Aluminium

Aluminium is the most abundant metal in the earths crust. It ranks second, next only to steel, in terms of volumes used due to its versatility, which stems from its excellent and diverse range of physical, chemical and mechanical properties. Aluminium, which is only one-third the weight of steel is highly resistant to most forms of corrosion, is non-magnetic, non-combustible, is non-toxic and impervious (hence used in the food and packaging industries) and is also a superb conductor of electricity. Other valuable properties include high reflectivity and rapid heat dissipation. The metal is malleable and easily worked by the common manufacturing and shaping processes.

2. Use of aluminium metal are as follows:-

- In construction- windows, doors, cladding, weather-proofing, light constructions such as conservatories and canopies.
- In transport- auto, aerospace, rail and marine industries.
- Packaging- protection, storage and preparation for food and drinks.
- Electrical uses- overhead conductors and underground power-lines and power cables.
- Water treatment and medicine-antacid to combat gastric upsets, anti-perspirants.
- Machineries and Equipments.
- Castings- Automobile components etc.
- Utensils.

In India the electrical sector is the largest consumer of aluminium. Bulk of the Aluminium usage is in overhead conductors and power cables used in generation, transmission and distribution of electricity. Aluminium is used in switchboards, coil windings, capacitors, and many other applications as well.

The global aluminium production which was 41.93 million tonnes in 2010 increased to 45.54 million tonnes in 2011, as per CRU Monitor-Aluminium. The Global aluminium production is forecast to increase by about 8.23% i.e. to 49.28 million tonnes in 2012. The world aluminium consumption in 2010 and 2011 was 40.96 million tonnes and 44.88 million tonnes respectively. India produced 15.25 lakh tonnes aluminium in 2009-10 and 16.29 lakh tonnes in 2010-11 which approximately was about 3.6% of world production.

India is endowed with rich bauxite reserve of 2300 million tonnes (approx. 6.76% of the world total) and ranks 5th in the world bauxite reserve base. The primary aluminium industry in India consists of three producers viz. National Aluminium Company Limited (NALCO), HINDALCO Industries Limited and The Vedanta Group comprising Bharat Aluminium Company Limited (BALCO), Madras Aluminium Company Limited (MALCO) and Vedanta Aluminium Limited(VAL). Vedanta Aluminium Limited(VAL) started its operations in April, 2008 and MALCO closed its operations since December, 2008. Out of these Companies, only NALCO is in the Public Sector. The production of aluminium by primary aluminium producers in the years 2009-10 to 2011-12 (upto December, 2011) is given at Table 3.4 and Sales figures of Aluminium in the years 2009-10 to 2011-12 (upto December, 2011) is given at Table 3.5.

Table 3.4
Production of Aluminium

(Unit in tonnes)

Name of the company	Aluminium production

	2009-10	2010-11	2011-12(upto December, 2011) Provisional**
NALCO	4,31,488	4,43,600	3,09,017
HINDALCO	5,55,404	5,43,670	4,31,757
VEDANTA GROUP	5,37,508	6,42,249	4,98,498
Total	15,24,400	16,29,519	12,39,272

** Compiled on the basis of information provided by primary aluminium producers to the Ministry.

Table 3.5
Sales Figures of Aluminium

(Unit in tonnes)

Items	2009-10	2010-11	2011-12 (upto December, 2011) Provisional
Domestic sales	11,58,964	13,19,431	9,90,959
Export sales	3,72,801	2,97,155	2,33,275
Total sales	15,31,765	16,16,586	12,24,234

The price of aluminium fixed by the primary producers is generally aligned to the London Metal Exchange (LME) prices. During financial year 2010-11, the average LME Aluminium price was USD 2257.34 per MT which was around 21% higher than the average LME aluminium price of USD 1865.71 per MT during 2009-10. During 2011-12 (upto December, 2011), the LME aluminium prices fell from a high of USD 2772 during April, 2011 to USD 1945 during December, 2011 and the average LME price during this period is USD 2364.35 per MT. Analysts cited the eurozone crisis and China's economic slowdown having impact on demand growth and weakening aluminium prices that have declined below many producers break-even level. However, downside potential is likely to remain limited because even at current price level, over 30% of world producers are operating at a cost level above the LME price with 70% of these producers based in China.

Downward movement of aluminium prices increased inflow of metal into LME warehouses and stocks rose from 4.6 million tonnes during April, 2011 to 4.9 million tonnes at the end of December, 2011.

A deteriorating demand outlook and suppressed market sentiment in Europe during 2012 due to unresolved debt crisis in Europe are likely to put pressure on aluminium prices over the next few months. Until the uncertainty in Europe eases, steady upward movement in price is not expected. This is expected to force additional metal from off-warrant holdings into LME warehouses, placing further pressure on metal prices. Analysts have forecast an average LME Aluminium prices during 2012 to be in the range of USD 2200 to USD 2300 per tonne.

COPPER INDUSTRY IN INDIA

Copper is a very important element and the oldest known commodity in the world that directly affects the world's economy. Copper is a malleable and ductile metallic element that is

an excellent conductor of heat and electricity as well as being corrosion resistant and antimicrobial. It is found in sulfide deposits (as chalcopyrite, bornite, chalcocite, covellite), in carbonate deposits (as azurite and malachite), in silicate deposits (as chrysycolla and dioptase) and as pure "native" copper. Archaeological evidence demonstrates that copper was one of the first metals used by humans and was used at least 10,000 years ago for items such as coins and ornaments in western Asia. Regardless of competition from substitutes like iron, aluminum, plastic & fibre, copper's chemical, physical and aesthetic properties make it a material of choice in a wide range of domestic, industrial and high technology applications. Copper is a critical metal being used in areas such as defence, space programme, railways, power cables, mint, electronics & communications, auto ancillaries etc.

At present, the demand for copper minerals for primary copper production is met through two sources i.e. Copper ore mined from indigenous mines and imported concentrates. The indigenous mining activity among the primary copper producers is limited to only Hindustan Copper Limited (HCL). The other primary copper producers in the private sector import the required mineral in the form of concentrate. Indian Copper ores have low grade and large scale mechanization in the underground mines is rendered difficult due to the geometry of the ore body (narrow width and a flatter inclination). Manufacture of primary copper based on indigenous ores is characterized by high energy consumption because of low scale of operations and minimal automation.

Till 1997, the only producer of primary refined copper was Hindustan Copper Limited (HCL), a public sector enterprise under the Ministry of Mines. The installed capacity for refined copper production at its two integrated copper plants was around 47,500 tonne per year, which used to meet approximately 25-30% of India's requirement for refined copper. The balance demand was met through imports. However, the scenario has changed drastically after coming of the other two primary producers of Copper in private sector namely M/s Hindalco Ind. Ltd. (Unit: Birla Copper) and M/s. Sterlite Industries (I) Ltd. Their present annual capacities are 5,00,000 MT and 4,00,000 MT of refined copper respectively. The plants of M/s Hindalco Ind. Ltd. (Unit: Birla Copper) and M/s Sterlite Industries (I) Ltd. are based on imported copper concentrate. Besides, another private player viz. M/s Jagadia Copper Ltd. (formerly SWIL Ltd.) had started operating its plant based on secondary route. Continuous Cast Rod (CCR) plants of M/s TDT and M/s Finolex are based on imported cathode. The capacity for production of primary copper in India has risen from a mere 47,500 tonnes per year till 1997 to 9,49,500 tonnes at present which excludes 50,000 tonnes from secondary route by M/s. Jagadia Copper Ltd.(which is not in operation currently), with the result that India is now a net exporter of refined copper. HCL enhanced its refined copper capacity to 49,500 tonnes in 2008.

The details of production of major players in copper industry during 2011-12 (upto December, 2011) are given in Table 3.6.

Table 3.6

(In tonnes)

Sl. No	Commodity	Unit of Prodn.	No. of Factories	Installed Capacity	Production during 2011-12 (upto Dec, 2011)
1	2	3	4	5	6
1	Cathode				
	a) HCL	tonnes	2	49,500	13,103
	b) Sterlite Industries (I) Ltd.	tonnes	1	4,00,000	2,45,494

	c) Hindalco Ind. Ltd. (Unit: Birla Copper	tonnes	1	5,00,000	2,35,528
	Total			9,49,500	4,94,125

PRICE OF COPPER

The domestic price of copper is linked to London Metal Exchange (LME) price. The LME Cash Settlement Price (CSP) is the basis on which prices of copper products are declared by domestic producers.

Customs duty on imported copper had been reduced in phases from 35% in 2002-03 to 5% at present leading to a steep reduction in price, which, in turn, affected the profitability of domestic copper manufacturers. HCL is the only Company having captive mines, whereas private producers have to depend on import of copper concentrate to operate their smelter & refining plants, and their profitability is strongly dependent on the international variation in Treatment Charges and Refining Charges.

3.33 The year wise average LME price per tonne of copper is shown in the Table 3.7.

Table 3.7

YEAR	Average LME price of Copper (US $ per ton)
1995-96	2844
1996-97	2257
1997-98	2096
1998-99	1581
1999-2000	1670
2000-2001	1806
2001-2002	1527
2002-2003	1586
2003-2004	2046
2004-2005	3000
2005-2006	4097
2006-2007	6970

2007-2008	7584
2008-2009	5864
2009-2010	6101
2010-2011	8140
2011-12 (upto December, 2011)	8544

TRENDS IN COPPER CONSUMPTION

Copper consumption in a country is an indicator of its level of economic development. Per capita consumption in India is in the order of 0.50 Kg as compared to 10 Kg in developed nations.

Per capita consumption of copper of China and other European countries are given below:

- China - 5.4 kg/person
- Germany - 13.6 kg/person
- Italy - 8.9 kg/person
- Russia - 3.3 kg/person
- USA - 5.5kg/person

Source: ICSG

The known mineral resources for copper within the country are few with low grades of copper with the average metal content being in the region of a mere 1% and the precious metal content being very low. HCL has access to over two-thirds of the copper ore reserves in India. IMC-SRGC has reviewed and classified HCL's mineral reserves and resources in accordance with the Australian Joint Ore Reserves Committee (JORC)'s Code. As per the assessment, HCL has estimated reserves of approx. 411.53 million tonnes of copper ore, with an average of 1.05% copper content as on 1st April, 2010.

As per the data of Indian Copper Development Centre (ICDC), during 2009-10 and 2010-11, total domestic refined copper usage was approximately 548,924 tonnes and 560,836 tonnes respectively, whereas, total world refined copper usage was 18,108,000 tonnes in 2009 and 19,386,000 tonnes (provisional) in 2010. International Copper Study Group (ICSG) expects world apparent refined usage in the year 2011 to grow by only 1.5% from that in 2010 to 19.7 million tonnes. For the year 2012, world usage is expected to grow by 3.6% mainly supported by a growth of 6% in China as the rest of the world is expected to grow by only 2%. However, the production and consumption of refined copper in 2011-12 would depend on the growth of the economy and LME price.

Electrical, Electronics and Telecommunications sectors account for nearly 52% of copper usage in India. The demand again is primarily from the telecom, power and infrastructural sectors. There has been substantial reduction in demand of copper in telecom sector with

increased application of Fibre optic cables and fast penetration of wireless communication through cell phones, Wireless in Local Loop and Direct to Home (DTH) Telecasting.

3.39 In the household wiring sector, despite many advantages of using copper conductors, aluminum conductors are widely used. The trend, however, has started reversing and increased usage of copper in this sector is perceptible. But unfortunately, in place of cables and wirings made from high grade electrolytic tough pitch copper, applications are mostly of cables and wirings made from "Scrap recycled" (commercial copper) resulting to substantial electrical energy loss to the country without counting indirect losses and other costs due to failure of these wirings. Usage of copper in building construction, as prevalent in Western World, is slowly making inroads into the country, mainly in metro cities and industrial projects.

The projection of refined production capacities of major Asian counties upto year 2015 is given below:

(in million tonnes)

Country	2011	2012	2013	2014	2015
China	5.23	6.07	6.50	6.99	7.09
India	0.99	0.99	1.41	1.41	1.41
Iran	0.25	0.25	0.25	0.27	0.70
Japan	1.71	1.71	1.71	1.71	1.71
Kazakhstan	0.52	0.59	0.60	0.62	0.62
Korea Republic	0.60	0.60	0.60	0.60	0.60
Philippines	0.21	0.21	0.21	0.21	0.21

Source :- ICSG

Projection for LME for copper, Tc/Rc rates and Marketing trends in the world are given below:

Long terms LME copper price and Tc/Rc charges are projected by different commodity forecasters of the world periodically based on market trends and assumption for the future. The data of the forecast also is not consistent among all the firms and vary across for all the years.

International Copper Study Group (ICSG), a intergovernmental organization based at Lisbon, regularly projects a forecast of the world's supply demand of copper based on the inputs received from all the countries. The projections of ICSG shared its last meeting held on September,2011 is given below:

(a) According to preliminary ICSG data, global growth in copper demand for 2011 is expected to exceed global growth in copper production, and a production deficit of about 200,000 metric tonnes of refined copper is projected for the full year. For the year 2012, ICSG data projections indicate a deficit of about 250,000 tonnes as supply growth will continue to lag behind demand growth. By 2013, however, increased production and lower growth in demand are expected to yield a nearly balanced market.

(b) In developing its projections, the International Copper Study Group recognized that numerous factors including a world economic slow down, European Union sovereign debt issues, political disturbances in the Middle East and North Africa, and market price volatility create significant uncertainty, and that the global market balances could vary from

those projected. In the first half of 2011, operational problems, lower head grades, adverse weather conditions and labor unrest combined to constrain mine output and production for 2011 is now anticipated to grow by only 0.7%.

(c) Capacity utilization rates for the year 2011 are expected to be around 79%, 1% lower than in 2010. Although producers anticipate a strong growth of 9% [1.5 million metric tons (Mt)] in 2012 (mainly due to higher capacity utilization at existing mines as few new projects are expected to start), it is expected that the actual increase will be significantly lower as production disruptions, which have become the norm in recent years, continue.

(d) World refined copper production for the year 2012 (adjusted for production disruptions) is therefore projected to increase by only about 3.4% to 20.1 Mt from 19.5 Mt in 2011. Secondary refined production (from scrap), which is anticipated to increase by around 10% in 2011, is expected to grow by only 5% in 2012.

(e) ICSG expects world apparent refined usage in the year 2011 to grow by only 1.5% from that in 2010 to 19.7 Mt. The 0.7% growth rate of the first half of 2011 is anticipated to improve to 2.3% in the second half owing to an expected recovery in China apparent usage.

ISCG World Copper Forecast:-

Particulars	2010	2011	2012	2013
World Mine Production (Million tonne)	15.97	16.09	17.60	18.86
Refined Production (Million tonne)	19.03	19.69	20.85	21.78
Consumption (Million tonne)	18.83	19.71	20.45	21.30
Refined balance	1.99	-2.20	-3.0	-0.12

Projection for mining and making the lower grading minerable.

The Company at its Malanjkhand unit has large reserves of low grade sulphide copper ore. The estimated reserve of low grade is around 80.0 million tonne with an average grade of 0.3%. Due to limited capacity of concentrator plant at Malanjkhand, the milling of large quantity of low grade of ore is constraint. However, the Company is looking for appropriate technology for liquidation of above low grade.

In the year 2008-09, HCL had collaborated with Institute of Minerals & Materials Technology (IMMT), Bhubneshwar to develop bacterial leaching technique at MCP to treat low grade ore. However, experimental trials of the technique were not successful for commercialization.

Lead & Zinc

As per the data made available by the Indian Bureau of Mines (IBM), the production of zinc is more than its consumption in the country. However, there appears to be shortage of lead in the country as its production is less than its consumption. During the year 2010-11(P), the production of primary lead was 57294 tonnes and that of zinc metal was 740402 tonnes. As against this, the apparent consumption of lead was 181526 tonnes and that of zinc was 545342 tonnes in 2010-11(P). The exact details of demand and supply of lead and zinc are not maintained as Lead and Zinc are freely importable as per the import policy of the Government. Data relating to export/ import of lead and zinc and the data regarding apparent consumption/production of lead and zinc for the years 2008-09, 2009-10 and 2010-11 (provisional) is shown at Table 3.8 and Table 3.9.

Table 3.8
Production Imports/Exports and Apparent consumption of Lead (2008-09 to 2011-12

(Quantity in Tonnes)

Item	2008-09	2009-10	2010-11	2011-12 (Up to June -2011)
			(Provisional)	(Provisional
Total produvtion Lead (primary)	60323	64319	57294	14801
Total imports*	209455	253275	285662	46767
Total exports*	12566	53779	161430	NA
Apparent consumption	257212	263815	181526	NA

* Lead and alloys & scrap (Apparent Consumption = Production + Imports - Exports)
NA: Not available

Table 3.9
Production Imports/Exports and Apparent consumption of Lead (2008-09 to 2011-12)

Item	2008-09	2009-10	2010-11	2011-12 (Up to June -2011)
			(Provisional)	(Provisional)
Total produvtion Zinc (ingots)	579091	613964	740402	200190
Total imports* *	94694	153920	112228	27252
Total exports* *	209434	175767	307288	NA
Apparent consumption	464351	592117	545342	NA

* *Zinc and alloys & scrap (Apparent Consumption = Production + Imports - Exports)
NA: Not available

Rare Earth Elements

There are 17 Rare Earth elements (REEs), 15 within the chemical group called lanthanides, plus yttrium and scandium. The lanthanides consist of the following: lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. Rare earths are not rare in the sense of their abundance, but have earned this descriptive because they are rarely concentrated enough for an easy recovery from their ores.

Rare earths are characterized by high density, high melting point, high conductivity and high thermal conductance. These unique properties make them indispensible for a variety of emerging and critical technology applications relevant to India's energy security. i.e. clean energy technology, defense and civilian application etc.

Given the concerns over China's flexing of its muscle on the international stage by restricting Rare Earth exports, a wave of Mining projects are reviewed worldwide to tap sizable deposits of Rare Earth. Lyna Corporation's new mining operation in Australia and Molycorop's

plan to restart Mothballed Mountain Pass Mines is a step in this direction. It has also encouraged further exploration and spurring more recycling of Rare Earths.

SUPPLY AND DEMAND

The demand for rare earths has grown enormously in recent times as they have become essential for many new technologies. The demand shows no signs of abating. In 2015 the world's industries are forecast to consume an estimated 185 000 tonnes of rare earths, 50 % more than the total for 2010. It is felt that the discovery of new deposits will not be able to meet the increase in demand as the time lag involved in exploration of new deposits and their eventual production will be about 10 years.

As regards the available resources of REE, China has 48 % of the world's reserves; the United States has 13 %. Russia, Australia, and Canada have substantial deposits as well. Recently, it is discovered that Afghanistan may have large deposits of rare earth metals, occurring on the south bank of the Helmand River in southern Afghanistan.

INDIAN SCENARIO

In India, monazite is the principal source of rare earths, which is a prescribed substance as per the notification under the Atomic Energy Act, 1962. Indian Rare Earths Limited (IREL) has been the sole producer of RE compounds in the country. The recovery of Rare Earth Elements from Monazite has been restricted due to its high thorium content.

AMD has been carrying out its resource evaluation of Monazite for over five decades. It occurs in association with other heavy minerals, such as ilmenite, rutile, zircon, etc. in concentrations of 0.4 - 4.3% of total heavies in the beach and inland placer deposits of the country. The resource estimates of monazite in the beach and inland placer deposits have been enhanced from 7.90 million tonnes in 2002 to 10.21 million tonnes in 2005.

The state wise resources of Monazite are given at Table 3.10.

Table 3.10
Resources of Monazite

(In million tonnes)

Andhra Pradesh	3.73
Bihar	0.22
Kerala	1.37
Odisha	1.82
Tamil Nadu	1.85
West Bengal	1.22
All India	10.21*

Source: Department of Atomic Energy, Mumbai.

Keeping this in view and increasing demand of these metals for high tech applications, Ministry of Mines has stressed the need to incentivize exploration & process R&D for creating indigenous production capacities. To achieve this, a high level Steering Committee has been constituted to look into the current availability of Rare Earth and to suggest short medium and long term

strategies for exploration, production, and processing of RE, to ensure long term availability of the raw material.

Indian Rare Earths Limited (IREL) which has stopped production of Rare Earth Elements (REE) in wake of cheaper competition from China, plans to restart the production of REE (2250 tonne per year) by the last qtr of 2012 from its plant located at Odisha & Kochi. There is a need for concerted efforts both by GSI and AMD to explore the primary source of Rare Earth Elements. GSI plans to give high priority to the exploration of primary sources of REE during the 12th Five year plan.