



# DARTON COMMODITIES LIMITED



## Cobalt Market Review December 2008

The dynamics of the cobalt market in 2008 dramatically swung from availability concerns during the first nine months of the year to demand concerns as the fallout from the global financial crisis began to take hold on industry in Q4.

The price of cobalt hit levels in March 2008 not seen since 1978, when rebel forces invaded the Katanga region of the then Zaire. Driven by good demand from all consuming sectors, low producer inventories and production dislocations which included power issues in Zambia and lost production at Minara, prices peaked at over USD 50 per lb. However as early as May at the CDI meeting in Toronto the spectre of cheap availability of cobalt chemicals from China became apparent and it was clear that the "China" factor was going to negatively impact market sentiment as record quantities of cobalt units in concentrates and intermediate products were being imported into China (see 1.3 The China Factor in the Supply section of this review).

Although the surplus units available from China lead to a significant correction in prices during the summer months there was recognition that cobalt in refined cobalt metal form was still tight and underlying demand still solid. A price recovery was experienced in September as a result. Then the unthinkable happened as Lehman brothers went bankrupt and a financial meltdown not seen since the Great Depression lead to a rapid loss of confidence industry wide. Prices deteriorated from the USD 30 per lb level to USD 10 per lb without touching the sides. Demand imploded, particularly in the automotive sector, and the new price level was now testing production costs in conjunction with the collapse of both copper and nickel. As a result we have seen significant production closures in the DRC and in December Chambishi announced the furnace would close until a price recovery was seen. In addition to closed capacity a number of projects are being delayed and are in danger of being cancelled (see 1.2 Global Financial Crisis - Impact on Supply).

Trying to predict what will happen in 2009 is as difficult as ever; demand will continue to be adversely affected by the drop in consumer requirements yet the current price levels are clearly unsustainable and will lead to further production closures. It is argued that today USD 15/lb broadly signifies production cost and therefore it would seem that prices will rebound above this level in the first quarter. With the predicted avalanche of cobalt now pushed back we do not think that a return to sub USD 10/lb cobalt is realistic in the short term.

Meanwhile we at Darton Commodities wish you and your families a very merry Christmas and a healthy New Year.

If you have any queries or require clarification on any of the enclosed information please don't hesitate to contact either Andries Gerbens [agerbens@dartoncommodities.co.uk](mailto:agerbens@dartoncommodities.co.uk) or Guy Darby [gdarby@dartoncommodities.co.uk](mailto:gdarby@dartoncommodities.co.uk). We also welcome any feedback or comments that you may have on any of the information provided herein.

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## Executive Summary

### Refined Cobalt Production

- Total refined cobalt availability is forecasted to have increased by a marginal 375 MT or 0.7% in 2008 to just over 54,000 MT. Production by CDI member producers dropped 1,900 MT whereas refined output from non-member producers increased by almost 2,700 MT.
- Refined cobalt metal production fell by approximately 2,000 MT in 2008. New metal production from Katanga Mining (850 MT) has been offset by reductions at Norilsk, Xstrata, ICCI / Sherritt, Minara and Mopani.

### Impact of Global Financial Crisis

- The global financial crisis has had a significant impact on the cobalt supply structure during the fourth quarter. A rapid deterioration of market demand and sentiment has had a detrimental impact on global commodity prices. In line with general trends across the resource sector, the cobalt industry has been faced with cutbacks, curtailments, freezing of capital expenditure programs and decisions to place operations under care and maintenance, a trend certain to trim earlier projections of build ups in cobalt output.
- The suspension of existing refining operations at Camec, Katanga Mining and more recently Chambishi is contributing to an overall reduction in cobalt production / availability that can reach 1,000 MT per month during the first quarter of 2009.
- Copper / nickel projects that were scheduled to commence production of additional cobalt units during 2009 / 2010 are being delayed indefinitely as mining companies focus their attention on cash retention.

### The China Factor

- Imports of ores, concentrates and intermediate products rose dramatically during 2008, allowing Chinese refiners to achieve a record production of just over 16,000 MT of cobalt contained, up from 13,245 MT in 2007.
- Concentrate imports reached just over 200,000 MT during the first 10 months of 2008, up 110% from the 95,000 MT imported into China over the same period last year. The amount of cobalt contained that was imported during this period is estimated at just over 18,000 MT, up 62%.
- Primary refined production in China has seen substantial cuts during the last quarter as a result of poor downstream demand and deteriorating market prices. Anecdotal evidence suggests that overall output has been cut by as much as 30-50%, resulting in a substantial build up of inventory of refining feed material, estimated at 3,500 - 4,000 MT by year-end.

### Demand

- Refined cobalt demand has been estimated at 57,160 MT - a 3% year on year increase.
- Primary cobalt demand exceeded refined availability for the third year in a row by 3,200 MT.
- A strong aerospace and industrial gas turbine market has been driving demand growth in superalloys, growing an estimated 4% in 2008. While airplane order backlogs reached record heights in 2008, a reduction in new orders, the strike at Boeing and delays in its 787 program has started to impact superalloy demand during the fourth quarter of the year.
- The market for lithium-ion batteries has grown some 13-14% in 2008 pushing cobalt consumption in the rechargeable battery sector to 14,000 MT. Substitution of traditional LiCoO<sub>2</sub> material by less or non cobalt containing cathode materials and production cutbacks at the end of the year has decelerated growth of cobalt usage in this sector.

### Prices

- Cobalt prices reached record highs of \$51.00/lb. during the first quarter, dropping to a five year low during the last quarter of the year on the back of deteriorating market sentiment and a demand slowdown. The Low Grade cobalt price averaged US \$36.01/lb. and High Grade \$38.48/lb. in 2008, up from \$28.27/lb. and \$29.42/lb. respectively in 2007.



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### 1.0 SUPPLY 2008

#### 1.1 Refined cobalt production

- Based on published first half production data and second half production forecasts, global refined cobalt supply increased marginally by 375 MT to 54,042 MT, a 0.7 % increase from 2007. Refined output from CDI-member producers dropped by 1,900 MT in 2008, down 6 % from 2007 levels. This is primarily due to substantial reductions in metal production at Norilsk and Xstrata. Reductions are also seen at BHP Billiton and ICCI / Sherritt. Total refined cobalt output from non-member companies is forecasted to be up by almost 2,700 MT in 2008.
- Chinese refined output has seen substantial growth as the availability and imports of refining materials from the Democratic Republic of the Congo rapidly improved during the course of this year. Total refined output in China is expected to have increased some 2,955 MT this year, up almost 22% from 2007. However, substantial production cuts at major Chinese cobalt processors have been made during November and December on the back of weak demand and depressed market prices. The impact of these cutbacks is difficult to quantify but actual refined output could fall well below the 16,000 MT level by the end of this year.
- Refined cobalt metal production has declined by approximately 2,000 MT during 2008, whereby new metal production at Katanga Mining has been offset by output reductions at Norilsk, Xstrata and several other metal refiners.

Refined Cobalt Availability							
CDI Member companies	2004	2005	2006	2007	2008 (E)*	Difference yoy MT	Difference yoy in %
CTT, <i>Morocco</i>	1,593	1,613	1,405	1,591	1,672	81	5%
Xstrata, <i>Norway</i>	4,670	5,021	4,927	3,939	3,330	-609	-15%
ICCI / Sherritt, <i>Canada</i>	3,225	3,391	3,312	3,573	3,400	-173	-5%
Vale Inco, <i>Canada</i>	1,562	1,563	1,711	2,033	2,140	107	5%
OMG, <i>Finland</i>	7,893	8,170	8,580	9,100	9,000	-100	-1%
BHP Billiton, <i>Australia</i>	1,900	1,400	1,600	1,800	1,600	-200	-11%
Sumitomo, <i>Japan</i>	429	471	920	1,084	1,180	96	9%
Norilsk, <i>Russia</i>	4,524	4,748	4,759	3,587	2,320	-1267	-35%
Chambishi, <i>Zambia</i>	3,769	3,648	3,227	2,635	2,650	15	1%
Eramet, <i>France</i>	199	280	256	305	330	25	8%
Umicore, <i>Belgium</i> <sup>(1)</sup>	2,947	3,298	2,840	2,825	2,950	125	4%
<b>Total</b>	<b>32,711</b>	<b>33,603</b>	<b>33,537</b>	<b>32,472</b>	<b>30,572</b>	<b>-1900</b>	<b>-6%</b>
Non-Member companies	2,004	2,005	2,006	2,007	2008 (E)*		
Tocantins, <i>Brazil</i>	1,155	1,136	902	1,148	980	-168	-15%
Various, <i>China</i> <sup>(2)</sup>	8,000	12,700	12,700	13,245	16,200	2955	22%
Gecamines, <i>DRC</i>	735	600	550	606	260	-346	-57%
Various, <i>India</i>	545	1,220	1,184	980	900	-80	-8%
Mopani Copper, <i>Zambia</i>	2,022	1,774	1,438	1,700	1,500	-200	-12%
South Africa	300	214	257	307	240	-67	-22%
Kasese, <i>Uganda</i>	457	638	674	698	630	-68	-10%
Murrin Murrin, <i>Australia</i>	1,979	1,750	2,096	1,884	1,700	-184	-10%
Katanga Mining, <i>DRC</i>	-	-	-	-	850	850	
<b>Total</b>	<b>15,193</b>	<b>20,032</b>	<b>19,801</b>	<b>20,568</b>	<b>23,260</b>	<b>2,692</b>	<b>13%</b>
Other Sources of Supply							
DLA Deliveries	1,632	1,199	294	617	200	-417	-68%
<b>Total Supply</b> <sup>(2)</sup>	<b>49,536</b>	<b>54,834</b>	<b>53,632</b>	<b>53,657</b>	<b>54,032</b>	<b>375</b>	<b>0.7%</b>
Change year on year (MT)	4,641	5,298	- 686	25	375		
Change year on year (%)	10.3%	10.7%	-2.2%	0.0%	0.7%		

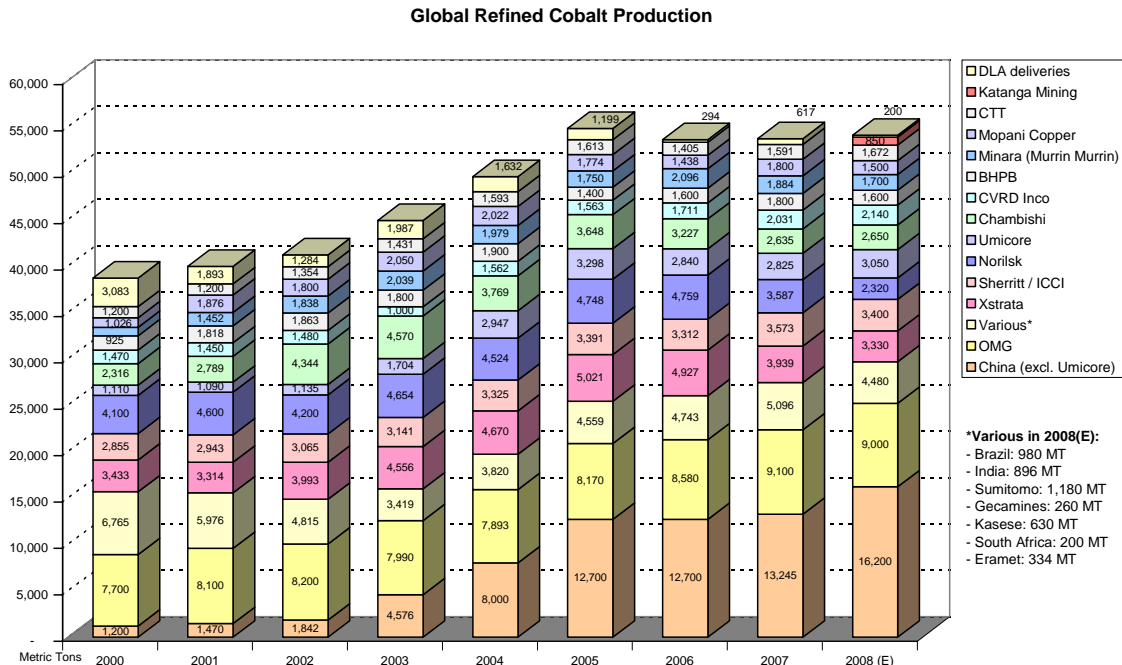
(1) Includes China production  
(2) Excludes Umicore

Refined Cobalt Availability – Source: '04-'07 Cobalt Development Institute / '08(E) Darton Commodities Ltd



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During the 2002 - 2005 period, refined cobalt availability grew at an average of 4,542 MT, or approximately 10% per annum, primarily driven by rapid growth of the Chinese refining industry. This growth stalled abruptly in 2006 as limited availability of ores and other refining feed materials restricted producers in expanding and in some cases, maintaining production levels. As a result, refined output declined for the first time since 1994 and fell from 54,834 MT to 53,657 MT, a decline of 2.2%. In 2007 there was practically no growth in supply and output remained at a similar level to that seen in 2006. For 2008, we are estimating a marginal 0.7% increase, bringing global refined output back to 54,032 MT, a level that is still below the availability seen in 2005.



Global Refined Cobalt Production; source: Cobalt Development Institute / Darton Commodities Ltd.

## 1.2 Global financial crisis - impact on supply.

During the first part of the year, cobalt metal prices surged to record highs over availability concerns. A perceived tightness in metal supply was exacerbated by African producers experiencing power supply cuts, lost production at Minara following a gas explosion and reduced metal supply by Norilsk following the OMG supply agreement.

As the fallout of the credit crisis impacted market demand and metal prices, a growing number of cobalt producers announced closures, cutbacks and suspensions of mining and refining operations. Furthermore, many of the scheduled nickel and copper projects which were expected to bring on new cobalt capacity and production over the next few years have been postponed, and in some cases cancelled.

The following summarizes some of the announcements that have been in the press recently which directly or indirectly impact global refined cobalt output;

- Officials with the state mining firm Gecamines say that more than half of the mineral processing firms in the DRC's Katanga province will close because of the collapse in global copper and cobalt prices.



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Latest analysis of the situation in the DRC by a regional mining minister indicates that up to 300,000 people may lose their jobs in the Katanga Province, mainly in artisanal copper and cobalt mining. The deterioration of the brownfield mining scene in the DRC is exacerbated by the incomplete government mining review. The damage continues to reach beyond small scale mining into the formal mining sector.

- UK based Central African Mining & Exploration Co. (Camec) halted its cobalt and copper mining in 'a swift reaction to a sudden steep decline in cobalt demand from China, as well as a further decline in copper price'. Prior to the stoppage, Camec was producing close to 600 MT per month of Co in concentrates and production from its Mukondo mine and Luita plant was initially forecasted to reach 8,000 MT of cobalt contained by March 2009.
- Katanga Mining announced that 'given the depressed price of cobalt' it would temporarily suspend operations at its Tilwezembe open pit and ore processing at the Kolwezi concentrator. While production has halted, Katanga continues to sell from its significant concentrate inventory (24,000 MT at the beginning of Q4). Metal production at its Luilu metallurgical plant resumed in November following a fire incident which damaged a transformer. However, estimates for metal output at Katanga have been adjusted downwards from initial estimates of 2,000 MT to an actual of 850 MT during 2008. Production of cobalt in concentrate form is estimated at 1,200 MT.
- Geovic Mining, developing the 4,100 MT p/a Nkamouna cobalt project in Cameroon announced that as a result of the recent turmoil in the global commodity and credit markets, debt and equity financing for the project, as well as its construction, will be delayed indefinitely.
- Sherritt International Corp. announced that it will slow down construction work at its Ambatovy nickel / cobalt project in Madagascar which is likely to cause delays to the 5,600 MT project completion, initially scheduled for 2010. In addition, planned investments of US \$221 million for expansion at the Moa plant in Cuba and refinery in Fort Saskatchewan have been put on hold in light of a continued decline in nickel and cobalt prices.
- Baja Mining is delaying the development of its 3,100 MT Boleo cobalt project pending improved market conditions and construction activities have been put on hold indefinitely.
- Although not a major cobalt miner, Canadian company FNX Mining announced that it is indefinitely suspending nickel ore production at two mines in Sudbury which indirectly will impact refined cobalt output at Vale Inco as it processes and refines some 240,000 lbs. of contained cobalt from FNX.
- Freeport McMoRan has announced the deferral of the company's Tenke Fungurume copper / cobalt project. Pushing back the start-up of one of the DRC's largest cobalt projects (8,000 MT p/a, startup 2009), will allow it to reduce capital expenditure by \$215 million.
- Chambishi Metals PLC, Africa's largest cobalt metal producer announced suspension of its main smelter operations in early December, responsible for approximately 2,800 MT of metal production. Suspension of its mining operations was announced only two weeks later.
- Compagnie Minière du Sud Katanga (CMSK) stopped operating on December 20. The company exploits the Luiswishi mine and treats the ore at the Kipushi concentrator, producing some 4,000 MT of cobalt contained in concentrates.

The above is only a brief summary of the official announcements that have made the press in recent weeks. However, as the outlook for copper, nickel and cobalt markets remain uncertain and the macro economic climate continues to deteriorate, we anticipate further production cuts and delays in brownfield and greenfield mining projects. Production at Kasese is earmarked for closure if current market prices prevail. At the same time we expect the commissioning of projects that were scheduled for 2009 to face significant delays; e.g. Formation Capital's Idaho cobalt project (1,500 MT) and CMCC's Ramu project (3,200 MT). Meanwhile Metorex is said to be six months behind schedule to complete its Ruashi Cu/Co SX EW facility and it has forced Metorex to enter into a debt and capital restructuring program to address the company's immediate liquidity requirements. Meanwhile speculation is mounting over the viability of BHP Billiton's Ravensthorpe mine which has been scheduled to produce up to 1,400 MT of cobalt by 2009. The falling price of nickel prompted BHP Billiton to write down its operations on the South Coast by \$2.1 billion. Unless nickel prices improve, analysts are expecting BHP Billiton to mothball the Ravensthorpe project.



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At the time of writing the review it is still unknown how the various production cutbacks and anticipated delays in projects will impact global refined cobalt production during 2009 and beyond. However, in line with general trends across the global resources sector, cutbacks, curtailments, and the freezing of capital expenditure programs are bound to trim earlier projections of build ups in cobalt output. The suspension of refining and mining operations at Chambishi, Camec, Katanga and CMSK alone are currently contributing to a reduction in refined and unrefined cobalt output that far exceeds 1,000 MT of cobalt contained per month.

### 1.3 The China Factor

- In 2007, Chinese supply was characterized by a structural tightness in feed material for refining purposes, resulting in record prices for both cobalt bearing concentrates and intermediate products. However, imports into China of ores and concentrates rose dramatically in the course of 2008. During the first ten months of 2008, Chinese trade statistics indicate that total imports reached just over 200,000 MT, compared to some 95,000 MT for the same period last year (an increase of 110%). A little over 93% of these imports originated from the DRC. Imports of cobalt intermediates increased 15% over the same period.
- An estimated total of 18,053 MT of cobalt contained in ores, matte / alliages blanc and intermediates were imported into China during the January - October period this year. Despite a gradual reduction in the average cobalt content it is estimated that it represents an overall increase in cobalt contained of approximately 62% over the January - October period last year.

#### Import statistics of cobalt into China

Product	Jan-Dec 2007		Jan-Oct 2007		Jan-Oct 2008	
	Quantity (KG)	Co cont (MT)	Quantity (KG)	Co cont (MT)	Quantity (KG)	Co cont (MT)
Cobalt Acetate	-	-	-	-	-	-
Cobalt Carbonate	456,146	205	455,987	205	31,912	14
Cobalt Chloride	-	-	-	-	-	-
Cobalt Matte	6,316,044	2,211	4,829,304	1,690	8,190,058	2,867
Cobalt Nitrate	12,830	2	12,829	2	3,902	1
Cobalt Ores	118,353,215	8,285	95,210,515	6,665	201,781,491	12,107
Cobalt Oxide & Hydroxide	518,214	337	359,510	234	442,665	288
Cobalt Sulphate	157,836	24	141,720	28	159,426	32
Cobalt Waste & Scrap	-	-	-	-	-	-
Intermediate Cobalt	13,544,576	2,709	11,182,819	2,237	12,815,478	2,563
Other Cobalt	111,983	110	89,233	87	185,689	182
<b>Total Imports</b>		<b>13,882</b>		<b>11,148</b>		<b>18,053</b>

(\*cobalt contents estimated basis assumed Co content)

Source: General Administration of Chinese Customs / World Bureau of Metal Statistics

- While imports of concentrates reached a record 31,800 MT during October, November imports fell 13% to 27,576 MT (as other import data was not available at the time of writing, the above table reflects the Jan-Oct period only). December imports are expected to be substantially lower. However, demand for cobalt concentrates started to fall sharply during the third quarter and a collapse in the cobalt concentrate price has led to a vast buildup of processing feedstock. Concentrate shipments from the DRC continue albeit at a substantially lower rate. However, total cobalt imports for 2008 are still likely to exceed the 20,000 MT mark by year-end.
- In the mid-year Market Review it was mentioned that despite the growing concentrate surplus, overall refined cobalt production in China was not expected to show significant growth during 2008. At the CDI conference in May, Beijing Antaike Information Development Co. of China forecasted that overall refined cobalt production in 2008 would drop marginally from 13,245 MT in 2007 to approximately 13,000 MT this year as a result of rising costs, a tighter monetary policy, thinner margins and the removal of export rebates. However, recent estimates from Antaike presented during the Nanjing Co / Ni Industry forum in November show that Chinese refined cobalt production for 2008 is expected to reach 18,000 MT (or 16,700 MT if one excludes production of the Ganzhou Yihao Umicore operation).



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- Anecdotal evidence indicates that a vast majority of Chinese cobalt processors, primarily producers of salts and oxides, have cut output in recent months and that in some cases producers have shut down production. Overall output is thought to have been cut by 30-50% while companies continue to sell cobalt products at a loss in order to meet financing and tax obligations. While total cobalt imports in 2008 could be as high as 20,000 MT we believe that approximately 3,500 - 4,000 MT of cobalt contained will have accumulated as unprocessed stock at yearend due to the abrupt drop in consumption seen during the fourth quarter.
- While concentrate imports will fall substantially following the suspension of mining operations in the DRC, companies like Katanga and Camec are still shipping concentrates from stock. Estimates therefore show that it will take several months before de-stocking will bring inventory levels back to those seen at the end of 2007. Galico, one of China's largest cobalt salts producers, meanwhile predicts that as a consequence of the mining closures in the DRC, 65% of the Chinese cobalt industry will shut down during the second quarter of 2009 as a result of a shortage in feed material arriving from the DRC. 'While current stocks may sustain production for the first quarter, a restart of production in March would mean that shipments do not arrive until July...'

### 1.4 DLA (US Defense Logistical Agency)

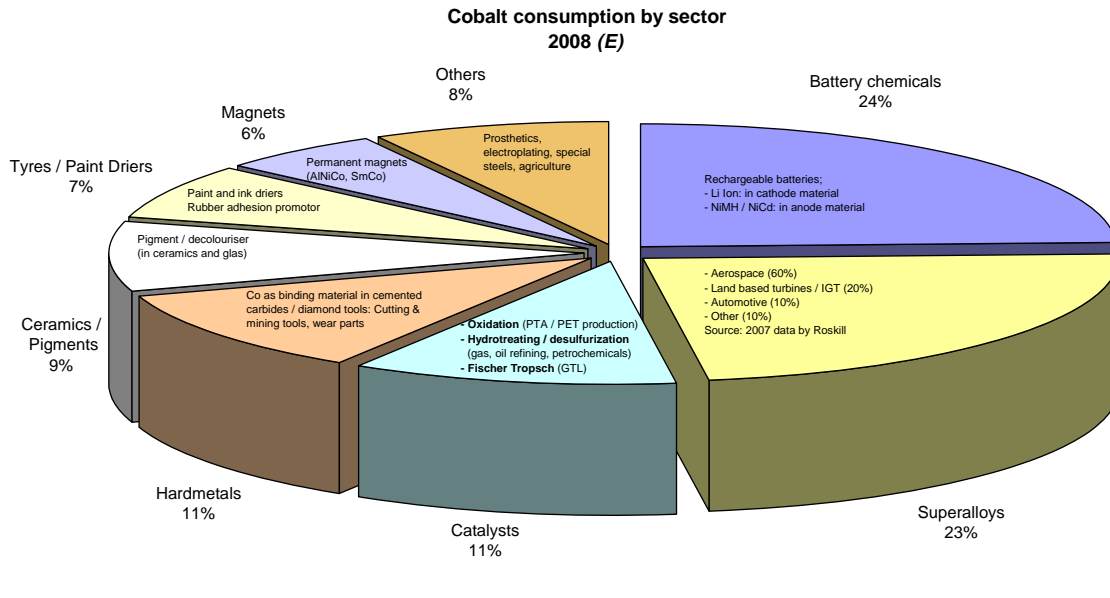
During 2008 the DLA is estimated to have sold just 185 MT of cobalt metal, its lowest sales figure for more than 10 years. As per January 1 2009, the DLA will have 497 MT of high grade cobalt cathodes left in its strategic stockpile which, according to the 2009 Fiscal Year Annual Materials Plan it is authorized to sell in its entirety during 2009. Meanwhile, the DLA has temporarily suspended payment terms on all active solicitations, saying it will only award contracts on a prepaid basis.

<i>DLA Sales 2008</i>			
<i>Month</i>	<i>Metric Tons sold</i>	<i>Average price per lb.</i>	<i>Remaining inventory</i>
<i>Jan 08</i>	<i>45.95</i>	<i>\$43.43</i>	<i>630.29</i>
<i>Feb 08</i>	<i>10.00</i>	<i>\$50.00</i>	<i>620.29</i>
<i>Mar 08</i>	<i>0.0</i>	<i>-</i>	
<i>Apr 08</i>	<i>4.0</i>	<i>\$46.51</i>	<i>616.29</i>
<i>May 08</i>	<i>4.0</i>	<i>\$46.55</i>	<i>612.29</i>
<i>Jun 08</i>	<i>0.0</i>	<i>-</i>	
<i>Jul 08</i>	<i>6.0</i>	<i>\$37.27</i>	<i>606.33</i>
<i>Aug 08</i>	<i>55.8</i>	<i>\$27.00</i>	<i>550.53</i>
<i>Sep 08</i>	<i>52.93</i>	<i>\$33.85</i>	<i>497.61</i>
<i>Oct 08</i>	<i>0.0</i>	<i>-</i>	
<i>Nov 08</i>	<i>0.0</i>	<i>-</i>	
<i>Dec 08</i>	<i>TBA</i>	<i>-</i>	

## 2.0 Demand 2008

### 2.1 Refined cobalt demand.

Apparent refined cobalt demand for 2008 has been estimated at 57,160 MT, up 3% from the 55,780 MT consumed in 2007. Approximately 53% of this was consumed in the chemical sector, the balance in alloys, hardmetals, magnets and diamond tools.



## 2.2 Key developments per sector

### Superalloys

- Demand growth in the superalloy sector is estimated at 4% in 2008, reaching 13,200 MT. This sector has seen robust demand for civilian and military aircraft together with firm demand for gas turbines for electrical power generation. Aerospace related demand has been the primary growth driver in this sector, with order backlogs for airplanes and aero engines reaching new record level at the beginning of this year. The Airbus delivery order backlog reached a record 3700 planes by the middle of this year, translating into an equivalent of around six years production. Boeing estimated in their recently published Current Market Outlook 2008-2027 that the current global order book for airplanes over 100 seats has risen to 7,900 aircraft. However, most airplane manufacturers have been faced with a gradual reduction in airplane orders this year as a result of the slowing world economy and slowing traffic growth. For the first 10 months of the year Airbus added 878 planes to its order books (compared to 1,021 over the same period last year) of which 122 have now been recorded as cancellations. Boeing meanwhile recorded 640 net orders over the first eleven months of 2008 versus a total of 1,413 orders in 2007. Deliveries dropped substantially to 334 planes versus earlier forecasts of 480-490 planes, partly as a result from the 8 week long strike which paralyzed Boeing's production in September and October.
- Superalloy demand clearly has not been immune to the economic fallout from the global credit crisis. Demand and pricing for superalloy products have been impacted by the growing uncertainties in global economies, the impact from the strike at Boeing and the delay in its 787 program, as well as rapidly falling prices of raw materials. Most of the alloying raw materials have fallen significantly due to reduced global demand and deleveraging of certain traded commodities. As a result, orders have slowed during the second half of the year and downstream users are adjusting the timing of their projects until raw material prices adjust and stabilize. As a result, superalloy production at some of the major producers has been adjusted downwards in a reaction to this trend.



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- Surging oil / kerosene prices have been the driver behind the strong market for fuel efficient jet engines, further supporting the replacement rate of engines on older aircraft. Kerosene prices increased 80% within a year which further intensified the drive for more fuel efficient and higher thrust engines. This in turn supported usage of cobalt based alloys as the addition of these alloys in the engine's hot section allows for higher operating temperatures to be achieved, thus improving thrust and fuel economy. However, the dramatic drop in oil prices (down 72% from its peak of \$145 per barrel 5 months ago) can potentially undermine this trend.
- The market for Industrial Gas Turbines has seen strong demand growth from the energy sector and superalloy demand from that sector is still reported to be healthy. Roughly 20% of superalloy production is used in IGT production although cobalt is less often used as an alloying agent in this particular application. Forecasts indicate that the installed IGT base will grow by 30% over the next 10 years.

### Batteries

- With close to 14,000 MT of cobalt being consumed in battery chemicals, the battery industry still represents the single largest consuming sector in 2008. Demand for Li-ion batteries is estimated to have increased 13-14% during 2008 (3,300 million cells versus 2,840 million cells in 2007). However, substitution of the traditional  $\text{LiCoO}_2$  cathode material, accelerated by soaring cobalt prices earlier this year, has negatively impacting the growth for cobalt demand in this sector. In 2005 over 90% of the cathode material used in Li-ion batteries was based on  $\text{LiCoO}_2$ , containing up to 60% of cobalt. According to data presented by Umicore at The CDI Conference in Toronto earlier this year, usage is estimated to have dropped to 73% in 2008. The replacement materials that are increasingly used are  $\text{LiNiCoMnO}_2$  (10-20% Co),  $\text{LiNiCoAlO}_2$  (9% Co),  $\text{LiMn}_2\text{O}_4$  and  $\text{LiFePO}_4$ , both containing no cobalt. For 2012, Umicore is forecasting that the use of  $\text{LiCoO}_2$  as cathode material for Li-ion batteries will have dropped to 36%, while use of  $\text{LiNiCoMnO}_2$  and  $\text{LiNiCoAlO}_2$  will have grown to 34% and 10% respectively.
- Despite the global economic slowdown, the market for Li-ion batteries is still expected to grow by 6-8% in 2009. However, this is down to approximately half the growth rate seen in 2008 and lower than estimates of 10-12% made by industry analysts earlier in the year. Much of the growth in 2009 will be driven by the demand for cylindrical cells going into laptop computers (estimated 19% growth in 2009), offset by lower growth rates expected for prismatic cells used mostly in mobile telephones and small portable electronic devices.
- The market for Li-ion cells will be boosted by the substitution of NiCd and NiMH batteries in power tools, new applications and the ultimate shift from NiMH to Li-ion battery technology for HEV vehicles. By now it has become evident that Li-ion is the technology of choice and this will overtake the use of NiMH batteries in HEV vehicles by 2012. According to Hiedge, a Japanese based research firm, the HEV market will reach five million vehicles by 2015, a 14-fold increase from the 365,000 vehicles sold in 2006. GM is forecasting that over 80% of vehicles will require some form of hybridization by 2020 and battery makers have been investing heavily in the expansion of Li-ion production lines. Although a strong driver for Li-ion battery demand, cathode materials for these batteries are likely to be based on  $\text{LiNiCoMnO}_2$  (10-20% Co),  $\text{LiNiCoAlO}_2$  (9% Co) and / or  $\text{LiMn}_2\text{O}_4$ . Cobalt is therefore used as an additive of which its content in a typical HEV Li-ion battery does not exceed 10%.
- Unconfirmed reports suggest that major battery producers, amongst which Panasonic and Sanyo, have started to cut back battery production at the end of November by up to 70-80% as part of a major de-stocking exercise, meanwhile having instructed suppliers to cut deliveries of raw materials down to as little 20-30% of contractual volumes. This in turn could have a significant impact on the levels of cobalt metal and cobalt oxide being delivered into this sector but at the time of writing the extent and duration of any such production cutbacks are still unclear.



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### Others

- Of the 6,500 MT of cobalt consumed by the catalysts industry in 2007, approximately 4,500 MT was consumed as a polymerization catalyst in purified terephthalic acid (PTA), which in turn is used in polyester fibres and polyethylene terephthalate (PET) packaging materials. World consumption of PTA is expected to increase at a healthy 7.6% per year according to Tecnon OrbiChem but growing overcapacity as a result of major capacity additions in China has added pressure to the market in 2008. While China is expected to grow its PTA production capacity by 14% p/a over the 2008-2013 period, it will continue to be a net importer of PTA partially because demand for polyester fiber is expected to maintain a growth rate of >17% per annum over the next five years. More advanced recycling technologies and the increased regeneration of spent catalyst means cobalt consumption in this sector has grown more gradually than global PTA demand.
- The soaring oil price has been a major driver for oil companies to fast-track development of commercial gas to liquid (GTL) production facilities, yet construction of the various scheduled projects continues to be delayed. While many GTL projects do not progress from the initial planning phase, Sassol (Chevron) and Shell are the only two oil companies currently producing GTL products on a commercial scale. Construction of the \$15 billion Shell Pearl Project in Qatar is on track and expected to be operational by end 2010. The Sassol Oryx plant in Qatar, which became operational in early 2007 has been experiencing technical difficulties as a result of higher-than-expected levels of fine material being produced in the Fischer-Tropsch process. As a result, the plant has been producing well below its 34,000 bpd capacity although additional downstream filtration equipment has resulted in improved production rates. Meanwhile, construction of its Nigerian GTL plant in JV with Chevron is running behind schedule and the completion date has slipped again from 2010 to 2011. The dramatic drop in oil prices and the freezing of capital expenditure programs is likely to delay further investments in installing new capacity in the short to mid-term. As a result, cobalt demand for GTL catalysts is not likely to exceed several hundred tons per annum over the next few years.
- Approximately 6,000 MT of cobalt will have been consumed in cemented carbide and diamond tool applications during 2008 (respectively 8% and 2.6% of global demand). Escalating cobalt prices have stimulated and intensified industry efforts to substitute the traditional cobalt binder with more economical materials (i.e. lower cobalt content), offsetting the relatively strong industry growth which the diamond tool and cemented carbide sectors have experienced in previous years. Furthermore, demand for fine cobalt powders has softened in recent months as this is being driven by slowdowns in demand from the construction, automotive and diamond tool markets.
- Cobalt demand for use in pigments, ceramics and paint driers has seen a negative impact from the global slowdown in the housing and construction industry. Meanwhile, tire adhesion bonding materials and permanent magnets are likely to see a reduction in demand as a result of the weakening car industry.

### 2.3 Demand - The China Factor

Consumption growth of primary refined cobalt in China has slowed during 2008. Whereas demand in China grew some 7% during 2007, latest estimates by Antaika suggest that this may have slowed to approximately 1.4% during 2008. Consumption of cobalt compounds weakened significantly during the second half of the year as the global economic slowdown impacted down-stream demand, resulting in rapid price decreases and significant inventory build-up.

Due to the demand slowdown in the latter part of the year, total primary cobalt consumption in China is estimated to have been 12,700 MT compared to approximately 12,500 MT in 2007.



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### Cobalt Consumption China - by Industry

Industry	2006	2007	2008 (E)	y.o.y. growth %
Battery	5,771	6,100	6,600	8.0 %
Cemented carbides	1,500	1,640	1,700	3.6 %
Ceramics	1,500	1,620	1,400	- 13.6 %
Petrochemical catalysts	1,000	1,170	1,000	- 14.5 %
Magnets	1,024	1,067	980	- 8.2 %
Driers	360	396	450	14.9 %
Superalloys, special steel etc.	300	322	370	14.9 %
Others	210	220	200	- 9.0 %
<b>TOTAL</b>	<b>11,665</b>	<b>12,535</b>	<b>12,700</b>	<b>1.4%</b>

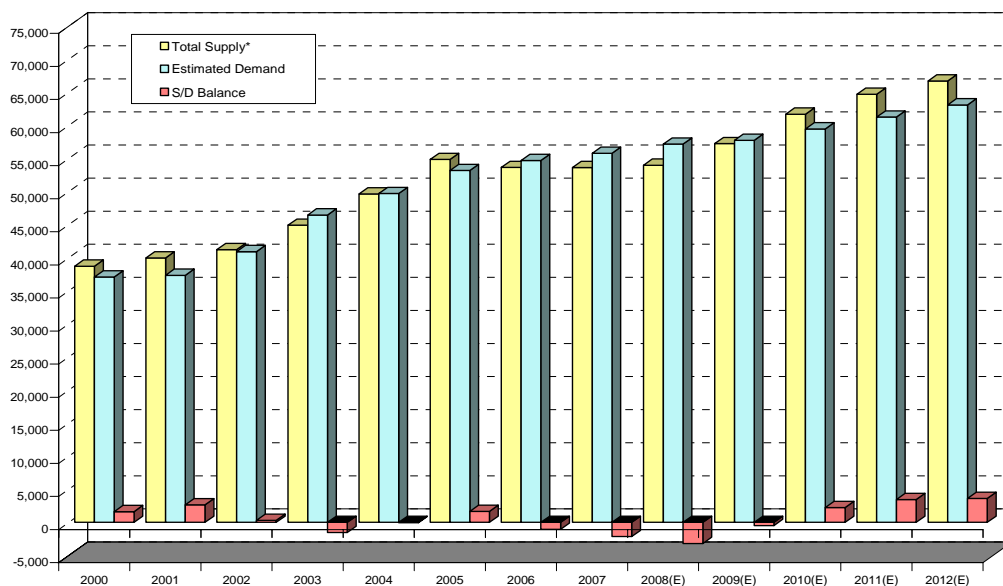
Source: Darton Commodities Ltd / Beijing Antaika Information Development Co Ltd.

The increase in battery related demand has been offset by a reduction in demand from ceramics, catalysts and the magnet industry. Apparent demand could be closer to 15,000 MT if one takes into account the consumption of recycled materials, which was up significantly in 2008 (2,800 MT versus 1,600 MT in 2007).

### 3.0 Supply / Demand balance

Estimates show that cobalt demand exceeded primary refined cobalt production for a third year in a row, or some 3,200 MT during 2008. This supply deficit was largely met by producer, trader and governmental stockpiles and through secondary materials as a result of increased recycling efforts. Earlier market forecasts suggested that the market would move into structural oversupply commencing 2009 as several new and expansion projects would commence production of additional cobalt units, resulting in an oversupply of several thousand tons by 2010 and beyond. However, recent supply developments seem to suggest that much of the additional production initially anticipated for 2009 will not materialize until 2010 at the earliest. Meanwhile, demand for primary refined cobalt in 2009 is expected to see little to no growth during at least the first part of the year as a result of a weak macro economic environment. As a result, we should see a significantly more balanced market in 2009 than initially forecasted. At the same time, a further curtailment in output or a continuation of the recently announced production cutbacks into the first quarter of 2009 can quickly tilt this delicate market balance back into deficit.

Global Cobalt Supply / Demand Balance



Source: Darton Commodities Ltd.

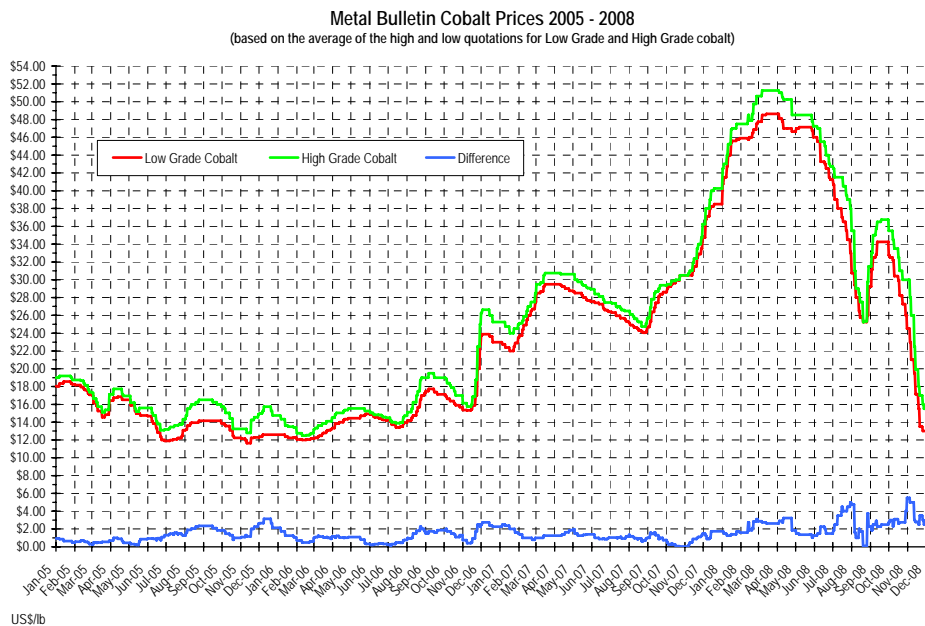


## 4.0 Market Prices

Cobalt prices reached record highs during the first quarter 2008, breaching the \$50/lb. level in February and ultimately peaking at an average of \$51.25/lb. for high grade and \$48.63/lb. for low grade by mid March. The firmly established bull trend, which started early September 2007 and lasted a little over seven months, resulted in price increases of more than 100%. Strong underlying market fundamentals reflecting both robust market demand and widespread availability concerns helped underpin market prices during the first quarter.

Following a brief period of price consolidation during March and April, prices started to show some initial weakness as profit taking from the trade resulted in lower priced offers. During the course of May, the impact of the soaring concentrate imports and deteriorating market conditions in China became evident, changing market sentiment and adding further price pressure. With published prices in decline and buyers sensing a weakening market, consumers sidelined themselves, drawing down inventories and buying on a hand-to-mouth basis.

As the market entered the traditionally slow summer period, further price pressure was seen and prices eventually found a floor at approximately \$24.00/lb. by end of August. Buyers were quickly drawn back into the market and prices gained just over \$10.00/lb. in two weeks on the back of substantial consumer covering and the resurfacing of availability concerns.



Source: Metal Bulletin

Market prices briefly consolidated during October but this was soon followed by downward price pressure as short-term concerns over the financial system and the global economy kept many consumers out of the market. While consumer demand quickly slowed, traders and producers looked to liquidate stocks with some selling aggressively into a further weakening market. An unprecedented lack of consumer buying, anxious supplier selling and rapidly deteriorating market sentiment drove the cobalt metal price into a freefall - in little more than two months the Metal Bulletin Low Grade low cobalt price fell 72%, from \$32.50/lb. to \$9.00/lb.



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	Low Grade Cobalt			High Grade Cobalt		
	Low	High	Average	Low	High	Average
<b>2007</b>						
Jan-07	\$21.64	\$23.56	\$22.60	\$24.17	\$25.17	\$24.67
Feb-07	\$25.18	\$26.13	\$25.65	\$26.14	\$27.22	\$26.68
Mar-07	\$28.61	\$29.71	\$29.16	\$29.67	\$30.99	\$30.33
Apr-07	\$28.46	\$29.71	\$29.09	\$29.79	\$31.50	\$30.64
May-07	\$27.42	\$28.88	\$28.15	\$29.02	\$30.12	\$29.57
Jun-07	\$26.54	\$27.49	\$27.02	\$27.68	\$28.34	\$28.01
Jul-07	\$25.44	\$26.25	\$25.85	\$26.73	\$27.08	\$26.90
Aug-07	\$24.08	\$24.98	\$24.53	\$25.18	\$25.82	\$25.50
Sep-07	\$26.89	\$28.04	\$27.46	\$28.15	\$29.11	\$28.63
Oct-07	\$29.41	\$30.31	\$29.86	\$29.61	\$30.44	\$30.03
Nov-07	\$31.42	\$32.50	\$31.96	\$32.24	\$33.30	\$32.77
Dec-07	\$37.13	\$38.58	\$37.85	\$38.67	\$39.83	\$39.25
Average	\$27.69	\$28.85	\$28.27	\$28.92	\$29.91	\$29.42
<b>2008</b>						
Jan-08	\$43.22	\$45.08	\$44.15	\$44.50	\$46.75	\$45.63
Feb-08	\$45.67	\$47.24	\$46.46	\$47.33	\$49.89	\$48.61
Mar-08	\$46.62	\$47.94	\$47.28	\$48.83	\$51.06	\$49.94
Apr-08	\$46.62	\$47.94	\$47.28	\$48.83	\$51.06	\$49.94
May-08	\$46.53	\$47.36	\$46.94	\$47.78	\$48.78	\$48.28
Jun-08	\$42.72	\$43.84	\$43.28	\$44.50	\$45.50	\$45.00
Jul-08	\$35.98	\$37.83	\$36.91	\$40.11	\$41.11	\$40.61
Aug-08	\$26.79	\$28.31	\$27.35	\$28.28	\$30.24	\$29.26
Sep-08	\$32.59	\$34.33	\$33.46	\$35.09	\$36.66	\$35.88
Oct-08	\$28.65	\$30.18	\$29.41	\$31.90	\$33.30	\$32.60
Nov-08	\$16.00	\$17.91	\$16.96	\$19.44	\$21.29	\$20.37
Dec-08	\$9.50	\$13.38	\$11.48	\$13.33	\$15.50	\$14.42
Average	\$35.19	\$36.86	\$36.01	\$37.58	\$39.38	\$38.48

Source: Metal Bulletin (Monthly averages in US\$ per lb.)

By mid December the market started to see early signs of a price recovery. The announcement by Chambishi to suspend production was soon followed by multiple sales reported by BHP Billiton's online sales system (over 90 MT was reportedly sold in a single week), driving the price of high grade metal higher. Prices for lower grade metal initially lagged the upward trend as it took longer for low grade demand to return to the market but as it became evident to consumers that the market had bottomed out, some of the pent up consumer demand led to more transactions at gradually higher numbers. At the time of writing, cobalt prices recovered to \$13 - \$15 for low grade and approximately \$16 - \$18 for high grade metal.

As many industrial consumers will have extended shutdowns over the December holidays, it is generally assumed that the cobalt market will continue to trade mostly sideways for the remainder of the year. However, in light of the prolonged period of de-stocking, hand to mouth buying and delayed purchasing decisions on annual contracts we anticipate a relatively strong (spot) market in January which is likely to underpin current price levels, possibly providing further upside potential in the short term.

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