

10 Cobalt Supply & Demand 2004

Supply

Although cobalt is fairly widespread in the Earth's crust and makes up .002% of it on average (ranked element No. 33), its low concentration usually means that it is produced as a by-product of another metal. Almost all land-based deposits contain cobalt in combination with nickel or copper and a few with arsenic and silver. Until recently, world supply was predominantly African from the Copper Belt of the Democratic Republic of Congo and Zambia but in the last few years changes in the supply characteristics of cobalt have occurred. Cobalt, as a by-product of nickel operations and as a primary product, has increased significantly. It is estimated that in 2004 nearly 40% of refined cobalt came from operations where cobalt was the main product.

Cobalt is available as a by-product of precious metal mining in South Africa (usually as sulphate) and Morocco exports arsenical concentrates to China as well as producing cobalt cathode from concentrates and tailings. A new refinery was commissioned in Morocco in the second half of 1999. This ramped up to capacity rapidly such that Moroccan cobalt production now stands at 1,500 tpa.

The list of potential new sources of cobalt is large, ranging from huge new cobalt-containing nickel and copper deposits in Canada, Western Australia and the DRC, copper slags in Zambia and the Democratic Republic of Congo to smaller projects involving the treatment of old copper tailings/slugs in Uganda and Zambia. From these sources, three new cobalt extraction and refining operations were commissioned in Western Australia in 1999 and two in Africa in 2000 and 2001. Difficulties had been experienced by all three Western Australian operations and only one is now producing cobalt. The Kasese Cobalt operation in Uganda was placed on care and maintenance at the beginning of 2003. This was restarted at the beginning of 2004 when the cobalt price had risen significantly.

Country	Mined	Refined	Approx. Refined Qty
Australia	√	√	3,900 ↑*
Belgium		√	1,800 ↑
Botswana	√		
Brazil	√	√	1,100 ↑
Canada	√	√	4,500 ↑
China	√	√	8,000 ↑
Cuba	√		
Finland		√	8,000 ↑
France		√	200 →
India			350 ↑
Japan		√	350 ↑
Morocco	√	√	1,500 →
New Caledonia	√		
Norway		√	4,500 →
Russia	√	√	4,500 →
South Africa	√	√	400 →
D.R. of Congo	√	√	700 ↑
Uganda		√	450 ↑
Zambia	√	√	6,000 →
			<u>41,650 (tonnes)</u>

*Future Trend
Refining can be from newly mined ores or from older slags, by-products and scrap. The definition is that "new" cobalt is produced.

The major feature in 2004 was the increase in Chinese production, particularly from Jinchuan. A large part of this production was obtained from feed materials from the DRC. The Defense Logistics Agency continued to sell cobalt during the year.

Table 1 is a guide to 2004 world output. In the past, we have tried to estimate world resources (in the ground!) but these are continually going up, as new and richer ores seem to appear. There seems to be enough known land sources for at least 100 years and for another 2 or 300 years under the sea. So we can still say cobalt is not running out.

In primary nickel and copper operations, the price of cobalt is usually irrelevant to the viability of the project. However, the viability of primary cobalt projects is critically dependent on the price of cobalt.

Production

In 2001, the CDI re-examined its methodology for determining cobalt statistics. It has been recognised that in the past, production statistics have contained a varying degree of double counting as some members' figures included material sent to other members for further refining. This element was obviously counted twice. The Institute has drawn up a definition for refined production which we believe removes this discrepancy such that, as of 1998, all double counting was eliminated.

World refined cobalt production has been defined as "all cobalt units, whether in metal or chemicals, derived from feed requiring further refining". For the purposes of this definition, the following sources of material shall not be counted as feed:

a) DLA and other stockpile releases; b) Russian; c) Likasi; d) Lower grade Moroccan.

Table 2 – Refined Cobalt Production/Availability (Tonnes)		
Europe	Production/Supply	Source of Feed
Belgium	1,444	Various secondary/Australia
Finland	7,893	New Caledonia/Africa/Australia/Others
France	199	Nickel by-product New Caledonia
Norway	4,670	Canada/Africa/Australia/Russia
Africa		
Morocco	1,593	Domestic
South Africa	300	Domestic
D.R. of Congo	735	Domestic
Uganda	457	Domestic
Zambia	5,791	Domestic
Americas		
Brazil	1,155	Domestic
Canada	4,787	Domestic/Australia/Cuba/Secondary
Asia		
China	9,500	Domestic/Morocco/DRC
India	545	Domestic/Cuba/DRC
Japan	429	Australia
Others		
Australia	3,879	New Caledonia
Russia (Export)	4,524	Domestic
DLA (Deliveries)	<u>1,632</u>	Stock Release (via DLA stock report)
TOTAL	49,536	

Using this definition, Table 2 illustrates 2004 availability of refined cobalt. The origin is where the refinery is located. The feed sources can be from many other places, not necessarily domestic. One should also be clear that we are talking about "available new" cobalt, it is not "sales". We include refining in Belgium from so-called secondary feedstocks (old slags and cements), and stock releases from the DLA. The inclusion of "secondary" material refining is subject to some comment. The 1,444 tonnes for Belgium is an estimate as some of Umicore's reported refined production is actually produced elsewhere. Similarly, the 9,500 tonnes reported for China includes an estimate of Umicore's production in China. Taking these comments into consideration, Table 3 illustrates refined cobalt production from CDI members from 1998 to 2004.

Cobalt production from other producers, deliveries from the DLA and other stockpiles from 1998 to 2004 are shown in Table 4.

The total refined cobalt available from 1998 to 2004 is shown in Table 5.

Availability should not be confused with sales, as we make no recognition of stocks which may have changed in 2004. Not all "primary" production is from freshly mined ore. The supply figures merely indicate material which **could** come onto the market as new cobalt. "Re-use", recycling – e.g. remelting superalloy scrap as a source of cobalt – is another matter and no account of that type of recycling is considered here, apart from that treated by the major cobalt producers.

Table 3 – CDI Production Statistics (Tonnes)

	1998	1999	2000	2001	2002	2003	2004
CTT	241	470	1,200	1,200	1,354	1,431	1,593
Eramet	172	180	204	199	176	181	199
Falconbridge	3,851	4,009	3,433	3,314	3,993	4,556	4,670
ICCI	2,640	2,770	2,855	2,943	3,065	3,141	3,225
Inco	1,740	1,420	1,470	1,450	1,480	1,000	1,562
Norilsk	3,700	4,000	4,100	4,600	4,200	4,654	4,524
OMG	5,250	6,200	7,700	8,100	8,200	7,990	7,893
QNI	1,395	1,539	1,520	1,818	1,863	1,800	1,900
Sumitomo	329	221	311	350	354	379	429
Umicore ¹	1,200	950	1,110	1,090	1,135	1,704	2,947
Zambia	5,011	3,946	2,316 ²	2,789 ²	4,344 ²	4,570 ²	3,769 ²
TOTAL	25,529	25,705	26,219	27,853	30,164	31,406	32,711

¹ Includes Umicore's global refined production

² Chambishi Metals plc, Zambia

Table 4 – Other Cobalt Production/DLA (Tonnes)

	1998	1999	2000	2001	2002	2003	2004
Brazil	364	630	792	889	960	1,097	1,155
Bulong		79	170	203	200	0	
China ¹	1,200	1,200	1,200	1,470	1,842	4,576	8,000
Gécamines	4,490	5,180	4,320	3,199	2,149	1,200	735
India	120	120	206	250	270	255	545
Kasese		77	420	634	450	0	457
Mopani Copper			1,026	1,876	1,800	2,050	2,022
Murrin Murrin		83	925	1,452	1,838	2,039	1,979
RSA	320	320	320	252	250	285	300
TOTAL	6,494	7,689	9,401	10,225	9,765	11,502	15,193
DLA Deliveries	2,310	1,679	3,083	1,896	1,284	1,987	1,632
TOTAL	8,804	9,368	12,484	12,121	11,049	13,489	16,825

¹ Excludes estimates of Umicore's refined production in China

Table 5 – Refined Cobalt Availability (Tonnes)

	1998	1999	2000	2001	2002	2003	2004
CDI Members	25,529	25,705	26,219	27,853	30,164	31,406	32,711
Others	8,804	9,368	12,484	12,121	11,049	13,489	16,825
TOTAL	34,333	35,073	38,703	39,974	41,213	44,895	49,536

Demand

During 2000, a major fundamental change in marketing cobalt occurred. In 1999, WMC began selling cobalt on its website and in September 2000, it was joined by OMG who began selling its briquettes in this manner. In addition to these producers, a number of trading companies began to offer a buying and selling service through the Internet. As usual, this is the most difficult side of the supply/demand equation to quantify and it is generally recognised that figures based on official reports are lower than actual figures.

The CDI has continued to analyse critically cobalt import/export data over the last year in an attempt to improve its demand statistics. It has just published a statistics book jointly with the World Bureau of Metal Statistics (WBMS) which includes apparent cobalt demand by geographical location calculated from import/export data. This publication can be purchased from the CDI or the WBMS. Published data suggest that worldwide cobalt demand in 2004 was 51,400 tonnes, about 8.25% up on 2003.

Market	%	Cobalt Materials Possibility
Superalloy (Ni/Co/Fe)	20.0	Metal, recycle
Hardfacing & Other Alloys	5.5	Metal & mesh powders, recycle
Magnets All Types	7.0	Metal, powders, recycle
Hard Materials – Carbides, Diamond Tooling	10.5	Powders – Fine and very fine
Catalysts	11.0	Salts – Carbonate, sulphate, nitrate, Acetate, metal
Colours – Glass, Enamels, Plastics, Ceramics, Artists Colours, Fabrics	11.0	Oxide, + some sulphate, hydroxide, carbonate
Feestuffs, Anodising, Recording, Electrolysis, Cu Electrowinning	4.5	Mainly sulphate, but some carbonate and hydroxide
Batteries	21.0	Hydroxide, powder, LiCoO ₂
Tyre Adhesives, Soaps, Driers (paint/ink)	<u>9.5</u>	Soaps & complexes made from metal starting point
	100	

Since the decline in demand noted in 2001 resulting from the slow-down in the world's economies and the terrorist attack in New York on 11 September, worldwide demand has risen steadily. The rapid increases noted in 2003 and 2004 resulted almost exclusively from massive increases in China and Japan. In spite of some recovery in the superalloys sector since 2001, the levels of cobalt demand in this sector have not reverted to those seen prior to the terrorist attack in New York. In the past few years, there have been two major shifts in cobalt demand patterns. First, there was a significant shift in demand from the USA and Western Europe to Asia. The apparent demand in Asia has increased by about 80% since 2002 whereas demand in the USA and Western Europe has remained relatively steady. Second, the increase in demand resulted almost exclusively from increases in chemical applications, most notably rechargeable batteries. In 2004, it is estimated that chemical applications accounted for more than 50% of worldwide cobalt demand.

Demand estimates in the individual market segments are shown in Table 6.

Price

The graph illustrates the change seen in the average quarterly metal Bulletin free-market price quotation for cobalt since 1989 for 99.8% and 99.3% minimum cobalt. Based on quarterly averages, the graph does not show short-term price fluctuations. This is evident in that the averages for the final quarter of 2003 and first quarter of 2004 do not reflect the peak prices reached.

At the end of 2002, the price of refined cobalt stood at about US\$6.70/lb. and US\$6.20/lb. for high- and low-grade metal respectively. The prices were about US\$0.80/lb. lower than in early January and were the lowest recorded since about 1987.

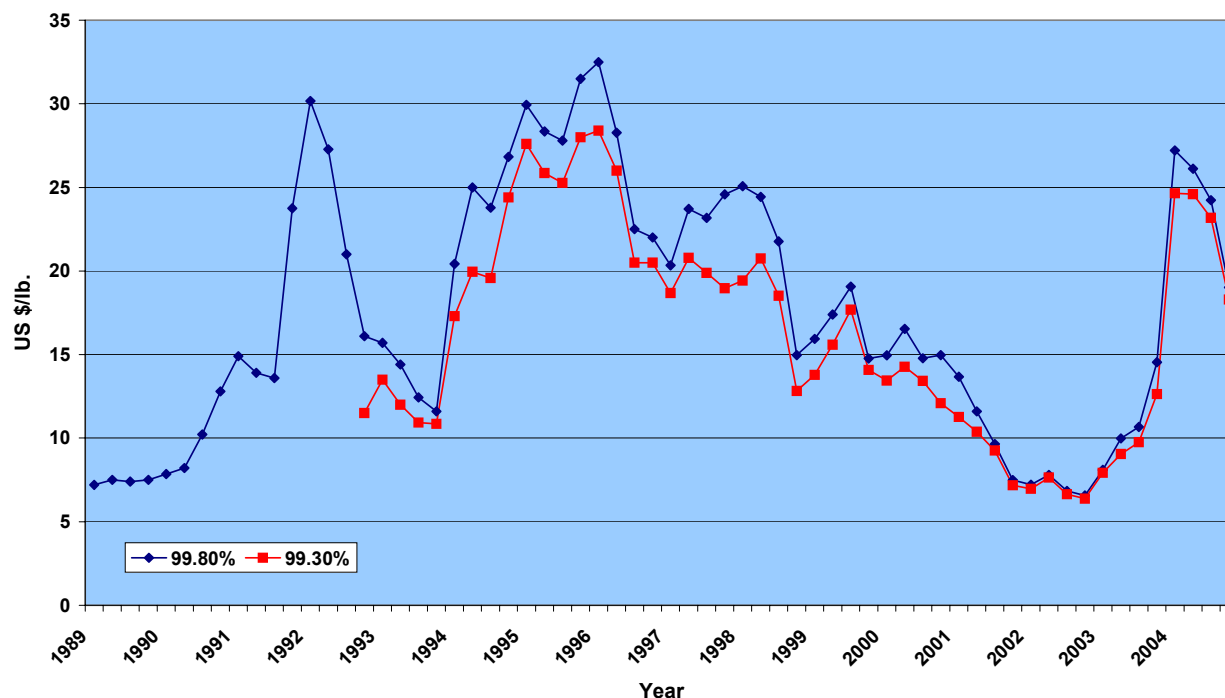
Prices rose slowly as producers became more disciplined in the market and reached averages of US\$10.45/lb. and US\$9.50/lb. for high- and low-grade metal respectively in July. Thereafter they remained relatively flat until October when they began to rise rapidly as a result of the increase in demand, particularly in China.

The realisation that very little additional cobalt was available to the market at a time when demand was rising rapidly caused the sharp rise in price. At the end of 2003, prices had reached an average of US\$22.00/lb/ and US\$20.50/lb. for high- and low-grade metal respectively.

At the same time, as prices were rising throughout the year, the differential between high- and low-grade metal widened. This was attributed to fears within the industry of a shortage of high-grade metal as a result of the announcement of a strike at Inco's Sudbury operations and production difficulties on the part of two other producers. These factors resulted in a shortage of low nickel content material which is essential to the rechargeable-battery sector.

In the first quarter of 2004, prices continued to rise rapidly reaching a peak of about US\$ 28.50/lb and US\$ 25.50/lb for high and low grade metal respectively. Thereafter, prices declined steadily to end the year at about US\$ 19.40/lb and US\$ 18.50/lb.

The decline in price occurred for several reasons. First, consumers had stockpiled metal earlier in the year amidst fears of supply shortages. They reduced purchases once they realised that these fears were unfounded.



Cobalt Price

Second, the massive increase in cobalt demand in China was largely met from increases in domestic production from imported ores and concentrates as opposed to imports of refined metal. A cursory glance at CDI supply/demand statistics shows that worldwide refined availability slightly exceeded apparent demand.