

What is manganese?

- Manganese is the world's fourth most heavily consumed metal (after iron, aluminium and copper)
- Global mine output of 17 million tonnes (contained metal) in 2014 – over 90% goes into steel
- All steels contain manganese
- Manganese is used to remove sulphur from liquid steel (sulphur causes steel to crack)
- There is no viable substitute for manganese as a de-sulphuriser
- Manganese is also used to improve the strength of certain steels (especially structural steels, high strength flat steels)
- Non-steel consumption of manganese includes de-polarisation of dry-cell batteries, an additive in certain aluminium and copper alloys and animal feed

Manganese industry value chain



The steel industry consumes over 90% of all manganese units

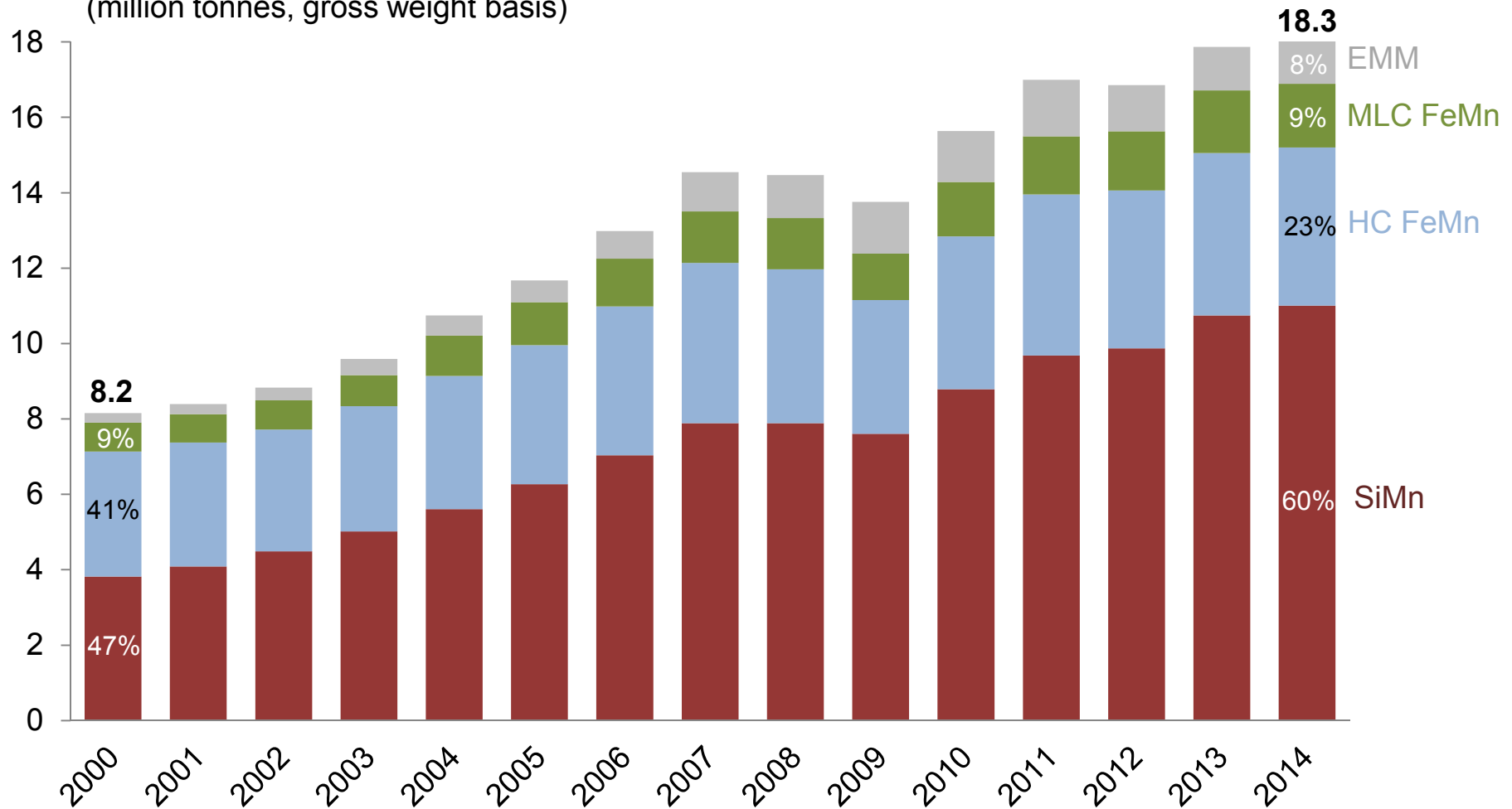
- Manganese needs to be smelted into ferroalloy because it is added into steel after decarburisation (Mn ore is too impure to add to decarburised steel)
- Main Mn alloys are silicomanganese (SiMn), high carbon ferromanganese (HC FeMn), medium/low carbon ferromanganese (MLC FeMn), electrolytic manganese metal (EMM)
- The Mn ore industry is relatively consolidated , dominated by a few large producers (BHP Billiton / South32 by far the largest).....though the industry is now fragmenting
- The Mn alloy industry is highly fragmented and characterised by low profitability. Around 60% of Mn alloys are produced in China. Output is dominated by a very large number of small Chinese companies (up to 1,000).

Main steel product demand drivers for manganese alloys

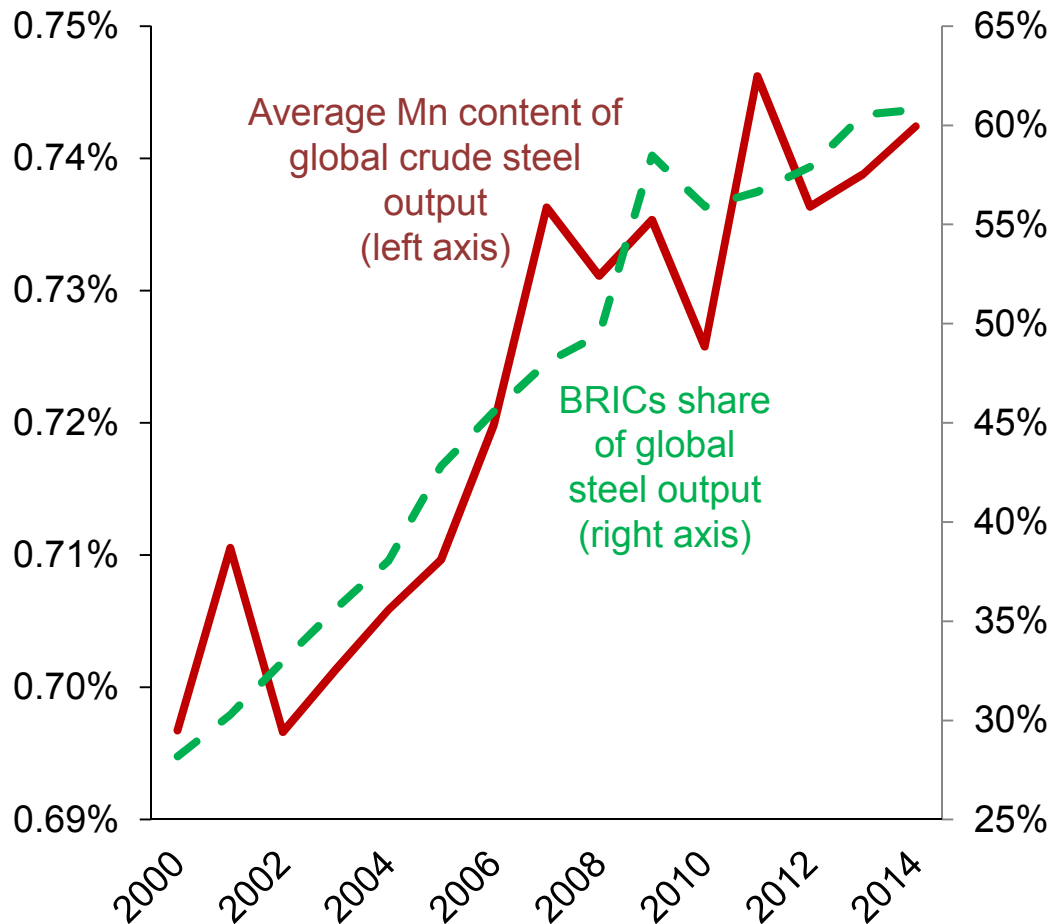
<u>Steel product</u>	<u>Key specifications</u>	<u>Main Mn alloy product</u>
Automotive strip mill carbon steel products	Low carbon content Low silicon content	MLC FeMn
Other surface critical strip mill carbon steel products	Low silicon content	HC FeMn
Standard strip mill carbon steel products	Low carbon content	SiMn
Standard carbon steel long products	Higher carbon content Higher silicon content	SiMn
High carbon steel long products	High carbon content	HC FeMn
Stainless steel flat products	Low carbon content High silicon content	LC SiMn in Europe, USA EMM in Asia

Global demand for Mn alloys – trend has been towards SiMn and away from HC FeMn

Global consumption of Mn alloys
(million tonnes, gross weight basis)



There are good reasons to expect that the average Mn content of steel will continue to rise



Structural steels require strength, so tend to have a high manganese content

Developing countries focus more on structural steel consumption – for infrastructure and buildings

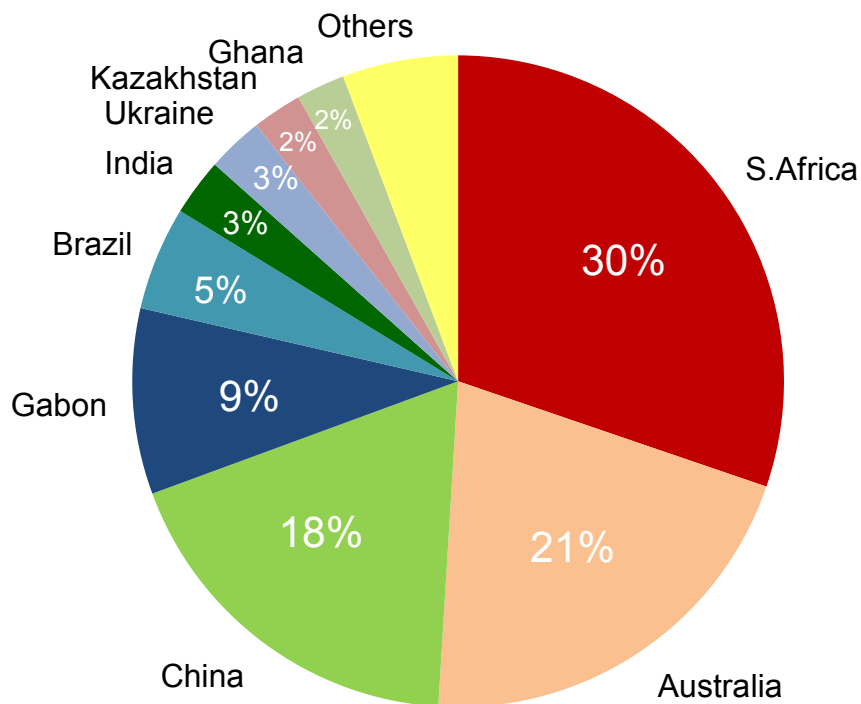
Chinese building / earthquake resistance standards will continue to tighten, leading to higher Mn content in steel (especially rebar)

Strong demand potential from India and other early-stage developing nations

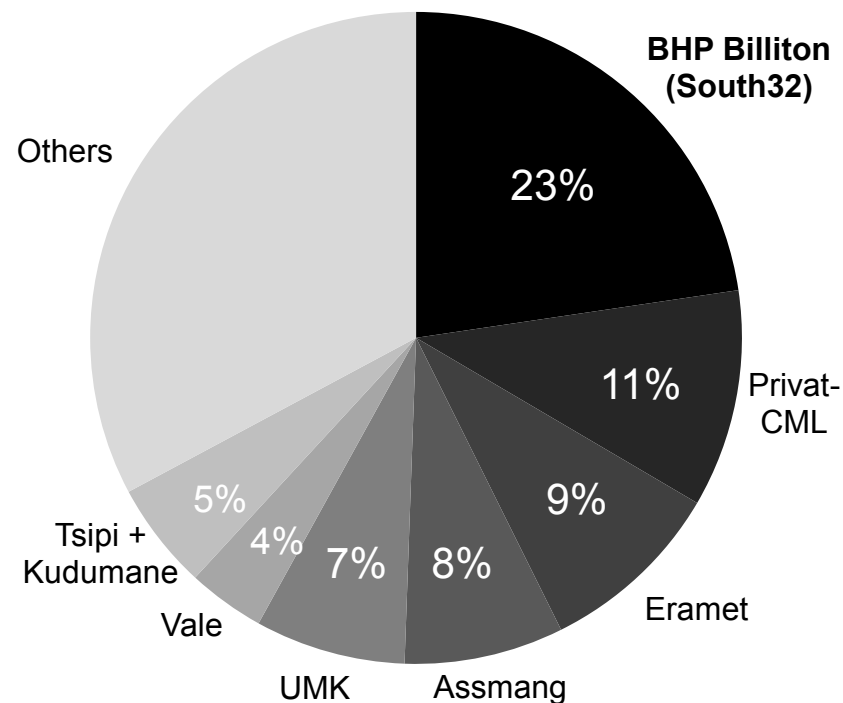
Increasing use of high-strength steels in automotive sector

Manganese ore production by country and company, 2014 – BHP more than twice the size of the next largest producer

Global Mn ore production by country, 2014



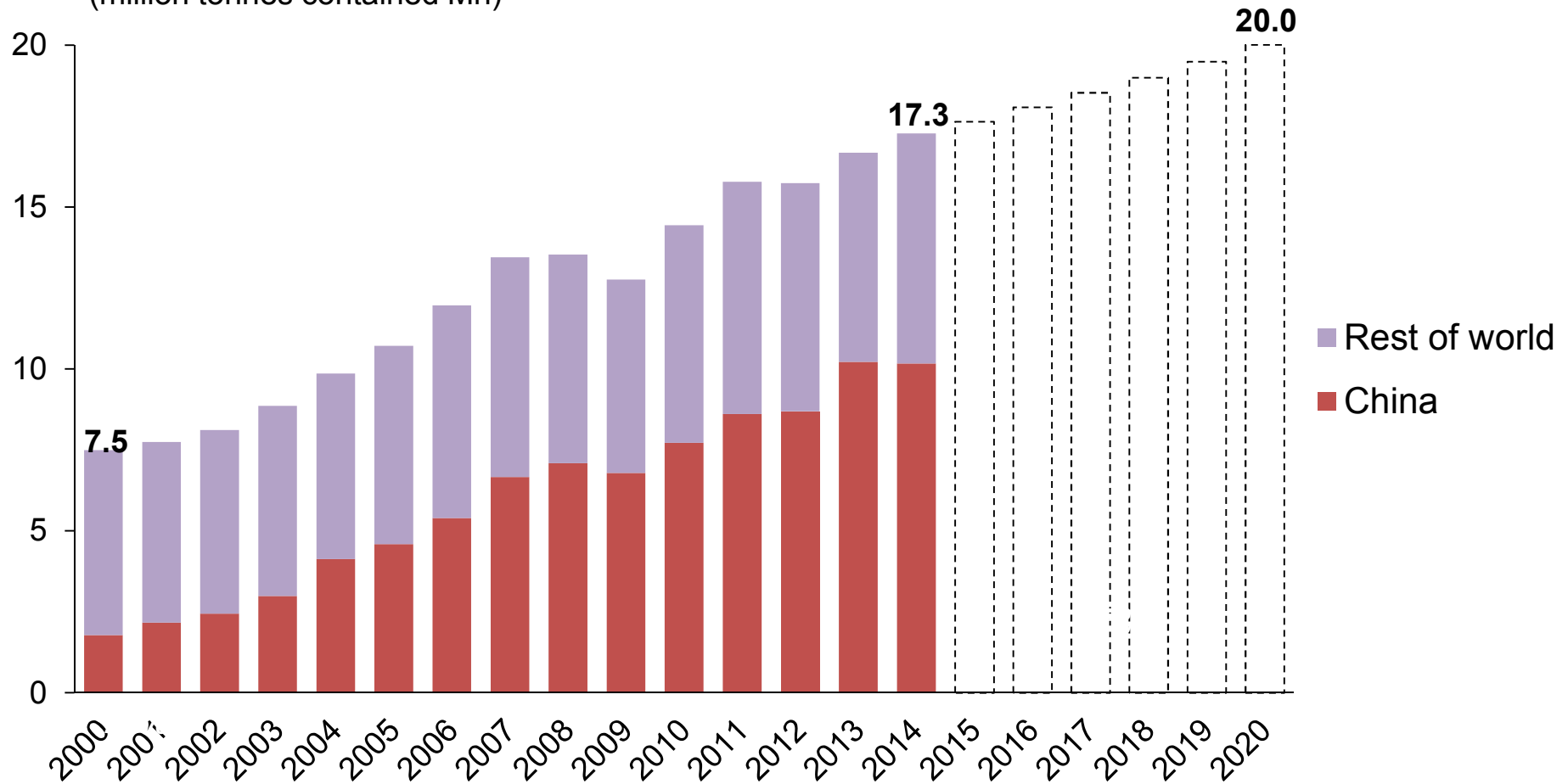
Global Mn ore production by company, 2014



Total: ~17 million tonnes
Data shown on a contained metal basis

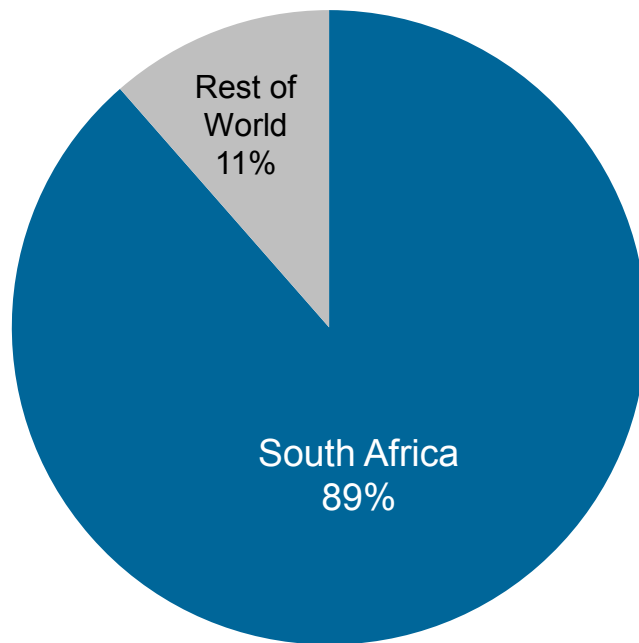
Global demand for Mn ore – actual & forecast – Despite slowdown, demand will rise by ~3Mtpy by 2020

Global demand for manganese ore
(million tonnes contained Mn)



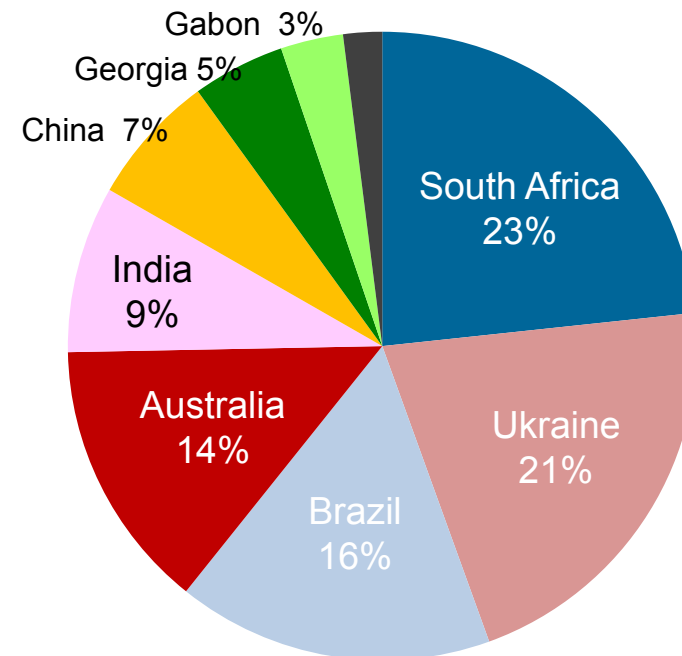
Manganese ore global reserves & resources – South Africa utterly dominates global resources

Known world Mn resources



total ~10 billion tonnes
(~650 years of supply*)

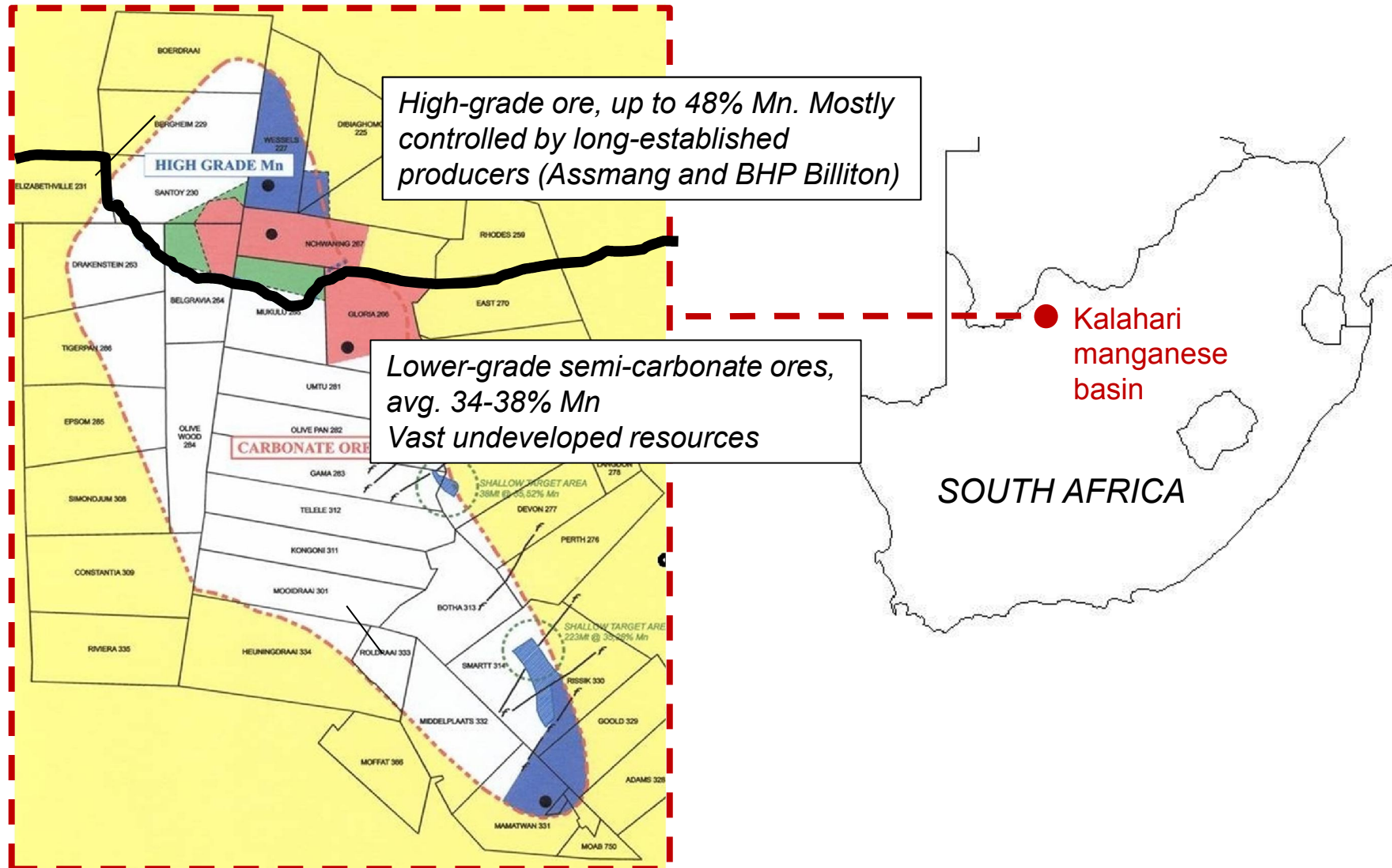
Reported world Mn reserves



total ~650 million tonnes
(~40 years of supply*)

* assuming current rate of mining

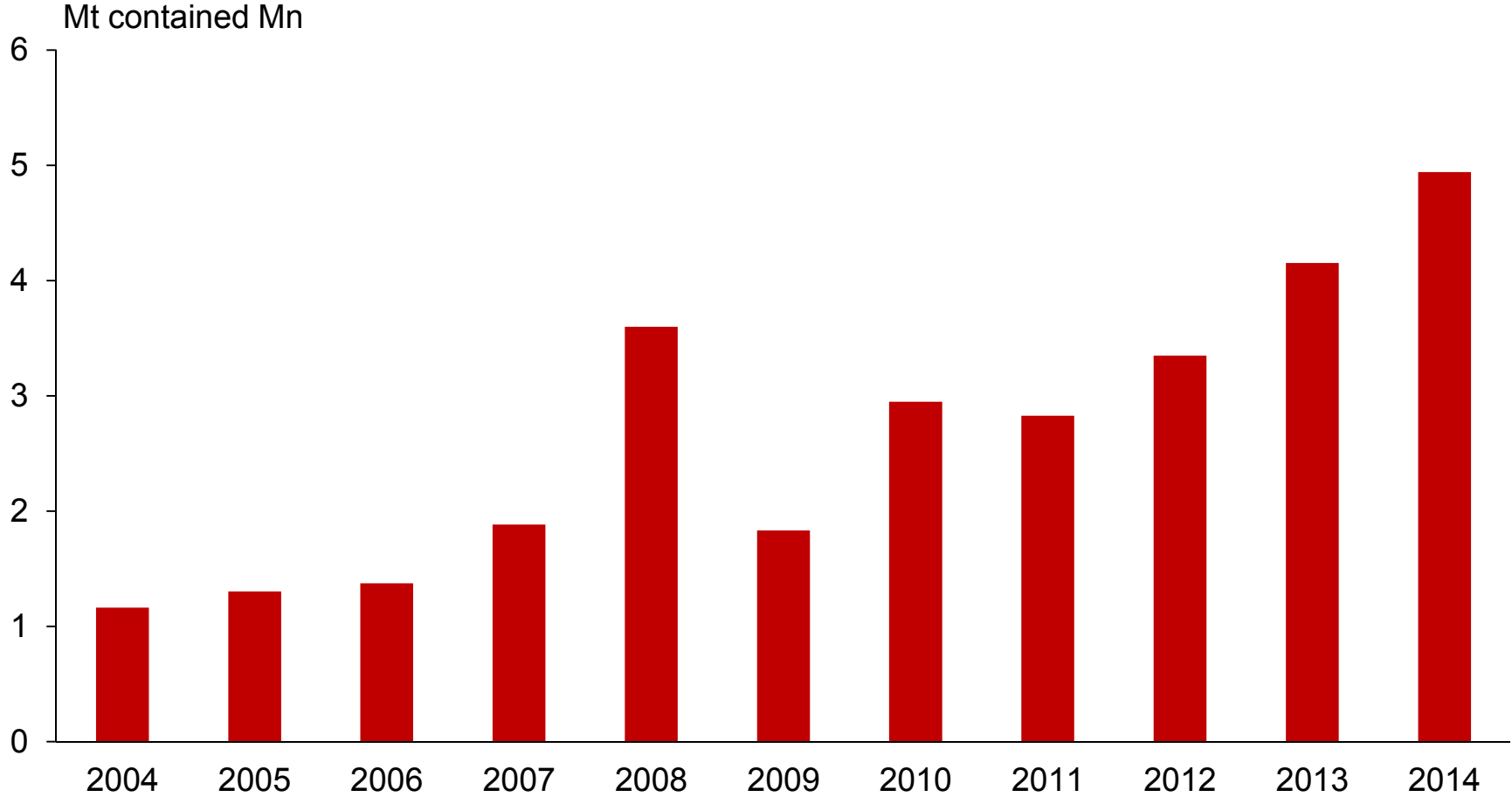
Most Mn ore in South Africa is in the Kalahari basin. New operations are based on lower grade semi-carbonate ore



Mn ore supply from S.Africa is currently constrained by rail and port capacity bottlenecks

- Manganese ore for export from the Kalahari basin is subject to significant logistical bottlenecks in terms of rail and port capacity
- This has led to rationing of rail paths between producers, with increasing pressure from the new mines coming on-stream
- Current plans from Transnet propose expanded rail capacity and port terminal by earliest 2019-20. This has made it challenging for new entrants to ramp up as planned from 2012-15
- Trucking of Mn ore from the Kalahari has risen substantially, but comes with its own constraints in terms of cost, road/truck capacity and environmental/safety pressures. Mn ore also needs dedicated port capacity
- Current low Mn prices reduce business case for infrastructure investment
- More smelting in South Africa extremely difficult due to electricity shortage

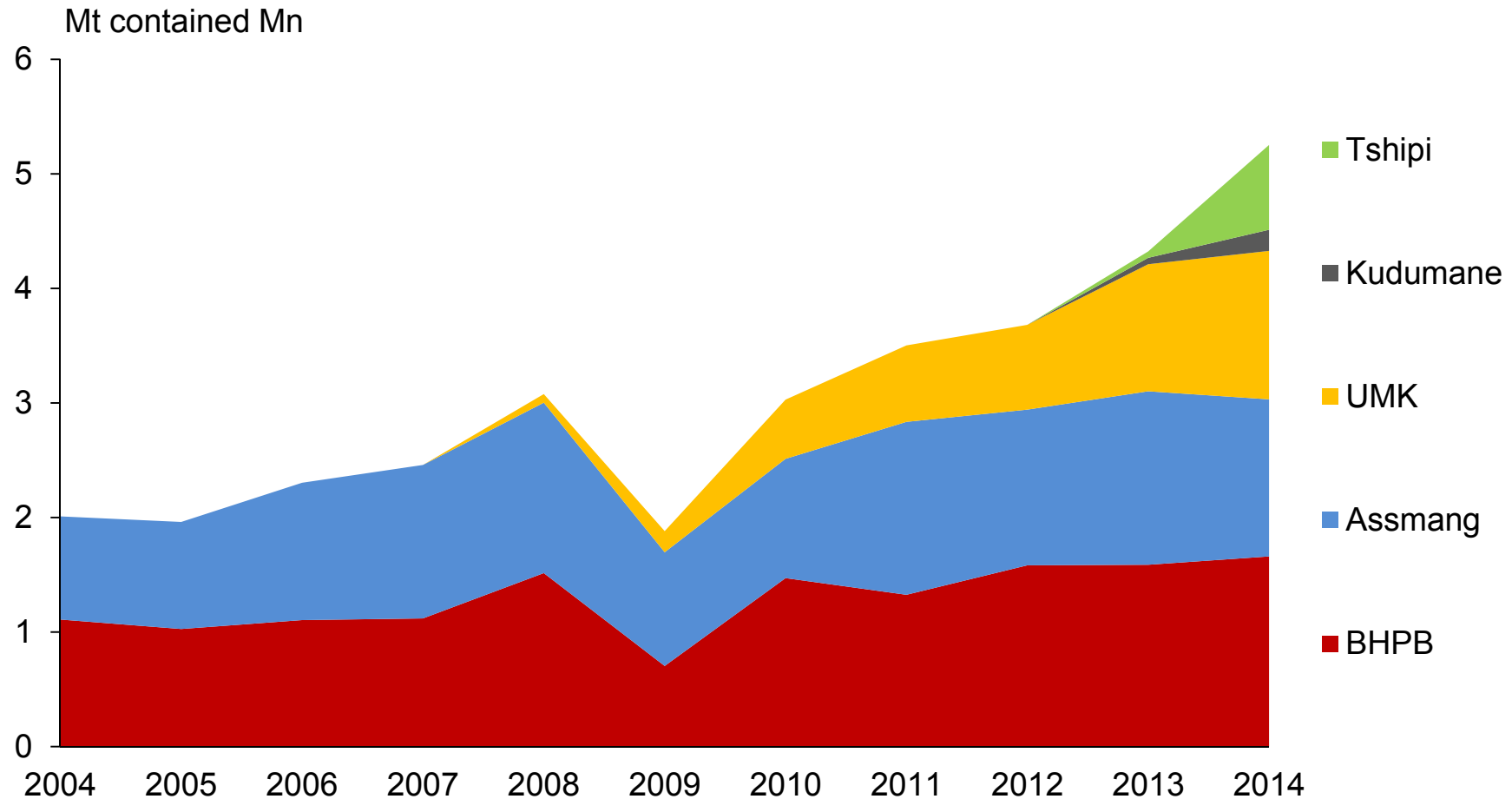
South Africa Mn ore exports – Exports have risen strongly despite infrastructure constraints



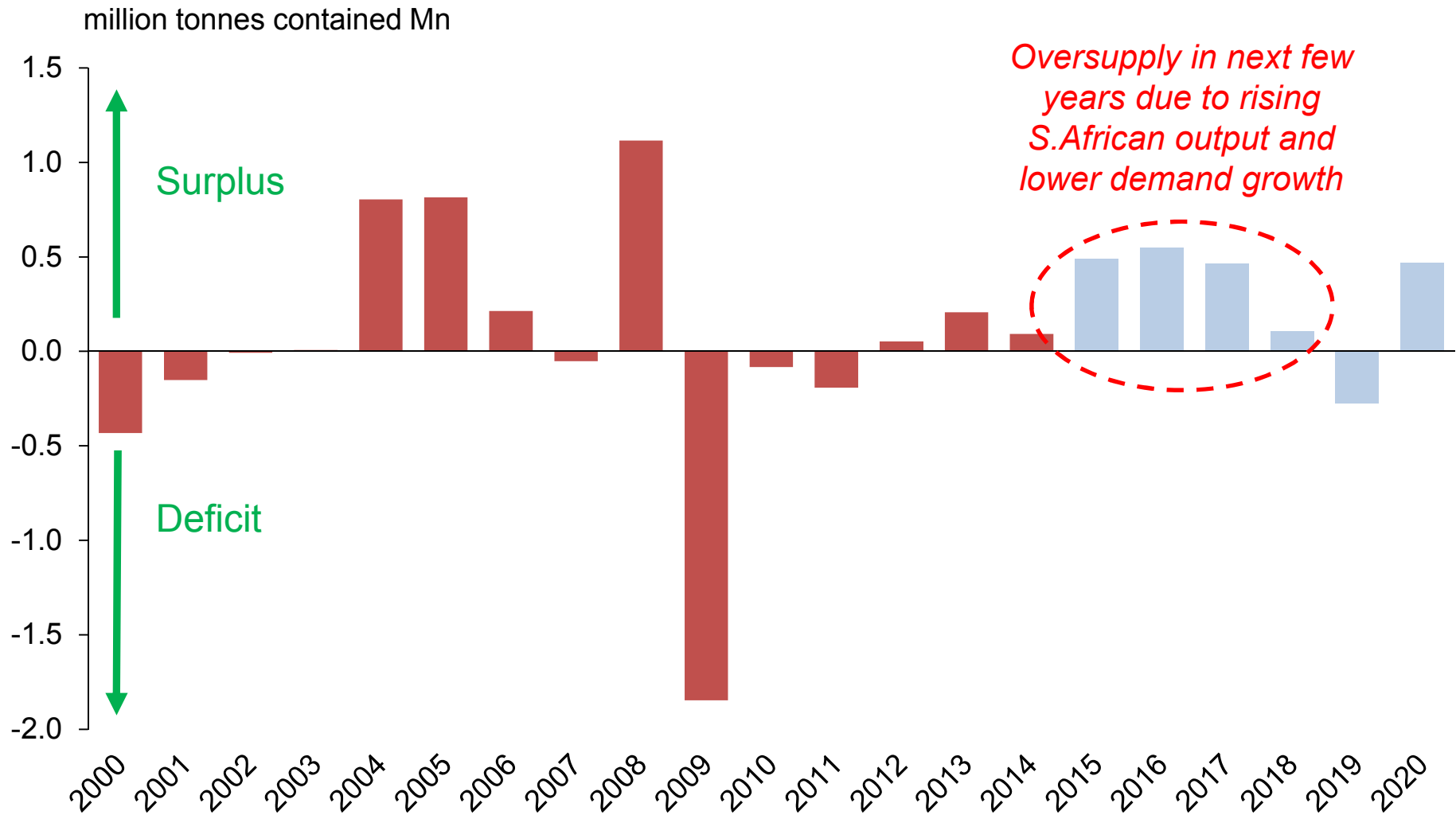
South Africa Mn ore exports – Exports have risen strongly despite infrastructure constraints

- Mn ore exports from South Africa have nearly doubled since 2011
- 2014 export volume (12Mt gross wt, 5Mt contained Mn) was considered by most to be impossible under current infrastructure constraints
- New producers have found creative ways to get new production to market
 - Low iron ore prices have opened up rail paths from Kalhari to Saldanha
 - Incumbent producers have lost some rail paths to new producers
 - Lower oil prices and weaker rand have reduced trucking costs
 - Some Mn ore exported in containers
- Difficult to see exports rising beyond 2014 levels, impacting further ramp-up of new producers

Estimated South Africa Mn ore production – Sharp increase as a result of new producers coming on-stream



Mn ore – actual & forecast market balance – Oversupply likely to persist for several years

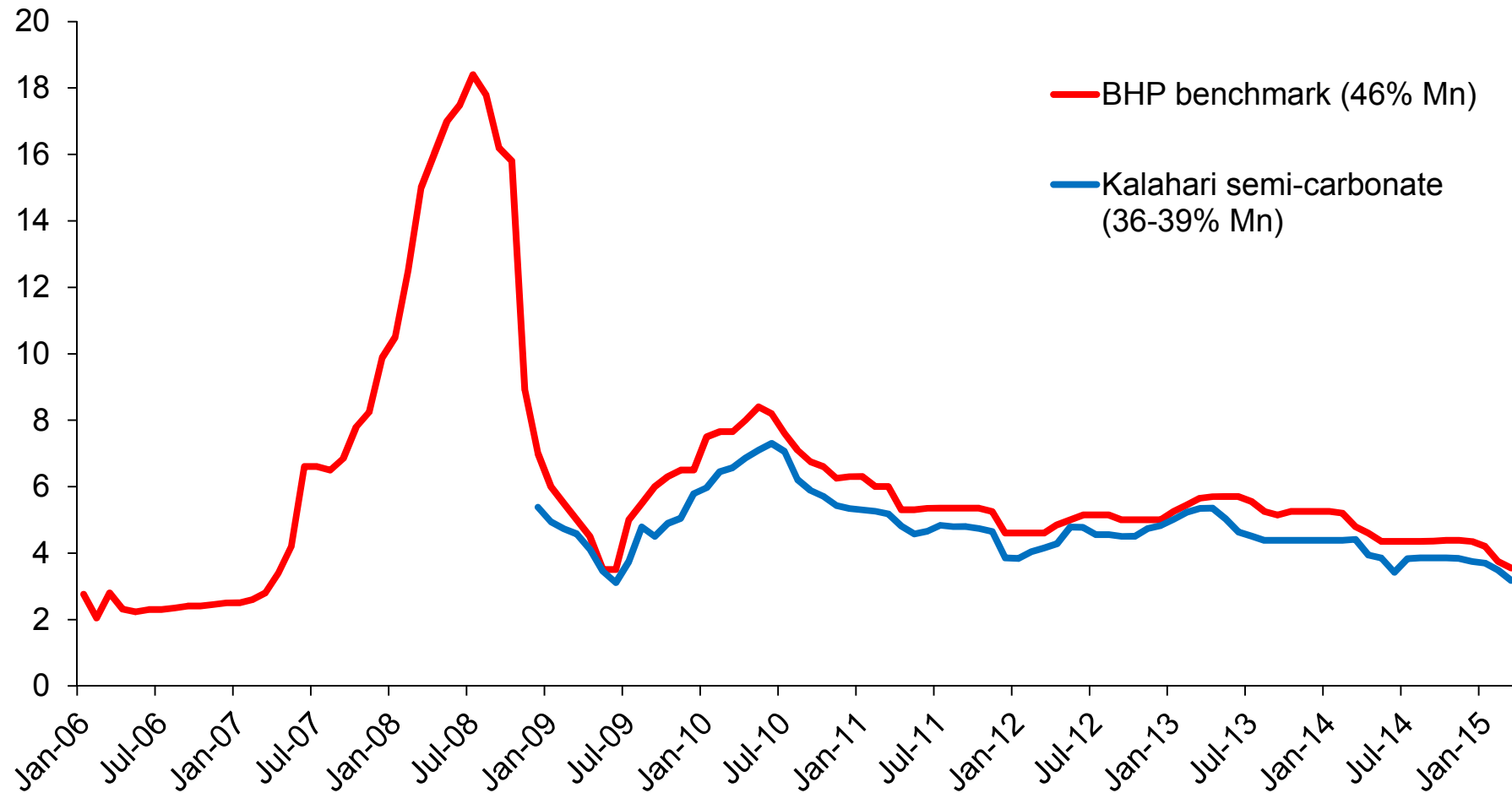


Major new Mn ore capacity – Vast majority of new output to come from South Africa

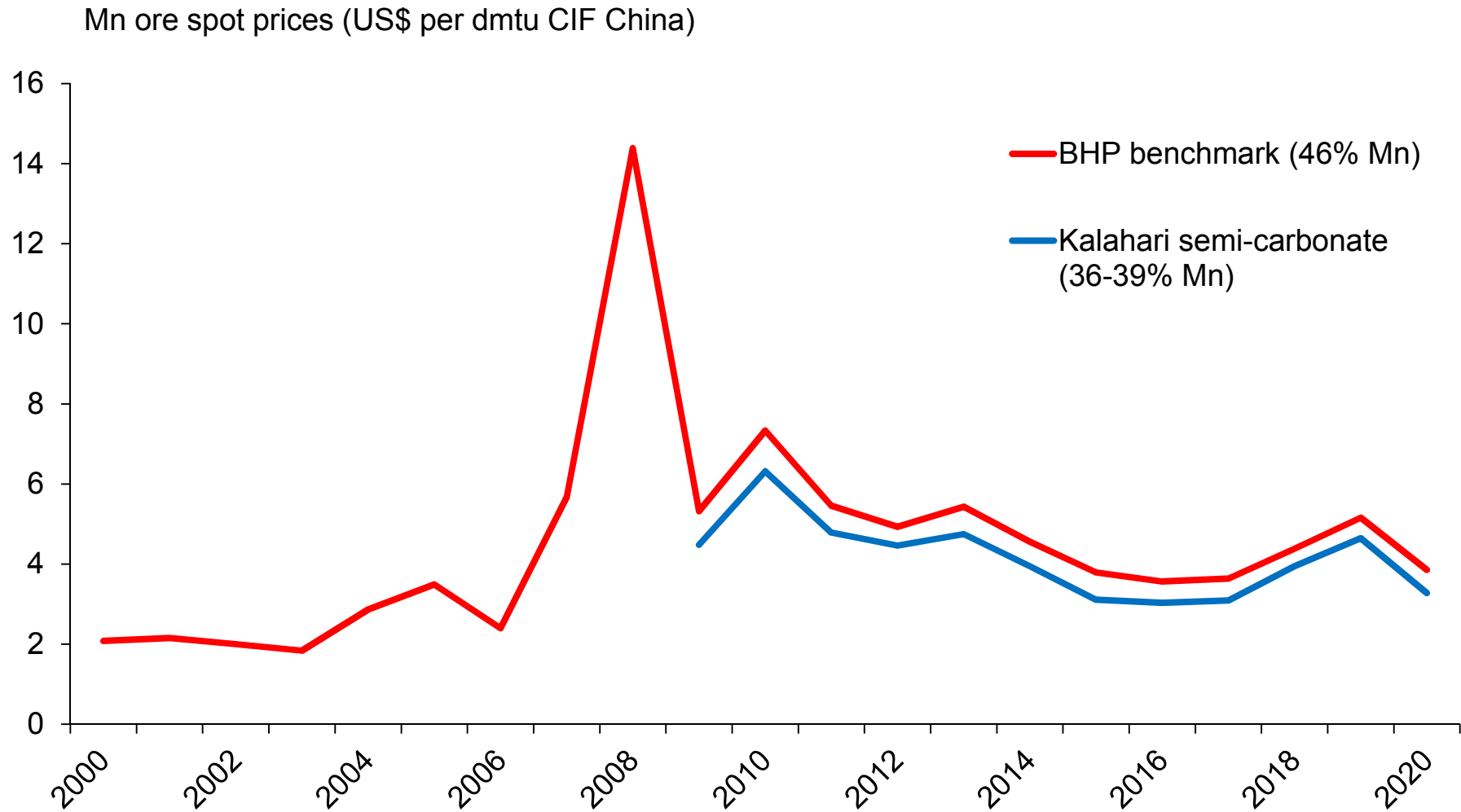
Country	Company	Capacity (ktpy cont. Mn)	Start-up	Production 2014 (ktpy cont. Mn)
S.Africa	Tsipi	900	2013	700
S.Africa	Kudumane	900	2013	200
S.Africa	Kalagadi	1,100	2015	0*
S.Africa	Total	2,900		900
Gabon	CITIC	250	2012	100
Burkina Faso	Tambao	170	2017?	0
Togo	Ferrex	100	2016	0
Indonesia	Gulf Ferroalloys	80	2018	0
Russia	Chek-su	70	2014	10
Rest of world	Total	670		110

Historical Mn ore prices (monthly)

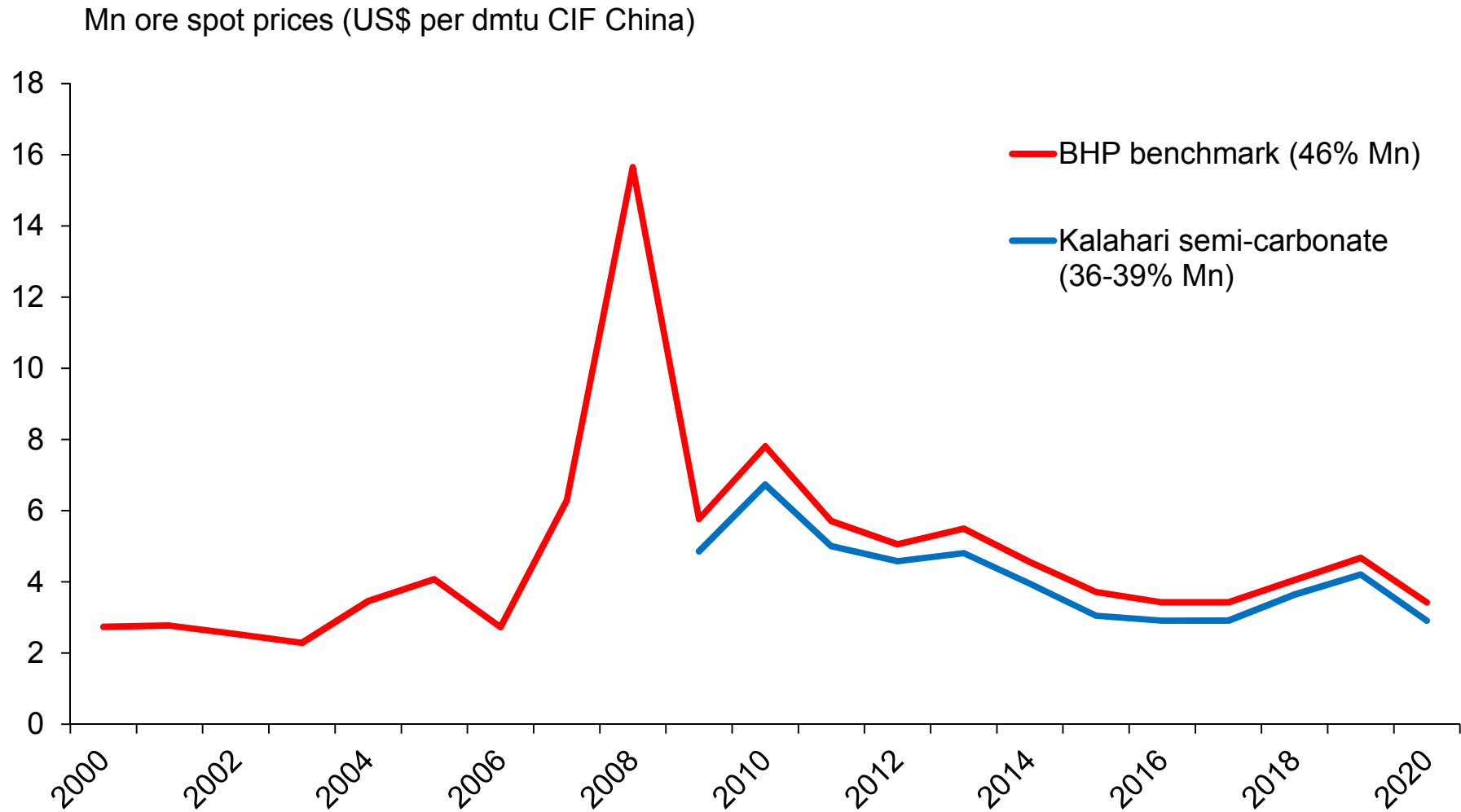
Mn ore spot prices (US\$ per dmtu CIF China, nominal)



Historical & forecast HC FeMn prices (nominal, annual average)



Historical & forecast Mn ore prices (real 2014\$, annual average)



Notes on manganese pricing mechanism (1)

- Up until a decade ago, Mn ore was typically sold on an annual contract basis (very similar to iron ore)
- The rise of China brought the “Chinese way” of buying on a spot basis into the Mn ore market....though some western customers still buy on annual agreements, spot pricing now totally dominates the Mn ore market (again, very similar to iron ore)
- Two spot price series are regularly published – “BHP benchmark” for high grade, “Kalahari semi-carbonate” for lower grade. Nevertheless the Mn ore market remains very untransparent...unlike steel and iron ore, index pricing for Mn ore has not significantly taken off
- Consequently, BHP Billiton remain a price setter in Mn ore, by virtue of their market leader status and publication of their benchmark prices. BHP Billiton have stated that they would prefer not to be in the position of setting the industry’s benchmark prices

Notes on manganese pricing mechanism (2)

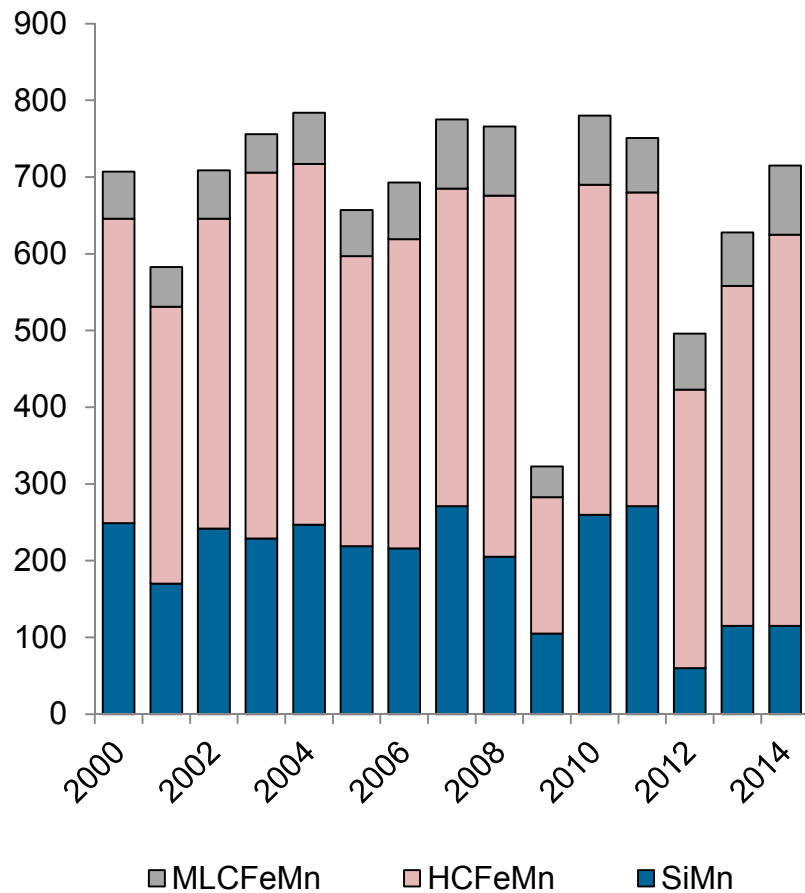
- In most markets, Mn alloy prices have never normally been agreed on an annual contract basis
- Outside China much business is done on quarterly contracts; in China and some other markets, spot prices predominate
- Mn alloy spot prices are published to a significantly greater extent than Mn ore. Numerous industry publications provide a wide array of Mn alloy prices (Metal Bulletin, CRU, Ryan's Notes, Asian Metal, Platts...)
- BHP Billiton does not have a market-leading presence in the Mn alloy markets (unlike Mn ore)
Nevertheless it is an important producer, especially of HC FeMn
- In 2012, BHP Billiton implemented a strategy of selling all its Mn alloys to traders. This has impacted some Mn alloy markets significantly. South32 may well choose to rescind this and sell directly to customers

Summary of BHP Billiton manganese operations

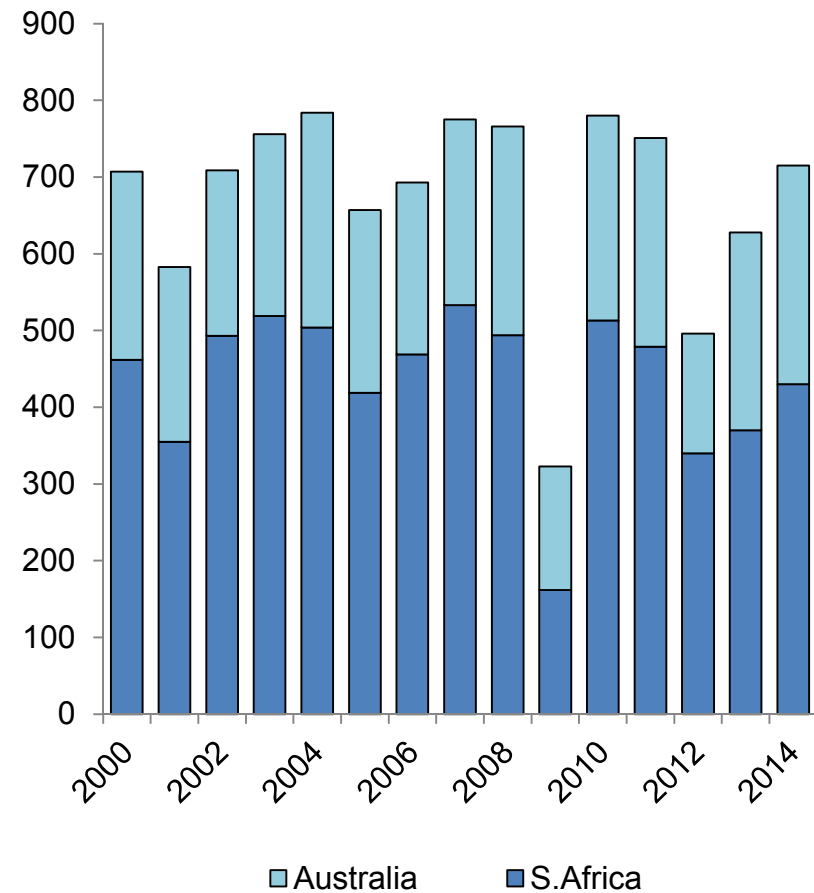
Country	Operation	Product	Capacity
Australia	Gemco	Mn ore (avg 45%)	4.8 Mtpa
S.Africa	Wessels	Mn ore (avg 44%)	1.2 Mtpa
S.Africa	Mamatwan	Mn ore (avg 40%)	3.5 Mtpa
Australia	Temco	SiMn	120ktpa
Australia	Temco	HC FeMn	150ktpa
S.Africa	Meyerton	HC FeMn	350ktpa
S.Africa	Meyerton	MLC FeMn	90ktpa

BHP Billiton manganese alloy production – by product and location

**BHP Billiton Mn alloy output by type
(kt gross weight)**

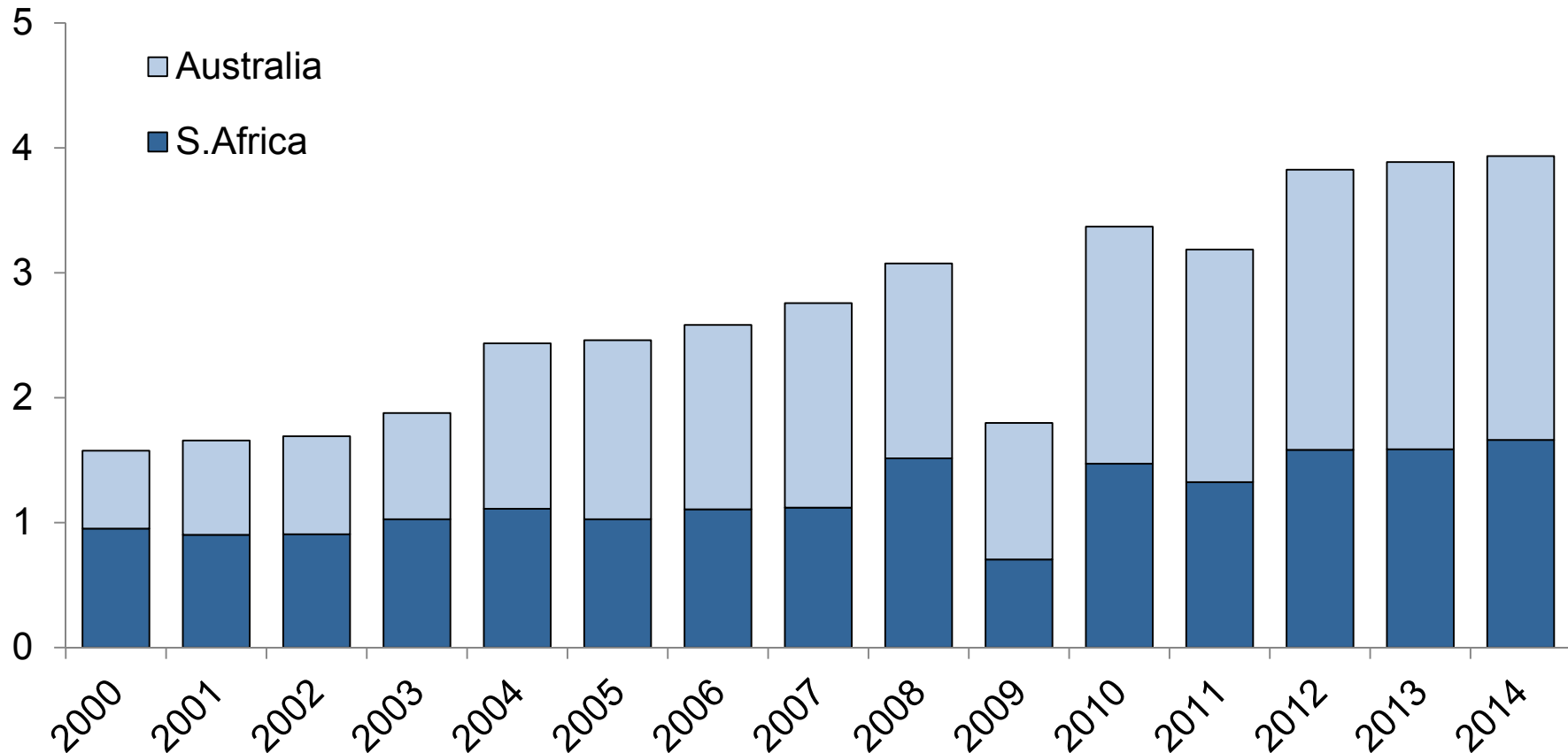


**BHP Billiton Mn alloy output by location
(kt gross weight)**



BHP Billiton Mn ore production – output has increased strongly, in contrast to Mn alloys, but has plateaued since 2012

BHP Billiton Mn ore output (Mt contained Mn)



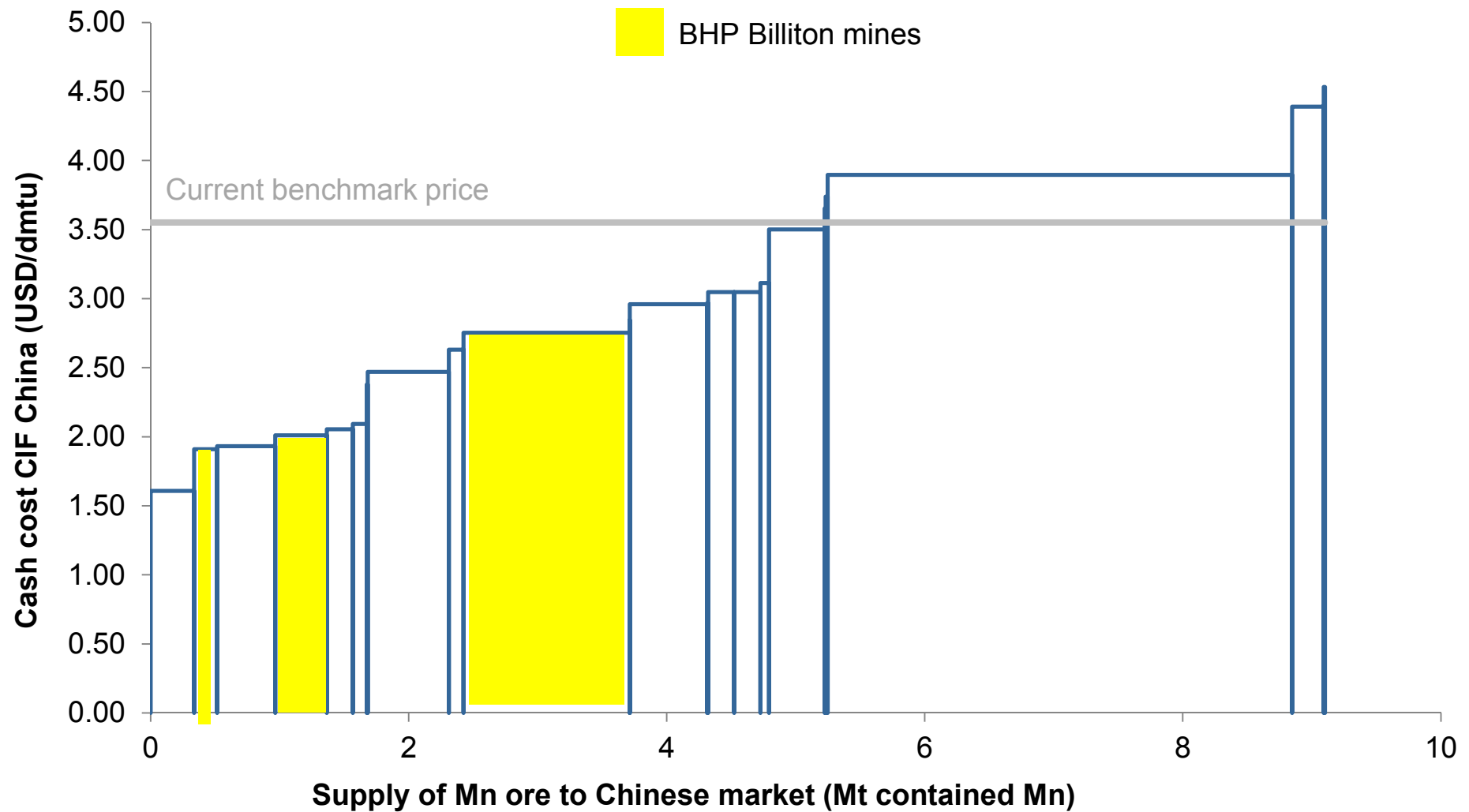
BHP Billiton – manganese business SWOT analysis

Strengths	Weaknesses
<ul style="list-style-type: none"> • World's largest producer of Mn ores and leading producer of Mn alloys • Vertically integrated Mn ore mining and smelting operations • Large resources of medium and high-grade ores, which are mostly low in phosphorous • Low ore and alloy production costs • Location in relation to Chinese market • Financial resources of parent company 	<ul style="list-style-type: none"> • Big exposure to South African challenges (ownership, power prices, infrastructure, new entrants) • Manganese very small percentage of company turnover, & profit; division is not a core business • Poor manganese market outlook for some years • Hard to sell all manganese assets together
Opportunities	Threats
<ul style="list-style-type: none"> • Financial resources available for expansion by acquisition, if appropriate targets can be identified • Dominant position in Mn ore market can be extended/consolidated, and leveraged • Manganese demand will still grow faster than steel output • Growth of India and other emerging economies partly to compensate for slowdown of Chinese growth 	<ul style="list-style-type: none"> • Structural oversupply – manganese ore supply base seems to be fragmenting • Persistently low prices reduce attractiveness of business • Potential loss of rail paths to new South African entrants • Macro risks (esp. exchange rates in South Africa) • Political risk from native land claims in Australia and the black-empowerment movement in South Africa • South African infrastructure constraints

Notes on M&A potential

- The Mn ore market remains quite consolidated, though has de-consolidated recently due to new entrants starting up in South Africa
- Potential for significant further consolidation appears limited at the present time, partly because the assets of the major producers are valued highly and there is a very limited number of potential buyers (this is partly why South32 is being formed – BHP Billiton were unable to sell their manganese assets conventionally)
- Consolidation of the new producers in South Africa would be complicated by political and Black Empowerment / ownership factors
- The Mn alloy industry is very fragmented, mostly because of the industry being dominated by hundreds of small Chinese producers. There seems little prospect of major consolidation in China, partly due to low barriers to entry
- Regulatory approval is unlikely to be a big hurdle to some further consolidation in the Mn ore and alloy markets

Mn ore cost curve, 2015 – BHP Billiton mines are in a favourable cost position



Notes on competitive landscape

- There is little prospect of technological change significantly altering the competitive landscape; manganese is unsubstitutable in steel and indeed use of Mn per tonne of steel is rising
- Political matters impacting the manganese market include
 - South Africa – BE laws, infrastructure bottlenecks, power shortages
 - Native land claims at certain mines
 - Toxicity of manganese as a substance, particularly harmful in dust form (linked to various brain diseases)
 - Anti-dumping duties, mostly in Mn alloys
 - Chinese export tax (20%) on Mn alloys

Average Mn grade (%) of major manganese ores – BHP Billiton amongst the higher grade mines

