



# *Steel Raw Materials: Ferroalloys*

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**International Copper Study Group**

**International Lead & Zinc Study Group**

**OECD Workshop on Steel and Related Raw Materials**

**Kuala Lumpur, Malaysia**

**15-16 December 2008**



# Presentation Overview

- **The Study Groups**
- **Steel and Stainless Steel**
- **Chromium**
- **Nickel**
- **Molybdenum**
- **Manganese**
- **Further issues**



# The Study Groups

Three independent intergovernmental organisations set up initially by the **United Nations**:

## **International Lead and Zinc Study Group (1959)**

➤ 30 member countries

## **International Nickel Study Group (1990)**

➤ 15 member countries

## **International Copper Study Group (1992)**

➤ 21 member countries



# The Study Groups

- a forum for discussion -

- **Markets:** forecasts of supply and demand for metals a year ahead
- **Trade:** monitoring of international trade in metals
- **Environmental policy:** sharing information on approaches to regulation
- **Industry Advisory Panel:** metals industry executives provide input to member governments
- **Study Group Sessions:** up to 200 participants at ILZSG (the largest)
- **Successful Joint Seminar with China Non-Ferrous Metals Industry (CNIA) on Metals in China** held in Lisbon in October 2008



# The Study Groups

- data provision-

- **Monthly Bulletins** of Statistics on Copper, Lead & Zinc and Nickel
- Biannual/annual **reporting** on mine, smelter and refinery start-ups, closures, expansions and planned development
- Reporting on **smelting and refining capacity** and other plant details
- Publication of data on **principal end uses** of metals
- Studies on trends in **downstream metals sectors**
- **Interactive data** on lead and zinc accessible through the internet
- **Historical data** series available on request
- Monthly **press releases** distributed widely



# The Study Groups

- sharing policy approaches -

- Discussion about national regulatory measures and market-based incentives
- Reporting by member countries on environmental approaches in their jurisdictions in relation, and discussion on multilateral **environmental policy**
- Forum to promote sustainable use of metals
- Work to develop **stewardship of metals** through the life cycle from mine to metal to recycling for re-use
- Work to determine the life cycle of products, the efficiency of recycling activity and End-of-Life Recycling Efficiency Rate (RER)



# The Study Groups

## - Meetings -

- All industry representatives from member countries are welcome to participate in Study Group Sessions
- Industry or government delegates from non-member countries can request participation in Study Group Meetings
- The Study Groups are unique forums where mining ministries can meet their global counterparts and the international metals industry
- Next Study Groups Meetings:
  - ICSG 20 and 21 April 2009
  - ILZSG 22 April 2009
  - Joint Seminar 22 April 2009
  - INSG 23 and 24 April 2009



# *Steel Alloys*



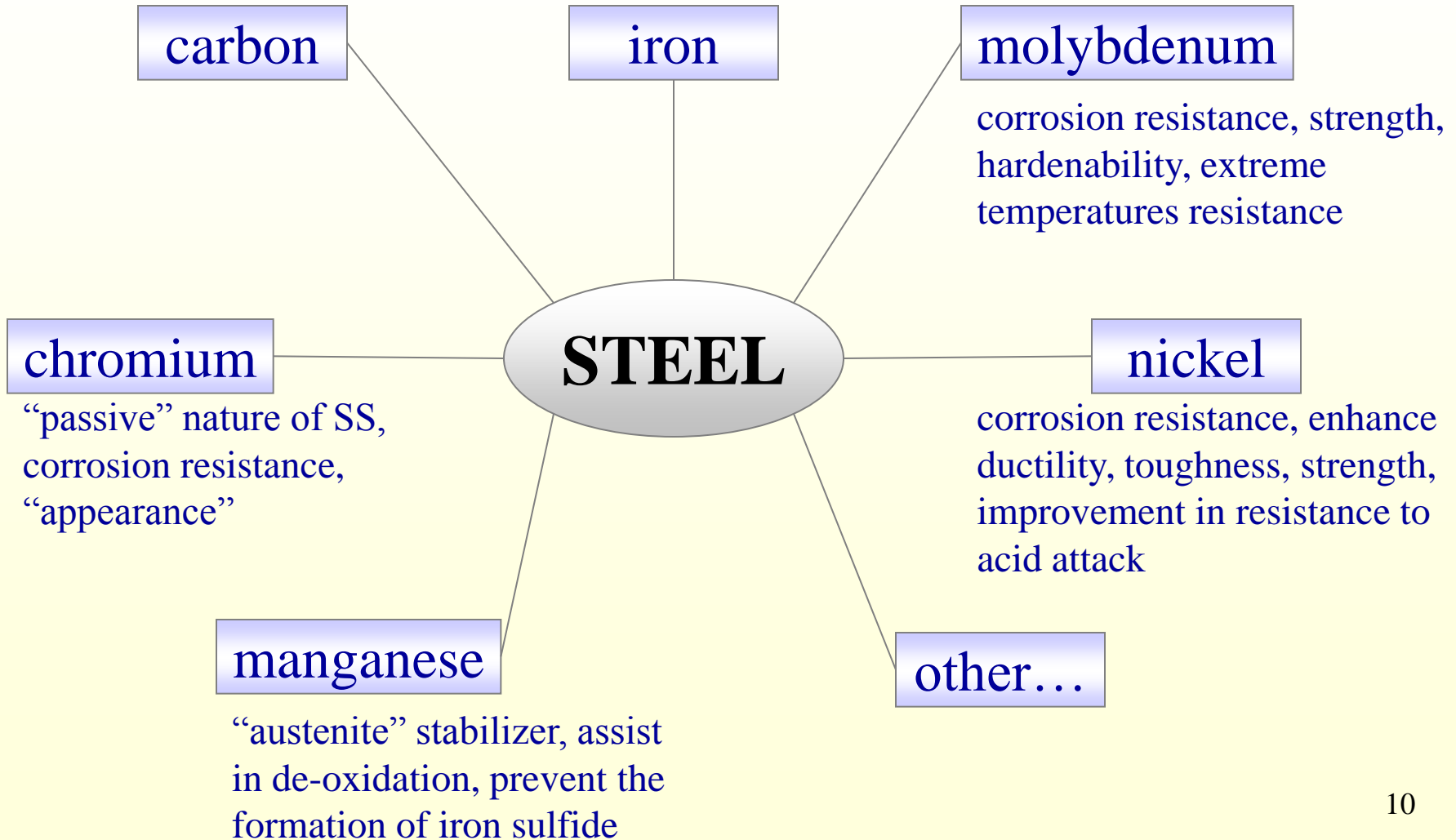


# Steel and alloying elements

- **Steel** is an **alloy** consisting mostly of **iron**, with a **carbon** content (less than 2%)
- other alloying elements are used such as **chromium, nickel, molybdenum, manganese, vanadium, tungsten, silicon, cobalt, ...**
- ... more than 3,500 different grades of steel with many different physical, chemical, and environmental properties



# Steel and alloying elements

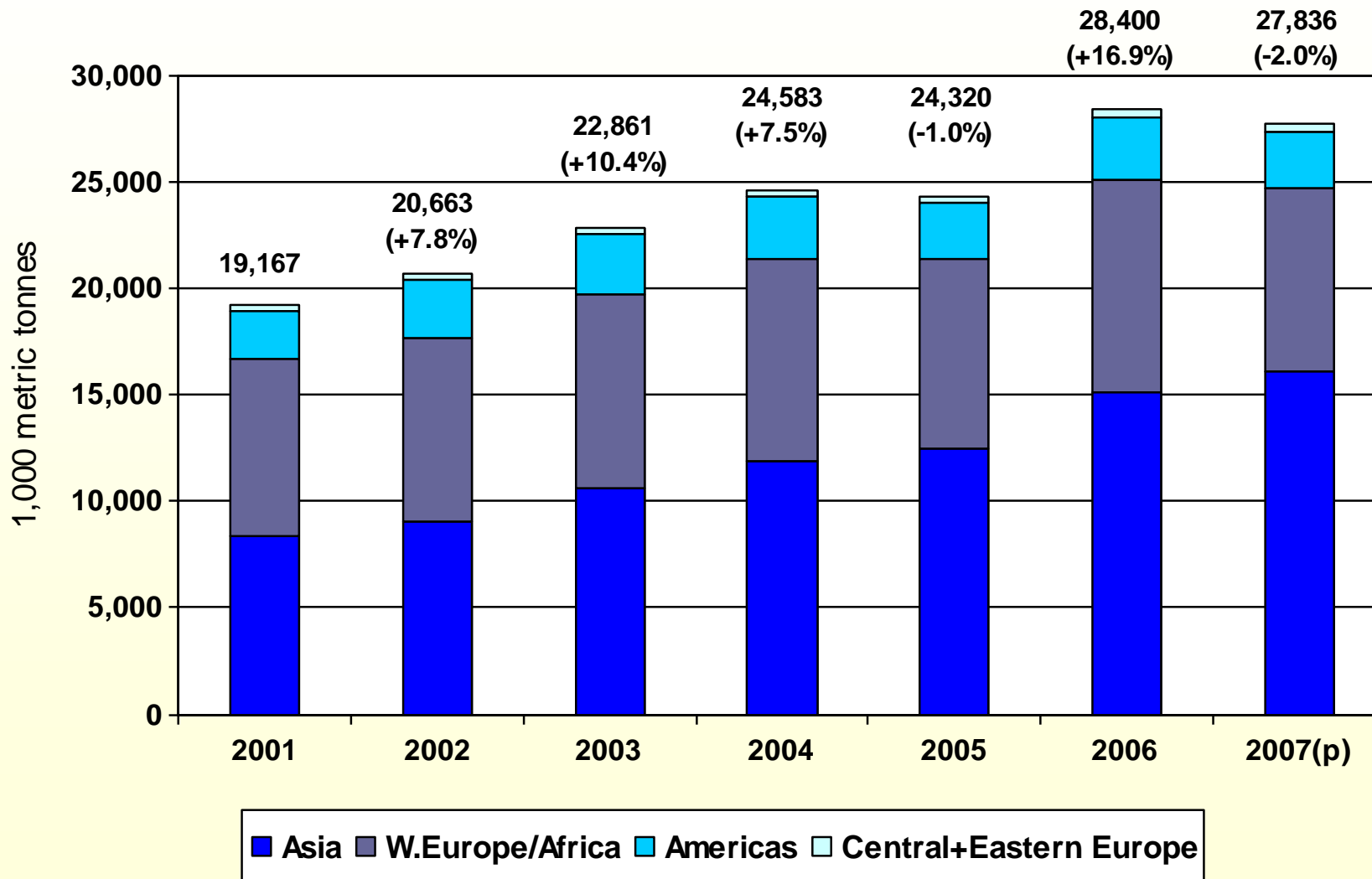




# *Stainless Steel*

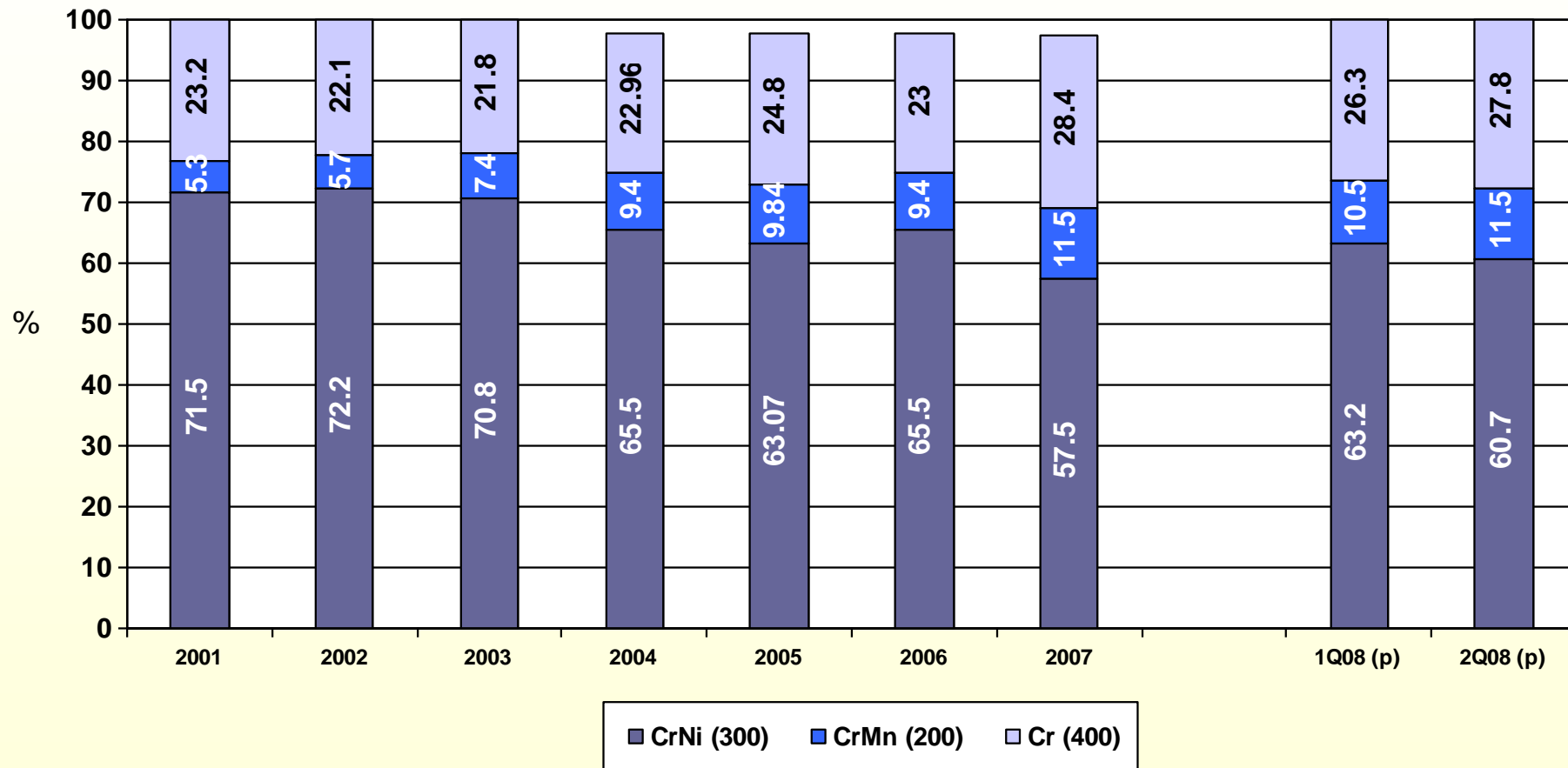


# World Stainless Crude Steel Production





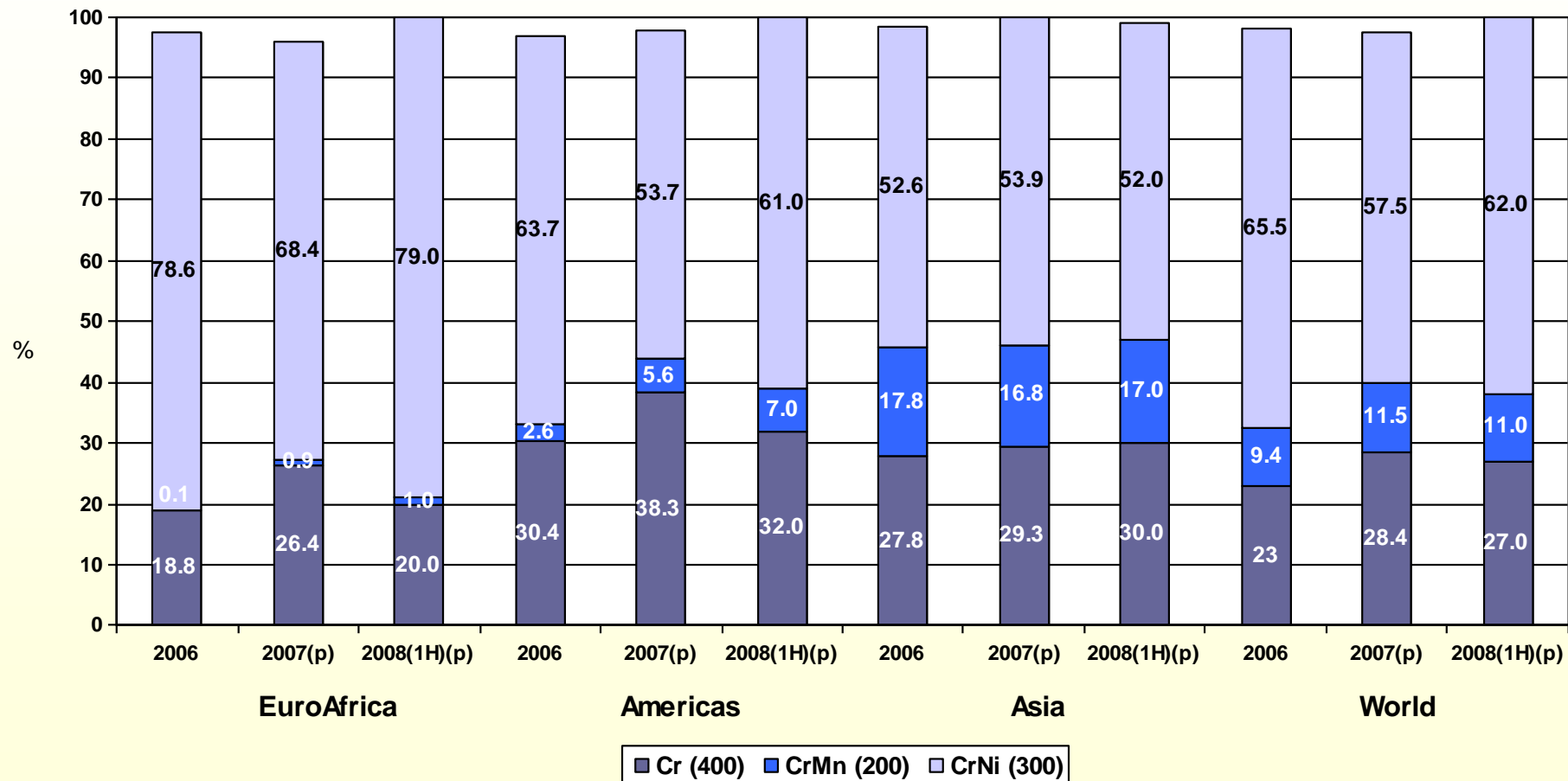
# Stainless Steel by Categories





# Stainless Crude Steel

## - World Production by grades -





# Stainless Steel Market

## - Observations -

- Stainless steel production was expected to recover in 2008:
  - Original forecast 2008 (ISSF): 29.3 million tons = + 5.3%
- SS Production Jan-Sep 2008:
  - ~21.3 million tons = +- 0%
- Sharp production cuts in 4Q2008, especially in China, so 2008 will be lower than 2007
- Currently it is not possible to verify how substantial the production cuts are.



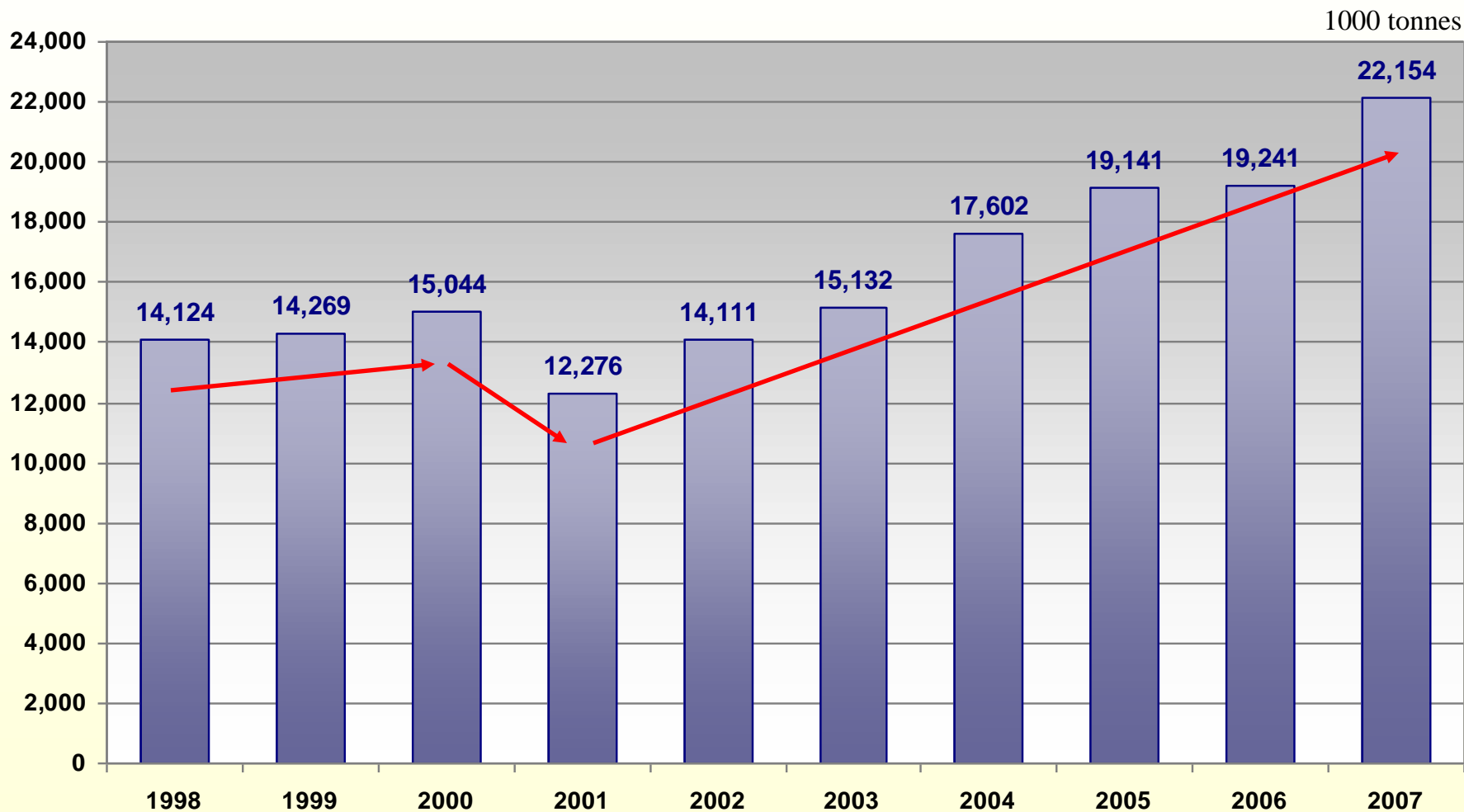
# *Chromium*





# Chromite Ore and Concentrates

- World Production -

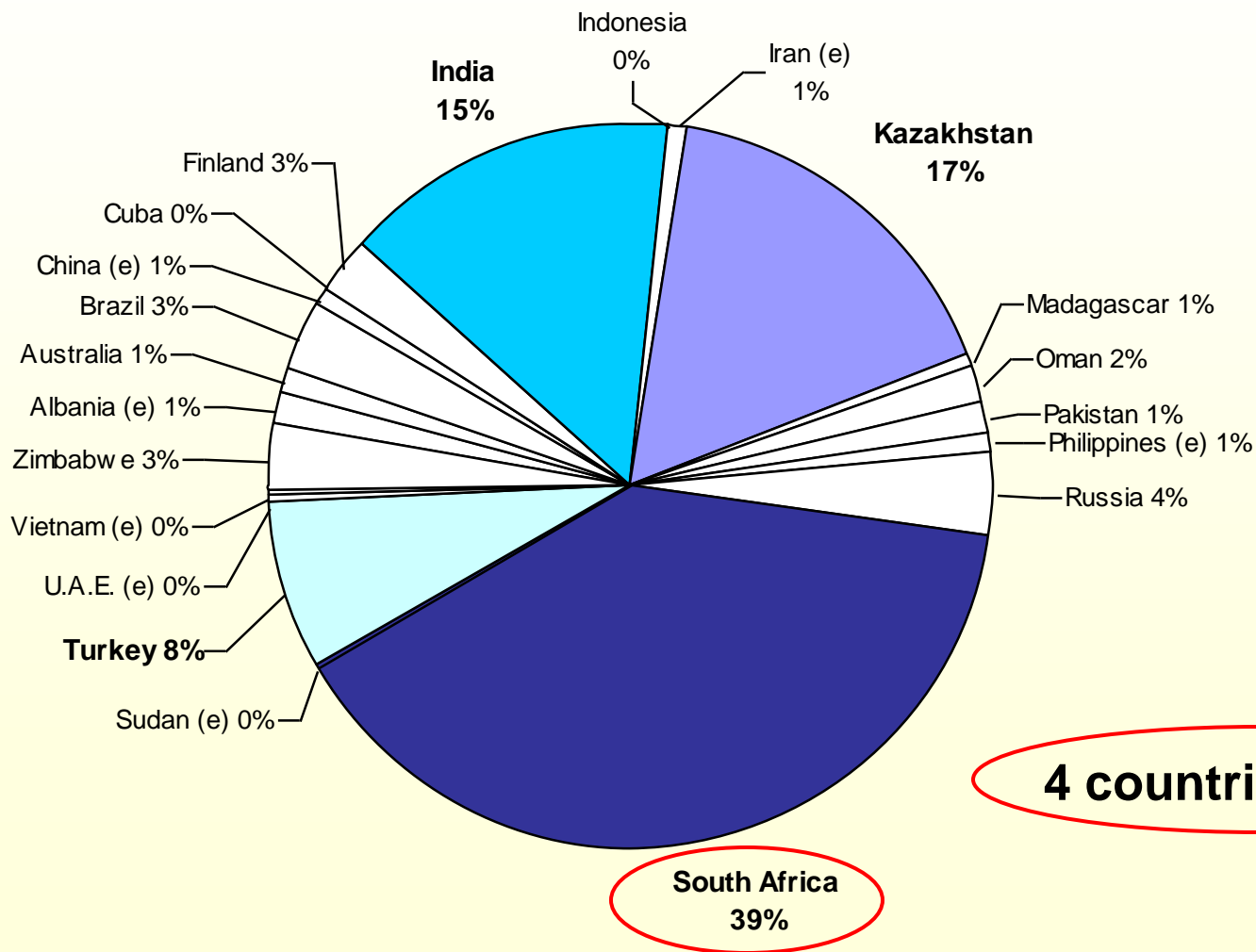


Source: ICDA



# Chromite Ore and Concentrates

- Production by Country 2007 -

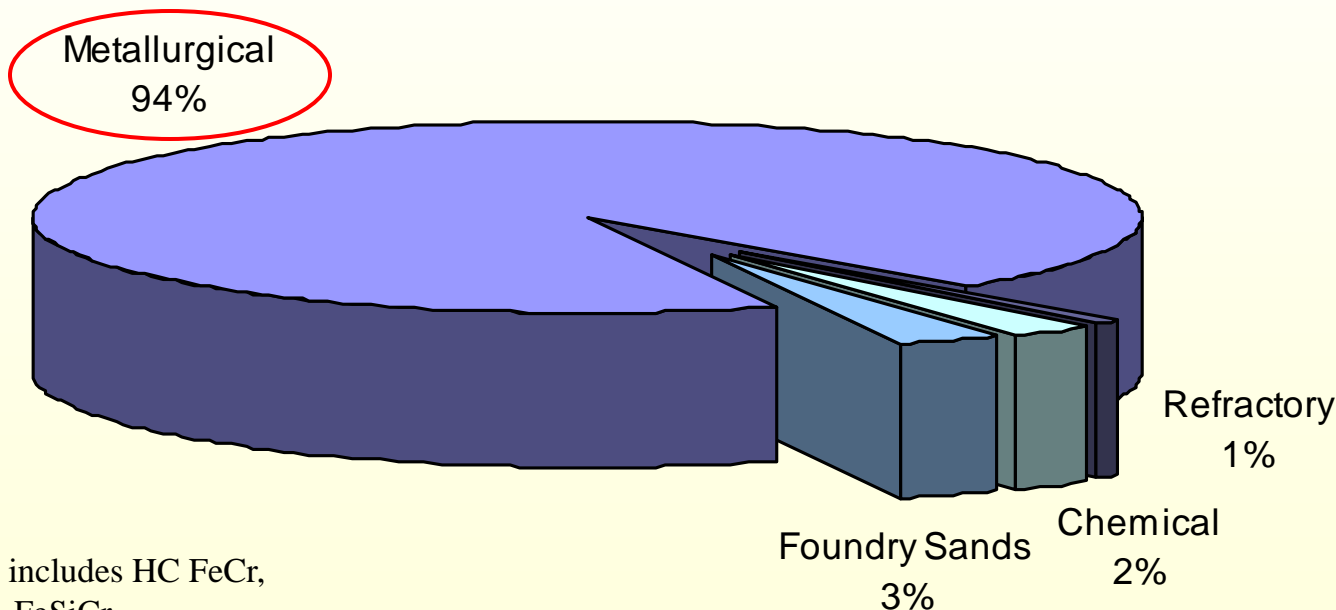




# Chromite Ore and Concentrates Production by End Use Sectors

2007

1000 tonnes

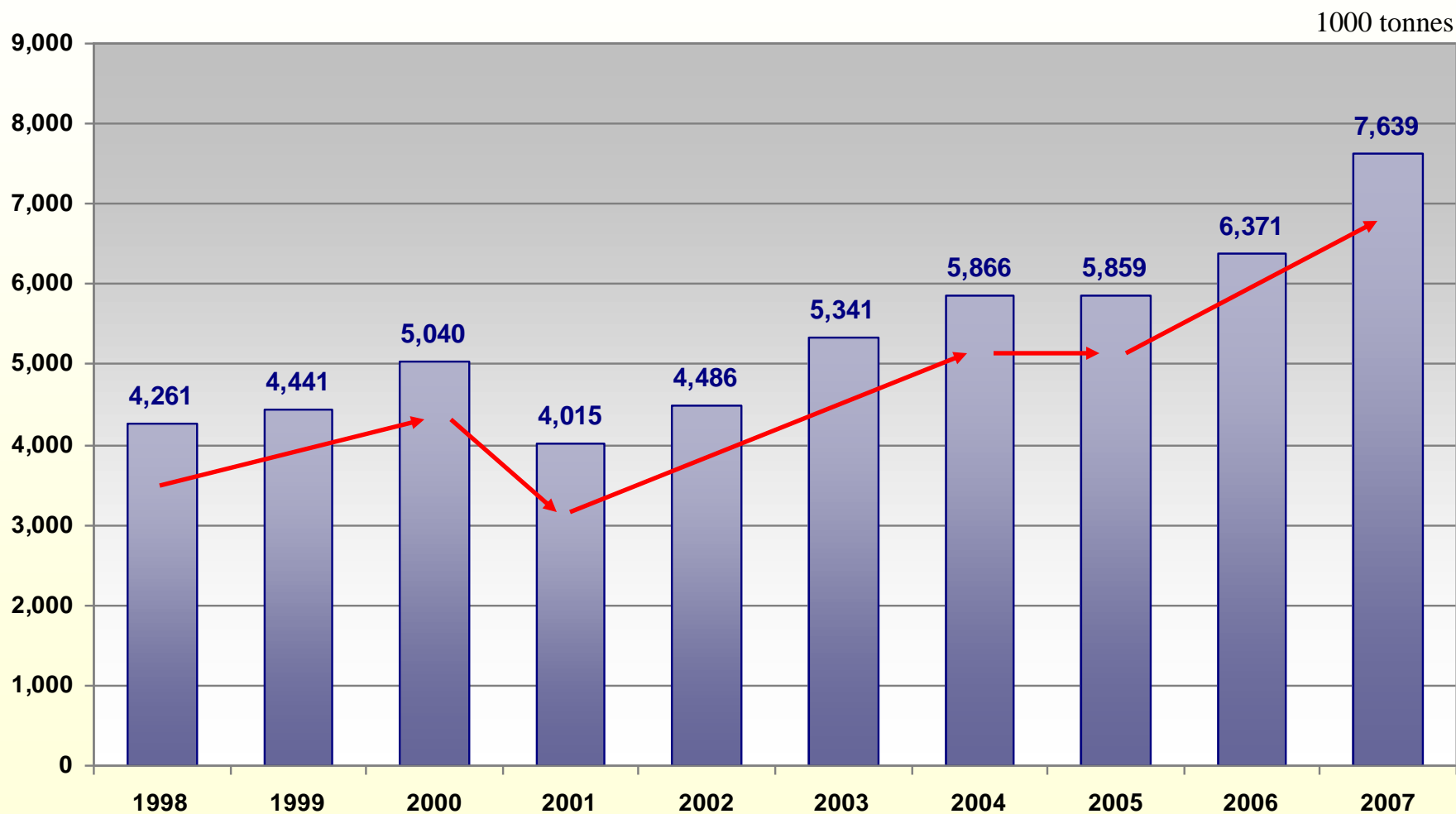


Metallurgical includes HC FeCr, MC FeCr, LC, FeSiCr



# High Carbon Ferrochromium

- World Production -

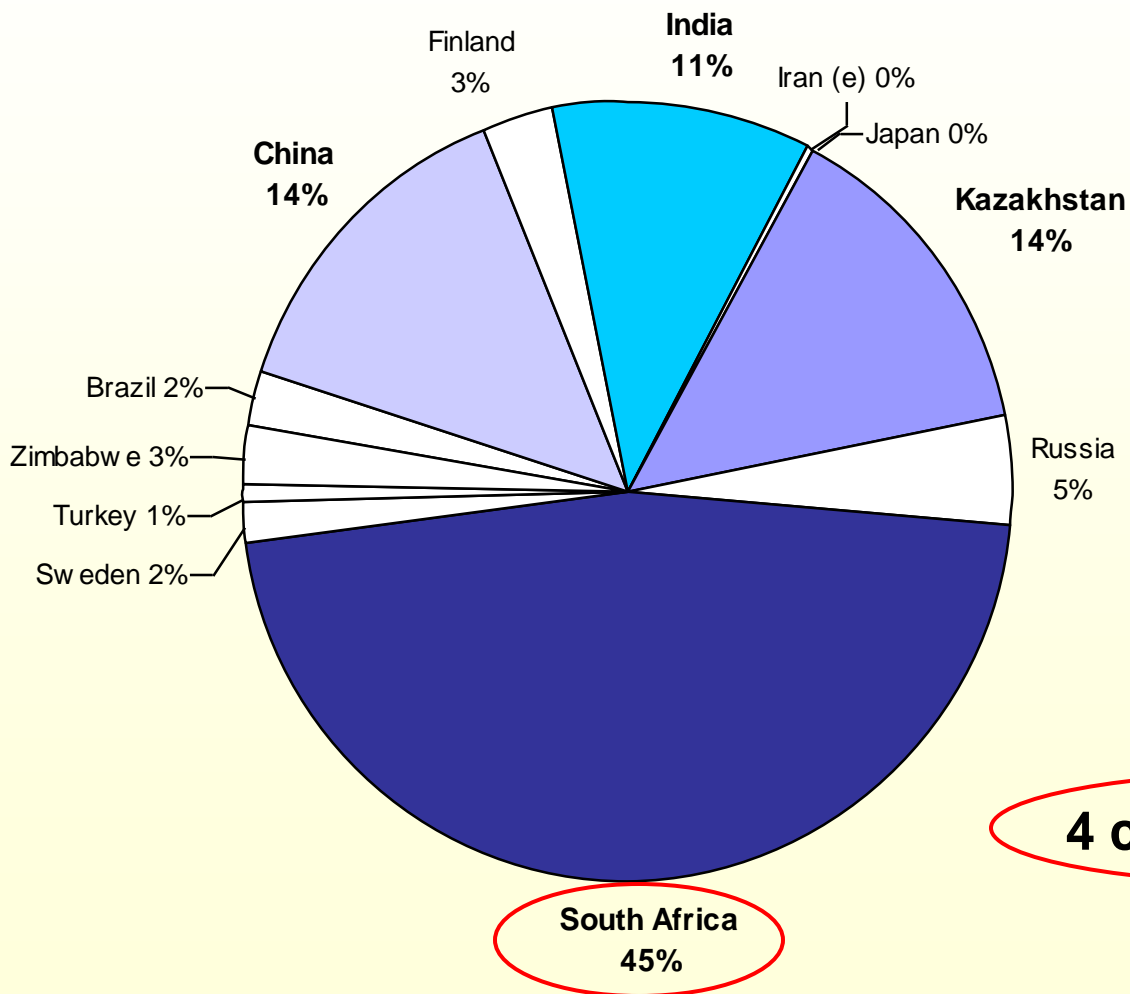


Source: ICDA



# High Carbon Ferrochromium

- Production by Country 2007 -

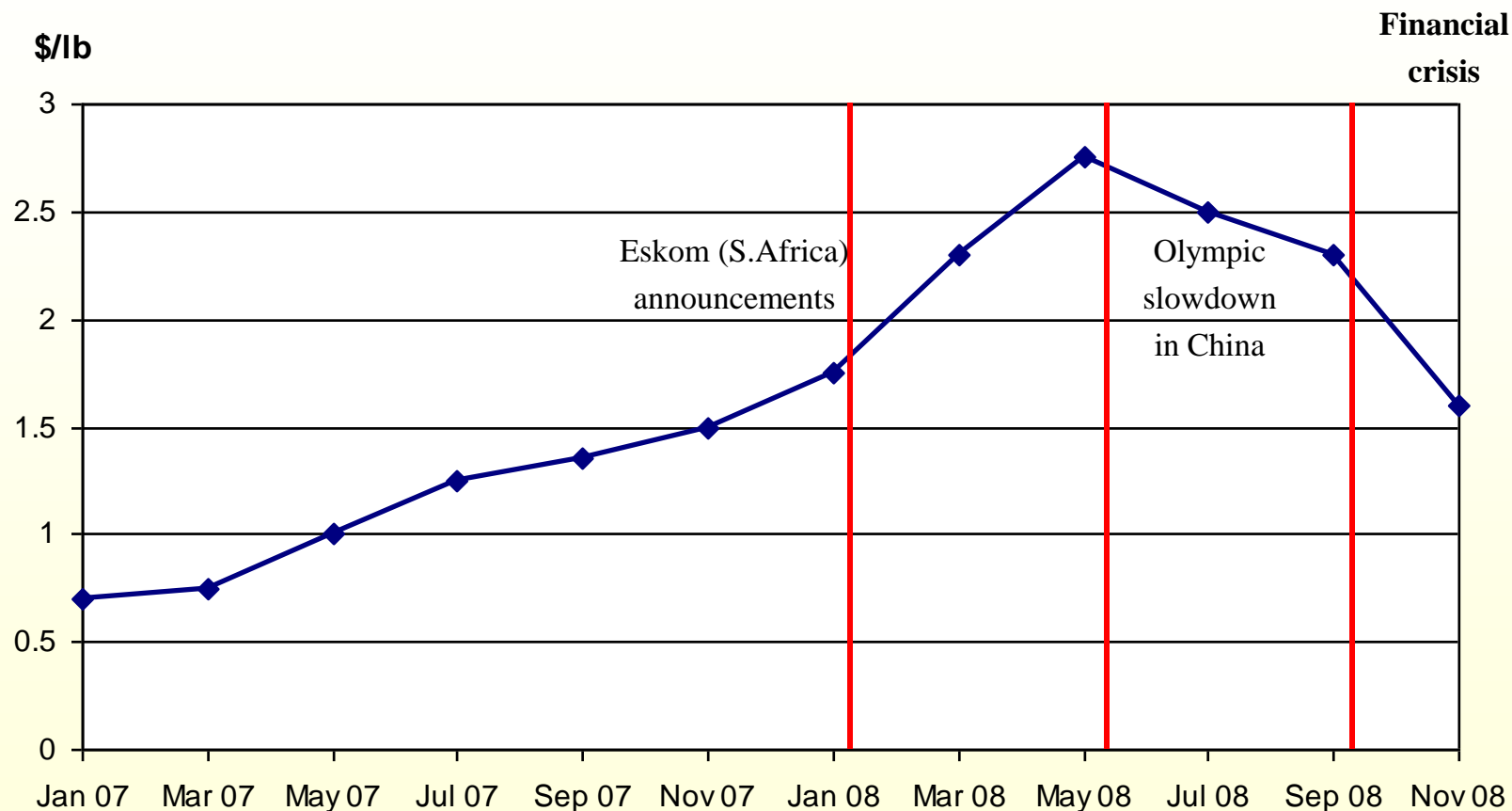


**4 countries ~ 85%**



# HC Ferrochromium

- spot prices -





# Chromium Market

## - Observations (1) -

- FeCr contains about 50-70% chromium alloyed with iron
- No substitute material for the production of stainless steel; uses over 80% of the world's FeCr
- Average chromium content in stainless steel is ~18%
- Ferrochromium production is a very energy-intensive process; capital costs have increased; shortage of skilled labour before the financial crisis
- World leading ferrochromium producers: Xstrata-Merafe S.A. (~20%), Several in China (~17%), ENRC Kazakhstan and Russia (~14%), Samancor S.A. (~13%), Hernic S.A. (~5%), Assmang S.A (~3), Outokumpu Finland (~3%)



# Chromium Market

## - Observations (2) -

- S.Africa: ~ 45% of world ferrochromium production
  - in 2007 companies produced at their full capacity; low stocks
  - power shortages (in 2007); electricity price increased
    - New FeCr projects (charge chromium) may be influenced
  - Major production decreases are anticipated
- Kazakhstan had planned to produce additional ~300,000 t/y (currently 1,070,000 t) before the financial crisis
- China P.R.: 2H2007 became net importer
- High prices in the 2Q2008 but decreased in 4Q2008 as a result of the financial crisis





# Chromium Market

## - Observations (3) -

- The market was tight in 2007; in recent months demand has dropped considerably and producers have announced production cuts (up to 40% annualised): Xstrata-Merafe (500 kt), Samancor (600 kt), Assmang (150 kt)
- Recently Xstrata-Merafe (largest producer) decided to shut down 11 ferrochromium furnaces, because demand from steelmakers is expected to remain weak into the 1H2009
- Prospects:
  - ferrochromium prices and sales under pressure in the short-term
  - producers reacted quickly to the crisis
  - ferritic stainless steel remains a strong focus
  - China will continue to be the main growth driver

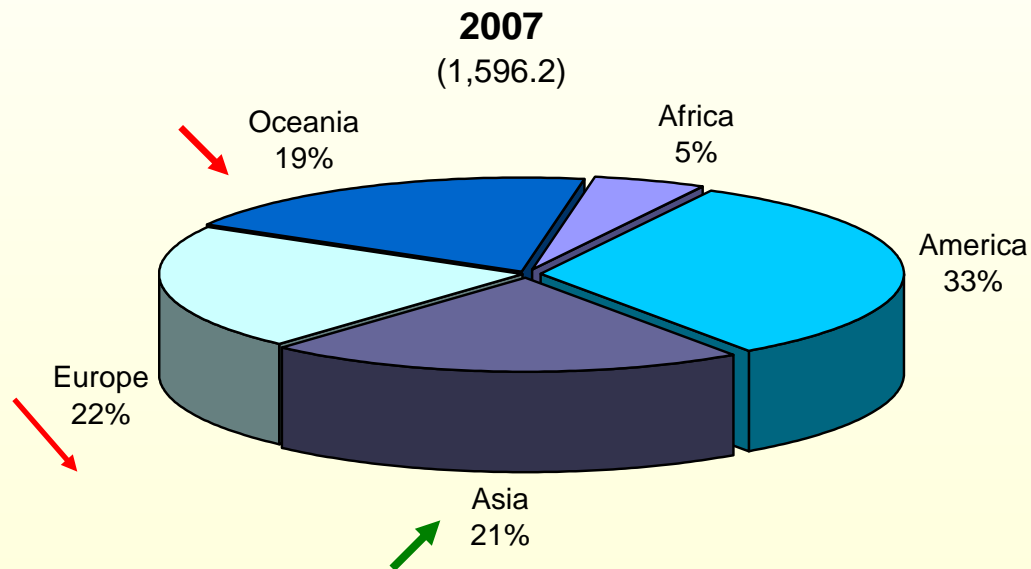
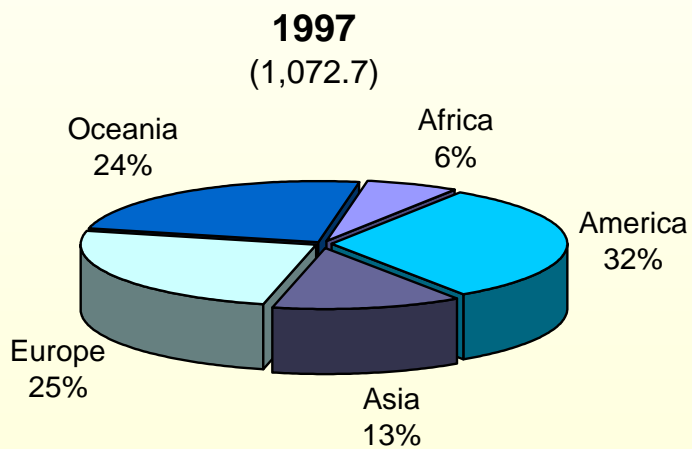


# *Nickel*



# World Nickel Ore Production

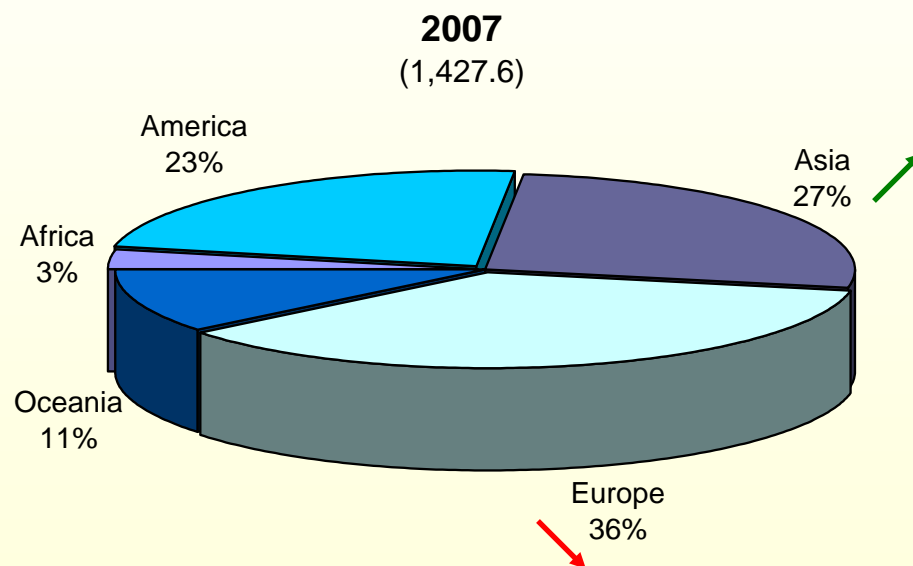
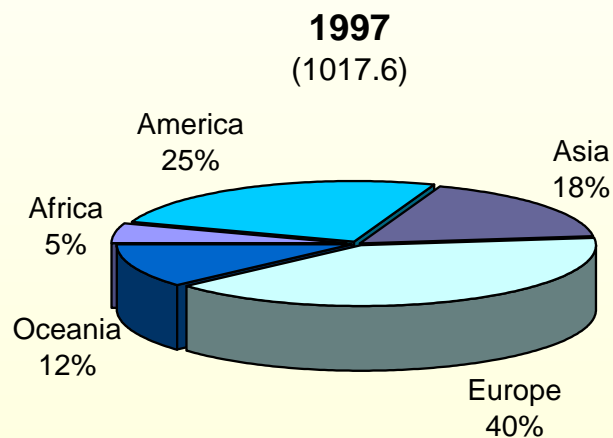
1000 tonnes





# World Primary Nickel Production

1000 tonnes





# World Primary Nickel Production

1000 tonnes

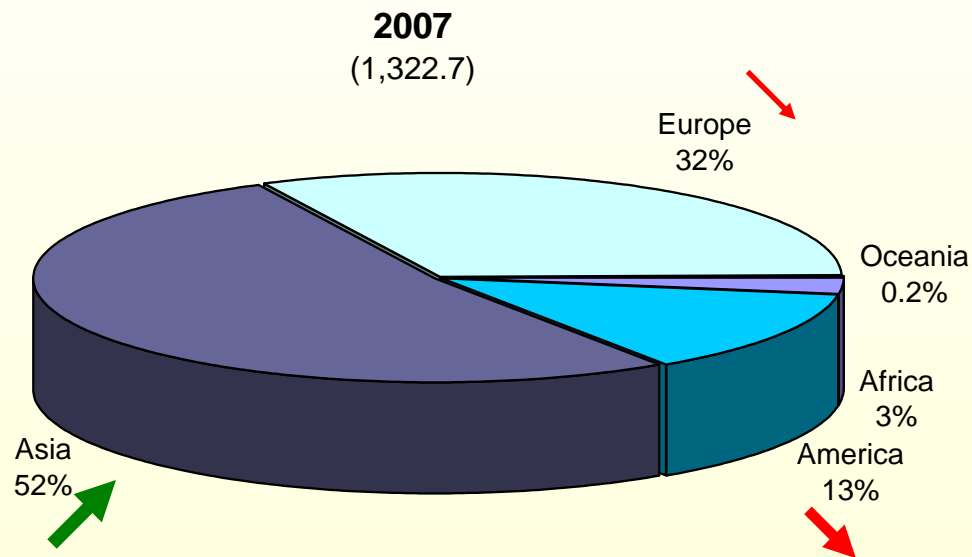
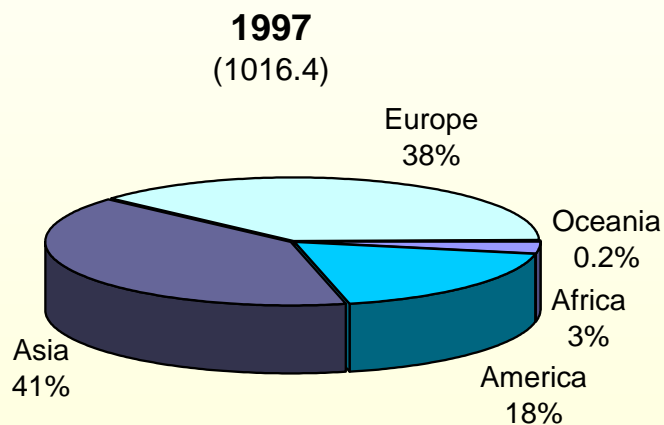
Area	2006	% change	2007	% change	2008 f	% change	2009 f	% change
Africa	54.5	-1.8	49.1	-9.9	42.0	-14.5	44.0	4.8
America	324.5	5.5	330.7	1.9	314.8	-4.8	355.0	12.8
Asia	303.5	12.2	379.4	25.0	387.9	2.2	431.3	11.2
Europe	512.9	10.9	512.2	-0.1	507.2	-1.0	509.0	0.4
Oceania	162.6	-8.4	156.2	-4.0	152.5	-2.3	207.0	35.7
<b>Total</b>	<b>1358.1</b>	<b>6.6</b>	<b>1427.6</b>	<b>5.1</b>	<b>1404.4</b>	<b>-1.6</b>	<b>1546.3</b>	<b>10.1</b>

(f) forecast date: October 7, 2008



# World Primary Nickel Usage

1000 tonnes





# World Primary Nickel Usage

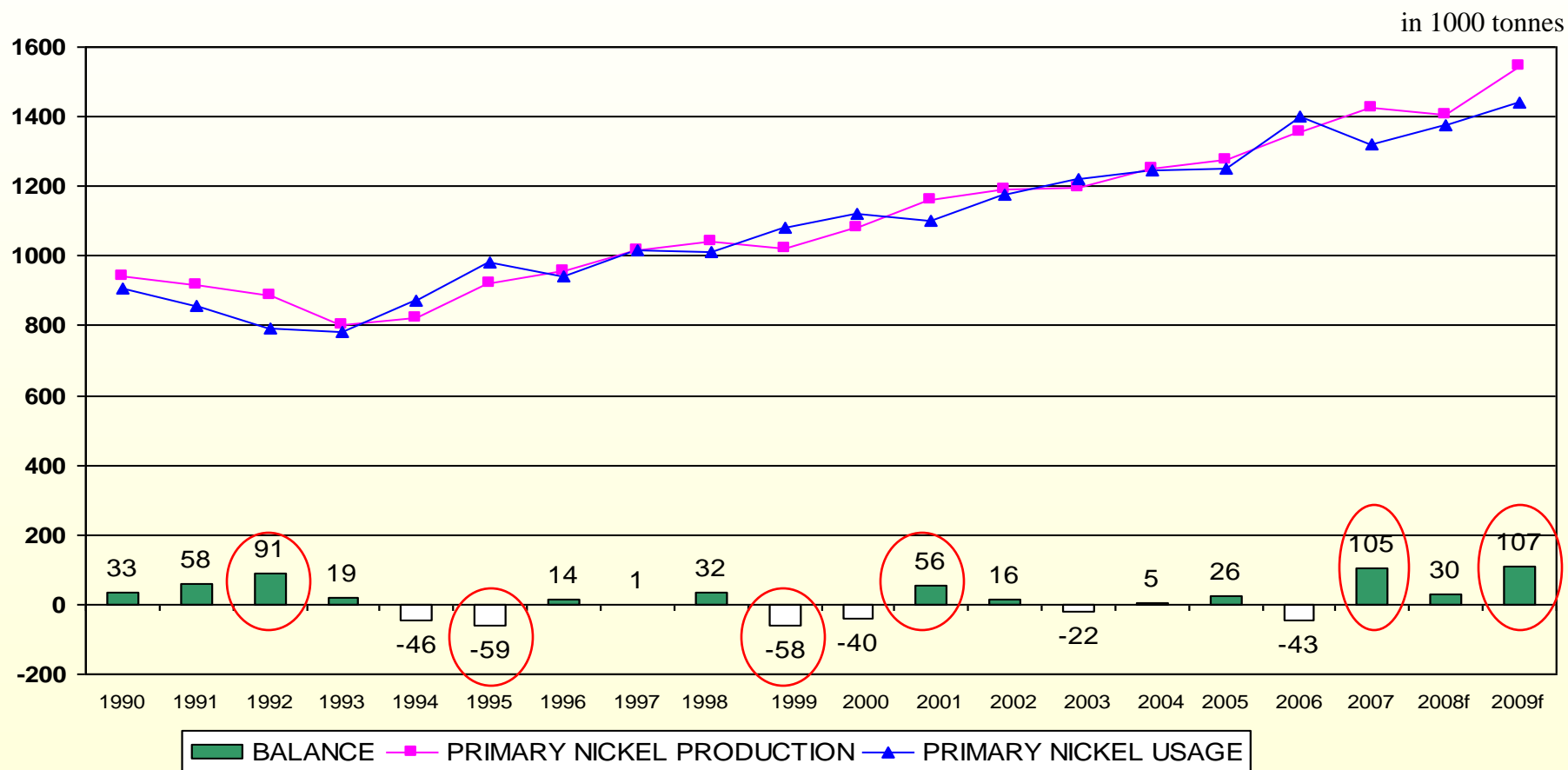
1000 tonnes

Area	2006	% change	2007	% change	2008 f	% change	2009 f	% change
Africa	42.0	31.3	33.6	-20.0	30.5	-9.2	34.6	13.4
America	180.4	3.5	171.4	-5.0	163.6	-4.6	169.8	3.8
Asia	683.7	15.5	690.9	1.0	735.5	6.5	790.3	7.5
Europe	492.1	10.0	423.9	-13.9	441.6	4.2	441.8	0.0
Oceania	2.9	2.9	2.9	0.7	3.0	3.4	3.0	0.0
<b>Total</b>	<b>1401.1</b>	<b>12.2</b>	<b>1322.7</b>	<b>-5.6</b>	<b>1374.2</b>	<b>3.9</b>	<b>1439.5</b>	<b>4.8</b>

(f) forecast date: October 7, 2008



# World Primary Nickel Balance







# World Primary Nickel Balance

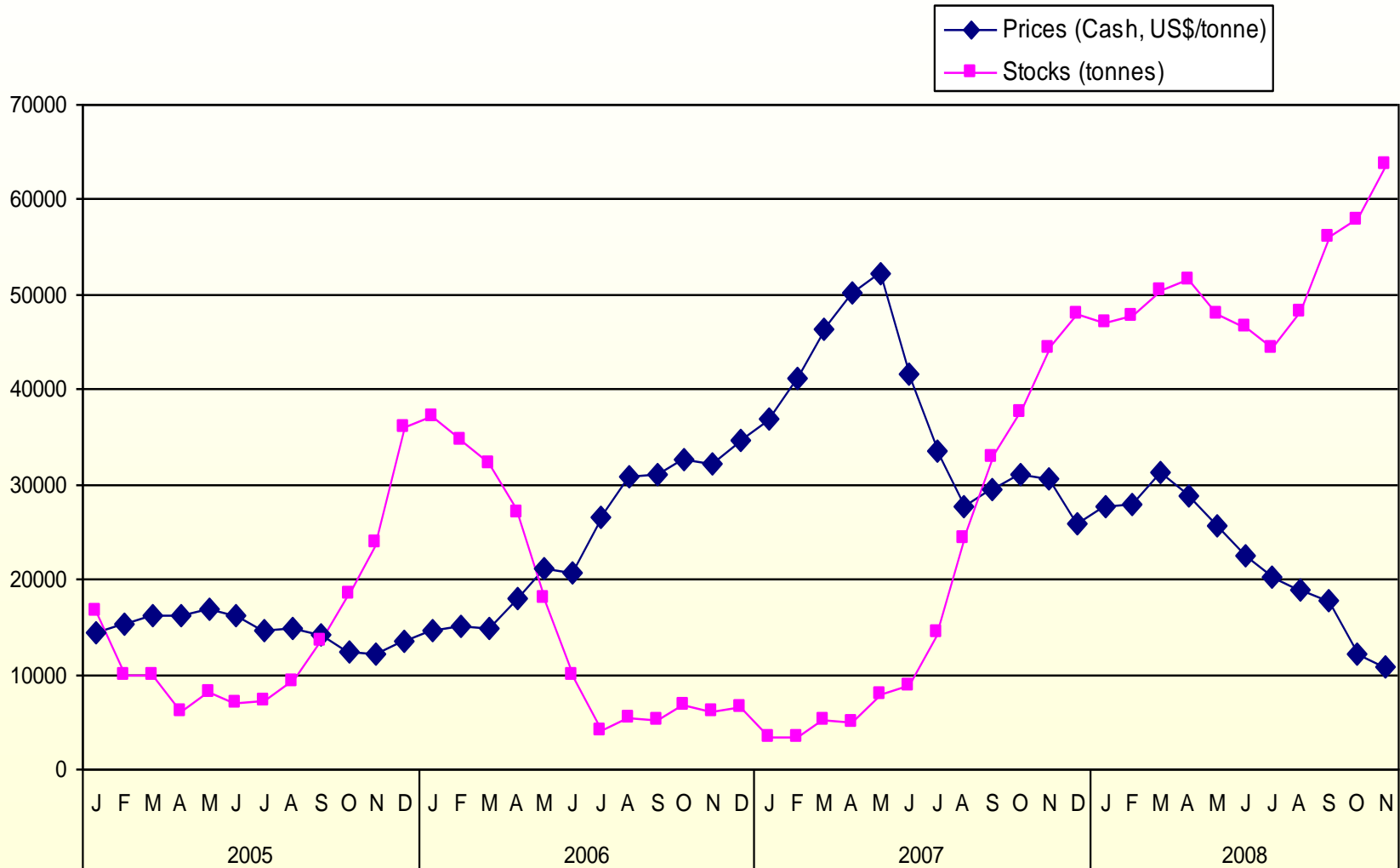
in 1000 tonnes

Area	2006	% change	2007	% change	2008 f	% change	2009 f	% change
Production	1358.1	6.6	1427.6	5.1	1404.4	-1.6	1546.3	10.1
Usage	1401.1	12.2	1322.7	-5.6	1374.2	3.9	1439.5	4.8
Balance	-43.1		104.9		30.2		106.8	

(f) forecast date: October 7, 2008

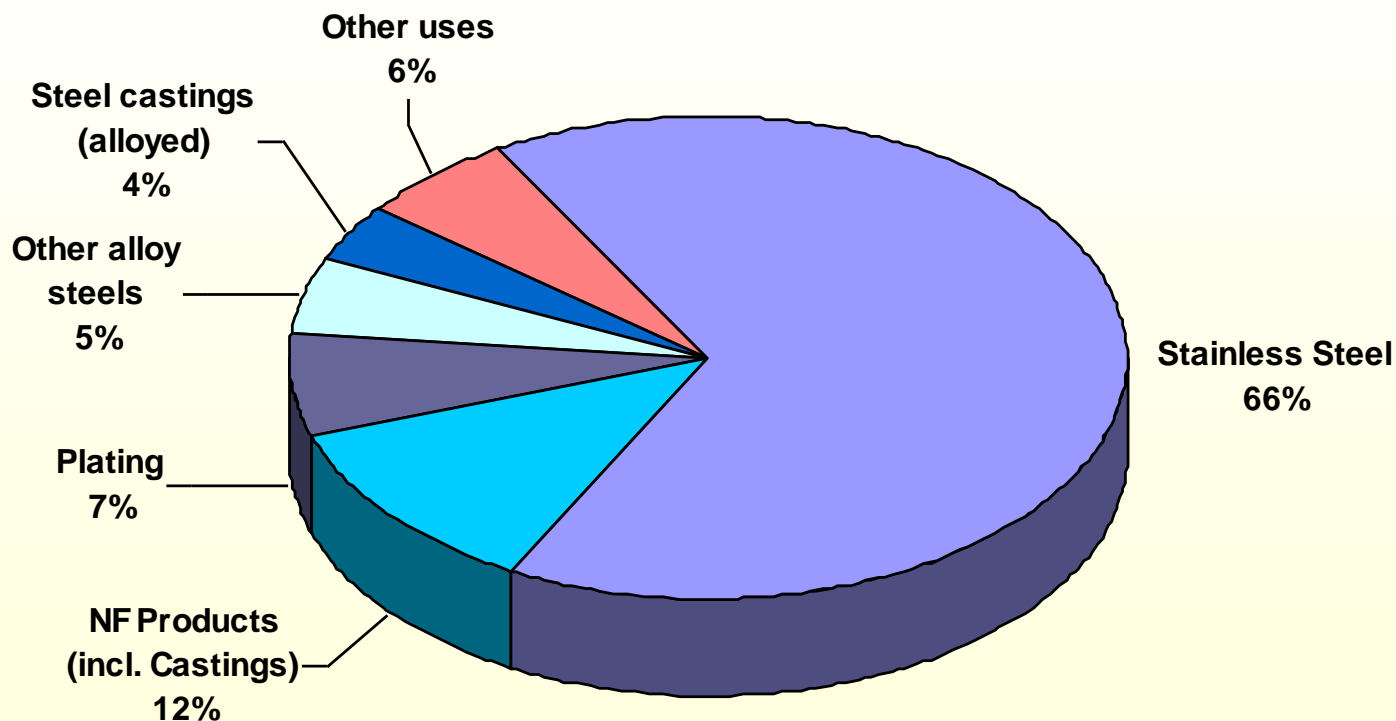


# LME nickel prices and stocks





# Principal End Uses of Primary Nickel





# Nickel projects 2008 Directory

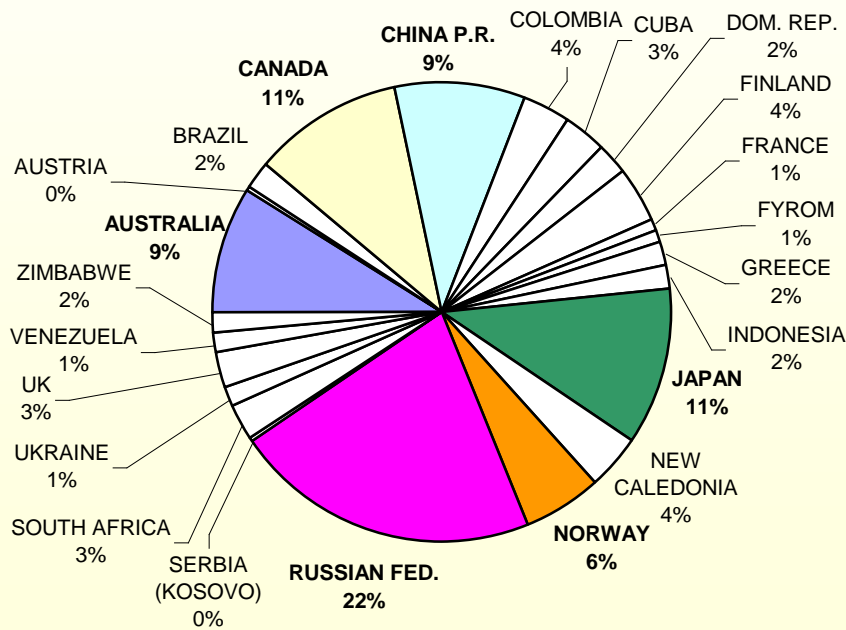
Capacity (Ni content, t/y)

	<b>Ore &amp; Concentrate</b>	<b>Intermediate Products</b>	<b>Refined products</b>
Committed Developments	264,570	83,400	522,300
Likely Project Developments	74,250	15,000	189,000
Potential Project Developments	134,000	94,600	387,900

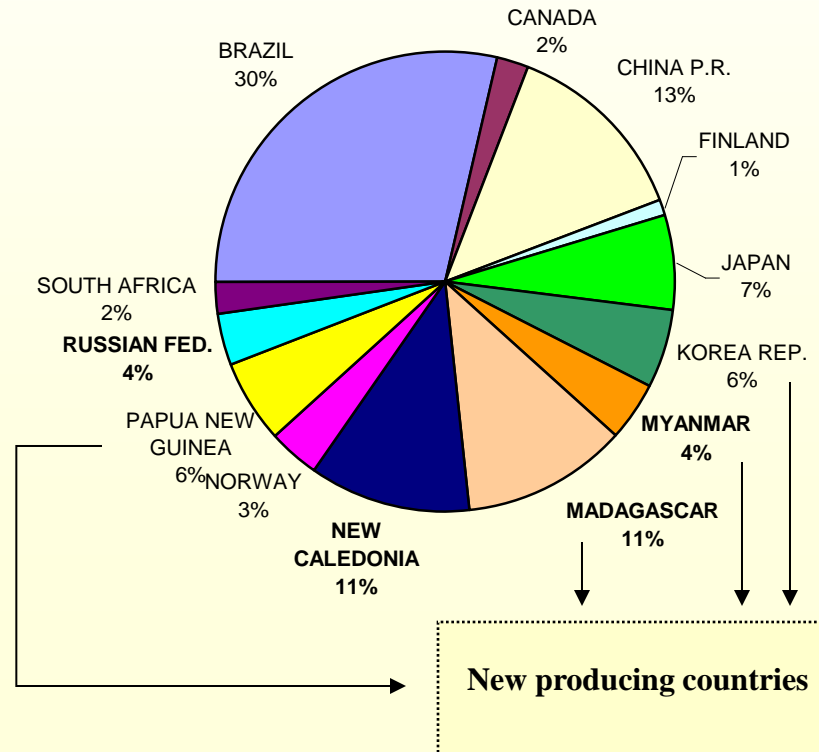


# Refined Nickel Capacity by Country – 2008 Directory

2007:  $\approx$  1.5Mt



Committed developments:  
 $\approx$  0.5Mt





# New “committed” developments – main projects

- **Australia:** Yabulu Refinery (BHP Billiton)
- **Brazil:** Onça Puma (Vale Inco), Barro Alto (Anglo American), Santa Rita (Mirabela / Vale Inco)
- **China P.R.:** Jinchuan
- **Finland:** Talvivaara, Keivitsa (Scandinavian Minerals)
- **Japan:** Niihama (Sumitomo)
- **Korea, Rep. of:** Posco (Posco / SMSP)
- **Madagascar:** Ambatovy (Sherritt / Sumitomo)
- **New Caledonia (France):** Goro (Goro Nickel), Koniambo (Xstrata)
- **Papua New Guinea:** Ramu (Highlands Pacific / PNG)
- **Zambia:** Munali (Albion)



# Nickel Projects

- One can see that there are no shortage of nickel projects, though some projects were deferred
- Difficulty to find “rich deposits”, most have a low to medium nickel content and limited quantity
- To obtain sufficient financing is a problem
- Actual timing to a possible realization of a deposit is virtually impossible to accurately forecast.



# Nickel Market

## - Observations (1) -

- FeNi contains about 15-40% nickel alloyed with iron
- Estimated average nickel content in type 304 steels >8%
- Around 2/3 of primary nickel is used in stainless steelmaking, steel castings (alloyed) ~4%, other alloy steels ~5%
- World leading nickel producers: Norilsk Nickel (~22%), Vale Inco (~ 16%), BHP Billiton (~10%), Xstrata (~11%), Jinchuan (~7%)
- INSG Meetings, 7 October 2008:
  - Primary nickel production increased by 5% in 2007, but might decrease 2% in 2008
  - Primary nickel usage down by 6% in 2007, but could increase by more than 3% in 2008 and 4% in 2009





# Nickel Market

## - Observations (2) -

- Primary nickel projects are starting to come into production and up to 0.5 Mt have been identified as committed
- The nickel market is currently experiencing a stock build up
- Prices have collapsed from an average of more than 52,000 US\$/tonne in May 2007 to an average around 10,700 US\$/tonne in November 2008
- Currently there is great uncertainty and volatility in the market
- Several announcements in regard to production cuts and suspensions have been released (mine and primary):
  - Australia several (>20 kt), Canada several (>16 kt), Belvedere Finland (2 kt), Bindura Nickel Zimbabwe (5 kt), Xstrata Domin. Rep. (29 kt)
  - PT Inco (15 kt), Jinchuan, (20 kt), Antam (5 kt), Ufaley (14 kt)



# Nickel Market

## - Observations (3) -

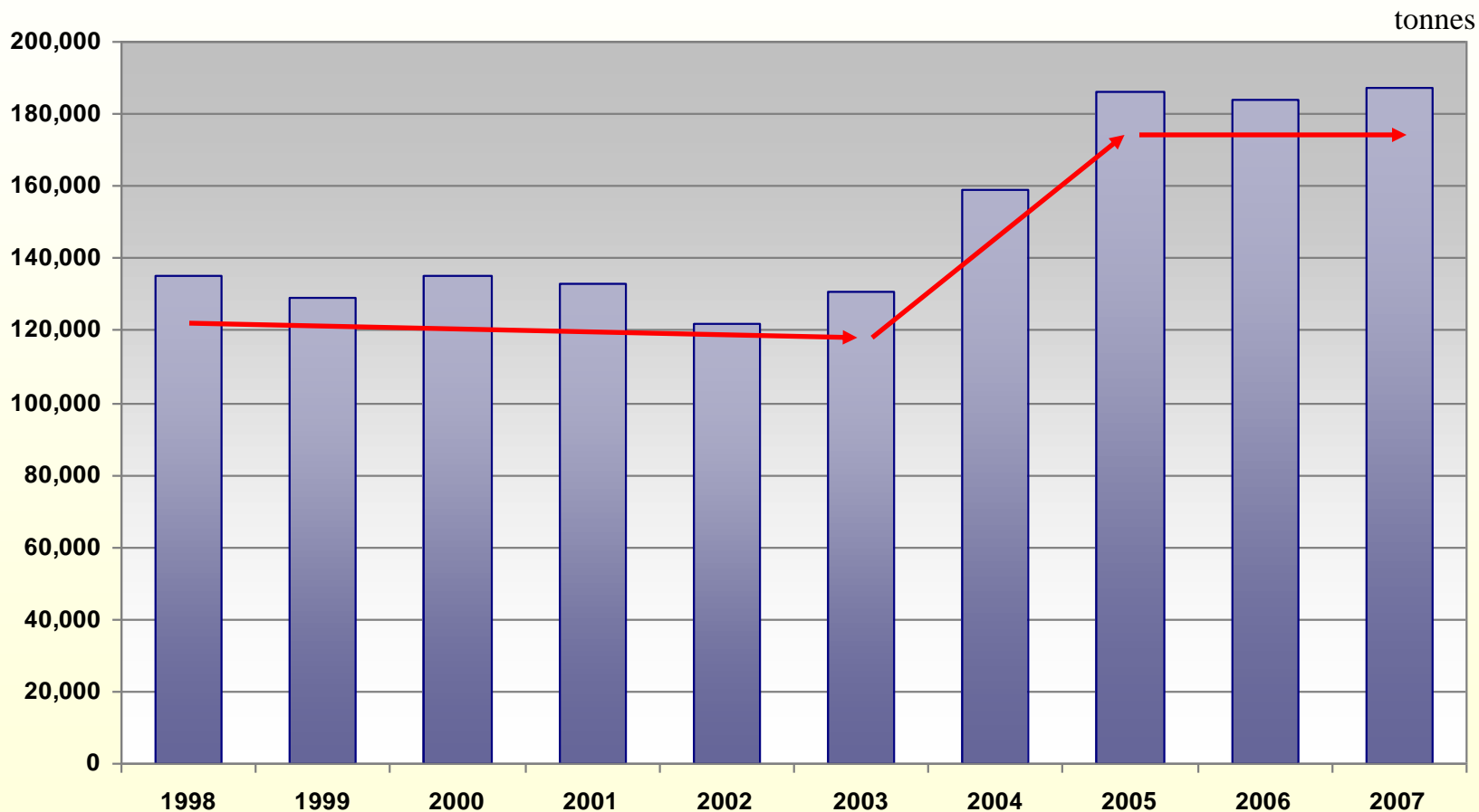
- Projects postponed: Fox Resources (Sholl B2; 2H2008 to 2009), Minara Resources (expansion at Murrin Murrin in Australia; by end-2009), Vale (Onça Puma in Brazil), HudBay (Fenix mine and ferro-nickel project in Guatemala; 2010), Sherritt (Ambatovy in Madagascar; could be delayed), Sherritt (suspends spending at Moa, Cuba and at Fort Saskatchewan refinery, Canada), Sumitomo (may delay the start of its Taganito project in the Philippines), Russian Nickel Co. (puts on hold its Altai project)
- China will remain the most important market.



# *Molybdenum*



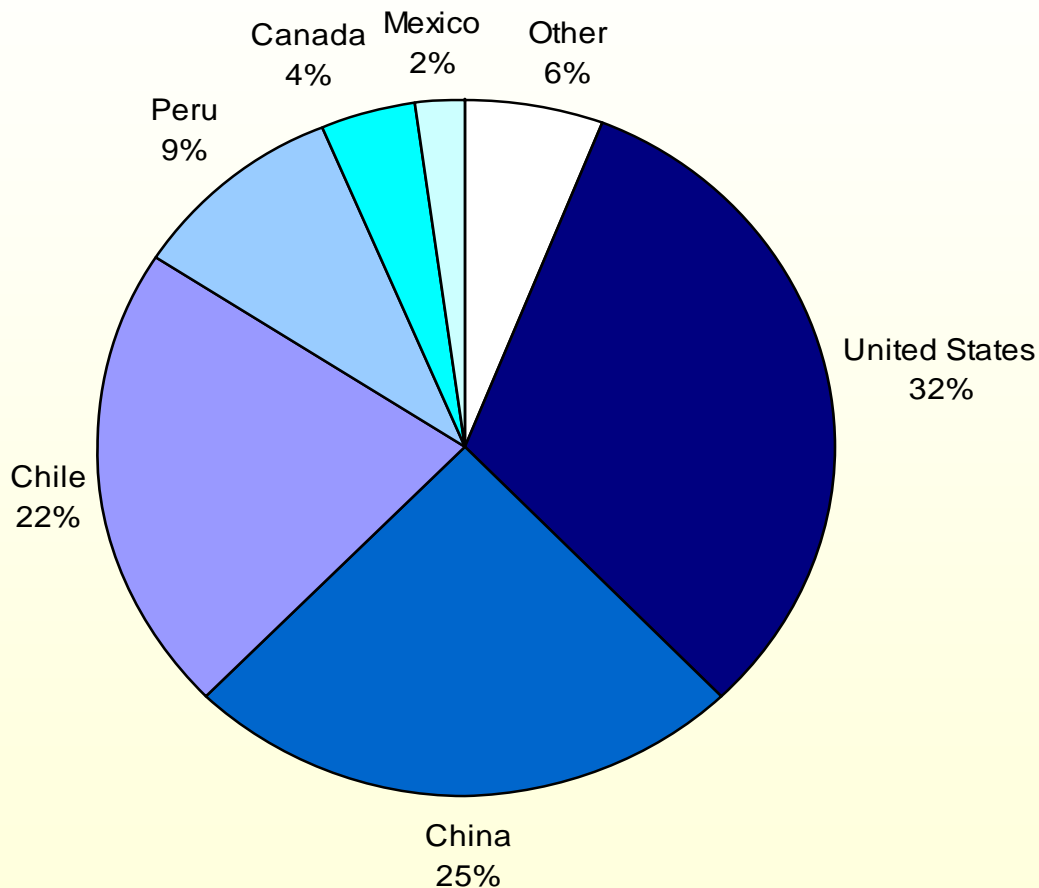
# Global Molybdenum Mine Production





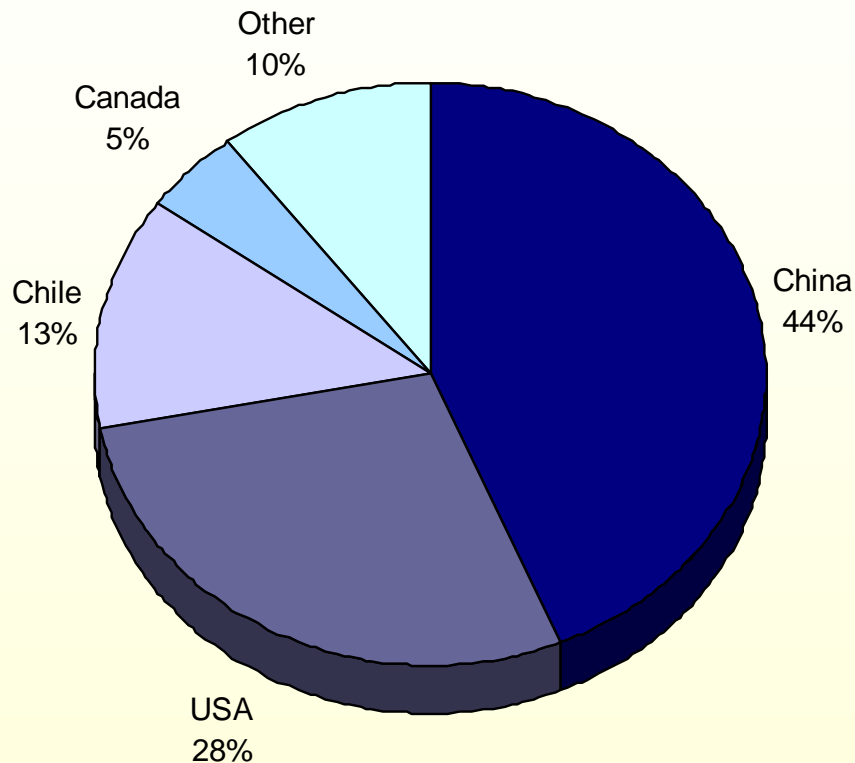
# Molybdenum

## - Mine Production by Country 2007 -





# Global Molybdenum Reserve Base 2007



Global molybdenum reserves total **19 million tons**

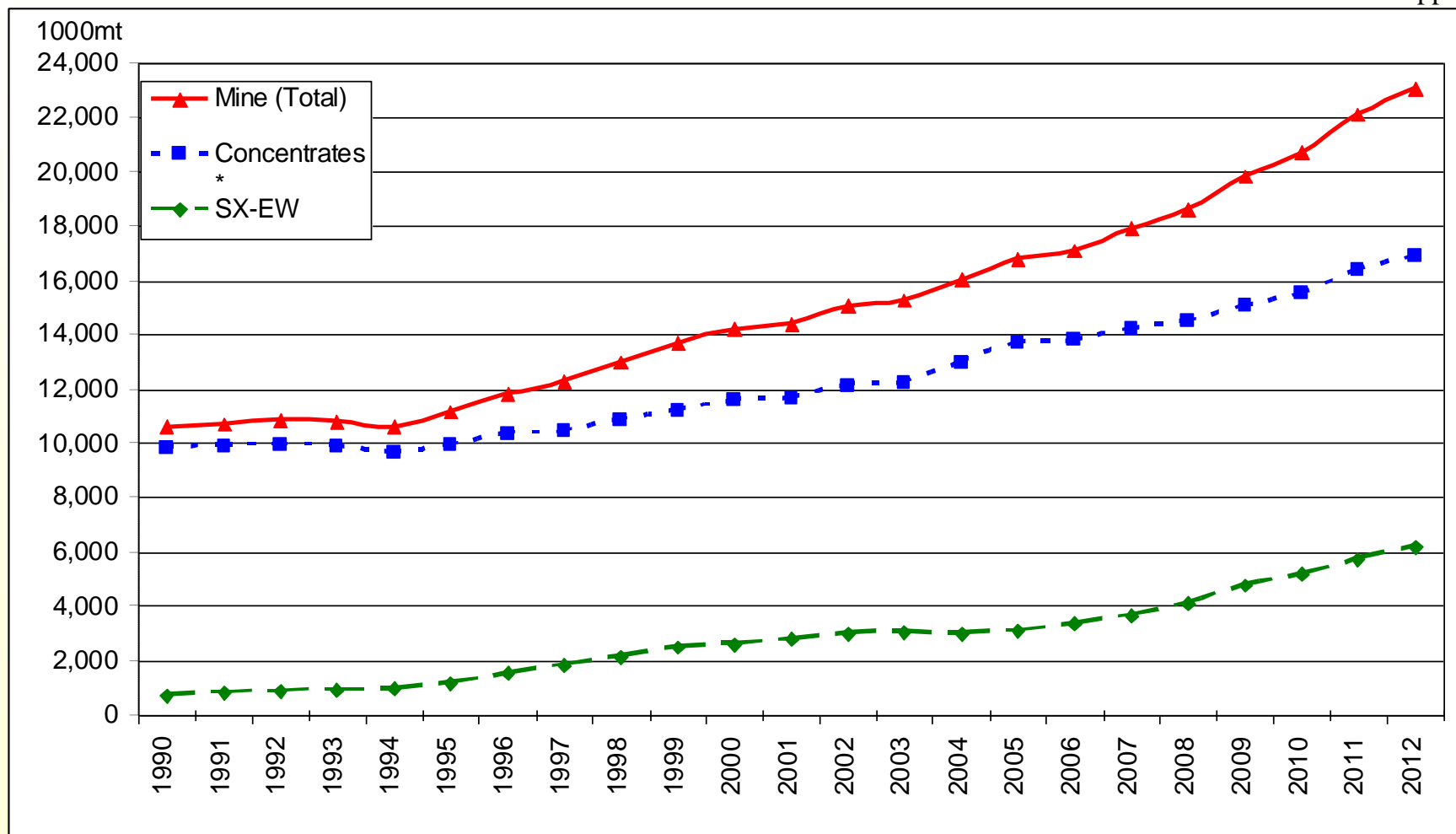
mainly situated in China and North America



# Copper

## - Trends in Mining Capacity -

thousand metric tonnes copper





# Copper

## - Mines and Plants Capacity Projections -

### WORLD COPPER PRODUCTION CAPACITY EVOLUTION

<i>000's metric tonnes Cu</i>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>% change 2007-2012</b>
SX-EW	3,659	4,118	4,769	5,154	5,723	6,187	69.1%
Concentrates	14,228	14,505	15,063	15,527	16,392	16,888	18.7%
Mines Total	17,887	18,623	19,832	20,681	22,115	23,075	29.0%
Smelters	16,591	17,254	17,818	18,200	18,525	18,710	12.8%
Electrolytic Refineries	17,126	17,572	18,195	18,365	18,580	18,685	9.1%
Refineries Total	21,525	22,478	23,723	24,320	25,062	25,631	19.1%
<b><i>Year on Year Changes (tonnage)</i></b>							<b><i>Accumulated 2007-2012</i></b>
SX-EW		459	651	384	569	464	2,528
Concentrates		277	558	464	865	496	2,660
Mines Total		736	1,209	848	1,434	960	5,188
Smelters		663	564	382	325	185	2,119
Electrolytic Refineries		446	623	170	215	105	1,559
Refineries Total		953	1,245	597	742	569	4,106





# Copper Market

## - Observations -

- The extent of the credit crunch “effects” in commodity markets and the depth of the slowdown in world economies is yet unknown and the impact in our forecast is therefore uncertain.
- Copper production: The credit crunch will likely have a negative impact on mine production by affecting the development of new projects as finance will be more difficult to obtain.

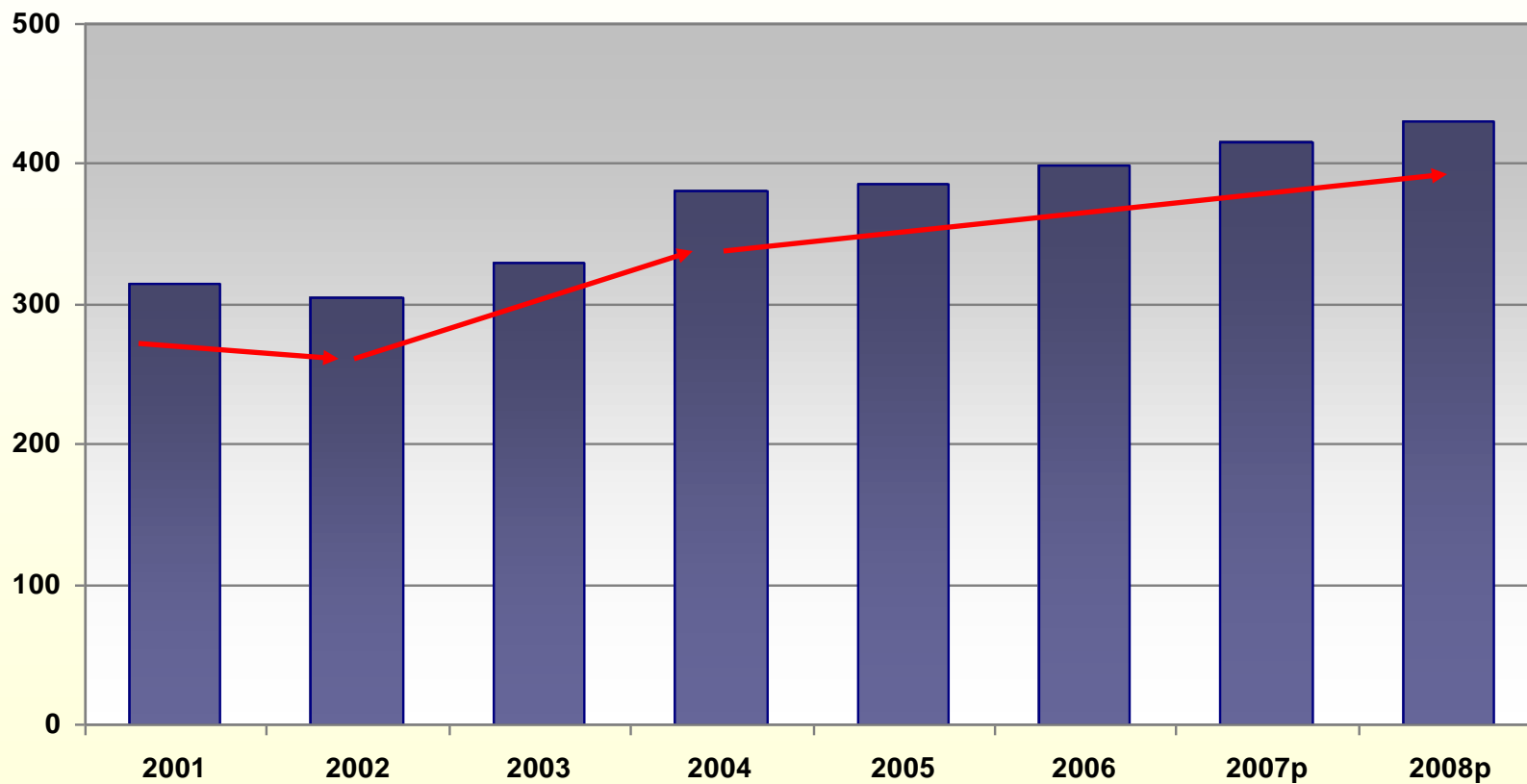
Therefore delays in the development or start-up of projects may occur or projects may even be postponed indefinitely (for example, in Finland construction of the Kylylahti mine was cancelled last month until better financial market conditions).

- World Mine production expected to grow by almost 11% in 2009 and a further 7% in 2010, supported by the ramp-up and start-up of new projects in Africa, America and Oceania. However, bearing in mind the recent financial turmoil these growths could be lower.



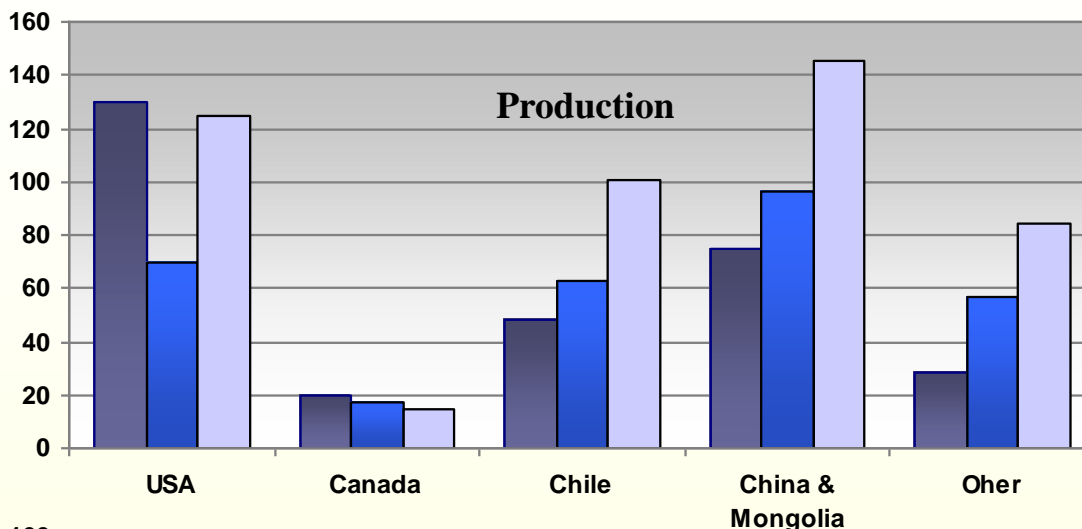
# Molybdenum Production

Million lb Mo

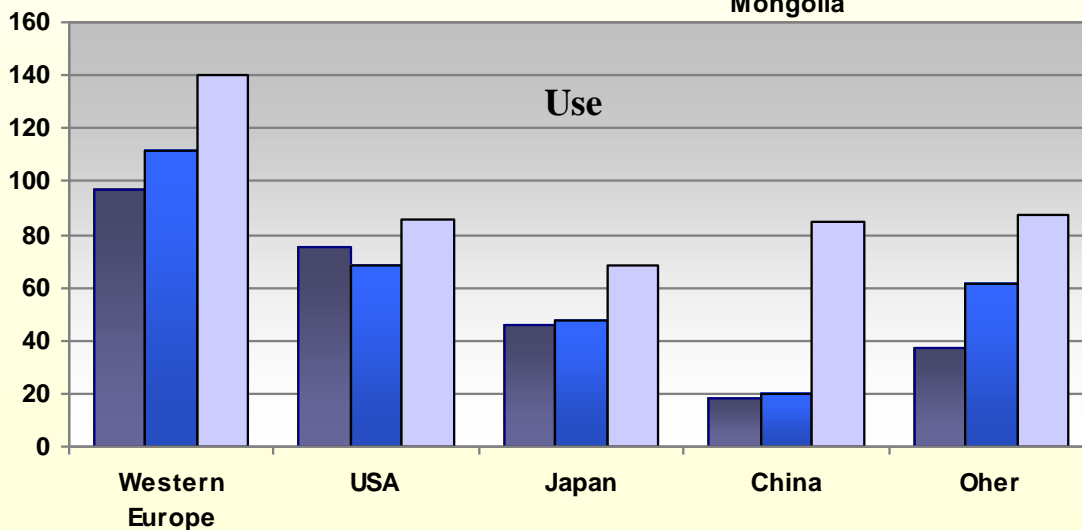




# Molybdenum Production and Use

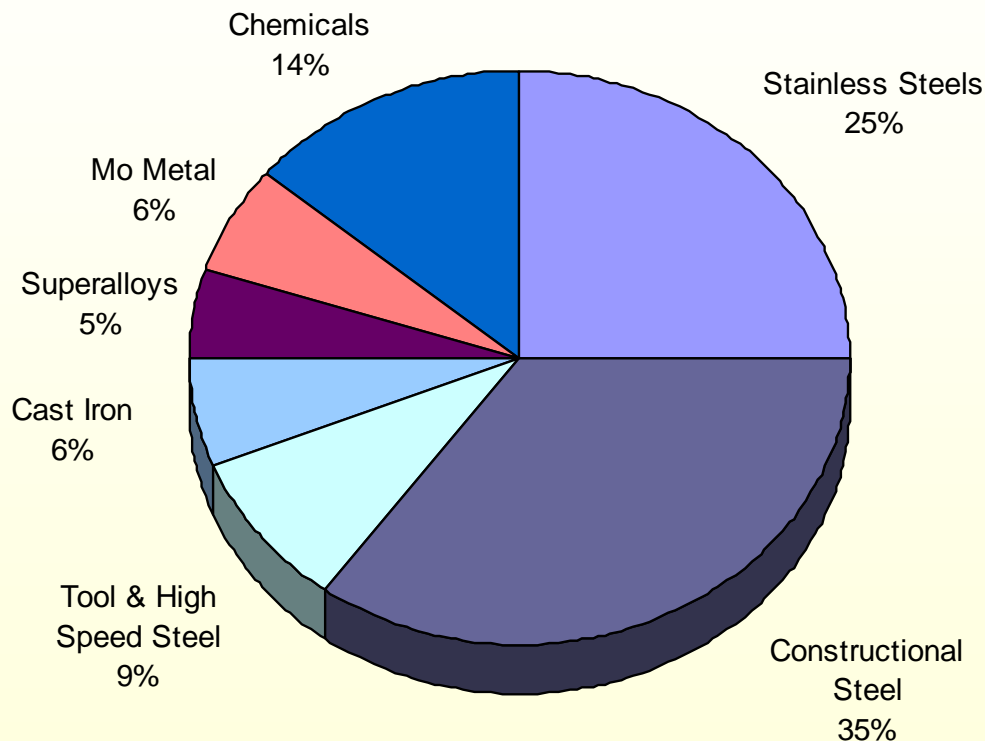


Million lb Mo





# First Use of New Molybdenum



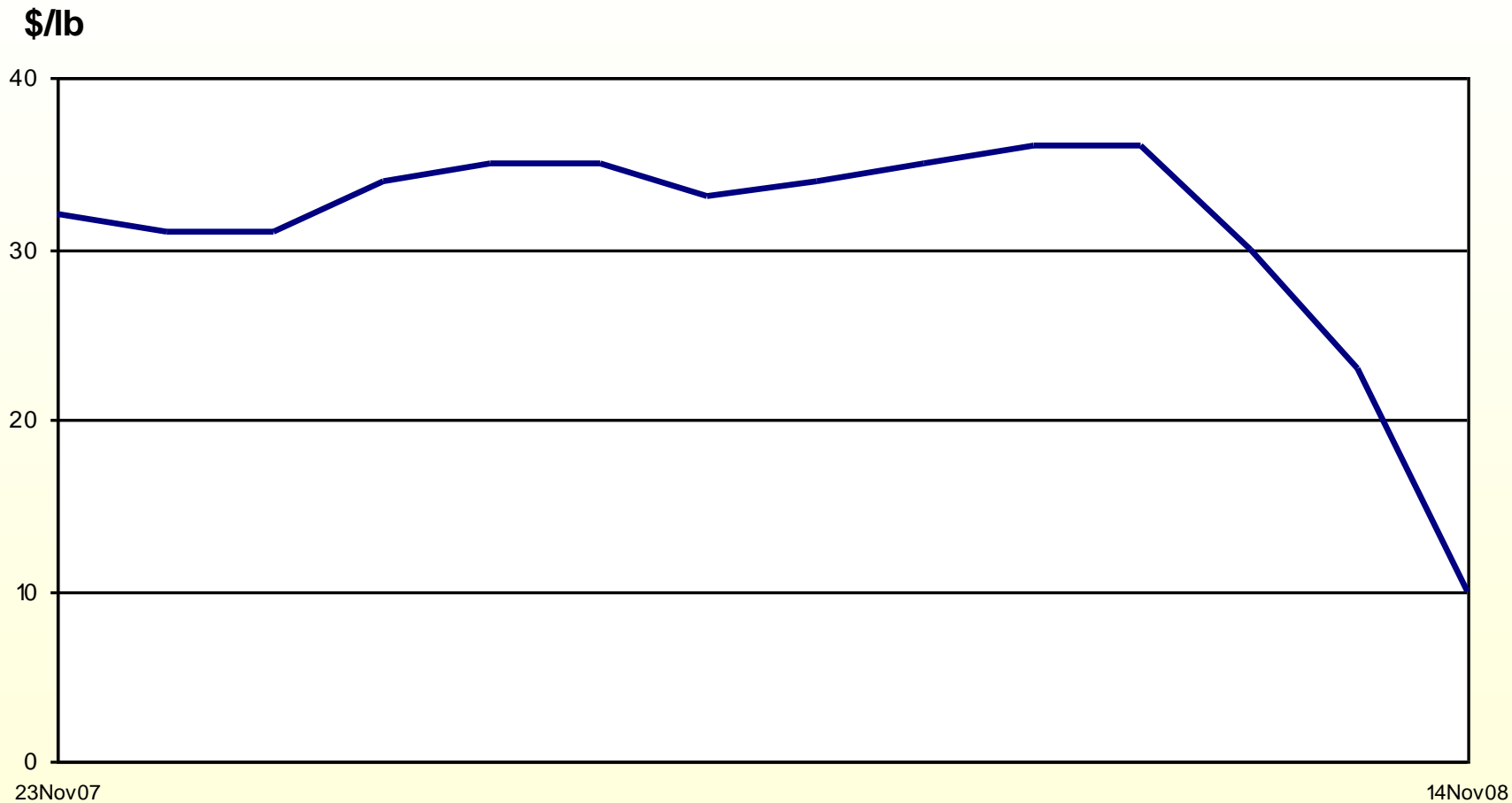
~25% is used to make stainless steel

~50% is used to is used for other iron-based alloys such as constructional steel, tool and high speed steel and cast iron



# Molybdenum Oxide

- Prices (N.America) -





# Molybdenum Market

## - Observations (1) -

- Molybdenum is an alloying element in steel and is almost always used in combination with other elements such as chromium, nickel, vanadium, tungsten or niobium
- Steel mills add molybdenum either as molybdenum oxide or ferromolybdenum
- Ferromolybdenum: contains 58%-64% of molybdenum
- Close to 75% of molybdenum is used in steelmaking
- Mine production may become more geographically diversified in the future:
  - projects in Australia (Spinifex Ridge 11 kt/y), Greenland (Malmbjerg 7.5-10.4 kt/y), Mongolia (Zuun Mod) and Philippines (Runruno 900 t/y)
  - ... but also in the U.S. (several projects: 36 kt/y), Canada (Ruby Creek, MAX, Chu), Mexico (Creston, Los Verdes, Cuatro Hermanos)



# Molybdenum Market

## - Observations (2) -

- World leading molybdenum producers: Freeport (~28%), Codelco (~23%), Grupo Mexico (~14%), Kennecott (~12%), Antofagasta (~8%), Thompson Creek (~7%), Antamina (~5%), Collahuasi (~3%)
- Molybdenum has been derived mainly as a by-product of copper mining around 60% but might decrease in the future
- End-use scope is expanding: oil and gas pipelines, duplex steels (6% Mo) replacing steels with only 2% Mo
- Rising cost structure
- Market was tight up to September 2008, with demand growing by ~4% annually



# Molybdenum Market

## - Observations (3) -

- Prices have collapsed in recent months
- China has built inventories in Q1,2,3 – 2008 but it is currently destocking
- Steel producers and traders are also reducing stocks
- The market begins to look oversupplied; before the financial crisis it was expected to be in deficit through 2009, but no longer
- Production cuts announced recently: Freeport (25% reduction in Henderson mine; considering other cuts like Chino mine in New Mexico)
- China: exports of molybdenum are down 6.1% in October, and 21.6% annually for the YoY period
- Projects are also being deferred: Freeport (Climax), BHP Billiton / Rio Tinto / Mitsubishi (plant at Escondida mine), Roca Mines (Max - Phase 2).

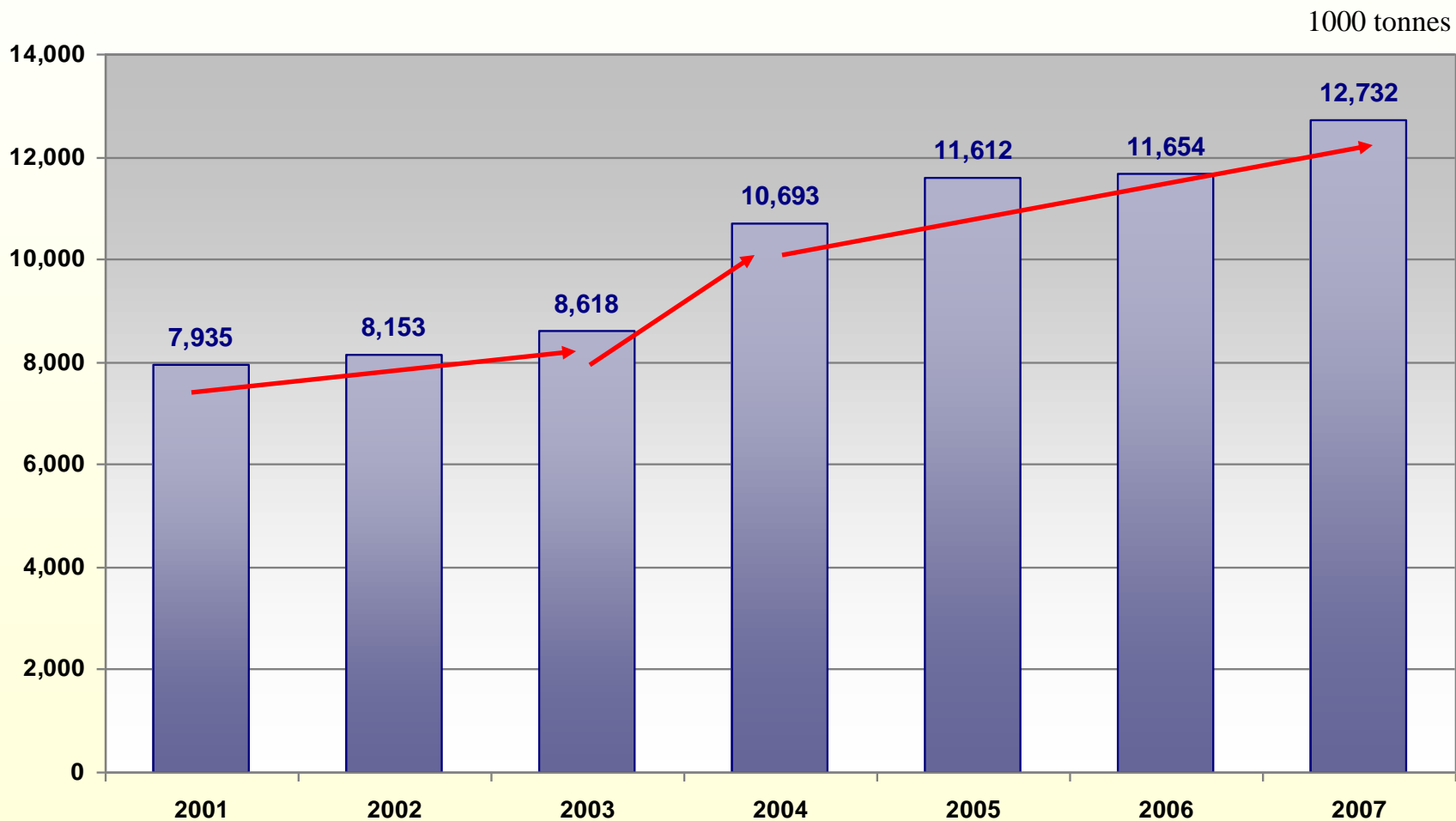




# *Manganese*

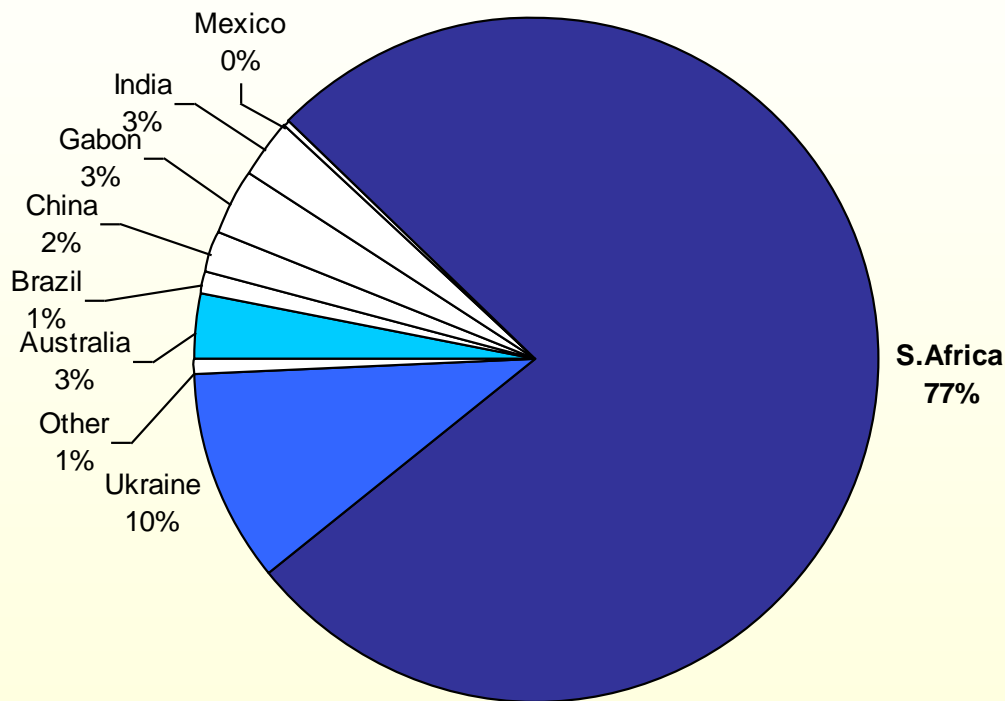


# World Manganese Ore Production





# Manganese Reserve Base 2007



Manganese reserves  
total  
**5.2 million tons**

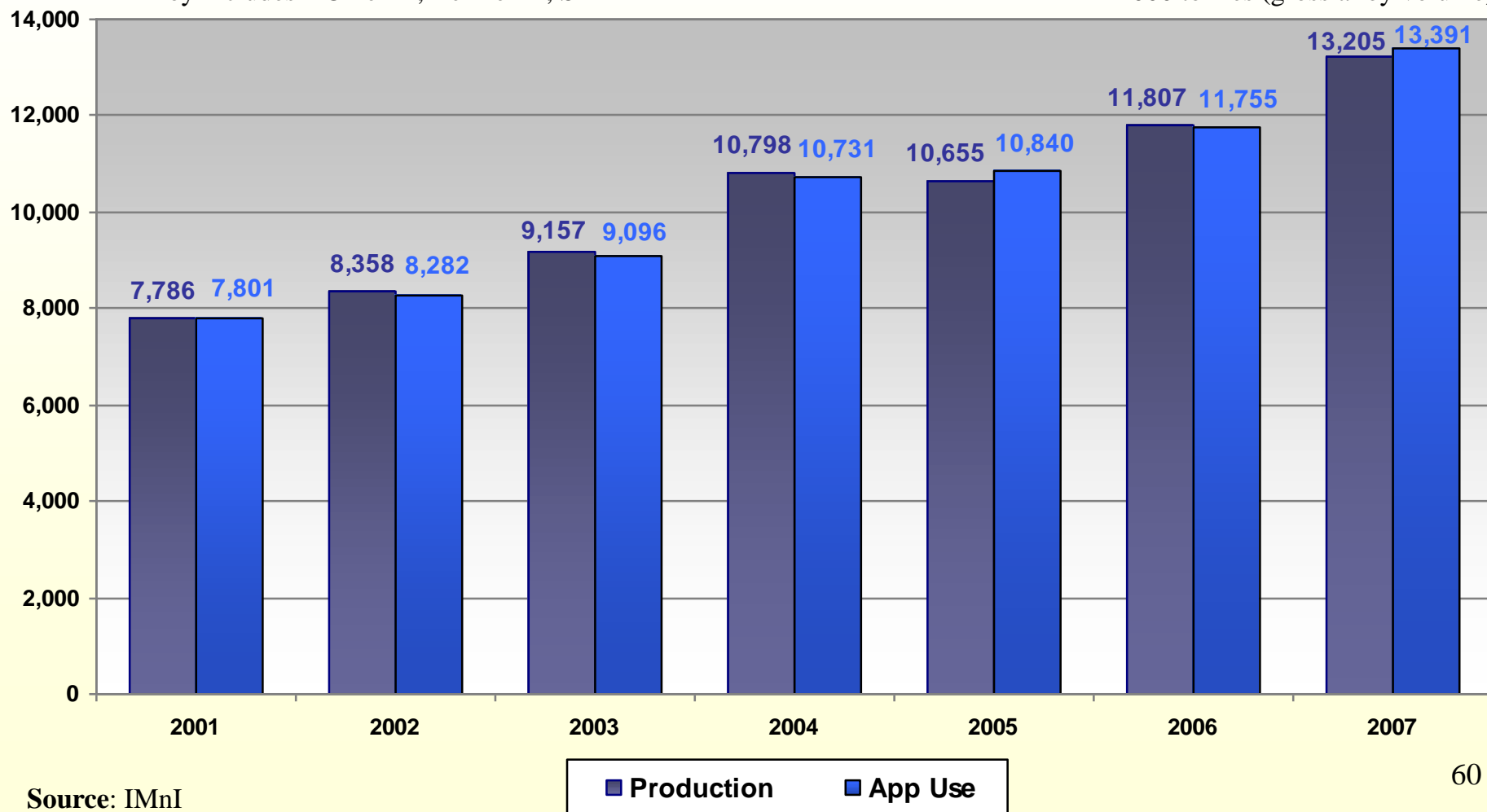
S. Africa and India include inferred resources



# World Manganese Alloy Production and App Use

Alloy includes HC FeMn, Ref FeMn, SiMn

1000 tonnes (gross alloy volume)

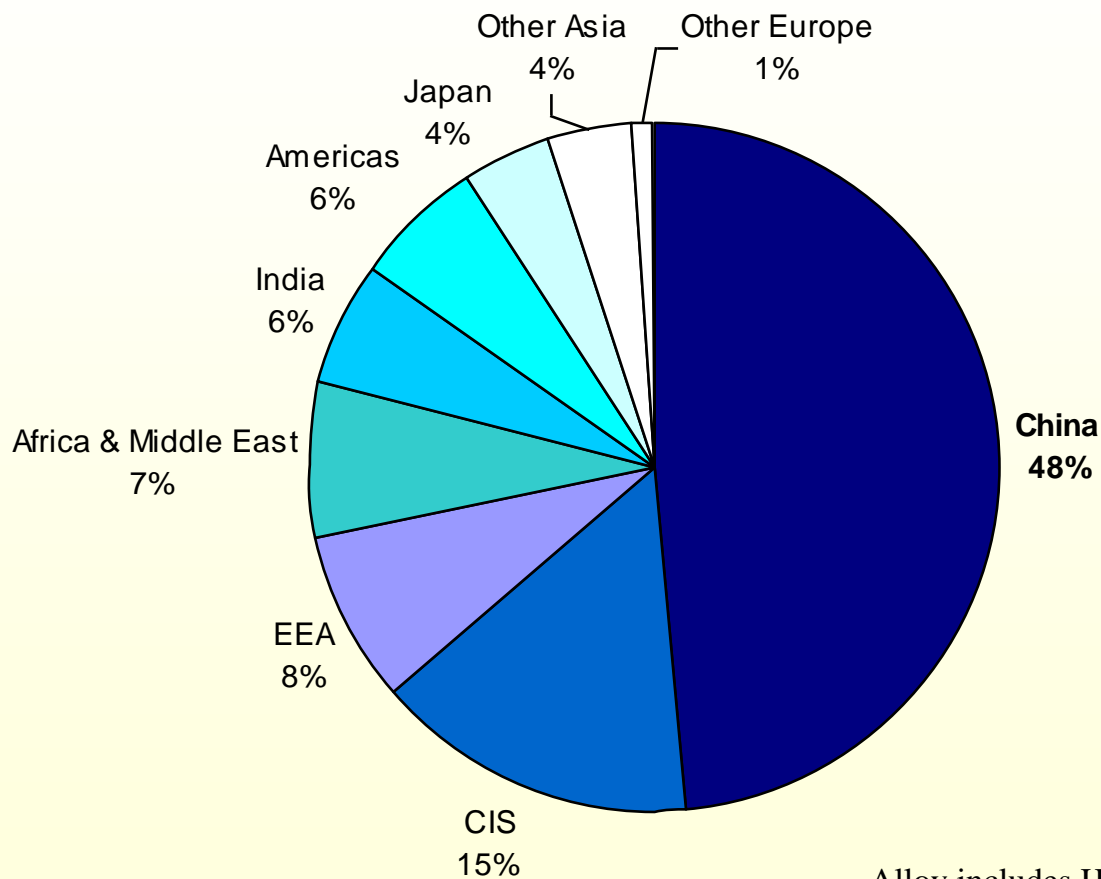


Source: IMnI



# World Manganese Alloys

- Production by Country / Region 2007 -



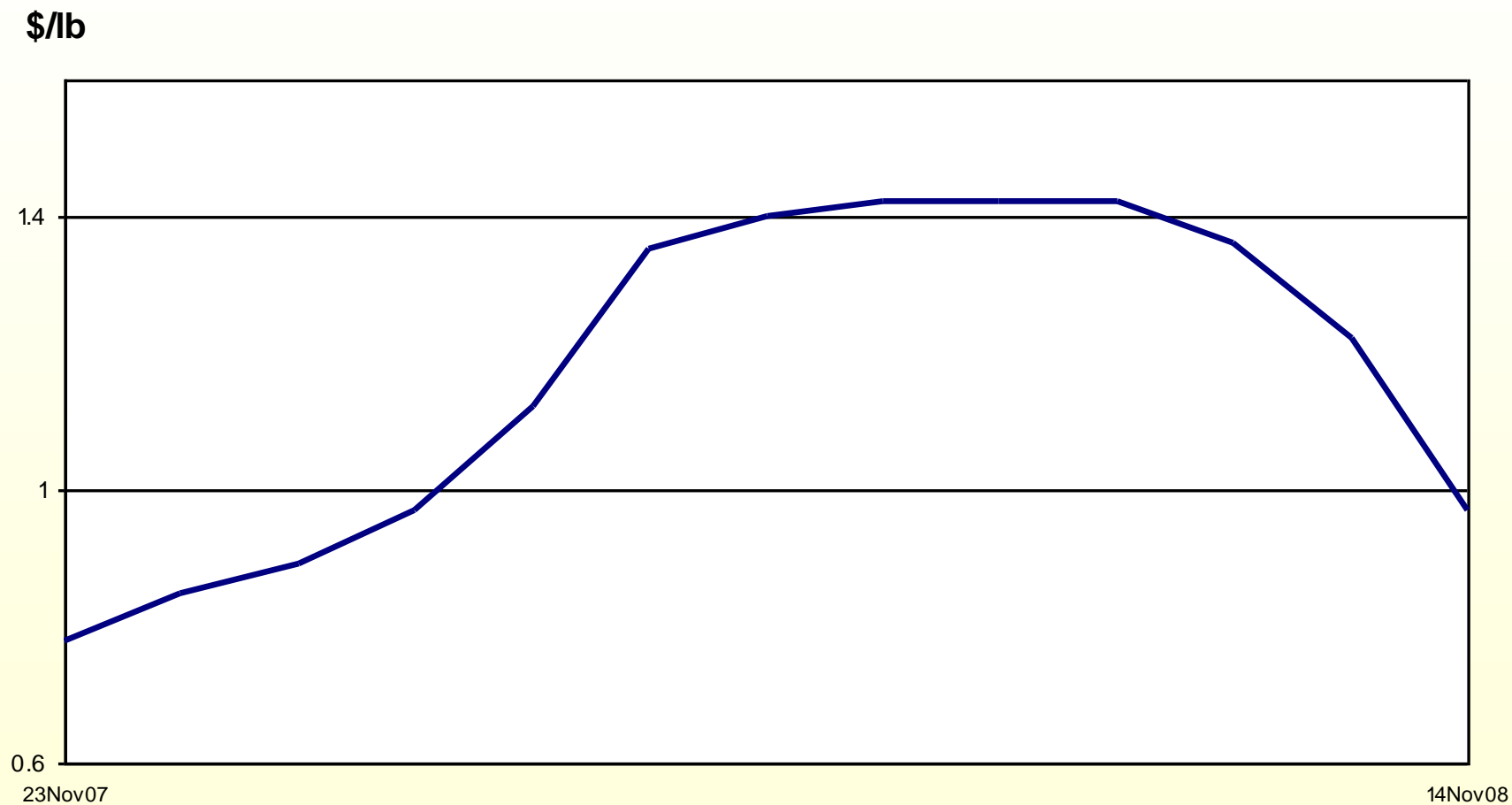
Alloy includes HC FeMn, Ref FeMn, SiMn

EEA includes France, Italy, Norway, Spain



# HC Ferromanganese

- Prices (N.America) -





# Manganese Market

## - Observations (1) -

- If only high grade ores (>44% Mn content) are considered → reserves are in the range of 680 million tons of ore
- Australia, Brazil, Gabon and South Africa supply over 90% of the international market for high grade ores
- About 85%-90% of all manganese used goes into steel as an alloying element
- Standard Ferromanganese (H.C. FeMn) contains around 78% of manganese
- World leading manganese alloys producers: Private Group (~20%), Eramet (~12%), BHP Billiton (~7%), Vale (~5%), Nippon Denko (~4%)

(Note: Eramet includes Tinfos, Norway, ~3%)



# Manganese Market

## - Observations (2) -

- China is a key driver for manganese alloys supply / demand and ore prices
- Prices have decreased in recent months, after increasing in the beginning of 2008
- Production cuts announced recently: BHP Billiton / Anglo American (Samancor: ore by 21% and alloy by 23% for 2009), some Chinese medium and small plants (excluding major producers) have suspended production of electrolytic manganese metal





# *Further Issues*

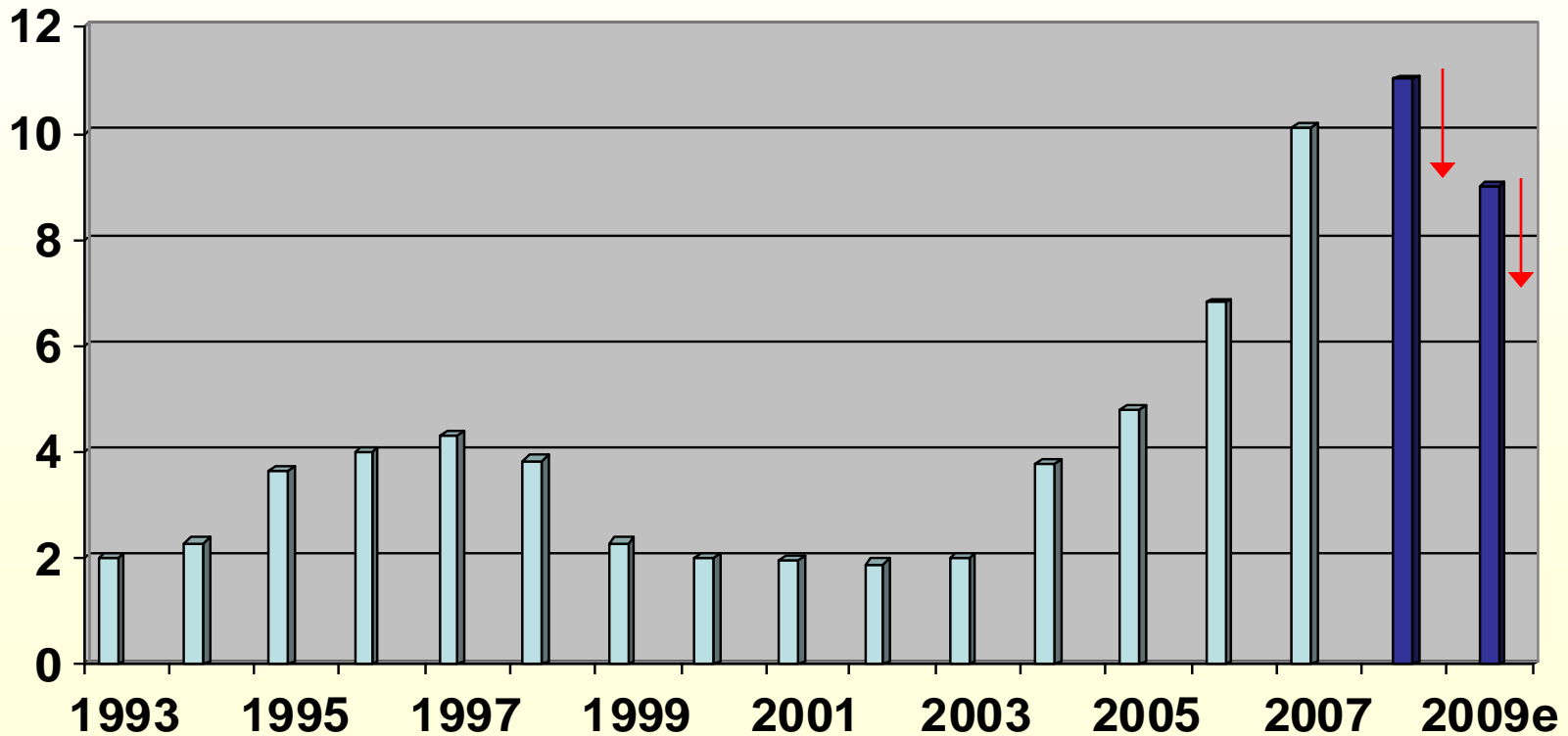


# Investment Outlook

## Global Mining Exploration Expenditure

*With 2008/2009 estimates*

*In US \$ billions*





# Investment Outlook

- Investment has tended to rise and fall in response to price movements
- A return to investment levels of the early 1990s or 2001-2003 is possible
- Decline in investment this time may be very rapid
- Fluctuations in exploration investment may be reflected 5 to 10 years later in supply, as new projects do not come through the pipeline in time to meet growing demand
- Therefore, the impact of the economic crisis will continue to be felt in the mining and metals industry for some time



## Further Issues

- Trade impacts - there are ongoing long term concerns on availability of raw materials and on potential protectionism
- Energy and environment – Emission Trading Scheme (ETS) will increase costs for the industry
- Regulatory issues – Nickel (e.g.) is subject to some important and potentially serious regulatory developments (read-across)



# Study Groups' Websites

**To learn more about the Groups:**

[www.icsg.org](http://www.icsg.org)

[www.insg.org](http://www.insg.org)

[www.ilzsg.org](http://www.ilzsg.org)



**Many thanks for your  
kind attention!**

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