



**A new service from World Mine Cost Data Exchange
(minecost.com) and CHR Metals Limited**

DYNAMIC COST CURVES

Copper – Zinc - Lead

COPPER, LEAD AND ZINC MINE COSTS – 2004 AND H1 2005

Copper, lead and zinc mine producers have experienced a dramatic turnaround in their fortunes since mid-2003. This has reflected both higher prices for their principal products *and* by-products, as well as lower smelter charges for treating concentrates. In the case of zinc and lead, treatment charges have remained low in 2005 although treatment and refining charges (TC/RCs) for copper have risen sharply in recent months. Table 1 below highlights changes in key metals prices and contract TC/RCs since 2003.

Table 1: Metal prices and contract TC/RCs, – 2003 and 2004 averages, Jan-May 2005

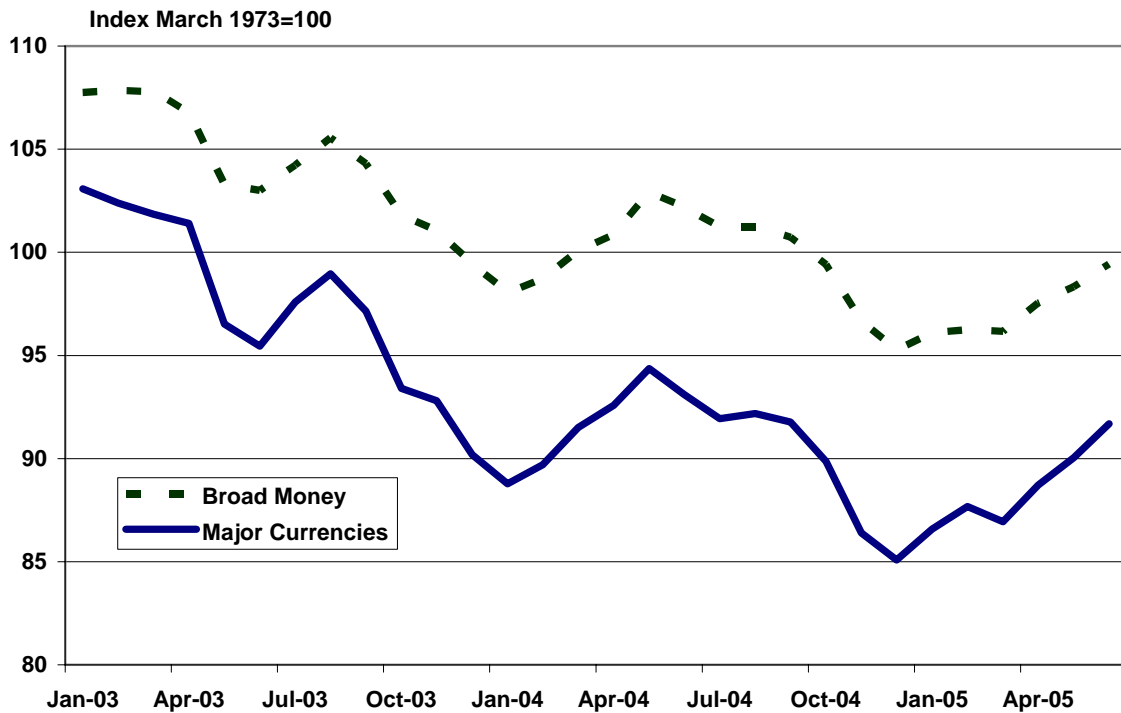
		<u>2003</u>		<u>2004</u>		<u>5M 2005</u>	
LME cash							
Cu	US\$/lb / \$/t	0.81	1779	1.30	2866	1.49	3285
Pb	US\$/lb / \$/t	0.23	515	0.40	886	0.44	978
Zn	US\$/lb / \$/t	0.38	828	0.48	1048	0.60	1316
Ni	US\$/lb / \$/t	4.37	9633	6.27	13830	6.96	15344
Market estimates							
Mo	US\$/lb	5.32		13.46		33.14	
Co	US\$/lb	10.60		24.50		17.32	
Sn	US\$/lb	2.22		3.86		3.67	
Ag	US\$/oz	4.88		6.67		7.04	
Au	US\$/oz	363		410		427	
Cu TC	\$/t	58		46		85	
Cu RC	c/lb	5.8		4.0		8.5	
Pb TC		122		120		145	
Basis Price	\$/t	475		600		780	
Zn TC		148		141		126	
Basis Price	\$/t	1000		1000		1000	

Metal prices and treatment charges are two of the key determinants of the profitability of mines. Production costs at the mine site reflect the inherent characteristics of individual operations and management. However, relative to metal prices, which are quoted in US

dollars, mine site costs are also affected by exchange rate movements. Through 2003 and 2004, the international value of the US dollar weakened (Figure 1) which meant that the competitive position of mines located in countries with appreciating currencies tended to deteriorate compared with those located in countries where the value of the domestic currency was tied closely to the US dollar, or was depreciating. Typically, though not exclusively, the major currencies such as the euro and the Canadian and Australian dollars appreciated more against the US dollar than the minor currencies. Notable exceptions amongst countries with large-scale mining industries were the Chilean peso and South African rand, both currencies appreciating strongly, especially in 2003. Since early 2005 the international value of the US dollar has risen, improving the competitive position of mines operating in countries with currencies which have been very strong against the dollar over the past year or two.

Another influence on the overall cost of mine production is ocean freight rates. While typically not a particularly significant component of total costs, the rapid escalation in freight rates seen in 2004 did add to the cost of delivering concentrates to smelters. In some cases the differential in freight costs to different locations influenced the ultimate destination of concentrates. This was especially noticeable for South American mines shipping to Asia and/or Europe.

Figure 1: Real international value of the US dollar



Source: US Federal Reserve

In the following analysis cash costs for 2004 have been estimated based principally on actual results reported for 2004. Where it has not yet been possible to include complete 2004 data in the analysis, an estimate of 2004 costs has been made using 2003 data as a basis. To derive estimates for 2005 costs these data have then been adjusted to reflect the key changes in external factors discussed above that have a direct bearing on costs. As the remaining data for 2004 becomes available this will be included in subsequent revisions to the Dynamic Cost Curve model.

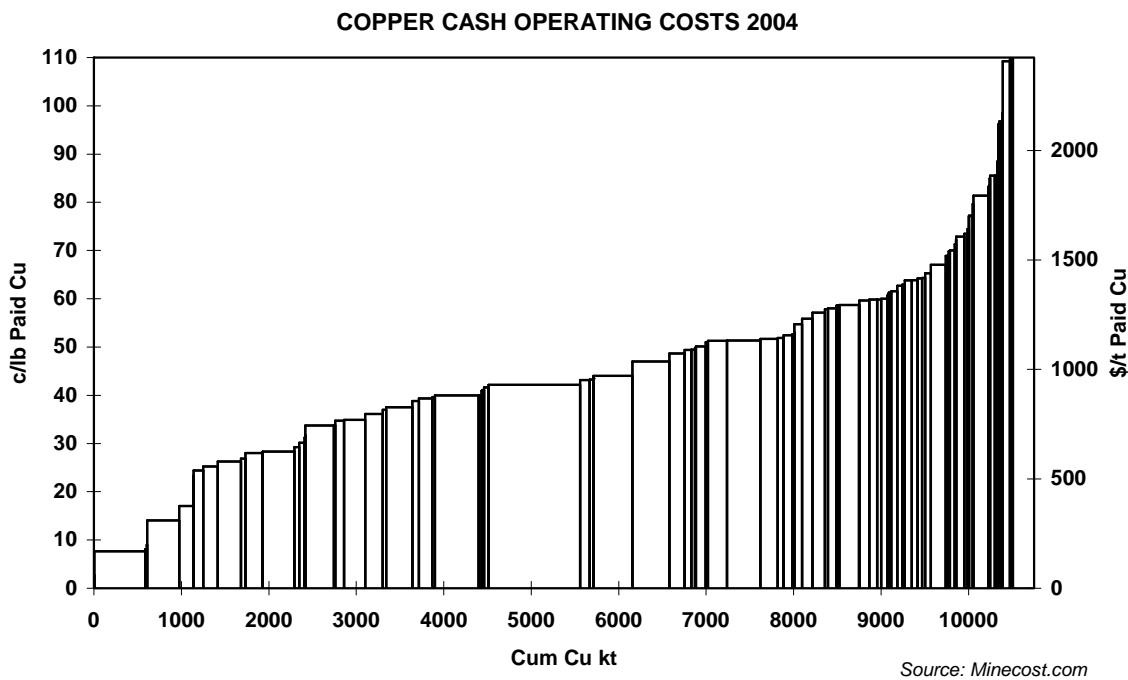
Copper Mine Costs

In 2004 we estimate that the average cash cost of producing copper from mines in the West was \$960/t or 43.5/lb (payable copper). This was \$68/t or 3c/lb lower than the

average in 2003. In the lowest quartile of the cost curve, costs did not exceed \$700/t (31.8c/lb) with significant benefit being derived from by-product credit revenues. Of particular note was an estimated cash cost of just under \$170/t (8c/lb) for Codelco's near 600kt of copper produced at its Chuquicamata sulphide operations reflecting high molybdenum credits. Another sizeable and very low cost mine was Antofagasta's Los Pelambres, also located in Chile. There production costs for 360kt of copper were \$310/t (14c/lb). Molybdenum was again a sizeable credit. At the other end of the cost curve only 10% of output was produced at a cost higher than \$1440/t (65c/lb).

With LME cash copper prices averaging \$2866/t (\$1.30/lb), copper mining was a highly profitable business in 2004, even for the highest cost producers (see Figure 2). Not only were prices high, but contract and spot TC/RCs were exceptionally low, effectively reducing miners' costs, all other things being equal. Undoubtedly, 2004 marked the low point in the current cycle of TC/RCs which had been on a downward trend since peaking in 1997. In contracts signed for concentrate deliveries in 2005, sharply higher TC/RCs were agreed. This has had the effect of increasing miners' costs. Mines had to agree to higher TC/RCs because the global market for copper concentrates moved from deficit to surplus, a situation exacerbated in early 2005 by a number of smelters taking maintenance shutdowns.

Figure 2: Copper mine costs



The impact of higher TC/RCs on average costs in the first 5 months of 2005 compared with the average in 2004 is stark. Using the Dynamic Cost Curve model it is possible to isolate the effect of various cost factors on total costs. Taking into account changes in average metal prices and exchange rates only in the first 5 months of 2005 has a relatively modest impact on copper mine production costs overall, with a fall of around \$10/t (0.5c/lb). A sharp rise in molybdenum by-product credits for some of the largest copper mines is a sizeable factor in this. However, introducing 2005 contract TC/RCs into the calculation immediately increases average mine costs by a remarkable \$235/t (10.5c/lb) compared with the 2004 average. In fact, this figure understates the typical rise in costs for copper sulphide miners as the industry average includes costs at SxEx operations which do not incur third-party treatment and refining charges. Moreover, some spot sales in the early months of 2005 were concluded at terms well in excess of the 2005 benchmark, further increasing costs for mines forced to sell concentrate on this basis.

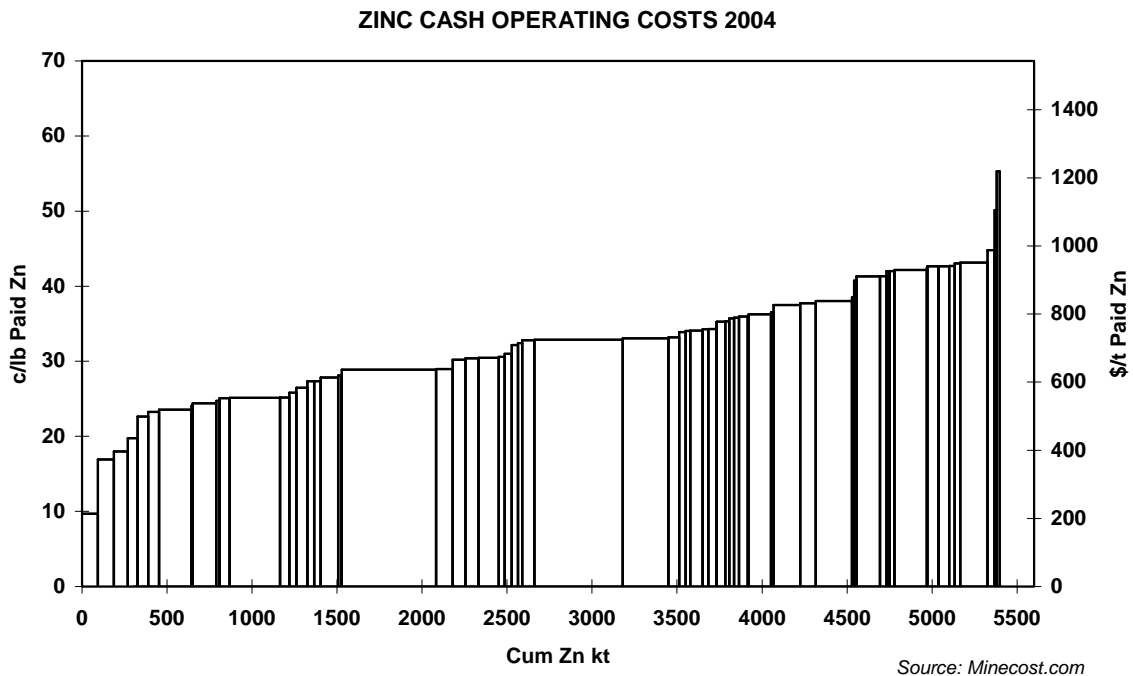
Zinc Mine Costs

The zinc market is at a completely different stage in the concentrate market cycle, with concentrate supplies very tight. This has meant lower benchmark treatment charges (TCs – in zinc and lead concentrate contracts there is no specific charge for refining as in copper concentrate contracts) in 2005 compared with 2004, with some spot deals now being concluded at exceptionally low TCs.

In 2004 we estimate that the average zinc mine cost was \$700/t (32c/lb) of payable zinc. This represented only a minor increase from 2003 when we estimate average costs to have been around \$690/t (31c/lb). The most significant factor in the cost increase between 2003 and 2004 was a rise in *realised* TCs, from \$124/t to \$149/t. This occurred notwithstanding the fact that benchmark TCs actually fell, from \$148/t to \$141/t (basis \$1000). However, with average zinc prices rising sharply in 2004 to above \$1000/t, price participation in concentrate contracts resulted in an increase in realised TCs, the reverse of the situation in 2003.

Another factor in the increase in zinc mine costs in 2004 compared with 2003 was currency appreciation against the US dollar, especially in Australia, Canada and in Europe, all areas with sizeable zinc production. However, because copper and lead metal prices rose faster in 2004 than zinc prices, under conditions of pro-rata costing a lower proportion of mine site costs at operations with significant copper, lead or silver co/by-product credits was allocated to zinc output in 2004 compared with 2003. For example, at Antamina, a large copper/zinc mine in Peru, although we estimate that there was a small increase in mine site costs in 2004 compared with 2003, zinc production costs actually fell by \$90/t (4c/lb). There was also a volume effect with relatively more copper produced than zinc.

Figure 3: Zinc mine costs



Sharply higher zinc prices in the first half of 2005 compared with 2004's average have had the effect of increasing mine production cash costs by \$40/t (2c/lb) to \$740/t (33.5c/lb). Although benchmark TCs are lower than in 2004, higher metal prices mean that realised TCs are actually higher than last year. Moreover, the percentage increase in average zinc prices in H1 2005 has been more than that of lead and copper, zinc's two

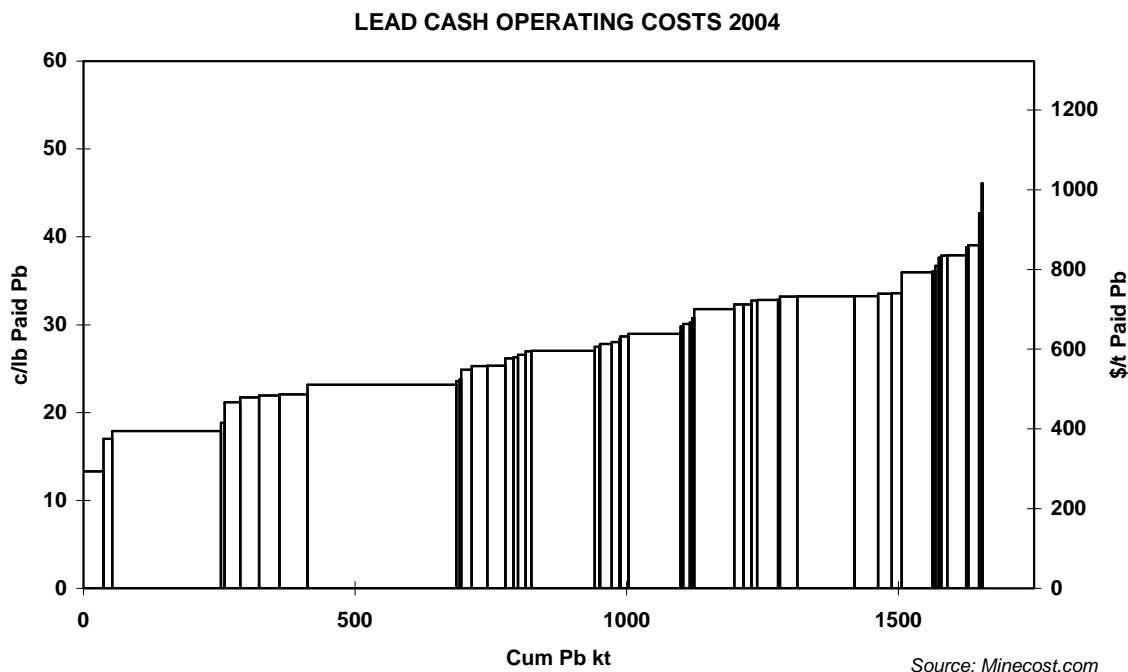
major co/by-products. Therefore, for such polymetallic operations costed on a pro-rata basis, zinc output assumed a higher proportion of mine site costs in H1 2005 than it did in 2004, increasing zinc production costs whilst reducing co/by-product production costs.

Lead Mine Costs

Demand for lead concentrates has exceeded available supply for several years and this has resulted in an extended period of low TCs, quite exceptional in historical terms. The key factor in this has been the rapid increase in lead smelter capacity in China which first outpaced domestic lead mine production and, subsequently, global mine capacity. However, in common with zinc, while benchmark TCs have been low, recent higher metal prices have lifted realised TCs and mine production costs.

We estimate the average cash cost of lead mine production¹ in 2003 was \$453/t (20.5c/lb). With average LME cash lead prices at just \$515/t, this meant that most producers operated on a very thin margin for their lead output, several producing lead at a loss. In 2004 lead mine production costs increased sharply, averaging \$590/t (27c/lb). However, with the average LME lead price for the year at \$886/t (40c/lb) most producers were able to record healthy cash margins, with more than half of production incurring costs estimated to be \$600/t (27c/lb) or lower. As in the case of zinc in 2005, some of the cost increase for lead mine output in 2004 was attributable to higher realised TCs as a consequence of higher prices. However, another factor in 2004 was the relatively faster increase in lead prices compared with zinc, its major co-product. Under the condition of pro-rata costing, lead output assumes a higher share of total costs than it did in 2003. Finally, currency appreciation in 2004, especially of the Australian dollar, with Australia accounting for one-third of Western lead mine output, was another consideration in the overall increase in costs. (There is also an interaction between metal prices and currency values as detailed by price-modelling work undertaken by our colleagues Bloomsbury Minerals Economics.)

Figure 4: Lead mine costs



¹ Lead mine production contributes just 30-35% of total refined output in the West. The balance is derived from recycling lead-acid batteries and a variety of lead-bearing residues and other scrap material. Globally, lead mine production accounts for around 40% of total refined output.

We estimate that lead mine production costs in the first half of 2005 fell modestly, by around \$10/t (0.5c/lb). Although realised TCs increased compared with 2004's average, lead production costs benefited from a higher allocation of total costs to zinc. Average zinc prices in H1 2005 were 25% higher than in 2004. In contrast, lead prices were only 10% higher.

In conclusion

Mine production costs are determined by numerous factors. At the mine site, costs in local currency terms largely reflect the inherent characteristics of the orebody, its geology, its grades, mining methods and processing technologies employed, metallurgical performance of the mill and management practice. These costs are under the direct control of management and, typically, are unlikely to vary significantly from year to year. During periods of exceptionally low prices, on-going development work and exploration may be scaled back or regular maintenance delayed. These are only temporary expedients. Although costs can be reduced for a time there is an offsetting increase in later years when this essential work is undertaken.

Once mine site costs are translated into US dollars, another significant variable is brought into the equation – currency exchange rates. Of course, for mines in the USA and in countries where movements in the international value of the domestic currency are tied closely to the value of the dollar, this has no impact on costs. However, when denominated in dollars, mine site costs elsewhere do change and this can have a major impact on the position of all mines on a competitive cost curve. All other things being equal, an appreciating dollar will improve the competitive position of mines located in countries where the currency is depreciating against the dollar and vice versa. The benefit of a stronger dollar is, however, often offset by weaker revenues, with movements in metal prices inversely correlated with the value of the dollar. (For a deeper insight into the relationship between currency movements and a range of non-ferrous metal prices we recommend the work on price modelling undertaken by our colleagues at Bloomsbury Minerals Economics.)

We have also noted how treatment and refining charges have a significant impact on costs, with higher charges increasing the cost of mine production. Finally, multi-metal mines exhibit changes in costs according to the relative movement of co/by-product prices.

In reality, costs, and the resulting competitive ranking of mines, are constantly changing. Minecost.com's Dynamic Cost Curves provide an accessible format for monitoring the changing cost structure of copper, lead and zinc mines. In addition, the suite of spreadsheets permits analysts to test a range of potential scenarios covering exchange rates, metals prices, treatment and refining charges and ocean freight costs.

UNDERSTANDING COST CURVES

A cost curve plots cumulative output for individual mines (x axis) ranked according to cash costs of production (y-axis). In essence, it represents the supply curve for the industry reflecting mine site costs, metal prices, exchange rates, treatment and refining charges (TC/RCs), ocean freights, etc. Typically, cost curves are calculated using annual averages for the various cost inputs.

Costs shown include not only all direct costs incurred at the mine site, but also the charges a mine has to bear when concentrates are sold to a smelter for conversion to metal. These include smelter treatment and refining charges and, usually, ocean freight to a designated port. Mine site costs are mainly incurred in local currency (labour, power, consumables, etc.) although these may be influenced by external factors, whereas all other charges are typically denominated in US dollars.

In order to prepare a ranking of mine costs it is necessary first to convert all individual mine costs to US dollars. The effect of this is that changes in relative exchange rates from one period to another have an impact on the position of individual mines in the cost curve. All other things being equal, mines located in countries with currencies appreciating against the dollar will see a deterioration in their cost ranking (their dollar-denominated costs will rise) compared with mines located in the USA or countries with currencies depreciating against the dollar.

Another reason for converting local costs to US dollars is that TC/RCs, ocean freight and metal prices are denominated in dollars. TC/RCs and ocean freight are direct charges borne by mines when selling concentrates to smelters. While smelters purchase the metal contained in concentrate (after allowing for a deduction) from the mine, they also make a charge for treating the concentrate to produce refined metal. This charge is netted off the payment for contained metal. It is a convention that mines usually pay ocean freight for the delivery of concentrate to smelters. Changes in TC/RCs and ocean freight have a direct straightforward impact on mine costs. Rising TC/RCs and freight rates add directly to mine costs and vice versa.

For mines producing more than one metal, changes in metal prices from one period to the next may also affect costs depending on how costs are allocated to each metal produced. If all costs are allocated to a single metal and all net revenue from co/by-products is credited to that metal, then changes in metal prices relative to each other will not have any impact on costs, although changes in absolute terms will. Changes in the price of the principal product will still have an influence on costs through the operation of price participation clauses in TC/RC contracts and changes in the price of co/by-products will affect the value of revenue to be credited.

Preparing a cost curve where all co/by-product net revenues are credited to a single metal is likely to produce a curve where some individual mines are shown with a negative production cost. This will happen when the net revenue from co/by-products for a particular mine exceeds the total cost for single metal chosen.

While it can be argued that it is correct to net off co/by-product credits for a specific mine where most revenue is earned by a single metal, there are also instances where such an approach to mine costing produces absurd results. The alternative is to allocate mine site costs to each co/by-product metal in proportion to their net revenue, so-called pro-rata costing. Using this method means that the net profit margin is equal for each metal. Again, it can be argued that this is the appropriate costing method to use for mines where a number of metals contribute in more or less equal measure to an individual mine's overall profitability. Several zinc/lead/silver mines would fall into this category, but also some copper zinc mines.

Perhaps the truest reflection of mine costs is provided by strict pro-rata costing. However, many producers where one metal dominates the revenue stream legitimately report lower costs for that metal than would be obtained by pro-rata costing, by crediting all co/by-product revenue and allocating all costs to that one selected metal.

The solution often adopted in drawing cost curves is a pragmatic approach whereby the two different costing methods are used to produce data for the same curve. In practice this means that, for mines where there is a clearly identified principal product accounting for a significant proportion of overall revenue, by-product net revenue is credited with all mine site costs allocated to the principal metal. Ideally, no mines shown on the cost curve for a particular metal should exhibit negative costs. This means setting the cut-off point between crediting by-product net revenue or adopting pro-rata costing at a level to achieve this. In the case of the 2004 copper cost curve an appropriate level to set this cut-off appears to be when any by-product accounts for 35% or less of net revenue. If net by-product revenue for any metal is worth more than 35% of total revenue, then copper costs are shown utilising the pro-rata costing method.

In the case of lead and zinc mines it is necessary to set the cut-off between by-product credit and pro-rata costing a little lower than for copper. In 2004 a cut-off of 30% appears appropriate.

It should be emphasised, however, that these cut-off points for crediting by-product revenues cannot be viewed as fixed, as they depend upon a particular mix of cost inputs at a specific point in time, nor is there an inherently right or wrong cut-off to use. This means that a cost curve is not a precise tool that can be used to determine unambiguously an individual mine's historical costs, still less its competitive cost ranking. It is, however, an extremely useful addition to an analyst's suite of tools as it does allow these measurements at specific points in time and under a particular set of conditions. Moreover, the Dynamic Cost Curve model permits the user to alter exchange rate, metal price, TC/RC and ocean freight inputs to observe their impact on the cost structure of the copper, zinc and lead cost curves and the individual mines that populate these curves.

Mine costs for 2004 and estimates for the first half of 2005 have been derived using the new Dynamic Cost Curve model from World Mine Cost Data Exchange. Using actual 2004 costs for 150 copper, zinc and lead producing mines as a base, the model allows users to evaluate the impact on costs of changes in exchange rates, prices and TC/RCs. Results, which may be viewed for individual mines, for mining companies and the industry as a whole, are complemented by a range of charts which may be customised by the user.

For further information about this new product visit www.chrmetals.com or contact Huw Roberts on +44 1483 423868 or email – huw.roberts@chrmetals.com.

For information about BME's metal price models please contact Peter Hollands - ph@bloomsburyminerals.com.

This release has been prepared by CHR Metals Limited. The information contained herein has been obtained from sources that are believed to be reliable but CHR Metals does not represent or warrant that it is accurate and complete. Neither CHR Metals nor its officers accepts any liability whatsoever for any direct or consequential loss arising from the use of this publication or its contents.

Copyright in this report is owned by CHR Metals (© 2005 CHR Metals Limited). No part of this report may be reproduced in any manner or transmitted to third parties without the prior written permission of CHR Metals.

DYNAMIC COST CURVES

ORDER FORM

I would like to subscribe to the following Dynamic Cost Curves service (tick one box only):

DYNAMIC COST CURVES – MULTI-METAL OPTIONS (Copper, Lead and Zinc)

Single User License valid for one year	US\$4000	<input type="checkbox"/>
Two Locations License valid for one year	US\$6000	<input type="checkbox"/>
Global Users License valid for one year	US\$8000	<input type="checkbox"/>

DYNAMIC COST CURVES – "SINGLE" METAL OPTIONS:

Copper:	One-year Single User License	US\$2500	<input type="checkbox"/>
Copper:	One-year Two Locations License	US\$3750	<input type="checkbox"/>
Copper:	One-year Global Users License	US\$5000	<input type="checkbox"/>
Lead/Zinc	One-year Single User License	US\$2500	<input type="checkbox"/>
Lead/Zinc:	One-year Two Locations License	US\$3750	<input type="checkbox"/>
Lead/Zinc:	One-year Global Users License	US\$5000	<input type="checkbox"/>

Subscriber Details:

Name:

Company Name:

Postal Address:

.....

Telephone: **Email:**

Payment Options:

I would like to pay US\$.....by Amex/Mastercard/Visa credit card/debit card
(please ring card type)

Name on card: Card Number:

Security Code: Expiry date:
(last 3 digits on back of Visa/MC card or 4 digits on front of Amex card)

Signature:
(a receipted invoice will be emailed/mailed to you)

OR (for payment by cheque/banker's draft/electronic transfer)

Please invoice me: Signature:

Please fax this form back to CHR Metals on +44 1483 527322