

CVRD

MINING

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ENERGY

# Manganese Industry: Scenarios for 2025

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*Presented by*

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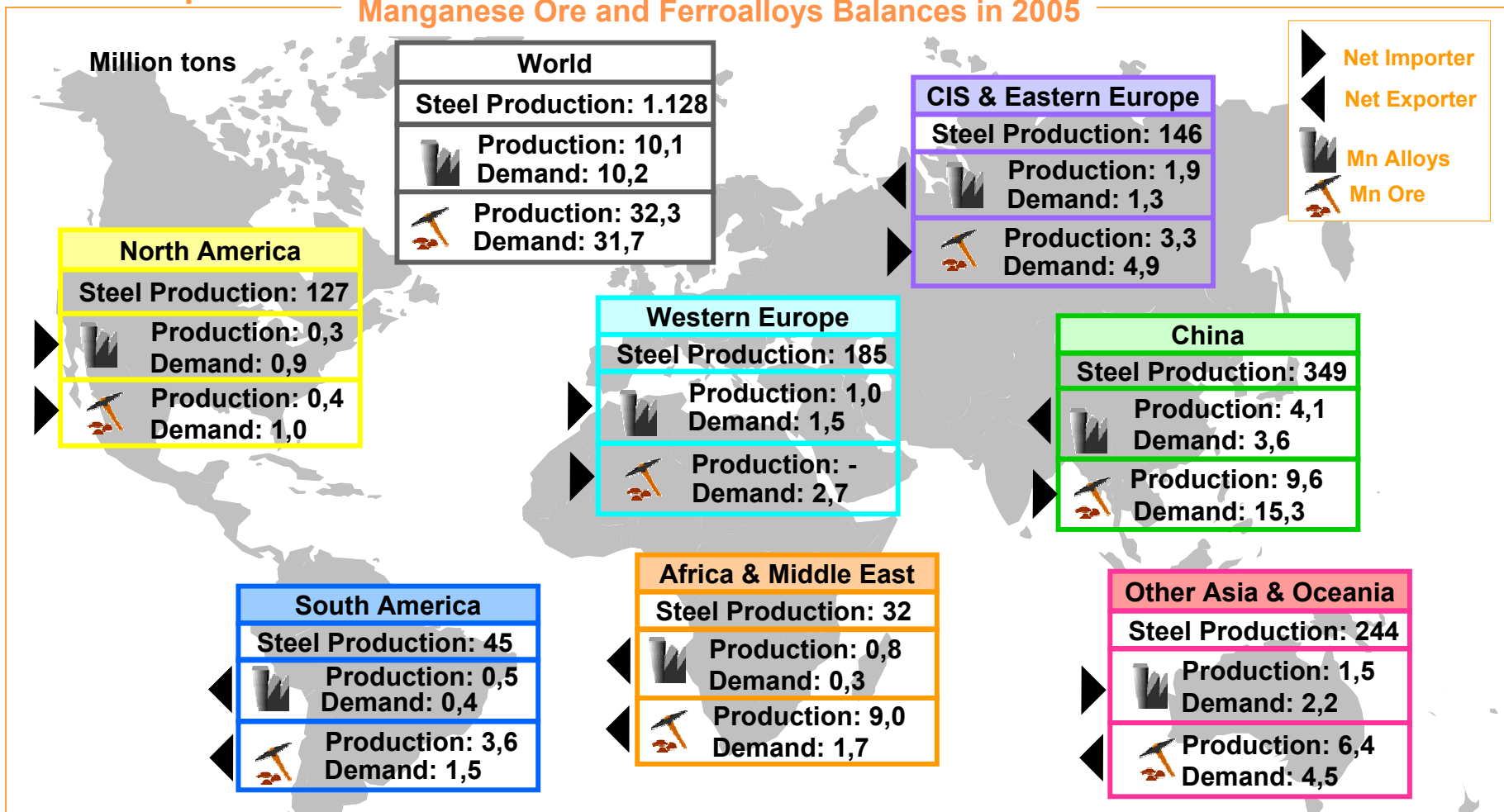
Companhia  
Vale do Rio Doce

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Current manganese balance points out China as the biggest ore importer. South America and Africa are both net exporters of ore and alloys. North America and Europe are net importers.

## Manganese Ore and Ferroalloys Balances in 2005



Sources: IMnI, CRU, CVRD analysys.

Estimates for the medium run indicate that the ferroalloys industry can support the path of demand growth, as proven reserves have indicated a 12 year life expectancy.

## Medium Run Expectations

Supply and Demand

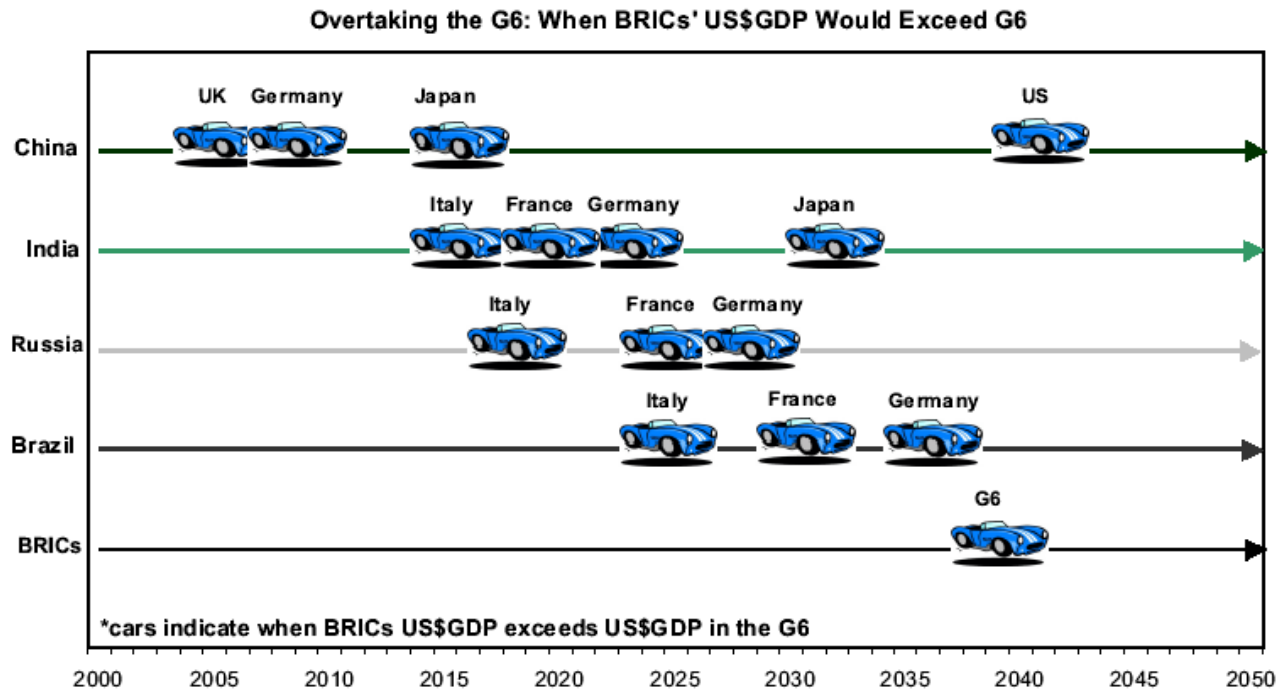
- ✓ The highest growth rates in manganese ferroalloys' markets for the next years are from China and Eastern Europe. ▶
- ✓ South Africa & Ukraine have the largest manganese potential reserves. There should be ore supply for at least 12 years, given today's proved reserves. ▶
- ✓ The manganese industry should be able to expand its capacity by 1 million t of ferroalloys and 2,1 million t of ore until 2010. ▶
- ✓ Manganese ore prices are expected to return to a level between US\$ 2 and 2,5/dmtu FOB South Africa – Japan until 2010. ▶
- ✓ Manganese ferroalloys production costs are expected to reach higher levels than those observed until 2003. ▶

Prices

In the long run, Brazil, Russia, India and China are being pointed out as a group of economies that could become richer than the G6.

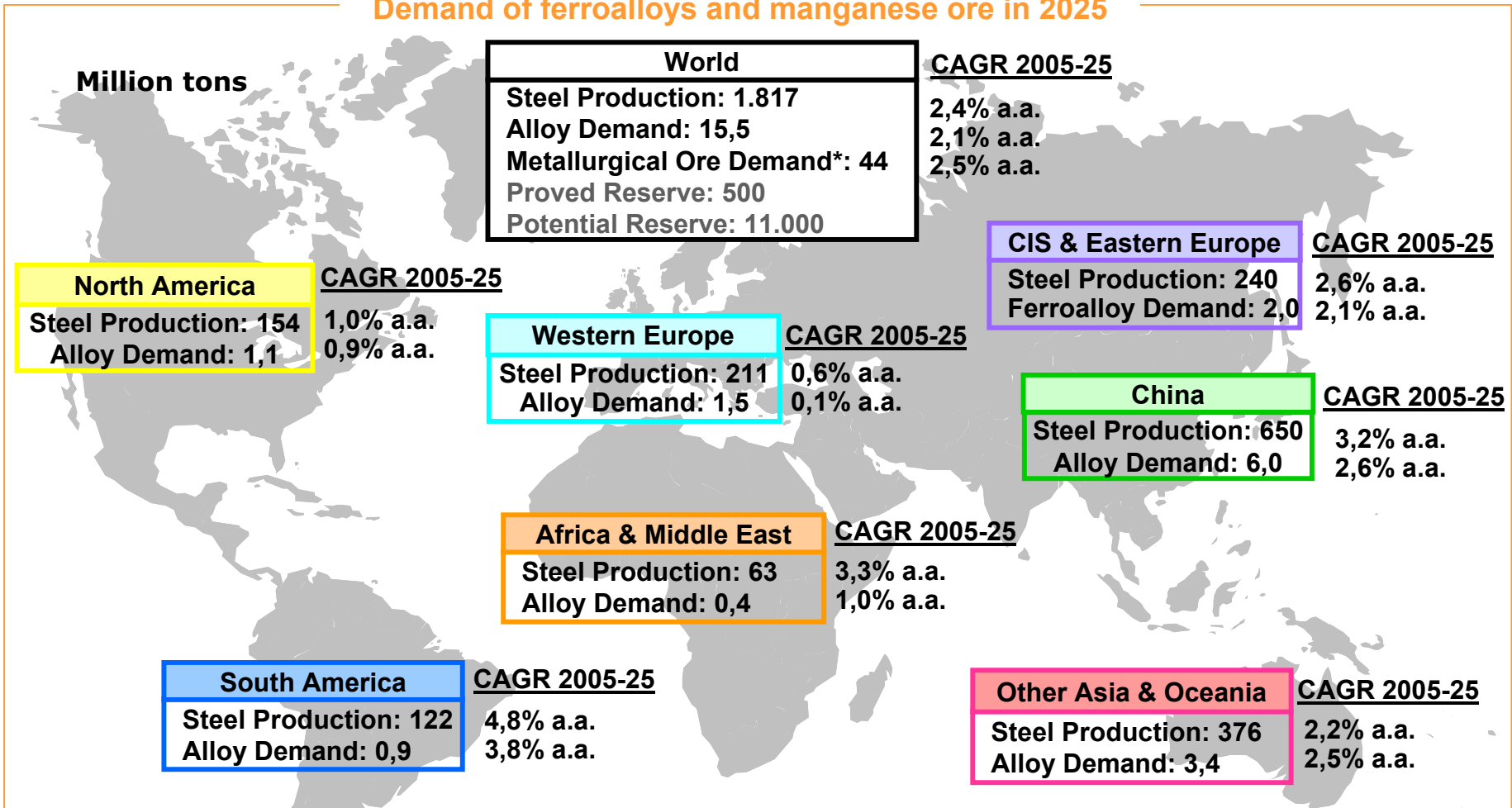
## Long Run Expectations

- ✓ Based on the Goldman Sachs analysis, in less than 40 years, the BRICs economies combined could be larger than the G6 in US dollar terms.
- ✓ By 2025 they could account for over half of the size of the G6. Currently they are worth less than 15%.
- ✓ From the current G6, only US and Japan may be among the six largest economies, in US dollar terms, by 2050.



Based on BRICs' assumptions, ferroalloys demand could reach 15,5 million t in 2025 and ore demand for metallurgical use is expected to reach 44 million t, supported by large reserves.

## Demand of ferroalloys and manganese ore in 2025



\*Considers only the use in manganese alloys.

Source: Goldman Sachs, CRU, announced projects, ISII, CVRD analysis, USGS.



... Nevertheless, future estimates are subject to several uncertainties. China's path, as well as the development of the manganese industry's structure are among those uncertainties to be highlighted.

## Main Uncertainties

### China's Path

- ✓ Condition to maintain status of one of the main world importers
- ✓ Mineral assets acquisitions, mainly in Africa
- ✓ Control over the steel and ferroalloys industries

### Structure of the Manganese Industry: Overseas Ore

- ✓ Entrance barriers to the sector (investments, costs, expertise)
- ✓ Supply and demand balance and pricing
- ✓ Technological development that supports overseas sales of marginal manganese ore
- ✓ Evolution of environmental regulation (control, enforcement & accountability)

Based on those two aspects, scenarios were created in order to design alternative worlds, addressing several variables that influence the manganese industry dynamics.

## Welcome to Shanghai



### 1. Power to the Client

- ✓ Disperse ore supply, without significant participation of the Chinese
- ✓ Market price relatively low
- ✓ Supply of marginal ores is disperse
- ✓ Given the variety of suppliers, China pressures for lower prices
- ✓ Strictness of environmental regulation varies among world regions, reducing entrance barriers
- ✓ Ferroalloys' industry tends not to be concentrated and to seek for more competitive sites in energy and reductants.



### 2. Taming the Dragon

- ✓ Concentrated supply of manganese ore in few players
- ✓ Market price relatively high
- ✓ Supply of marginal ores is also concentrated
- ✓ China keeps dependence on external supply of manganese ore
- ✓ Tight environmental regulation causing entrance barriers
- ✓ Ferroalloy industry tends to concentrate in integrated producers
- ✓ Ferroalloy producers seek for more competitive sites in manganese ore, energy and reductants.



### 3. Chinese Wall

- ✓ Concentration of manganese ore supply by few big players, including Chinese producers
- ✓ Market price in a reasonable level
- ✓ Supply of marginal ores is concentrated, mainly in Chinese players
- ✓ China reduces significantly its dependence on external supply of manganese ore
- ✓ Medium strictness environmental regulation - barriers to entry
- ✓ Chinese players acquire assets abroad, taking advantages of its economic power
- ✓ Ferroalloys' industry tends to be concentrated in integrated producers. Despite control policies taken by the Chinese government, China expands production due to local availability of reductants.



## These scenarios raise questions ...

- ✓ There are enough reserves of manganese ore for the industry's sustainability. But, will there be enough capacity?
- ✓ Will there be enough structured logistics to transport higher quantities of manganese ore from producers?
- ✓ Will the major reserves of manganese ore have conditions to replace shorter life-time mines?
- ✓ Will technological developments be able to provide marginal ores to supply the overseas market?
- ✓ What could be the impact of technology development on ore prices?

## CVRD Team

### Scenarios' Team:

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The End



Annexes

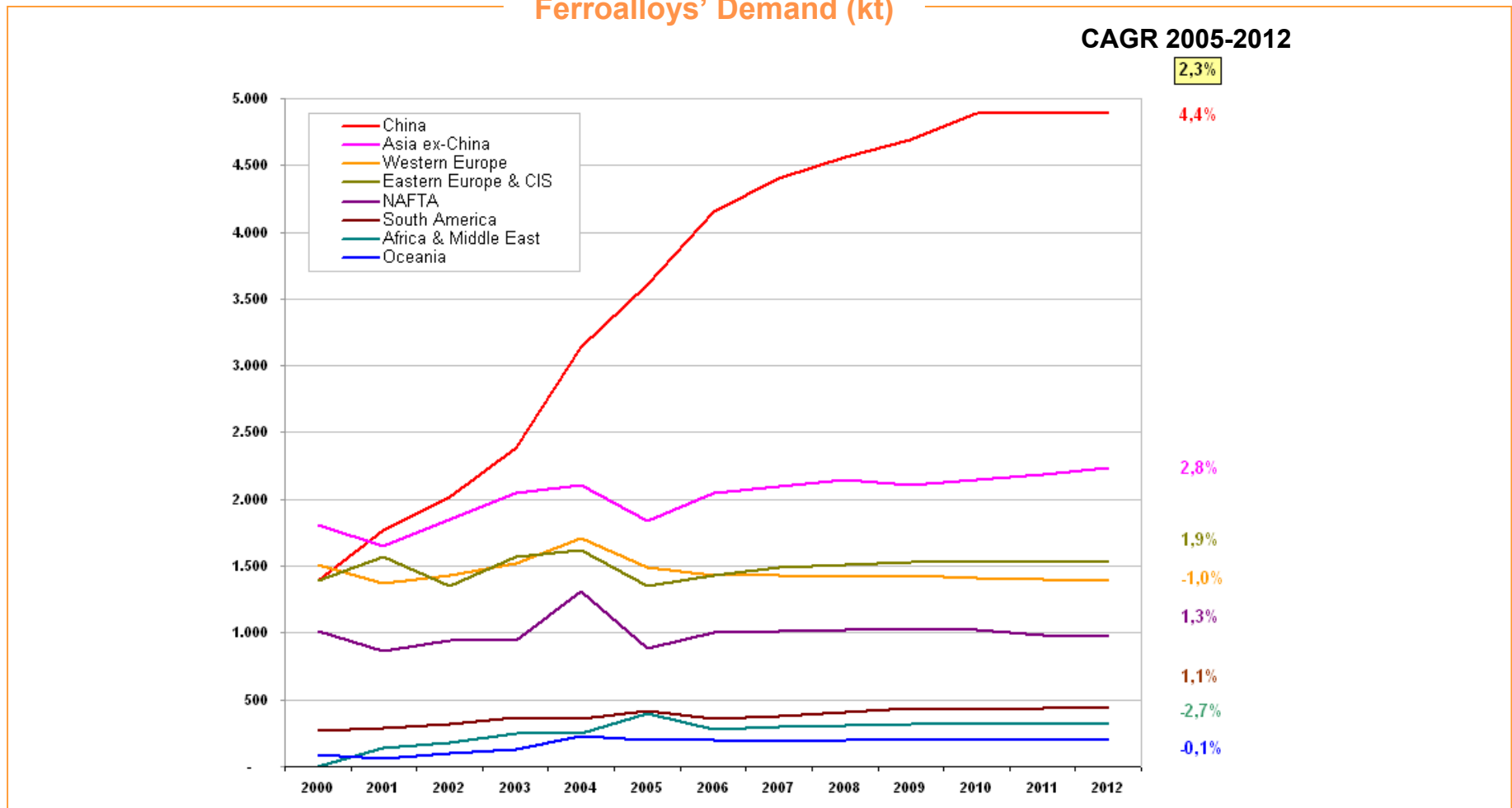
South Africa and Ukraine have the longest life-time manganese potential reserves. There will be ore supply for the next 12 years at least.

Billion t Contained Mn

Ore Grade	Producing Countries	Proved Reserves	Potential Reserves	Annual Production	Years of Proved Reserves	Years of Potential Reserves
HIGH	South Africa	32	4000	2.4	13.3	1,666.7
	Australia	68	130	1.6	42.5	81.3
	Brazil	23	51	1.5	15.3	34.0
	Gabon	20	160	1.6	12.5	100.0
LOW	Ukraine	140	520	0.7	200.0	742.9
	China	40	100	2.4	16.7	41.7
	India	93	160	0.9	103.3	177.8
	Mexico	4	9	0.1	40.0	90.0

**In terms of potential reserves, there will be manganese ore for at least 30 years in any of the producing regions.**

The highest growth rates in manganese ferroalloys' markets for the next years are from China and Eastern Europe.

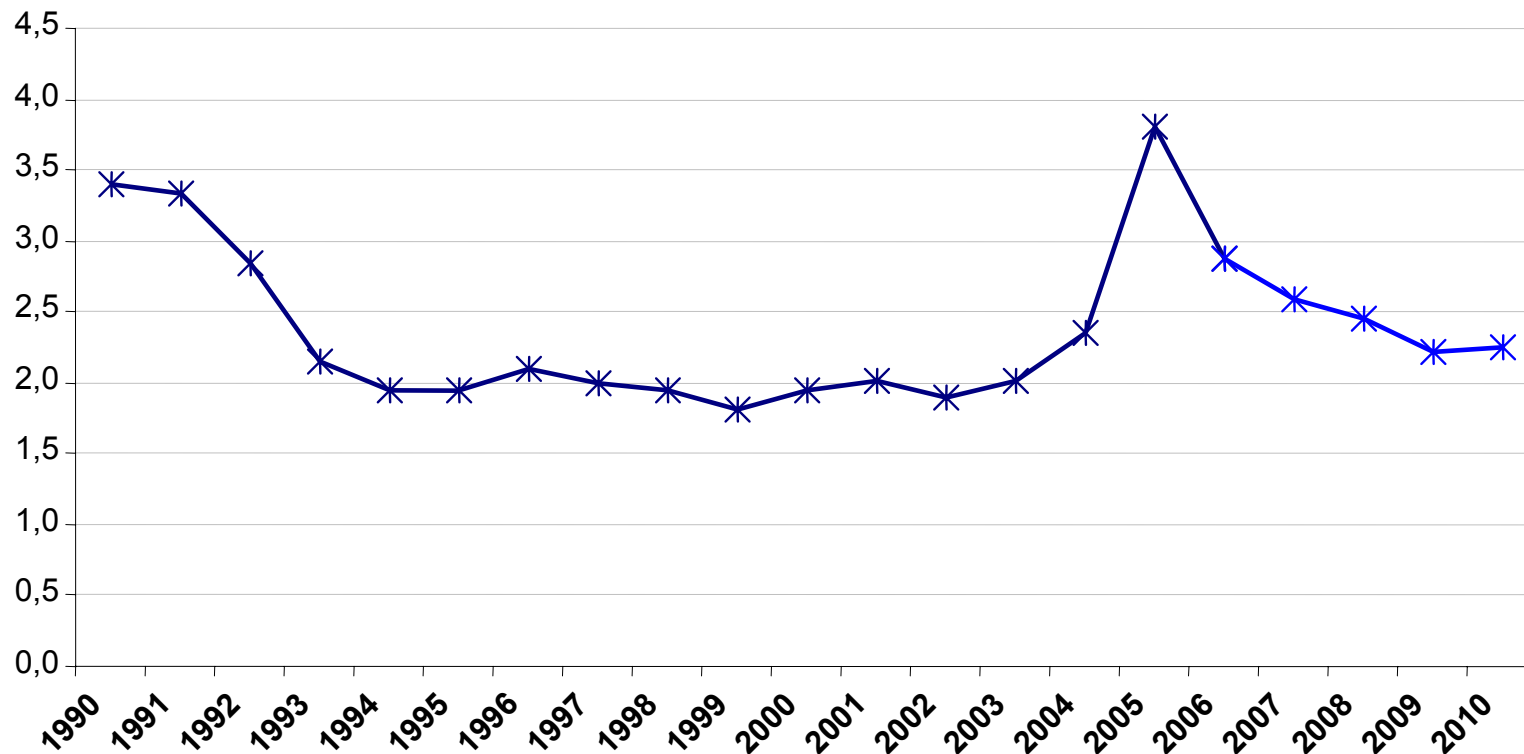


Sources: CVRD, ABRAFE and CRU.



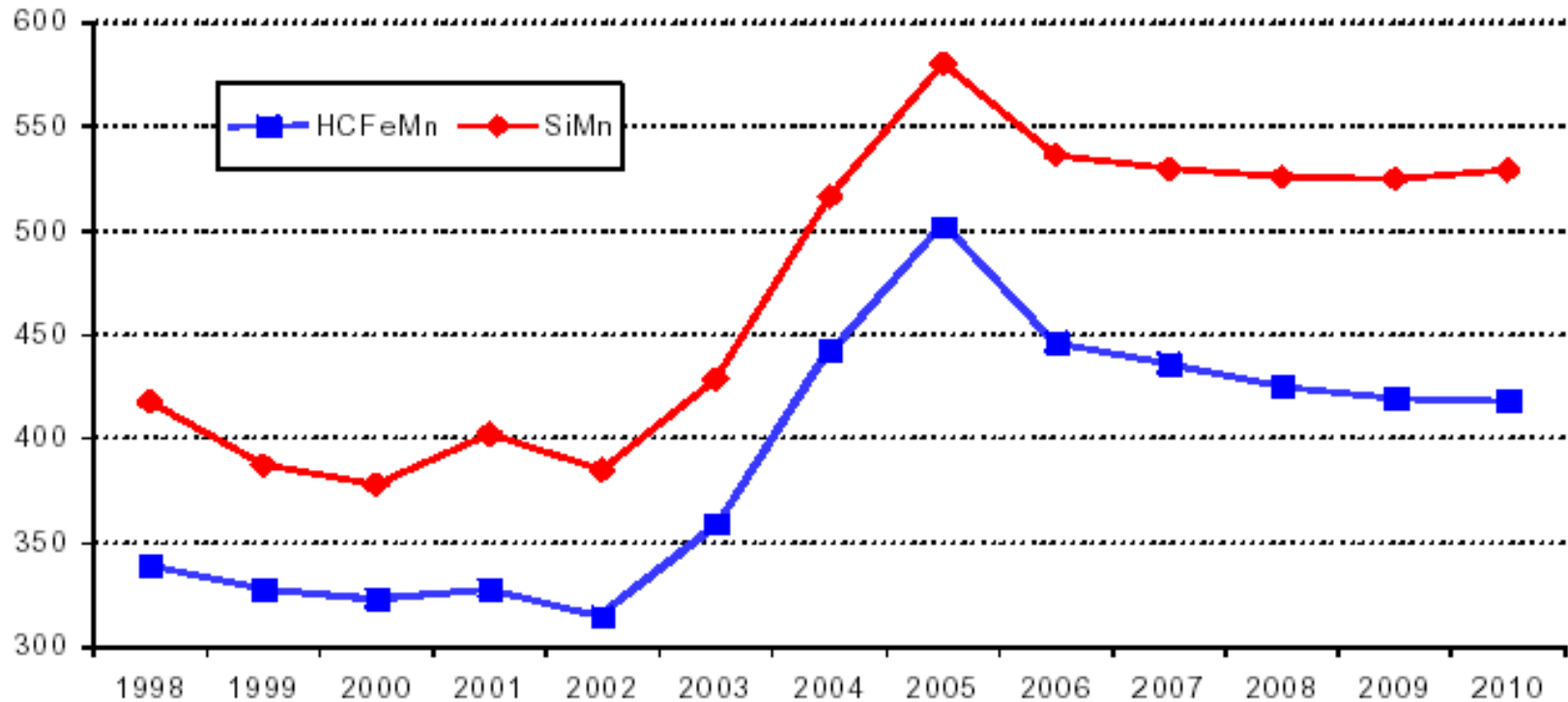
Manganese ore prices are expected to return to a level between US\$ 2 and 2,5/dmtu FOB South Africa – Japan until 2010.

**FOB Price of Manganese Ore from South Africa to Japan (US\$/dmtu)**



Manganese ferroalloys production costs are expected to reach higher levels than those observed until 2003.

**Costs of production of manganese ferroalloys (US\$/t)**



Source: CRU.



The manganese industry will be able to expand its capacity by 1 million t of ferroalloys and 2,1 million t of ore until 2010, considering announced projects.

## • Ferroalloys:

- **CHINA:** Alliance between Nippon Denko and Jinzhou Ferralloy Works SiMn in Liaoning, starting mar/2006 with 35 kt (total capacity of 50 kt), possibly producing HCFeMn.
- **USA:** Privat Bank acquired Highlanders (total production capacity between 110 and 150 kt of SiMn and HCFeMn).
- **SOUTH AFRICA:** JV between Renova and Pitsa Ya Setshaba for manganese ferroalloys, with capacity of 400-500 kt and start-up in 2008 to 2010.
- **BRAZIL:** Buritirama announced new ferroalloys plant project with capacity of 100 kt by the end of 2006.
- **EASTERN EUROPE:** Privat (Zaporozhye) closed 3 FeSi furnaces and might convert them to SiMn.

## • Technology:

- **SOUTH AFRICA:** Alliance of Kumba Resources and Samancor to use “Alloystream” technology to produce manganese ferroalloys. This technology would reduce costs by using fine low grade ores and coal. The construction of a plant of 200 kt using about 500 kt of Samancor’ s fine ores is being studied as well.

## • Mining:

- **GABON:** ERAMET Comilog expansion, in Moanda, to 3 Mkt in 2006 and 3,5 Mkt in 2008.
- **AUSTRALIA:** CML expansion from 785 kt to 1Mkt in 2006;  
Bootu Creek postponed its project from jun/05 to Q1 2006 (capacity of 550-600 kt).
- **BRAZIL:** Buritirama expansion to 1 Mkt/year (additional 300 kt).
- **BRAZIL:** CVRD expansion of additional 500 kt.



## Evolution of BRICs' Economies

✓ China's GDP growth rate falls to 5% in 2020. By the mid-2040s, growth slows to around 3.5%. High investment rates, a large labor force and steady convergence would mean **China becomes the world's largest economy by 2041**.

BRICs Real GDP Growth: 5-Year Period Averages				
%	Brazil	China	India	Russia
2000-2005	2.7	8.0	5.3	5.9
2005-2010	4.2	7.2	6.1	4.8
2010-2015	4.1	5.9	5.9	3.8
2015-2020	3.8	5.0	5.7	3.4
2020-2025	3.7	4.6	5.7	3.4
2025-2030	3.8	4.1	5.9	3.5
2030-2035	3.9	3.9	6.1	3.1
2035-2040	3.8	3.9	6.0	2.6
2040-2045	3.6	3.5	5.6	2.2
2045-2050	3.4	2.9	5.2	1.9

Source: Extracted from Global Economic Paper 99 – Goldman Sachs



## Evolution of BRICs' Economies

✓ **India's GDP outstrips that of Japan by 2032.** India has the potential to raise its US dollar income per capita in 2050 by 35 times in comparison to its current level. Still, India's income per capita will be significantly lower than any of the countries that are here compared.

BRICs Real GDP Growth: 5-Year Period Averages				
%	Brazil	China	India	Russia
2000-2005	2.7	8.0	5.3	5.9
2005-2010	4.2	7.2	6.1	4.8
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Source: Extracted from Global Economic Paper 99 – Goldman Sachs



## Evolution of BRICs' Economies

✓ Russia's growth projections are hampered by a shrinking population. But strong convergence rates work to Russia's benefit, and **by 2050, the country's GDP per capita is by far the highest in the group, and comparable to the G6.** Russia's economy overtakes Italy in 2018, France in 2024, UK in 2027 and Germany in 2028.

BRICs Real GDP Growth: 5-Year Period Averages				
%	Brazil	China	India	Russia
2000-2005	2.7	8.0	5.3	5.9
2005-2010	4.2	7.2	6.1	4.8
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2040-2045	3.6	3.5	5.6	2.2
2045-2050	3.4	2.9	5.2	1.9



## Evolution of BRICs' Economies

✓ *Brazil's GDP growth rate averages 3.6% over the next 50 years. Brazil's economy overtakes Italy by 2025, France by 2031, UK and Germany by 2036.*

BRICs Real GDP Growth: 5-Year Period Averages				
%	Brazil	China	India	Russia
2000-2005	2.7	8.0	5.3	5.9
2005-2010	4.2	7.2	6.1	4.8
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2040-2045	3.6	3.5	5.6	2.2
2045-2050	3.4	2.9	5.2	1.9

Source: Extracted from Global Economic Paper 99 – Goldman Sachs



In case there are a variety of manganese ore suppliers, China will have more power in price negotiations.

Power to the Client



## Ore supply

- ✓ Disperse manganese ore supply, with mild participation of Chinese producers, increases annual production, depressing market price and increasing its volatility.
- ✓ Despite control policies on steel and ferroalloys production, China keeps dependence on external raw materials supply to meet its economical growth. However, given the variety of ore suppliers, Chinese customers pressure for lower prices.

## Environmental regulation

- ✓ Environmental regulation varies around the world, reducing entrance barriers for new players in mining sector, increasing overall supply.

## Ferroalloys' industry

- ✓ A more dispersed ferroalloys' industry is expected to be the output of relatively low ore prices.

## Location

- ✓ Integrated players locate their alloys' plants close to ore mines and potential energy matrix regions. Although, non-integrated players, given the restrictions to mineral and coal assets, locate close to major markets in Asia and Eastern Europe.

This scenario considers that Chinese bargain power is little, given that China depends on a small group of manganese ore suppliers.

Taming  
the  
Dragon



## Ore supply

- ✓ High grade manganese ore supply concentrated in few major players. Market prices increase up to the limit that would make low quality ores' trade feasible.
- ✓ Despite the control policies on steel and ferroalloys production, China consolidates its position as the major world importer, depending on external raw materials supply to meet its economical growth.

## Environmental regulation

- ✓ Environmental regulation is strict, contributing to the maintenance of entrance barriers for new players in mining sector.

## Ferroalloys' industry

- ✓ A more integrated ferroalloys' industry is expected to be the output of higher ore prices in a concentrated mineral sector.

## Location

- ✓ Integrated players locate their alloys' plants close to ore mines and potential energy matrix regions, maintaining competitiveness and entrance barriers. China, Africa and Australia will probably nest new alloys' expansions.

In a concentrated ore industry, in which China is among the biggest international producers, Chinese market become smaller to non-Chinese producers.

Chinese Wall



## Ore supply

- ✓ High grade manganese ore supply concentrated in few major players, including some Chinese producers. Chinese market pushes down local prices, influencing overseas market.
- ✓ China significantly reduces its dependence on external ore supply, as local players acquire manganese ore assets abroad, mainly in Africa.

## Environmental regulation

- ✓ Environmental regulation is strict, contributing to the maintenance of entrance barriers for new players in mining sector.

## Ferroalloys' industry

- ✓ A more integrated ferroalloys' industry is expected to be the output of higher ore prices in a concentrated mineral sector.

## Location

- ✓ Ferroalloy production capacities tends to be located close to ore mines and regions with high power potentials, such as China, Africa and Australia.