

LEAD & ZINC



Indian Minerals Yearbook 2017

(Part- II : Metals & Alloys)

56th Edition

LEAD AND ZINC

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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March, 2018

10 Lead & Zinc

Lead is a soft, heavy, toxic and highly malleable metal. It is bluish white when freshly cut, but tarnishes to dull grey when exposed. Both lead & zinc are found to occur together in ore along with other metals like silver and cadmium. Zinc is a silvery blue-grey metal with a relatively low melting and boiling point.

World wide largest single use of lead today is in the manufacture of lead-acid storage batteries about 74%, while the single largest use for zinc is in the Galvanising Industry about 50%.

The country has the self-sufficiency in respect of zinc. In contrast, there is short supply of lead vis-a-vis the demand in the country.

The ever increasing demand for lead especially from Lead Acid Battery Sector is met by the thriving market of lead scrap recycling. Government of India has enacted Battery Management and Handling Rule (BMHR), 2002, which will further increase the availability of scrap from the Organised Sector. It is estimated that 56% of refined lead produced worldwide is from recycled material. Producing lead through this route requires around one-third of the energy needed to extract it from its ores. Recovery of secondary zinc and lead is economically more attractive because of certain advantages. Besides, lower energy consumption, it also entails low capital cost, less environmental hazards and high metal contents.

HZL is the only producer of primary lead and primary zinc in 2016-17 due to shutdown of the operation of Edayar Zinc Limited (EZL). Edayar Zinc Limited (Formerly Binani Zinc Limited) produced zinc from imported concentrates. During the year 2016-17, EZL did not operate its plant and the company has referred board for BIFR and the case is pending for determination of its sickness.

RESERVES / RESOURCES

The total reserves/ resources of lead and zinc ore as on 1.4.2015 as per NMI data based on UNFC system have been estimated at 749.46 million tonnes. Of these, 106.12 million tonnes (14.16%) fall under 'reserves' category while balance 643.34 million tonnes (85.84%) are classified as 'remaining resources'.

The reserves/resources of ore containing + 10% Pb & Zn were estimated at 124.23 million tonnes (16.57%), ore containing 5 to 10% Pb & Zn were 329.88 million tonnes (44%) and ore containing less than 5% Pb & Zn were 295.35 million tonnes (39.41%).

The total metal content in reserves/ resources of lead is 13 million tonnes and that of zinc is 36.36 million tonnes and for lead & zinc metal is 0.14 million tonnes. In terms of reserves, 2.48 million tonnes of lead metal and 9.99 million tonnes of zinc metal have been estimated. Rajasthan is endowed with the largest reserves/ resources of lead-zinc ore amounting to 670.34 million tonnes (89.44%), followed by Andhra Pradesh 22.69 million tonnes (3.03%), Madhya Pradesh 14.84 million tonnes (1.98%), Bihar 11.43 million tonnes (1.52%) and Maharashtra 9.27 million tonnes (1.24%). Resources are also established in Gujarat, Meghalaya, Odisha, Sikkim, Tamil Nadu, Uttarakhand and West Bengal (Table-1).

EXPLORATION & DEVELOPMENT

The Exploration & Development detail, if any, are given in the review on Exploration & Development in "General Reviews".

**Table – 1 : Reserves/Resources of Lead & Zinc Ore as on 1.4.2015
(By Grades/States)**

(In '000 tonnes)

Grade/State	Reserves				Remaining resources				Total resources (A+B)				
	Proved STD111	Probable		Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332		Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122		STD221	STD222							Total (A)
All India													
Ore	31662	68687	5767	106116	5564	17411	31297	37055	192083	355403	4530	643343	749459
Lead metal	624.56	1666.02	191.76	2482.34	119.31	521.74	780.56	690.65	2171.43	6237.67	-	10521.36	13003.7
Zinc metal	2871.75	6728.14	399.63	9999.52	364.08	940.26	1362.05	1941.94	7931.06	13722.2	101.65	26363.24	36362.76
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	120.76	22.37	143.13	143.13
By Grades													
Ore with (+)10% Pb & Zn	17597	36790	-	54387	155	148	81	-	24850	44605	-	69839	124226
Ore with 5-10 % Pb & Zn	14065	31897	5767	51729	5280	17146	31216	32449	29335	162730	-	278156	329885
Ore with (-)5% Pb & Zn	-	-	-	-	129	117	-	4606	137898	148068	4530	295348	295348
Lead metal	624.56	1666.02	191.76	2482.34	119.31	521.74	780.56	690.65	2171.43	6237.67	-	10521.36	13003.7
Zinc metal	2871.75	6728.14	399.63	9999.52	364.08	940.26	1362.05	1941.94	7931.06	13722.2	101.65	26363.24	36362.76
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	120.76	22.37	143.13	143.13
By States													
Andhra Pradesh													
Ore	-	-	-	-	-	-	-	1000	4159	17530	-	22689	22689
Lead metal	-	-	-	-	-	-	-	28.70	119.53	688.65	-	836.88	836.88
Zinc metal	-	-	-	-	-	-	-	12.40	43.57	7.19	-	63.16	63.16
Bihar													
Ore	-	-	-	-	-	-	-	-	435	11000	-	11435	11435
Lead metal	-	-	-	-	-	-	-	-	-	24	-	24	24
Zinc metal	-	-	-	-	-	-	-	-	14.75	24.00	-	38.75	38.75
Gujarat													
Ore	-	-	-	-	2470	3010	1380	129	-	200	-	7189	7189
Lead metal	-	-	-	-	74.1	90.3	41.4	3.9	-	-	-	209.70	209.70
Zinc metal	-	-	-	-	123.5	150.5	69	1.1	-	-	-	344.10	344.10
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	0.9	-	0.90	0.90
Madhya Pradesh													
Ore	-	-	-	-	129	117	-	1510	4006	5930	3150	14841	14841
Lead metal	-	-	-	-	-	-	-	26.12	5.13	5.04	-	36.29	36.29
Zinc metal	-	-	-	-	5.2	4.71	-	114.76	41.93	186.02	101.12	453.74	453.74
Maharashtra													
Ore	-	-	-	-	-	-	-	1967	6305	1000	-	9272	9272
Zinc metal	-	-	-	-	-	-	-	133.56	428.11	28	-	589.67	589.67

(Contd.)

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(In 000' tonnes)

Grade/State	Reserves				Remaining resources							Total resources (A+B)	
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)		
		STD121	STD122										STD221
Meghalaya													
Ore	-	-	-	-	-	-	-	880	-	-	-	880	880
Lead metal	-	-	-	-	-	-	-	16.50	-	-	-	16.50	16.50
Zinc metal	-	-	-	-	-	-	-	14.00	-	-	-	14.00	14.00
Odisha													
Ore	-	-	-	-	961	119	-	-	670	-	-	1750	1750
Lead metal	-	-	-	-	34.32	4.25	-	-	38.39	-	-	76.96	76.96
Rajasthan													
Ore	31662	68687	5767	106116	2965	12888	29734	170547	317929	1380	564221	670338	670338
Lead metal	624.56	1666.02	191.76	2482.34	45.21	390.22	733.23	1860.47	5462.09	-	8982.04	11464.38	11464.38
Zinc metal	2871.75	6728.14	399.63	9999.52	235.38	772.17	1289.91	7145.53	13435.31	0.53	24392.98	34392.5	34392.5
Lead & Zinc metal	-	-	-	-	-	-	-	-	119.86	22.37	142.23	142.23	142.23
Sikkim													
Ore	-	-	-	-	-	436	64	300	150	-	950	950	950
Lead metal	-	-	-	-	-	6.9	1.68	-	-	-	8.58	8.58	8.58
Zinc metal	-	-	-	-	-	12.88	3.14	3	1.05	-	20.07	20.07	20.07
Tamil Nadu													
Ore	-	-	-	-	-	-	-	200	590	-	790	790	790
Lead metal	-	-	-	-	-	-	-	2.26	5.48	-	7.74	7.74	7.74
Zinc metal	-	-	-	-	-	-	-	11.76	24.76	-	36.52	36.52	36.52
Uttarakhand													
Ore	-	-	-	-	-	-	-	3170	1790	660	5620	5620	5620
Lead metal	-	-	-	-	-	-	-	138.85	34.25	9.50	182.60	182.60	182.60
Zinc metal	-	-	-	-	-	-	-	151.21	87.99	27.63	266.83	266.83	266.83
West Bengal													
Ore	-	-	-	-	-	-	-	3371	335	-	3706	3706	3706
Lead metal	-	-	-	-	-	-	-	130.07	10.00	-	140.07	140.07	140.07
Zinc metal	-	-	-	-	-	-	-	130.42	13.00	-	143.42	143.42	143.42

Figures rounded off.

PRODUCTION & STOCKS

Lead & Zinc Ores and Concentrates

The entire output of lead & zinc ore and concentrates in 2015-16 and 2016-17 was reported by mines owned by Hindustan Zinc Ltd, a private sector company (Tables- 2 to 8).

The production of lead and zinc ore at 11.88 million tonnes in 2016-17 increased by 13.7% as compared to that in the previous year (Tables-2 & 3). The metal content of lead and zinc in the ore produced in 2016-17 works out to 2,15,066 tonnes and 8,96,572 tonnes respectively as against the corresponding figures of 1,96,670 tonnes and 8,20,636 tonnes in the previous year.

During the year 2016-17, 10.84 million tonnes of lead & zinc ore was treated as against 10.66 million tonnes in 2015-16 (Table-4).

The production of lead concentrates in 2016-17 at 2,68,051 tonnes increased by about 2.4% as compared to the previous year. Entire production of lead concentrates was reported from Rajasthan (Tables - 5 & 6).

The production of zinc concentrates increased marginally from 14,73,811 tonnes in 2015-16 to 14,84,245 tonnes in 2016-17. The entire production of zinc concentrates was reported from Rajasthan (Tables - 7 & 8).

Grade Analysis

All India average metal content of ore treated during 2016-17 worked out to be 9.46% (1.81% Pb and 7.65% Zn) as against 9.71% (1.85% Pb and 7.86% Zn) in 2015-16. The metal content of ore treated at Rampura Agucha mine in Bhilwara district Rajasthan was the highest at 13.05% (1.68% Pb and 11.37% Zn). The lead concentrates produced during 2016-17 were of grade 56.32% Pb as against 54.88% Pb in 2015-16. Metal content of zinc concentrates produced worked out to 50.92 % Zn in 2016-17 as against 50.26 % Zn in the previous year.

Stock

Mine-head closing stocks of lead concentrates in 2016-17 were 7,918 tonnes as against 10,375 tonnes in 2015-16. The entire quantity of the stocks at the end of the year was held in Rajasthan (Table-9).

Mine-head closing stocks of zinc concentrates in 2016-17 were 66,596 tonnes as against 29,529 tonnes in 2015-16. The entire quantity of the stocks was held in Rajasthan (Table-10).

Employment

The average daily labour employed in lead and zinc mines during the year under review was 7,397 as against 7,018 in 2015-16.

Lead and Zinc Metals

The production of primary lead during 2016-17 decreased to 1,42,231 tonnes from 1,45,257 tonnes in the previous year. The entire output of primary lead was from Chanderiya and Dariba smelters of Hindustan Zinc Ltd.

The production of zinc ingot metal at 6,72,010 tonnes in 2016-17 decreased by 11.4% as compared to that in the previous year. Hindustan Zinc Ltd, contributed 100 % of the total output. (Tables - 11 to 14).

Table - 2 : Producers of Lead & Zinc Ore, Concentrates & Metals, 2016-17

Name and address of the producer	Location	
	State	District
Hindustan Zinc Ltd, Yashad Bhavan, Udaipur - 313 004, Rajasthan.	Rajasthan	Ajmer Bhilwara Rajasmand Udaipur

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**Table – 3 : Production of Lead and Zinc Ore, 2015-16 and 2016-17
(By State)**

(In tonnes)

State	2015-16			2016-17 (P)		
	Ore Produced	Metal content		Ore Produced	Metal content	
		Lead (Pb)	Zinc (Zn)		Lead (Pb)	Zinc (Zn)
India/	10453038	196670	820363	11881236	215066	896572
Rajasthan	10453038	196670	820363	11881236	215066	896572

**Table – 4 : Lead and Zinc Ore Treated, 2015-16 and 2016-17
(By State)**

(In tonnes)

State	2015-16			2016-17 (P)		
	Ore Treated	Metal content		Ore Treated	Metal content	
		Pb	Zn		Pb	Zn
India/	10657035	196803	837672	10836827	196471	828814
Rajasthan	10657035	196803	837672	10836827	196471	828814

**Table – 5 : Production of Lead Concentrates, 2014-15 to 2016-17
(By State)**

(Quantity in tonnes; Value in ₹'000)

State	2014-15		2015-16		2016-17 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/	197668	5640013	261857	7885122	268051	9669168
Rajasthan	197668	5640013	261857	7885122	268051	9669168

**Table – 6 : Production of Lead Concentrates, 2015-16 and 2016-17
(By Sector/State/Districts)**

(Quantity in tonnes; Value in ₹'000)

State/District	2015-16				2016-17 (P)			
	No. of mines	Production			No. of mines	Production		
		Quantity	Pb%	Value		Quantity	Pb%	Value
India/	8	261857	54.88	7885122	8	268051	56.32	9669168
Private Sector	8	261857	54.88	7885122	8	268051	56.32	9669168
Rajasthan	8	261857	54.88	7885122	8	268051	56.32	9669168
Ajmer*	1	-	-	-	1	-	-	-
Bhilwara	1	109631	57.62	2814277	1	102068	59.33	3294063
Rajsamand	2	108196	51.40	3130270	2	116939	53.17	4278705
Udaipur	4	44030	56.62	1940575	4	49044	57.54	2096400

*: Reported production of lead and zinc ore only and processing is done along with ore produced from Rampura Agucha mine at Bhilwara.

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**Table – 7 : Production of Zinc Concentrates, 2014-15 to 2016-17
(By State)**

(Quantity in tonnes; Value in ₹'000)

State	2014-15		2015-16		2016-17 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/	1489374	31572181	1473811	34943088	1484245	43385607
Rajasthan	1489374	31572181	1473811	34943088	1484245	43385607

**Table – 8 : Production of Zinc Concentrates, 2015-16 & 2016-17
(By Sector/State/Districts)**

(Quantity in tonnes; Value in ₹'000)

State/District	No. of mines	2015-16			No. of mines	2016-17 (P)		
		Production				Production		
		Quantity	Zn%	Value		Quantity	Zn%	Value
India/	@	1473811	50.26	34943088	@	1484245	50.92	43385607
Private Sector	@	1473811	50.26	34943088	@	1484245	50.92	43385607
Rajasthan	@	1473811	50.26	34943088	@	1484245	50.92	43385607
Bhilwara	@	1179362	49.87	25317206	@	1129276	50.74	30741266
Rajsamand	@	235492	50.67	7021246	@	290994	50.21	9907697
Udaipur	@	58957	56.44	2604636	@	63975	57.44	2736644

@ Associated mines with lead concentrates.

**Table – 9 : Mine-head Closing Stocks of Lead Concentrates, 2015-16 & 2016-17
(By State)**

(In tonnes)

State	2015-16	2016-17 (P)
India/	10375	7918
Rajasthan	10375	7918

Table – 11 : Production of Lead Metal, 2014-15 to 2016-17

(Quantity in tonnes; Value in ₹'000)

Year	Lead Primary	
	Quantity	Value
2014-15	127142	18759110
2015-16	145257	20363511
2016-17 (P)	142231	23270410

**Table – 10 : Mine-head Closing Stocks of Zinc Concentrates, 2015-16 & 2016-17
(By State)**

(In tonnes)

State	2015-16	2016-17 (P)
India	29529	66596
Rajasthan	29529	66596

Table – 12 : Production of Zinc Metal, 2014-15 to 2016-17

(Quantity in tonnes; Value in ₹'000)

Year	Zinc Ingots	
	Quantity	Value
2014-15	732792	119987141
2015-16	758944	108928344
2016-17 (P)	672010	128211275

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**Table – 13 : Production of Lead (Primary), 2015-16 and 2016-17
(By State/Plant)**

(Quantity in tonnes; Value in ₹'000)

State	Plant	2015-16		2016-17 (P)	
		Quantity	Value	Quantity	Value
India		145257	20363511	142231	23270410
Rajasthan	HZL Chanderiya/ Dariba	145257	20363511	142231	23270410

**Table – 14 : Production of Zinc (Ingots), 2015-16 and 2016-17
(By States/Plants)**

(Quantity in tonnes; Value in ₹'000)

State	Plant	2015-16		2016-17 (P)	
		Quantity	Value	Quantity	Value
India		758944	108928344	672010	128211275
Rajasthan	HZL Chanderiya/ Debari/Dariba	758944	108928344	672010	128211275

MINING & MILLING

HZL is the only integrated lead and zinc producer in the country. Its operation can be classified into mining and smelting. At present, HZL's eight mines and all mining operations are located in Rajasthan. Eight mines are Rampura-Agucha mine (Bhilwara district), Kayad mine (Ajmer district), Rajpura-Dariba mine, Sindesar-Khurd mine (both in Rajsamand district) and Zawar group of mines (4 mines in Udaipur district), Rajasthan. Rampura-Agucha is the combination of opencast mine and underground mine of lead and zinc, with an annual production capacity of 6.15 million tonnes of lead zinc ore. Sindesar-Khurd mine is the highly mechanised and largest ore producing underground mine with annual production capacity of 4.50 million tonnes. The other six mines viz, Rajpura-Dariba, Zawar group of mines (Mochia, Ballaria, Zawarmala and Baroi) and Kayad mine are underground mines with an annual production capacity of 0.9 million tonnes, 4.0 million tonnes and 1.0 million tonne of lead & zinc ore, respectively (Table-15).

**Table – 15 : Ore Production Capacity of
HZL Mines**

Mine	Ore	Capacity (million tpy)
Total		16.55
Zawar Mines, Distt. Udaipur, Rajasthan.	Zinc-lead	4.00
Rajpura-Dariba, Distt. Rajsamand, Rajasthan.	Zinc-lead	0.90
Sindesar-Khurd Mine, Distt. Rajsamand, Rajasthan.	Zinc-lead	4.50
Rampura-Agucha, Distt. Bhilwara, Rajasthan.	Zinc-lead	6.15
Kayad Distt. Ajmer Rajasthan.	Zinc-lead	1.00

Source : HZL Annual Report 2016-17

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Zawar group of mines is a cluster of four underground mines viz. Mochia, Balaria, Zawarmala and Baroi mines and one beneficiation plant for all mines. Zawar group of mines are one of the oldest mine and are located about 40 km south of Udaipur. Lead-Zinc ore of the mines is divided into stope blocks which are drilled and blasted using sub-level open stoping mining method. Loading and transportation are done using combination of LHDs, LPDTs, LOCO and shaft hoisting to surface. The ore is further crushed and then undergoes a flotation process to produce concentrate. In 2016-17, the Zawar group of mines produced 1.77 million tonnes ore at 2.61% Zn and 2.14% Pb feed grade. Ore production capacity of the mine is planned to progressively increase to 4 million tonnes per annum by the year 2020. Environment Clearance of 4 million tonnes ore production and beneficiation was received during the year 2016-17.

The Rajpura-Dariba mine of HZL is an underground mine commissioned in 1983. It is located 75 kilometers north-east of Udaipur, Rajasthan. Mining is carried out by using the Vertical Crater Retreat method and Blast hole stoping method. Mined out stopes are backfilled with cement tailings. The proposed enhancement in ore production capacity is to be achieved by developing the blocks in 180-100 mRL block (North lode, 1850N-2550N), 11-100 mRL block (North lode, 1850 N-2550N), 212-285 mRL block (North lode, 1900N – 2550N), 13 to -87 mRL block (East lode 350N-750N), 200 to 300 mRL block (East lode 600N-750N), -119 to -257 mRL block (Main lode, 1825N – 1662N), -200 to – 400 mRL block (East lode / E-10 675 N-1600N). The current mining block – south lode (180-100 mRL) will be depleted by 2017-18. In the year 2016-17, the mine produced 0.74 million tonnes ore as compared to 0.67 million tonnes ore in previous year at average feed grade of 5.18% Zn and 1% Pb.

Rampura-Agucha mine is located 230 km north of Udaipur in Bhilwara district, Rajasthan and it was commissioned in 1991. It is high zinc-lead reserve grades averaging 15.8%. The production of ore carried out from both surface mining and underground mining. The mine is gradually transitioning from surface mining to underground

mining. The underground mine project includes a production shaft of 955 meters depth, two declines from surface, two ventilation shafts and a paste fill plant. The underground mine development achieved 17 km in the year 2016-17. In the year 2016-17, the mine produced 4.7 million tonnes of ore which is 40% of total ore production of HZL as against 45% last year at 12.17% Zn and 1.66% Pb feed grade. The main production shaft is expected to commence commercial production by 2019.

Sindesar-Khurd mine is located at 6 km NNE of Rajpura-Dariba mine and 82 km north east of Udaipur. It is an underground mine, commissioned in 2006. It produces high silver content ore at 113 gm/tonne. It is the largest underground mine in India in respect of production capacity. The mine is set to reach the enhanced targeted capacity of 4.5 million tonnes. Environment clearance and approval of mining plan for 4.5 million tonnes ore production and beneficiation is already in place. The mine consists of multiple standalone deposits, or auxiliary lenses, which gives three standalone production centres at present. The production is carried out from the main lode which has an annual capacity of 2.5 million tonnes & two auxiliary lens SKA2 and SKA6, are functioning at 1.5 million tonnes capacity. Further addition of SKA14 lens is planned during the year 2017-18. Main shaft sinking has been completed in the year 2015-16 up to the ultimate depth of 1,052 meters and off-shaft development work has also been completed in the year 2016-17. The new beneficiation plant of 1.5 million tonnes ore treating capacity has been commissioned in the year 2016-17. Sindesar-Khurd mine has deployed 63 tonnes capacity low profile dump truck (LPDT) which is the highest capacity deployment of LPDT in the country. In the year 2016-17, the mine produced 3.66 million tonnes ore as compared to 2.9 million tonnes ore in the previous year at average feed grade of 3.86% Zn and 2.1% Pb.

Kayad mine is newly developed underground mine near Ajmer, Rajasthan. It is commissioned in 2014 having small but high grade deposit. Kayad mine has access to the mine through decline for ore and waste transportation. Longitudinal Long Hole Open Stopping method is used for the steeper

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Table – 16 : Company-wise Capacity and Production of Primary Lead and Zinc

(In tonnes)

Company	Lead capacity tpy	Production		Zinc capacity tpy	Production	
		2015-16	2016-17 (P)		2015-16	2016-17 (P)
Hindustan Zinc Ltd	185000	145257	142231	833000	758944	672010
Edayar Zinc Ltd	-	-	-	38000	-	-
Total	185000	145257	142231	871000	758944	672010

and thinner portion of ore body and Transverse Long Hole Open Stopping method for flatty dipping and thick portion of the ore body. The production capacity of the mine is one million tonne. In the year 2016-17, the mine produced one million tonnes ore as compared to 0.76 million tonnes in the previous year at average feed grade of 9.01% Zn and 1.29% Pb. The ore from Kayad mine is treated at Rampura Agucha's beneficiation plant.

SMELTING

Primary lead was produced entirely by HZL which operated smelter at Chanderiya and Dariba having capacity of 85,000 tpy and 1,00,000 tpy of lead metal, respectively. Thus, the smelting capacity for lead (primary) in the country presently is 1,85,000 tpy. Company wise smelting capacity of lead and zinc smelters is furnished in Table - 16.

HZL and Edayar Zinc limited are the primary producers of Zinc. The smelting capacity of HZL for zinc is distributed between three smelters at Debari (88,000 tpy), Chanderiya (5,25,000 tpy) and Dariba (2,20,000 tpy). Edayar Zinc Ltd's plant at Binanipuram (Aluva), Kerala with capacity of 38,000 tpy. Thus, the smelting capacity for zinc in the country is 8,71,000 tpy. EZL produced zinc from imported concentrates but since the company declared as sick unit, it did not operate its plant. Besides lead & zinc capacities, HZL has capacities to produce 518 tpy of silver. India's largest manufacturer of sulphuric acid which is by product of its smelting operations.

In 2017 HZL produced 1.18 million tonnes of sulphuric acid. In addition to this, it is understood that HZL also produces Cadmium metal at Debari Zinc Smelter.

The Registrar of Companies has issued a fresh certificate to change in name from "Binani Zinc Limited" to "Edayar Zinc Limited" with effect from 6th October 2015. Edayar Zinc Ltd (EZL) has been incurring huge fixed costs due to shutdown of the plant from April 2014 onwards, except for a brief period of 59 days when the plant operated. In the year 2015, the Edayar Zinc Limited did not operate its plant for determination of its sickness by reference made to Board for Industrial and Financial Reconstr Sick Industrial Companies (Special Provisions) Act, 1985 (SICA), under review, the matter pending before BIFR for ascertaining the sickness of the company could not see much progress due to intermittent sitting of BIFR.

Chanderia Lead-zinc smelting complex is located at 110 km North of Udaipur in Chittorgarh district, Rajasthan. It was commissioned in 1991 with an initial production capacity of 70,000 tonnes per annum. Chanderia Lead-zinc smelting complex comprises one lead-zinc pyrometallurgical smelter having production capacity of 1,05,000 tonnes zinc and 35,000 tonnes lead, one Ausmelt lead smelter having production capacity of 50,000 tonnes and two Hydro metallurgical zinc smelters namely Hydro-I & Hydro-II having production capacity of 2,10,000 tonnes zinc each. It employs Roast Leach Electro-Wining technology in its Hydro metallurgical smelters, Imperial Smelting process in lead-zinc smelter and Top submerged Lance Technology (Designed by M/s Ausmelt Ltd, Australia) coupled with Cansolv Technology for its lead smelter. In the year 2016-17, Chanderia Lead-Zinc smelter produced 4,35,666 tonnes of zinc and 51,759 tonnes of lead as compared to 4,88,470 tonnes of zinc and 51,219 tonnes of lead

in previous year. A new project of 1,60,000 million tonne of Zinc Residue Fuming Project will commence by 2019. Zinc fuming is a process that recovers valuable metals from zinc residue and will help in higher recovery of zinc, lead and silver. At the Hydro plant, Hydro-2 cell house was upgraded from 192 kA to 200 kA enhancing zinc output.

Zinc Smelter Debari was commissioned in the year 1968 with an initial production capacity of 18,000 tonnes per annum of zinc and now it reached to 88,000 tonnes per annum of zinc. It is located at 13 km north of Udaipur, Rajasthan. Zinc smelter Debari employs Roast leach Electro-Winning Technology at its Hydro metallurgical zinc smelter. The plant has three roasting facilities, leaching and purification section, electrolysis, melting and casting sections. It produced surplus calcine, an intermediate product, which is supplied to the rest of the Hydro metallurgical zinc smelter. In the year 2016-17, zinc smelter Debari produced 46,442 tonnes of zinc as compared to 66,764 tonnes of zinc in the previous year.

Dariba smelting complex is located at 75 km north-east of Udaipur near to Rajpura-Dariba Mine and 7 km from Sindesar Khurd mine in Rajsamand district, Rajasthan. The zinc smelter at Dariba was commissioned in March 2010 and has a capacity of 210,000 tonnes per annum while lead smelter was commissioned in July, 2011 with a capacity of 1,00,000 tonnes lead per annum. Dariba smelting complex employs Roast Leach Electro-winning technology at its hydro metallurgical zinc smelter. The plant has two roasting facilities, a leaching and purification section and a cell house. The lead smelter employs SKS bottom blowing technology. The plant consists of SKS furnace – bottom blowing, blast furnace, electric arc furnace & fuming furnace and electro-refining. Fuming furnace is also installed to produce zinc-oxide from blast furnace slag. In the year 2016-17, the smelter produced 1,89,882 tonnes of zinc and 92,535 tonnes of lead metal as compared to 2,03,704 tonnes of zinc and 1,00,357 tonnes of lead metal in the previous year. Dariba Smelting Complex lead plant steam was utilised in Dariba Smelting

Complex Captive Power Plant (CPP) for reducing the auxiliary steam consumption.

The product range of HZL constitutes two grades, namely, Special High Grade (SHG) zinc containing 99.995% Zn (min.) and Prime Western (PW) containing 98.65% Zn (min.). Both these products are available in the form of slabs weighing 25 kg, SHG Jumbo weighing 1,000 kg and PW Jumbo weighing 600 kg. Lead is available as HZL Grade containing 99.99% Pb (min.) in the form of slab weighing 24 kg. In October 2016, a new zinc alloy value added product, HZDA or Hindustan Zinc Die-cast Alloy was added to the Company's portfolio from Chanderiya Lead-Zinc Smelter.

POLLUTION CONTROL & ENVIRONMENTAL MANAGEMENT EFFORTS

The standard for Emission or Discharge of Environment Pollutant from lead & zinc smelting is prescribed in Schedule-I of the Environment (Protection) Rules, 1986. The standards for Particulate Matter Emission in concentrator for lead & zinc smelter is 150 mg per normal cubic metre and the standard for emission of oxides of sulphur in smelter & convertor is that off-gases must be utilised for sulphuric acid manufacture. The limit of sulphur dioxide emission from stock shall not exceed 4 kg per tonne of concentrated (one hundred percent acid produced).

At underground mines, the tailings generated after beneficiation is utilised to backfill the underground mined stopes and the remaining tailings is stored in tailing dam at various mines location. During the process of recovery of metal at smelters, waste is generated. The waste contains toxic element i.e. waste water effluent sludge, smelter slag leach residues, suspended particulate matter (SPM), SO₂, NO_x and toxic metal fumes which are harmful at low exposure generated during the production of lead & zinc metal.

Smelting and mining operations of HZL are working on zero discharge principle and company is committed for efficient utilisation of waste generated at its mines and smelter. The Company has adopted Fumer technology to reduce jarosite

generation, which is known to be successful in few Chinese and Korean Zinc Plants.

Hindustan Zinc becomes Rajasthan's first Platinum Green Building by setting a benchmark through policy of Reduce, Recycle, Reuse and Reclaim. CII-Indian Green Building Council (IGBC) awarded Platinum rating to 'Yashad Bhawan', Hindustan Zinc's Head Office (Udaipur), in a ceremony on January 10, 2017. The award has been constituted by CII-IGBC and the Platinum rating is the highest rating. The 'Yashad Bhawan' is one of the few CII-IGBC Platinum rated buildings in India and the first in Rajasthan.

The storage battery scrap is the main source of secondary lead production. Many of the secondary lead producing units have operated in the unorganised sector and they create major pollution by emission of lead vapour and SO_x . The small scale units generally do not control process parameters such as smelting temperature, charge to fuel ratio, leakages in the body, etc. As per the National Ambient Air Quality standards, the permissible concentration of lead in ambient air is $0.50 \mu\text{g}/\text{m}^3$ while the permissible limit for SO_x is $50 \mu\text{g}/\text{m}^3$.

The sewage treatment plants at Debari and Chanderiya smelters were operated continuously and the recovered water was reutilised in the smelter and for plantation in the colony. Over the years, the company has been voluntarily filing Carbon Disclosure Project (CDP) responses as a proactive step towards reporting carbon footprint emissions.

HZL has entered into a charter on Corporate Responsibility for Environmental Protection (CREP) with MoEF, Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) for achieving a quantum jump in its environmental performance in the coming years.

RECYCLING OF LEAD & ZINC

Lead

Lead is one of the highest recycled metals. Lead is very easy to recycle. It can be re-melted any number of times, and provided enough

processes to remove impurities are performed, the final product (termed secondary lead) is indistinguishable from primary lead produced from ore. The amount of lead recycled is 50% of total lead production worldwide. The figure is higher in Western Europe at 60% and in USA at 70%. Used lead acid battery is one of the largest sources of secondary lead production globally including India. A standard lead acid battery for starting, lighting and ignition of vehicles has the following average composition by weight : Lead metal : 34%; Lead oxide paste : 39%, Electrolyte (free sulphuric acid): 11-12% others (ebonite, PVC, paper, etc.): 8-10%, polypropylene 5-6%. Lead battery industry in India is currently estimated at $\sim 40,000$ crore with 60% automotive and 40% industrial. The data from CPCB in respect of recycling unit is not readily available. However, there are 448 lead recyclers plant with production capacity of 16,97,958 tonnes of secondary lead in the country.

Lead when used as metal in batteries, cable sheathing and sheathing for containing radiation is fully recyclable and it does not lose its properties. There is indeed a thriving industry that recycles lead in the country. However, due to the health risk involved in lead recycling the Central Pollution Control Board issues licences to the lead-reprocessors to ensure adherence of stringent environmental norms.

Government of India has enacted Battery Management and Handling Rules (BMHR), 2002 to organise the recycling of lead acid batteries and to make available raw material to the lead reproducers.

Zinc

The largest consumer of zinc is the Galvanising Industry. The zinc once used for galvanising as well as for brass making is not recoverable. Hence, the quantum of zinc recycling is comparatively small as compared to lead recycling. The secondary zinc was recovered from pure zinc scrap in the form of sheet cutting, zinc roofings, old zinc anodes and alloys containing zinc as a major constituent.

CONSUMPTION

Consumption of lead and zinc in various industries is not available readily. However, it is known that lead and zinc are consumed in the form of metals as well as in the form of compounds and oxides.

Lead

The Battery Industry consumes about 74% of lead followed by pigments & compounds (9%), rolled and extruded products (8%), alloys (3%), cable sheathing (2%) and the balance 4% is consumed by other industries. The production of lead acid batteries by the units in the organised sector in 2015-16 was 849.57 lakh and in 2016-17 (April-Oct.) was 580.13 lakh. The export and import of lead acid batteries (HS code 8507) in 2016-17 was ₹ 1527.73 crore and ₹ 5308.54 crore respectively.

The apparent consumption of lead during the year 2015-16 and 2016-17 was calculated on the basis of production of lead (primary) and imports & exports of refined lead (unwrought). The apparent consumption thus arrived at was 1,89,842 tonnes in 2015-16 and 1,75,599 tonnes in 2016-17 (Table-17). In addition to this, it is understood that large quantities of recycled lead were also consumed in certain other industries.

Table – 17 : Apparent Consumption of Lead (Based on Production of Lead (Primary), and Imports & Exports of Refined Lead, Unwrought)

Item	(In tonnes)	
	2015-16	2016-17 (P)
Total Production Lead (Primary)	145257	142231
Total Imports*	108521	110749
Total Exports*	63936	77381
Apparent Consumption (Primary)	189842	175599

* DGCI & S, Kolkata.

Zinc

Owing to its corrosion resistance in varied types of environment, zinc is used for protecting

steel by way of galvanising. The Galvanising Industry alone consumes about 57% of zinc, followed by coatings (16%), die-casting alloys (14%), oxides & chemicals (7%) and extruded products (6%). The apparent consumption of zinc during the year 2015-16 and 2016-17 was calculated on the basis of production of zinc, import & export of zinc (not alloyed). The apparent consumption, thus arrived at was 6,34,888 tonnes in 2015-16 and 6,47,047 tonnes in 2016-17 (Table-18). The data on trade of zinc (not-alloyed) was taken from DGCI&S (HS Code 79011100). In addition to this, some quantities of recycled zinc are also consumed in certain other industries.

Table – 18 : Apparent Consumption of Zinc (Based on Production of Zinc (Ingots) and Imports & Exports of Zinc (not alloyed)

Item	(In tonnes)	
	2015-16	2016-17 (P)
Total Production Zinc	758944	672010
Total Imports*	108058	179403
Total Exports*	232114	202932
Apparent Consumption	634888	648481

*DGCI&S, Kolkata.

SUBSTITUTES & TECHNICAL POSSIBILITIES

Lead

Battery replacements include batteries of nickel-zinc, zinc lithium chloride, sulphide or nickel lithium hydride. The large-scale commercial use of any of these four possible substitutes was so far precluded by cost and operating problems. Polyethylene and other materials work as substitute in some cable applications.

In construction applications, in place of galvanised sheets, copper and aluminium are alternatives. In corrosive chemical environment, stainless steel, titanium, plastics and cements are substitutes. Tin, glass, plastics and aluminium are alternatives in tubes and containers; iron & steel or bismuth in shots for ammunition; and tin

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in solder. In Electronic Industry, there has been a move towards lead-free solders with varying compositions of tin, bismuth, silver and copper.

Environmental concerns for lead are limiting the uses, particularly in gasoline, where its use as an anti-knocking agent was phased out by the introduction of catalytic converters. Storage batteries for industrial load levelling, mains power management and electric vehicles have growing markets. The continued search for weight reduction is reducing the amount of lead per battery, and battery lives are being extended. Possible new developments include the use of lead as an anti-oxidant in asphalt, as a shielding material in nuclear waste, in protection of buildings against radon gases and as a sound buffer. Environmental legislation will inhibit the growth of new uses and possibly eliminate lead from many existing uses. The Organisation for Economic Cooperation & Development (OECD) is actively examining possible restrictions on uses of lead. New techniques to recover lead from concentrates and from scrap are being developed and are bound to become more important in future. Recycling of lead and zinc through environmentally safe processes needs to be encouraged as the growing use of lead and zinc in railway electrification as well as in road transport vehicles have created shortage in the country.

Zinc

Aluminium, magnesium and plastic compete in some die-casting applications. Ceramic and plastic coatings, electroplated cadmium & aluminium and special steel compete in some galvanising applications. Aluminium, magnesium and titanium can replace zinc in chemicals and pigments. Zirconium is an alternative in ceramic and enamel applications. New alloys, e.g. superplastic alloys of zinc and aluminium could be developed. Many elements are substitutes for zinc in chemical, electronic and pigment uses.

WORLD REVIEW RESERVES

Lead

The world's reserves of lead were estimated at 88 million tonnes in terms of lead content.

Australia possesses 40% of the world's reserves followed by China (19%), Russia & Peru (7% each), Mexico (6%) and USA (6%), etc. (Table- 19).

**Table – 19 : World Reserves of Lead
(By Principal Countries)**

(In '000 tonnes of lead content)

Country	Reserves
World: Total (rounded off)	88000
Australia	35000
Bolivia	1600
China	17000
India	2200
Mexico	5600
Peru	6000
Russia	6400
Sweden	1100
USA	5000
Turkey	860
Other countries	7000

Source: Mineral Commodity Summaries, 2018.

**Table – 20 : World Reserves of Zinc
(By Principal Countries)**

(In '000 tonnes of zinc content)

Country	Reserves
World: Total (rounded off)	230000
Australia	64000
Bolivia	4800
Canada	5400
China	41000
India	11000
Kazakhstan	13000
Mexico	20000
Peru	28000
Sweden	3800
USA	9700
Other countries	33000

Source: Mineral Commodity Summaries, 2018.

Zinc

The world's reserves of zinc were estimated at 230 million tonnes. Australia accounts for 28% of world's zinc reserves, followed by China (18%), Peru (12%), Mexico (9%), Kazakhstan (6%), USA (4%), etc. (Table-20).

PRODUCTION

Lead

World mine production of lead ore was about 4.7 million tonnes in terms of lead content in the year 2016 which is 6% less than previous year. China is the leading producing country with 2.23 million tonnes (48%) followed by Australia, USA and Peru (7% each), Mexico (5%), Russia (4%), India (3%), etc. (Table-21).

Zinc

World mine production of zinc ore was 12.91 million tonnes in terms of zinc content in the year 2016. China is at top position with 5.27 million tonnes thus contributed 41% followed by Peru (10%), Australia (7%), USA (6%), India and Mexico (5% each), Kazakhstan (3%) and Canada (2%), etc. (Table- 22).

Table – 21 : World Mine Production of Lead (By Principal Countries)

(In '000 tonnes of metal content)			
Country	2014	2015	2016
World Total (rounded off)	5300	5000	4700
Argentina	30	30	28 °
Australia	728	653	453
Bolivia	76	75	90
China	2609	2340	2230
India	111	147	151
Iran	36	41 °	42 °
Ireland	41	31	20
Kazakhstan	38	41	71
Korea, Dem. P.R. °	36	32	37
Macedonia	44	38	31
Mexico	250	264	241
Morocco	28	32	37
Peru	277	316	314
Poland	83	69	63
Russia	196	180	193
South Africa	29	35	39
Sweden	71	79	76
Tajikistan	28	31	47
Turkey	62	33	29
USA	379	367	335 °
Other countries	152	134	157

Source: World Mineral Production, 2012-16, BGS.

Table – 22 : World Mine Production of Zinc (By Principal Countries)

(In '000 tonnes of metal content)			
Country	2014	2015	2016
World Total (rounded off)	13600	13400	12300
Australia	1506	1610	884
Bolivia	475	442	487
Canada	352	290	322
China	5118	4750	4630
India	767	759	764
Kazakhstan	386	384	366
Mexico	660	787	661
Peru	1315	1421	1334
USA	832	825	780°
Other countries	2235	2114	2095

Source : World Mineral Production, 2012-16, BGS

Lead

World refined lead production (includes secondary production) was 11.12 million tonnes in which secondary lead production was 6.25 million tonnes in the year 2016. Secondary lead production represented about 56% of total refined lead production worldwide in 2016 compared with 57 % in 2015. The global production of refined lead in the year 2016 increased by 3.9% than previous year. China is the largest producer of refined lead with 4.66 million tonnes in the year 2016 and contributed 42 % of world refined lead production followed by USA (10%), Korea Rep. of (7%), India (5%), Germany (3%), United Kingdom, Mexico and Canada (3% each), Japan, Australia and Italy (2% each), etc.

World consumption of refined lead was 11.28 million tonnes in the year 2016 (including secondary lead) which is 5% more than the previous year. China is the largest refined lead consuming country with 4.65 million tonnes consumption during the year 2016 which was 41.2% of world refined lead consumption followed by USA (14%), Korea, Rep.of (6%), India (5%), Germany (3%), and Italy (2%). International Lead & Zinc Study Group (ILZSG) anticipates that global demand for refined metal will rise to 11.39 million tonnes in 2017. This will be primarily a consequence of higher output in China and India

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with smaller increase forecast in Belgium and USA where Aqua metals recently commissioned new used lead-acid battery recycling plants in Nevada.

Australia

In 2015, lead mine production in Australia decreased by about 10% as a result of reduced production at Ivernia Inc.'s (Canada) Paroo Station Mine (85,000-t/yr production capacity) in Western Australia. In January 2015, the mine was placed on care-and-maintenance status owing to market conditions, primarily due to the decline in lead prices. In 2014, the mine produced 80,900 tonnes of lead in concentrates.

Canada

Trevali Mining Corp. announced the commissioning of the mill at its Caribou Zinc Mine in northern New Brunswick following the start of underground mining operations earlier in the year. The company expected that the mill could process 3,000 t/d of ore and produce about 14,000 t/y of lead in concentrate at full capacity.

China

In 2015, China continued to be the leading global producer and consumer of lead and the leading producer of lead-acid batteries, although declines were reported for each compared with those in 2014. Refined lead production in 2015 decreased by 7% to 4.40 million tonnes from 4.74 million tonnes in 2014, the second consecutive annual decrease. The decline in primary refined lead production was attributed to less available production capacity in 2015 following plant shutdowns for maintenance or environmental reasons. The decline in secondary production was partially attributed to the reduction of a value-added tax rebate to 30% from 50% in July 2015 that increased the tax burden on secondary lead producers and resulted in some producers cutting back production during the second half of 2015. Lead in concentrate production in 2015 was about

2.40 million tonnes, a 17% decrease from the 2.90 million tonnes produced in 2014 and an 18% decrease from production in 2013. The decrease in mine production was attributed to price-induced production cutbacks and an increase in environmental regulations for mines by Provincial government.

According to the ILZSG, consumption of lead in China decreased by 6% to 4.41 million tonnes in 2015 from 4.71 million tonnes in 2014. The decline in domestic lead consumption was attributed to a slowdown in sales of electric bikes in 2015, as was the case in 2014, which accounted for about 30% of annual lead consumption.

Zinc

World refined zinc production was 13.73 million tonnes in the year 2016 and is 1% less than the previous year.

China is the largest producer of refined zinc with 6.27 million tonnes in the year 2016 which contributed 46% of world refined zinc production followed by Korea Rep. of (7%), India (4%), Canada (5%), Japan and Spain (4% each), Australia (3%), Peru (3%), Kazakhstan (2%), etc.

The world consumption of refined zinc was 13.93 million tonnes in the year 2016 which is 1.3% more than the previous year. China is the largest refined zinc consuming country with 6.69 million tonnes in the year 2016 which accounted for 48% of world followed by USA (6%), India (5%), Korea, Rep. of & Germany (4% each) and Japan (3%).

ILZSG forecasts that world refined zinc metal production is expected to increase by 6.7% to 13.7 million tonnes in 2017, and the consumption of refined zinc metal is expected to increase by 2.6% to 14.30 million tonnes in 2017. Demand is forecast to continue to growing demand in China & India, to remain stable in Japan & South Korea and to fall in Thailand.

Australia

In August, MMG Ltd completed mining activities at the Century Mine and continued to process about 700,000 t of stockpiled ore during the final months of 2015. Century operated for 16 years, and at full production, was one of the leading global zinc-producing mines. In 2015, the mine produced 393,000 t of zinc in concentrate, 16% less than that in 2014.

Canada

Zinc mine production in Canada was 277,000 t in 2015, 21% less than that in 2014. Production decreased in 2015 owing mostly to the closure of Yukon Zinc Corp.'s Wolverine Mine, lower zinc in concentrate output at Glencore's Matagami mill, and the temporary suspension of operations at Nyrstar's Myra Falls Mine. In January, Yukon Zinc announced that it planned to put the Wolverine Mine on care-and-maintenance status as a result of low zinc prices and high operating costs. Wolverine had been operating at 75% of capacity since 2013, producing 84,000 t of zinc concentrate (gross weight) in 2014. Nyrstar suspended operations at Myra Falls in order to improve mine conditions, and the company initially planned to restart the mine in the latter half of 2016. However, Nyrstar decided to defer development work at Myra Falls for at least an additional year due to the zinc price decline in the second half of 2015. Myra Falls produced 9,000 t of zinc in 2015 compared with 26,700 t in 2014.

China

Zinc mine production in China decreased by 13% in 2015 from that of 2014 to 4.3 million tonnes and took place predominantly in the Inner Mongolia Autonomous Region and Hunan & Yunnan Provinces, where combined production

accounted for more than one-half of China's zinc in concentrate production in 2015. According to Beijing Antaika Information Development Co., Ltd. (Antaika), stricter environmental regulations caused many small mines to close during the year, whereas other mines stopped production as a result of high smelter treatment charges and low zinc prices in the second half of the year. As a result of the decrease in mine production, China's net imports of zinc in concentrate increased considerably (by 37%) in 2015 to about 1.5 million tonnes. About 70% of China's zinc concentrate imports (gross weight) were sourced from Australia and Peru.

Zinc metal production rose by 5% in 2015 from that of 2014 to 6.1 million tonnes. Zinc smelters in China were reported to have operated at higher production rates in 2015 than in 2014 due to an increase in domestic smelter treatment charges during the year. Hunan, Shaanxi, and Yunnan were the three leading zinc-metal-producing Provinces in China and accounted for about one-half of the country's zinc metal production in 2015. Domestic smelter production capacity in China increased by at least 200,000 t/yr in 2015; Anhui Tongguan Non-Ferrous Metal Chizhou Co. Ltd and Western Mining Co. Ltd each added 100,000 t/yr of zinc metal production capacity at their smelters in Chizhou, Anhui Province, and Xining, Qinghai Province, respectively.

China's zinc consumption increased at a slower rate in 2015 from that of 2014, coinciding with a decreasing growth rate in the country's automotive, construction, and industrial sectors. ILZSG reported a slight year-on-year increase in zinc consumption in 2015 compared with an 8% increase in 2014.

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Ireland

Zinc mine production in Ireland decreased by 16% in 2015 from that of 2014 to 236,000 t of contained zinc mostly as a result of the closure of Vedanta's Lisheen Mine. Mining activities at Lisheen concluded in November, and concentrate production stopped in December. Lisheen began operating in 1999 and typically produced about 300,000 t/yr of zinc concentrate.

Namibia

Zinc mine and metal production decreased notably in Namibia in 2015 owing mostly to a decline in production at Vedanta's Skorpion complex in the southern Namib Desert. Mined zinc oxide ore at Skorpion was treated onsite at an SX-EW refinery with the capacity to produce 150,000 t/yr of SHG zinc. Vedanta reported that zinc metal production at Skorpion was 82,000 t in the fiscal year ending March 31, 2016, 20% less than production in the previous fiscal year as a result of lower ore grades at the mine, planned maintenance at the refinery, and a slower than anticipated rampup after maintenance work was completed. The company anticipated that the mine would close in the fiscal year ending March 31, 2017, and considered increasing the depth of the deposit to potentially extend the mine life to the fiscal year ending March 31, 2019. In November 2014, Vedanta announced that it had approved investment for the Gamsberg-Skorpion Integrated Zinc Project. The project included developing the Gamsberg zinc deposit in South Africa into an open pit mine and reconfiguring the Skorpion refinery to allow it to treat zinc sulfide concentrates, including those generated by Gamsberg. At the end of the fiscal year ending March 31, 2016, Vedanta was in the process of finalising a feasibility study for the refinery conversion.

Peru

Zinc mine production in Peru increased by 8% in 2015 from that of 2014 mostly as a result of increased production at the Antamina copper-zinc

mine. Zinc production increased by 11% at Antamina in 2015 to 235,000 t due to increased mill throughput and share of copper-zinc ore processed as opposed to copper ore. From 2017 through 2019, zinc production at Antamina was projected to increase significantly as mining was expected to take place in an area of higher zinc grades resulting in an increased proportion of copper-zinc ore mined. Copper and zinc production at Antamina can vary significantly from year to year due to the geology of the deposit. The Colquijirca Mine reached its full processing capacity of 18,000 t/d in December, resulting in zinc production increasing to 53,300 t in 2015 from 10,100 t in 2014. El Brocal completed a mill capacity expansion project at Colquijirca in 2014 that included building a second processing plant with a capacity of 11,000 t/d for the treatment of lead-zinc ore and increasing the capacity of the original concentrator, allocated for the treatment of copper ore from the adjacent Marcapunta Mine, to 7,000 t/d from 5,000 t/d.

South Africa

In November 2014, Vedanta approved capital expenditure for the Gamsberg-Skorpion Integrated Zinc Project, which included the development of the Gamsberg zinc deposit. According to the company, Gamsberg was one of the largest undeveloped zinc-bearing ore bodies globally and, once developed, would partially replace the zinc production lost from the closure of the company's Lisheen zinc mine in Ireland. Located in the Northern Cape Province near Vedanta's Black Mountain zinc mine, the deposit would be developed into an open pit mine that was expected to produce 250,000 t/yr of zinc in concentrate during a 13-year mine life with potential for further expansion. Vedanta began development work at Gamsberg. Mill construction and prestripping activities were expected to take 2 years to complete, and production was projected to begin in 2018 with the mine reaching full capacity in 9 to 12 months.

FOREIGN TRADE**Lead****Exports**

Exports of lead from the country are in the form of ore & concentrates, lead and alloys & scrap, lead waste & scrap, lead unrefined, refined lead unwrought, pig lead, lead & alloys worked and others.

Exports of lead ores and concentrates was one tonne in 2016-17 as compared to negligible in 2015-16.

Exports of lead and alloys including scrap increased to 1,08,065 tonnes during 2016-17 as compared to 89,389 in the preceding year. Export of lead and alloys increased to 1,08,064 tonnes in 2016-17 as compared to 89,379 tonnes in the previous year. Export of refined lead, unwrought also increased to 77,381 tonnes in 2016-17 as compared to 63,936 tonnes in the previous year. In 2016-17, USA with 58% followed by Taiwan (14%) and Rep. of Korea (10%) were the major export destinations for refined lead unwrought (Tables- 23 to 29).

Imports

Imports of lead in India are in the form of lead ores & concentrates, lead & alloys including scrap, lead & alloys unwrought, pig lead, antimonial lead worked, lead and alloys (bars, rods, plates, etc.).

Imports of lead ores & concentrates increased to 6,216 tonnes in 2016-17 as compared to 5334 tonnes in 2015-16. Imports were mainly from Turkey (67%), UAE (9%), and Yemen Republic (6%). Total imports of lead & alloys and scrap during 2016-17 were 3,04,913 tonnes as compared to 2,68,607 tonnes during 2015-16. Out of which imports of lead and alloys during 2016-17 was 2,38,262 tonnes as compared to 2,09,883 tonnes in 2015-16.

Imports comprised mainly of lead and alloys and the rest was scrap (22%). The major suppliers during 2016-17 were Korea, Rep. of (20%) Australia (15%), UAE (12%), Vietnam (7%) and UK(6%) (Tables- 30 to 37).

Zinc**Exports**

Exports of zinc are in the form of ores & concentrates, zinc & alloys including scrap and zinc & alloys in the form of bars, rods & plates.

Exports of zinc ores & concentrates increased drastically to 53912 tonnes in 2016-17 as against 558 tonnes in the previous year. Korea, Rep. of is the major export destination of zinc ores & concentrates accounted by 58% followed by China (22%) and Japan (20%).

Exports of zinc & alloys and scrap during 2016-17 were 2,28,025 tonnes as against 2,57,634 tonnes in the preceding year. Almost entire exports during 2016-17 were of zinc & alloys while those of scraps were nominal. Malaysia (23%), Korea, Rep. of (16%), Chinese Taipei/Taiwan (10%) and China (7%) were the main export destinations for zinc alloys & scrap. Export of zinc (scrap) were at 48 tonnes in 2016-17 as compared to 40 tonnes in the preceding year (Tables- 38 to 41).

Imports

Imports of zinc in the country are in the form of zinc ores & concentrates, zinc & alloys including scrap, zinc or spelter and zinc & alloys in the forms of bars, rods, plates, mazak, etc.

Imports of zinc ores & concentrates drastically increased to 1,771 tonnes in 2016-17 from 385 tonnes in the previous year. Imports were mainly from Turkey (79%), Spain (15%), and Japan (3%). Imports of zinc and alloys during 2016-17 were 2,41,074 tonnes as compared to 1,68,359 tonnes in 2015-16. Imports of zinc (scrap) were 69,746 tonnes during 2016-17 as compared to 58,944 tonnes in 2015-16. Imports of zinc or spelter were at 2,09,779 tonnes as compared to 1,37,761 tonnes during the previous year. The major suppliers of zinc & alloys during 2016-17 were Korea, Rep. of (58%), UAE (9%), Spain (5%) and Malaysia (4%) etc. (Tables- 42 to 47).

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**Table – 23 : Exports of Lead and Alloys
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	89379	11882679	108064	15867389
USA	18952	2328650	48758	6875963
Korea, Rep. of	24916	3190569	18263	2661217
Chinese Taipei/Taiwan	4427	584365	10531	1668120
UAE	3170	589652	8650	1414622
Vietnam	11140	1450705	4415	661474
Thailand	3195	420636	2888	441525
Bangladesh	1063	140102	2307	329951
Japan	2653	371590	1405	195014
Malaysia	1695	294918	1270	187440
Saudi Arabia	1434	183702	1263	180182
Other countries	16734	2327790	8314	1251881

**Table – 24 : Exports of Lead Ores & Concentrates
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	215	1	33
Bangladesh	-	-	1	33
Sri Lanka	++	215	-	-

**Table – 25: Exports of Lead & Alloys Including scrap
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	89389	11883141	108065	15868134
USA	18952	2328650	48758	6875963
Korea, Rep. of	24916	3190569	18263	2661217
Chinese Taipei/Taiwan	4427	584365	10531	1668120
UAE	3170	589655	8650	1414622
Vietnam	11140	1450705	4415	661474
Thailand	3195	420636	2888	441525
Bangladesh	1063	140102	2307	329951
Japan	2653	371590	1405	195014
Malaysia	1695	294918	1270	187440
Saudi Arabia	1434	183702	1263	180182
Other countries	16744	2328249	8315	1252626

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**Table – 26 : Exports of Lead and Waste & Scrap
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10	462	1	745
Nepal	-	-	1	728
Kenya	-	-	++	14
Gabon	-	-	++	3
Oman	10	458	-	-
UAE	++	3	-	-
Australia	++	1	-	-

**Table – 27 : Exports of Refined Lead, Unwrought
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	63936	8055806	77381	11165711
USA	18836	2309273	45072	6361197
Chinese Taipei/Taiwan	4426	584081	10531	1668120
Korea, Rep. of	11554	1437601	7848	1139225
Vietnam	11119	1447649	3666	539006
UAE	1191	152549	2888	415742
Thailand	3010	394302	2269	333958
Malaysia	796	96988	1062	141485
Korea Dem. Rep. of	1682	204960	901	131669
Bangladesh	591	76373	796	115578
Japan	2209	272204	443	60360
Other countries	8522	1079826	1905	259371

**Table – 28 : Exports of Lead & Alloys
Unwrought, NES
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	19013	2883697	17181	2736278
Korea, Rep. of	10880	1412535	6836	1010733
UAE	1126	30048	3387	637646
Saudi Arabia	1277	159901	1247	176561
Bangladesh	106	16061	854	121882
Japan	424	96732	862	118617
Oman	156	19895	765	110056
Thailand	109	14600	503	89202
Finland	1	367	397	71681
Vietnam	21	3056	396	64025
Sri Lanka	693	99496	420	62369
Other countries	4220	760565	1514	273506

**Table – 29 : Exports of Lead (Scrap)
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10	462	1	745
Nepal	-	-	1	728
Kenya	-	-	++	14
Gabon	-	-	++	3
Oman	10	458	-	-
UAE	++	3	-	-
Australia	++	1	-	-

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**Table – 30 : Imports of Lead Ores & Conc.
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5334	264663	6217	318697
Turkey	1597	91167	4181	210212
UAE	1707	67126	581	44017
South Africa	-	-	214	12459
Morocco	127	8778	137	10786
Yemen Republic	331	16668	343	10190
Saudi Arabia	503	24102	260	9436
Jordan	80	3856	172	8720
Sudan	198	8586	145	4661
Estonia	-	-	107	4218
Nigeria	29	1526	51	3287
Other countries	762	42854	26	711

**Table – 31 : Imports of Lead and Alloys Including Scrap : Total
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	268607	32144471	304913	40065602
Korea, Rep. of	51787	6870748	62022	9183868
Australia	49841	6301454	46376	6380614
UAE	30475	3134784	36122	4168035
Vietnam	10031	1195801	22558	2792268
UK	16256	1900189	18974	2525194
Malaysia	13391	1576100	18494	2438437
USA	16606	1813734	18280	2123195
Bangladesh	8949	1072698	14160	2084860
Saudi Arabia	6254	713121	7647	893663
Nigeria	4563	486163	5530	584918
Other countries	60454	7079679	54750	6890550

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**Table – 32 : Imports of Lead & Alloys
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	209883	26265198	238262	32861867
Korea, Rep. of	51787	6870748	62022	9183868
Australia	48115	6110039	44451	6148603
Vietnam	10031	1195801	22558	2792268
UAE	17425	2093616	20767	2791193
Malaysia	12675	1511107	17990	2376612
Bangladesh	8949	1072698	14160	2084860
UK	7184	876515	8114	1142162
Saudi Arabia	6132	703391	6276	724070
Sri Lanka	3193	382167	4142	535216
Nigeria	3310	390119	3526	436751
Other countries	41082	5058997	34256	4646264

**Table – 33 : Imports of Lead (Scrap)
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	58724	5879273	66651	7203735
USA	16260	1762760	18096	2091814
UK	9072	1023674	10860	1383032
UAE	13050	1041168	15355	1376842
Kuwait	922	91684	3081	310354
Germany	1952	206393	2487	296679
Australia	1726	191415	1925	232011
Saudi Arabia	122	9730	1371	169593
Netherland	3028	329153	1420	164013
Nigeria	1253	96044	2004	148167
Israel	400	26898	1669	122413
Other countries	10939	1100354	8383	908817

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**Table – 34 : Imports of Lead: Pig Lead
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5243	617928	6367	817080
UAE	2558	304952	4464	589638
Saudi Arabia	723	80550	577	66201
Nigeria	127	14071	292	35012
Iran	-	-	189	21747
Azerbaijan	-	-	144	21437
Senegal	50	5276	165	18639
Lebanon	-	-	153	17576
Yemen Republic	-	-	137	16237
Korea, Rep. of	-	-	67	7825
Jordan	103	10517	50	5939
Other countries	1682	202562	129	16829

**Table – 35 : Imports of Lead Unrefined, NES
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	33988	4057968	44516	5930455
Bangladesh	8909	1067651	14120	2079152
Vietnam	7650	910725	8286	1052777
Malaysia	4074	483696	5768	753274
UAE	3172	382837	5601	726211
Saudi Arabia	941	103667	3450	400346
Sri Lanka	423	52971	1250	163230
Myanmar	-	-	950	115556
Yemen Republic	388	45457	885	108110
Jordan	54	5950	655	80776
Nigeria	976	115256	542	63651
Other countries	7401	889758	3009	387372

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**Table – 36 : Imports of Refined Lead Unwrought
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	108521	13596145	110749	15347116
Korea, Rep. of	36023	4609201	42977	6151751
Australia	42390	5365656	38713	5310761
UK	6601	795339	7507	1054019
UAE	5163	615396	5343	692371
Malaysia	3356	406783	4923	650490
Thailand	801	99138	2494	332662
Mayanmar	46	5615	1500	226805
Sri Lanka	326	40478	850	110144
South Africa	-	-	801	100490
Uzbekistan	1107	124238	758	99059
Other countries	12708	1534301	4883	618564

**Table – 37 : Imports of Lead
(By Items)**

Item	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	268607	32144471	304913	40065602
Lead & Alloys	209883	26265198	238262	32861867
Antimonial Lead	4385	554014	7626	1069821
Lead & Alloys :Worked (Bars,Rods,Plates, Etc)	250	123563	387	143415
Lead & Alloys Unwrought Nes	57496	7315580	68617	9553980
Lead Unrefined, Nes	33988	4057968	44516	5930455
Lead: Pig Lead	5243	617928	6367	817080
Refined Lead, Unwrought	108521	13596145	110749	15347116
Lead (Scrap)	58724	5879273	66651	7203735

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**Table – 38 : Exports of Zinc Ores & Concentrates
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	558	11346	53912	3990176
Korea, Rep. of	-	-	31423	2368367
China	558	11338	11913	832091
Japan	-	-	10576	789709
USA	-	-	++	7
Canada	-	-	++	1
UK	-	-	++	1
Australia	++	8	-	-

**Table – 39 : Exports of Zinc & Alloys Including Scrap : Total
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	257634	34345663	228025	40967513
Malaysia	50446	6196724	51837	9616658
Korea, Rep. of	42561	5695185	36493	6273618
Chinese Taipei/Taiwan	26337	3756779	23945	4242039
China	9356	1261203	16026	3120056
UAE	14796	2089629	10504	1908432
Bangladesh	7233	876003	8827	1603549
Indonesia	8992	1176553	8701	1493227
Thailand	7121	978179	7897	1484343
South Africa	1064	141778	8355	1478306
Kenya	6019	777882	7947	1337397
Other countries	83709	11395748	47493	8409888

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**Table – 40 : Exports of Zinc & Alloys
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	257590	34339933	227977	40960486
Malaysia	50446	6196724	51837	9616658
Korea, Rep. of	42561	5695185	36493	6273618
Chinese Taipei/Taiwan	26337	3756779	23945	4242039
China	9356	1261203	16026	3120056
UAE	14776	2087147	10479	1904773
Bangladesh	7233	876003	8827	1603549
Indonesia	8992	1176553	8701	1493227
Thailand	7121	978179	7897	1484343
South Africa	1064	141778	8355	1478306
Kenya	6019	777882	7947	1337397
Other countries	83685	11392500	47470	8406520

**Table – 41 : Exports of Zinc (Scrap)
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	44	5730	48	7027
UAE	20	2482	25	3659
Singapore	22	2770	20	2778
Nepal	-	-	1	305
USA	2	387	2	254
UK	++	66	++	29
Mauritius	-	-	++	2
France	++	22	-	-
Canada	++	3	-	-

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**Table – 42 : Imports of Zinc Ores & Conc.
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	385	18721	1771	86640
Turkey	-	-	1394	61466
Spain	-	-	257	16166
Japan	-	-	45	2931
USA	198	7506	26	2285
Korea, Rep. of	-	-	24	2263
Morocco	-	-	10	847
UAE	87	5384	15	682
Ethiopia	100	5831	-	-

**Table – 43 : Imports of Zinc and Alloys Including Scrap
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	227303	30128362	310820	47056547
Korea, Rep. of	88053	12262031	140545	22582330
UAE	29826	3655031	26679	4016369
Spain	10548	1503733	13160	1930510
Malaysia	9226	1196250	13257	1869154
USA	10419	1211820	13397	1787029
Australia	14653	2082969	9783	1509822
Belgium	5649	726239	9537	1462086
Kazakhstan	4436	642330	6471	1047358
Thailand	2648	286778	7065	937538
Saudi Arabia	5395	589111	5748	748472
Other countries	46450	5972070	65178	9165879

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**Table – 44 : Imports of Zinc & Alloys
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	168359	23734742	241074	38274764
Korea, Rep. of	85973	12042095	139607	22468887
UAE	24302	3069266	21055	3278855
Spain	9710	1409923	11832	1766206
Malaysia	6000	862017	10611	1531299
Australia	13945	2004568	9339	1452553
Belgium	3923	532669	7133	1166351
Kazakhstan	4436	642330	6471	1047358
Peru	3021	417606	5046	686244
USA	957	156581	4465	663421
China	1367	539561	1882	553966
Other countries	14725	2058126	23633	3659624

**Table – 45 : Imports of Zinc or Spelter
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	137761	18888382	209779	32501012
Korea, Rep. of	70591	9820499	119826	19071978
UAE	23054	2923902	20501	3203752
Spain	9664	1404248	11795	1761243
Malaysia	3872	513384	8381	1119270
Australia	10292	1473803	6974	1056348
Kazakhstan	4436	642330	6471	1047358
Belgium	2386	307835	5853	952521
Peru	3021	417606	5046	686244
USA	579	80751	3914	563474
Namibia	251	35846	3440	475535
Other countries	9615	1268178	17578	2563289

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**Table – 46 : Imports of Zinc (Scrap)
(By Countries)**

Country	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	58944	6393620	69746	8781783
USA	9462	1055239	8932	1123608
UAE	5524	585765	5624	737514
Saudi Arabia	5071	552717	5316	693280
Italy	4084	447569	4888	599913
Thailand	2395	250576	4032	495986
Mexico	3450	391363	3212	394713
Malaysia	3226	334233	2646	337855
Vietnam	602	69387	2440	321804
Belgium	1726	193570	2404	295735
Germany	577	60731	1798	239715
Other countries	22827	2452470	28454	3541660

**Table – 47 : Imports of Zinc
(By Items)**

Item	2015-16 (R)		2016-17 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	227303	30128362	310820	47056547
Zinc & Alloys	168359	23734742	241074	38274764
Mazak	15371	2207388	18016	3054555
Zinc & Alloys:Worked (Bars,Rods,Plates, Etc)	5518	911699	5547	998311
Zinc & Alloys Nes	9709	1727273	7732	1720886
Zinc Or Spelter	137761	18888382	209779	32501012
Zinc (Scrap)	58944	6393620	69746	8781783

FUTURE OUTLOOK

ILZSG forecasts that world refined zinc metal production is expected to increase by 6.7% to 13.7 million tonnes in 2017, and the consumption of refined zinc metal is expected to increase by 2.6% to 14.30 million tonnes in 2017. Demand is forecast to continue to growing demand in China and India, to remain stable in Japan, South Korea and to fall in Thailand.

HZL has ambitious plans to expand in mining extraction & production of zinc, depending on the country's need while in lead, the recycling sector is likely to emerge as the major sector in future.

As every major national plan sees continuous rise in the power generation capacity of the country, the demand for galvanised transmission tower also increases by about 4-5% along with

increasing necessity of erection of mobile towers, higher investment in the infrastructure, Railways will also lead to increase the use of galvanised steel. Over the past decade, zinc consumption in India has trebled, the CAGR from 2001 to 2009 being 10%. CARE Research predicts zinc demand to grow at the rate of 8 to 9% in the current decade (2010-20). The domestic demand is expected to reach 09 lakh tonnes by 2020. Lead metal will remain in demand for the electric vehicles in view of pressure on petrol fuel driven automobiles. Increased volume of transportation prompted by higher industrialisation is going to keep lead in demand. Government entrust in automobile industries to produce battery running vehicles. All the automobile sector was recommended by Government to encourage the investment in battery vehicles. So there is huge demand in future and it is expected to be 6 lakh tonnes by 2020.

