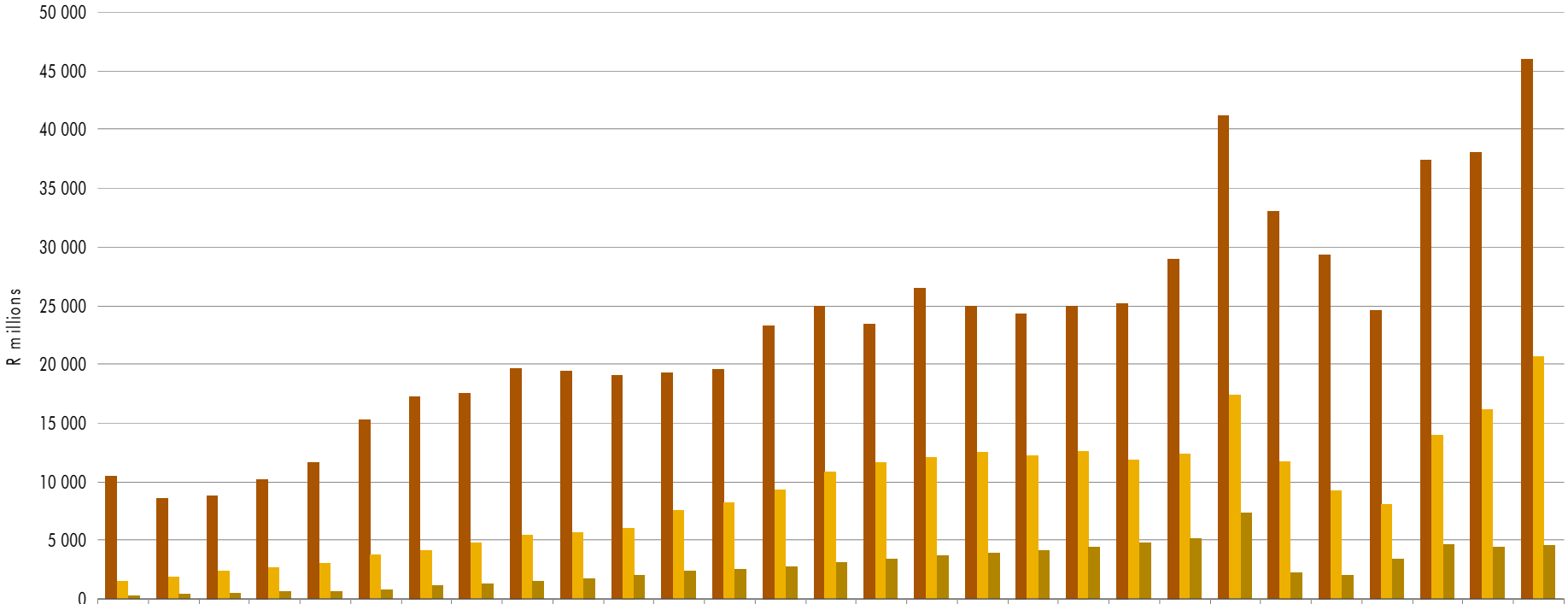
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
								Rand millions						
Output (sales)	10 395	8 554	8 778	10 177	11 574	15 291	17 283	17 495	19 701	19 439	18 994	19 296	19 513	23 239
Intermediate consumption	1 454	1 860	2 379	2 639	3 028	3 822	4 219	4 814	5 372	5 651	6 069	7 511	8 232	9 314
Compensation of employees														
Total	1 448	1 793	2 098	2 438	2 844	3 311	3 949	4 852	5 521	6 100	6 720	6 849	6 940	7 217
Male	1 430	1 769	2 068	2 402	2 801	3 256	3 880	4 763	5 417	5 982	6 585	6 701	6 795	7 068
Female	18	24	30	36	43	56	69	89	103	117	135	148	145	149
Consumption of fixed capital	306	385	478	575	658	817	1 074	1 262	1 527	1 776	2 069	2 331	2 567	2 808
Opportunity cost of capital														
SDR 3%	173	223	279	339	394	495	651	752	902	1 053	1 201	1 318	1 411	1 499
SDR 5%	289	372	464	565	657	826	1 085	1 254	1 504	1 756	2 002	2 196	2 352	2 498
SDR 11,7%	676	870	1 086	1 322	1 537	1 932	2 538	2 935	3 520	4 108	4 684	5 139	5 503	5 845
Rent														
SDR 3%	7 013	4 293	3 544	4 186	4 650	6 845	7 391	5 814	6 378	4 859	2 935	1 288	363	2 401
SDR 5%	6 898	4 144	3 358	3 961	4 387	6 515	6 957	5 312	5 777	4 157	2 135	409	-578	1 402
SDR 11,7%	6 510	3 646	2 736	3 204	3 507	5 408	5 503	3 631	3 761	1 805	-548	-2 534	-3 729	-1 945
Unit rent (R/kg)														
SDR 3%	10 390	6 524	5 338	6 157	6 818	10 171	11 548	9 625	10 288	7 992	4 852	2 142	591	3 879
SDR 5%	10 219	6 298	5 058	5 824	6 433	9 680	10 870	8 794	9 317	6 837	3 528	681	-943	2 265
SDR 11,7%	9 645	5 541	4 121	4 711	5 143	8 036	8 599	6 012	6 067	2 968	-905	-4 216	-6 083	-3 142
Unit rent (R/kg) 5-year moving average														
SDR 3%	10 390	8 457	7 417	7 102	7 045	7 002	8 006	8 864	9 690	9 925	8 861	6 980	5 173	3 891
SDR 5%	10 219	8 259	7 192	6 850	6 766	6 659	7 573	8 320	9 019	9 100	7 870	5 832	3 884	2 474
SDR 11,7%	9 645	7 593	6 436	6 005	5 832	5 511	6 122	6 500	6 771	6 336	4 548	1 985	-434	-2 276

Table 4: Gold: resource rent and other calculations for South Africa, 1980–2008 (concluded)[2a, 2b, 11, 12, 13]

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Rand millions														
Output (sales)	24 953	23 465	26 468	24 905	24 295	24 915	25 190	28 904	41 222	33 053	29 330	24 601	37 443	38 036	45 992
Intermediate consumption	10 870	11 579	12 102	12 508	12 226	12 558	11 876	12 358	17 353	11 765	9 133	8 077	13 965	16 115	20 709
Compensation of employees															
Total	7 612	8 292	8 807	9 613	9 372	9 100	9 846	10 904	11 324	12 496	12 610	12 153	12 865	14 506	15 960
Male	7 462	8 107	8 602	9 390	9 164	8 902	9 623	10 674	11 081	12 219	12 320	11 787	12 435	13 958	15 249
Female	150	185	205	223	208	198	224	230	243	277	289	367	430	549	712
Consumption of fixed capital	3 090	3 382	3 661	3 948	4 125	4 370	4 734	5 113	7 292	2 309	2 049	3 442	4 658	4 391	4 539
Opportunity cost of capital															
SDR 3%	1 595	1 693	1 779	1 862	1 875	1 917	2 002	2 087	2 976	1 019	904	1 232	2 078	1 726	2 345
SDR 5%	2 659	2 822	2 964	3 103	3 125	3 195	3 337	3 478	4 960	1 698	1 507	2 053	3 464	2 877	3 908
SDR 11,7%	6 221	6 604	6 937	7 261	7 313	7 477	7 808	8 959	12 777	3 973	3 526	4 805	8 106	6 731	9 144
Rent															
SDR 3%	1 786	-1 481	119	-3 026	-3 304	-3 030	-3 268	-1 557	2 277	5 464	4 635	-303	3 877	1 297	2 439
SDR 5%	723	-2 609	-1 067	-4 267	-4 554	-4 308	-4 603	-2 948	293	4 785	4 032	-1 124	2 491	147	876
SDR 11,7%	-2 840	-6 391	-5 039	-8 425	-8 742	-8 590	-9 074	-8 430	-7 524	2 509	2 013	-3 876	-2 151	-3 708	-4 360
Unit rent (R/kg)															
SDR 3%	3 079	-2 826	238	-6 162	-7 105	-6 719	-7 583	-3 943	5 707	14 648	13 752	-1 027	14 252	5 128	11 453
SDR 5%	1 246	-4 980	-2 143	-8 690	-9 794	-9 553	-10 680	-7 464	736	12 827	11 964	-3 811	9 158	580	4 115
SDR 11,7%	-4 896	-12 197	-10 119	-17 159	-18 800	-19 047	-21 054	-21 341	-18 857	6 727	5 973	-13 138	-7 908	-14 655	-20 468
Unit rent (R/kg) 5-year moving average															
SDR 3%	2 909	1 373	993	-358	-2 555	-4 515	-5 466	-6 302	-3 928	422	4 517	5 828	9 467	9 351	8 712
SDR 5%	1 355	-346	-911	-2 460	-4 872	-7 032	-8 172	-9 236	-7 351	-2 827	1 477	2 850	6 175	6 144	4 401
SDR 11,7%	-3 849	-6 107	-7 288	-9 503	-12 634	-15 464	-17 236	-19 480	-19 820	-14 714	-9 710	-8 127	-5 441	-4 600	-10 039

Note: Where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Figure 4: Gold: output, intermediate consumption and consumption of fixed capital, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Output (Sales)	10 395	8 554	8 778	10 177	11 574	15 291	17 283	17 495	19 701	19 439	18 994	19 296	19 513	23 239	24 953	23 465	26 468	24 905	24 295	24 915	25 190	28 904	41 222	33 053	29 330	24 601	37 443	38 036	45 992
Intermediate consumption	1 454	1 860	2 379	2 639	3 028	3 822	4 219	4 814	5 372	5 651	6 069	7 511	8 232	9 314	10 870	11 579	12 102	12 508	12 226	12 558	11 876	12 358	17 353	11 765	9 133	8 077	13 965	16 115	20 709
Consumption of fixed capital	306	385	478	575	658	817	1 074	1 262	1 527	1 776	2 069	2 331	2 567	2 808	3 090	3 382	3 661	3 948	4 125	4 370	4 734	5 113	7 292	2 309	2 049	3 442	4 658	4 391	4 539

Calculations: Statistics South Africa.

4.2 Platinum group metals

The resource rent and other calculations for PGM are presented in Table 5 for the years 1980 to 2008 at current prices. PGM output (sales) increased from R851 million in 1980 to R91 353 million in 2008. It is interesting to note that in 2008 even though the production (extraction) decreased, the output (sales) increased. This is because in 2008 there was a 17% depreciation in the rand exchange rate to a level of just above R8 per US$1 and the further rise in US$ commodity prices which resulted in the value of South African mineral sales rising. If the mining sector had been able to respond to the higher prices via the production (extraction) of higher volumes, the growth in revenues could have been significantly stronger.

Figure 5 shows how PGM output (sales), intermediate consumption and consumption of fixed capital follow a similar trend. Intermediate consumption increased from R128 million in 1980 to R5 237 million in 1997. From 1997 intermediate consumption began to increase at a faster pace on an annual basis to R39 005 million in 2008.

Resource rents at 3%, 5% and 11,7% have all experienced a steady increase for the years from 1980 to 2008. The negative resource rents are present at 3%, 5% and 11,7% from 1992 to 2000. As in the case of gold, one reason for the negative resource rents may be the price of PGM during the negative resource rent periods. As the price of PGM decreases, it may become non-viable to mine the PGM. The monthly average platinum price for December 1993 was US$383 per ounce[14]. The platinum price held steady between US$300 per ounce and US$400 per ounce until 2000. Platinum peaked at US$625 per ounce in January 2001 and continued to increase to just above US$850 per ounce in December 2008[14].

Table 5: Platinum group metals: resource rent and other calculations for South Africa, 1980–2008[2a, 2b, 11, 12, 13]

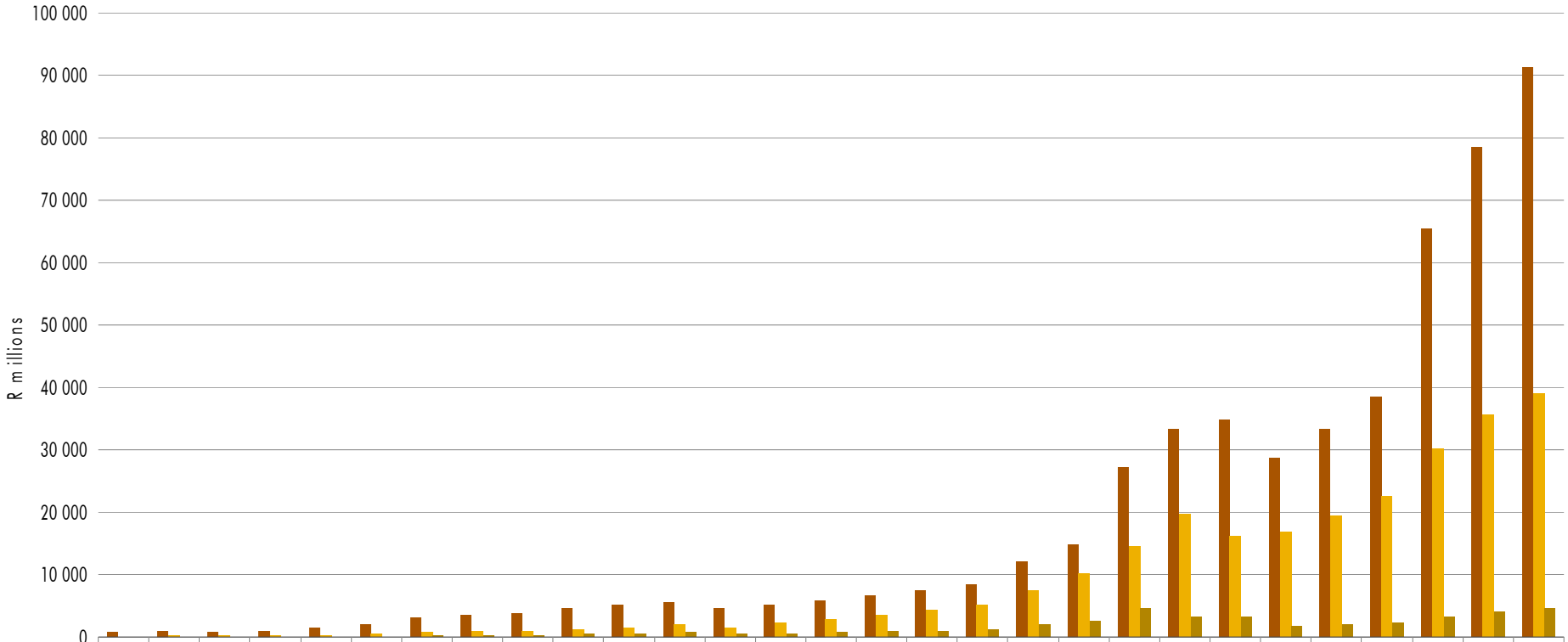
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	Rand millions													
Output (sales)	851	937	852	1 118	1 432	1 998	2 964	3 581	3 813	4 611	5 164	5 692	4 678	5 189
Intermediate consumption	128	206	230	291	372	500	830	967	1 030	1 337	1 652	1 935	1 637	2 243
Compensation of employees														
Total	224	278	235	254	341	450	570	768	933	1 136	1 505	1 658	1 901	2 111
Male	221	273	231	250	337	444	564	758	921	1 119	1 472	1 631	1 869	2 079
Female	3	5	4	4	4	6	7	9	12	16	32	27	33	33
Consumption of fixed capital	26	47	43	67	86	100	178	251	305	415	568	683	608	623
Opportunity cost of capital														
SDR 3%	17	28	26	34	43	60	119	143	191	231	310	398	327	311
SDR 5%	26	37	43	67	86	100	178	251	305	415	568	626	561	571
SDR 11,7%	73	106	114	157	188	239	368	520	550	696	917	1 091	990	1 047
Rent														
SDR 3%	456	378	319	472	590	889	1 268	1 452	1 355	1 493	1 130	1 018	204	-100
SDR 5%	448	369	302	439	547	849	1 208	1 345	1 240	1 309	872	790	-30	-359
SDR 11,7%	401	300	231	349	445	710	1 018	1 075	995	1 028	523	326	-458	-835
Unit rent (R/kg)														
SDR 3%	4 004	3 259	3 751	5 249	5 515	7 284	10 476	11 344	10 264	11 142	7 956	7 116	1 332	-566
SDR 5%	3 929	3 178	3 551	4 876	5 114	6 956	9 986	10 505	9 397	9 766	6 138	5 524	-197	-2 040
SDR 11,7%	3 516	2 583	2 712	3 873	4 156	5 820	8 411	8 400	7 540	7 671	3 682	2 276	-2 997	-4 747
Unit rent (R/kg) 5-year moving average														
SDR 3%	4 004	3 631	3 671	4 066	4 356	5 012	6 455	7 974	8 977	10 102	10 236	9 565	7 562	5 396
SDR 5%	3 929	3 554	3 553	3 884	4 130	4 735	6 096	7 487	8 392	9 322	9 158	8 266	6 126	3 838
SDR 11,7%	3 516	3 050	2 937	3 171	3 368	3 829	4 995	6 132	6 866	7 569	7 141	5 914	3 635	1 177

Table 5: Platinum group metals: resource rent and other calculations for South Africa, 1980–2008 (concluded)[2a, 2b, 11, 12, 13]

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Rand millions														
Output (sales)	5 810	6 573	7 486	8 510	11 930	14 887	27 095	33 371	34 829	28 824	33 313	38 451	65 444	78 414	91 353
Intermediate consumption	2 935	3 631	4 246	5 237	7 446	10 237	14 708	19 748	16 205	17 014	19 487	22 542	30 382	35 580	39 005
Compensation of employees															
Total	2 241	2 522	2 725	2 979	3 444	3 740	4 373	4 915	5 937	7 243	9 064	11 358	12 585	18 341	23 344
Male	2 199	2 471	2 664	2 920	3 364	3 653	4 278	4 806	5 783	7 022	8 743	10 925	11 953	17 376	21 843
Female	43	51	61	59	80	88	96	109	154	221	321	432	633	965	1 501
Consumption of fixed capital	697	920	1 048	1 362	2 028	2 531	4 606	3 295	3 439	1 782	2 060	2 428	3 357	4 118	4 727
Opportunity cost of capital															
SDR 3%	349	460	524	596	954	1 191	2 168	1 212	1 265	839	970	1 090	1 226	1 470	2 132
SDR 5%	639	789	823	1 021	1 551	1 935	3 522	2 060	2 150	1 398	1 616	1 816	2 043	2 450	3 553
SDR 11,7%	1 132	1 216	1 255	1 395	1 925	2 385	3 624	4 463	4 658	3 272	3 782	4 249	4 781	5 732	8 314
Rent															
SDR 3%	-412	-961	-1 057	-1 664	-1 943	-2 812	1 240	4 201	7 983	1 946	1 733	1 033	17 894	18 906	22 144
SDR 5%	-703	-1 289	-1 356	-2 089	-2 540	-3 556	-115	3 353	7 098	1 386	1 086	307	17 076	17 926	20 723
SDR 11,7%	-1 196	-1 716	-1 788	-2 463	-2 914	-4 006	-216	950	4 590	-488	-1 079	-2 126	14 338	14 643	15 962
Unit rent (R/kg)															
SDR 3%	-2 242	-5 250	-5 591	-8 445	-9 716	-13 018	5 989	18 263	33 684	7 342	6 279	3 410	57 908	62 189	80 234
SDR 5%	-3 820	-7 046	-7 176	-10 605	-12 698	-16 464	-556	14 576	29 949	5 231	3 937	1 013	55 263	58 966	75 084
SDR 11,7%	-6 497	-9 380	-9 459	-12 501	-14 568	-18 546	-1 045	4 128	19 367	-1 840	-3 910	-7 018	46 402	48 168	57 834
Unit rent (R/kg) 5-year moving average															
SDR 3%	2 719	78	-2 464	-4 419	-6 249	-8 404	-6 156	-1 385	7 040	10 452	14 311	13 796	21 724	27 426	42 004
SDR 5%	1 121	-1 516	-4 056	-6 138	-8 269	-10 798	-9 500	-5 149	2 962	6 547	10 628	10 941	19 079	24 882	38 852
SDR 11,7%	-1 656	-4 269	-6 616	-8 517	-10 481	-12 891	-11 224	-8 506	-2 133	413	3 340	2 146	10 600	16 360	28 295

Note: Where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Figure 5: Platinum group metals: output, intermediate consumption and consumption of fixed capital, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Output (Sales)	851	937	852	1 118	1 432	1 998	2 964	3 581	3 813	4 611	5 164	5 692	4 678	5 189	5 810	6 573	7 486	8 510	11 930	14 887	27 095	33 371	34 829	28 824	33 313	38 451	65 444	78 414	91 353
Intermediate consumption	128	206	230	291	372	500	830	967	1 030	1 337	1 652	1 935	1 637	2 243	2 935	3 631	4 246	5 237	7 446	10 237	14 708	19 748	16 205	17 014	19 487	22 542	30 382	35 580	39 005
Consumption of fixed capital	26	47	43	67	86	100	178	251	305	415	568	683	608	623	697	920	1 048	1 362	2 028	2 531	4 606	3 295	3 439	1 782	2 060	2 428	3 357	4 118	4 727

Calculations: Statistics South Africa.

4.3 Coal

The resource rent and other calculations for coal are presented in Table 6 for the years 1980 to 2008 at current prices. Coal output (sales) experienced a large increase from R1 497 million in 1980 to R72 508 million in 2008. From Figure 6, intermediate consumption increased steadily from R507 million in 1980 to R3 816 million in 1992. From 1993, intermediate consumption began to increase at a faster pace on an annual basis reaching R25 455 million in 2008.

Resource rents at 3%, 5% and 11,7% have all experienced a steady increase for the years 1980 to 2008. Negative resource rent may indicate that mining of coal may have not been economically viable. Unlike gold and PGM, coal only experienced negative resource rents at 11,7% for 1999, 2000, 2002, 2003 and 2004. One indicator may be the price of coal during the negative resource rent periods. As the price of coal decreases, it may become non-viable to mine the coal. The coal price was US$156 per ton in 2008[5]. Despite the global commodity boom, significant increases in demand for primary energy and rising thermal coal prices, South Africa's coal mining sector experienced a decline in export sales from 68 million tons in 2007 to 58 million tons in 2008[2a]. The fall in coal exports was mainly due to lower coal railings (efficiency and rolling stock of Transnet Rail Freight), production (extraction) shortages (permit and rain problems) and the diversion of some export quality coal back to Eskom in order to improve power station stock levels. Domestic sales, on the other hand, increased by 8% year-on-year to 197 million tons in 2008[2a]. While gold and PGM production (extraction) decreased in 2008, total saleable coal production (extraction) in South Africa was estimated to have grown by about 2% to 252 million tons in 2008.

Table 6: Coal: resource rent and other calculations for South Africa, 1980–2008[2a, 2b, 11, 12, 13]

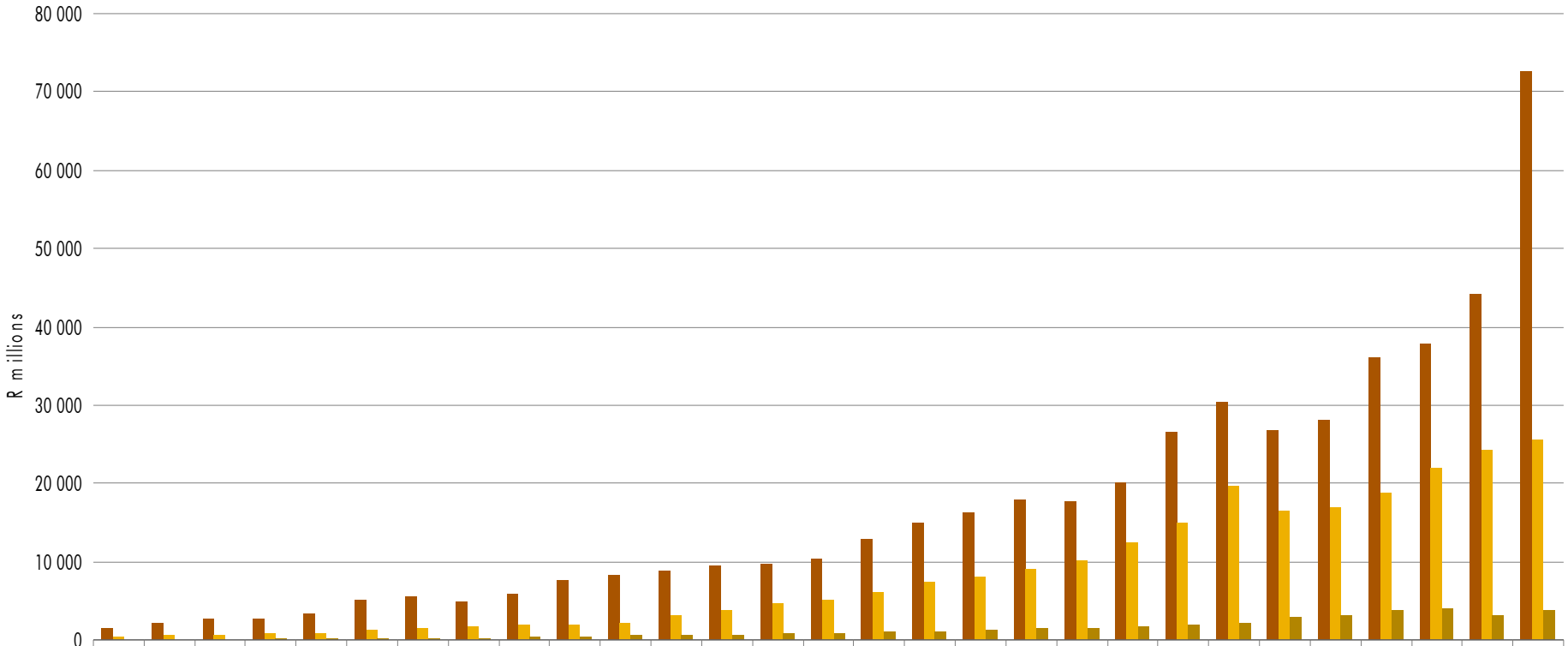
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	Rand millions													
Output (sales)	1 497	2 146	2 653	2 651	3 474	5 102	5 433	4 846	5 952	7 574	8 173	8 785	9 424	9 714
Intermediate consumption	507	609	732	794	886	1 261	1 449	1 730	1 885	1 963	2 080	3 237	3 816	4 684
Compensation of employees														
Total	567	738	792	803	903	1 064	1 246	1 383	1 545	1 870	2 130	2 441	2 082	1 884
Male	554	720	769	777	872	1 028	1 203	1 332	1 487	1 802	2 046	2 344	2 010	1 821
Female	13	18	23	26	31	37	43	51	58	68	84	97	71	62
Consumption of fixed capital	55	73	96	121	143	184	243	286	356	430	534	645	728	814
Opportunity cost of capital														
SDR 3%	38	51	68	83	98	124	161	186	228	270	334	401	442	481
SDR 5%	63	85	113	139	164	207	269	310	380	450	557	668	736	802
SDR 11,7%	148	198	264	325	383	485	629	724	888	1 052	1 303	1 562	1 723	1 876
Rent														
SDR 3%	330	675	965	850	1 444	2 468	2 334	1 261	1 938	3 041	3 096	2 062	2 356	1 851
SDR 5%	305	641	920	794	1 378	2 385	2 226	1 137	1 786	2 861	2 873	1 794	2 062	1 531
SDR 11,7%	220	528	769	608	1 159	2 107	1 866	722	1 277	2 259	2 127	900	1 075	456
Unit rent (R/kg)														
SDR 3%	2 872	5 194	6 749	5 821	8 858	14 024	13 184	7 162	10 649	17 085	17 689	11 582	13 313	10 062
SDR 5%	2 652	4 933	6 433	5 440	8 457	13 553	12 577	6 459	9 814	16 074	16 416	10 081	11 649	8 319
SDR 11,7%	1 913	4 060	5 377	4 163	7 112	11 973	10 544	4 102	7 019	12 689	12 153	5 055	6 074	2 481
Unit rent (R/kg) 5-year moving average														
SDR 3%	2 872	4 033	4 938	5 159	5 899	8 129	9 727	9 810	10 775	12 421	13 154	12 833	14 063	13 946
SDR 5%	2 652	3 792	4 673	4 864	5 583	7 763	9 292	9 297	10 172	11 695	12 268	11 769	12 807	12 508
SDR 11,7%	1 913	2 986	3 783	3 878	4 525	6 537	7 834	7 579	8 150	9 265	9 301	8 204	8 598	7 690

Table 6: Coal: resource rent and other calculations for South Africa, 1980–2008 (concluded)[2a, 2b, 11, 12, 13]

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Rand millions														
Output (sales)	10 353	12 818	14 891	16 287	18 024	17 681	20 039	26 596	30 468	26 734	28 139	36 033	37 867	44 166	72 508
Intermediate consumption	5 106	6 221	7 287	7 997	9 085	10 081	12 410	15 026	19 589	16 539	16 830	18 864	21 986	24 183	25 455
Compensation of employees															
Total	2 021	2 371	2 782	3 204	3 523	3 831	4 287	4 451	4 468	5 481	5 863	6 482	7 270	8 692	11 021
Male	1 949	2 288	2 687	3 095	3 399	3 698	4 127	4 293	4 289	5 252	5 582	6 156	6 855	8 107	10 195
Female	72	83	95	109	124	133	161	158	180	229	281	326	415	585	826
Consumption of fixed capital	911	1 019	1 145	1 269	1 377	1 508	1 708	1 909	2 187	2 996	3 154	3 879	3 968	3 162	3 709
Opportunity cost of capital															
SDR 3%	526	574	633	686	729	780	873	786	900	644	678	758	726	808	1 375
SDR 5%	876	956	1 056	1 144	1 215	1 301	1 455	1 309	1 500	1 074	1 130	1 263	1 211	1 346	2 292
SDR 11,7%	2 051	2 238	2 470	2 676	2 842	3 043	3 404	4 518	5 176	2 513	2 645	2 956	2 833	3 150	5 362
Rent															
SDR 3%	1 789	2 633	3 044	3 131	3 310	1 481	760	4 424	3 323	1 074	1 614	6 051	3 916	7 322	30 948
SDR 5%	1 439	2 250	2 622	2 674	2 825	961	178	3 901	2 724	644	1 162	5 545	3 432	6 783	30 032
SDR 11,7%	264	969	1 207	1 141	1 197	-782	-1 771	691	-952	-794	-353	3 852	1 810	4 979	26 961
Unit rent (R/kg)															
SDR 3%	9 129	12 781	14 849	14 297	14 778	6 670	3 379	19 838	15 106	4 512	6 640	24 696	15 986	29 522	124 791
SDR 5%	7 340	10 924	12 789	12 208	12 610	4 327	793	17 493	12 383	2 707	4 780	22 633	14 009	27 351	119 173
SDR 11,7%	1 349	4 704	5 889	5 211	5 344	-3 523	-7 872	3 101	-4 329	-3 338	-1 452	15 724	7 387	20 076	106 988
Unit rent (R/kg) 5-year moving average															
SDR 3%	12 355	11 373	12 027	12 223	13 167	12 675	10 795	11 793	11 954	9 901	9 895	14 159	13 388	16 271	40 327
SDR 5%	10 761	9 663	10 204	10 316	11 174	10 572	8 545	9 486	9 521	7 540	7 631	11 999	11 303	14 296	37 589
SDR 11,7%	5 422	3 933	4 099	3 927	4 499	3 525	1 010	452	-1 456	-3 192	-2 778	1 941	2 798	7 679	29 745

Note: Where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Figure 6: Coal: output, intermediate consumption and consumption of fixed capital, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Output (Sales)	1 497	2 146	2 653	2 651	3 474	5 102	5 433	4 846	5 952	7 574	8 173	8 785	9 424	9 714	10 353	12 818	14 891	16 287	18 024	17 681	20 039	26 596	30 468	26 734	28 139	36 033	37 867	44 166	72 508
Intermediate consumption	507	609	732	794	886	1 261	1 449	1 730	1 885	1 963	2 080	3 237	3 816	4 684	5 106	6 221	7 287	7 997	9 085	10 081	12 410	15 026	19 589	16 539	16 830	18 864	21 986	24 183	25 455
Consumption of fixed capital	55	73	96	121	143	184	243	286	356	430	534	645	728	814	911	1 019	1 145	1 269	1 377	1 508	1 708	1 909	2 187	2 996	3 154	3 879	3 968	3 162	3 709

Calculations: Statistics South Africa.

5. Monetary accounts for the South African mining industry

This section focuses on the monetary accounts for South Africa's gold, PGM and coal mining industries. The results from the resource rent calculations in section 4 were used in the compilation of the monetary accounts. The negative resource rent values are carried through to the monetary accounts. The in-depth discussion into the negative resource rent values presented in section 4 is also of vital importance for the monetary accounts as it looks at how the fluctuating mineral prices will have an effect on the value of mineral assets represented in the monetary accounts. In other words, if there are negative resource rents, this may present negative values for the mineral asset.

Monetary accounts are presented both in current resource rent (the rent calculated for each year) and using a 5-year moving average. The 5-year moving average is used to reflect the fact that mineral prices can have large fluctuations within one year and therefore the current value of mineral assets is not always best represented by the unit rent in any single year[15].

5.1 Gold

Monetary accounts for gold in South Africa are shown in Tables 7 and 8, with opening stock, depletion, revaluation and closing stock in rand values. The values are represented by 3%, 5% and 11,7% SDR values. Table 7 is calculated in annual unit rent figures and Table 8 is calculated with unit rents in 5-year moving averages.

Opening stock in 1981 for annual units was R201 542 million, R132 713 million and R55 611 million at 3%, 5% and 11,7% SDR values respectively. The opening stock has shown a decrease from 1981 to 2008. On an annual basis for the period 1980 to 2008, the closing stock has decreased by 60% at 3% SDR, and has decreased by 87% and 167% at an SDR of 5% and 11,7% respectively (refer to Table 7 and Figure 7). On a 5-year moving average, closing stock has decreased by 70%, 86%, and 133%, at an SDR of 3%, 5% and 11,7% respectively (refer to Table 8 and Figure 8).

The mineral asset value for closing stock at 3%, 5% and 11,7% demonstrated a fluctuating trend that peaked in 1986 and began to decline through 1987 to 2002 (refer to Figures 7 and 8). Figure 7 shows that the asset value for closing stock was negative from 1995 to 2002. The closing stock began to recover in 2003 but kept fluctuating until 2008. This observed trend may be due to the fluctuations in the gold price as discussed in section 4.1.

Table 7: Gold: monetary accounts for South Africa, annual 1980–2008[2a, 2b, 11, 12, 13]

Year	Opening stock			Depletion			Revaluation			Closing stock		
	Rand millions											
	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%
1980	0	0	0	7 013	6 898	6 510	0	0	0	201 542	132 713	55 611
1981	201 542	132 713	55 611	4 293	4 144	3 646	-82 047	-57 012	-28 112	123 787	79 845	31 145
1982	123 787	79 845	31 145	3 544	3 358	2 736	-25 913	-18 699	-10 509	101 418	64 505	23 373
1983	101 418	64 505	23 373	4 186	3 961	3 204	12 643	7 186	781	118 248	75 652	27 358
1984	118 248	75 652	27 358	4 650	4 387	3 507	7 598	3 530	-918	130 496	83 569	29 947
1985	130 496	83 569	29 947	6 845	6 515	5 408	54 584	33 961	10 824	191 925	124 045	46 179
1986	191 925	124 045	46 179	7 391	6 957	5 503	10 383	2 142	-4 683	209 699	133 144	46 999
1987	209 699	133 144	46 999	5 814	5 312	3 631	-48 244	-36 204	-19 612	167 268	102 252	31 019
1988	167 268	102 252	31 019	6 378	5 777	3 761	7 426	2 555	-2 658	181 073	110 583	32 122
1989	181 073	110 583	32 122	4 859	4 157	1 805	-47 793	-35 117	-18 515	138 139	79 624	15 412
1990	138 139	79 624	15 412	2 935	2 135	-548	-57 923	-40 933	-19 541	83 151	40 825	-4 677
1991	83 151	40 825	-4 677	1 288	409	-2 534	-48 076	-33 421	-14 426	36 363	7 813	-21 637
1992	36 363	7 813	-21 637	363	-578	-3 729	-26 613	-18 217	-6 472	10 112	-10 982	-31 837
1993	10 112	-10 982	-31 837	2 401	1 402	-1 945	53 833	36 099	17 180	66 346	26 519	-16 603
1994	66 346	26 519	-16 603	1 786	723	-2 840	-17 911	-13 465	-4 807	50 221	13 776	-24 250
1995	50 221	13 776	-24 250	-1 481	-2 609	-6 391	-91 573	-61 508	-23 956	-42 832	-50 341	-54 596
1996	-42 832	-50 341	-54 596	119	-1 067	-5 039	46 185	30 733	16 581	3 471	-20 675	-43 055
1997	3 471	-20 675	-43 055	-3 026	-4 267	-8 425	-88 952	-57 732	-20 501	-88 506	-82 673	-71 981
1998	-88 506	-82 673	-71 981	-3 304	-4 554	-8 742	-5 972	-1 396	6 025	-97 782	-88 623	-74 699
1999	-97 782	-88 623	-74 699	-3 030	-4 308	-8 590	10 711	8 951	9 887	-90 101	-83 980	-73 402
2000	-90 101	-83 980	-73 402	-3 268	-4 603	-9 074	-4 649	-1 409	4 933	-98 018	-89 992	-77 543
2001	-98 018	-89 992	-77 543	-1 557	-2 948	-8 430	52 012	34 957	13 931	-47 564	-57 983	-72 041
2002	-47 564	-57 983	-72 041	2 277	293	-7 524	114 484	63 452	15 267	69 198	5 763	-64 298
2003	69 198	5 763	-64 298	5 464	4 785	2 509	93 460	83 759	83 235	168 122	94 306	21 446
2004	168 122	94 306	21 446	4 635	4 032	2 013	-27 576	-18 482	-6 256	145 180	79 856	17 203
2005	145 180	79 856	17 203	-303	-1 124	-3 876	-154 557	-101 100	-46 453	-9 680	-22 368	-33 126
2006	-9 680	-22 368	-33 126	3 877	2 491	-2 151	130 791	69 518	16 892	124 988	49 641	-18 385
2007	124 988	49 641	-18 385	1 297	147	-3 708	-84 165	-46 859	-9 597	42 120	2 929	-31 690
2008	42 120	2 929	-31 690	2 439	876	-4 360	35 654	13 709	-1 212	80 214	17 514	-37 262

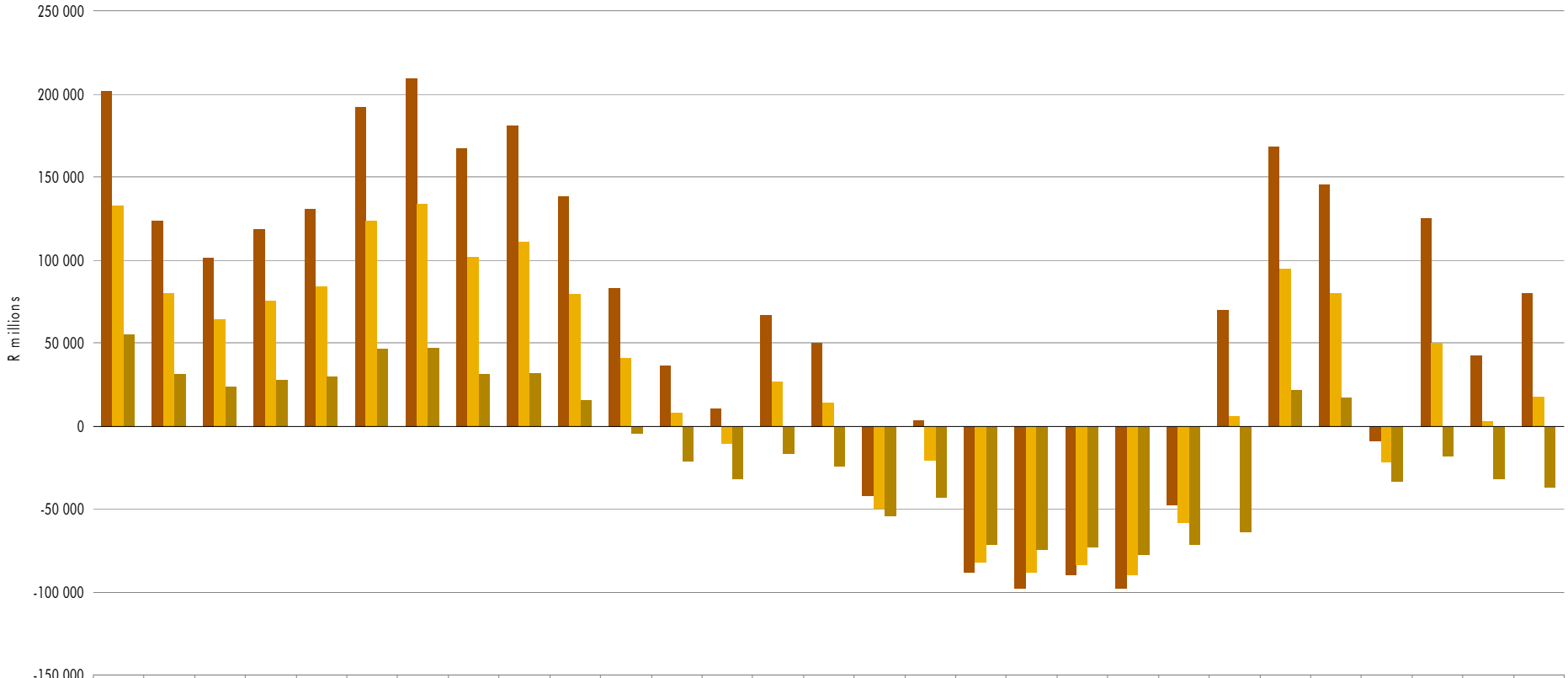
Notes: 0 = Data not available; where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Table 8: Gold: monetary accounts for South Africa, 5-year moving average 1980–2008[2a, 2b, 11, 12, 13]

Year	Opening stock			Depletion			Revaluation			Closing stock		
	Rand millions											
	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%
1980	0	0	0	7 013	6 898	6 510	0	0	0	201 542	132 713	55 611
1981	201 542	132 713	55 611	5 565	5 434	4 996	-46 644	-33 450	-17 928	160 463	104 698	42 679
1982	160 463	104 698	42 679	4 925	4 775	4 273	-24 453	-17 756	-10 452	140 935	91 717	36 500
1983	140 935	91 717	36 500	4 829	4 658	4 083	-9 355	-7 403	-5 715	136 409	88 972	34 868
1984	136 409	88 972	34 868	4 805	4 615	3 978	-6 370	-5 686	-4 883	134 844	87 900	33 962
1985	134 844	87 900	33 962	4 712	4 481	3 709	-7 440	-7 056	-6 006	132 115	85 325	31 665
1986	132 115	85 325	31 665	5 124	4 847	3 918	8 144	2 587	-2 121	145 383	92 760	33 462
1987	145 383	92 760	33 462	5 354	5 026	3 926	3 303	-1 044	-3 850	154 040	96 741	33 537
1988	154 040	96 741	33 537	6 008	5 592	4 198	10 504	4 710	-1 882	170 551	107 042	35 854
1989	170 551	107 042	35 854	6 034	5 533	3 853	-5 042	-6 601	-6 804	171 544	105 975	32 902
1990	171 544	105 975	32 902	5 361	4 761	2 752	-25 038	-19 678	-12 155	151 867	91 058	23 498
1991	151 867	91 058	23 498	4 195	3 505	1 193	-37 586	-27 618	-14 503	118 476	66 944	10 188
1992	118 476	66 944	10 188	3 171	2 381	-266	-33 193	-24 095	-12 193	88 454	45 230	-2 271
1993	88 454	45 230	-2 271	2 409	1 531	-1 409	-24 307	-17 799	-8 344	66 556	28 963	-12 024
1994	66 556	28 963	-12 024	1 687	786	-2 232	-20 806	-14 763	-4 804	47 437	14 986	-19 060
1995	47 437	14 986	-19 060	720	-181	-3 200	-27 340	-18 305	-5 076	20 816	-3 501	-27 337
1996	20 816	-3 501	-27 337	494	-454	-3 629	-6 853	-4 835	-41	14 457	-8 790	-31 007
1997	14 457	-8 790	-31 007	-176	-1 208	-4 666	-19 427	-13 409	-4 191	-5 145	-23 407	-39 864
1998	-5 145	-23 407	-39 864	-1 188	-2 266	-5 875	-28 830	-18 415	-4 461	-35 163	-44 087	-50 200
1999	-35 163	-44 087	-50 200	-2 036	-3 171	-6 974	-23 347	-14 561	-2 422	-60 546	-61 820	-59 596
2000	-60 546	-61 820	-59 596	-2 356	-3 522	-7 429	-7 755	-3 518	3 544	-70 657	-68 860	-63 481
2001	-70 657	-68 860	-63 481	-2 489	-3 648	-7 695	-2 886	760	5 416	-76 032	-71 748	-65 760
2002	-76 032	-71 748	-65 760	-1 567	-2 933	-7 908	29 972	17 091	6 086	-47 628	-57 590	-67 583
2003	-47 628	-57 590	-67 583	158	-1 054	-5 488	52 318	37 863	26 165	4 848	-20 781	-46 906
2004	4 848	-20 781	-46 906	1 522	498	-3 272	41 310	30 140	22 210	47 680	9 856	-27 968
2005	47 680	9 856	-27 968	1 719	841	-2 397	5 523	6 032	9 874	54 923	16 729	-20 491
2006	54 923	16 729	-20 491	2 575	1 680	-1 480	25 523	15 063	9 323	83 021	33 471	-12 648
2007	83 021	33 471	-12 648	2 366	1 554	-1 164	-8 585	-4 015	3 864	76 801	31 011	-9 947
2008	76 801	31 011	-9 947	1 856	937	-2 138	-17 642	-13 215	-6 191	61 015	18 733	-18 277

Notes: 0 = Data not available; where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

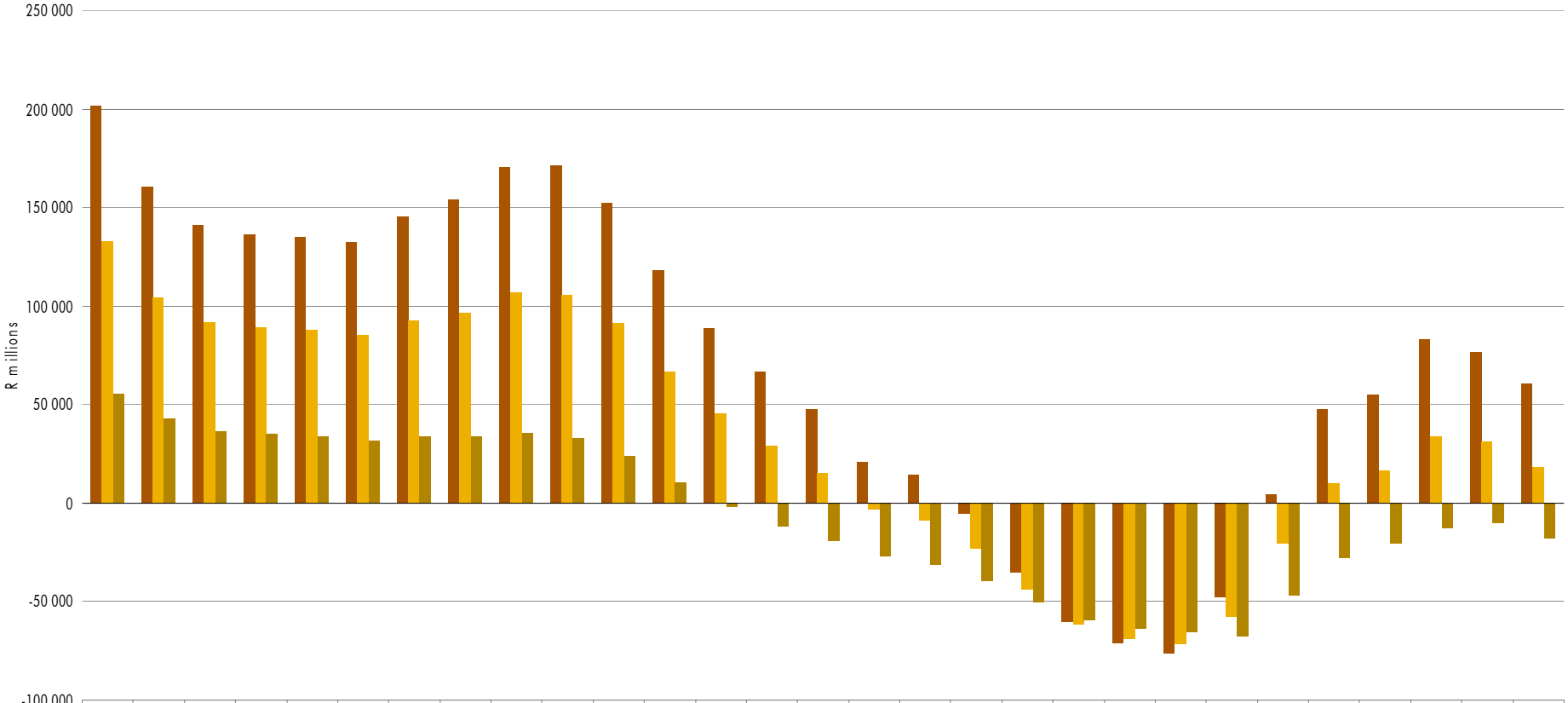
Figure 7: Gold: value of annual closing stock, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Closing Stock 3%	201 542	123 787	101 418	118 248	130 496	191 925	209 699	167 268	181 073	138 139	83 151	36 363	10 112	66 346	50 221	-42 832	3 471	-88 506	-97 782	-90 101	-98 018	-47 564	69 198	168 122	145 180	-9 680	124 988	42 120	80 214
Closing Stock 5%	132 713	79 845	64 505	75 652	83 569	124 045	133 144	102 252	110 583	79 624	40 825	7 813	-10 982	26 519	13 776	-50 341	-20 675	-82 673	-88 623	-83 980	-89 992	-57 983	5 763	94 306	79 856	-22 368	49 641	2 929	17 514
Closing Stock 11,7%	55 611	31 145	23 373	27 358	29 947	46 179	46 999	31 019	32 122	15 412	-4 677	-21 637	-31 837	-16 603	-24 250	-54 596	-43 055	-71 981	-74 699	-73 402	-77 543	-72 041	-64 298	21 446	17 203	-33 126	-18 385	-31 690	-37 262

Calculations: Statistics South Africa.

Figure 8: Gold: value of 5-year moving average closing stock, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Closing Stock 3%	201 542	160 463	140 935	136 409	134 844	132 115	145 383	154 040	170 551	171 544	151 867	118 476	88 454	66 556	47 437	20 816	14 457	-5 145	-35 163	-60 546	-70 657	-76 032	-47 628	4 848	47 680	54 923	83 021	76 801	61 015
Closing Stock 5%	132 713	104 698	91 717	88 972	87 900	85 325	92 760	96 741	107 042	105 975	91 058	66 944	45 230	28 963	14 986	-3 501	-8 790	-23 407	-44 087	-61 820	-68 860	-71 748	-57 590	-20 781	9 856	16 729	33 471	31 011	18 733
Closing Stock 11,7%	55 611	42 679	36 500	34 868	33 962	31 665	33 462	33 537	35 854	32 902	23 498	10 188	-2 271	-12 024	-19 060	-27 337	-31 007	-39 864	-50 200	-59 596	-63 481	-65 760	-67 583	-46 906	-27 968	-20 491	-12 648	-9 947	-18 277

Calculations: Statistics South Africa.

5.2 Platinum group metals

Tables 9 and 10 present the monetary accounts for PGM in South Africa. The tables show opening stock, depletion, revaluation and closing stock in rand values. The values are represented by 3%, 5% and 11,7% SDR values. Table 9 is calculated in annual unit rent figures, whereas Table 10 is calculated with unit rents in 5-year moving averages.

Opening stock in 1981 was R15 215 million, R8 959 million and R3 426 million at 3%, 5% and 11,7% SDR values respectively. Opening stocks have shown an increase from 1981 to 2008 (refer to Figure 9). On both an annual basis and on a 5-year moving average, opening stock was increasing.

The closing stock for PGM for the 3%, 5% and 11,7% SDR values all showed an increasing trend from 1980. From 1990 to 1999 the annual asset values, closing stock at 3%, 5% and 11,7% for PGM started to show a declining trend. For the same period, the annual asset values, closing stock at 3% represented negative values for the years 1993 to 1999. From 2000, the closing stock for PGM showed a recovery trend up to 2008 (refer to Figures 9 and 10). This trend could be attributed to the price of PGM as discussed in section 4.2.

Table 9: Platinum group metals: monetary accounts for South Africa, annual 1980–2008[2a, 2b, 11, 12, 13]

Year	Opening stock			Depletion			Revaluation			Closing stock		
	Rand millions											
	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%
1980	0	0	0	456	448	401	0	0	0	15 215	8 959	3 426
1981	15 215	8 959	3 426	378	369	300	-2 992	-1 954	-1 164	12 601	7 373	2 561
1982	12 601	7 373	2 561	319	302	231	-2 292	-1 639	-821	10 628	6 036	1 971
1983	10 628	6 036	1 971	472	439	349	4 646	2 302	660	15 746	8 777	2 979
1984	15 746	8 777	2 979	590	547	445	3 335	1 619	377	19 671	10 943	3 801
1985	19 671	10 943	3 801	889	849	710	9 062	5 181	1 558	29 621	16 973	6 069
1986	29 621	16 973	6 069	1 268	1 208	1 018	11 363	5 984	1 613	42 251	24 165	8 699
1987	42 251	24 165	8 699	1 452	1 345	1 075	4 700	1 384	-584	48 403	26 893	9 190
1988	48 403	26 893	9 190	1 355	1 240	995	-4 596	-3 325	-1 679	45 162	24 809	8 507
1989	45 162	24 809	8 507	1 493	1 309	1 028	3 114	55	-749	49 768	26 172	8 786
1990	49 768	26 172	8 786	1 130	872	523	-13 240	-9 613	-4 840	37 658	17 431	4 469
1991	37 658	17 431	4 469	1 018	790	326	-4 755	-2 422	-2 013	33 920	15 799	2 782
1992	33 920	15 799	2 782	204	-30	-458	-27 332	-16 371	-6 242	6 792	-602	-3 919
1993	6 792	-602	-3 919	-100	-359	-835	-10 015	-6 221	-2 387	-3 322	-7 182	-7 141
1994	-3 322	-7 182	-7 141	-412	-703	-1 196	-10 015	-6 174	-1 882	-13 749	-14 059	-10 218
1995	-13 749	-14 059	-10 218	-961	-1 289	-1 716	-17 317	-10 440	-2 736	-32 027	-25 789	-14 671
1996	-32 027	-25 789	-14 671	-1 057	-1 356	-1 788	-2 141	21	1 179	-35 224	-27 124	-15 280
1997	-35 224	-27 124	-15 280	-1 664	-2 089	-2 463	-18 570	-12 572	-3 305	-55 458	-41 785	-21 048
1998	-55 458	-41 785	-21 048	-1 943	-2 540	-2 914	-7 369	-6 468	-941	-64 770	-50 793	-24 902
1999	-64 770	-50 793	-24 902	-2 812	-3 556	-4 006	-26 142	-16 776	-5 331	-93 724	-71 125	-34 239
2000	-93 724	-71 125	-34 239	1 240	-115	-216	133 806	68 939	32 606	41 322	-2 301	-1 849
2001	41 322	-2 301	-1 849	4 201	3 353	950	94 482	65 999	9 015	140 004	67 051	8 116
2002	140 004	67 051	8 116	7 983	7 098	4 590	118 079	67 811	26 525	266 066	141 959	39 231
2003	266 066	141 959	39 231	1 946	1 386	-488	-203 180	-115 620	-42 911	64 832	27 725	-4 167
2004	64 832	27 725	-4 167	1 733	1 086	-1 079	-8 828	-7 083	-3 978	57 737	21 729	-9 224
2005	57 737	21 729	-9 224	1 033	307	-2 126	-24 364	-15 899	-6 824	34 407	6 137	-18 175
2006	34 407	6 137	-18 175	17 894	17 076	14 338	543 454	318 306	126 386	595 754	341 520	122 549
2007	595 754	341 520	122 549	18 906	17 926	14 643	14 847	-936	-12 038	629 506	358 509	125 155
2008	629 506	358 509	125 155	22 144	20 723	15 962	86 088	35 231	-4 688	737 739	414 463	136 429

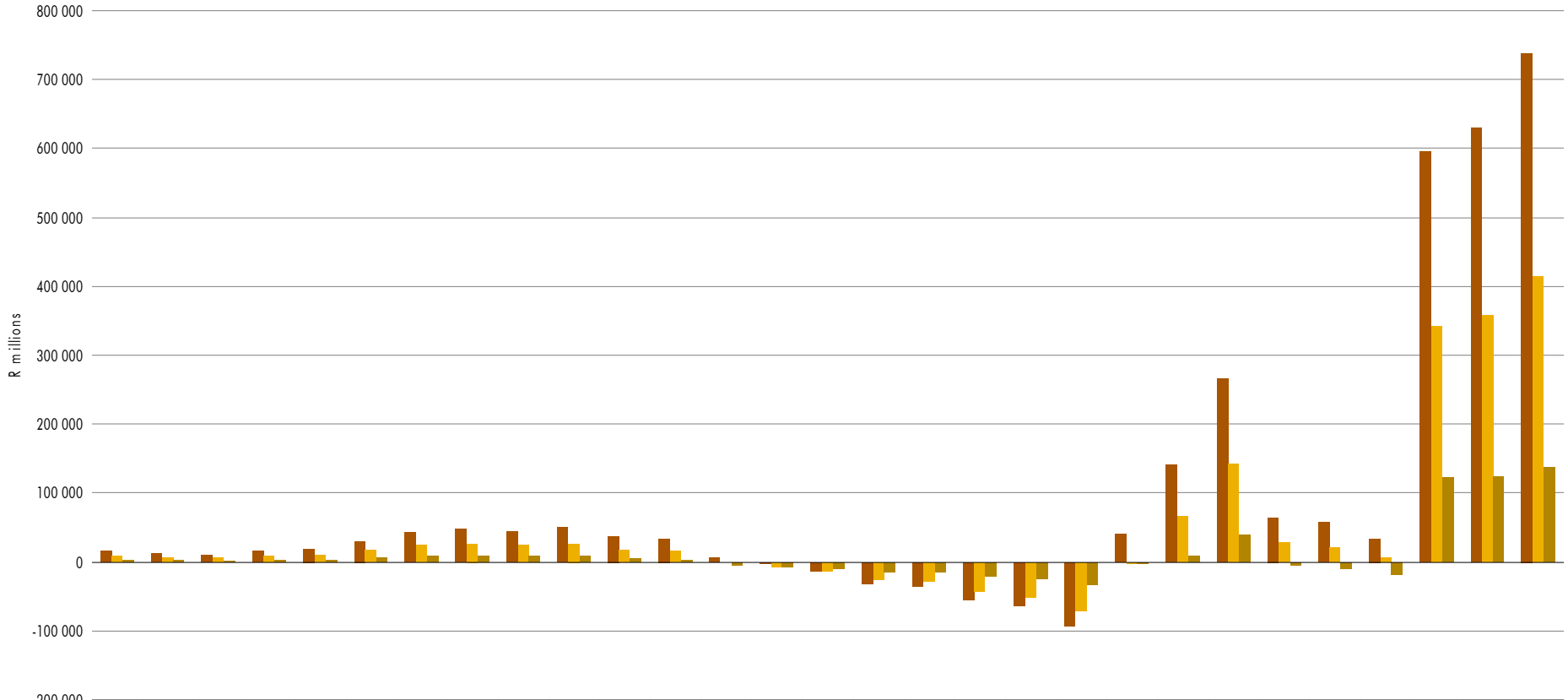
Notes: 0 = Data not available; where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Table 10: Platinum group metals: monetary accounts for South Africa, 5-year moving average 1980–2008[2a, 2b, 11, 12, 13]

Year	Opening stock			Depletion			Revaluation			Closing stock		
	Rand millions											
	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%
1980	0	0	0	456	448	401	0	0	0	15 215	8 959	3 426
1981	15 215	8 959	3 426	421	412	354	-1 595	-1 126	-756	14 042	8 245	3 024
1982	14 042	8 245	3 024	312	302	250	-3 952	-2 507	-1 139	10 402	6 040	2 134
1983	10 402	6 040	2 134	366	350	285	1 429	601	20	12 197	6 990	2 439
1984	12 197	6 990	2 439	466	442	360	2 872	1 405	281	15 535	8 837	3 080
1985	15 535	8 837	3 080	611	578	467	4 234	2 138	445	20 380	11 553	3 993
1986	20 380	11 553	3 993	781	738	604	4 873	2 462	568	26 035	14 753	5 165
1987	26 035	14 753	5 165	1 021	958	785	6 965	3 456	758	34 020	19 168	6 709
1988	34 020	19 168	6 709	1 185	1 108	906	4 292	1 879	131	39 497	22 154	7 746
1989	39 497	22 154	7 746	1 354	1 249	1 014	4 272	1 580	-92	45 122	24 983	8 668
1990	45 122	24 983	8 668	1 454	1 300	1 014	1 876	-274	-1 015	48 452	26 009	8 667
1991	48 452	26 009	8 667	1 368	1 182	846	-4 229	-3 551	-2 284	45 591	23 641	7 228
1992	45 591	23 641	7 228	1 157	937	556	-8 182	-5 834	-3 031	38 566	18 744	4 753
1993	38 566	18 744	4 753	950	675	207	-7 860	-5 910	-3 189	31 656	13 510	1 771
1994	31 656	13 510	1 771	500	206	-305	-15 479	-9 592	-4 071	16 678	4 124	-2 605
1995	16 678	4 124	-2 605	14	-277	-781	-16 216	-9 395	-3 291	475	-5 548	-6 677
1996	475	-5 548	-6 677	-466	-767	-1 250	-15 530	-9 016	-2 760	-15 520	-15 331	-10 687
1997	-15 520	-15 331	-10 687	-871	-1 209	-1 678	-12 627	-7 642	-1 975	-29 018	-24 182	-14 340
1998	-29 018	-24 182	-14 340	-1 250	-1 654	-2 096	-11 391	-7 241	-1 480	-41 658	-33 077	-17 916
1999	-41 658	-33 077	-17 916	-1 815	-2 332	-2 784	-17 033	-11 238	-3 098	-60 507	-46 647	-23 798
2000	-60 507	-46 647	-23 798	-1 274	-1 966	-2 323	19 304	9 284	6 264	-42 477	-39 329	-19 857
2001	-42 477	-39 329	-19 857	-319	-1 184	-1 956	32 175	16 826	5 092	-10 620	-23 687	-16 721
2002	-10 620	-23 687	-16 721	1 669	702	-505	64 564	37 023	12 907	55 612	14 038	-4 320
2003	55 612	14 038	-4 320	2 770	1 735	109	33 912	18 928	5 146	92 294	34 701	935
2004	92 294	34 701	935	3 950	2 933	922	35 356	21 029	6 022	131 600	58 664	7 879
2005	131 600	58 664	7 879	4 180	3 315	650	3 417	4 324	-2 973	139 197	66 303	5 556
2006	139 197	66 303	5 556	6 713	5 895	3 275	77 591	45 705	19 164	223 500	117 904	27 996
2007	223 500	117 904	27 996	8 337	7 564	4 974	45 776	25 812	9 540	277 613	151 280	42 509
2008	277 613	151 280	42 509	11 593	10 723	7 809	97 015	52 462	16 429	386 222	214 465	66 748

Notes: 0 = Data not available; where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

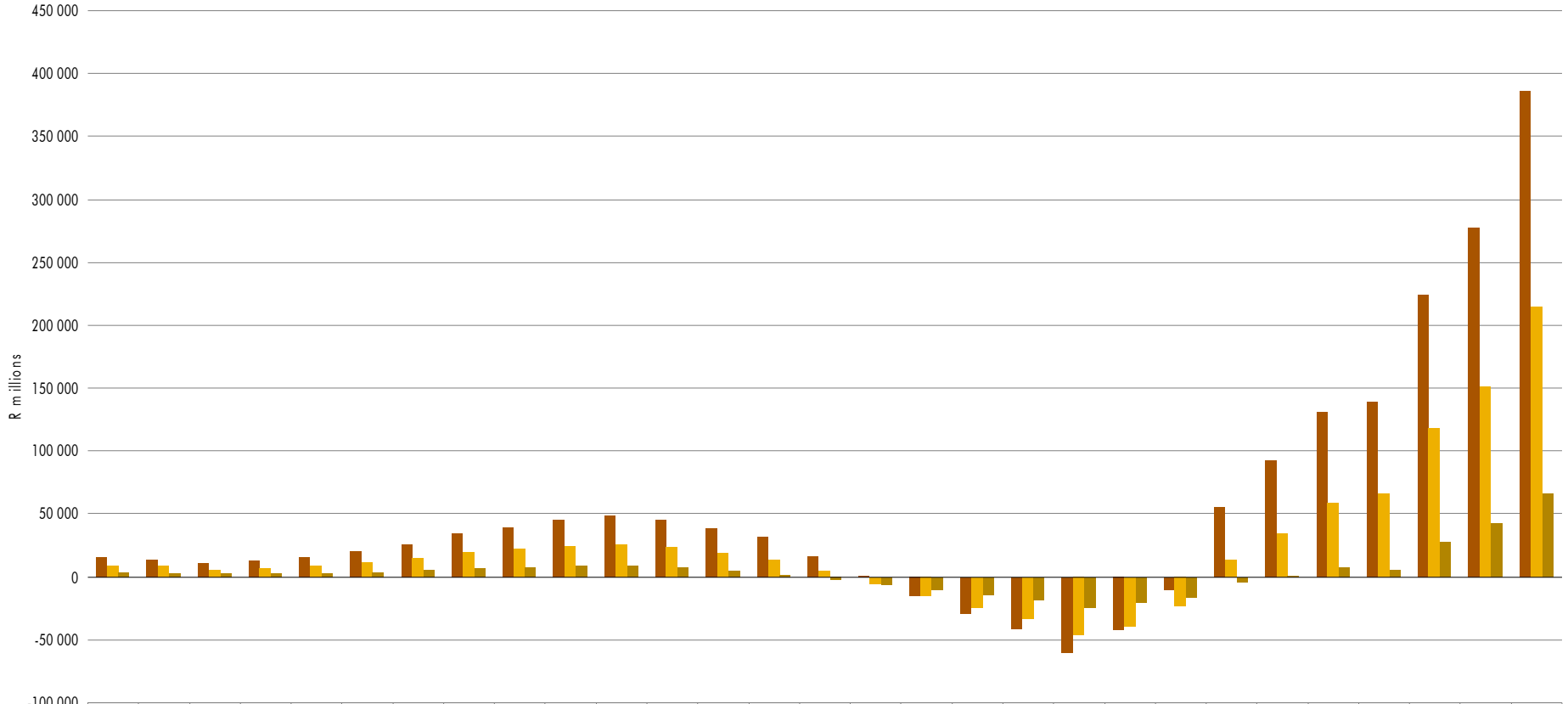
Figure 9: Platinum group metals: value of annual closing stock 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Closing Stock 3%	15 215	12 601	10 628	15 746	19 671	29 621	42 251	48 403	45 162	49 768	37 658	33 920	6 792	-3 322	-13 749	-32 027	-35 224	-55 458	-64 770	-93 724	41 322	140 004	266 066	64 832	57 737	34 407	595 754	629 506	737 739
Closing Stock 5%	8 959	7 373	6 036	8 777	10 943	16 973	24 165	26 893	24 809	26 172	17 431	15 799	-602	-7 182	-14 059	-25 789	-27 124	-41 785	-50 793	-71 125	-2 301	67 051	141 959	27 725	21 729	6 137	341 520	358 509	414 463
Closing Stock 11,7%	3 426	2 561	1 971	2 979	3 801	6 069	8 699	9 190	8 507	8 786	4 469	2 782	-3 919	-7 141	-10 218	-14 671	-15 280	-21 048	-24 902	-34 239	-1 849	8 116	39 231	-4 167	-9 224	-18 175	122 549	125 155	136 429

Calculations: Statistics South Africa.

Figure 10: Platinum group metals: value of 5-year moving average closing stock, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Closing Stock 3%	15 215	14 042	10 402	12 197	15 535	20 380	26 035	34 020	39 497	45 122	48 452	45 591	38 566	31 656	16 678	475	-15 520	-29 018	-41 658	-60 507	-42 477	-10 620	55 612	92 294	131 600	139 197	223 500	277 613	386 222
Closing Stock 5%	8 959	8 245	6 040	6 990	8 837	11 553	14 753	19 168	22 154	24 983	26 009	23 641	18 744	13 510	4 124	-5 548	-15 331	-24 182	-33 077	-46 647	-39 329	-23 687	14 038	34 701	58 664	66 303	117 904	151 280	214 465
Closing Stock 11,7%	3 426	3 024	2 134	2 439	3 080	3 993	5 165	6 709	7 746	8 668	8 667	7 228	4 753	1 771	-2 605	-6 677	-10 687	-14 340	-17 916	-23 798	-19 857	-16 721	-4 320	935	7 879	5 556	27 996	42 509	66 748

Calculations: Statistics South Africa.

5.3 Coal

Tables 11 and 12 present the monetary accounts for coal in South Africa. The tables show opening stock, depletion, revaluation and closing stock in rand values. The values are represented by 3%, 5% and 11,7% SDR values. Table 11 is calculated in annual unit rent figures, whereas Table 12 is calculated with unit rents in 5-year moving averages.

The closing stock and opening stock for coal for 1980 to 2008 has shown a positive trend for both annual and 5-year moving averages (refer to Figures 11 and 12) with negative values only in 1999, 2000 and 2002 to 2004 at the discount rate of 11,7% for annual values (refer to Figure 11) and at 5-year moving averages there were only negative values only for 2002 to 2004 at 11,7% (refer to Figure 12).

Table 11: Coal: monetary accounts for South Africa, annual 1980–2008[2a, 2b, 11, 12, 13]

Year	Opening stock			Depletion			Revaluation			Closing stock		
	Rand millions											
	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%
1980	0	0	0	330	305	220	0	0	0	11 009	6 099	1 880
1981	11 009	6 099	1 880	675	641	528	10 816	6 086	2 103	22 500	12 826	4 511
1982	22 500	12 826	4 511	965	920	769	8 684	4 653	1 292	32 148	18 399	6 572
1983	32 148	18 399	6 572	850	794	608	-4 690	-3 309	-1 985	28 308	15 885	5 195
1984	28 308	15 885	5 195	1 444	1 378	1 159	18 299	10 305	3 554	48 051	27 568	9 908
1985	48 051	27 568	9 908	2 468	2 385	2 107	31 533	17 749	5 996	82 052	47 702	18 011
1986	82 052	47 702	18 011	2 334	2 226	1 866	-6 822	-5 408	-3 927	77 564	44 520	15 951
1987	77 564	44 520	15 951	1 261	1 137	722	-36 925	-22 923	-10 501	41 899	22 734	6 171
1988	41 899	22 734	6 171	1 938	1 786	1 277	20 534	11 200	3 470	64 371	35 721	10 918
1989	64 371	35 721	10 918	3 041	2 861	2 259	33 631	18 638	6 127	101 043	57 220	19 304
1990	101 043	57 220	19 304	3 096	2 873	2 127	-1 265	-2 640	-3 254	102 873	57 453	18 177
1991	102 873	57 453	18 177	2 062	1 794	900	-36 453	-23 361	-11 386	68 482	35 886	7 691
1992	68 482	35 886	7 691	2 356	2 062	1 075	7 440	3 286	423	78 278	41 233	9 189
1993	78 278	41 233	9 189	1 851	1 531	456	-18 686	-12 154	-5 744	61 443	30 610	3 901
1994	61 443	30 610	3 901	1 789	1 439	264	-3 967	-3 282	-1 906	59 266	28 767	2 259
1995	59 266	28 767	2 259	2 633	2 250	969	25 138	13 975	5 054	87 037	44 992	8 283
1996	87 037	44 992	8 283	3 044	2 622	1 207	10 541	4 803	829	100 622	52 416	10 319
1997	100 622	52 416	10 319	3 131	2 674	1 141	-598	-1 651	-1 707	103 155	53 438	9 753
1998	103 155	53 438	9 753	3 310	2 825	1 197	2 419	183	-720	108 884	56 446	10 231
1999	108 884	56 446	10 231	1 481	961	-782	-61 654	-38 210	-16 133	48 711	19 196	-6 685
2000	48 711	19 196	-6 685	760	178	-1 771	-24 491	-15 810	-6 682	24 980	3 564	-15 138
2001	24 980	3 564	-15 138	4 424	3 901	691	115 964	70 483	20 357	145 368	77 948	5 910
2002	145 368	77 948	5 910	3 323	2 724	-952	-39 442	-26 234	-13 098	109 250	54 438	-8 140
2003	109 250	54 438	-8 140	1 074	644	-794	-75 231	-42 214	2 144	35 093	12 868	-6 790
2004	35 093	12 868	-6 790	1 614	1 162	-353	15 901	9 159	4 127	52 607	23 189	-3 015
2005	52 607	23 189	-3 015	6 051	5 545	3 852	138 323	81 946	32 089	196 981	110 680	32 926
2006	196 981	110 680	32 926	3 916	3 432	1 810	-73 483	-45 614	-19 268	127 414	68 498	15 468
2007	127 414	68 498	15 468	7 322	6 783	4 979	102 999	60 053	22 109	237 734	135 334	42 555
2008	237 734	135 334	42 555	31 447	30 032	26 961	749 455	433 600	160 918	1 018 637	598 966	230 434

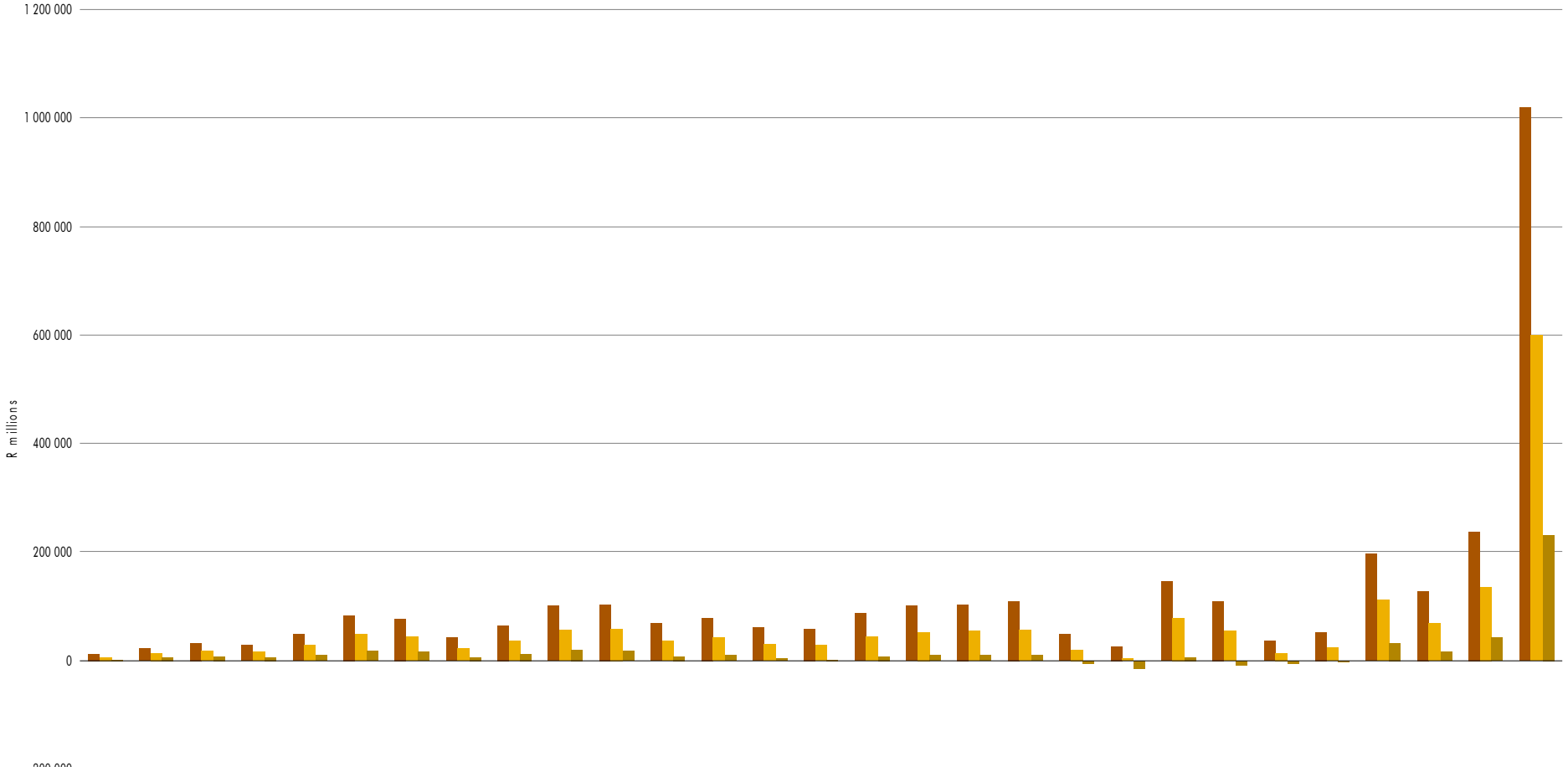
Notes: 0 = Data not available; where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Table 12: Coal: monetary accounts for South Africa, 5-year moving average 1980–2008[2a, 2b, 11, 12, 13]

Year	Opening stock			Depletion			Revaluation			Closing stock		
	Rand millions											
	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%	3%	5%	11,7%
1980	0	0	0	330	305	220	0	0	0	11 009	6 099	1 880
1981	11 009	6 099	1 880	524	493	388	5 938	3 268	1 050	17 471	9 860	3 318
1982	17 471	9 860	3 318	706	668	541	5 347	2 836	765	23 524	13 364	4 624
1983	23 524	13 364	4 624	753	710	566	811	130	-351	25 088	14 204	4 840
1984	25 088	14 204	4 840	961	910	738	5 948	3 086	727	31 998	18 200	6 304
1985	31 998	18 200	6 304	1 431	1 366	1 151	14 134	7 758	2 379	47 562	27 325	9 834
1986	47 562	27 325	9 834	1 722	1 645	1 387	7 942	3 922	631	57 226	32 891	11 851
1987	57 226	32 891	11 851	1 727	1 636	1 334	-1 565	-1 804	-1 784	57 387	32 724	11 401
1988	57 387	32 724	11 401	1 961	1 851	1 483	5 790	2 448	-206	65 138	37 022	12 678
1989	65 138	37 022	12 678	2 211	2 082	1 649	6 110	2 528	-231	73 459	41 632	14 096
1990	73 459	41 632	14 096	2 302	2 147	1 628	738	-844	-1 812	76 499	42 936	13 912
1991	76 499	42 936	13 912	2 284	2 095	1 460	-2 900	-3 137	-2 892	75 883	41 894	12 481
1992	75 883	41 894	12 481	2 489	2 267	1 522	4 318	1 172	-995	82 690	45 333	13 007
1993	82 690	45 333	13 007	2 566	2 301	1 415	-94	-1 611	-2 328	85 162	46 023	12 094
1994	85 162	46 023	12 094	2 422	2 109	1 063	-7 372	-5 959	-4 073	80 211	42 174	9 083
1995	80 211	42 174	9 083	2 343	1 991	810	-5 104	-4 368	-2 970	77 450	39 796	6 924
1996	77 450	39 796	6 924	2 465	2 092	840	1 583	-66	-582	81 498	41 822	7 183
1997	81 498	41 822	7 183	2 677	2 259	860	4 018	1 075	-693	88 193	45 156	7 350
1998	88 193	45 156	7 350	2 949	2 503	1 008	5 868	2 362	256	97 010	50 021	8 614
1999	97 010	50 021	8 614	2 814	2 347	783	-7 259	-5 467	-2 708	92 565	46 901	6 688
2000	92 565	46 901	6 688	2 429	1 923	227	-15 193	-10 405	-4 974	79 801	38 419	1 942
2001	79 801	38 419	1 942	2 630	2 115	101	3 983	1 735	-1 181	86 414	42 270	862
2002	86 414	42 270	862	2 630	2 095	-320	-2 588	-2 508	-3 279	86 455	41 856	-2 738
2003	86 455	41 856	-2 738	2 356	1 795	-760	-11 807	-7 813	-2 996	77 005	35 838	-6 493
2004	77 005	35 838	-6 493	2 405	1 854	-675	-1 018	-673	1 399	78 392	37 020	-5 770
2005	78 392	37 020	-5 770	3 469	2 940	476	31 071	18 718	9 359	112 932	58 678	4 065
2006	112 932	58 678	4 065	3 280	2 769	686	-9 502	-6 182	1 109	106 710	55 265	5 860
2007	106 710	55 265	5 860	4 035	3 545	1 904	20 283	11 928	8 513	131 028	70 739	16 278
2008	131 028	70 739	16 278	10 162	9 472	7 496	187 988	108 713	40 292	329 179	188 924	64 065

Notes: 0 = Data not available; where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

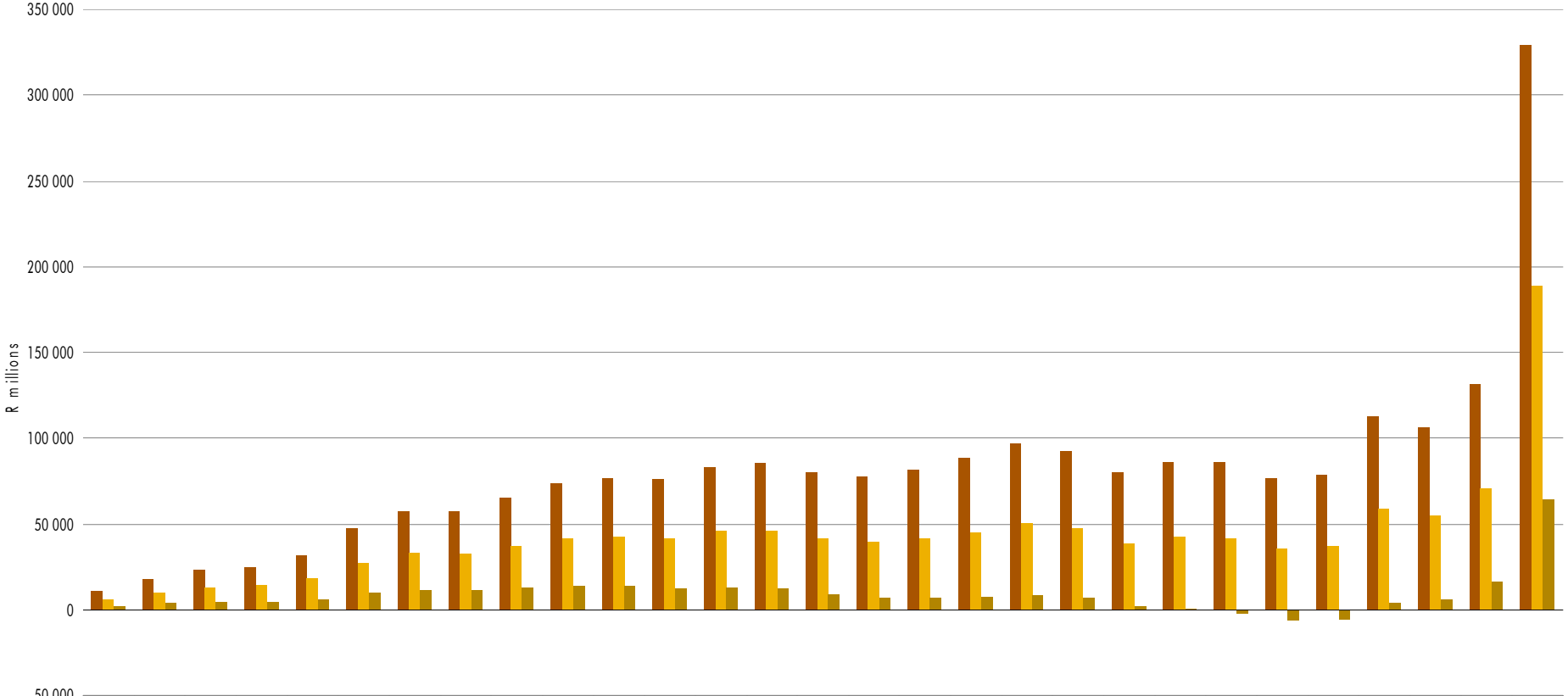
Figure 11: Coal: value of annual closing stock 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Closing Stock 3%	11 009	22 500	32 148	28 308	48 051	82 052	77 564	41 899	64 371	101 043	102 873	68 482	78 278	61 443	59 266	87 037	100 622	103 155	108 884	48 711	24 980	145 368	109 250	35 093	52 607	196 981	127 414	237 734	1 018 637
Closing Stock 5%	6 099	12 826	18 399	15 885	27 568	47 702	44 520	22 734	35 721	57 220	57 453	35 886	41 233	30 610	28 767	44 992	52 416	53 438	56 446	19 196	3 564	77 948	54 438	12 868	23 189	110 680	68 498	135 334	598 966
Closing Stock 11,7%	1 880	4 511	6 572	5 195	9 908	18 011	15 951	6 171	10 918	19 304	18 177	7 691	9 189	3 901	2 259	8 283	10 319	9 753	10 231	-6 685	-15 138	5 910	-8 140	-6 790	-3 015	32 926	15 468	42 555	230 434

Calculations: Statistics South Africa.

Figure 12: Coal: value of 5-year moving average closing stock, 1980–2008[2a, 2b, 11, 12, 13]



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Closing Stock 3%	11 009	17 471	23 524	25 088	31 998	47 562	57 226	57 387	65 138	73 459	76 499	75 883	82 690	85 162	80 211	77 450	81 498	88 193	97 010	92 565	79 801	86 414	86 455	77 005	78 392	112 932	106 710	131 028	329 179
Closing Stock 5%	6 099	9 860	13 364	14 204	18 200	27 325	32 891	32 724	37 022	41 632	42 936	41 894	45 333	46 023	42 174	39 796	41 822	45 156	50 021	46 901	38 419	42 270	41 856	35 838	37 020	58 678	55 265	70 739	188 924
Closing Stock 11,7%	1 880	3 318	4 624	4 840	6 304	9 834	11 851	11 401	12 678	14 096	13 912	12 481	13 007	12 094	9 083	6 924	7 183	7 350	8 614	6 688	1 942	862	-2 738	-6 493	-5 770	4 065	5 860	16 278	64 065

Calculations: Statistics South Africa.

6. Policy analysis

Environmental protection, for the benefit of present and future generations, requires sound legislative and other measures that secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. The Environmental Policy Directorate from the Department of Mineral Resources (DMR) undertakes research to develop, communicate and promulgate environmental policy, legislation, norms, standards and strategies within the Minerals and Petroleum Resources Development Act (MPRDA) (Act No. 28 of 2002)[16]. Section 6 of the MPRDA briefly discusses mineral resource royalties and the Minerals and Petroleum Resources Royalty Bill (MPRRB) (B59–2008)[17], which complements the MPRDA. This section of the document closes with a discussion and results of El-Serafy's Use-Cost method as a policy analysis tool for mineral resource royalties.

6.1 Mineral resource royalties

The DMR is the primary government entity responsible for the establishment and implementation of the minerals policy and for overseeing the country's mineral industry. Discriminatory policies excluded a large sector of the population from full participation in the South African minerals industry prior to 1994, before democracy was realised. The MPRDA is the legislation behind the official policy concerning the exploitation of the country's minerals. The restructuring of the South African economy and changing local and international circumstances were taken into consideration by the DMR in drafting the new Act. Section 3(2)(b) of the MPRDA[16], states: 'As the custodian of the nation's mineral and petroleum resources, the State, acting through the Minister may: in consultation with the Minister of Finance, determine and levy, any fee or consideration payable in terms of any relevant Act of Parliament.'

The exploration for and extraction of mineral resources in South Africa have been subject to various pieces of legislation over the years. This legislation dealt with numerous issues, such as the ownership of mineral resources; the right to undertake exploration and mining operations, environmental and safety concerns relating to mining operations, and State mining lease payments (where applicable). The MPRDA brings South Africa's mining legislation in line with international norms. All mineral rights will vest with the State as custodian of mineral resources on behalf of South African citizens. The MPRRB, which complements the MPRDA provides for the compensation to the State as custodian for the country's permanent loss of non-renewable resources. Where consideration for the extraction of mineral resources was previously payable to the State only in certain cases (i.e. where mining was conducted on State land), the exploitation of all mineral resources in South Africa will require consideration in the form of mineral royalties payable to the State[18]. Section 3(3) of the MPRDA[16] also states that the Minister must ensure the sustainable development for South Africa's mineral and petroleum resources within a framework of national environmental policy, norms and standards while promoting economic and social development.

On 24 April 2009, the South African President, in terms of Section 14 of the National Environmental Management Act (NEMA) (Act No. 62 of 2008)[19], announced in the *Government Gazette* that the MPRDA would come into effect on 1 May 2009. However, the amended MPRDA did not come into effect until March 2010, which meant that the provisions of NEMA only become applicable to mining and the pre-amendment provisions prevailed when the MPRDA came into force when the transitional mechanisms had taken effect. To ensure the sustainable development for South Africa's mineral and petroleum resources, proper usage of the resource rent or royalties (i.e. are the royalties that should be collected being used for capital or current income investment) needs to be considered (refer to section 6.2). Government investment of the resource royalties that will be collected needs to be transparent. As

per section 2 of the MPRRB, all royalties received will be for the benefit of the National Revenue Fund[17]. According to the National Treasury, the royalties for the National Revenue Fund were requested for earmarking by the mineral industry stakeholders. That is a decision that rests with Treasury and has not been earmarked yet. Royalties only came into effect in March 2010, having been postponed from the original date of May 2009. The first royalty payments were received in June 2010[20].

6.2 El-Serafy's Use-Cost method

The Use-Cost method is a measure of sustainable use of minerals. It divides resource rent into two components, namely:

- A capital component – part of resource rent that needs to be reinvested to maintain a constant stream of income; and
- An income component – residual amount that can be consumed as current income.

The results of the El-Serafy's Use-Cost formula[21] (refer to section 2.4 of Annexure 1) are presented in Tables 13, 14 and 15 for gold, PGM and coal respectively. The calculations are done using a 3%, 5% and 11,7% SDR/RRR[c].

With a decrease in the income component, less of the revenue from gold mining has to be invested to maintain a constant stream of income. With a decrease in the capital component less of the revenue from mining can be consumed as current income. The reverse is true if there is and increase for the income or capital components.

The income component (X) for gold at a RRR of 11,7% decreased over the 28 years. In Table 13 the income component in 1980 was R6 506 million decreasing to negative R4 360 million in 2008. The capital component also showed a decrease from approximately R4 million to R0 million. The capital depreciation factor in 1980 was 0% remaining relatively unchanged to 2008. The results from gold suggest that South Africa has to invest a relatively small amount of the revenue from gold mining into substitute forms of capital.

The income component (X) for PGM at a RRR of 11,7% increased over the 28 years from 1980 to 2008. In Table 14 the income component in 1980 was R401 million increasing to R15 962 million in 2008. The capital component remained unchanged at R0 million. The capital depreciation factor also remained relatively unchanged at 0% until 2008. The results from PGM suggest that South Africa does not have to invest any of the revenue from PGM mining into substitute forms of capital.

The income component (X) for coal at a RRR of 11,7% increased over the 28 years from 1980 to 2008. In Table 15 the income component in 1980 was R220 million increasing to R26 961 million in 2008 which is a significant increase. The capital component also remained relatively unchanged at R0 million. The capital depreciation factor remained relatively unchanged at 0% over the 28 years. The results from coal suggest that South Africa does not have to invest any of the revenue from coal mining into substitute forms of capital.

Government policy analysis can be informed by El-Serafy's Use-Cost method to help determine how much of resource rent should be consumed and how much should be reinvested to maintain a constant stream of income.

[c] SDR is the same as RRR as shown in El-Serafy's Use-Cost formula.

Table 13: Gold: income and capital component of resource rent 1980–2008

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	Rand millions													
Income component (X)														
Rent consumed as income (RRR 11,7%)	6 506	3 644	2 735	3 201	3 504	5 403	5 499	3 629	3 758	1 803	-547	-2 531	-3 725	-1 943
Rent consumed as income (RRR 5%)	6 645	3 998	3 230	3 790	4 188	6 217	6 670	5 120	5 539	3 988	2 045	391	-550	1 330
Rent consumed as income (RRR 3%)	6 163	3 782	3 105	3 632	4 015	5 907	6 433	5 114	5 554	4 236	2 552	1 117	312	2 050
Capital component (R-X) Reinvestment														
Remaining rent invested (RRR 11,7%)	3,91	2,02	1,81	2,82	3,51	5,52	4,40	2,12	2,97	1,38	-0,45	-2,23	-4,21	-2,62
Remaining rent invested (RRR 5%)	252	147	128	170	199	298	287	192	237	169	89	18	-28	72
Remaining rent invested (RRR 3%)	850	510	439	554	635	938	957	700	824	623	383	171	51	351
	Percentage													
Capital depreciation factor (R-X)/R (%)														
Percentage of reinvestment (RRR 11,7%)	0,06	0,06	0,07	0,09	0,10	0,10	0,08	0,06	0,08	0,08	0,08	0,09	0,11	0,13
Percentage of reinvestment (RRR 5%)	3,66	3,54	3,81	4,30	4,54	4,58	4,13	3,62	4,11	4,06	4,19	4,30	4,78	5,14
Percentage of reinvestment (RRR 3%)	12,12	11,89	12,40	13,24	13,65	13,71	12,95	12,04	12,92	12,83	13,05	13,25	14,03	14,61

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Rand millions														
Income component (X)															
Rent consumed as income (RRR 11,7%)	-2 837	-6 388	-5 037	-8 422	-8 740	-8 588	-9 073	-8 429	-7 523	2 509	2 013	-3 876	-2 151	-3 708	-4 360
Rent consumed as income (RRR 5%)	690	-2 520	-1 035	-4 138	-4 434	-4 202	-4 502	-2 900	288	4 716	3 993	-1 118	2 482	146	876
Rent consumed as income (RRR 3%)	1 544	-1 308	106	-2 696	-2 971	-2 735	-2 970	-1 437	2 092	5 074	4 371	-291	3 754	1 264	2 407
Capital component (R-X) Reinvestment															
Remaining rent invested (RRR 11,7%)	-2,74	-3,28	-1,94	-3,25	-2,42	-2,06	-1,65	-0,78	-0,86	0,17	0,05	-0,03	-0,01	0,00	0,00
Remaining rent invested (RRR 5%)	32	-89	-32	-129	-120	-107	-101	-48	5	68	39	-6	9	0	1
Remaining rent invested (RRR 3%)	242	-173	13	-330	-333	-295	-298	-120	185	390	263	-12	123	33	33
	Percentage														
Capital depreciation factor (R-X)/R (%)															
Percentage of reinvestment (RRR 11,7%)	0,10	0,05	0,04	0,04	0,03	0,02	0,02	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 5%)	4,47	3,42	3,03	3,03	2,63	2,47	2,20	1,64	1,79	1,43	0,96	0,52	0,35	0,24	0,08
Percentage of reinvestment (RRR 3%)	13,53	11,67	10,91	10,91	10,08	9,74	9,11	7,73	8,12	7,14	5,68	3,99	3,17	2,54	1,34

Note: Where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Table 14: Platinum group metals: income and capital component of resource rent 1980–2008

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	Rand millions													
Income component (X)														
Rent consumed as income (RRR 11,7%)	401	300	231	349	445	710	1 018	1 075	995	1 028	523	326	-458	-835
Rent consumed as income (RRR 5%)	448	369	302	439	547	849	1 208	1 345	1 240	1 309	872	790	-30	-359
Rent consumed as income (RRR 3%)	456	378	319	472	590	889	1 268	1 452	1 355	1 493	1 130	1 018	204	-100
Capital component (R-X) Reinvestment														
Remaining rent invested (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Remaining rent invested (RRR 5%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Remaining rent invested (RRR 3%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	Percentage													
Capital depreciation factor (R-X)/R (%)														
Percentage of reinvestment (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 5%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 3%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Rand millions														
Income component (X)															
Rent consumed as income (RRR 11,7%)	-1 196	-1 716	-1 788	-2 463	-2 914	-4 006	-216	950	4 590	-488	-1 079	-2 126	14 338	14 643	15 962
Rent consumed as income (RRR 5%)	-703	-1 289	-1 356	-2 089	-2 540	-3 556	-115	3 353	7 098	1 386	1 086	307	17 076	17 925	20 723
Rent consumed as income (RRR 3%)	-412	-961	-1 057	-1 664	-1 943	-2 812	1 240	4 200	7 982	1 945	1 732	1 032	17 873	18 885	22 132
Capital component (R-X) Reinvestment															
Remaining rent invested (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Remaining rent invested (RRR 5%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,25	0,23	0,09
Remaining rent invested (RRR 3%)	0,00	-0,01	-0,01	-0,03	-0,04	-0,14	0,04	0,40	1,04	0,67	0,85	1,02	20,89	20,35	12,28
	Percentage														
Capital depreciation factor (R-X)/R (%)															
Percentage of reinvestment (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 5%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 3%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,03	0,05	0,10	0,12	0,11	0,06

Note: Where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

Table 15: Coal: income and capital component of resource rent 1980–2008

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	Rand millions													
Income component (X)														
Rent consumed as income (RRR 11,7%)	220	528	769	608	1 159	2 107	1 866	722	1 277	2 259	2 127	900	1 075	456
Rent consumed as income (RRR 5%)	305	641	920	794	1 378	2 385	2 226	1 137	1 786	2 861	2 873	1 794	2 062	1 531
Rent consumed as income (RRR 3%)	330	675	964	849	1 442	2 462	2 327	1 257	1 931	3 031	3 086	2 054	2 348	1 843
Capital component (R-X) Reinvestment														
Remaining rent invested (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Remaining rent invested (RRR 5%)	0,00	0,00	0,00	0,01	0,03	0,14	0,14	0,07	0,16	0,22	0,20	0,15	0,18	0,20
Remaining rent invested (RRR 3%)	0,03	0,19	0,60	0,63	2,34	6,61	6,66	3,58	6,88	9,80	9,31	7,04	8,03	8,06
	Percentage													
Capital depreciation factor (R-X)/R (%)														
Percentage of reinvestment (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 5%)	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Percentage of reinvestment (RRR 3%)	0,01	0,03	0,06	0,07	0,16	0,27	0,29	0,28	0,35	0,32	0,30	0,34	0,34	0,44

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Rand millions														
Income component (X)															
Rent consumed as income (RRR 11,7%)	264	969	1 207	1 141	1 197	-782	-1 771	691	-952	-794	-353	3 852	1 810	4 979	26 961
Rent consumed as income (RRR 5%)	1 438	2 250	2 621	2 672	2 822	960	178	3 897	2 722	643	1 159	5 534	3 425	6 767	29 949
Rent consumed as income (RRR 3%)	1 778	2 611	3 019	3 095	3 267	1 462	750	4 362	3 278	1 053	1 579	5 913	3 825	7 137	30 098
Capital component (R-X) Reinvestment															
Remaining rent invested (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,04
Remaining rent invested (RRR 5%)	0,33	0,82	0,97	1,72	2,24	0,75	0,16	3,47	2,31	0,98	2,12	11,19	7,27	16,25	83,09
Remaining rent invested (RRR 3%)	11,16	21,60	25,12	36,03	43,27	19,18	10,73	61,93	45,23	20,69	34,65	137,87	91,86	184,69	850,18
	Percentage														
Capital depreciation factor (R-X)/R (%)															
Percentage of reinvestment (RRR 11,7%)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Percentage of reinvestment (RRR 5%)	0,02	0,04	0,04	0,06	0,08	0,08	0,09	0,09	0,08	0,15	0,18	0,20	0,21	0,24	0,28
Percentage of reinvestment (RRR 3%)	0,62	0,82	0,83	1,15	1,31	1,30	1,41	1,40	1,36	1,93	2,15	2,28	2,35	2,52	2,75

Note: Where figures have been rounded, discrepancies may occur with totals.
Calculations: Statistics South Africa.

7. Sustainability of minerals in South Africa

This section begins with a discussion of concepts of sustainability and the implications for approaches to measuring sustainability. Sustainable management of mineral resources requires that resource rent be reinvested in other activities which will generate income after the mineral resources are exhausted. Sustainability in mining refers to the transition from mining to other activities that could replace it once the mineral resources are depleted. The South African government bears a responsibility to ensure the transformation of mineral wealth into other forms of wealth. This transformation requires establishing taxes to recover resource rent and commitment to reinvest the rent.

There are guidelines for reinvesting mineral rent; however, there is no specific rule to determine the amount of rent that must be reinvested. The El Serafy's rule specifies the minimum amount that must be reinvested in order to maintain wealth. There are ways in which natural capital can be transformed into other forms of wealth, such as:

1. Natural resources must be managed to maximise the generation of resource rent;
2. Resource rent must be recovered by an agent capable of reinvesting it; and
3. Resource rent must be used for productive investments.

Sustainability requires non-decreasing levels of capital stock over time, or, at the level of the individual, non-decreasing per capita capital stock. Indicators of sustainability could be based on the value of total assets for every period, or by the change in wealth, i.e. consumption of capital (depreciation) in the conventional national accounts. For a proper measure of sustainability, all assets should be included in such an indicator: manufactured capital, natural capital and human capital. In the past, only manufactured capital was recorded in the System of National Accounts (SNA), but the recognition of the importance of natural capital has led to the expansion of the asset boundary to include this asset. Human capital has not been included because there is no agreement about how to measure it[22].

To encourage sustainability, fees should be set high enough to recover the rent generated at the most profitable, sustainable level of production (extraction), so that it becomes unprofitable for companies to harvest at levels that deplete the resource stock. The Sustainable Budget Index (SBI) is used to indicate how much of the mineral revenues are used for capital expenditures including spending for human capital[22]. The SBI[d] value of one or less is interpreted to mean that current government consumption is sustainable because it is financed entirely out of revenues other than from minerals, and all the revenue derived from mineral resources is used for public investment. An SBI value greater than one means that consumption relies in part on the revenues from mineral resources that is fiscally unsustainable[22].

7.1 Resource rent collection

The collection of rent usually comes about through negotiation between the resource owner and the resource user. Rent can be a fixed sum, or a variety of mechanisms including auctions, royalties and taxes. When designing a rent collection mechanism, it is important to take into account a number of considerations, as follows:

[d] SBI = Spending/Revenue

- Avoiding or minimising economic distortions is a key issue for rent recovery that affects the quantity or value of the output so that it is no longer efficient.
- A poorly designed rent collection mechanism can negatively affect innovation. For instance, consider an immature industry that could not pay rent based on competing existing uses, attempting to collect rent could prevent this immature industry from developing because, at least initially, costs may be very high and only the potential to generate and capture rent would justify development. In this situation, a government might choose to forego rent for a period of time with the prospect of collecting rent in the future. Or a government could use a resource rent tax or accounting profits royalty, effectively sharing the profits and the risk with a developer.
- There may be cases in which rent recovery would be unfair to the resource user. The resource rent is collected for different reasons, e.g. to ensure a return on investment, to avoid inefficient allocation and to achieve ethical objectives.

7.2 Resource rent applications

For resources that are owned by private individuals, there is no constraint on how rental income is spent. However, where the government owns and manages a resource on behalf of the public, in principle there is no reason why rental income should be used only in relation to the resource or activity being charged for. If the government owns mineral resources, which is a public resource, the rent should be used in a way that provides maximum benefit to the public. Rent recovery from non-renewable resources such as minerals could be used for developing renewable alternatives. Resource rent is also collected to enable investment that will enhance the welfare of the future generations. Section 3(1) of the MPRDA states that mineral resources must provide a benefit to all South Africans and the Minister must ensure the sustainable development of South Africa's mineral and petroleum resources within the framework of the national environmental policy, while promoting economic and social development[16].

8. Linkages between minerals, energy and water

8.1 Minerals and energy

Electricity is an important input to all mining activities. Eskom generates about 95% of South Africa's electricity and about 45% for Africa. In generating electricity, water is an important factor. For 2008/2009 about 88% of South Africa's electricity was generated in coal-fired power stations[4] compared to 67,3% in 2006 (refer to Table 16). South Africa produces about 34 000 Megawatts (MW) of electricity to meet current demand and this figure is growing annually. In 1999 the mining industry consumed 28 877 Gigawatt hours (GWh)[e] of electricity compared to about 31 503 GWh of electricity in 2006[23]. By March 2007 electricity sales grew to 218 120 GWh and in 2008 Eskom electricity sales reached 224 366 GWh[24, 25]. Coal, as the major indigenous energy resource, is relied on for the generation of most of the country's electricity. These figures demonstrate the importance of energy as a key driver of South Africa's economy and growth.

[e] One Kilowatt hour (KWh) is a unit of energy equal to 1 000 Watt hours (Wh). One Wh is the amount of energy used by a one-watt load, such as a small light bulb, drawing power for one hour. A Gigawatt hour (GWh) is a unit of electrical energy equal to one million KWh. One GWh represents one hour of electricity consumed at a constant rate of one GW.

Coal reserves are the world's most significant fossil fuel resource. Energy supply is from various resources with coal as the major energy source. In 2006 the energy supply was as follows:

Table 16: Energy supply table for South Africa, 2006[26]

	Coal	Crude oil	Electricity	Gas to users	Hydro	Nuclear	Petroleum products	Renewables and waste	Total energy supply
					Terajoules (TJ)				
Domestic production	5 788 411	287 766	856 008	125 797	9 895	109 375	991 004	430 427	8 598 682
	67,3%	3,3%	10,0%	1,5%	0,1%	1,3%	11,5%	5,0%	100,0%

The energy supply is unlikely to change significantly in the next two decades, due to the relative lack of suitable and cost-effective alternatives to coal as an energy source. Many of the deposits can be exploited at extremely favourable costs and as a result, a large coal-mining industry has developed. Since South Africa has abundant coal reserves, it supplies two-thirds of Africa's electricity. Eskom is mandated to provide South Africa with affordable and reliable electricity. It is also Eskom's duty to manage environmental impacts and to combat climate change. The mining industry is, however, not only a major consumer of electricity it is also the major supplier to the electricity supply industry. Eskom coal-fired power stations follow a policy of recycling, and re-use water in a closed cycle to reduce pollution and water usage. It is therefore clear that the mining industry, and especially the coal-mining industry, has a special interest in the well-being of the electricity supply industry. South Africa's indigenous energy resource base is dominated by coal. Coal is currently still the most economical way to generate electricity in South Africa, although alternative energy sources are investigated for future use. South African rivers are not providing constant and sufficient stream flow to make large-scale hydro-generation possible. There is abundant sunlight in South Africa as a source of solar energy, but the technology has not been sufficiently explored to harness the resource for electricity generation.

Internationally, coal is the most widely used primary fuel, accounting for about 36% of the total fuel consumption of the world's electricity production, without which there cannot be economic development. About 47% of South African coal mining is done underground and about 53% is produced by opencast methods[4]. South African coal for domestic electricity production is among the cheapest in the world. Beneficiation of coal, particularly for export, results in more than 65 million tons of coal discards being produced annually. The remainder of South Africa's coal production (extraction) feeds the various domestic industries. About 110 million tons are used for electricity generation, 41 million tons for petrochemical industries, 8 million tons for general industry, 7 million tons for the metallurgical industry, and 7 million tons are purchased by coal merchants and sold domestically or exported. The key role played by South Africa's coal reserves in the economy is illustrated by the fact that Eskom ranks first as steam coal user and seventh as electricity generator in the world. Both the mining and energy sectors have adopted a zero liquid effluent discharge (ZLED) policy in which all reasonable steps are taken to prevent pollution of water resources. In terms of the ZLED policy, water is cascaded from good to poor quality uses until all pollutants are finally captured in ash dams. The objective is to dispose of the maximum mass of salts with the smallest possible volume of water without compromising the ability of the ash to encapsulate the salt load imposed.

8.2 Water utilisation in mines

Water is a renewable source of energy. South Africa's water resources are stressed[f], bordering on water scarcity, with a water availability of 1 100 cubic metres (m^3) per person per annum. Water plays a crucial role in mining and energy sectors. Mining is heavily reliant on available water resources for mineral extraction and processing. As mining expands, increased pressure is placed on the availability of water resources for other uses such as human consumption and the natural functions within ecosystems. Eskom uses water to generate electricity. Gold and PGM mines receive potable water from bulk providers, such as Rand Water, which is stored in reservoirs from where it is reticulated through the mining area. Wastewater is collected, treated and re-used or disposed of. Most mines undertake extensive treatment and recycling of water used for dust allaying, cooling and metallurgical processes. Most mines distribute potable water to hostels and villages for drinking, cooking and sanitation. It is estimated that some 30% of the water purchased from Rand Water by mines is distributed for such domestic applications[27]. These mines are therefore also water service providers as envisaged in the Water Services Act (Act No. 108 of 1997). Most underground mines experience an inflow of groundwater. This water has to be pumped out to maintain safety in the working areas. Energy generation requires water as coolant for power stations. Eskom has three hydrological power stations, namely a conventional reservoir, run-off river and pumped storage schemes.

9. Conclusion

Minerals are an important natural resource in South Africa and are important in terms of economic development. The decline in gold production (extraction) and volumes sold has masked significant growth in other mining sectors in South Africa. At the same time the years to depletion for gold are increasing. Measured in terms of production (extraction), coal and PGM have approximately doubled in size since 1980. PGM is in a growth phase, with South Africa boasting around half or more of world production (extraction) and reserves. Years to depletion for both coal and PGM have shown a significant decline since 1980. The mineral resources measured in these accounts are gold, PGM and coal, as they are the major contributors to South Africa's mining industry as measured by the GDP.

Mineral resources need to be sustained in order to prolong their depletion period. The resource rents needs to be reinvested to ensure a sustainable future for the mineral industry. Rent recovery from non-renewable resources could be used for developing renewable alternatives. The South African Revenue Service (SARS) now records the mineral resource royalties that have been collected since June 2010 under the MPRDA. This would facilitate analysis, and comparison of such data with the resource rent calculations will be possible in the near future. The importance of the minerals account has been highlighted earlier in this document, one aspect of which is the positive contribution towards the GDP. Mineral resources do not stand on their own, as they have both a positive and negative impact on other natural resources such as energy and water, i.e. mines use both to extract mineral resources. The linkages between minerals, energy and water are strong and should be accounted for. The minerals account will be updated periodically, based on data availability from the DMR. It is important to publish future minerals accounts as official statistics and for the DMR and Stats SA to embark on the institutional arrangements that is a prerequisite to the quality assessment of data.

[f] According to the United Nations water availability of less than 1 700 m^3 per person per annum constitutes water stress, with values below 1 000 m^3 per person per annum classified as water scarcity.

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Glossary

Term	Description
Account	An account is a tool which records, for a given aspect of economic life, (a) the uses and resources or (b) the changes in assets and the changes in liabilities and/or (c) the stock of assets and liabilities existing at a certain time; the transactions accounts include a balancing item which is used to equate the two sides of the accounts (e.g. resources and uses) and which is a meaningful measure of economic performance in itself.
Anthracite	A hard, black coal that burns slowly with little flame or smoke but gives off intense heat, formed at the later stages of the coal cycle by the folding and hardening of sedimentary strata containing bituminous coal. This is the most highly metamorphosed form of coal, containing 92% to 98% of fixed carbon.
Compensation of employees	Compensation of employees is defined as the total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the latter during the accounting period. Compensation of employees does not include any taxes payable by the employer on the wage and salary bill. Note that in this report, compensation of employees will not be equal with other figures published by Stats SA because such figures are adjusted to benchmarking levels done in 1999, whereas figures in this report are not adjusted.
Constant prices	Constant prices are obtained by directly factoring changes over time in the values of flows or stocks of goods and services into two components reflecting changes in the prices of the goods and services concerned and changes in their volumes, i.e. changes in 'constant price terms'.
Consumption of capital	Consumption of fixed capital is a cost of production. It may be defined in general terms as the decline, during the course of the accounting period, in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage. It excludes the value of fixed assets destroyed by acts of war or exceptional events such as major natural disasters, which occur very infrequently.
Current prices	A fundamental principle underlying the measurement of gross value added, and hence GDP, is that output and intermediate consumption must be valued at the prices current at the time the production takes place.
Depletion	The depletion of natural deposits covers the reduction in the value of deposits of subsoil assets as a result of the physical removal and using up of the asset. The changes recorded here are the negative counterparts of gross additions to the level of exploitable subsoil resources that result from reassessments of exploitability,

Term	Description
	because of changes in technology or relative prices.
Environmental Economic Accounts	Environmental Economic Accounts brings together economic and environmental information in a common framework to measure the contribution of the environment to the economy, and the impact of the economy on the environment.
Fixed assets	Fixed assets may have been purchased in the past at times when both relative prices and the general price level were very different from prices in the current period. In order to be consistent with the other entries, consumption of fixed capital must be valued with reference to the same overall set of current prices as that used to value output and intermediate consumption.
Fixed assets or inventories	Subsoil assets are different from the stocks of fixed assets and inventories, the major difference being that the process of production has created them. Although they are neither fixed assets nor inventories, they present characteristics of both. The 1993 SNA assumes that all receipts generated from the use of natural assets can be recorded as income, specifically as part operating surplus. The implicit assumption is that assets are not exhaustible and therefore no deductions from the receipts are necessary.
Gigawatt hour	One kilowatt hour (kWh) is a unit of energy equal to 1 000 watt hours (Wh). One Wh is the amount of energy used by a one-watt load, such as a small light bulb, drawing power for one hour. A gigawatt hour (gWh) is a unit of electrical energy equal to one million kWh. One gWh represents one hour of electricity consumed at a constant rate of one gW.
Intermediate consumption	Intermediate consumption consists of the value of the goods and services consumed as inputs by a process of production, excluding fixed assets whose consumption is recorded as consumption of fixed capital. The goods or services may be either transformed or used up by the production process. Some inputs re-emerge after having been transformed and incorporated into the outputs. Other inputs are completely consumed or used up. Intermediate consumption includes the rentals paid on the use of fixed assets.
Joules	One joule is the amount of energy required to perform the following physical actions: • The work done by a force of one Newton travelling through a distance of one metre. • The work required to move an electric charge of one coulomb through an electrical potential difference of one volt; or one coulomb volt, with the symbol C·V.

Term	Description
	• The work done to produce the power of one watt continuously for one second or one watt second (compare kilowatt-hour), with the symbol W·s. Thus a kilowatt-hour is 3 600 000 joules.
Mineral exploration	Mineral exploration consists of the value of expenditures on exploration for petroleum and natural gas and for non-petroleum deposits; it includes pre-licence costs, licence and acquisition costs, appraisal costs and the costs of actual test drilling and boring, as well as the costs of aerial and other surveys, transportation costs, etc. incurred to make it possible to carry out the tests.
Monetary accounts	Accounts expressed in monetary terms, using only currency as the unit of measure. Monetary is to be taken as synonymous with 'economic value' as understood in economic theory.
National accounts	National accounts are a coherent, consistent and integrated set of macro-economic accounts; balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. National accounts provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision-taking and policy-making.
Natural Resource Accounting	Natural Resource Accounting is an accounting system that deals with stocks and stock changes of natural assets, comprising biota (produced or wild), subsoil assets (proved reserves), water and land with their aquatic and terrestrial ecosystems. It is frequently used in the sense of physical accounting as distinguished from monetary (environmental) accounting.
Natural resources	Natural assets (raw materials) occurring in nature that can be used for economic production or consumption. The naturally occurring assets that provide use benefits through the provision of raw materials and energy used in economic activity (or that may provide such benefits in future) and that are subject primarily to quantitative depletion through human use are subdivided into four categories: mineral and energy resources, soil resources, water resources and biological resources.
Non-renewable natural resources	Exhaustible natural resources such as mineral resources that cannot be regenerated after exploitation.
Nominal holding gains	Nominal holding gains depend upon changes in the prices, or more generally, the monetary values, of assets and liabilities over time. Nominal holding gains may accrue on assets held for any length of time during the accounting period and not merely on assets that appear in the opening or closing balance sheets. Nominal holding gains are calculated with reference to assets or liabilities that remain

Term	Description
	qualitatively and quantitatively unchanged during the period over which the holding gain is measured.
Opportunity cost	In the System, the cost of using, or using up, some existing asset or good in one particular process of production is measured by the amount of benefits that could have been secured by using the asset or good in alternative ways. Opportunity cost is calculated with reference to the opportunities foregone at the time the asset or resource is used, as distinct from the costs incurred at some time in the past to acquire the asset.
Proved reserves	Such estimated quantities of mineral deposits, at a specific date, as analysis of geological engineering data demonstrates with reasonable certainty to be recoverable in the future under the same economic and operational conditions.
Physical accounting	Natural resource and environmental accounting of stocks and changes in stocks in physical (non-monetary) units, for example, weight, area or number. Qualitative measures, expressed in terms of quality classes, types of uses or ecosystem characteristics, may supplement quantitative measures. The combined changes in asset quality and quantity are called volume changes.
Rent/royalties	The owners of assets, whether private or government units, may grant leases to other institutional units permitting them to extract such deposits over a specified period of time in return for the payment of rents. These payments are often described as royalties, but they are essentially rents that accrue to owners of the assets in return for putting them at the disposal of other institutional units for specified periods of time and are treated as such in the System. The rents may take the form of periodic payments of fixed amounts, irrespective of the rate of extraction or, more likely, they may be a function of the quantity or volume of the asset extracted.
Revaluation	Revaluation is the positive or negative holding gain accrued during the accounting period to the owners of financial or non-financial assets and liabilities.
Satellite accounts	Satellite accounts provide a framework linked to the central accounts and which enables attention to be focused on a certain field or aspect of economic and social life in the context of national accounts: common examples are satellite accounts for the environment, tourism or unpaid household work.
Standard Industrial Classification of all Economic Activates (SIC)	A South African version of a classification coding system used to classify an enterprise according to its economic activity. Note: It is based on the United Nation's (UN) International Standard Industrial Classification of all Economic Activities (ISIC), with a number of adaptations for local conditions.

Term	Description
Stocks	Stocks are a position in, or holdings of, assets and liabilities at a point in time and the SNA records stocks in accounts, usually referred to as balance sheets, and tables at the beginning and end of the accounting period. Stocks result from the accumulation of prior transactions and other flows, and they are changed by transactions and other flows in the period (note that stocks of goods are referred to as 'inventories' in the SNA).
Subsoil assets	Subsoil assets are defined in the 1993 SNA as proven resources of mineral deposits located on or below the earth's surface that are economically exploitable, given current technology and relative prices. Subsoil assets consist of coal, oil and natural gas reserves, metallic mineral reserves and non-metallic mineral reserves. The SEEA (System of Integrated Environmental and Economic Accounting) adopts the same definition as the SNA. Subsoil assets are classified according to: -The degree of geological certainty; and -The degree of economic feasibility of the reserves. The boundary between discovered and undiscovered reserves fluctuates as a result of exploration and development, differing geological conditions and technological improvements. The degree of economic feasibility on the other hand categorises the resource as economic, marginally economic and sub-economic; according to the relationship between prices and extraction costs and technological exploitability.
System of Integrated Environmental and Economic Accounting (SEEA)	Satellite system of the System of National Accounts (SNA) proposed by the United Nations for the incorporation of environment concerns (environmental costs, benefits and assets) into national accounts.
Taxes	Taxes are compulsory, unrequited payments, in cash or in kind, made by institutional units to government units. They are transfers because the government provides nothing in return to the individual unit making the payment, although government may use the funds raised in taxes to provide goods and services to other units, either individually or collectively, or to the community as a whole.
1993 System of National Accounts	The revised (1993) system adopted worldwide for conventional economic (national) accounting (Commission of the European Communities and others, 1993).

Annexure 1: Methodological notes

This section focuses on the methodologies used to construct Environmental Economic Accounts, namely the methodologies and development of physical accounts (section 2.1), the calculation of resource rent (section 2.2) and the mythologies followed to develop the monetary accounts (section 2.3)[28]. The latter can only be compiled after resource values have been established. Section 2.4 focuses on the methodology used to calculate the User-cost method which is a powerful tool for determining the capital component and the part of resource rent that needs to be reinvested to maintain a constant stream of income.

2.1 Physical accounts

The format of the physical account starts with the volume (tons) of opening stocks at the beginning of the reference period, to which additions are added and from which extraction[2a] is subtracted to arrive at the volume (tons) of the closing stock. In the case of South Africa, the following four entries are included in the physical accounts:

- Total volume sold (in tons)[2a]
- Change in inventories (in tons) – calculated as the difference between the production volume (extraction) and the volume sold;
- Closing stock (in tons), including change in inventories; and
- Years to depletion – calculated as the ratio of closing stock over production volume (extraction).

Three alternative definitions and measures of the stock (reserves) of minerals are known, namely:

- Total stock of the mineral;
- Economically proven reserves defined as that proportion of the mineral resource that is economically feasible to extract; and
- Economically proven reserves, less any possible waste that may occur during the extraction process.

The second measure was used for the South African mineral accounts, as South Africa has information only on economically proven reserves.

Resources are divided into identified resources and undiscovered resources.

Identified resources are specific bodies of mineral-bearing material whose location, quality and quantity are known from geological evidence, supported by engineering measurements. These identified resources are further sub-divided into:

- *Measured resources*: material for which quantity and quality estimates are within a margin of error of less than 20%, from geologically known sample sites;
- *Indicated resources*: material for which quantity and quality are estimated partly from sample analyses and partly from geological projections; and
- *Inferred resources*: material in unexplored extensions of demonstrated resources based on geological projections.

- **Undiscovered resources** are unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geological knowledge and theory. Undiscovered resources are sub-divided into:
  - *Hypothetical resources*: undiscovered materials reasonably expected to exist in a known mining district under known geological conditions; and
  - *Speculative resources*: undiscovered materials that may occur in either known types of deposits in favourable geological settings where no discoveries have been made, or in yet unknown types of deposits that remain to be recognised.

It is important to note that the mineral accounts only account for identified resources.

The method of calculating closing and opening stock is as follows:

- Verify the confirmed closing stock for gold, PGM and coal for the last year in question (e.g. coal, 2008, identified resources according to the South African Minerals Industry (SAMI) publication from DMR, 2009[2b].
- Calculate the opening stock and closing stock (sub-soil assets) for each year by working backwards from the last year of reference (confirmed closing stock).
- The opening stock for 2008 will thus be the closing stock (confirmed) for 2007 plus the production (extraction) for 2007.
- The closing stock for 2007 will thus equal the opening stock for 2008.

There are three ways to estimate the lifetime of reserves (years to depletion) on the basis of current year information:

- Stock at the beginning of the year / extraction of the year;
- Stock at the beginning of the year plus appearances / extraction of the year; and
- Stock at the end of the year / extraction of the year.

Stock at the end of the year / extraction of the year was used to calculate the years to depletion for minerals in the compilation of the mineral accounts for South Africa.

2.2 Resource rent

Resource rent is a measure of the scarcity value of extractive resources (such as minerals) as their finite stocks are reduced with extraction. Calculation of resource rent is therefore the first step in developing monetary accounts. The method defined in the 1993 System of National Accounts (1993 SNA) was adopted to calculate resource rent for South Africa's mineral accounts. Accordingly, resource rent for each mineral are calculated as follows:

- Value of output (at producer prices) minus production costs.

Production costs include the cost of intermediate inputs in mining, compensation of employees, consumption of fixed capital, and a normal rate of return on investment capital.

The formula for calculating resource rent R is[15]:

$$R_t = TR_t - IC_t - CE_t - CFC_t - NP_t \quad (1)$$

$$NP_t = i_t K_t \quad (2)$$

Where:

R	= the resource rent
TR	= total revenue from mining sector (output/sales)
IC	= intermediate consumption
CE	= compensation of employees
CFC	= consumption of fixed capital
NP	= 'normal profit', a return to fixed capital
K	= fixed capital stock invested in an industry
i	= the rate of investment considered the opportunity cost of capital

The normal rate of return on fixed capital investments is the opportunity cost or economic value of financial capital that may be invested in alternative profit-making economic activities. The average long-term nominal interest rate minus the prevailing interest inflation rate is used as the rate of return to capital, which is multiplied by the fixed capital stock in mining to derive estimates of normal profits.

In the *Mineral Accounts for South Africa* discussion document[29], the average real rate of interest in South Africa was calculated at 2% for the period 1973 to 1982 and 3% for the period 1983 to 2001[g]. A SDR (r)[h] of 3% and an alternative discount rate of 5% were used for calculations of the resource rent tables (refer to Tables 4, 5 and 6).

The Organisation for Economic Co-operation and Development (OECD) suggests two approaches to the measurement of SDR (r). These are:

- The use of national accounts statistics on operating surplus; and
- The use of market interest rates.

Stats SA decided to make use of the market interest rates approach.

The interest that could be earned and the interest that would be paid are equally relevant for investment decisions; thus the average between interest earned and interest paid should be calculated and then taking the harmonic mean of this averaged series to get to the discount rate[30]. One can use government bond rates (i.e. the R153) for interest paid, and for interest earned the repurchase rate, which in effect is the earning rate government makes from lending money. This way, like-for-like is compared in terms of

[g] Percentages obtained from unpublished data from the South African Reserve Bank.
[h] The letter 'r' refers to the stock formula below and not the SDR previously referred to in this document.

keeping the rates at the government (relatively risk-free) level. But due to the lack of data for government bond rates before 1993 it was decided to use only the repurchase rate[i] to calculate the SDR. The average SDR in South Africa was 11,7% for the period 1980 to 2008.

Average rather than marginal costs were used in calculating resource rent. The unit rent was calculated as total rent divided by the volume of depletion for a specific year.

Due to lack of data regarding intermediate consumption from 1980 to 1992, consumption of fixed capital from 1980 to 2001, and opportunity cost of capital from 1980 to 2001 for the PGM mining sector, these variables were calculated as percentages of output that were derived from ratios of gold. For consumption of fixed capital for 2002 and 2003, and opportunity cost of capital for 2002 and 2003 for gold, PGM and coal, the following method was used (refer to Table 16):

Consumption of fixed capital (2002) = Consumption of fixed capital (2001) / Output (Sales) (2001) x Output (Sales) (2002)

3 439 = (3 295/33 371) x 34 829 (3)

Extract of platinum group metals: resource rent table, 2001–2005

	2001	2002	2003	2004	2005
			Rand millions		
Output (sales)	33 371	34 829	28 824	33 313	38 451
Consumption of fixed capital	3 295	3 439	1 782	2 060	2 428
Opportunity cost of capital					
SDR 3%	1 212	1 265	839	970	1 090
SDR 5%	2 060	2 150	1 398	1 616	1 816
SDR 11,7%	4 463	4 658	3 272	3 782	4 249

For gold and coal, replacement values were used for the consumption of fixed capital and fixed capital stock from 1980 to 2001. Data for consumption of fixed capital for gold, PGM and coal for 2004 were sourced from the Large Sample Survey: Mining industry, 2004 to 2008[13]. For 2005 to 2008, data were sourced from the Annual Financial Statistics[12]. For intermediate consumption, data were only available every third year, i.e. 1981, 1984, 1987 and 1990 from the Census of Mining[11]. The missing years from 1980 to 1992 were calculated using interpolation. Intermediate consumption for gold, PGM and coal from 1993 to 2008 was sourced from the GDP[6]. The data for output (sales) and compensation of employees were sourced from the DMR–SAM: 2007/2008[2b] along with the Statistical Tables: 1986 to 2008[2a].

[i] Repurchase rates were sourced from the South African Reserve Bank (SARB).

2.3 Monetary accounts

The three approaches to calculate monetary accounts are discussed in detail in this section, namely:

- Using environmental expenditure. This is the most common approach in most industrialised economies, reflecting the prime concern about pollution and environmental quality in these countries. This approach works within the existing structure of the SNA 93, leading to minor modifications, especially in definition and classifications of income and expenditure entries.
- Using natural asset depreciation. This approach has been mainly adopted on marketed natural resources such as subsoil assets, timber and fisheries.
- Full environmental accounting. This represents an attempt to accommodate all entries of the more comprehensive physical resource account in the 1993 SNA with money values assigned.

Based on the sets of data available in South Africa, option number three was adopted for calculating monetary accounts. Closing stock or resource asset (at the end of the period) in the monetary accounts for mineral resources in South Africa is calculated as follows:

	Value of opening stock (equal to the value of the closing stock of the previous year)
Less	Value of the depleted stock (valued at the unit rent multiplied by the volume of depletion)
Plus	Value of new discoveries, additions and other volume changes (valued at the changes in the present value due to the increase in the number of years over which production (extraction) can go on at current extraction rates given these new volumes)
Plus	Any revaluation due to time passing (valued by discounting for one year less)
Plus	Nominal holding gain (calculated as a residual)

The formula for calculating the net present value of mineral assets V at period τ is[15]:

$$\mathbf{V}\tau = \sum_{\mathbf{t}=\tau}^{\mathbf{T}} \frac{\mathbf{p_t Q_t}}{\mathbf{(1+r)^t}} \qquad (3)$$

$$\mathbf{p_t} = \frac{\mathbf{R_t}}{\mathbf{Q_t}} \qquad (4)$$

$$\mathbf{T_t} = \frac{\mathbf{S_t}}{\mathbf{Q_t}} \qquad (5)$$

Where:

V = value of the asset
p = unit rent price of the resource
Q = quantity of resource extracted
r = the social discount rate
R = total resource rent
T = the remaining lifespan of the resource
S = the stock of mineral reserves at the close of the accounting period

There are two approaches to the valuation of assets that were adopted namely:

- Annual unit rent; and
- The 5-year moving average approach.

The 5-year moving average approach is utilised as a result of the fluctuating annual price of minerals and hence the value of mineral assets is not best represented by the per unit rent in any single year[31]. To reduce volatility and better represent the longer-term value of mineral assets, a 5-year lagged moving average of the unit rent is used for the mineral accounts.

2.4 Policy analysis

For policy analysis El-Serafy's Use-Cost method was used to help answer the question, 'How much of resource rent should be consumed and how much should be reinvested to maintain a constant stream of income?'

The Use-Cost method is a measure of sustainable use of minerals. It divides resource rent into two components:

- Capital component: part of resource rent that needs to be reinvested to maintain a constant stream of income; and
- Income component: residual amount that can be consumed as current income.

2.4.1 The capital component

The part that must be invested depends on the following two factors:

- Remaining life expectancy of the resource; and
- The real rate of return earned on the amount saved.

The share of rent that can be consumed as income (X) is calculated as:

$$\mathbf{X_t} = \mathbf{R_t}\left(\mathbf{1} - \frac{\mathbf{1}}{(\mathbf{1}+\mathbf{r})^{\mathbf{N}+\mathbf{1}}}\right) \qquad (6)$$

Where:

X = the share of rent that can be consumed as income
R = the total resource rent
r = rate of return
N = number of years to depletion that can take place at current rate

The remaining amount of resource rent (R-X) must be reinvested.