



Steelmaking raw materials

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Introduction

Comprehensive view of the market structure of 12 steel raw material, including

- Supply: largest suppliers and reserves/resources
- Consumption and trade flows for each raw material
- Price movements and stocks of each raw material
- export restrictions and environmental/health issues related to the production of each raw material



List of steelmaking raw materials examined in the paper

- Main steelmaking raw materials (3)
 - **Iron ore** and **coking coal** are the two main inputs in the integrated steelmaking process
 - **Scrap** is used mainly in EAF but also in BOF
- Other metals used in smaller amounts (9)
 - In all or most steels : **manganese, silicon**
 - In some steels : **nickel, chromium, zinc and tin**
 - Minor alloying elements : **molybdenum, vanadium and tungsten**



Properties of minor metals in steel

- **Manganese:** Desulphurising (sulphur causes steel to crack) and as alloying element for strength and toughness
- **Silicon:** Used to de-oxidise steel
- **Nickel:** Anti-corrosion (nickel content in high quality stainless steel 8-10%)
- **Chromium:** Resistance to corrosion, temperature and wear (used in stainless steel (average content 18%))
- **Zinc:** Used to galvanise steel (enhances corrosion resistance)
- **Tin:** Brings protective coating to steel (used in food and drink cans)
- **Molybdenum:** Resistance to heat, corrosion (high-end steel). Brings weldability to steel (construction steel)
- **Vanadium:** Brings extreme hardness to steel (high-strength steel)
- **Tungsten:** Brings extreme hardness to steel (high-speed steel)



Steel industry share of the use of these metals, %

- **Manganese:** 90%. Used also in batteries.
- **Silicon:** 60%. Used also in construction materials and production of glass.
- **Chromium:** 75%. Used also in aerospace superalloys, iron castings, refractory products, paints, cosmetics and welding rods.
- **Nickel:** 60%. Used also in aerospace superalloys and batteries.
- **Zinc:** 60%. Used also in die-casting and in the production of brass and bronze.
- **Tin:** 20%. Used also in solder.
- **Molybdenum:** 60%. Used also in aircraft engine parts, chemicals and alloys for making tools.
- **Vanadium:** 85%. Used also in longer-range electric car batteries.
- **Tungsten:** 20%. Used also for making abrasives, knives and armaments, and in fluorescent lighting



Iron ore (2009)

- Share of steel industry in demand : 98%
- **Production** : 1.6 bn tonnes, 1. Australia (25%), 2. Brazil (19%), 3. India (16%)
- **Reserves** : 48 years of output, 1. Russia
- **Exports** : 954mmt : 1. Australia (38%), 2. Brazil (28%), 3. India (12%)
- **Imports:** 937 mmt : 1. China (67%), 2. Brazil (11%), 3. Europe (10%)



Coking coal (2009)

- Share of steel industry in demand : 100%
- **Production** : 794mmt, 1. China (52%), 2. Australia (16%), 3. Russia (7%)
- **Reserves** : 1. US, 2. China, 3. Russia
- **Exports** : 232mmt : 1. Australia (54%), 2. US (15%), 3. Indonesia (13%)
- **Imports**: 199 mmt : 1. China (26%), 2. China (18%), 3. India (12%)



Ferrous Scrap (2009)

- Share of steel industry in demand : 100%
- **Generation** : 424mmt, 1. China (17%), 2. US (16%), 3. Japan (9%)
- **Exports** : 92mmt : 1. US (24%), 2. Japan (11%), 3. Germany (8%)
- **Imports** : 91.2 mmt : 1. Turkey (17%), 2. China (15%), 3. South Korea (8%)



Manganese (2010)

- Share of steel industry in demand : 90%
- **Production** : 14 mmt, 1. South Africa (25%), 2. Australia (19%), 3. China (16%)
- **Reserves** : 44 years of output, 1. Ukraine
- **Exports** : 8mmt : 1. South Africa (37%), 2. Australia (29%), 3. Gabon (15%)
- **Imports** : 7mmt : 1. China (67%), 2. Ukraine (7%), 3. Norway (7%)



Silicon ferro-alloys (2010)

- Share of steel industry in demand : 60%
- **Production** : 8mmt, 1. China (64%), 2. Brazil (6%), 3. Russia (6%)
- **Reserves** : Ample
- **Exports** : 2.5mmt : 1. China (48%), 2. Norway (16%), 3. Russia (12%)
- **Imports** : 2.1mmt : 1. Japan (33%), 2. Germany (24%), 3. US (14%)



Chromium (2010)

- Share of steel industry in demand : 75%
- **Production** : 26 mmt, 1. South Africa (39%), 2. Kazakhstan (17%), 3. India (14%)
- **Reserves** : 13 yrs of output, 1. Kazakhstan
- **Exports** : 9mmt : 1. South Africa (57%) 2. Turkey (19%), 3. Kazakhstan (15%)
- **Imports** : 8mmt : 1. China (85%), 2. Russia (10%), 3. Turkey (1%)



Nickel (2010)

- Share of steel industry in demand : 60%
- **Production** : 1.5 mmt, 1. Russia (25%), 2. Indonesia (13%), 3. Philippines (13%)
- **Reserves** : 50 years of output, 1. Australia
- **Exports** : 20mmt : 1. Indonesia (53%), 2. Philippines (44%), 3. Australia (2%)
- **Imports** : 22mmt : 1. China (74%), 2. Japan (16%), 3. South Korea (5%)



Zinc (2010)

- Share of steel industry in demand : 60%
- **Production** : 12 mmt, 1. China (27%), 2. Australia (12%), 3. Peru (11%)
- **Reserves** : 20 years of output, 1. Australia
- **Exports** : 8mmt : 1. Peru (32%), 2. Australia (28%), 3. Bolivia (11%)
- **Imports**: 8mmt : 1. China (50%), 2. South Korea (17%), 3. Spain (12%)



Tin (2010)

- Share of steel industry in demand : 20%
- **Production** : 284 mmt, 1. China (34%), 2. Indonesia (32%), 3. Peru (12%)
- **Reserves** : 18 years of output, 1. China
- **Exports** : 30mmt : 1. Australia (40%), 2. Rwanda (17%), 3. Bolivia (17%)
- **Imports** : 54mmt : 1. Malaysia (43%), 2. Thailand (33%), 3. China (19%)



Molybdenum (2010)

- Share of steel industry in demand : 60%
- **Production** : 220 mmt, 1. China (40%), 2. US (24%), 3. Chile (17%)
- **Reserves** : 45 years of output, 1. China
- **Exports** : 175mmt : 1. Chile (41%), 2. US (17%), 3. Peru (13%)
- **Imports** : 159mmt : 1. China (39%), 2. Belgium (23%), 3. Chile (19%)



Vanadium (2010)

- Share of steel industry in demand : 85%
- **Production** : 64 mmt, 1. China (47%), 2. South Africa (22%), 3. Russia (11%)
- **Reserves** : 212 years of output, 1. China
- **Exportation** : 10mmt : 1. China (40%), 2. Russia (30%), 3. South Africa (20%)
- **Importation** : 8mmt : 1. Czech Republic (38%), 2. Korea (25%), 3. Japan (25%)



Tungsten (2010)

- Share of steel industry in demand : 20%
- **Production** : 61 mmt, 1. China (85%), 2. Russia (5%), 3. Canada (3%)
- **Reserves** : 47 years of output, 1. China



Summary of main findings (1/2)

	Largest three producing economies (% of world total)	Company	Reserves (years)	Major Producer	Major Consumer	Trade Policy	Environmental Impact
Iron ore	1. Australia (25%) 2. Brazil (19%) 3. India (16%)	Vale	48	Australia	China	Export duties and quantitative restrictions	environmental impact
Coking coal	1. China (52%) 2. Australia (16%) 3. Russia (7%)	BHP Billiton Mitsubishi	na	Australia	Japan	Export duties and quantitative restrictions	Significant environmental impact
Ferrous Scrap	1. China (17%) 2. US (16%) 3. Japan (9%)	na	na	United States	Turkey	Export duties and quantitative restrictions	Relatively undamaging
Manganese	1. South Africa (25%) 2. Australia (19%) 3. China (16%)	Joint venture of BHP Billiton and Anglo American Plc	44	South Africa	China	Export duties and quantitative restrictions	Toxic and explosive
Silicon ferro-alloys	1. China (64%) 2. Brazil (6%) 3. Russia (6%)	Erdos	Not estimated because ample	China	Japan		Relatively undamaging
Chromium	1. South Africa (39%) 2. Kazakhstan (17%) 3. India (14%)	International Mineral Resources	13	South Africa	China	Export duties (on waste) and quantitative restrictions	Very toxic



Summary of main findings (2/2)

	Largest three producing economies	Top producing company	Reserves in years of output at current production rate	Main exporter	Main importer	Trade restrictions	Environmental impact/toxicity
Nickel			50	Indonesia	China	Export duties and quantitative restrictions (both on waste)	Toxic
Zinc	5. Peru (11%)	Xstrata Plc	20	Peru	China	Export duties and quantitative restrictions	Mildly toxic
Tin	1. China (34%) 2. Indonesia (32%) 3. Peru (12%)	Yunnan Australia Resource Ltd		Indonesia	Malaysia	Export duties and quantitative restrictions	Least toxic industrial metal
Molybdenum	1. China (40%) 2. US (24%) 3. Chile (17%)	Freeport-McMoRan Copper & Gold		Peru	China	Export duties and quantitative restrictions	Mildly toxic
Vanadium	1. China (47%) 2. South Africa (22%) 3. Russia (11%)	Evraz Group		South Africa	Czech Republic	Quantitative restrictions (on waste)	Toxic
Tungsten	1. China (85%) 2. Russia (5%) 3. Canada (3%)	Xiamen Tungsten Co Ltd	47	China	China	Export duties and quantitative restrictions	Relatively undamaging

Level of reserves is not a constraint on supply

Export restrictions are frequent for steelmaking raw materials

Implications

- The potential for supply shocks is very large -> the costs of making steel might remain volatile
- Export restrictions on raw materials are widespread – hurting the competitiveness of steelmakers who rely on imports
- Ensuring secure and accessible supply of raw materials remains of major importance for the steel industry