REPORT R75/2009

SUPPLY DEMAND DYNAMICS OF BASE METALS VERSUS PRICES, 1997 - 2006

DIRECTORATE: MINERAL ECONOMICS

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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Compiled by: Thomas Chili, Mathabo Ikaneng, Refiloe Motsie & Eunice Pitso
Email: Thomas.Chili@dme.gov.za
Mathabo.Ikaneng@dme.gov.za
Refiloe.Motsie@dme.gov.za
LetsieloEunice.Pitso@dme.gov.za

Issued by and obtainable from
The Director: Mineral Economics, Mineralia Centre,
234 Visagie Street, Pretoria 0001, Private Bag X 59, Pretoria, 0001
Telephone: (012) 317 8538, Fax (012) 320 4327
Website: http://www.dme.gov.za

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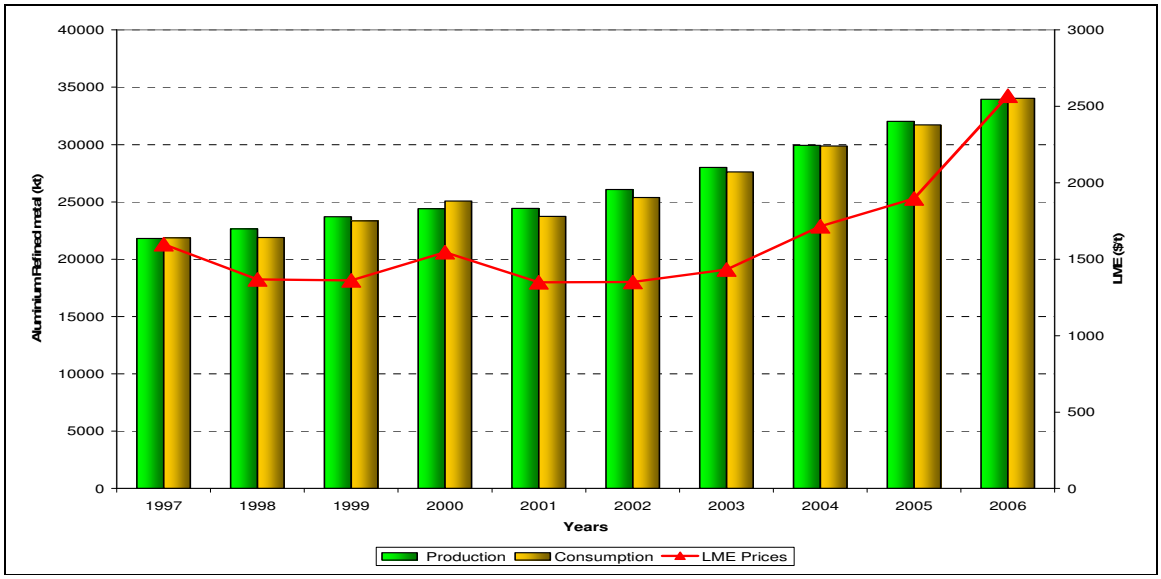
1. Aluminium

1.1 Demand

Over the last decade (1997-2006), global consumption of refined aluminium increased at an annual rate of 5 percent from 21, 86 Mt in 1997 to 34, 02 Mt in 2006 (Figure 1). Demand for refined aluminium is driven by transport at 26 percent, followed by construction and packaging at 22 percent each, as well as machinery and electrical at 8 percent each (Figure 2). During this period, Chinese consumption of aluminium grew at an average of 4, 9 percent per annum from 1, 94 Mt in 1997 to 6, 19 Mt in 2006, driven by growth in the production of automobiles, followed by housing and infrastructural development.

Figure 1: World refined aluminium production, consumption and LME price (1997-2006)

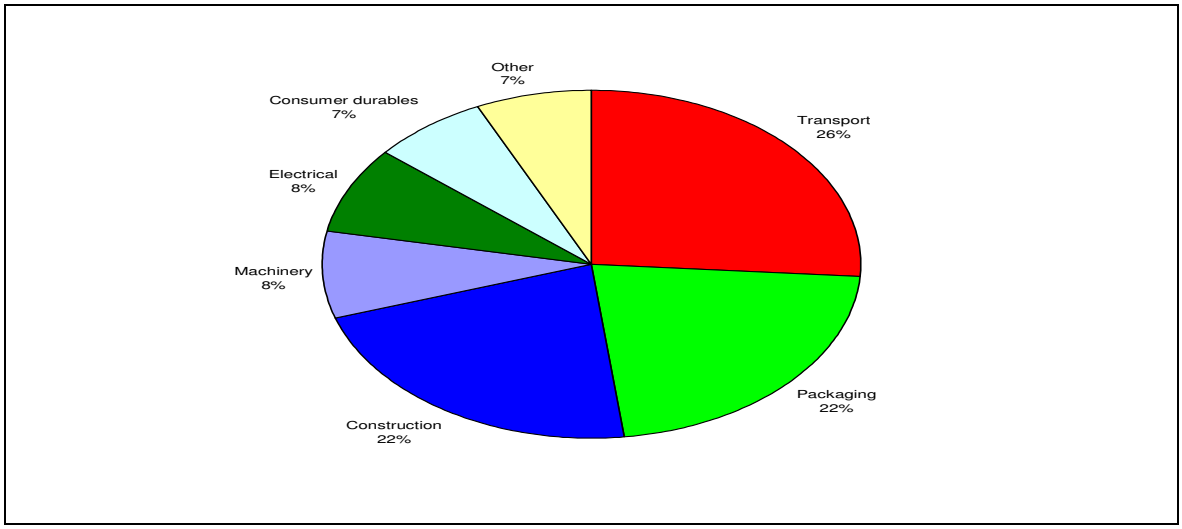


Source: Wold Metal Statistics Yearbook

1.2 Supply

Over the period of four years (1997 to 2000) USA ranked number one as the major producer of refined aluminium production, with production growing from 3, 6 Mt in 1997 to 3,66 Mt in 2000 followed by Russia and Canada. During this period, USA production increased at an annual rate of 0,7 percent while Russia's increased by 3,7 percent and Canada by 6, 6 percent. However, China overtook USA as the major producer as it raised production from 2, 03 Mt 1997 to 3,37 Mt in 2001, while the USA dropped from 3,6 Mt to 2,6 Mt over the same period as the result of an increase in energy cost. A global production growth rate of 4, 5 percent over the period of five years was recorded as the major producers rejuvenated previously idled capacity and a new capacity was brought on stream.

Figure 2: Sectorial demand of high grade primary aluminium

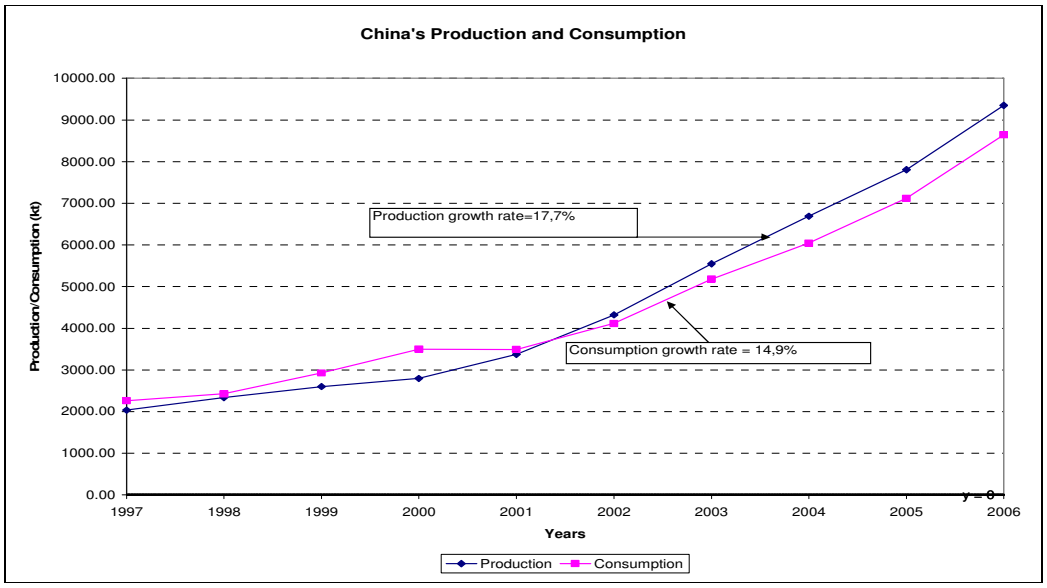


Sources: London Metal Exchange

High levels of inventory stock held by both LME and non brokers put a downward pressure on prices, with prices dropping from $1 599/t in 1997 to $1 349 in 2001 (Figure 1). However, tight market conditions brought about by depletion of stocks and supplies between 2002 and 2006 exerted an upward pressure on prices. Consequently, prices rose by 47 percent to $2 569/t in 2006. Further market tightness persisted through 2006 with the market

swinging into deficit from mid 2006 onwards; driven by strong demand by Asia (16 Mt) and America (8, 4 Mt).

Figure 3: China's production and consumption (1997-2006)



Source: Wold Metal Statistics yearbook

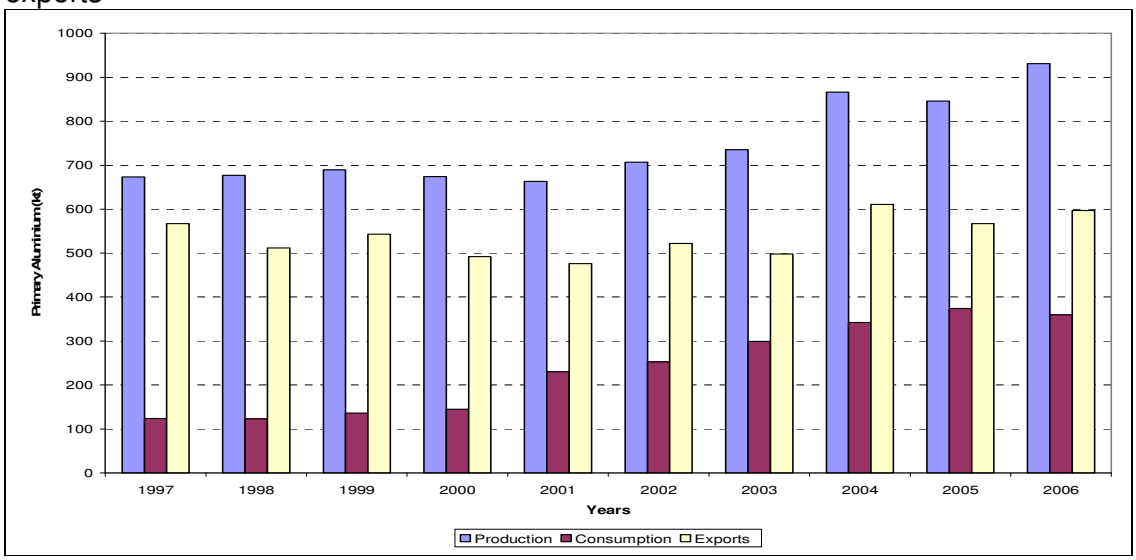
1.3 South Africa's Developments

South Africa's aluminium industry is one of the largest sectors in non-ferrous metals, despite the country having no known economical viable deposit and thus importing all of its feedstock from Australia. The industry is segmented into primary and secondary rolled products and extruded products. Locally, primary aluminium is converted into rolled products, casting, de-oxidants, redraw rod, direct cast and powder and paste.

Over the past decade, the country produced 7,46 Mt of primary aluminium, of which, about 31, 1 percent was consumed locally and the balance exported. Over this period, local production grew at an average annual rate of 3,6 percent from 673 kt in 1997 to 931 kt in 2006, mainly as a result of capacity expansion, particularly the completion of BHP Hill Three Expansions project (Figure 4). Revenue from local sales amounted to R6, 05 billion while exports mounted to R9, 8 billion in 2006. Exports grew at the average annual rate of 1, 15 percent from 567 kt to 597 kt over the past decade while local

consumption grew at the rate of 14, 4 percent per annum from 102 kt to 360 kilotons.

Figure 4: South Africa's primary Aluminium production, consumption and exports



Source: South Africa's Mineral Industries

1.4 Outlook

Aluminium production is expected to increase by 8 percent as new additional capacity comes on stream. The expansion are expected from Alcoa's (344 kt) Nordulal's Grundartangi smelter (40 kt), Alcan ISAL smelter expansion (280 kt) in 2010, while Russia's Rusal is expected to increase production to 5 Mt in 2013. While Aluminium production is expected to rise by more than 8 percent, prices are expected to fall by 8 percent to $2 350/t as the markets are expected to swings back to a state of equilibrium.

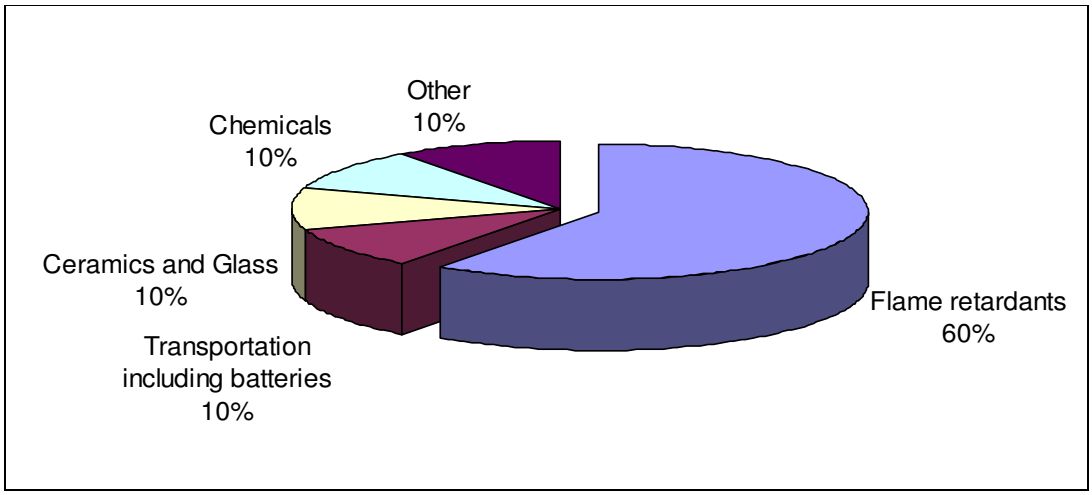
2. Antimony

2.1 Demand

Demand for antimony is mainly driven by the flame retardants sector, which account for about 60 percent of primary antimony demand and 90 percent of the demand for antimony trioxide. Other uses are in ceramics, batteries and chemicals (Figure 5). Over the past decade (1996–2006), global demand for antimony concentrates has risen above supply due to the high growth of

antimony trioxide metal in the production of flame retardants, with China and the United States of America as major consumers.

Figure 5: Global antimony consumption by sector



During 2003, demand for antimony declined as consumers looked for cheaper substitutes driven by prohibitively high prices. In the US, which along with Japan and Korea, provided the major markets of consumption, imports of ore concentrates dropped to an estimated total of 24,4 kt in 2004 against 26,7 kt in 2003.

2.2 Supply

China accounts for about 80 percent of the World's mine and antimony metal production, followed by the Commonwealth of Independent States (CIS) at 4,9 percent and South Africa at 4,1 percent respectively.

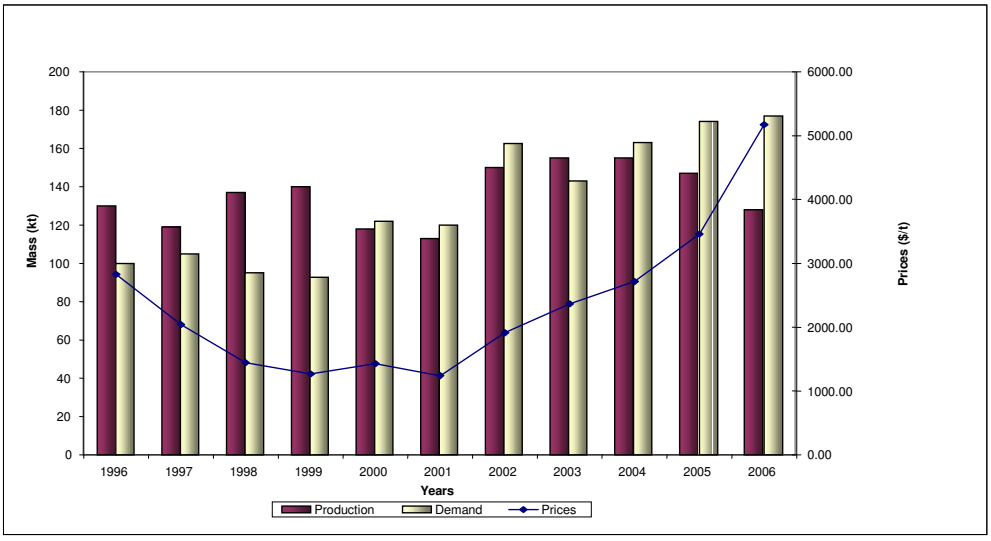
World antimony production declined by 4,2 percent from 118 kt in 2000 to 113 kt in 2001 (Figure 2), due to a 5 percent decrease in China's mine and metal production owing to the mining disaster that led to a cut in production. This situation led to increased supply deficit in antimony. In addition, wide ranging policy reforms by the Chinese government aimed at resource conservation, orderly development, mine safety and environmental protection had a combined effect on the reduction of production and exports.

Between 1996 and 2006, Chinese exports of antimony trioxide grew from 20 kt to 41 kt, while the U.S. production fell by 94 percent to 1,5 kt in 2006. Over the same period, global antimony production grew marginally at a rate of 1,42 percent per annum with demand exceeding supply. Production has been lagging behind demand since 2000 (Figure 6).

2.3 Prices

Antimony prices have risen from a 40 year low of $1 241,65/t in August 2001 to a record high of $5 171,99/t in 2006 as a result of the growing global deficit of antimony concentrates (Figure 6). Furthermore application of more stringent flammability standards and the dependence of the flame retardant sector on antimony trioxide metal are expected to exert a further upward pressure on prices, which could reach $6 000/t by 2010.

Figure 6: Global antimony production, consumption and prices (1996 – 2006)



Sources: Demand determined from various sources and analysis
Production obtained from BGS and USGS data

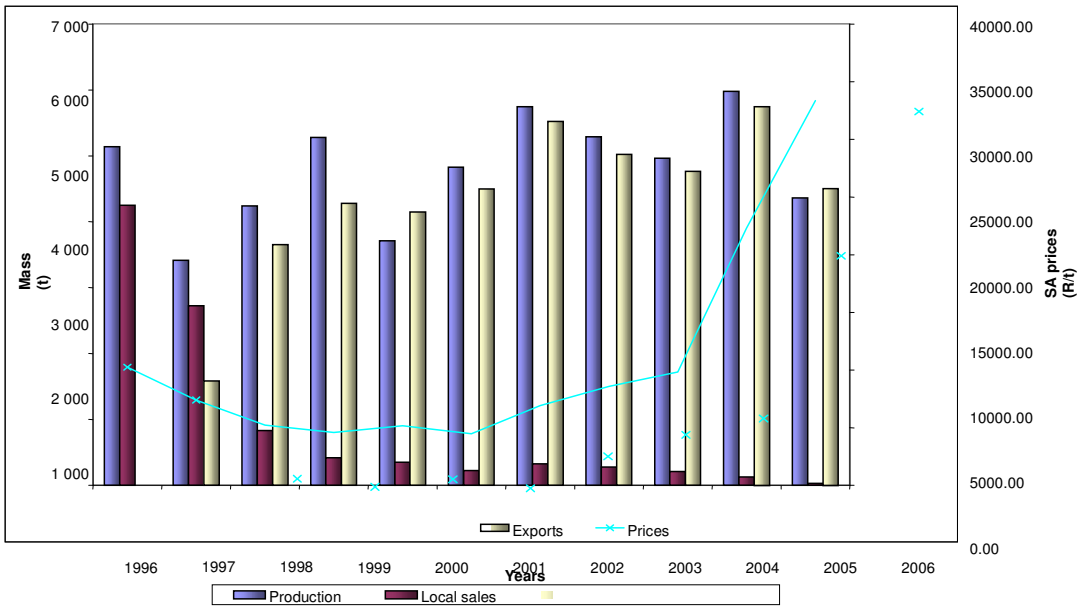
2.4 Developments in South Africa

For the period 1996 – 2006, South Africa produced a total of 53 kt antimony concentrates. During this period, production fluctuated between 3,4 kt and 6 kt per annum with a growth rate of 2,13 percent over the years (Figure 7).

In 2001, South Africa's antimony concentrate production increased by 30 percent from 3,7 kt in 2000 to 4,8 kt following the reopening, equipping and development of the Beta Shaft at Consolidated Murchison mine. In the same period, local sales of antimony dropped by 34,3 percent to 0,23 kt and export sales increased by 7,1 percent to 4,5 kt in 2001. The low prices experienced in 2000 and 2001 were due to a neutral global supply demand balance.

Local producers continued exploiting the rising trend in prices as well as the weaker local currency. Consequently, local sales plummeted to a low of 31 t in 2006 as exports surged to R 33 358/t compared to R 10 252/t in 1996 (Figure 7).

Figure 7: South Africa's antimony production, consumption and exports (1996 – 2006)



Antimony production slowed down in 2004 due to declining demand as consumers opted for substitute products driven by the prohibitively higher antimony prices. Up to 50% of the antimony is replaced by alternative products like zinc borate in markets such as flexible PVC, due to the relative cost reduction to antimony trioxide. However, depending on the applications,

antimony trioxide continues to be used in sectors where high flammability standards are imposed.

2.5 Outlook

Antimony consumption is expected to continue its upward trend on the back of increasing demand from the flame-retardant sector following stringent flammability laws and regulations being applied by developing countries, the world over. Demand for antimony trioxide in this market is forecast to rise by 7,5 percent per annum from an estimated 146 kt in 2008 to 162 kt by 2010.

Production constraints in China and the clampdown on illegal mines and smelters could further slow down the world supply of antimony and maintain or exacerbate supply deficit in the short term. However, the planned installation of new capacity in China could bring the trioxide market back to a state of equilibrium by 2010.

Moreover, planned installation of capacity in Australia, America, Russia and South Africa could swing the market to a positive supply demand balance situation and exert a downward pressure on prices. Furthermore, successful re-utilization of mothballed capacity in Europe could contribute positively to antimony supply, depending on weather the prices are attractive enough to absorb the high costs of these operations.

Future prices of antimony are expected to rise to $6,000 per tonne and remain at or around this level up to 2010, in view of more stringent standards in the flame retardant sector and the persistent demand for antimony trioxide metal.

3. Cobalt

Over the past decade, not much has changed in the cobalt production profile. Cobalt is produced as a by-product in copper and nickel mining activities, with 48 percent of the global cobalt production produced from nickel mining,

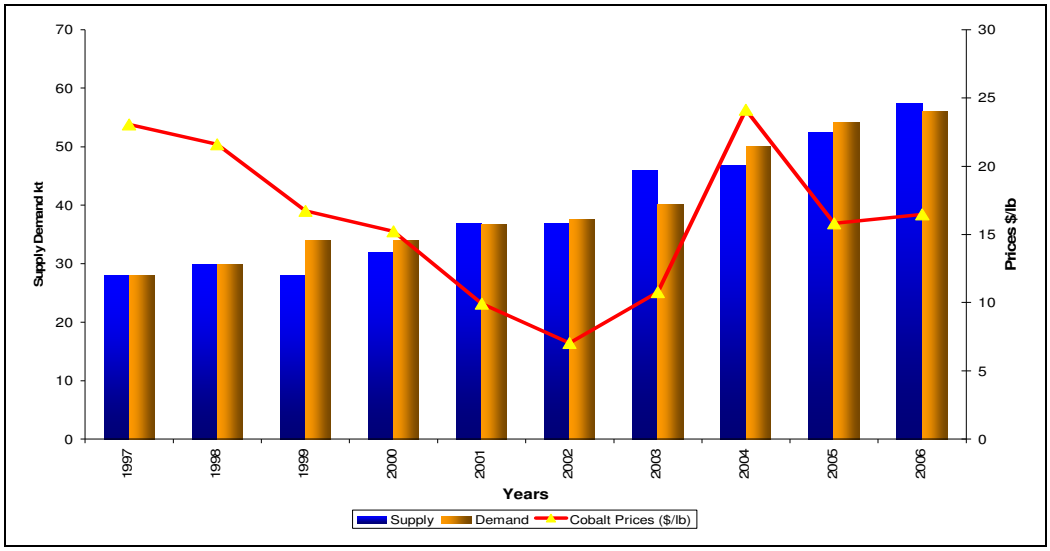
followed by 37 percent from copper industry and 15 percent from primary cobalt operations.

3.1 Supply

World mine production of cobalt has more than doubled over the last decade, from a total production of 27, 9 kt in 1997 to 57, 5 kt in 2006. This increase corresponds to an annual average production growth rate of 8, 5 percent, with year to year growth rate ranging from 4, 3 percent to 11,9 percent.

The total world refined cobalt production amounted to 53, 7 kt in 2006, a 6,8 percent compound annual growth rate compared to 28,7 kt in 1997. China has emerged as the single largest producer of refined cobalt, with world market share of about 24 percent. Much of China's refined cobalt production were sourced from cobalt-rich ores of the Democratic Republic of Congo.

Figure 8: Cobalt supply-demand versus prices



Source: South African Minerals Industries

3.2 Demand

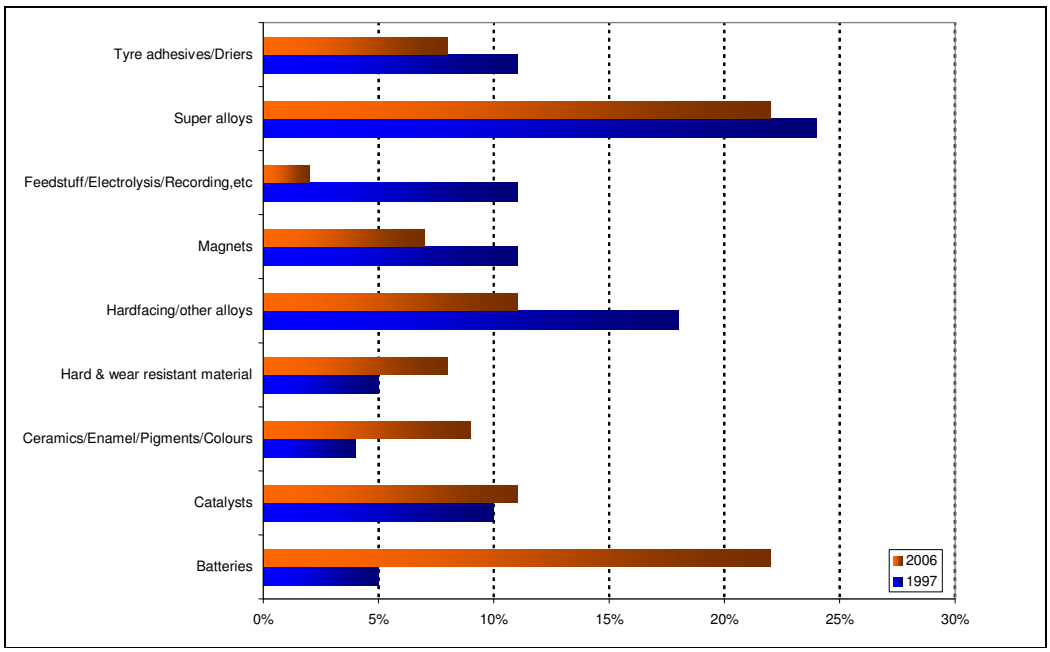
Demand for cobalt has grown at a compound annual growth rate (CAGR) of 6, 6 percent over the past decade (Figure 8). The notable increase in the demand in recent years is almost exclusively as a result of the increased demand for the metal in China and Japan. The apparent demand in Asia has increased by about 80 percent since 2002. The demand for refined cobalt

was around 56kt in 2006, of which an estimated 50 percent was used in chemical applications.

3.2.1 End user demand

In terms of the end use market demands, there has been a significant change over the past decade (Figure 9). A large portion of the increased demand for cobalt in the period 1997-2006 was due to the sustained growth in production of rechargeable batteries, which represents 22 percent of the total world cobalt consumption, relative to 5 percent in 1997. Demand for cobalt in super-alloys has risen substantially and is expected to continue trending upwards for the next few years, in line with the increase in the number of new commercial aircrafts being manufactured, defence procurement and demand for gas turbines to produce electricity.

Figure 9: Cobalt demand by end user, 1997 versus 2006



Source: Cobalt news

3.3 Prices

The face of cobalt marketing has changed fundamentally as more producers started marketing their products online at the end of the 1990's. A number of

trading companies also joined the producers and began offering a buying and selling service through the internet.

Panic buying by consumers driven by fears of supply shortages and disruptions drove prices down between 1997 and 2005 (Figure 8). Furthermore, despite the high demand for the commodity in China, the prices remained depressed as the Chinese utilised whatever excess there was in the market due to prolonged positive supply demand balance situation. The persistently high demand swung the market into deficit thus driving the prices up. By December 2006, the market was excessively undersupplied due to the increase in Chinese demand and the supply constrains of raw material from the Democratic Republic of Congo resulting in prices soaring to $25/lb in 2004.

3.4 Developments in Africa and South Africa

In South Africa, cobalt is produced as a by-product of nine platinum-group-metal (PGM) mines. According to available data, there is an annual compound growth rate decline of 1,5 percent in South Africa's cobalt production. In 2006, the total cobalt production was 266,8t, a 13 percent decline compared to 317t in 1997. Approximately 10 percent of the locally produced cobalt is sold locally and 90 percent is exported. The total revenue generated by cobalt sales is R648 million over past ten years of which, 91 percent (R587 million) was generated from the export market and 9 percent (R60 million) from the local market.

Africa plays a vital role in the global cobalt markets, with African countries such as Democratic Republic of Congo (DRC), Zambia, Morocco and Uganda contributing significantly to the world production. In 2006, the Democratic Republic of Congo was the top producer of cobalt, with 38,3 percent of the world share, followed by Zambia at 5 percent.
Annual refined cobalt output has also declined from 6110t in 1996 to 550t in 2006 in the DRC, the world number one producer of cobalt, due to the moratorium on the export of raw concentrates from the country.

3.5 Outlook

As demand for cobalt continued to grow since the beginning of the new millennium; modest growth rate of about 3 percent is predicted for the coming years. With the continued growth in industrial development in China, demand for cobalt across the end-user spectrum looks positive. The current refined production is about 54kt, it is predicted that the rate of consumption could reach 65kt by 2011. This situation suggests that the market could be in deficit by 11 kt based on the current supply. However, such a deficit might not materialise if the expected new sources for cobalt are realised. The Democratic Republic of Congo is expected to play a major role in responding to the surging demand as 65 percent of new production is expected from projects in that country. The Americas and Australia will each contribute about 15 percent and the remaining 5 percent will come from Asia. The bulk of the production is scheduled for 2009/10.

The persistently high prices driven by the uncertainty of future supplies, high cobalt consuming sectors are looking at ways of substituting cobalt with limited effect on the markets. Nonetheless, sectors such as superalloys, catalysts, gas-to-liquid technology and electric hybrid vehicles will continue to drive the growth in the demand for cobalt globally. In the short term, prices are expected to remain volatile but will soften with the development of new projects.

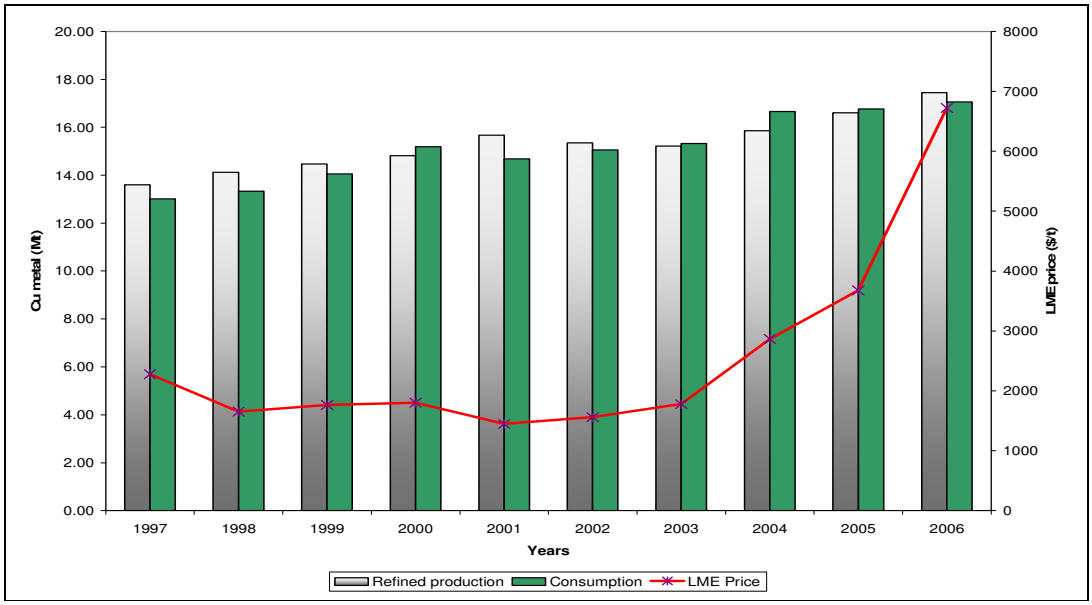
4. Copper

Population growth and economic development over the past decade (1997 to 2006) have continued to support the global demand for copper. The demand for refined copper is tied to its main driver construction, which accounts for 37 percent of global consumption followed by electrical power, automobiles, plumbing supplies, telecommunication devices and air conditioners. The global construction, electrical power and appliance growth are highly dependant on the world population growth.

4.1 Supply and Demand

The world refined copper consumption achieved a steady annual growth rate of 3,2 percent from 13,6 Mt in 1997 to 17,4 Mt in 2006 (Figure 10). World refined copper production's has risen at an annual growth rate of 3 percent from 13,61 Mt in 1997 to 17,44 Mt in 2006. Chile has dominated in the world mine production accounting for 35 percent, followed by USA at 8,1 percent, Peru at 6,9 percent and Indonesia at5,3 percent in the past ten years.

Figure 10: World production, consumption and prices of refined copper



Source: World Bureau of Metal Statistics, DME statistics

China's refined consumption grew at annual rate growth rate of 13,2 percent followed by Germany (0,9 percent) over the past decade. Copper production increases have not been able to keep up with demand, which resulted in supply/demand deficit in 2004 (Figure 10).

4.2 Prices

Copper exchange inventories have been available to fill up the demand deficit gab but, reduced to critical low level in 2005 as copper demand increased. London Metal Exchange (LME) copper warehouse inventory fell to the lowest level declining from 855 kt in 2002 to 48,9 kt in 2004 resulting in high price from $1 559/t in 2002 to $2 865,75/t.

The rapid economic growth in China has raised the level of demand for copper and hence put an upward pressure on the LME refined copper price which resulted in soaring copper prices averaging $6 723,54/t in 2006 representing an increase of 83 percent over the average price of 2005 (Figure 11).

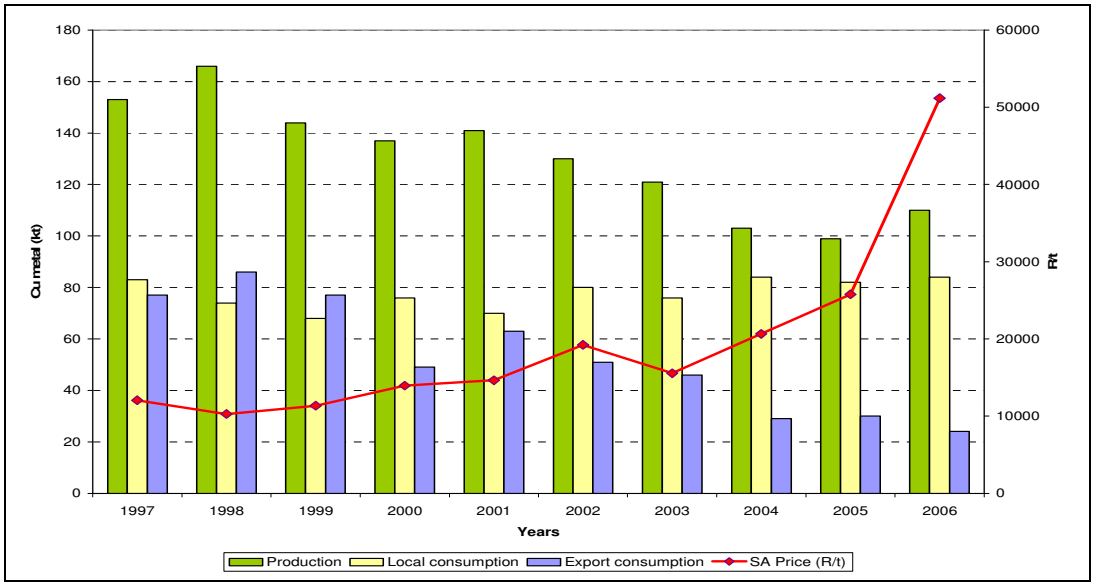
LME prices averaged at the constant rate of $1 750,64/t over the period of five years (1997 to 2001) as the result of oversupply and demand buoyancy. As the stock levels dropped between 2002 and 2006 prices improved, recording a 3,6 percent growth over the period.

4.3 Developments in South Africa

South Africa has about 13 Mt copper reserves and accounts for 1,4 percent of world production, primarily sourced from Palabora Copper Mine and the balanced contributed as by-product from Platinum mines.

South Africa's copper production showed a continuous negative trend over the past decade, declining by 5,2 percent from 153 kt in 1997 to 110 kt in 2006 (Figure 11). The negative trend in production resulted from closure of Messina (1992); Prieska (1993), Spoedwel and O'kiep (2004) as the result of depleted ore reserves. This was compounded when Palabora Copper Mine ceased its open pit mining operation and commenced with underground operation that resulted in operational and hoisting constraint. In addition, Metorex South Africa discontinued its copper slag treatment operation. Local consumption of refined copper rose at an annual growth rate of 4,2 percent from 83 kt in 1997 to 84 kt in 2006 (Figure 11). Exports decreased at an annual rate of 12,6 percent from 77 kt to 24 kt over the past decade.

Figure 11: South Africa's copper production, consumption and prices



Source: World Bureau of Metal Statistics, DME statistics

The South Africa's copper price, rose from R14 648/t in 2001 to R19 236/t 2002 as the rand depreciated. However, in 2003 the rand regained its strength against the weakening dollar, which was also weakening against the world major currencies as results of continued war in Iraq, which affected world markets negatively. This resulted in the sharpening of South Africa's rand price from R15 556/t in 2003 to R51 185/t in 2006.

4.4 Outlook

High copper prices are expected to encourage the development of additional world mine production. Xstrata, Codelco and Anglo American anticipate a 3, 1 million tons additions in copper mining from their planned greenfield projects at EL Pachan, Las Bambas, Tampakan Antopaccay and Frieda River. Collahuasi expansion joint venture is expected to raise production to 650 kt by 2010 at a cost of a $660 million. Olympic Dam expansion (owned by BHP Billiton) is at pre-feasibility to produce 200 kt.

The global demand for refined copper is forecast to grow at an annual rate of over 3,5 percent to reach 18 Mt annually in 2009. The largest increases in

copper demand are expected to come from Asia, led by China. Supply is expected to be tight in 2008 because of low-level stock and projects that are planned to salvage copper supply deficit are still in the pipeline.

5. Lead

South Africa is a small player in the lead industry as compared to other countries such as China, Australia, United States and Peru. World reserve base for lead is 140Mt and South Africa contributes only 3Mt, which is equivalent to 2 percent of the world total and is ranked number five globally. Lead is the one of the most widely used non-ferrous metals after aluminium and copper and is a vital material in everyday life. It is mined and smelted in many countries both the developed and developing world. An increasing proportion of the supply of lead (over 50%) is being met by recycling. Consumption is predominantly in industrialised countries but is increasing rapidly in the developing world.

5.1 Supply

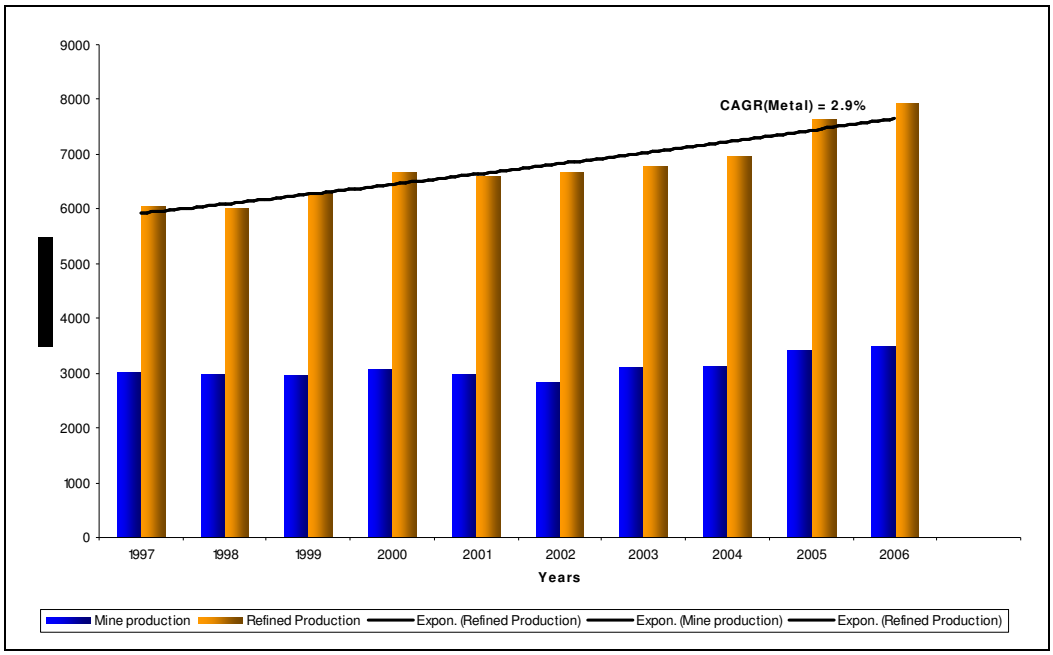
5.1.1 Mine

World lead production grew at an annual growth rate of 2,9 percent from 3023 kt in 1997 to 3473 kt in 2006 (Figure 12). Global lead mine output fell by 0.9% from 2001 to 2004, this was primarily due to recent mine closures in Canada and Macedonia and reduced output from existing operations in Bulgaria, China, Poland and South Africa. Lead mine closures in Canada have resulted in halving of the country's output over the period 1999 to 2003.

Australia, China and the United States remained the largest producers of lead concentrates during the period 1996 to 2006. In 2003 the three countries accounted for over 60% of world output. Chinese net imports of lead contained in lead concentrates from the West increased by 68% to a record 337,000 tonnes.

Growth in the lead industry has been overwhelming and the principal use of lead was in the lead acid battery manufacturing. In 2001, almost three quarters of world lead production was applied in battery manufacturing.

Figure 12: Global mine production vs metal production (1997-2006)



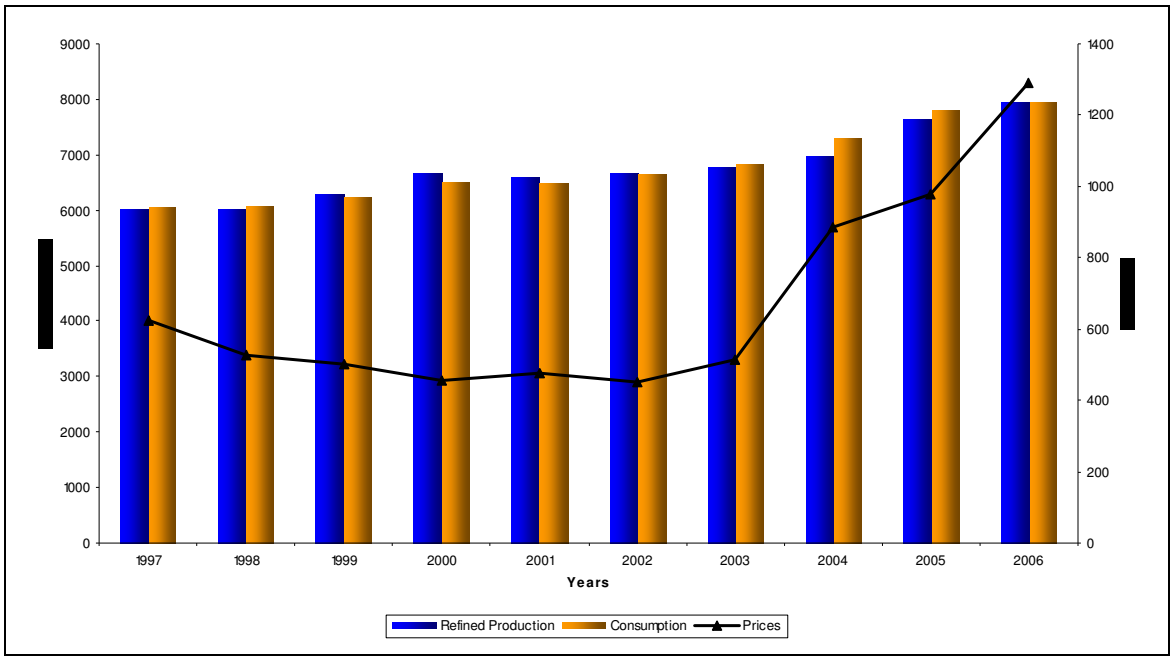
5.1.2 Metal

Recycling is the major feature of the base metal business and, considerably more lead is now recycled than mined, of the base metals. More than half of the world' consumption comes from recycled source. In the major economies, recycling of lead is a mature business, and biggest economy. In the United State 93 percent of batteries are recycled.

While the lead battery has the market for SLI (starter, light and ignition), there is increasing demand for stationary and electric vehicle batteries. While lead is constantly meeting this market challenge, it is also proving its sustainable development credentials.

Globally, for the past tens years, metal production and consumption have been very tight. Despite a significant 12.5% increase in China, global output of refined lead metal has shown stability with more increase from 2004 to 2006.

Figure 13: Metal production, consumption and prices (1997-2006)



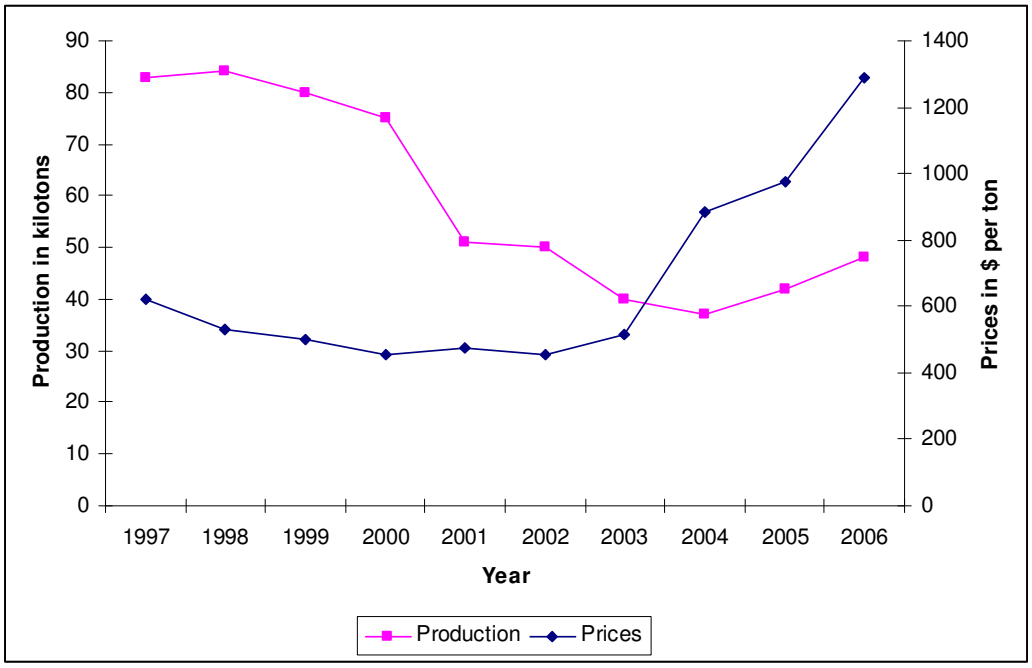
5.2 Prices

Lead prices have been declining for years and, while the price has been falling; demand for lead has been growing fairly steadily. However, in 2003 then the prices increased dramatically by about an average of 2 percent and prices are still increasing up to date (Figure 13). However, despite this growth in demand, if supply-demand is imbalance, there will the familiar depressing effects on price.

5.3 South African Development

Black Mountain is the sole source of lead concentrate supply. From the period of 1997 to 2004 (Figure 14) lead production have been decreasing dramatically while the prices were stable, this may be attributed to closure of some operations due to depletion of the reserves. From 2004 to 2006 production increased a little bit but the prices shot to more than twice the amount in 1997.

Figure 14 South Africa's Lead production and prices



5.4 Outlook

The current outlook for World supply and demand for lead was presented during ILZSG's 52nd Session on 4-5 October 2007 and the following forecast was published:

• Global **lead usage** is forecast to increase by 4.1% in both 2007 and 2008 to 8.32 million tonnes and 8.67 million tonnes respectively

• Global **lead mine production** is forecast to increase by 5.5% to 3.64 million tonnes in 2007 and 10.4% to 4.02 million tonnes in 2008. The principal rises will be in China and Bolivia

• Driven primarily by increases in Canada, China, India, Kazakhstan, Poland, the United Kingdom and the United States global **output of refined lead metal** is expected to rise by 3.9% to 8.23 million tonnes in 2007 and by 5.4% to 8.67 million tonnes in 2008.

Because much of the world's primary lead is mined together with zinc, the future of lead supply may have been influenced somewhat by the course of the zinc industry. However, the dominant factor in the future of lead will be the rate growth in demand and the maintenance of the market position of batteries.

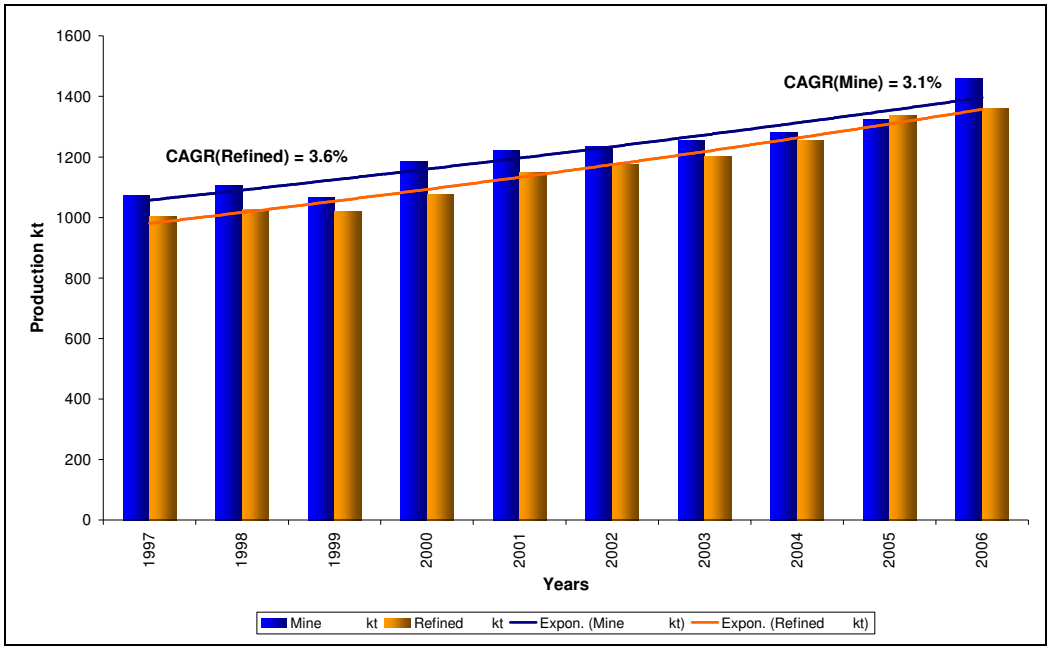
6. Nickel

Growth in the world economy in the last ten years has continued to support the rising nickel production. The usage of primary nickel is tied to its main driver, the production of stainless steel, which accounts for 67 percent of the annual volume of this primary nickel usage. The momentum of the world stainless steel consumption is highly dependant on the global economic situation, and on average, nickel has achieved a long term annual growth rate of almost 6 percent since the 1950's, to reach nearly 1,4 Mt in 2006.

6.1 Supply

World nickel mine production compounded annual growth rate is 3, 1 percent from 1074, 3kt in 1997 to 1400kt in 2006 (Figure 15). According to the United States Geological Survey, the top five producers (including percentage of world production) were Russia (20,6 percent), Canada (14,8 percent), Australia (12,3 percent), Indonesia (9,3 percent) and New Caledonia (7,2 percent). World refined nickel production has risen at a compound annual growth rate of 3, 6 percent from 1004.1kt in 1997 to 1356,7kt in 2006.

Figure15: Production growth rate for mined and refined nickel

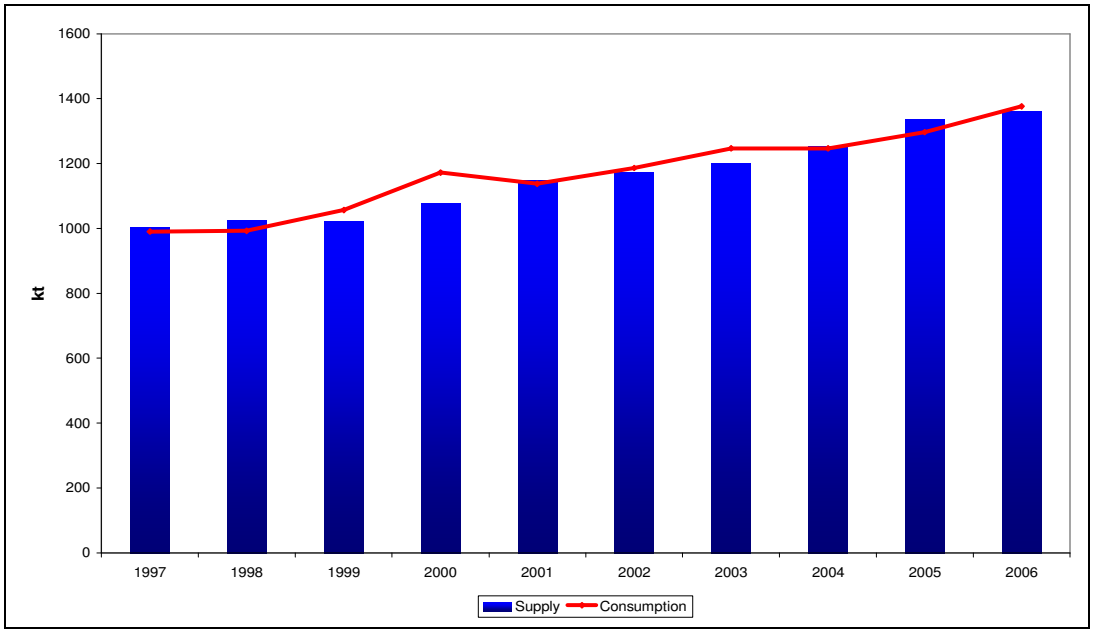


Source: South African Minerals Industry, DME, 2006/2007

6.2 Demand

Growth in the nickel industry has been driven by the demand for stainless steel market which has grown at a compound annual rate of 3, 8 percent in the past decade (Figure 16). The production of stainless steel has increased globally, particularly in China. China's stainless steel production has soared, with the country now accounting for about a quarter of global output. Chinese nickel imports were up 19, 2 percent in 2006 despite the impact of high prices for the metal.

Figure 16: Nickel supply versus consumption



Source: South African Minerals Industry, DME, 2006/2007

6.3 Prices

The rapid economic growth in China has raised the level of world demand for nickel and this has put an upward pressure on the nickel prices, resulting in nickel prices soaring from $6 927/t in 1997 to $24 246/t in 2006. Nickel prices have risen to their highest levels since 1989. The high prices can be attributed to a number of factors, including the depletion of nickel stocks, the increased demand in the rechargeable battery sector. Countries like Japan, China and India are moving towards substituting ferritic stainless steel for austenitic steels which uses manganese instead of nickel.

6.4 Developments in South Africa

In South Africa, nickel is mined predominantly as a by-product of Platinum Group Metals, accounting for 87 percent of the total output while about 1 percent arises from copper mining, i.e. Palabora Copper Mine. There is only one operation in South Africa which primarily mines nickel, the Nkomati Nickel and it produces about 12 percent of the country's total output.

Over the past decade, South African nickel production has increased from 34,8kt in 1997 to 41, 8kt in 2006, a marginal increase of 2.1 percent. The record high prices have increased South African nickel sales over the last decade by 20, 6 percent to R6, 78 billion in 2006.

South Africa's nickel output is expected to increase in the future, with Nkomati Nickel mine's phase 2 expansion project projected to increase the average annual production of nickel to 20,5kt over 18 years and the estimated 1886kt of nickel resources available in new PGM projects over 30 years.

6.5 Outlook

World primary refined nickel production was at 1,36Mt in 2006 and, it is estimated to increase to 1,57Mt in 2008. With the Asian thirst for nickel not expected to significantly taper off anytime soon, and the demand for stainless steel goods increasing, world primary nickel consumption may increase to 1,47Mt in 2008.

The high nickel price spike has impacted on both the supply and demand of the nickel industry. Due to these high prices, many stainless steel producers, representing the largest single demand for nickel, are diversifying, switching more of their output to low nickel or nickel free alternatives such as the introduction of processes to produce nickel-free 400 series stainless steel. This will result in large inventory build of nickel and subsequent reversal in the market perception regarding the supply and demand dynamics for nickel.

7. Zinc

Like lead, zinc is a significant contributor to the world economy, both metals continue to have important and well established industrial use in modern society, and their consumption is growing, year by year. Yet globally, producer in the late 1980's and early 1990's have had to endure very poor profitability, with zinc in chronic oversupply and prices at very low levels.

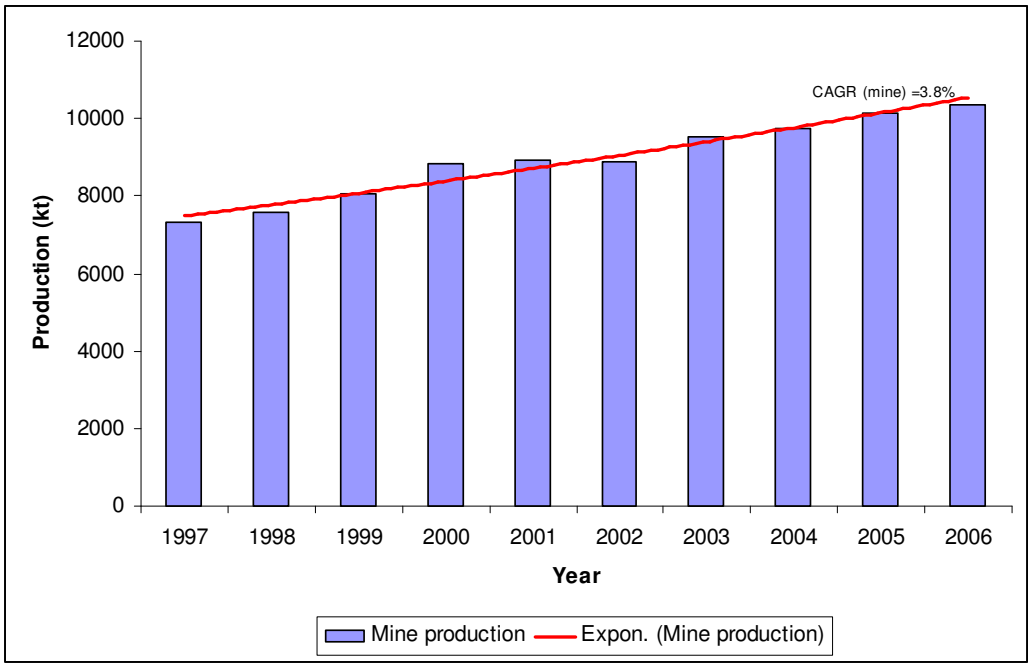
7.1 Supply

7.1.1 Mine

Global mine output have been increasing steadily with an annual growth of 3,8 percent from 7 338 kt in 1997 to 10 346 kt in 2006 (Figure 17), and this was recorded as a surplus. However, despite growth in demand, production seems to have depressing effect on the price in the 1990's.

In the 1990,s the zinc industry failed to adjust to the increase of zinc production that emanated from the Eastern Europe and China. Throughout that period, China accounted for almost two thirds of the total world growth in zinc supply and, while the demand for zinc is growing, it continues to be outstripped by supply.

Figure 17 Global Mine Production (1997-2006)



7.1.2 Metal

World refined zinc production has been increasing steadily for the past 10 years. Refined zinc declined slightly by 0,9 percent to 10 268 kt during 2005, while consumption decreased by 0,1 percent kt to 10 628 kt in 2005 (Figure 18).

Although zinc will never reach the level of lead in recycling, it is increasingly being recycles (about 30 percent). Despite the established position, zinc has provided very poor returns on investment in the 90's, and particularly in 2001. Producers of half the world's zinc were understood to be sustaining cash losses at the prices then.

7.2 Demand

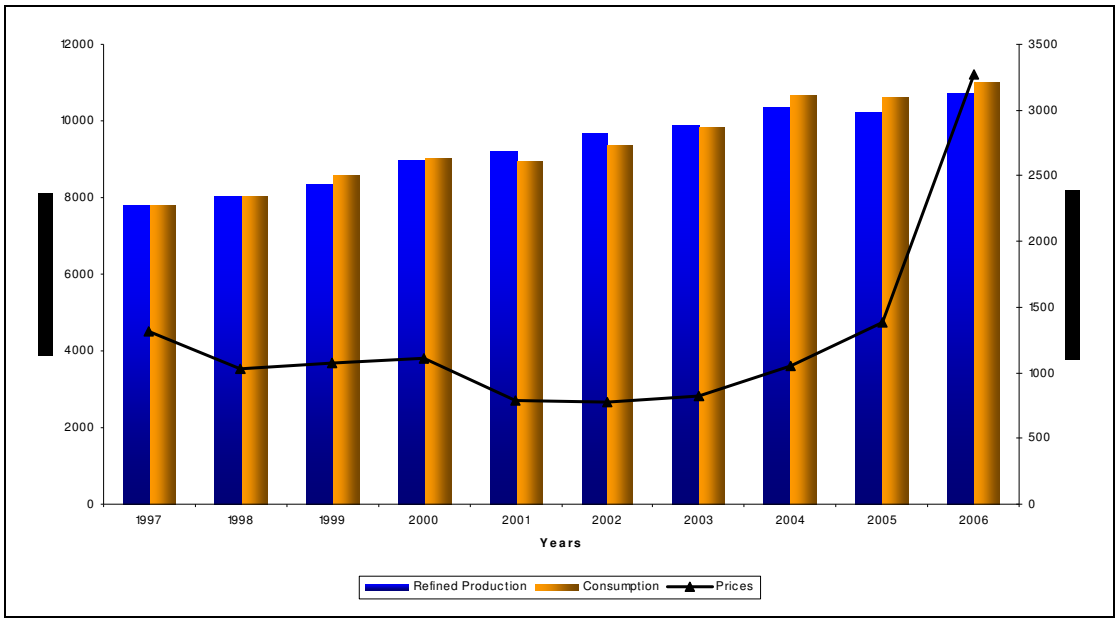
Zinc usage is dominated by the galvanising of steel which has been increasing to the point where it accounts for half of the Western World consumption of zinc. However, steel protection is also the area that offers the most opportunity for growth in zinc consumption.

Demand for zinc has doubled over the past ten years, and can be expected to continue to increase with economic growth, particularly in the developing countries. However, despite this growth in demand, if production continues to increase as anticipated, supply will still be in surplus, thus depressing the effect on prices.

7.3 Prices

It is well recognised that the real prices of base metals have been declining for years. However, the fall in the zinc price has been particularly, highlighted by the fact that in late 2001, the US dollar price fell to the level of previous 15 years. The pricing formula does allow for charges to vary from agreed base rate with the metal prices, and this provides some incentive for smelter/refineries to see the price rise.

Figure 18: fined zinc production consumption and prices



In 2001, supply deficit and LME stocks were at low level. In 2006 three Month prices on the LME averaged US$1285 and US$1280 respectively, 31.7% and 36% higher than in 2005. The highest Cash Settlement Price of US$1,809 was recorded on 11 December 2006 and the lowest of US$915 on 20 June 2006. At the end of 2006 stocks of refined lead metal held in LME warehouses amounted to 41kt, 3kt lower than at the end of 2005. Stocks reported by producers declined by 8kt.

7.4 South African Development

In South Africa, there remains only one producer of zinc, which supplies the only one refinery: Zincor and both mine production and metal production have been decreasing gradually over the last ten years. However, with Gamsberg project in place, there might be some significant changes.

7.5 Outlook

The current outlook for World and Western World supply and demand for zinc was presented during ILZSG's 52nd Session on 4-5 October 2007 and the following forecast was published

• Global **zinc mine output** is forecast to increase by 7.4% to 11.18 million tonnes in 2007 and by 9.5% to 12.24 million tonnes in 2008

• The recently-opened San Cristobal mine will substantially boost production in Bolivia. Australian and Canadian outputs are also predicted to rise sharply, influenced by the commissioning of a number of mines in both 2007 and 2008. Anticipated rises in Peru will be principally the result of increases at the Antamina mine and the opening of Minera Milpo's Cerro Lindo operation

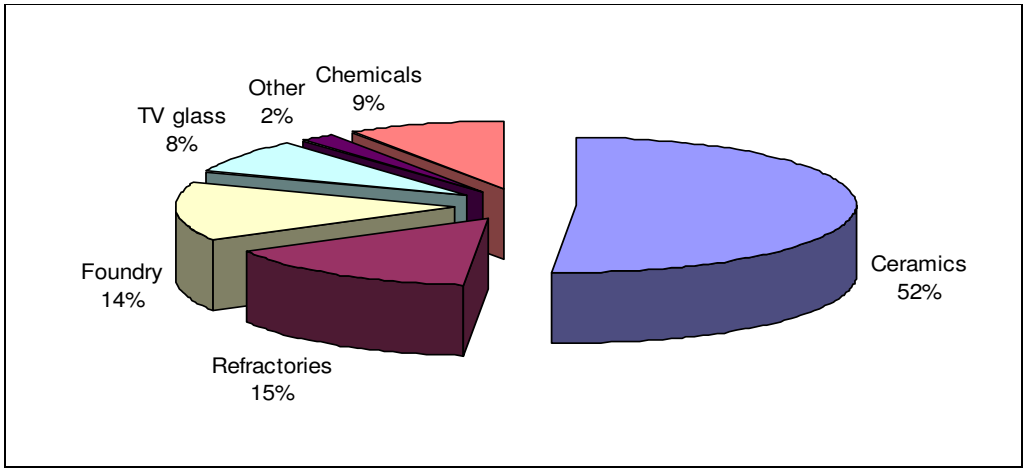
• **Global refined zinc production** was forecast to increase by 5.9% to 11.32 million tonnes in 2007 and by 7.8% to 12.2 million tonnes in 2008.

8. Zircon

8.1 Demand

Demand for zirconium minerals is driven by the ceramics sector which consumes just over 50 percent of the global production (Figure 19). Other applications are in the refractory industry which accounts for about 15 percent of total world consumption and the remainder of 32 percent is consumed in foundry, TV glass, zirconia chemicals and other applications. The World's main zircon consumers by region are Europe, China, Asia Pacific and North America (Figure 20).

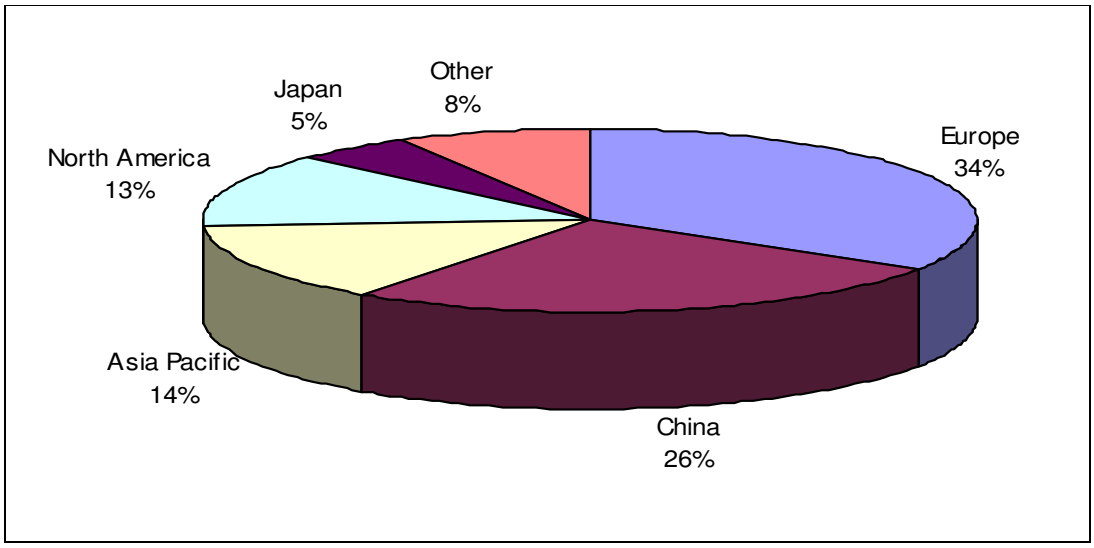
Figure 19: Global zircon consumption by sector



Global demand for zircon in the past decade has grown by an average of 3,3 percent, with China displaying the strongest growth of about 12,7 percent as a result of increased construction activities. This together with the 2008 Olympics construction needs enhanced the ceramics products consumption.

In 2006, world consumption of zircon was about 1230 kt, with Asia (including China and Japan) accounting for about 45 percent of the consumption, mainly because of the increased demand in the ceramics and refractories sectors in China.

Figure 20: lobal zircon consumption by region



8.2 Supply

The World's top producers of zirconium minerals are Australia and South Africa, together accounting for about 66 percent of the World's total production. The industry is dominated by four companies which control about 25 percent of the world's zircon supply and they are: Iluka Resources, with operations in Australia and the USA; Rio Tinto and BHPBilliton, which jointly own Richards Bay Minerals in South Africa; and Exxaro Resources, which owns Namakwa Sands in South Africa and ultimately controls the Ticor operations in both South Africa and Australia.

In 2006 a combined output by the top zirconium minerals producers was just over 1015 kt which was about 90 percent of the world's total production. Global supply of zirconium minerals increased significantly by 13,7 per cent to 1027 kt in 1998 compared to 1997 (Figure 21). This was mainly due to the commissioning of Westralian Sands 30 kt/a Old Hickory operation and Consolidated Rutile Ltd's (Australia) 13 percent increase in zircon production.

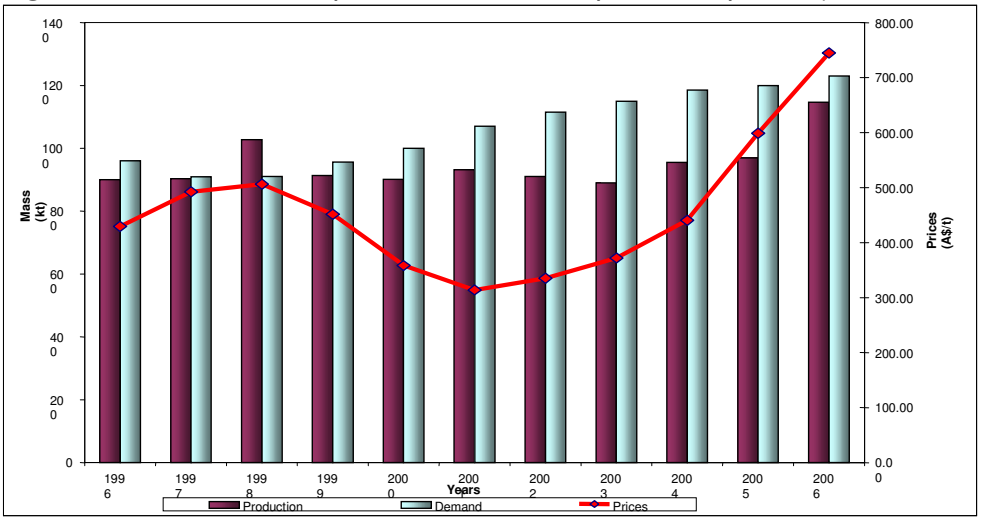
8.3 Supply-demand balance

During 1999 – 2000 global supply demand of zirconium mineral concentrates was finely balanced as a result of the stockpiles that were accumulated in 1998. The accrued stockpiles of 1998 together with the supply of 1999 and 2000 exerted a downward pressure in prices leading to a 34 percent decline in 2000. However, the delicate state of equilibrium was soon disturbed as demand eclipsed supply and the market swung to a state of deficit after the depletion of stockpiles in 2001. This resulted once again into an upward pressure on prices due to the higher global demand, thus reawakening the interest of new projects. like the Iluka Resources' zircon finishing plant at its Geraldton processing complex, which was commissioned in the second half of 2002. The commissioning of the United Kingdom, UCM plc, new production line in late 2002, which increased its fused zirconia capacity by 10 kt per year.

Over the period 1996 -2006, shortage of zircon supply also gave rise to the emergence of new major suppliers such as Indonesia. The combined production from Indonesia and other projects in various stages of development, such as Matilda Minerals' Tiwi Islands project in Australia, Kenmare' s Moma project in Mozambique, Carnegie' s project in The Gambia and Sierra Rutile' s Gbangbama project, Australian Zircon' s Mindarie project are set to contribute to the sustained supply forecasted period in the markets. And such projects are anticipated to provide a total of around 250 kt of new zircon supply.

The zircon prices have shown a cyclical behaviour over the past decade (1996 – 2006). This saw prices reaching highs of A$ 506,19/t in 1998 and dropping down to levels of A$ 314,01 in 2001 as a result of the supply build up that was experienced in 1998, which helped to sustain global demand in the subsequent years. However, the zircon markets started experiencing a supply deficit in 2001 which later pushed prices upwards as a result of the depletion of the stockpiles of 1998 and the absence of a significant zircon supply coming on line during this period.

Figure 21: Global zircon production, consumption and prices (1996 – 2006)



Sources: Demand determined from Carnegie Minerals plc market overview
Production obtained from BGS and USGS data

8.4 Prices

Zircon prices started to surge up again in 2002, reacting to the increased global demand without any suffuse of significant supply into the markets to counteract the growing demand. Nevertheless, in 2006 the zircon markets displayed a tight supply-demand dynamics with global demand exceeding supply by about 80 kt. Such market conditions coupled with the persistent increase in demand, resulted in a 24 percent rise in annual zircon prices. This resulted in zircon prices reaching A$745/t in 2006, almost double prices seen in 2002 (Figure 21). Prices may however soften in the near future until markets are able to catch up with new supply as a result of the possible influx of new entrants into the industry together with expansion project, if demand growth remains steady.

Since 2001, prices have been increasing with respect to the growing global demand and supply shortage. This surge in prices may come to a halt as prices are set to decline to levels of A$ 450/t by 2011, following forecasted additional supply from expansion projects and new entrants into the industry.

8.4 Developments in South Africa

Over the past three decades there has been a major shift in global distribution of zircon production. During the 1970s South Africa was a very minor producer while Australia produced just over half of the World's total zircon output. The development of the Richards Bay beach sands operation in the late 1970s made South Africa the second-largest producer of zircon worldwide. That position was reinforced with the start-up of the Namakwa Sands mine in 1995 with an output of about 142 kt per annum and the commencement of operations by Ticor in 2001 with production of about 53 kt per annum. As a result, South Africa accounts for about 35 percent of total global output to date.

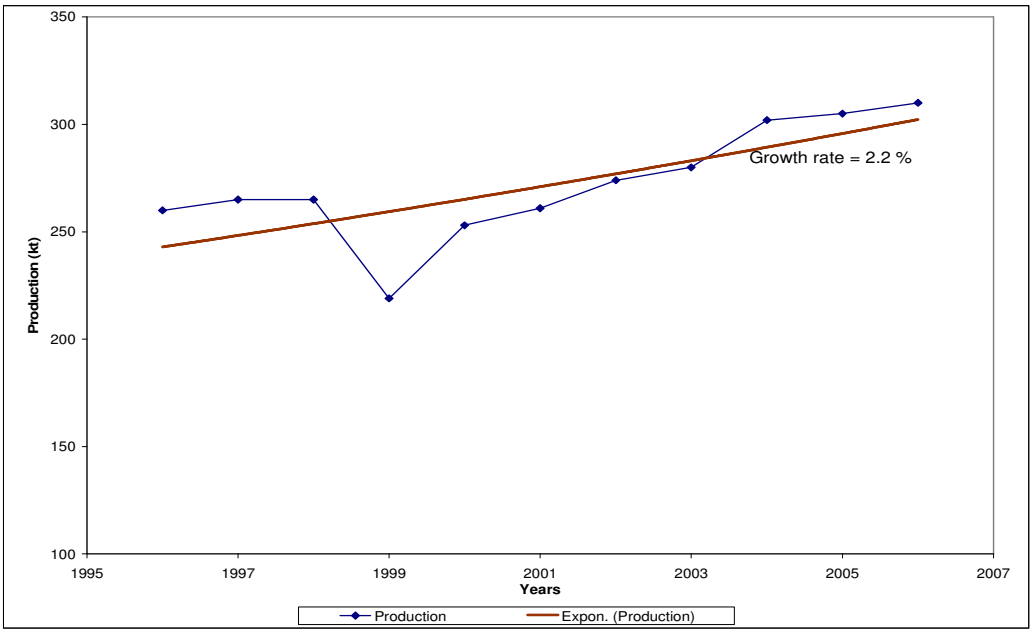
The closure of South Africa's Palabora Mining Company (PMC) in 2001 prompted by mining operation switching from open pit to underground mine

was not expected to bring a gap in South Africa's zircon supply markets. The mine was producing low volumes of about 1574 t of zirconium concentrates and therefore the plant closure did not have that much impact on the markets as local production and exports still increased steadily over the years.

A great percentage of South Africa's production of zirconium minerals are exported and about 3,5 percent is consumed locally. The total sales for the country grew by 5,7 percent over a period of 1996 – 2006 as a result of increased production output encouraged by the growing global demand in surging prices.

The country has accumulatively produced a total of about 3,0 Mt of zirconium mineral concentrates over the past decade (1996 – 2006). Production over the years increased at a rate of 2,2 percent (Figure 22). The continued price hikes and shortage of zircon in the world has resulted in South Africa increasing its production in the past few years (2003 – 2006) by 3.2 percent following the persistent global demand of zirconium minerals.

Figure 22: South Africa's zircon production and growth rate (1996 – 2006)



Sources: BGS and USGS data

Recent and future developments include:

- The attainment of mining rights to the Bothaville heavy mineral occurrence by the Southern Mining Corporation, with inferred resources estimated to be in an excess of 185 Mt.
- The newly formed metals and minerals division of Grinaker-LTA M&E in 2006 secured the contract for all the multidisciplinary construction work on 'Project 1000' at Exxaro's Namakwa Sands on the West Coast of South Africa.
- A proposed hydraulic Fairbreeze mining operation by Exxaro, 45 km south-west of Richards Bay. The mine is aimed at supplementing Hillandale's output to enable KZN Sands mineral separation plant to operate at design capacity of 105 tonnes per hour. Commissioning of the mine is planned in the second half of 2008.
- The proposed Xolobeni mineral sands project by the Australian mining company, Mineral Resource Commodities (MRC) and its community-based partners, Xolco. The project is expected to produce 15 kt/y (zircon and leucoxene), 250 kt/y (ilmenite) and 19 kt/y (rutile).
- The Tormin project by MRC which is about 400-km from Cape Town, and about 50-km south of the Anglo American Namakwa Sands project at Brand-se-Baai. The project is expected to produce 49 kt/y of high quality enriched non-magnetic concentrate containing predominantly zircon and rutile. Production is expected to take place in the first quarter of 2009.

8.5 Outlook

The upbeat zircon supply observed in recent years coming from new projects like the Australian Mindarie project, Kenmare's Moma project in Mozambique together with other projects in various stages of development is set to raise global production to more than 400 kt of new supply by 2009.

Overall zircon demand is forecast to grow at an average rate of 3,8 percent per annum to reach just over 1500 kt by 2011, as a result of the increased demand in the ceramics and refractories sectors.

The industry could however encounter a restrained period in future due to the possibility of the influx of new entrants into the industry, and thus resulting in a slow down of price hikes until markets are able to cope with the new supply. This could lead to prices declining to levels of around A$ 450/t by 2011.

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