January 16, 2013

GS Mining Commodity Forecasts for 2013, and Beyond

Goldman Sachs

Commodities Research

Extending our forecast horizon over the medium to long term

In this note we present our mining commodity supply, demand and price forecasts for the short, medium and long term, following the extension of our economists annual GDP and IP forecasts. This includes updated annual price forecasts for 2013-2017, as well as long-term prices, for the bulk commodities (thermal coal, metallurgical coals, iron ore), as well as base and precious metals, mineral sands, and rare earths. These forecasts form the basis of our Global Investment Research mining equity models.

Copper, palladium and metallurgical coal preferred in 2013

Taking into account anticipated producer margins and industry structure, as well as outright price upside/downside, our most preferred mining commodities are copper, palladium, and metallurgical coal, and least preferred are aluminium, nickel and zircon, on a 12-mo horizon (N.B. we have not changed any of our 3-, 6- or 12-mo commodity forecasts). Over the medium to long term we are most bullish on the prospects for palladium and metallurgical coal (especially premium hard coking coal).

The most significant changes to our forecasts are the downgrade of our 2013 zircon price forecast to $1,350/t (from $1,500/t), and the lowering of our 2014 aluminium price forecast to $2,050/t (from $2,204/t), with the latter following the build out of a smelter by smelter Chinese supply model and resulting increased confidence in supply growth. Finally, we downgrade our 2014 zinc price forecast to $2,175/t (from $2,326/t), to account for lower-than-anticipated marginal Chinese output costs.

Establishing long-term commodity prices: Copper in the spotlight

In addition to releasing a number of mining commodity long-term price forecasts, we provide detailed justification of our c.$6,600/t ($3/lb) real copper price forecast (2013 dollar terms), which 'kicks in' in 2018 at $7,660/t. Our long-term copper price view is derived from our "incentive price" and "cost curve" forecasting methodologies, and supported by the fact that 5-year copper forwards have averaged almost $8,000/t ($3.63/lb) over the past two years.

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Investors should consider this report as only a single factor in making their investment decision. For Reg AC certification and other important disclosures, see the Disclosure Appendix, or go to www.gs.com/research/hedge.html.

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Prices in this report are as of the close on January 14, 2013, unless otherwise noted.

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Mining commodities overview – Bullish copper, palladium and metallurgical coal for 2013

In this note we present our mining commodity supply, demand and price forecasts for the short, medium and long term, following the extension of our economist's annual GDP and IP forecasts. This includes updated annual price forecasts for 2013-2017, as well as long-term prices, for the bulk commodities (thermal coal, metallurgical coals, iron ore), as well as base and precious metals, mineral sands, and rare earths (see Exhibit 1). The forecasts form the basis of our Global Investment Research mining equity models.

Exhibit 1: Goldman Sachs mining commodity price forecasts (changes are shaded)

		2012A	2013E	2014E	2015E	2016E	2017E	Long Term 2018E Nominal
Aluminium	US$/t	**2023** *(2021)*	**2050** *(2050)*	**2050** *(2204)*	**2100**	**2200**	**2315**	**2553**
Copper	US$/t	**7959** *(7970)*	**8458** *(8458)*	**7250** *(7017)*	**6875**	**7500**	**7500**	**7660**
Lead	US$/t	**2062** *(2049)*	**2163** *(2194)*	**2338** *(2469)*	**2365**	**2365**	**2365**	**2553**
Nickel	US$/t	**17536** *(17581)*	**16625** *(17000)*	**17000** *(17240)*	**17000**	**17000**	**17000**	**19717**
Zinc	US$/t	**1950** *(1953)*	**2013** *(2075)*	**2175** *(2326)*	**2200**	**2200**	**2200**	**2553**
Iron Ore[1]	US$/t	**130** *(130)*	**144** *(140)*	**126** *(126)*	**90**	**80**	**85**	**88**
Lump Premium[1]	US$/t	**8** *(8)*	**10** *(10)*	**9** *(9)*	**9**	**9**	**10**	**10**
Hard Coking Coal[2]	US$/t	**191** *(191)*	**178** *(178)*	**195** *(195)*	**205**	**210**	**210**	**206**
Semi-soft Coal[2]	US$/t	**119** *(118)*	**114** *(114)*	**115** *(115)*	**115**	**115**	**115**	**124**
PCI[2]	US$/t	**136** *(136)*	**134** *(134)*	**135** *(135)*	**140**	**145**	**145**	**144**
Thermal Coal[3]	US$/t	**95** *(95)*	**99** *(99)*	**100** *(100)*	**100**	**100**	**92**	**92**
Zircon[4]	US$/t	**2275** *(2275)*	**1350** *(1500)*	**1575** *(1575)*	**1600**	**1600**	**1600**	**1648**
Rutile[5]	US$/t	**2400** *(2400)*	**1563** *(1563)*	**1700** *(1700)*	**1700**	**1700**	**1700**	**1082**
Synthetic Rutile[5]	US$/t	**2200** *(2200)*	**1425** *(1425)*	**1525** *(1525)*	**1600**	**1600**	**1600**	**973**
Ilmenite[6]	US$/t	**298** *(298)*	**283** *(283)*	**255** *(255)*	**230**	**220**	**220**	**200**
Chloride Slag (ex cont)	US$/t	**1920** *(1920)*	**1325** *(1325)*	**1425** *(1425)*	**1500**	**1500**	**1500**	**902**
Sulphate Slag (ex cont)	US$/t	**1800** *(1800)*	**1225** *(1225)*	**1325** *(1325)*	**1400**	**1400**	**1400**	**782**
Rare Earth Basket[7]	US$/kg	**65** *(65)*	**40** *(40)*	**40** *(40)*	**38**	**38**	**60**	**60**
Gold	US$/oz	**1670** *(1678)*	**1810** *(1810)*	**1750** *(1750)*	**1625**	**1460**	**1295**	**1200**
Platinum	US$/oz	**1555** *(1560)*	**1575** *(1544)*	**1600** *(1581)*	**1650**	**1750**	**1794**	**1854**
Palladium	US$/oz	**646** *(646)*	**781** *(781)*	**925** *(925)*	**1000**	**1050**	**1050**	**927**
Rhodium	US$/oz	**1277** *(1286)*	**1225** *(1288)*	**1300** *(1375)*	**1350**	**1400**	**1400**	**1339**
Oil[8]	US$/bbl	**120** *(120)*	**110** *(110)*	**105** *(105)*	**100**	**85**	**85**	**85**

Notes: (1) CFR China, basis 62% Fe fines; (2) FOB Queensland; (3) We show the spot market price for thermal coal (as opposed to contract), FOB Newcastle; (4) GS hybrid price series for bulk and bagged zircon, FOB Australia; (5) Our prices for rutile and synthetic rutile represent our best estimates of prices obtainable by major Australian producers, out of contract; (6) Chloride grade, FOB Australia; (7) LYC production mix; (8) Brent

Sources: LME; IRESS; Bloomberg; TEX Report; TZMI; Johnson Matthey; Goldman Sachs Global ECS Research Estimates.

Source: LME, IRESS, Bloomberg, Platts, McCloskey, TZMI, TEX Report, Johnson Matthey, Goldman Sachs Global ECS Research estimates.

Taking account of anticipated producer margins and industry structure, as well as outright price upside/downside, our most preferred mining commodities on a 12-mo horizon are copper, palladium, and metallurgical coal (see Exhibit 2), and least preferred are aluminium, nickel and zircon (N.B. we have not changed any of our 3-, 6- or 12-mo commodity price forecasts). Over the medium to long term our most preferred mining commodities are palladium, metallurgical coal (especially premium hard coking), and mineral sands.

The most significant individual changes to the mining commodity forecasts was the downgrade of our 2013 zircon forecast to $1,350/t (from $1,500/t), and the lowering of our 2014 aluminium price forecast to $2,050/t (from $2,204/t), with the latter following the build out of a smelter by smelter Chinese supply model and resulting increased confidence in supply growth. Our 2014 zinc price forecast was also downgraded to $2,175/t (from $2,326/t), to account for lower-than-anticipated marginal Chinese output costs.

Exhibit 2: We prefer copper, palladium and metallurgical coal
GS mining commodity rankings; 12-month view

	Spot price	GS Price 2013E	Demand growth 2013/12	Market balance 2013
Most preferred				
Copper	$ 8,017	$ 8,458	3.8%	Lower stocks in wks demand
Metallurgical coal	$ 160	$ 178	1.6%	broadly balanced
Palladium	$ 697	$ 781	4.4%	deficit
Least preferred				
Aluminium	$ 2,063	$ 2,050	6.9%	surplus
Nickel	$ 17,524	$ 16,625	4.1%	surplus
Zircon	$ 1,300	$ 1,350	9.8%	surplus

Source: Goldman Sachs Global ECS Research estimates.

In addition to releasing a number of mining commodity long-term price forecasts, we provide detailed justification of our c.$6,600/t ($3/lb) real copper price forecasts (2013 dollar terms). These assumptions 'kick in' in 2018, after being inflated by 3%.p.a, in line with our economists inflation forecasts. Our long-term copper price is derived from our "incentive price" and "cost curve" forecasting methodologies, and supported by the fact that 5-year copper forwards have averaged almost $8,000/t ($3.63/lb) over the past two years.

Base metals – Bullish copper (for now), incrementally bearish on aluminium, nickel
We remain bullish on the outlook for **copper** in 2013, with prices expected to average $8,458/t, though we expect prices to move down to average $7,250/t in 2014 and $6,875/t in 2015. From current prices we are cautious on the outlook for **aluminium** over the short, medium and long term, bearish on **nickel** (from prices above $17,000/t), and *relatively* constructive on **zinc** on a medium/long-term horizon (from prices sub $2,000/t).

Gold – Cycle set to turn on improved macro outlook
We expect higher **gold** prices in coming months given our economists forecast for weak growth early in 2013 as well as the uncertainty associated with the debt ceiling and potential budget sequestration. Assuming that the sequester does not take effect on March 1, we expect that the cycle in gold prices will likely turn later this year on improving US growth with prices gradually decreasing over the next five years to stabilize near $1,200/oz. For more details on our recently updated gold framework, please see *Precious Metal Outlook: Gold cycle set to turn on improving US recovery*, December 5, 2012.

PGMs – Structurally bullish on palladium; platinum to be supported only near term
South African supply issues have seen both platinum and palladium rally in recent weeks. However, we expect palladium will remain tight over the course of 2013-2015 and as such forecast that it will outperform platinum which is forecast to remain broadly in balance over the same period.

Bulk commodities – Bullish thermal coal, iron ore in its final phases
We believe **iron ore** will continue to see super-normal prices in 2013 (average $144/t), followed by a transitional year in 2014 (average $126/t). The iron ore market is headed for a long period of significant oversupply, in our view, but this is still two years away (see *Global: Mining: Iron age not over: stay bullish and position for next phase*, October 15, 2012). Relative to the other bulk commodities, **metallurgical coal** was the worst performer in 2012 with prices down 29%. However, we believe that current prices are below marginal production costs and see 17% upside potential versus spot relative to our 2H2013 forecast of $185/t for premium HCC (see *Global: Commodities: Metallurgical coal in a world of slower growth*, August 21, 2012). Finally, we believe that seaborne **thermal coal** prices will trade within a range of $90-100/t set by: a) the China arbitrage price on the upside; and b) marginal production costs on the downside (see *Mining Commodities: Coal price recovery to continue but upside is capped*, December 10, 2012).

Copper – Bullish 2013 outlook before move to temporary surplus

Copper remains our preferred base metal for 2013. Its high exposure to continued strength in late cycle Chinese construction completions (c.50% of Chinese consumption, Exhibit 5), together with an anticipated rebound in underperforming sectors in China (consumer appliances, manufacturing, machinery) and a pick-up in ex-Chinese consumption (US housing, general EM activity) are expected to underpin copper consumption growth through at least late 2013. While we also expect copper mine supply growth to accelerate to 2.8% yoy in 2013, this is not expected to shift the market into a noticeable surplus until 2014.

In 2014, further acceleration in mine supply growth – to 6.7% yoy – in the face of a sharp slowdown in Chinese construction completions is expected to move copper into a surplus of c.450,000t (Exhibits 3 and 4). Weak construction completions are expected to last at least into 1H2015, which together with significant supply growth should keep copper in surplus to the tune of 500,000t in 2015 (despite an assumed robust ex-Chinese demand recovery). As such, we see prices falling more than 10% from their 2013E average of $8,458/t to $7,250/t in 2014E and $6,825/t in 2015E (from peak to trough prices may decline more than 20%). With this outlook we strongly recommend producers consider hedging 2014 positions at prices in the c.$8,000-9,000/t range.

While questions about supply's ability to respond to current prices remain, we believe that the capex boom (Exhibit 7) will temporarily outweigh the impact of ageing mines, trend declines in ore grades, and project delays/cancellations (with the latter mainly affecting supply from 2016 onwards). There are major risks to this view, however the base of large existing mines has been underperforming so much over the past eight years (output down 1.5mt or 20%; Exhibit 8), it is very difficult to see this deterioration continuing from such a low base, at least over the 2013-2015 period. Further, supply growth in 2013 and 2014 is very broad based, and we are eight years into the price boom (it generally takes c.6-10 years to complete engineering designs and build a copper mine). Finally, we incorporate sizeable disruption allowances of 5.8% in 2013, 6.3% in 2014, 7.9% in 2015, and 10.8% in 2016 in our model, compared to average disruptions of c.5% in recent years.

By 2016, and beyond, we see copper tightening up once more as mine supply growth dries up – i.e. the current environment, together with the forecast period of price weakness in 2014 and 2015, is expected to result in project delays, and while demand is expected to continue to grow.

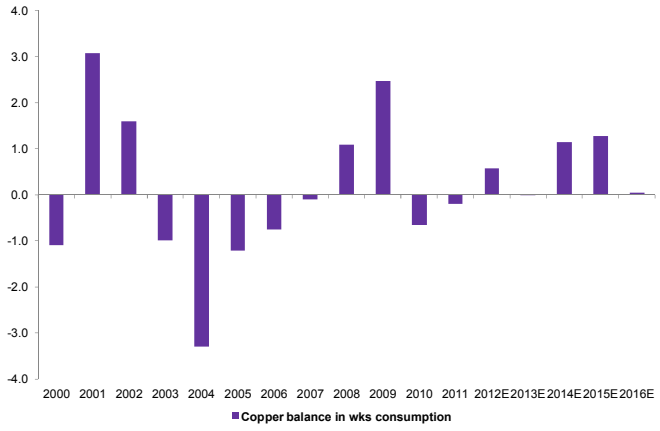
Exhibit 3: Global refined copper supply and demand balance
'000t

	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Global mine supply	**15960**	**16185**	**16101**	**16335**	**16796**	**17928**	**18884**	**19276**
% change	*1.6*	*1.4*	*-0.5*	*1.5*	*2.8*	*6.7*	*5.3*	*2.1*
Including disruption allow. (%)	*0.0*	*0.0*	*0.0*	*0.0*	*5.8*	*6.3*	*7.9*	*10.8*
Global refined supply	**18309**	**19017**	**19687**	**19761**	**20285**	**21495**	**22537**	**23156**
% change	*0.3*	*3.9*	*3.5*	*0.4*	*2.7*	*6.0*	*4.8*	*2.7*
Global refined consumption	**17477**	**19258**	**19763**	**19545**	**20291**	**21032**	**21999**	**23134**
% change	*-2.3*	*10.2*	*2.6*	*-1.1*	*3.8*	*3.7*	*4.6*	*5.2*
Of which China	6523	7416	7941	8179	8833	9098	9553	10126
% change	*29.3*	*13.7*	*7.1*	*3.0*	*8.0*	*3.0*	*5.0*	*6.0*
Of which World ex-China	10954	11842	11823	11366	11458	11933	12446	13008
% change	*-14.7*	*8.1*	*-0.2*	*-3.9*	*0.8*	*4.2*	*4.3*	*4.5*
Balance	**833**	**-241**	**-77**	**216**	**-6**	**463**	**538**	**22**
Year end inventory (weeks)	**2.9**	**3.0**	**2.4**	**3.5**	**3.3**	**4.3**	**5.4**	**5.2**
LME Price ($/t)	**5163**	**7543**	**8824**	**7959**	**8458**	**7250**	**6875**	**7500**
LME Price (c/lb)	234	342	400	361	384	329	312	340

N.B. - our long term copper price forecast is $3/lb, or c.$6,600/t, in 2013 dollar terms.

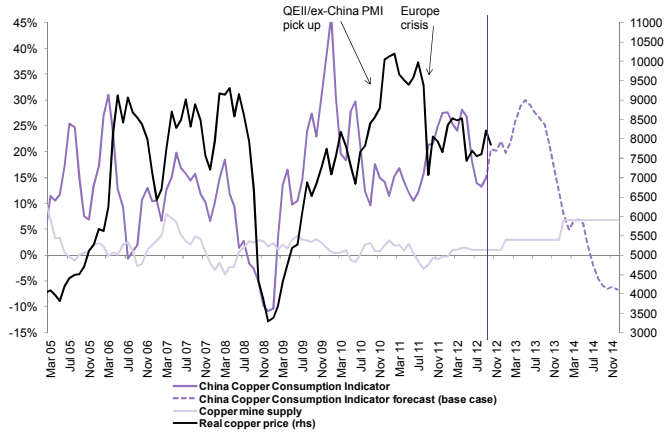
Source: Wood Mackenzie, CRU, Goldman Sachs Global ECS Research estimates.

Exhibit 4: Refined copper balance changes – period of surplus to last c.2 years, but not here yet
Weeks consumption



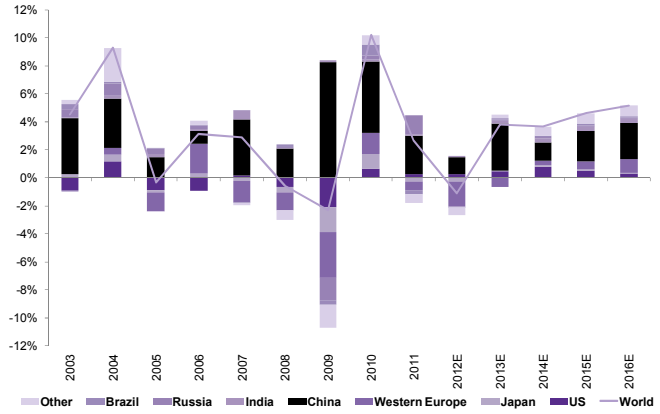
Source: Goldman Sachs Global ECS Research estimates.

Exhibit 5: Chinese demand growth slowdown in face of stronger supply growth may dent copper prices in 2014
Percent change yoy, 3-mo moving average (lhs), $/t $2013 terms (rhs)



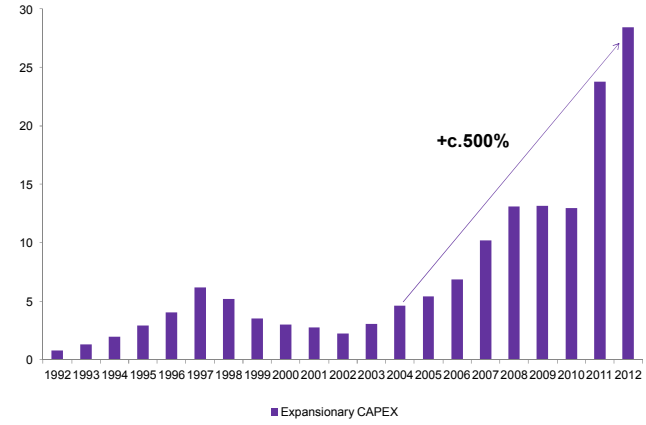
Source: LME, Reuters, ICSG, Goldman Sachs Global ECS Research estimates.

Exhibit 6: Copper demand growth by country/region
Percent yoy growth



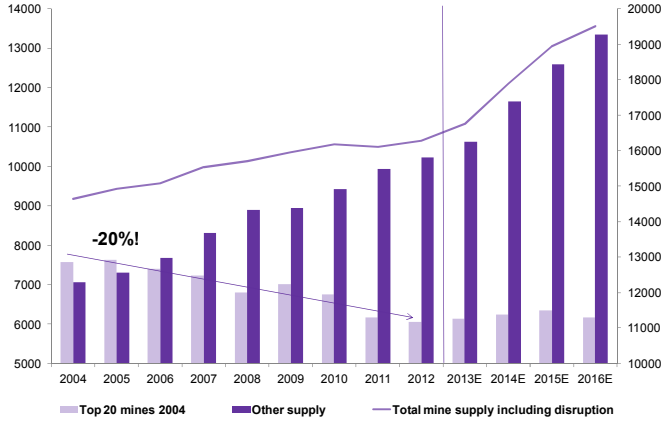
Source: Wood Mackenzie, Goldman Sachs Global ECS Research estimates.

Exhibit 7: Copper mining capex booming …
$bn



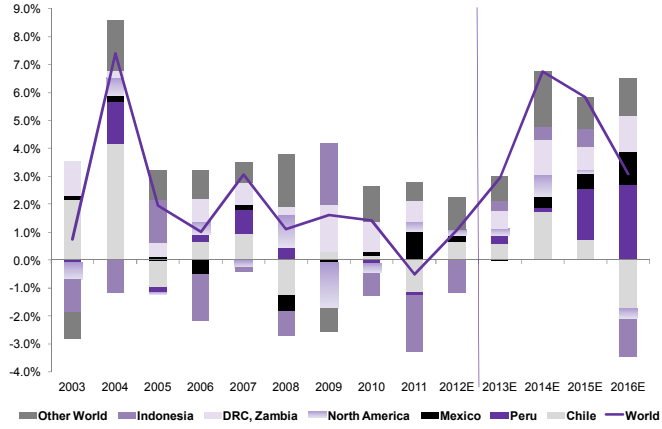
Source: Wood Mackenzie, Goldman Sachs Global ECS Research.

Exhibit 8: … together with a stabilisation in output from the base of large mines = mine supply growth pick up
'000t, including disruption allowance



Source: Wood Mackenzie, Goldman Sachs Global ECS Research estimates.

Exhibit 9: Copper mine supply growth by country/region
Percent yoy growth, including disruption allowance



Source: Wood Mackenzie, Goldman Sachs Global ECS Research estimates.

Long-term copper prices – *c.*$3/lb or $6,600/t in 2013 dollar terms required to clear the market

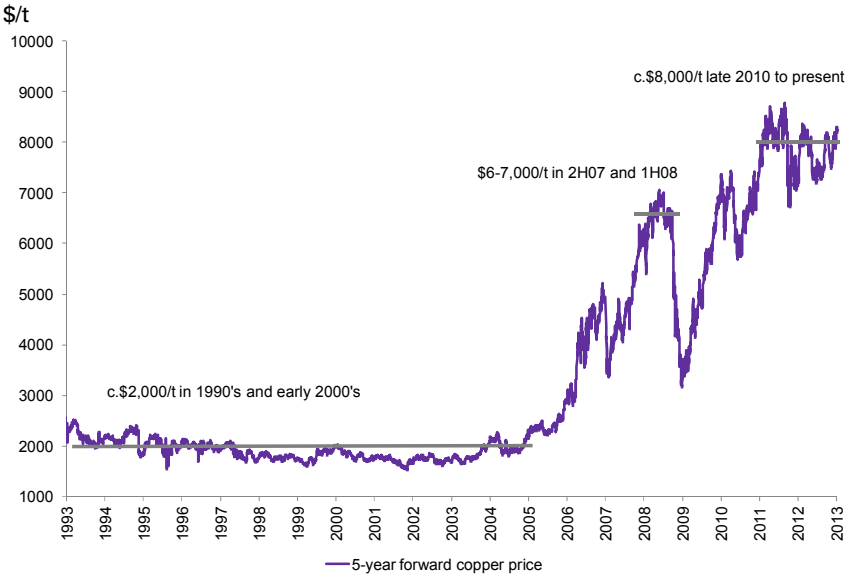
Long-term price assumptions are critically important in valuing equities (particularly in DCF models), as well as in informing capital allocation decisions by miners. We use three approaches to formulate our long-term copper price forecast. All three approaches lead us to the conclusion that a reasonable long-term copper price assumption is c.$6,600/t ($3/lb) in 2013 dollar terms (real).

The first approach is a simple read of the long-dated copper forward curve – which has dramatically shifted up over the past 10 years and therefore points to a structural change in the prices required to incentivize new supply to be brought online. The second approach involves estimating the incentivize price required to balance the market over the long term. We do this by combining the GS 60 incentive price work by Fawzi Hanano (supply) with our own trend demand estimates. Using this "incentive price" approach alone however would give us volatile results, since capex and opex used to estimate individual project incentive prices tend to be pro-cyclical (i.e. long-term price estimates tend to rise in upswings and fall in downturns). Our final measure is more backward looking, but more stable, and uses copper's historical price relationship with its cost curve to estimate futures long-term prices.

Long-dated copper forward prices have shifted up

After trading at c.$2,000/t in the 1990's and early 2000's (Exhibit 10), long-dated copper forward prices shifted up in the mid 2000's to incentivize supply growth, following a period of significant underinvestment. Long-term prices reached c.$7,000/t in 2008, and averaged almost $8,000/t ($3.63/lb) over the course of 2011 and 2012. **Currently the 5-year copper price is trading above $8,200/t ($3.72/lb), supporting our $3/lb long-term copper price forecast**. This phenomenal increase in long-dated pricing reflects an increase in the incentive prices required to bring new copper supply, whether it be mine supply or scrap, to the market over the medium to long term. Unlike oil however, copper has had no shale gas revolution. Indeed, what is notable is that despite this extremely high forward price by historical standards, some major projects are being cancelled or delayed, including Antofagasta's Antucoya project and a number of Codelco's projects, owing primarily to unanticipated project cost escalation.

Exhibit 10: 5-year LME copper forward price



Source: LME, Goldman Sachs Global ECS Research.

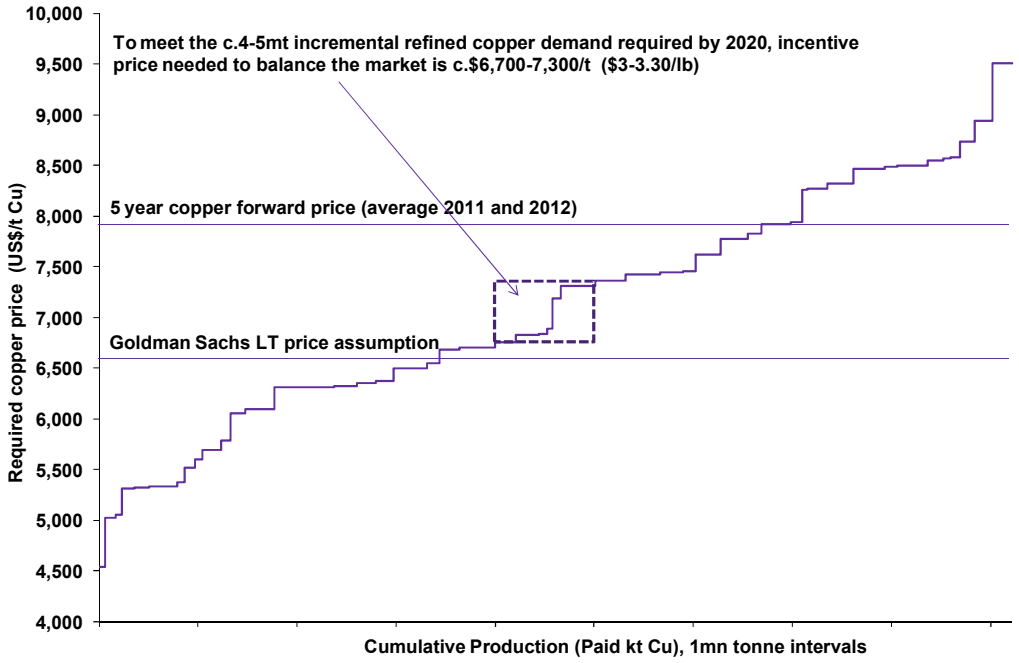
Forward-looking incentive price approach

In the second approach we take an incentive price curve of the projects we believe will come online by 2020 (a new supply curve based on capex, opex, and returns on capex assumptions for more than 50 major projects[1]), and compare it to the required supply if demand grows at a trend rate of 3%-4% between 2012 and 2020.

As background, capex requirements for new mining projects in the copper space have been under sustained upward pressure, driving up capital intensity and incentive pricing; this is mainly due to: (1) the ongoing decline in copper ore grades, requiring much larger mining and milling capacities; and (2) the growing proportion of projects located in developing economies and remote areas with little existing infrastructure.

Exhibit 11 illustrates the intersection of new supply and incremental demand (or required mine supply), and suggests that to incentivise 4-5mt of new copper supply we would need prices of **$6,700-7,300/t ($3.04-3.31/lb)**. To test these particular results we extended our copper model (internally) to 2020 and found that deficits are likely to occur towards the end of the decade should trend demand register 3.5% p.a. between 2012 and 2020 and less than 4-5mt incremental mine supply come online over the period.

Exhibit 11: Adjusted GS 60 curve and its intersection with GS copper demand forecasts
$/t



Source: Goldman Sachs Global ECS Research estimates.

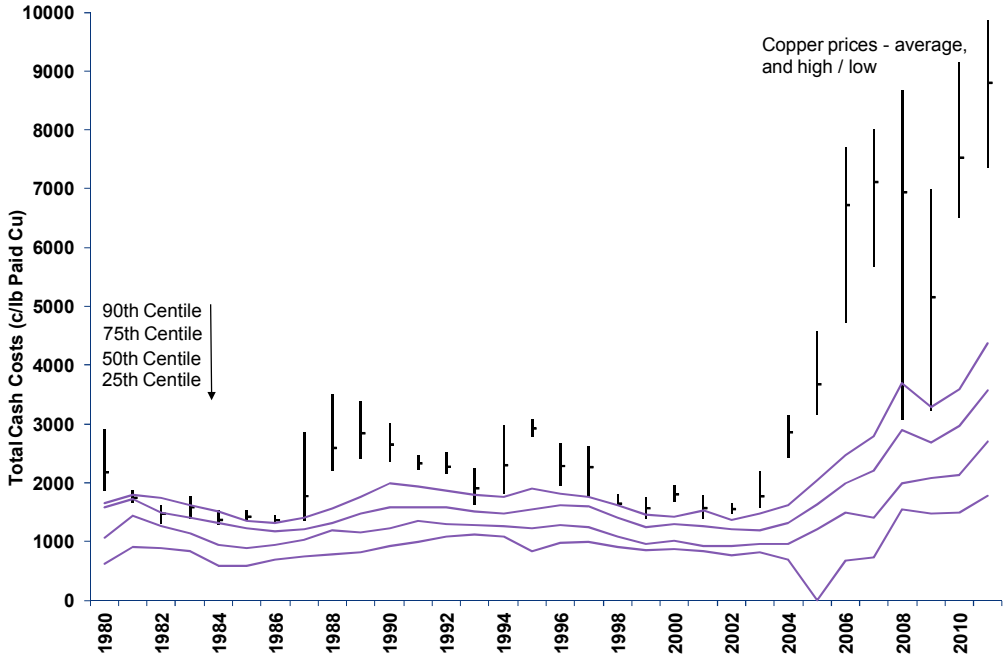
[1] We filtered through the list of the top 60 largest copper projects due over the next decade to exclude those that we believe are unlikely to go ahead (the GS 60 project list covers the majority of copper production set to come online by 2020). Many of the projects we evaluated do not have compelling economics and require a relatively high sustained copper price to ensure viability - this is particularly true for longer-dated greenfield projects. The lower economic attractiveness of new projects has driven mining companies to re-evaluate their capex programs in copper and other commodities and as a result, there have been recent announcements of project sequencing, deferrals and cancellations. The resulting copper incentive supply curve for the screened projects is used in our analysis, and reflects the copper price required to deliver a 15% IRR.

Backward looking 'margin' approach (relatively stable)

Since 1980 the copper market has been through a number of cycles, owing to supply and demand factors both exogenous and endogenous to the market. Over this period of more than 30 years, copper prices have traded at a 32% median premium to the 90%ile of the cash cost curve (see Exhibit 12). A relatively stable way of forecasting long-term copper prices is to assume that the factors driving this median premium in the past (over the very long term), remain similar in the future. Thus, estimating the real 90%ile of the cost curve and adding 32% provides a rough forecast of future long-term prices. The 2011 90%ile of the cost curve was $4,400/t or $2/lb. **Using this as the base we can justify a long-term price for copper of at least $5,800/t, or $2.64/lb.** However copper mining inflation may outstrip general inflation, and thus the 90%ile would be higher than the $2/lb in 2013 dollar terms over the medium to long term. Indeed, a 90%ile at $2.27/lb in 2013 dollar terms would be consistent with $3/lb long-term copper prices after adding the 32% premium. This approach provides some strong support for our forecasts, and is relatively stable given that it is based on 32 years of historical data.

Exhibit 12: Copper has traded at a 32% median premium to the 90%ile of cash cost curve over the past 32 years

$/t



Source: Wood Mackenzie.

Aluminium – A structurally bearish outlook

At today's global aluminium prices and physical premia we see few production closures in order to balance a market currently in moderate surplus. Indeed, global aluminium inventories are extremely high, and overcapacity issues remain. These issues are likely to be compounded by the extremely strong supply growth from Northern and Western China that we see over the short to medium term, which together with growth in output from the Middle East, is expected to more than offset a reacceleration in global aluminium demand growth, resulting in a significant surplus over the 2013-2016 period, everything else equal (see Exhibits 13, 14 and 15). Of course, a market cannot trade in significant surplus over such a long time period, and as such we forecast that prices (and/or) premia will need to fall and/or costs rise in order to restrict high cost Chinese and ex-Chinese output and/or delay new global project starts.

China is expected to bear the brunt of the surplus over the period ahead given that the vast bulk of output growth is expected to come from this region (Exhibit 16), with ex-China balancing up on the back of stronger demand growth and a lack of supply growth. By our calculations, the price related adjustments required are in the order of 2-3mt, which we forecast will require SHFE prices of c.14,000-14,500rmb/t (Exhibit17), and LME prices of $2,000-2,050/t over a sustained period. As a result of this price weakness we expect to see the market moving back towards balance by 2015/2016 (our base case). The balancing valve is expected to be higher Chinese semi's exports, with potential reductions in refined Chinese export tariffs (opening the door for higher Chinese refined exports) and/or potential further SRB buying to clear the domestic market.

Overall we see risks to our new price forecasts as skewed to the downside. This is because we assume a relatively orderly closure process. However, if high cost Chinese smelters are supported (either by further SRB purchases or other government subsidies), ex-Chinese producers will likely bear more of the brunt of the projected surplus. In addition, our 2013 and 2014 price forecasts assume that financing deals and LME rules with respect to aluminium continue between 2013-2016, and this is by no means a certainty.

In terms of potential upside risks – higher energy prices, higher bauxite prices, and faster-than-anticipated producer cuts, we believe that none are likely to drive aluminium prices significantly higher than current prices for a sustained period. Indeed, we hold broadly neutral short- to medium-term views on global coal and oil prices given China is building significant alumina capacity based on domestic bauxite (+6mt capacity in 2013E) to reduce its reliance on Indonesian ores, and producers are very unlikely to cut supply at current prices and premia. Having said this, given the relatively flat nature of the aluminium cost curve producers are in our view likely to respond over time by cutting output, should prices fall to the $1,900-$2,000/t range.

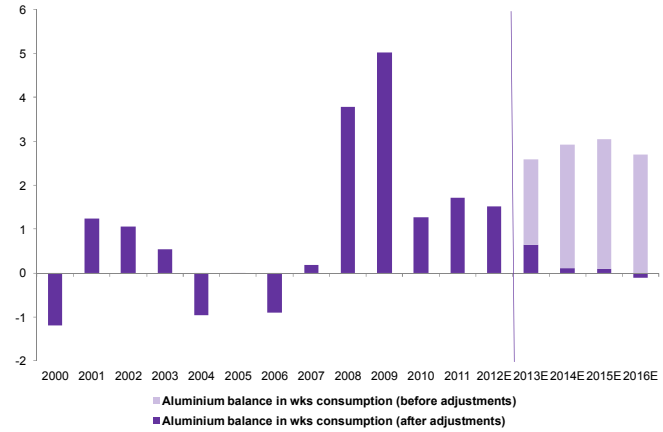
Exhibit 13: Aluminium supply, demand and price forecasts
'000t

	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Refined Production	**37616**	**41936**	**46084**	**47676**	**50131**	**52974**	**56390**	**59836**
% Change YoY	*-6.3*	*11.5*	*9.9*	*3.5*	*5.1*	*5.7*	*6.4*	*6.1*
% Global capacity utilisation	*78*	*80*	*83*	*82*	*80*	*80*	*82*	*84*
Including market adjustments	***0***	***0***	***0***	***0***	***-1853***	***-2869***	***-3186***	***-3103***
Refined Consumption	**34297**	**40938**	**44616**	**46322**	**49520**	**52864**	**56282**	**59957**
% change	*-8.3*	*19.4*	*9.0*	*3.8*	*6.9*	*6.8*	*6.5*	*6.5*
Of which China	14010	16800	19100	20750	23261	25481	27776	30265
% change	*11.2*	*19.9*	*13.7*	*8.6*	*12.1*	*9.5*	*9.0*	*9.0*
Of which ex-China	20287	24138	25516	25572	26259	27382	28506	29692
% change	*-18.2*	*19.0*	*5.7*	*0.2*	*2.7*	*4.3*	*4.1*	*4.2*
Balance	**3319**	**998**	**1468**	**1354**	**611**	**111**	**108**	**-121**
LME Price ($/t)	**1664**	**2172**	**2399**	**2044**	**2050**	**2050**	**2100**	**2200**
LME Price (c/lb)	76	99	109	93	93	93	95	100

N.B. Our long term aluminium price forecast is $1/lb, or c.$2,200/t, in 2013 dollar terms.

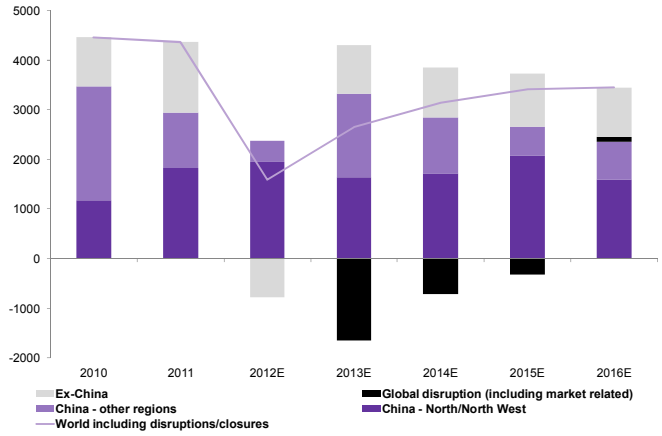
Source: LME, CRU, IAI, Wood Mackenzie, Goldman Sachs Global ECS Research estimates.

Exhibit 14: Refined aluminium balance with and without market and non-market production adjustments
Weeks consumption



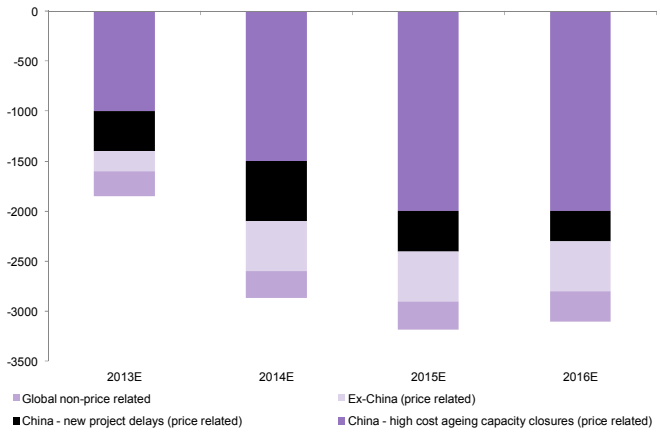
Source: CRU, Goldman Sachs Global ECS Research estimates.

Exhibit 15: Global output growth driven by low cost capacity expansions in North and North Western China
'000t



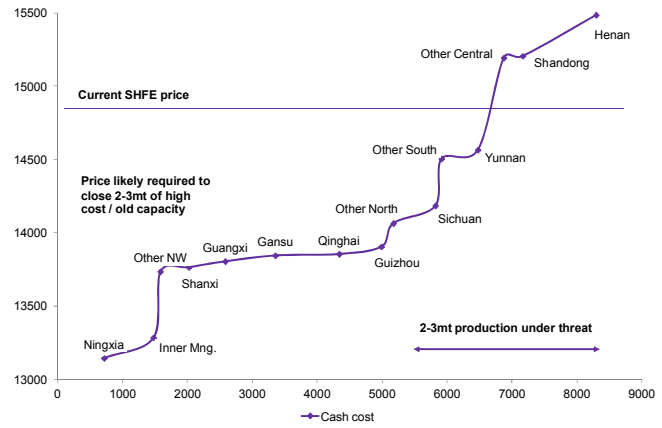
Source: CRU, Goldman Sachs Global ECS Research estimates.

Exhibit 16: Cuts are expected to come from China … with world losses (market and non- market related) of c.3mt per annum 'required' between 2014 and 2016 …
'000t



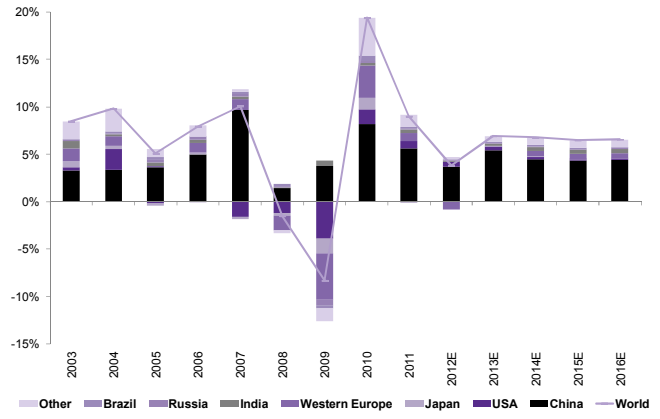
Source: Goldman Sachs Global ECS Research estimates.

Exhibit 17: … based on our China grid-based smelter cost curve work we find that SHFE prices of RM14-14,500/t may be required to see sufficient cuts
RMB/t



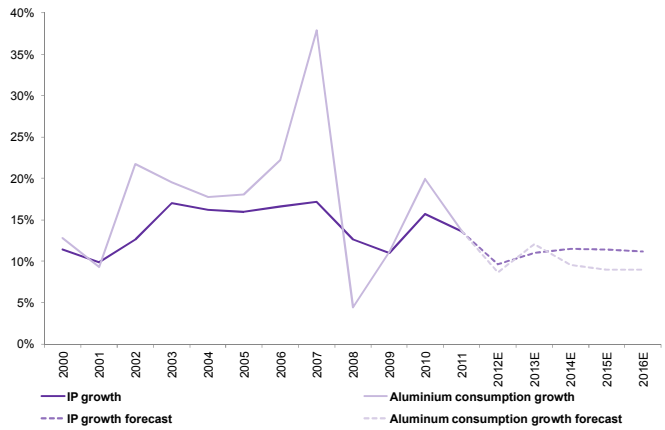
Source: CRU, Wood Mackenzie, Goldman Sachs Global ECS Research estimates.

Exhibit 18: Global demand growth to continues to be driven by China
Contribution to growth by country



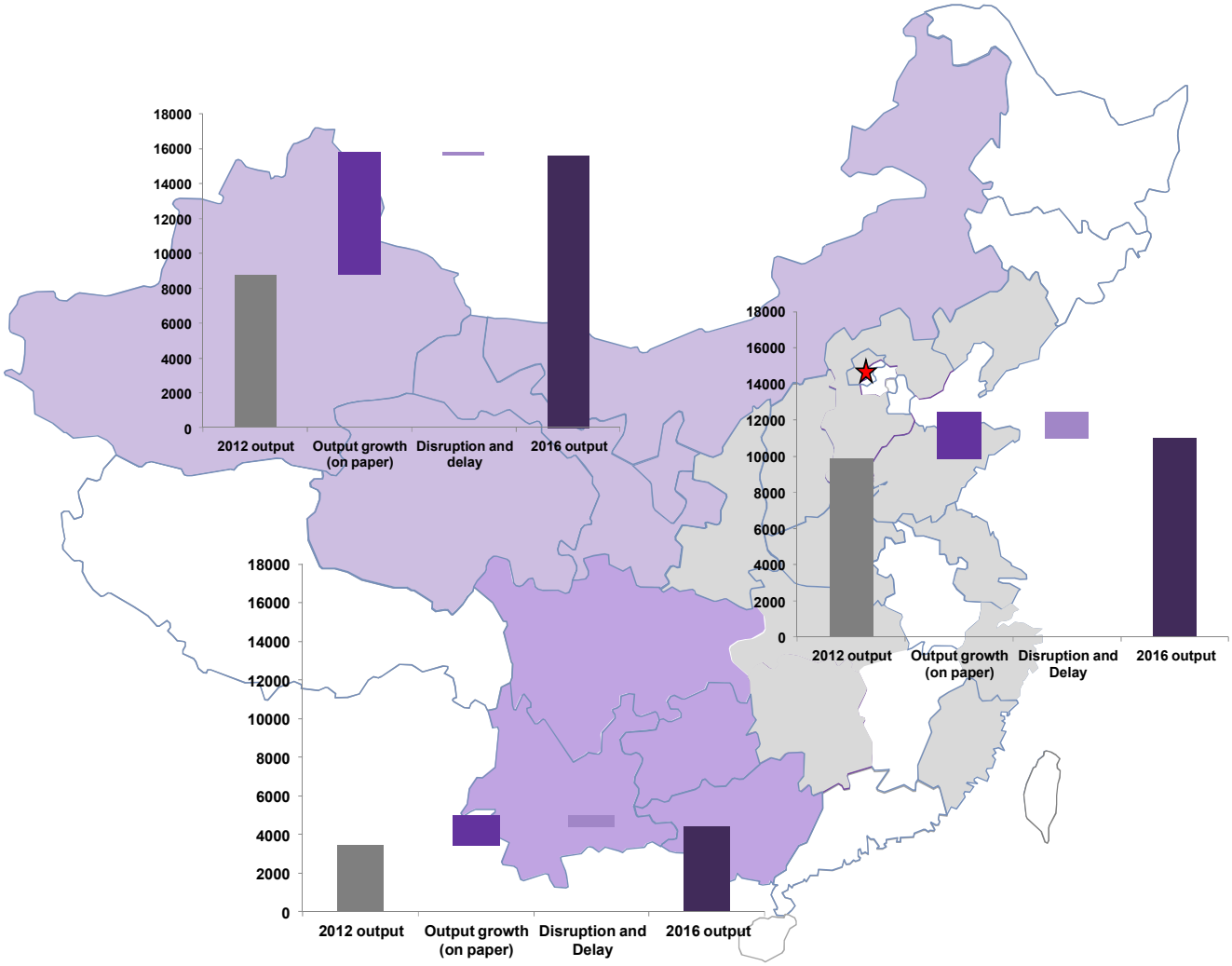
Source: CRU, Goldman Sachs Global ECS Research estimates.

Exhibit 19: Chinese growth driven by IP, though we assume lower consumption intensity
Percent yoy growth



Source: CRU, Goldman Sachs Global ECS Research estimates.

Exhibit 20: Chinese supply growth by region – North and North West expected to add 7mt of production by 2016!
'000t



Source: Goldman Sachs Global ECS Research estimates.

Zinc – Tightness still some way off

We continue to forecast that the zinc market will register a small surplus of 181kt in 2013, before moving towards balance in 2014 (Exhibit 21). While we see limited upside for zinc from current prices over the next 3-12 months, there is the potential for closure of the Brunswick mine (c.200kt output in 2012) in 1H2013 which could result in a price overshoot in the near term.

In our view the key to the medium-term outlook for zinc is the extent to which Chinese mine supply can grow (at current prices), and the extent to which 'probable' project supply is delivered. We find that there is more than enough zinc supply on paper to fill the medium-term supply gap left by depletions of ageing mines over the next 4-5 years, however current prices and capital market conditions likely preclude any structural oversupply.

Our base case is that Chinese mine supply grows by 10% in 2013 and by 6% p.a thereafter, and that a small but rising scale of probable projects are delivered (20% of on-paper supply in 2014 and 2015 and 40% in 2016). Using these assumptions we do see a moderate tightening in the zinc balance in weeks of consumption, by 2014, which accelerates in 2016. Having said this, the ability of mine supply to respond to higher prices both inside and outside of China means that we do not expect average annual prices to rise significantly above $2,200/t over the medium term.

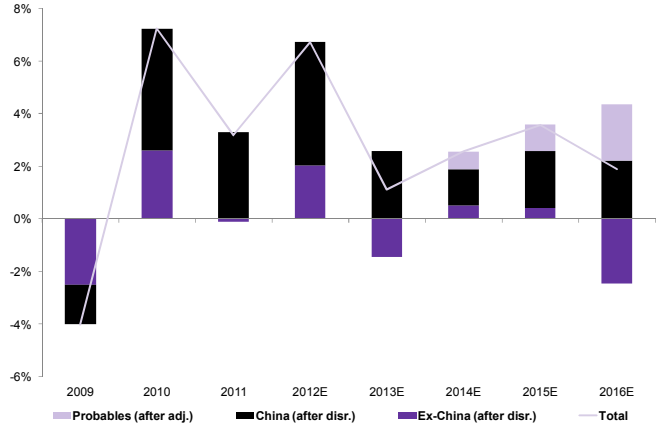
Exhibit 21: Zinc supply, demand and price forecasts
'000t

	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Global mine supply	11021	11817	12194	13013	13159	13495	13977	14242
% change	*-4.0*	*7.2*	*3.2*	*6.7*	*1.1*	*2.6*	*3.6*	*1.9*
Including disruption allow. (%)	*0.0*	*0.0*	*0.0*	*1.0*	*3.0*	*4.0*	*4.0*	*4.0*
Global refined supply	**11174**	**12288**	**12920**	**13020**	**13300**	**13750**	**14300**	**14700**
% change	*-3.2*	*10.0*	*5.1*	*0.8*	*2.2*	*3.4*	*4.0*	*2.8*
Global refined consumption	**10136**	**11754**	**12517**	**12627**	**13119**	**13699**	**14316**	**14976**
% change	*-9.5*	*16.0*	*6.5*	*0.9*	*3.9*	*4.4*	*4.5*	*4.6*
Of which China	4100	4705	5081	5285	5549	5937	6353	6798
% change	*8.0*	*14.8*	*8.0*	*4.0*	*5.0*	*7.0*	*7.0*	*7.0*
Of which World ex-China	6036	7049	7436	7342	7570	7762	7963	8178
% change	*-17.8*	*16.8*	*5.5*	*-1.3*	*3.1*	*2.5*	*2.6*	*2.7*
Balance	**1038**	**534**	**403**	**393**	**181**	**51**	**-16**	**-276**
Year end inventory (weeks)	**4.8**	**6.2**	**6.7**	**8.3**	**8.7**	**8.5**	**8.1**	**6.8**
LME Price ($/t)	**1655**	**2162**	**2194**	**1950**	**2013**	**2175**	**2200**	**2200**
LME Price ($/t)	75	98	100	88	91	99	100	100

N.B. Our long term zinc price forecast is $1/lb, or c.$2,200/t, in 2013 dollar terms.

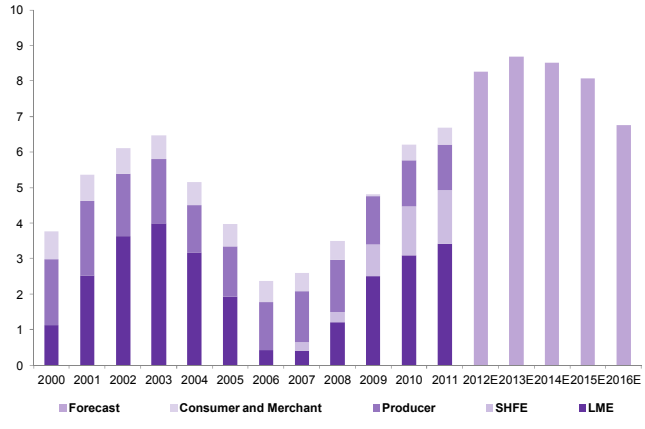
Source: WoodMackenzie, CRU, Goldman Sachs Global ECS Research estimates.

Exhibit 22: Global mine supply growth to slow on ex-China mine closures (depletions) over the medium term
Percent mine supply growth yoy after disruption allowance



Source: Wood Mackenzie, Goldman Sachs Global ECS Research estimates.

Exhibit 23: Contributing to the peaking of reported zinc stocks in weeks of consumption 2013E
Reported zinc stocks in weeks of consumption



Source: Bloomberg, Goldman Sachs Global ECS Research estimates.

Nickel – RKEF capacity to keep market under significant pressure

We continue to be structurally bearish on nickel market fundamentals, due to an expectation of substantial supply growth (primarily low-cost Rotary Kiln Electric Arc Furnace (RKEF) nickel pig iron output), as well as the ability of other nickel pig iron output to respond to higher prices, combined with significant stock overhang. Despite the fact that High Pressure Acid Leach (HPAL), PAL and ferronickel supply growth continues to underperform, we still expect supply growth will broadly match demand growth in 2013 and 2014, keeping nickel in moderate surplus (a 35,000t surplus in 2013E, followed by a 30,000t surplus in 2014E, Exhibit 25).

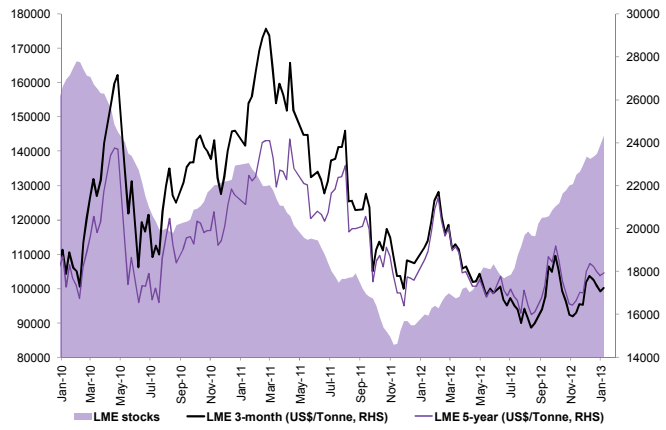
In particular, we believe technological improvement is set to put downward pressure on the high end of the nickel cost curve – China has been expanding RKEF capacity aggressively since 2011. Around 80ktpa of capacity is being ramped up and a further 320ktpa of capacity is under construction – of which c.140ktpa is expected to be completed in 2013. This growth could result in nickel pig iron output rising from these sources by at least 60-70kt in 2013.

Together with extremely high (and rising) refined stock levels (Exhibit 24), the recent rally above $17,500/t is in our view a good level to hedge/establish a short position. For reference, recent prices compare to older Electric Arc Furnace (EAF) and blast furnace nickel output costs of c.$16,000/t, and new RKEF output costs of c.$15,000/t.

Though we forecast a moderate surplus in 2014, we do anticipate that a pick-up in global demand, and some related restocking (post a 2-year period of industry-wide destocking) may result in the need for some high-cost nickel pig iron to clear the market, supporting prices at c.$17,000/t over this horizon.

The biggest risk to this view is that Indonesia and/or the Philippines restrict exports of, or raise taxes on exports of nickel ores (or their products), since these are the primary feedstock sources for RKEF, EAF, and blast furnace nickel pig iron production. Indonesia's 2014 total export ban presents a risk, but at this stage there is more reason to believe that exports will continue, than that exports will be stopped given recent export permit grants.

Exhibit 24: LME stocks rose sharply in 2012
$/t l(lhs), '000t (rhs)



Source: LME.

Exhibit 25: Nickel supply, demand and price forecasts
'000t

	2010	2011	2012E	2013E	2014E
Refined Production	1451	1650	1697	1752	1815
% change	*9.1*	*13.7*	*2.9*	*3.3*	*3.6*
Refined Consumption	1517	1633	1650	1717	1785
% change	*15.0*	*7.7*	*1.0*	*4.1*	*3.9*
Of which China	519	651	668	701	738
% change	*23.8*	*25.4*	*2.7*	*4.9*	*5.3*
Of which World ex-China	218	215	224	237	255
% change	*-10.0*	*-1.6*	*4.4*	*5.7*	*7.8*
Balance	-66	17	47	35	30
LME Price ($/t)	**21804**	**22900**	**17536**	**16625**	**17000**
LME Price (c/lb)	989	1039	795	754	771

N.B. Our long term nickel price forecast is $7.71/lb, or c.$17,000/t, in 2013 dollar terms.

Source: Wood Mackenzie; CRU International; Goldman Sachs Global ECS Research estimates.

PGMs – Short-term support for platinum on production cuts but palladium still preferred

Platinum group metals (PGMs) have been wrestling with the negatives of weak end-use demand (primarily European autos) and the positive market impact of ongoing supply disruptions in South Africa.

This section was authored by Eugene King, GS equity analyst

Our view is that there will be a mild recovery in industrial demand (including autos) for PGMs in 2013 due to higher global growth. Higher primary demand combined with the recently announced c.300k Pt oz production cuts by Anglo American will likely see support for platinum pricing on a 3-month horizon from investors, a theme playing out in the platinum price now.

We see two major uncertainties with regards to PGM pricing in 2013:

1. The risk of further supply disruption following Anglo Platinum's supply cut announcement. Both the South African mines minister and the unions have expressed concern over the announced cuts; and
2. Potential increases in investment demand as market participant for exposure to ongoing supply disruptions.

Platinum: For platinum we forecast a 2013 average price of $1,575/oz. The current spot price (close to $1,680/oz) in our view reflects the recently announced Anglo Platinum supply cuts and potentially some future expectation of further supply issues. Based on fundamentals, we believe the market was headed for a surplus in 2013 and that the cuts will bring the market closer to balance. The rise of secondary supply from auto recycling and jewellery returning to the market grew to almost 2mn Pt oz per year in 2012 (from c.700k oz in 2005) while demand has remained relatively flat. Given the low cost of recycling ounces, higher cost mines have been loss making. Anglo, as the market leader, has reduced global mined capacity by 5% (c.300k oz) and is planning to sell its high-cost Union mine. Anglo reduced its production guidance to 2.1-2.3mn Pt oz from c.2.5mn oz.

In the short-term there may well be significant support for the platinum price. However, we still see platinum pricing being set by the cost curve, where we see the marginal South African producer's cost per Pt oz at c.$1,550/oz including by-products at c.R8.5:1 versus the US$. As recycling from autos, in particular, grows in future years we expect further supply cuts will be required to stave off losses in the mining sector. The cutting of the marginal high-cost capacity in future years will likely act as a cap to platinum price inflation, hence our relatively range-bound forecasts of $1,600/oz in 2014 and $1,650/oz in 2015.

Palladium: For palladium we reiterate our bullish view on prices as production cuts in South Africa by Anglo American (c.150k oz) and the lack of a supply response from Russia (Norilsk) or North America (Stillwater) is expected to result in a deficit over the short to medium term, even allowing significant ongoing sales from Russian stocks.

Our ongoing thesis is that palladium demand will grow in the autos sector due to: a) majority of growth in global automotive coming from gasoline (petrol) markets (e.g. US, China); b) palladium continuing to substitute for platinum in diesel markets due to technology improvements; and c) implementation of Euro 6 emissions regulations in Europe seeing a subtle shift back to gasoline (petrol) from diesel, as auto makers seek to minimise implementation costs. This is expected to combine with increased demand from the broader industrial sector on stronger global GDP. Thus we believe palladium will outperform platinum over 2013-2015, and reiterate our 2013-2015 forecasts of $781/$925/$1,000/oz respectively. Other reasons to be bullish on palladium are the scope for further disruption to South African supply as well as the potential for reduced sales from Russia stockpiles.

Exhibit 26: Platinum group supply & demand balance and price forecast
K oz

'000 oz	2004	2005	2006	2007	2008	2009	2010	2011	2012E	2013E	2014E	2015E	CAGR ('07-'11)	CAGR ('11-'15E)
Supply														
South Africa	4,970	5,120	5,295	5,070	4,515	4,635	4,635	4,855	4,240	4,363	4,659	4,907	-1.1%	0.3%
Russia	850	751	752	915	805	785	835	835	841	845	845	845	-2.3%	0.3%
North America	385	365	345	325	325	260	200	350	316	317	318	318	1.9%	-2.4%
Zimbabwe	83	155	169	170	170	229	279	340	357	364	376	416	18.9%	5.2%
Others	115	120	269	120	115	115	110	100	102	104	106	108	-4.5%	2.0%
Mine Supply	**6,460**	**6,511**	**6,830**	**6,600**	**5,930**	**6,024**	**6,059**	**6,480**	**5,855**	**5,993**	**6,304**	**6,594**	**-0.5%**	**0.4%**
Auto recycling	705	770	860	935	1,120	883	1,085	1,225	1,238	1,285	1,315	1,360	7.0%	2.6%
Jewellery recycling			555	655	700	565	735	810	840	871	908	940	5.5%	3.8%
Total Supply	**7,165**	**7,281**	**8,245**	**8,190**	**7,750**	**7,472**	**7,879**	**8,515**	**7,933**	**8,149**	**8,527**	**8,894**	**1.0%**	**1.1%**

Demand by Application	2004	2005	2006	2007	2008	2009	2010	2011	2012E	2013E	2014E	2015E	CAGR ('07-'11)	CAGR ('11-'15)
Autocatalyst	3,490	3,795	3,905	4,145	3,660	2,185	3,075	3,105	3,080	3,055	3,290	3,345	-7.0%	1.9%
Chemical	325	325	395	420	400	290	440	470	472	478	492	507	2.9%	1.9%
Electrical	300	360	360	255	225	190	225	225	274	278	286	289	-3.1%	6.5%
Glass	290	360	405	470	320	10	385	555	585	591	597	602	4.2%	2.1%
Investment	40	15	-40	170	560	670	660	470	415	230	200	200	28.9%	-19.2%
Jewellery	2,160	1,970	2,195	2,110	2,065	2,810	2,415	2,480	2,582	2,678	2,790	2,909	4.1%	4.1%
Petroleum	150	170	180	205	245	210	170	210	216	219	222	223	0.6%	1.5%
Other	470	475	490	495	500	440	530	585	586	584	586	587	4.3%	0.1%
Gross demand	**7,225**	**7,470**	**7,890**	**8,270**	**7,975**	**6,805**	**7,900**	**8,100**	**8,209**	**8,112**	**8,462**	**8,662**	**-0.5%**	**1.7%**
Global Platinum surplus/(deficit)	**-60**	**-189**	**355**	**-80**	**-225**	**667**	**-21**	**415**	**-276**	**36**	**65**	**232**		

Source: Johnson Matthey Platinum 2011, Goldman Sachs Global ECS Research estimates.

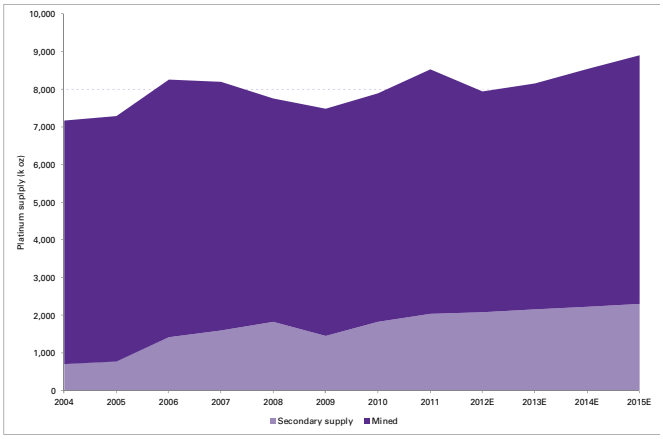
Exhibit 27: Palladium group supply & demand balance and price forecast
k oz

'000 oz	2004	2005	2006	2007	2008	2009	2010	2011	2012E	2013E	2014E	2015E	CAGR ('07-'11)	CAGR ('11-'15E)
Supply														
South Africa	2,480	2,605	2,775	2,765	2,430	2,370	2,640	2,560	2,429	2,508	2,673	2,858	-1.9%	2.8%
Russia	4,800	3,135	3,220	3,050	2,700	2,675	2,720	2,705	2,671	2,705	2,705	2,705	-3.0%	0.0%
North America	1,035	910	985	990	910	755	590	900	865	847	801	801	-2.4%	-2.9%
Zimbabwe	0	125	135	135	140	180	220	265	279	285	295	327	18.4%	5.4%
Others	265	145	135	150	170	160	185	155	150	172	175	178	0.8%	3.6%
Mine Supply	**8,580**	**6,920**	**7,250**	**7,090**	**6,350**	**6,140**	**6,355**	**6,585**	**6,395**	**6,516**	**6,648**	**6,870**	**-1.8%**	**1.1%**
Auto recycling	530	625	805	1,000	1,140	965	1,310	1,655	1,680	1,720	1,750	1,785	13.4%	1.9%
Electronic recycling	0	305	290	315	345	395	440	425	450	480	500	525	7.8%	5.4%
Jewellery recycling	0	60	135	235	130	70	80	150	230	250	250	150	-10.6%	0.0%
Sales from stock	0	1,485	700	1,490	960	960	1,000	775	700	700	600	600	-15.1%	-6.2%
Total Supply	**9,110**	**9,395**	**9,180**	**10,130**	**8,925**	**8,530**	**9,185**	**9,590**	**9,455**	**9,666**	**9,748**	**9,930**	**-1.4%**	**0.9%**

Demand by Application	2004	2005	2006	2007	2008	2009	2010	2011	2012E	2013E	2014E	2015E	CAGR ('06-'10)	CAGR ('10-'15E)
Autocatalyst	3,790	3,865	4,015	4,470	4,465	4,050	5,580	6,030	6,370	6,665	7,040	7,075	7.8%	4.1%
Chemical	310	415	440	375	350	325	395	378	360	380	420	400	0.2%	1.4%
Electrical	920	1,275	1,495	1,550	1,370	1,270	1,410	1,380	1,350	1,450	1,450	1,450	-2.9%	1.2%
Dental	850	815	620	630	625	615	580	610	590	580	575	575	-0.8%	-1.5%
Investment	200	220	50	260	420	625	1,085	-600	250	200	200	200	na	na
Jewellery	930	1,490	1,140	950	985	815	620	650	550	550	550	550	-9.1%	-4.1%
Other	90	265	85	85	75	70	85	85	80	85	85	85	0.0%	0.0%
Gross demand	**7,090**	**8,345**	**7,845**	**8,320**	**8,290**	**7,770**	**9,755**	**8,533**	**9,550**	**9,910**	**10,320**	**10,335**	**0.6%**	**4.9%**
Global Palladium surplus/(deficit)	**2,020**	**1,050**	**1,335**	**1,810**	**635**	**760**	**-570**	**1,057**	**-95**	**-244**	**-572**	**-405**		

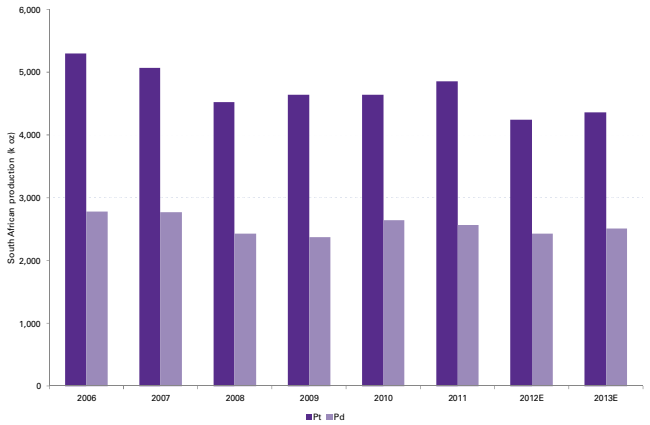
Source: Johnson Matthey Platinum 2011, Goldman Sachs Global ECS Research estimates.

Exhibit 28: Second supply is growing quickly, displacing high-cost mining capacity
Total platinum supply by mined and secondary sources



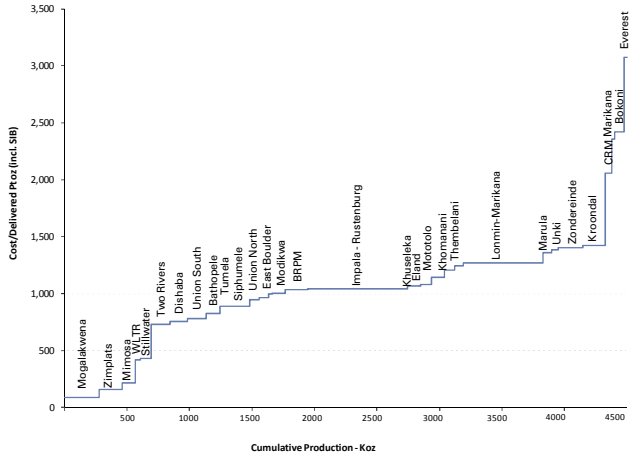
Source: Johnson Matthey Platinum 2011, Goldman Sachs Research estimates.

Exhibit 29: South African production decreasing as a result
South African platinum and palladium production (k oz)



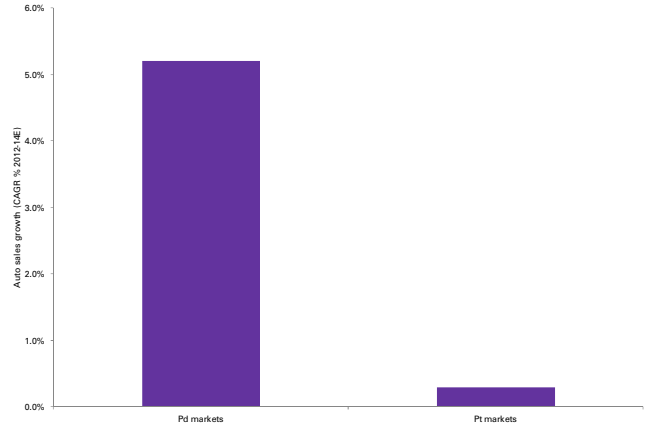
Source: Johnson Matthey Platinum 2011, Goldman Sachs Research estimates.

Exhibit 30: Marginal cash cost of platinum c.$1,550/oz
Platinum cash cost curve (2012)



Source: Johnson Matthey Platinum 2011, Goldman Sachs Research estimates.

Exhibit 31: Gasoline auto markets have superior growth
Auto sales growth (CAGR % 2012-14)



Source: HS Global Insight; Goldman Sachs Research estimates

Exhibit 32: Palladium auto demand is increasing vs. platinum
Auto demand for Pt & Pd and unit loading/car (g)

Source: Johnson Matthey Platinum 2011, Goldman Sachs Research estimates.

Exhibit 33: Palladium to be in deficit including stock sales
Summary supply-demand for palladium

	2008	2009	2010	2011	2012E	2013E	2013E
Mine supply	6,350	6,140	6,355	6,585	6,395	6,516	6,648
Recycling	1,615	1,430	1,830	2,230	2,360	2,450	2,500
Demand	8,290	7,770	9,755	8,533	9,550	9,910	10,320
Surplus (Deficit)	**-325**	**-200**	**-1,570**	**282**	**-795**	**-944**	**-1,172**
Sales from stock	*960*	*960*	*1,000*	*775*	*700*	*700*	*600*
Final Surplus (Deficit)	**635**	**760**	**-570**	**1,057**	**-95**	**-244**	**-572**

Source: Johnson Matthey Platinum 2011, Goldman Sachs Research estimates.

Gold – Cycle set to turn on improved macro outlook

We expect higher gold prices in coming months given our economists' forecast for weak growth early in 2013 as well as uncertainty associated with the debt ceiling and potential budget sequestration. Assuming that the sequester does not take effect on March 1, we expect that the cycle in gold prices will likely turn later this year on improving US growth with prices gradually decreasing over the next five years to stabilize near $1,200/toz. For more details on our recently updated gold framework, please see *Precious Metal Outlook: Gold cycle set to turn on improving US recovery,* December 5, 2012.

Gold cycle likely to turn as improving US growth offsets further Fed easing

Our economists forecast a slowdown in US economic growth in the first half of 2013 following the negative impact of fiscal retrenchment. After "muddling through" this early weakness, they expect growth to accelerate back to a trend rate in the second half. As they expect unemployment to only fall slowly, they forecast both more easing than consensus through Fed balance sheet expansion in 2014-15 as well as inflation below 2% out to 2016.

In the short term, the combination of weaker growth and the run up to the debt ceiling/potential budget sequestration should prove supportive to gold prices. Medium term however, our expanded modeling suggests that improving US growth will outweigh further Fed balance sheet expansion and that the cycle in gold prices will likely turn in 2013. Net, our 3-, 6- and 12-mo COMEX gold price forecasts are $1,825/toz, $1,805/toz and $1,800/toz. We expect gold prices to average $1,810/toz in 2013 and $1,750/toz in 2014.

Extending our gold price forecasts

Assuming a linear increase in US real rates back to 2.0% by 2018, as proxied by the 10-year US TIPS yield, we expect that gold prices will continue to trend lower over the coming five years and introduce our long-term gold price of $1,200/oz from 2018 forward. This forecast is in coordination with our equity analysts and higher than their prior assumption.

What about monetary demand for gold and inflation?

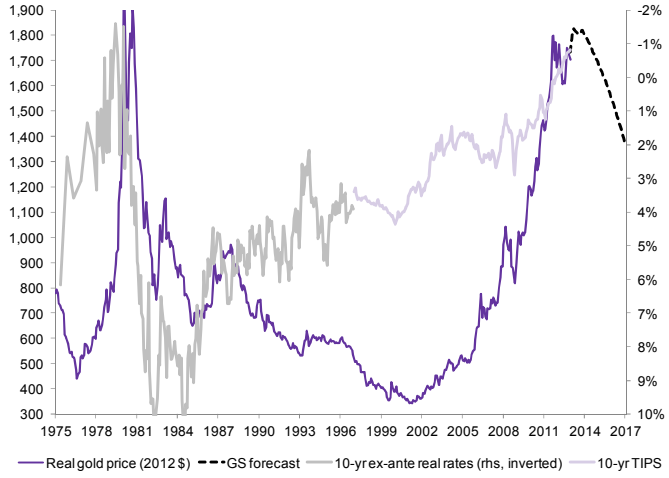
Beyond real interest rates, fluctuations in the monetary demand for gold also exert an influence on gold prices. Our forecast currently embeds physical gold demand from ETFs and central banks growing in 2013 at the 2009-2012 pace, with ETF purchases slowing in 2014. In our forecast, this steady monetary gold demand helps slow the decline in prices over the coming years. Given the risk around this assumption, we also considered alternative paths for physical gold demand but found that, while not negligible, the impact of gold prices to stronger or weaker monetary demand for gold remains modest compared to the influence exerted by real rates and the Fed's QE. As a result, it would require a significant further increase in monetary demand for gold to change our outlook for gold prices. While a very significant increase in monetary gold demand by EM investors and central banks could hold the potential for such a large impact, it is also worth noting that a decline in gold prices pushing ETF gold holdings sharply lower would in turn precipitate this fall in gold prices.

Our framework for evaluating gold prices relates the real (inflation-adjusted) price of gold to real interest rates and the monetary demand for gold. As a result, a higher rate of US inflation would inflate our forecasted gold price proportionally. For now, our economists view inflation above the Fed's target as a low probability risk given: (1) inflation expectations have remained well anchored despite significant expansion of the Fed's balance sheet, (2) the margin of economic slack will only gradually decline given their expected slow decline in unemployment, and (3) we further forecast that commodity prices will remain more stable than in prior years. Finally, even if higher inflation materializes, its impact on gold prices could be offset by: (1) US real interest rates rising more quickly than we anticipate if the economic recovery is accelerating, or (2) an end to the Fed's aggressive balance sheet expansion if inflation expectations become unhinged.

Risks to our views

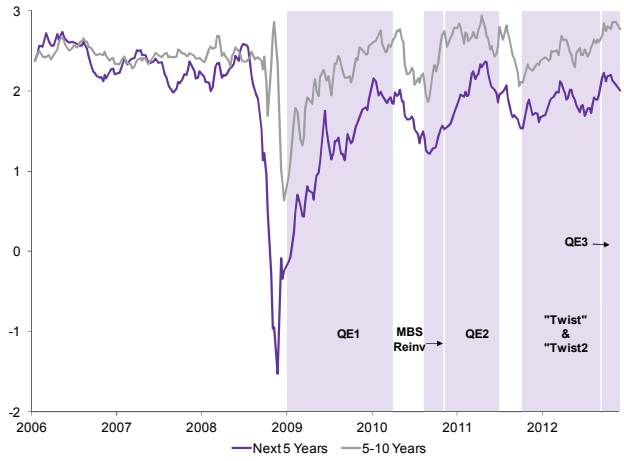
On net, our US economic outlook implies that the gold price cycle will turn similarly to that of late 1980, though not as severely. As shown in Exhibit 34, real gold prices fell dramatically after the rise in US real interest rates in the early 1980s. However, this rise in US real rates was exceptionally sharp given the intent of the US Federal Reserve under Chairman Volcker to choke off inflation. This time we expect the rise will be far more gradual, driven by a gradually recovering US economy. Given the uncertainty surrounding the US economic outlook both in the near and medium term as well as the uncertainty surrounding the debt ceiling and potential budget sequestration negotiations, risks to this forecast remain elevated. In particular, a larger decline in US growth than we expect would keep US real rates lower for longer and require further Fed easing and support to gold prices.

Exhibit 34: We expect the gold cycle to turn as real interest rates begin to increase
Gold in 2012 US$/oz (lhs), 10-yr US real rates (rhs, inverted)



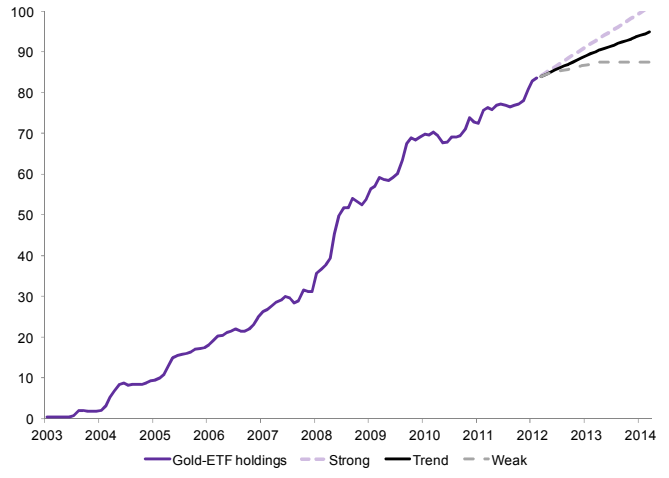
Source: COMEX, FRB, Goldman Sachs Global ECS Research estimates.

Exhibit 35: Inflation expectations remain anchored despite additional easing
Market-implied inflation expectations (%)



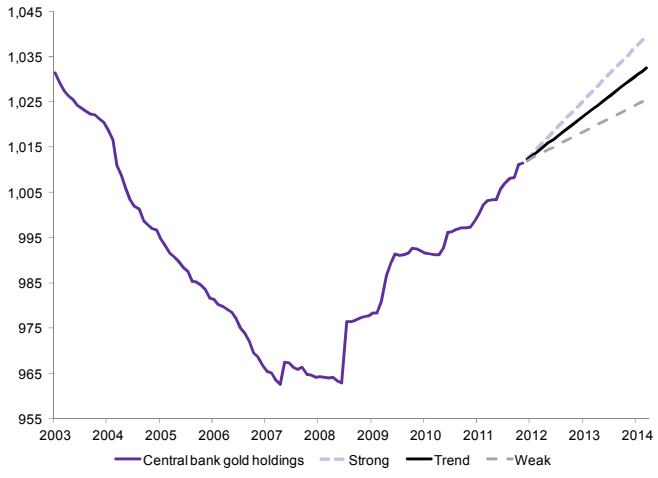
Source: FRB.

Exhibit 36: Under our base-case, ETF gold holdings will continue to grow …
Million oz



Source: Bloomberg, Goldman Sachs Global ECS Research estimates.

Exhibit 37: … while the turnaround in central bank purchases is expected to continue
Million oz



Source: IMF, Goldman Sachs Global ECS Research estimates.

Iron Ore – The last two years of super-normal profits

We remain relatively bullish and believe iron ore will continue to see super-normal prices and margins for the next two years. Strong demand growth in China has induced the development of low-grade, high-cost operations that require relatively high prices in order to remain viable. As long as those mines remain in operation, we believe the seaborne price will be supported at a high level. For further details please refer to *Global: Mining: Iron age not over: stay bullish and position for next phase*, October 15, 2012.

Exhibit 38: Iron ore supply & demand balance and price forecast
Million tonnes

	2008	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Global demand									
Crude steel production (incl. scrap)	1,327	1,227	1,412	1,518	1,542	1,608	1,676	1,728	1,786
Iron ore consumption	1,615	1,578	1,767	1,849	1,895	1,976	2,057	2,118	2,185
% growth	*-2.7%*	*-2.4%*	*10.7%*	*4.4%*	*2.5%*	*4.1%*	*3.9%*	*2.9%*	*3.1%*
Seaborne demand									
China	446	628	624	687	720	760	815	850	880
RoW	414	285	387	390	386	393	401	406	413
Total	860	913	1,011	1,077	1,106	1,153	1,216	1,256	1,293
% growth	*8.9%*	*5.8%*	*9.6%*	*6.2%*	*2.6%*	*4.1%*	*5.2%*	*3.2%*	*2.9%*
Seaborne supply									
Australia	309	363	402	438	485	560	654	733	780
Brazil	282	266	311	316	312	330	362	414	438
RoW	252	276	286	275	272	282	277	287	290
Total	844	906	999	1,028	1,069	1,172	1,293	1,433	1,508
% growth	*7.1%*	*6.9%*	*9.4%*	*2.8%*	*3.8%*	*8.8%*	*9.3%*	*9.8%*	*5.0%*
Seaborne balance									
Surplus/(deficit)	(17)	(8)	(11)	(49)	(37)	20	77	178	215
Price									
IO fines 62% Fe CFR China (US$/dmt)	$ -	$ -	$ 145	$ 168	$ 130	$ 144	$ 126	$ 90	$ 80

Source: IISI, Goldman Sachs Global ECS Research estimates.

The iron ore market has experienced a year of significant price volatility and swings in market sentiment. Unlike previous downturns in the period up to June 2012, the price decline in 2H2012 was both deeper and long lasting (Exhibit 43). In our view, the current downturn was triggered by a monthly increase in supply at a time when demand was flat to declining. Once market expectations of continually falling prices started to set in, a destocking cycle contributed to depress demand further.

Iron ore prices continue to strengthen as the restocking phase continues, supply starts to tighten and market sentiment becomes more bullish. Six months after the start of a long and deep downturn, the spot price at the end of 2012 was up 63% from the trough of $89/t and 3% above our assessment of cost support at $140/t.

The iron ore market is headed for a long period of significant oversupply, but in our view this is still two years away. In the meantime, we expect iron ore producers will see one last year of exceptional prices and profit margins in 2013 (GS forecast: $144/t), followed by a transitional year in 2014 (GS forecast: $126/t).

In the short term, we note the following factors supportive of iron ore prices:

- Iron ore does not appear expensive relative to steel prices, in particular given the weakness in metallurgical coal. Moreover, we tend to see the steel industry as a price taker as far as raw materials are concerned.

- Steel production growth in China is due to accelerate to 4.9% in 2013, according to our forecasts; this implies an increase on the current daily production rate of 1.95Mt (Exhibit 40).
- Iron ore inventory levels in Chinese ports of 73Mt are at their lowest since January 2011 (Exhibit 42), and we believe the restocking phase has not fully run its course yet.

Eventually, iron ore prices will be set at the marginal cost of seaborne production, rather than the inducement price or the high-end of the Chinese cost curve. From 2015 onwards we believe that the growth in seaborne supply to be delivered during our forecast period is likely to exceed future demand. On that basis, we expect the seaborne price will reflect the marginal cost of production of the marginal suppliers in the medium to long term. We have based our long-term price forecast on the cost structure of mines that: a) have sufficient scale to influence the market price; and b) have low Fe grades and/or poor geological conditions, and therefore high costs. In our view, low grade hematite deposits and magnetite/itabirite deposits in Australia and Brazil will be the marginal suppliers with a cost of production in the range of $70 to $75/dmt (Exhibit 39).

Exhibit 39: We estimate marginal costs of production at c.$70-75/dmt CFR China
Indicative production costs for generic iron ore mines – in 2012 US$

Region		**Australia**	**Australia**	**Brazil**
Ore type		hematite	magnetite	itabirite
Ore grade	Fe % content	58%	35%	38%
Overburden	$ / t waste	$ 6.00	$ 5.50	$ 4.00
SR	t waste / t ROM	4.0	1.8	1.5
Overburden	$ / t ROM	$ 24.00	$ 9.90	$ 6.00
Mining	$ / t ROM	$ 5.50	$ 5.00	$ 3.50
sub-total	$ / t ROM	$ 29.50	$ 14.90	$ 9.50
Product grade	Fe % content	58%	66%	66%
Yield	%	100%	53%	58%
Processing	$ / t ROM	$ 4.00	$ 9.00	$ 8.00
sub-total	$ / t	$ 33.50	$ 45.07	$ 30.39
Sustaining capital	$ / t	$ 6.00	$ 5.00	$ 4.00
Royalties *(note 1)*	$ / t	$ 3.00	$ 3.00	$ 2.40
Overheads	$ / t	$ 1.50	$ 1.50	$ 1.50
FOR	$ / t	$ 44.00	$ 54.57	$ 38.29
Distance to port	km	300	300	500
Transportation rate	$ / t.km	$ 0.015	$ 0.015	$ 0.025
Transportation	$ / t	$ 4.50	$ 4.50	$ 12.50
Port fees	$ / t	$ 3.00	$ 3.00	$ 4.00
FOB	$ / wmt	$ 52	$ 62	$ 55
Freight to China	$ / wmt	$ 10	$ 10	$ 19
CFR China - 62% Fe	$/dmt	$ 70	$ 72	$ 74

Note: 1) for the sake of consistency, we calculate royalties using our long term price forecast rather than the current, higher price. For Australian mines we apply the new 7.5% rate, and for Brazilian mines we assume that new regulations have introduced a 4% rate on the FOB price.

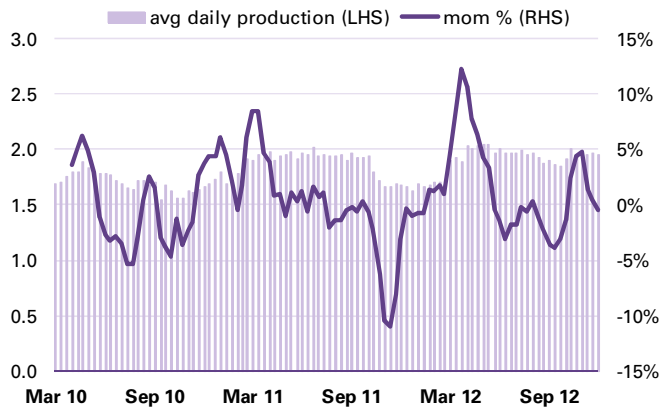
Source: Goldman Sachs Global ECS Research estimates.

Risks to our views

We highlight the top three risks that have the potential to undermine our forward view of the seaborne market and our investment framework for iron ore:

- **Chinese supply**: After years of solid growth, domestic production growth stalled in 2012 (Exhibit 44). In the future local government could decide to support the domestic iron ore industry on a sustainable basis. Lower fuel/electricity tariffs and lower taxes for mining companies and/or concentrators would reduce the production costs of Chinese ore and shift the industry curve downward. Alternatively, increased investment in production capacity could surprise on the upside, to the detriment of seaborne imports.
- **Global trends in steel**: In our view, the Chinese economy is going through a period of structural change and we forecast steel demand growth to lag behind GDP growth to 2016. Steel demand could yet surprise on the upside. However, we are also focused on the role of secondary steel production which is due to grow in China and other markets in coming years, to the detriment of iron ore consumption.
- **Foreign exchange rates**: The macroeconomic outlook could lead to further volatility in the exchange rates of currencies most relevant to the seaborne market. An appreciation of the US dollar relative to the commodity currencies (A$, R$, etc) would shift the cost curve downward.

Exhibit 40: Steel production volumes
Average crude steel production per day - Mt

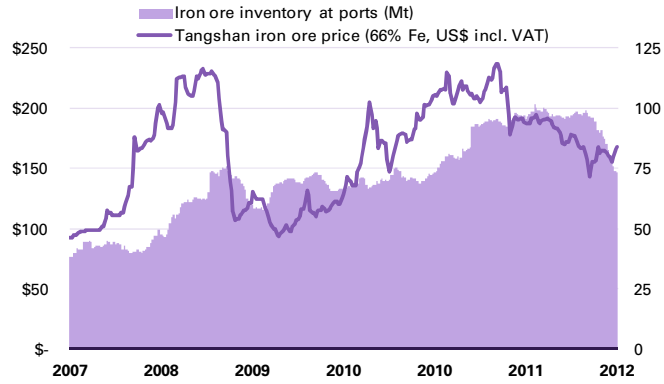


Source: CISA.

Exhibit 41: Steel in China has decoupled from GDP
Annual growth in steel consumption and real GDP

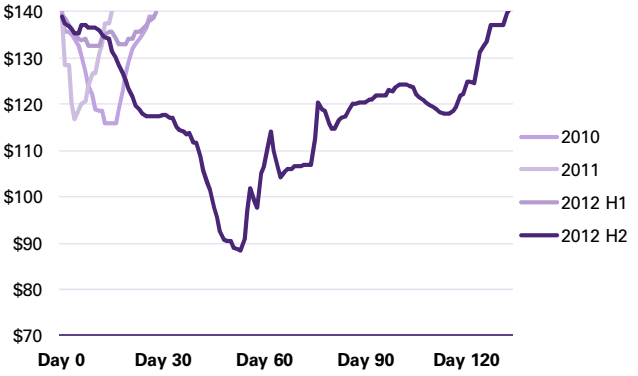
Source: World Steel Association, IMF, Goldman Sachs Global ECS Research.

Exhibit 42: China port stocks have fallen in 4Q2012
China iron ore port inventory & domestic price



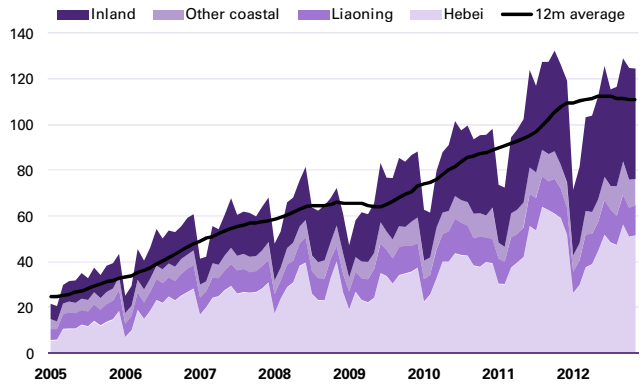
Source: Platts, MySteel, Goldman Sachs Global ECS Research.

Exhibit 43: A deeper and longer downturn
Iron ore price – trading days under $140/t CFR China



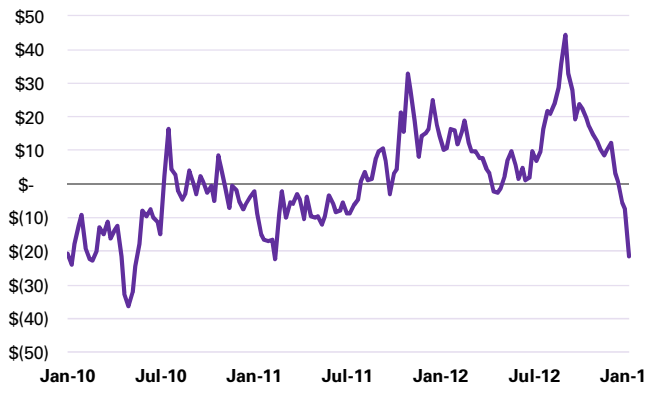
Source: Platts, Goldman Sachs Global ECS Research.

Exhibit 44: Chinese domestic ore production flat in 2012
Raw iron ore production by region – Mt per month



Source: Antaike.

Exhibit 45: Seaborne ore now sells at a premium
Price differential between domestic and seaborne iron ore (CFR Tangshan, adjusted for FE% and VAT)



Source: MySteel, Platts, Goldman Sachs Global ECS Research.

Metallurgical Coal – A gradual recovery to cost support

Spot demand for metallurgical coal remains weak and prices have not benefited from the uplift in iron ore prices. Relative to the other bulk commodities, metallurgical coal is the worst performer in 2012 with prices down 29% during the course of the year. However, we consider that current prices are unsustainable since they are below marginal production costs. We continue to expect a gradual recovery in 2013 and **see 17% upside potential versus spot relative to our 2H2013 forecast of $185/t for premium HCC**. Based on our analysis of production costs at Australian and US mines we believe that a sustainable price level for premium HCC is approximately $180/t.

Exhibit 46: Metallurgical coal supply & demand balance and price forecast
Million tonnes

	2008	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Global demand									
Crude steel production (incl. scrap)	1,327	1,227	1,412	1,518	1,542	1,608	1,676	1,728	1,786
Coking coal consumption	764	783	906	959	980	1,011	1,042	1,066	1,092
% growth	*-0.2%*	*2.4%*	*13.7%*	*5.5%*	*2.1%*	*3.1%*	*3.0%*	*2.2%*	*2.4%*
Seaborne demand									
OECD	127	96	123	127	129	128	129	131	133
non-OECD	59	87	96	89	96	101	117	121	128
Total	186	183	220	216	225	228	246	252	261
% growth	*6.2%*	*-1.6%*	*16.7%*	*-1.6%*	*3.7%*	*1.6%*	*7.2%*	*2.5%*	*3.5%*
Seaborne supply									
Australia	111	111	133	112	117	123	132	135	139
US	35	32	48	59	57	49	45	39	37
RoW	41	32	43	44	50	56	61	65	70
Total	188	175	224	216	224	227	238	240	246
Seaborne balance									
Surplus/(deficit)	2	(8)	4	(1)	(1)	(1)	(8)	(12)	(15)
Price									
Premium HCC FOB Australia (US$/t)	$ -	$ 172	$ 191	$ 289	$ 191	$ 178	$ 195	$ 205	$ 210

Source: Goldman Sachs Global ECS Research estimates.

The market was oversupplied in 1H2012, partly as a result of incremental volumes from marginal mines that high prices had induced in 2011. As inventories increased and spot demand evaporated, a steep drop in prices forced the supply side to respond with production cuts and mine closures. However, we believe the outlook for metallurgical coal is gradually improving.

The seaborne price of premium HCC is now 15% above the trough of $140/t reached in September, and we expect prices will continue to increase further into 2013. We expect average annual seaborne demand growth of 2.4% in the period 2013-16, while the average growth rate in steel production, rated by its share of seaborne metallurgical coal demand, will be 2.7% (Exhibit 46). China continues to lead in terms of metallurgical coal consumption (Exhibit 48) but we believe that the Chinese market will be relatively balanced. Domestic production growth is expected to exceed demand growth during 2012 (3.0% versus 2.9%) and 2013 (4.0% versus 3.7%). We do not expect seaborne imports to increase materially from current levels (Exhibit 49).

Despite a moderate rate of demand growth, we expect the spare capacity in metallurgical coal supply to shrink. On the one hand, we estimate approximately 10Mtpa in production capacity in Australia has closed (e.g. Norwich Park, Gregory, etc) while some expansions have been delayed. We also note that exports from Queensland have yet to recover to their 2010 peak (Exhibit 50). On the other hand, we still expect global steel production growth to

accelerate from 1.6% in 2012 to 3.6% in 2013. As a result, we think the seaborne market will gradually tighten, and prices will increase moderately during our forecast period.

Seaborne coal is competitive into the Chinese market at current prices (Exhibit 51). We note that in recent years the price differential between seaborne imports and domestic coal has lagged the trend in import volumes, rather than preceded it. Imports have also declined but not stopped altogether when spot prices would suggest that imports were out of the money, for instance during 1H2011 when prices increased dramatically on the back of weather-related supply disruptions in Australia. For 2013 and beyond we expect import levels to remain relatively stable.

Finally, the gradual price recovery also reflects the attractive industry fundamentals of the metallurgical coal sector (see *Global: Commodities: Metallurgical coal in a world of slower growth*, August 21, 2012). In particular we like:

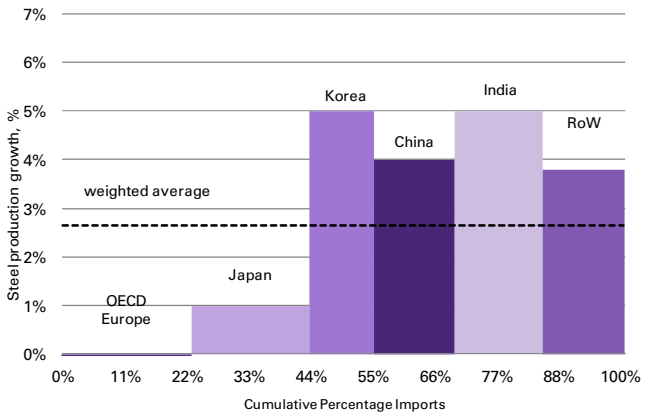
- **Industry structure**: The seaborne metallurgical coal market is highly concentrated.
- **Barriers to entry**: Metallurgical coal is a scarce resource, unlike thermal coal.
- **Threat of substitution**: The threat posed by alternative processes to produce steel without the need for metallurgical coke is limited in the medium term.
- **Customers**: Historically, metallurgical coal producers have captured a larger share of the value in the supply chain than steel companies.

Our long-term price forecast reflects the need to induce new mining and infrastructure capacity in order to satisfy incremental demand. Based on our analysis of inducement prices on Australia, Indonesia, Mongolia, Mozambique and Russia, a long-term price of $170/t real US$ basis would be sufficient to cover the capital amortization and the operating costs of future projects. We therefore forecast a long-term price of $200/t after converting from current US$ to 2017 US$ and allowing for a modest margin.

Risks to our views

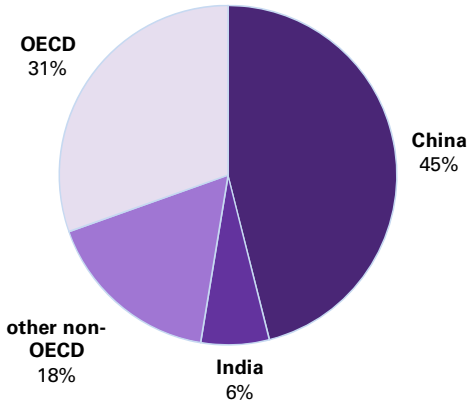
- **Supply disruptions**: Supply availability and therefore prices have been vulnerable in recent years to supply disruptions, both weather-related (e.g. Queensland floods) and man-made (e.g. industrial action at mines, rail and ports).
- **Foreign exchange rates**: The macroeconomic outlook could lead to further volatility in the exchange rates of the currencies most relevant to the seaborne market. An appreciation of the US dollar relative to the commodity currencies (A$, C$, rubl, etc) could shift the seaborne cost curve downward.
- **Chinese government policy**: The government has declared that domestic metallurgical coal reserves must be exploited in a sustainable manner, but the details of a potential cap on production and other restrictions on current and planned mines are still to be announced. The ambition of these targets and the degree to which the coal industry adheres to them could have a positive impact on seaborne demand and prices. Conversely, acceleration in domestic production could lead to a rebound in exports and drive lower seaborne prices.
- **The development of the Mongolian coal industry**: Mongolia is a relatively immature country in terms of mining legislation and infrastructure. The way in which it manages the associated challenges of its commodities boom (skills shortage, cost inflation, etc) will determine the extent in which Mongolian coal will compete with seaborne imports in the Chinese market.

Exhibit 47: Steel demand to improve in 2013
2013 steel growth and seaborne metallurgical coal imports



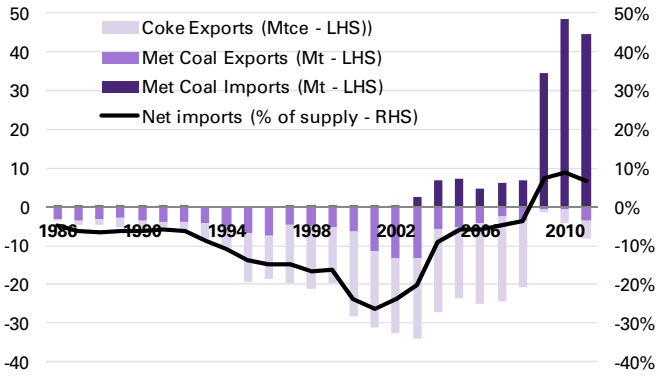
Source: Goldman Sachs Global ECS Research estimates.

Exhibit 48: China leads in production from blast furnaces
Share of global BF production by region – 2016E



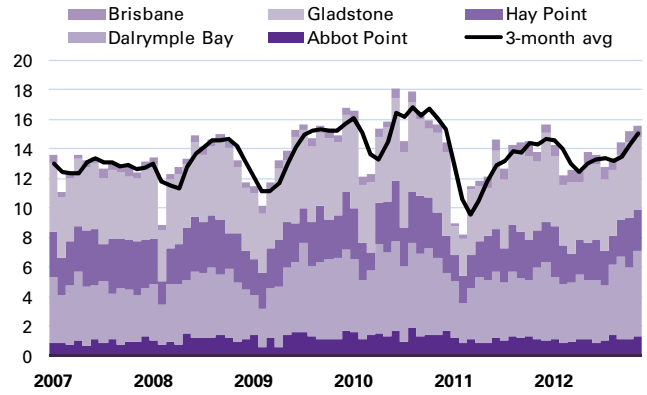
Source: Goldman Sachs Global ECS Research estimates.

Exhibit 49: China has become a net importer
Metallurgical coal trade



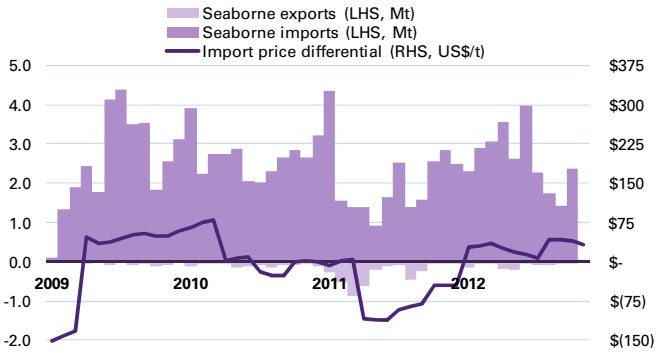
Source: International Energy Agency, McCloskey, Goldman Sachs Global ECS Research.

Exhibit 50: Queensland exports remain below their peak
Monthly metallurgical coal exports by port - Mt



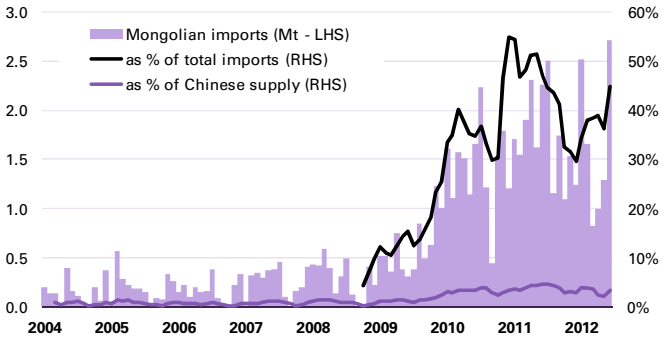
Source: McCloskey, Goldman Sachs Global ECS Research.

Exhibit 51: Imports are price-sensitive
Coking coal seaborne trade and price arbitrage



Source: China Coal Information Center, McCloskey, Goldman Sachs Global ECS Research.

Exhibit 52: Mongolia accounts for ~40% of imports
Mongolian exports and share of Chinese supply



Source: McCloskey, Goldman Sachs Global ECS Research.

Thermal Coal – Price upside capped by Chinese supply

We believe that seaborne thermal coal prices will trade within a range set by a) the China arbitrage price on the upside and b) marginal production costs on the downside. If prices stay below cost support, production will eventually slow down and the market will tighten. Conversely, if seaborne coal becomes uncompetitive in the Chinese market, demand will evaporate and prices will fall.

Exhibit 53: Thermal coal supply & demand balance and price forecast
Million tonnes

	2008	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Global demand									
Energy sector	3,968	3,914	4,095	4,352	4,330	4,596	4,709	4,818	4,940
Other sectors (e.g. cement, etc)	933	1,034	1,127	1,127	1,252	1,315	1,381	1,450	1,523
Total	4,901	4,947	5,223	5,480	5,582	5,911	6,089	6,268	6,463
% growth	*2.3%*	*0.9%*	*5.3%*	*4.7%*	*1.8%*	*5.6%*	*2.9%*	*2.8%*	*3.0%*
Seaborne demand									
OECD Europe	161	144	130	138	157	154	143	143	141
China	15	58	92	102	131	110	115	115	115
India	36	60	75	93	114	130	145	160	175
Japan	121	107	123	120	129	132	135	136	137
RoW	260	255	271	280	281	294	305	316	328
Total	593	624	692	733	812	820	844	870	897
% growth	*1.4%*	*4.9%*	*9.8%*	*5.6%*	*9.8%*	*1.0%*	*2.8%*	*3.0%*	*3.0%*
Seaborne supply									
Indonesia	196	229	287	319	346	355	362	377	393
Australia	125	139	141	148	168	171	176	183	190
RoW	276	252	251	273	306	297	306	309	312
Total	597	621	679	739	820	822	844	869	895
Seaborne balance									
Surplus/(deficit)	4	(3)	(13)	7	8	2	0	(1)	(2)
Price									
Benchmark 6,000kcal NAR FOB (US$/t)	$ -	$ 84	$ 91	$ 121	$ 95	$ 99	$ 100	$ 100	$ 100

Source: Goldman Sachs Global ECS Research estimates.

By virtue of the size of its domestic market and ability to arbitrage, China sets a price cap on the seaborne market. Ever since China became a significant importer of thermal coal in 2H2009, the price arbitrage between domestic coal and seaborne coal has been a good indicator of import volumes. After years of strong demand growth, thermal coal consumption slowed in 2012 (Exhibit 54) and this eventually led to an oversupplied domestic market and a price correction (Exhibit 55). We believe the Chinese market will not tighten significantly again during our forecast period, and as a result we now expect the price upside for thermal coal to be rather limited. Based on our methodology to determine the price arbitrage (Exhibit 56), a domestic price forecast of Rmb650/t is roughly consistent with $100/t FOB Newcastle. We expect seaborne coal to remain competitive in the Chinese market even if import volumes drop below 2012 levels.

In line with a more balanced market outlook in China we now expect imports to decline in 2013 and to remain below their 2012 peak for the duration of our forecast period. This is largely offset by a more constructive outlook in India (Exhibit 57) and in Europe. On the one hand, we take a more positive view of the potential for reforms in India, for instance in the areas of coal price pooling (*India: Utilities: Mobilising 650mt of coal to power IPP utilization; Buy APL*, November 21, 2012). We are conscious that the latent demand for energy in India is significant, as the recent blackouts attest. On the other hand, coal-fired generation has remained very competitive against gas-fired generation in Europe. Imports performed strongly in 2012 in spite of environmental regulations to incentivize low-carbon

energy (e.g. carbon pricing, SOx/NOx emission standards, etc) and a net decline in coal-fired generating capacity. Finally, coal has regained some lost ground in the US fuel mix, but we still expect its share to decline over the long term (Exhibit 58).

We expect the seaborne market to grow at an average rate of 2.5% in the period 2013-17, equivalent to 25Mtpa of new demand each year. This represents a slowdown relative to the period 2008-2012 when seaborne demand grew at an average rate of 6.3%.

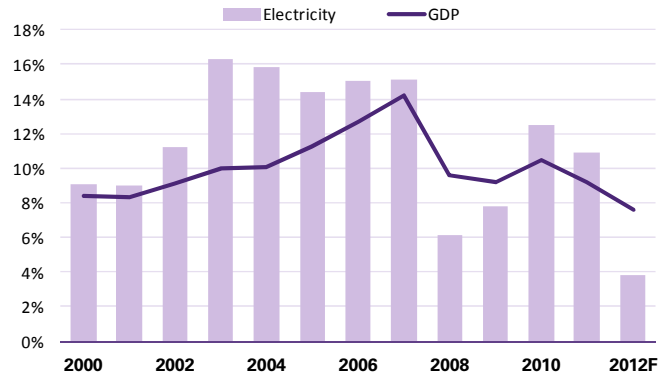
Limiting the downside, we estimate cost support for seaborne thermal coal at c.$90/t FOB Newcastle. Years of cost inflation and an appreciating currency have pushed Australian mines towards the top half of the cost curve. In Indonesia, Tier 2 miners who tend to operate mines producing coal with lower calorific value (CV) and located further inland from the more established players also tend to be in the top half of the curve.

Based on our forecasts, thermal coal prices will remain somewhat inexpensive relative to oil, but the gap will narrow during our forecast period (Exhibit 59). The correlation between oil and coal prices is explained by the fact that coal competes against gas in several markets (e.g. in Europe during the summer months), and gas prices are often indexed to oil. We believe that non-OPEC supply growth, and in particular unconventional production in North America, will lead to a gradual softening in oil prices and on that basis we expect Brent oil to decline gradually to $100/bbl by 2015.

Risks to our views

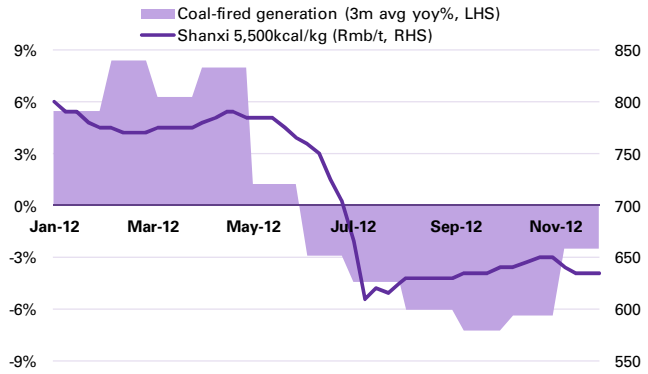
- **Trends in the Chinese coal industry**: The future rate of growth in domestic production and the impact of rail upgrades and cost inflation on the CIF cost curve is the biggest uncertainty for the seaborne market, in our view.
- **Power deregulation in the Indian market**: The regulation of power prices in India has been a tool to fight inflation, but it has led many utilities to idle plants despite latent demand. If generators were able to pass through the costs of generating electricity in a deregulated market, and assuming that there is no demand destruction as a result of higher prices, seaborne demand from India would be likely to increase.
- **Foreign exchange rates**: The macroeconomic outlook could also lead to further volatility in the exchange rates of currencies most relevant to the seaborne market. Further appreciation of the Chinese renminbi relative to the US dollar would enhance the competitiveness of imported coal and be supportive of future demand and prices. Conversely, the marginal cost of supply will drop if the currency of marginal suppliers depreciates.
- **Environmental policies**: The prospects for a globally binding deal to limit emissions appear remote. Instead, the focus on regulation has moved to the national level, as individual countries develop their own policies and targets. An increasing number of countries may adopt policies that undermine coal demand directly (e.g. via emission standards and/or emission trading schemes) or indirectly (e.g. by supporting alternative energy sources and/or by reducing electricity intensity). Alternatively, these policies may lose momentum and fail to challenge coal's dominant position in the fuel mix.

Exhibit 54: Power in China has decoupled from GDP
Annual growth in electricity consumption and real GDP



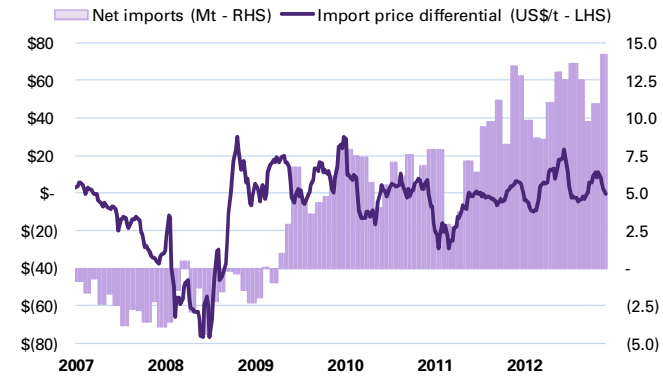
Source: International Energy Agency, IMF, Goldman Sachs Global ECS Research estimates.

Exhibit 55: Domestic prices fell after consumption
China coal-fired generation and domestic coal prices



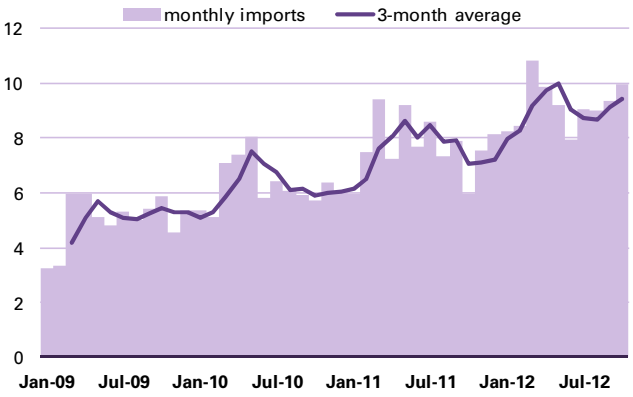
Source: National Bureau of Statistics, SxCoal, Goldman Sachs Global ECS Research.

Exhibit 56: China arbitrage window has narrowed
Net monthly imports and differential against domestic coal



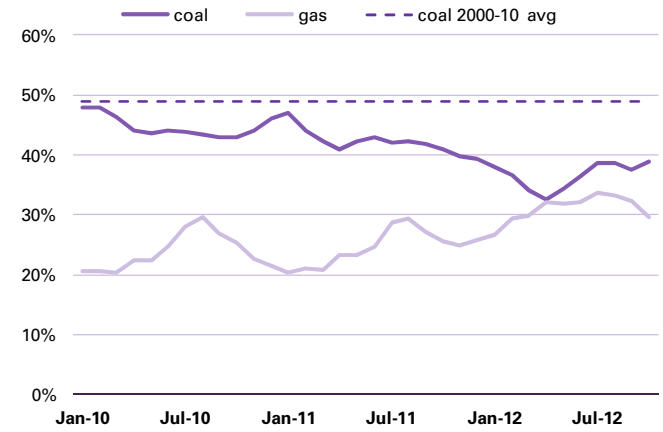
Source: China Coal Information Center, McCloskey, Goldman Sachs Global ECS Research.

Exhibit 57: Indian imports continue to rise
Monthly imports - Mt



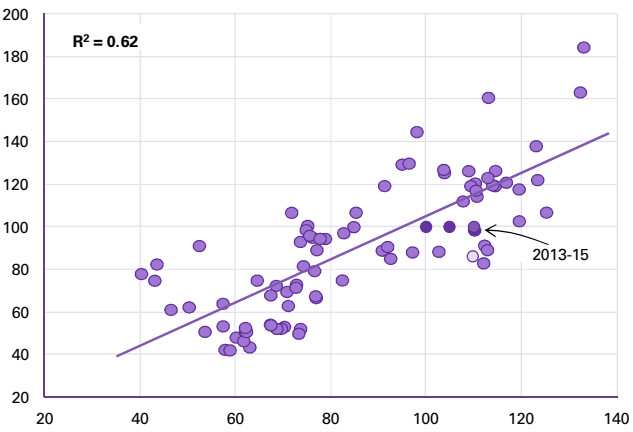
Source: McCloskey.

Exhibit 58: US coal is sliding against cheap gas
Net electricity generation by fuel – as % of total generation



Source: Energy Information Administration.

Exhibit 59: Coal is slightly cheap relative to oil
Brent oil (US$/bbl, x-axis) and Newcastle coal (US$/t, y-axis)



Source: McCloskey, Bloomberg, Goldman Sachs Global ECS Research estimates.

Mineral Sands – A difficult year ahead

Zircon: Demand destruction and excess inventory

The demand contraction in 2012E partly reflects the response of ceramic tile manufacturers to high zircon prices starting in 2010 all the way through the end of 2011. The amount of zircon used per square meter has been significantly reduced, and we believe it is unlikely that this trend will reverse as a result of lower prices in 2013. Based on industry sources, we believe that inventories at the end of 2012 are equivalent to approximately 6 months of 2013E demand), well above normal annual requirements of approximately 250Kt.

Exhibit 60: Zircon supply & demand balance and price forecast
Thousand tonnes

	2008	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Demand									
China	421	398	578	581	400	445	470	495	520
Europe	300	229	328	313	220	235	245	255	260
North America	121	86	113	116	98	105	110	110	115
Japan	45	37	45	45	45	40	40	45	45
RoW	274	237	308	331	239	275	285	295	310
Total	1,161	987	1,372	1,385	1,002	1,100	1,150	1,200	1,250
% growth	*-7.5%*	*-15.0%*	*39.0%*	*0.9%*	*-27.7%*	*9.8%*	*4.5%*	*4.3%*	*4.2%*
Supply									
Australia	500	413	528	710	465	319	385	406	589
South Africa	398	355	355	388	380	335	355	365	365
RoW	345	282	383	478	330	270	340	405	395
Total	1,242	1,049	1,266	1,576	1,175	924	1,079	1,176	1,349
% growth	*-1.2%*	*-15.6%*	*20.7%*	*24.5%*	*-25.4%*	*-21.4%*	*16.8%*	*9.0%*	*14.7%*
Inventory									
Global	205	267	161	352	525	349	279	255	354
Price									
Zircon (US$/t)	$ -	$ 900	$ 906	$ 1,898	$ 2,275	$ 1,350	$ 1,575	$ 1,600	$ 1,600

Source: TZMI, Goldman Sachs Global ECS Research estimates.

We downgrade our 2013 forecast on the back of an oversupplied market and deteriorating producer discipline. The largest mineral sands producers can reduce product availability during periods of oversupply as a way to moderate the decline in prices. The first step would be to direct the heavy metals concentrate (HMC) to the stockpile and reduce the feed going into the mineral separation plant (MSP). Incremental cuts can be achieved by idling the MSP for a short period. More drastic cuts to production might involve switching to mining areas with lower grades and/or reducing mining output. However, if producer discipline deteriorates in a fight for market share, we believe the downside risk for prices could be significant. We believe producer discipline in 2013 will be less than solid.

We expect zircon demand to stage a gradual recovery and excess inventories to decline from 2013 onwards. However, unless demand improves and/or producers restrict production beyond our current expectations, the market is likely to remain amply supplied.

TiO_2 feedstocks: Gradual improvement in 2H2013

End-user demand for pigment slowed down in 2012. Pigment producers have responded by destocking pigment inventories even as TiO_2 feedstock inventories build up. We expect the mining sector to finish the year in oversupply, and believe that a supply response will be required in 2013 to balance the market. We expect supply to contract marginally by 0.2% this year before resuming growth from 2014 onwards.

Exhibit 61: Titanium feedstocks supply & demand balance and price forecast
Thousand TiO2 units

	2008	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Demand									
Pigments - North America	1,694	1,434	1,685	1,736	1,562	1,594	1,673	1,723	1,767
Pigments - Europe	1,576	1,200	1,620	1,701	1,497	1,482	1,534	1,565	1,580
Pigments - China	1,004	1,082	1,358	1,521	1,445	1,546	1,701	1,854	2,002
Pigments - RoW	1,059	993	1,109	1,171	1,085	1,109	1,169	1,221	1,269
Other sectors	675	569	652	900	966	1,020	1,056	1,093	1,131
Total	6,008	5,279	6,424	7,030	6,555	6,751	7,133	7,456	7,749
% growth	*-6.4%*	*-12.1%*	*21.7%*	*9.4%*	*-6.8%*	*3.0%*	*5.7%*	*4.5%*	*3.9%*
Supply									
Chloride grade	3,559	3,104	3,590	3,577	3,348	3,379	3,510	3,646	3,731
Sulfate grade	2,534	2,038	2,890	3,575	3,512	3,467	3,624	3,853	4,120
Total	6,093	5,142	6,480	7,152	6,860	6,846	7,134	7,500	7,851
% growth	*-2.5%*	*-15.6%*	*26.0%*	*10.4%*	*-4.1%*	*-0.2%*	*4.2%*	*5.1%*	*4.7%*
Inventory									
Global	925	788	843	965	1,270	1,365	1,366	1,409	1,511
Price									
Rutile	$ -	$ 540	$ 560	$ 1,055	$ 2,400	$ 1,563	$ 1,700	$ 1,700	$ 1,700
Ilmenite (chloride grade)	$ -	$ 110	$ 107	$ 181	$ 298	$ 283	$ 255	$ 230	$ 220

Source: TZMI, Goldman Sachs Global ECS Research estimates.

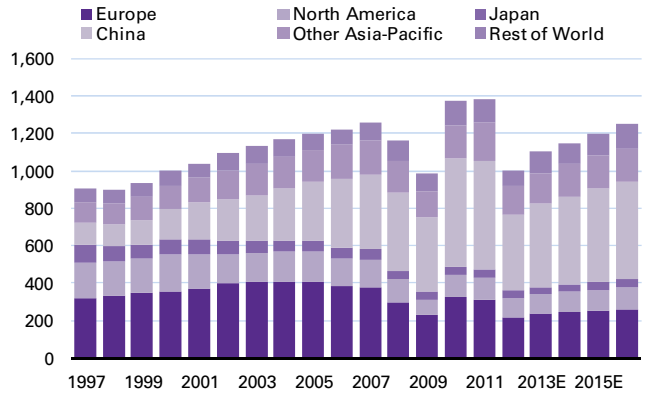
The consensus view among market participants present at the recent TZMI conference points to a very disappointing outcome in 1Q2013 in terms of sales volumes and prices. According to TZMI, the market could improve during 2H2013 but the risk of ongoing oversupply will remain. The long-term outlook for 2015+ depends in part on the ability of early stage projects to secure funding despite difficult market conditions.

In summary, we are not unduly concerned by the scale of excess inventory and the relatively modest disconnect between supply and demand. On that basis we leave our price forecasts unchanged.

Risks to our views

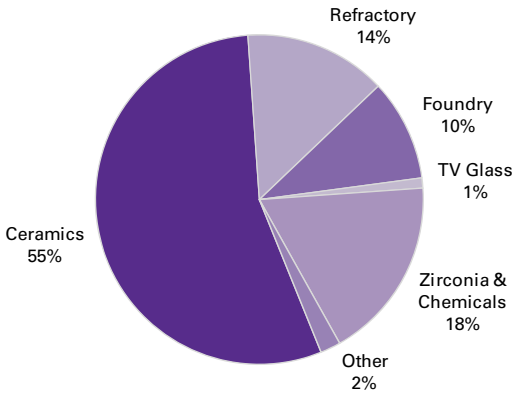
- **Cost support**: Though data is scarce we believe our current price forecast is somewhat above the marginal production cost. In an oversupplied market we recognize the risk that prices could fall until they test the cost support level.
- **Trends in zircon use**: The scale of thrifting and substitution in zircon use over the past year has surprised the market. We believe that zircon content now has limited downside, and that if prices were to fall further then demand may start to increase. However, we believe there is very limited visibility in this area.

Exhibit 62: Zircon demand to remain below 2011 peak
Zircon consumption by region – Kt



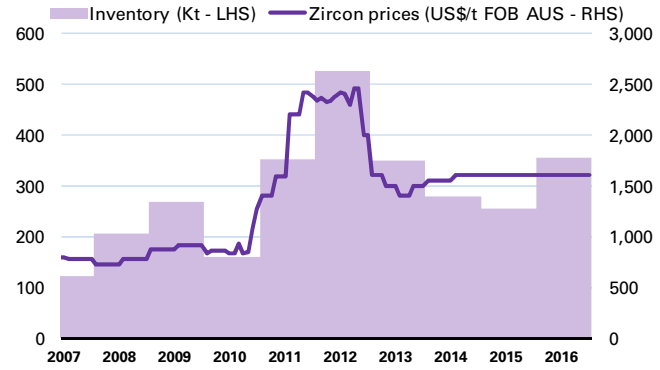
Source: TZMI, Goldman Sachs Global ECS Research estimates.

Exhibit 63: Ceramic tiles drive zircon demand
2011 zircon demand by end-use



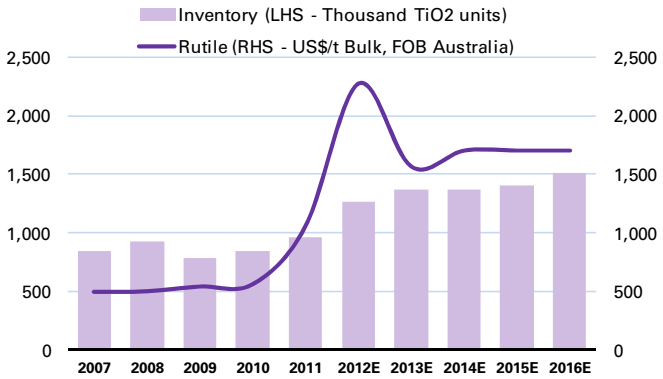
Source: TZMI.

Exhibit 64: Price correction on higher inventories
Zircon inventory and prices



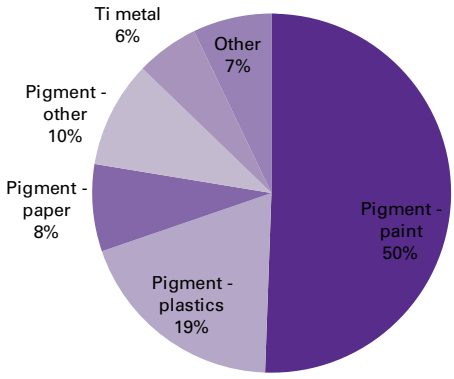
Source: Institute of Economic Affairs, Global Insight, McKinsey Global Institute.

Exhibit 65: Price correction on higher inventories
TiO2 inventory and yearly average price



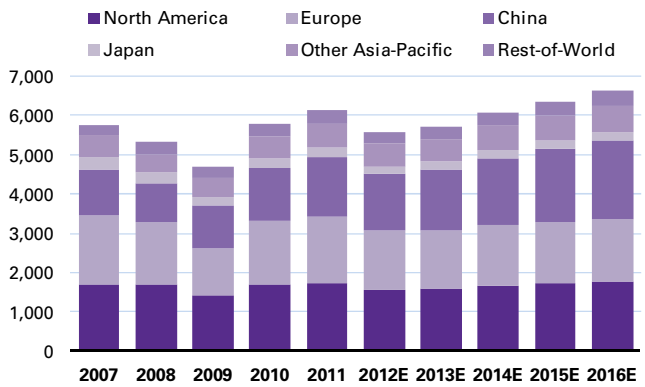
Source: TZMI, Goldman Sachs Global ECS Research estimates.

Exhibit 66: Pigment drives demand for TiO_2
2011 TiO_2 feedstocks demand by end-use



Source: TZMI.

Exhibit 67: Pigment demand set to recover
Pigment demand by region – Thousand TiO2 units



Source: TZMI, Goldman Sachs Global ECS Research estimates.

Rare Earths – Diverging outlook for Light and Heavy REEs

Prices fell significantly during 2012, with the price of our Light Rare Earth Element (REE) and Heavy REE baskets down 56% and 58% yoy respectively in December (Exhibit 69). Current prices are approximately 70% below their monthly peaks of 2011, and we do not expect much upside during our forecast period on the back of a looming oversupply of light REEs and of an apparent policy shift in China. We also believe that the respective basket prices will diverge over time, with light REEs trading close to cost support and heavy REEs seeing scarcity prices.

Exhibit 68: Rare earths supply & demand balance and price forecast
Tonnes of Rare Earths Oxide (REO)

	2008	2009	2010	2011	2012E	2013E	2014E	2015E	2016E
Demand									
Light REE - China	65,659	53,255	73,506	62,931	70,544	75,945	81,744	87,968	94,646
Light REE - RoW	45,526	26,473	42,958	30,997	31,956	35,060	38,513	42,355	46,632
Total	111,186	79,728	116,464	93,928	102,500	111,005	120,257	130,323	141,278
% growth	*4.5%*	*-28.3%*	*46.1%*	*-19.4%*	*9.1%*	*8.3%*	*8.3%*	*8.4%*	*8.4%*
Heavy REE - China	9,341	6,745	9,494	7,069	8,456	9,280	10,196	11,217	12,354
Heavy REE - RoW	4,974	3,527	4,892	4,003	4,044	5,097	6,249	7,504	8,868
Total	14,314	10,272	14,386	11,072	12,500	14,377	16,445	18,721	21,222
% growth	*5.0%*	*-28.2%*	*40.0%*	*-23.0%*	*12.9%*	*15.0%*	*14.4%*	*13.8%*	*13.4%*
Supply									
China	115,000	110,000	118,000	115,000	110,000	107,250	109,931	112,680	115,497
RoW	8,000	7,900	11,000	12,450	13,280	34,959	60,380	72,735	73,901
Total	123,000	117,900	129,000	127,450	123,280	142,209	170,312	185,415	189,397
% growth	*15.5%*	*-4.1%*	*9.4%*	*-1.2%*	*-3.3%*	*15.4%*	*19.8%*	*8.9%*	*2.1%*
Balance									
Light REE - surplus/(deficit)	(749)	26,179	(640)	20,566	8,237	18,475	36,547	40,996	33,566
Heavy REE - surplus/(deficit)	(1,751)	1,721	(1,210)	1,884	43	(1,649)	(2,937)	(4,625)	(6,669)
Price									
Light REE basket	$ 108	$ 101	$ 137	$ 706	$ 463	$ 285	$ 285	$ 285	$ 285
Heavy REE basket	$ 196	$ 122	$ 203	$ 1,027	$ 785	$ 553	$ 581	$ 610	$ 641

Note: the Light Rare Earth Oxide (REO) basket is composed of Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Samarium (Sm) and Europium (Eu); the Heavy REO basket is composed of Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy) and Yttrium (Y) but it does not include prices for Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb) or Lutetium (Lu) due to lack of price data.

Source: Metal Pages, IMCOA, Goldman Sachs Global ECS Research estimates.

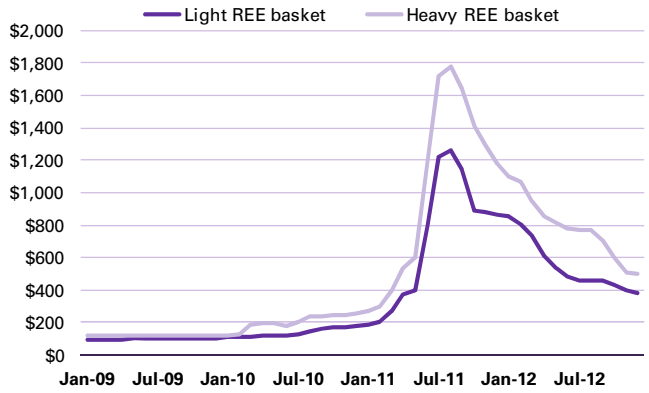
We see a growing divergence between light and heavy REEs (Exhibit 70). For the first time in recent years we believe that the world ex-China will post a surplus in light REEs from 2013 onwards, largely as a result of new production capacity in the US and Australia. On the other hand, heavy REEs are expected to remain in deficit during our forecast period. This implies that high prices will induce: a) additional demand destruction via thrifting and substitution in applications such as magnets, and/or b) new production capacity to come online, assuming project developers can develop the appropriate technologies to process heavy REE deposits on a commercial basis.

A policy shift has taken place in China. In contrast to 2011 when China was actively limiting supply, the export quota in 2012 did not affect supply (approximately 60% of the quota remained unused) and the first batch export quotas for 2013 is in line with 2012 volumes. Moreover, the Chinese government announced some modest subsidies for the domestic REE industry in August 2012. This new approach to the sector suggests that price volatility will be lower in the future. In our view, China is unlikely to restrict exports deliberately but this will not stop consumers around the world, and Japan in particular, to seek alternative supply sources elsewhere and ensure greater diversity and security of supply.

Risks to our views

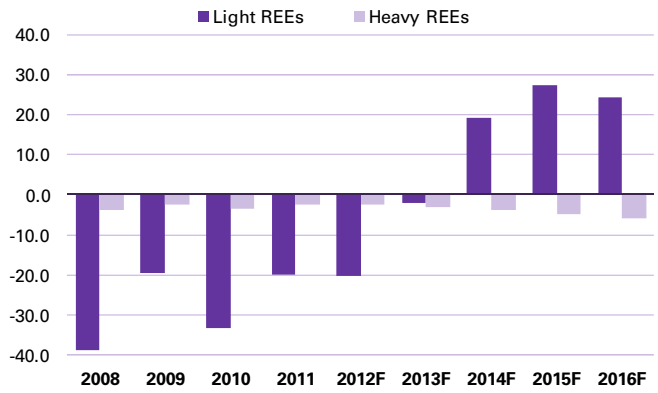
- **Chinese policies on production and exports**: Given its dominant role in global supply (Exhibit 71), Chinese policies on stockpiles, industry consolidation, production and export quotas as well as potential subsidies to domestic producers will continue to have a material impact on the realized prices and (in the case of light REEs) the market share of overseas producers.
- **Illegal exports in China**: According to a China Daily report, illegal exports in 2011 amounted to 20,000 tonnes, equivalent to approximately 20% of global supply. The success of future efforts to regulate and clamp down on illegal mining could impact the supply/demand balance of the export market.
- **Trends in REE demand**: The applications of REE are predominantly in high technology sectors such as wind turbines, electric cars, unconventional oil production and touch screens (Exhibit 73). Demand for REEs will vary according to the growth rate in each of these sectors and to any future innovation in thrifting and substitution, particularly for heavy REEs.

Exhibit 69: Prices have fallen well below their 2011 peak
Monthly REE prices – US$/t REO



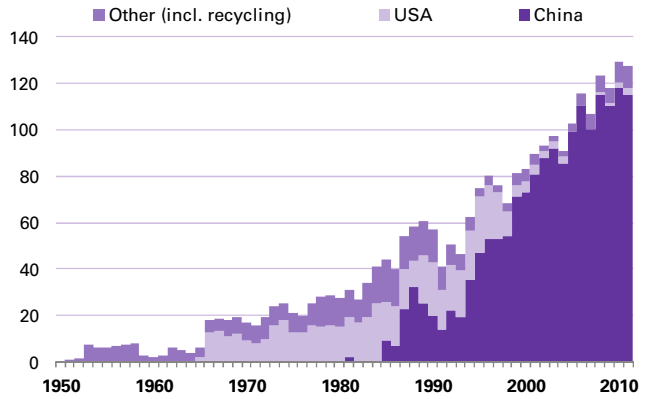
Source: Metal Pages, Goldman Sachs Global ECS Research.

Exhibit 70: Light REEs will switch to surplus from 2013E
Annual REE balance, world ex-China – thousand t ROE



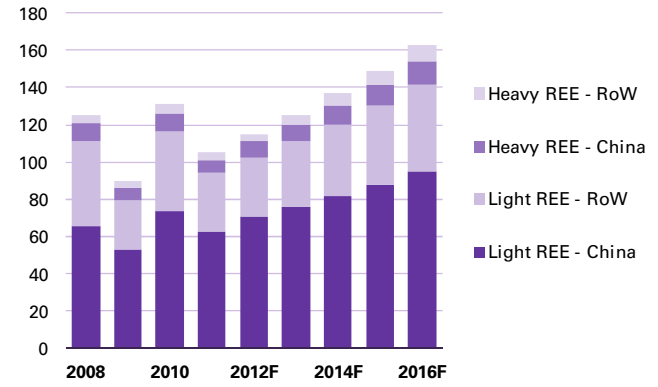
Source: IMCOA, Goldman Sachs Global ECS Research estimates.

Exhibit 71: China dominates global supply
Global REE production – thousand t ROE



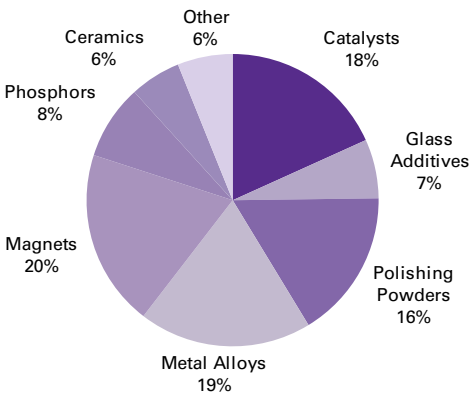
Source: USGS, Company data, IMCOA, Goldman Sachs Global ECS Research

Exhibit 72: We expect demand to grow at ~9% pa
REE demand by region and type – thousand t ROE



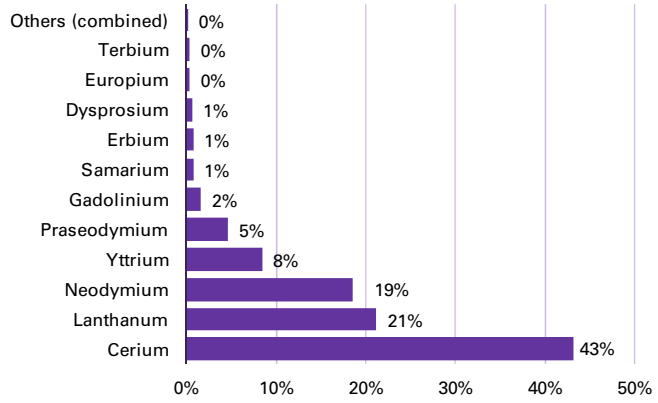
Source: IMCOA, Goldman Sachs Global ECS Research estimates.

Exhibit 73: REE exposure to high tech sectors
Major applications for REE in 2012



Source: IMCOA.

Exhibit 74: Light REEs will continue to dominate
2016 demand forecast by REE – as % of global demand



Source: IMCOA.

Current trading recommendations

Current trades	First recommended	Initial value	Current Value	Current profit/(loss)[1]
The Commodity Carry Basket: Crude, Corn and Base (CCB)				
Long the S&P GSCI Petroleum, Corn and Copper total return indices, short the S&P GSCI F3 Aluminium total return index, equally weighted	December 5, 2012 - *2013-2014 Outlook*	100.00	100.66	**0.66**
Long NYMEX natural gas one-by-two call spread				
Long one Jul-13 NYMEX natural gas $3.85/mmBtu call, short two Jul-13 NYMEX natural gas $4.70/mmBtu calls	November 11, 2012 - Natural Gas Watch	$0.12/mmBtu	$0.11/mmBtu	**($0.01/mmBtu)**
Long Jun-13 NYMEX WTI crude vs. short Jun-13 ICE Brent crude				
Buy 1 Jun-13 NYMEX WTI crude, sell 1 Jun-13 ICE Brent	August 21, 2012 - *Energy Weekly*	($12.33/bbl)	($13.47/bbl)	**($1.14/bbl)**
Long S&P GSCI Brent crude oil total return index				
Long S&P GSCI Brent crude oil total return index at initial index value of 1,174.26	August 21, 2012 - *Energy Weekly*	1,174.26	1,181.38	**(10.16%)**
Rolled from a long September 2012 NYMEX WTI Crude Oil position on 21-Aug-12 , carrying forward a potential loss of 10.77%				
Long Gold				
Buy April 2013 COMEX Gold, sell $1,850/toz Apr-13 call, buy $1,575/toz Apr-13 put	October 11, 2010 - *Precious Metals*	$1,717.5/toz	$1,678.0/toz	**$278.3/toz**
Rolled from a long Dec-12 COMEX Gold future position on 4-Dec-12 with a potential gain of $317.8/toz				

[1]As of close on January 14, 2013. Inclusive of all previous rolling profits/losses.

Source: Goldman Sachs Global ECS Research estimates.

Price actions, volatilities and forecasts

	Prices and monthly changes[1]			Volatilities (%) and monthly changes[2]				Historical Prices						Price Forecasts[3]		
	units	14 Jan	Change	Implied[2]	Change	Realized[2]	Change	2Q 11	3Q 11	4Q 11	1Q 12	2Q 12	3Q 12	3m	6m	12m
Energy																
WTI Crude Oil	$/bbl	93.56	↑ 7.77	26.5	-2.82	15.0	-5.9	102.34	89.54	94.06	103.03	93.35	92.20	**102.50**	**105.00**	**98.00**
Brent Crude Oil	$/bbl	110.64	↑ 2.63	24.5	-2.00	15.7	-2.0	116.99	112.09	109.02	118.45	108.76	109.42	**110.00**	**110.00**	**105.00**
RBOB Gasoline	$/gal	2.74	↑ 0.13	24.0	-2.65	18.9	-2.5	3.10	2.89	2.62	3.06	2.95	2.95	**2.92**	**2.85**	**2.56**
NYMEX Heating Oil	$/gal	3.01	↑ 0.08	23.1	-1.58	15.4	-3.6	3.05	2.98	2.98	3.16	2.89	3.00	**3.10**	**3.09**	**3.01**
NYMEX Nat. Gas	$/mmBtu	3.33	↓ -0.09	36.6	0.91	40.1	-0.2	4.38	4.06	3.48	2.50	2.35	2.89	**3.75**	**3.75**	**4.25**
UK NBP Nat. Gas	p/th	67.44	↑ 0.67	18.0	-2.74	18.1	-2.3	58.04	57.03	61.56	57.46	55.89	56.92	**73.20**	**70.50**	**76.20**
Industrial Metals[4]																
LME Aluminum	$/mt	2,098	↓ -19	19.5	0.03	23.2	2.8	2,618	2,430	2,115	2,219	2,019	1,950	**2,000**	**2,000**	**2,100**
LME Copper	$/mt	8,045	↓ -55	18.8	-2.93	17.6	3.4	9,163	8,993	7,530	8,329	7,829	7,721	**8,000**	**9,000**	**8,000**
LME Nickel	$/mt	17,585	↓ -215	24.7	-1.81	22.0	-2.7	24,191	22,037	18,396	19,709	17,211	16,396	**16,500**	**16,500**	**17,000**
LME Zinc	$/mt	2,015	↓ -66	20.7	-1.48	23.6	5.5	2,271	2,247	1,917	2,042	1,932	1,905	**1,950**	**2,000**	**2,100**
Precious Metals																
COMEX Gold	$/troy oz	1,661	↓ -48	12.7	-0.73	14.1	2.1	1,508	1,704	1,685	1,693	1,612	1,654	**1,825**	**1,805**	**1,800**
COMEX Silver	$/troy oz	30.4	↓ -2.5	23.7	0.18	31.6	7.7	38.3	38.8	31.8	32.7	29.4	29.9	**30.5**	**30.1**	**30.1**
Agriculture																
CBOT Wheat	Cent/bu	755	↓ -67	26.3	0.68	19.6	-4.1	745	690	615	643	641	871	**950**	**950**	**800**
CBOT Soybean	Cent/bu	1,358	↓ -89	20.4	0.67	14.5	-3.9	1,361	1,356	1,175	1,272	1,426	1,677	**1,525**	**1,400**	**1,350**
CBOT Corn	Cent/bu	709	↓ -16	26.6	2.90	15.9	-1.3	731	696	620	641	618	783	**825**	**825**	**650**
NYBOT Cotton	Cent/lb	76	↑ 1	20.4	-1.34	13.6	-2.3	156	106	95	93	80	73	**70**	**75**	**75**
NYBOT Coffee	Cent/lb	153	↑ 12	29.2	0.73	41.1	2.9	271	256	229	205	170	172	**155**	**165**	**175**
NYBOT Cocoa	$/mt	2,256	↓ -178	26.2	-0.07	20.4	-1.1	3043	2,962	2,383	2,308	2,222	2,438	**2,300**	**2,400**	**2,500**
NYBOT Sugar	Cent/lb	19.2	↑ 0.3	21.1	-0.75	21.3	-2.7	24	29	25	25	21	21	**18.5**	**18.5**	**19.0**
CME Live Cattle	Cent/lb	130.6	↑ 4.1	9.6	-1.14	16.1	8.4	111	115	121	125	117	122	**130.0**	**128.0**	**130.0**
CME Lean Hog	Cent/lb	84.2	↑ 2.1	14.9	-0.66	16.8	4.0	94	94	88	87	88	83	**85.0**	**94.0**	**85.0**

[1] Monthly change is difference of close on last business day and close a month ago.

[2] Monthly volatility change is difference of average volatility over the past month and that of the prior month (3-mo ATM implied, 1-mo realized).

[3] Price forecasts refer to prompt contract price forecasts in 3-, 6-, and 12-months time.

[4] Based on LME three month prices.

Source: Goldman Sachs Global ECS research estimates.

Disclosure Appendix

Reg AC

We, Christian Lelong, Max Layton, Damien Courvalin, Jeffrey Currie and Roger Yuan, hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm's business or client relationships.

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