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RARE EARTHS

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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24 Rare Earths

The term "rare earth" arises from the minerals from which they were first isolated, which are common oxide-type minerals (earths) found in Gadolinite extracted from one mine in the village of Ytterby, Sweden. However, with the exception of the highly-unstable promethium, rare-earth elements are found in relatively high concentrations in the earth's crust with cerium being 25^{th} most abundant element in the earth's crust at 68 parts per million.

Rare Earths are a group of 17 elements starting with lanthanum in the periodic table of elements and include scandium and yttrium. They are moderately abundant in earth's crust but not concentrated enough to make them economically exploitable. The REEs find key applications in defence, electronics, energy systems etc. For instance, magnets made from rare earths are many times more powerful than conventional ones. Along with energy critical elements (ECE), such as, lithium which has become ubiquitous battery material, REEs have emerged as strategic elements essential for sustainable energy systems.

The Rare-earth Elements (REE) are a collection of 17 elements, namely, scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71, namely, lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu).

Although these elements tend to occur together, the lanthanide elements are divided into two groups. The light elements are those with atomic numbers 57 to 63 (La, Ce, Pr, Nd, Pm, Sm and Eu) and the heavy elements are those with atomic numbers 64 to 71 (Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu).

REEs are characterised by high density, high melting point, high conductivity and high thermal conductance. A number of rare-earth minerals contain thorium and uranium in variable amounts, but they do not constitute essential components in the composition of the minerals.

The principal sources of REE are bastnaesite (a fluorocarbonate which occurs in carbonatites and related igneous rocks), xenotime (yttrium phosphate) commonly found in mineral sand deposits, loparite which occurs in alkaline igneous rocks and monazite (a phosphate). The rare earths occur in many other minerals and are recoverable as by-products from phosphate rock and from spent uranium leaching. In India, monazite is the principal source of rare earths and thorium.

RESERVES/RESOURCES

The mineral monazite is a prescribed substance as per the Notification under the Atomic Energy Act, 1962. AMD has been carrying out its resource evaluation for over six 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 11.935 million tonnes in 2012 to 12.47 million tonnes in 2016 which corresponds to about 1 million tonnes of thorium oxide. The Statewise resources are provided in Table-1.

Table – 1: Resources of Monazite

(In million tonnes)

State	Resources*
All India	**12.47**
Andhra Pradesh	3.69
Gujarat	0.003
Jharkhand	0.21
Kerala	1.84
Maharashtra	0.004
Odisha	3.06
Tamil Nadu	2.46
West Bengal	1.20

**Inclusive of indicated, inferred and speculative categories.*

Source : *As per letter received from Department of Atomic Energy dated 26/07/2018. The resources of beach sand minerals (BSM) viz. Ilmenite, Rutile, Zircon, Garnet, Leucoxene, Monazite and Sillimanite were last updated in the year 2016 by AMD.*

The major deposits which contain monazite (thorium and REE ore mineral) are :

1. Chavara barrier beach and Eastern Extension, Kollam district, Kerala
2. Manavalakurichi beach sand deposit, Kanniyakumari district, Tamil Nadu
3. Sathankulam Teri sand deposit, Tamil Nadu
4. Ovari Manapadu Teri Sand deposit, Tamil Nadu
5. Navaladi-Ovari Teri Sand deposit, Tamil Nadu
6. Kuduraimoli Teri Sand deposit, Tamil Nadu
7. Bhimunipatnam beach sand deposit, Andhra Pradesh
8. Kandivalasa beach sand deposit, Andhra Pradesh
9. Kalingapatanam beach sand deposit, Andhra Pradesh
10. Srikurman beach sand deposit, Andhra Pradesh
11. Bhavanapadu beach sand deposit, Andhra Pradesh
12. Gopalpur beach sand deposit, Odisha
13. Chhatrapur beach sand deposit, Odisha
14. Brahmagiri beach sand deposit, Odisha

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are furnished in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION AND PRICES

Indian Rare Earth Limited (IREL), a Mini Ratna Company, is a Government of India Undertaking under the Department of Atomic Energy (DAE) and KMML, a Kerala State Government Undertaking, are actively engaged in mining and processing of beach sand minerals from placer deposits. IREL is the only entity processing monazite to produce Rare Earth (RE) compounds. The RE values produced by IREL is in the form of mixed RE chloride and separated high pure RE. IREL produced 2,265 tonnes of RE chloride in 2016-17.The production of RE chloride for the year 2017-18 and 2018-19 was 2,724 and 4,215 tonnes, respectively. The prices of rare earths in India during 2015-16 to 2018-19 are presented in Table-2.

Table – 2: Domestic Prices of Rare Earths 2015-16 to 2018-19

(In ` per kg)

Year	Grade	Price	Remarks
2015-16	RE chloride	180	Ex-works, packed
	RE fluoride (lumps)	450	Ex-works, packed
	Dicarbonate - Wet	150	Ex-works, packed
	Difluoride	285	Ex-works, packed
	Cerium hydrate -Dry	500	Ex-works, packed
	Cerium oxide B	550	Ex-works, packed
	Neo oxide - 95%	3420	Ex-works, packed
	Neo oxide - 99%	3800	Ex-works, packed
2016-17	Not Available		
2017-18	Not Available		
2018-19	Not Available		

Source: *Department of Atomic Energy, Mumbai.*

MINING AND PROCESSING

Mining of beach sand is being carried out by IREL and KMML. The installed capacity of monazite (96% pure) separation plant of IREL at Manavalakurichi is 6,000 tpy while that of KMML at Chavara is 240 tpy. Details regarding mining and processing, etc., are provided in the Review on 'Ilmenite and Rutile'.

INDUSTRY

IREL has a plant at Udyogamandal, Aluva, located in Ernakulam district, Kerala, wherein the monazite obtained from Manavalakurichi is chemically treated to separate rare earths in its composite chloride form and thorium as hydroxide upgrade. Ground monazite is digested with caustic soda to produce trisodium phosphate (TSP) and mixed hydroxide slurry. This slurry is used for production of diverse rare earth compounds. Elaborate solvent extraction and ion exchange facilities were built to produce individual RE oxides, like oxides of Y, Ce, Nd, Pr and La of specific purities. India is the second largest supplier of yttrium in the world and the maximum production is reported from the plant in Kerala. Uranium values present in monazite which are recovered in the form of nuclear grade ammonium diuranate (ADU) are vital supplement to the indigenous supply of uranium. Thorium is separated in its pure oxalate form. A part of it is taken to OSCOM for further processing by solvent extraction to produce thorium nitrate. A small part of the purified thorium nitrate is converted to nuclear grade thorium oxide powder for supply to Bhabha Atomic Research Centre (BARC) and Nuclear Fuel Complex (NFC) for developing thorium-based fuel for nuclear reactors. IREL has built a large stockpile of impure thorium hydroxide upgrade associated with rare earths and unreacted materials.

IREL has also entered into a Memorandum of Understanding (MoU) with BARC, DMRL and International Advanced Research Center for powder metallurgy & New material (ARCI) for development of rare earth permanent magnet rings. DMRL has the necessary technology for production of rare earth magnets. BARC has developed the technology for manufacturing of RE Phosphors. However, these technologies are yet to see commercial application. Japan and India have reached at a basic agreement to jointly develop rare earths, used in the production of several high-tech goods from weapons to cellphones. IREL has also set up a Monazite Processing Plant (MoPP) at Odisha to produce about 11,000 tonnes of Rare Earth Chloride and associated products and High Pure Rare Earths (HPRE) plant at Rare Earth Division, Aluva, to produce separated Rare Earth Oxide/ Carbonates. The Company is also in the process of facilitation, setting up of industry in value chain of minerals produced other than expanding its existing capacity in near future. IREL has in-house R&D division at Kollam, Kerala, to support mineral and chemical operation and Corporate Office at Mumbai, Maharashtra.

The production of rare-earth compounds from monazite at Udyogamandal plant is furnished in Table-3.

Table – 3: Production of Rare-earth Compounds

(In tonnes)

Product	Specification	Installed capacity (tpy)	Production		
			2016-17	2017-18	2018-19
RE chloride	REO 45% min. CeO_2/REO 45% min.	11,200	2265	2724	4215
RE fluoride	TO>78%, F>26% CeO_2/TO>45%	114	-	-	-
RE oxide	-	-	-	-	-
Cerium hydrate	Total REO>80% (dry) (30% for wet) CeO_2>68%, CeO_2/Total REO >85%	-	-	-	-
Cerium oxide	Grade C: CeO_2 99.00% min. Grade D: CeO_2 99.95% min. CeO_2 99.99% min.				
ADU	Nuclear Grade	28	28	-	-
Yttrium oxide	-	-	-	-	

***Source**: Indian Rare Earths Ltd*

ADU: Ammonium diuranate. RE: Rare Earths.

IREL has invited research projects pertaining to improvement in recovery of heavy minerals, improvement in plant & energy efficiency and value addition of ilmenite, zircon and rare-earth compounds during the financial year 2018-19. IRELTDC has approved three projects with the value of ` 217.35 lakh during this financial year in the field of Nano Ceria, Nano Titania and Zirconia.

Further, in-house Research & Development carried out by IREL during 2018-19 are :

1. Production of lanthanum zirconate, using lanthanum carbonate and zirconyl nitrate suitable for thermal barrier application on metal substrate and graphite for prevention of oxidation.

2. Development of electrochemical device, such as, oxygen sensor from 8 mol% yttria-stabilised zirconia.

3. Production of Hafnia free 8 mol% Yttria-stabilised zirconia for reactor application.

4. Development of process for production of 99% pure hafnium oxide from neutral cake of NFC.

Production of NGADU stood at 34.9 tonnes which is the highest production in the last decade. Production of minerals increased by 6.7% (P) with respect to previous fiscal, which is also the highest production achieved since the last 7 years. Production of Mixed Rare Earth Chloride increased by about 55% compared to the previous fiscal.

Production of 1 kg hafnia with purity level of 99% was reported by IREL in laboratory scale. Samples have been sent to BARC for confirmation on the purity.

Solvent extraction process flowsheets have been developed and demonstrated to produce high purity (>99%) Y_2O_3, Dy_2O_3 and Tb_4O_7 from heavy rare-earth concentrate of monazite mineral.

POLICY

The recent amendment to Atomic Mineral Concession Rules (AMCR) 2016 stipulates reserving all Beach Sand Mines (BSM) deposits containing more than 0.75 per cent monazite in the Total Heavy Minerals (THM) for Government-owned corporations. As per the Foreign Trade Policy, 2015-2020 and the effective policy on export and import, the import of ores and concentrates of rare-earth metals (under HS Code 25309040) and of rare-earth oxides including rutile sand (HS Code 26140031) are permitted 'freely'.

As per Gazette Notification No 26/2015-2020 dated 21.08.2018, the export of rare-earth compounds classified as Beach Sand Minerals (BSM), namely, [Ilmenite, Rutile, Leucoxene (Titanium-bearing mineral), Zircon, Garnet, Sillimanite and Monazite (Uranium and Thorium)], shall be regulated in terms of Sl No 98A of Chapter 26 Schedule 2 of ITC (HS) Classification.

Other minerals under Code 2617 are freely exportable, except those which have been notified as prescribed substances and controlled under Atomic Energy Act 1962.

Export of Beach Sand Minerals have been brought under STE and shall be canalised through Indian Rare Earths Limited (IREL). Beach sand minerals, permitted anywhere in the export policy, will now be regulated in terms of policy under at Sl No 98A of Chapter 26 of Schedule 2 of the Export Policy.

As per Gazette Notification No : GSR.134 (E) dated 20.2.2019, the particulars of threshold values for atomic minerals in respect of Beach Sand Minerals (BSM) shall be regulated as Schedule A [Rule 2(1)(m) and Rule 36] (Table-4).

Table - 4 : Particulars of Threshold Value for Atomic Minerals [See Rule 2 (1)(m) and Rule 36]

Uranium-bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2.
Zirconium-bearing minerals and ores including zircon.	All cases of zirconium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2000 ppm of hafnium.
Beach Sand Minerals i.e. economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite.	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

Efforts toward increasing the production in rare earths extraction plant at OSCOM and High Pure Rare Earths Divisions are being made on a sustained basis. Tender for technical audit of the two plants has been floated so that significant increase in capacity utilization is achieved. Fructification of these would lead to added revenue for IREL.

The implementation of brownfield expansion of OSCOM unit by augmentation of capacity was well on course with receipt of Environmental Clearance in January 2019 and subsequent consent to establish 6,35,000 tonnes and consent to operate for 30% enhanced capacity at 3,70,000 tonnes. The ramping up of the capacity to 3,70,000 mt will help in significant improvement in revenue generation. The phased increase to full capacity of 6,35,000 mt will further enhance the revenue. The JV company IREL-IDCOL Limited with IDCOL (as Odisha Government company) for greenfield project for production of beach sand minerals is progressing satisfactorily. Further progress is made in setting up of SmCo magnet facility at Vizag for strategic purpose and Rare Earths Theme Park at Bhopal. Both the projects are proceeding satisfactorily. In the long, run these are expected to act as catalyst for domestic consumption of High Pure Rare Earths produced at Aluva and hence, are of importance to IREL.

Rare Earths (RE) are important resources for use in high-tech applications in various strategic sector, such as, defence, atomic energy, space, oil, green energy, electronics etc. India has significant rare earths primary and secondary resources. The country depends on import of these resources and has not achieved the self-sufficiency inspite of being in this domain since 1950s. Self-sufficiency in RE is vital and critical to our strategic sectors, emerging non-conventional energy mission and other high-tech products.

In view of the above, an expert committee was constituted by NITI Aayog to solve strategy issues for self-reliance and develop a roadmap to address restrictive trade practice and harness the availability of domestic and global resources. The committee has submitted its report.

USES & CONSUMPTION

The Rare Earth Permanent Magnet (REPM) in Vizag and Rare Earth and Titanium Theme Park (RETTP) in Bhopal have kick started with the funding assistance of Government of India, which will enhance the visibility of IREL in the strategic and niche sector.

Environmental clearance for REPM project has been received from MoEF&CC and M/s MECON Limited, Bengaluru has been appointed as consulting firm for detailed engineering. As regards RETTP project, lease deed execution towards land has been completed. A Letter of Understanding has been inked with BARC towards developing and transferring laboratory-scale technologies in the value chain of Rare Earths which will be suitably upscaled by IREL to pilot-scale and installed in the theme park.

In addition, IREL has been assigned the responsibility of carrying out civil construction works on behalf of BARC for the 5 million liters per day (MLD) hybrid seawater desalination plant at OSCOM. About 60% construction of plant building has been completed.

Execution of Supplimentary Mining Lease deed for OSCOM Mines till a period up to the year 2047 has been completed under the provisions of AMCR 2016. Communication on precise area of the Bramhagiri Mineral Sands Deposit in Puri district under AMCR, 2016 is in the final stages of issuance by the Government of Odisha.

Rare earth materials are utilised in a wide range of critical products enabling many emerging green energy technologies, high-tech applications and defence systems, such as, hybrid cars, plug-in-hybrid electric-vehicles (PHEVs), the latest generation of efficient windpower turbines, computer disc drives, missile guidance systems, etc. The lanthanide elements as a group have magnetic, chemical and spectroscopic properties that have led to their application in a wide range of end-uses. Cerium finds application in polishing of glass items like lenses & display screens of cathode-ray tubes, liquid-crystal displays & plasma-display panels, in petrol & diesel fuels as fuel additive and along with lanthanum for replacement of cadmium in red pigments. Mixed salts of the cerium group of elements, other than fluorides are used in medicine, non-irritating antiseptic dressings, waterproofing agents and fungicides in textile manufacture. The principal uses of commercially pure cerium compounds that are in the form of nitrate is in the manufacture of incandescent gas mantles and cerium compounds as oxide. It also finds usage as a polishing agent of glass. Cerium compounds are also used in ceramic and glass as colouring pigments and also as catalysts in Chemical Industry.

Department of Atomic Energy (DAE), has accorded in principal approval for futuristic proposal of IREL towards setting up of rare earth theme park which inter alia includes setting up of pilot plants in the value chain of rare earths, skill-cum-enterpreneur development center. This will be a first of its kind theme park in the country.

To produce samarium-cobalt (Sm-Co) magnet for meeting national objectives, a Special Purpose Vehicle (SPV) has been formed. Production of Sm-Co metal and Magnet is based on technologies developed by BARC, Mumbai & DMRL, Hyderabad. Activities for firming up the investment, plant location etc., are under progress.

Supply of Nuclear Grade Ammonium diuranate (NGADU) from new source, i.e, the newly commissioned monazite processing plant at OSCOM, Odisha has commenced.

Approval has been received for entering into production sharing contract viz. concessions and profits sharing option with land owner having surface rights within IREL mining lease area with a view to mitigate the difficulties in sourcing land for new material of the southern operating units of IREL.

Subsequent to identification and development of conditions for dissolution of Rare Earths (REE) from fly ash generated at lignite coal fired thermal power plant at Neyveli, Tamil Nadu, studies were taken up to understand the overall process efficiency and precipitate dissolved rare earths in purified form.

Cerium, lanthanum and neodymium are used as glass additives in optical lenses and display screens, as catalysts in automobiles to reduce sulphur dioxide emission, in multilayer capacitors and along with yttrium in magnesium, aluminium and hydrogen storage alloys. Mischmetal which is an alloy of cerium with small amounts of other rare earth metals is used in lighter flints, for desulphurisation in steel and foundry, and with lanthanum alloys, in batteries and hydrogen storage systems meant for electronics and hybrid cars. Cerium oxide is used in glass polishing industries.

Lanthanum oxide and neodymium compounds are used in special glass manufacture. Lanthanum finds application in X-ray films as phosphors; yttrium in advanced ceramics like nitrides,Y-stabilised ceramics, etc., and gadolinium in magnet alloys. Yttrium, europium and terbium are used as phosphors in displays of computers, TV, etc. and with lanthanum, cerium & gadolinium as phosphors in fluorescent and halogen lamps. Neodymium, samarium, dysprosium, praseodymium and terbium have application as high intensity magnets in electronics, electric motors and audio equipment. Lanthanum, erbium and ytterbium have application in fibre optics and lasers. Lanthanum and yttrium find application in solid oxide fuel cells. Scandium is used mainly in aluminium alloys for sporting goods. Scandium in minor amounts is used in semiconductors and special lighting, including halogen bulbs. Mixed rare earth products are used as catalysts in petroleum refining and fluid cracking. Neodymium is used in welding in heavy industries and also in MRI scanners. Praseodymium is not a primary element for any specific use, but finds use as a substitute for neodymium in magnets.

Samarium is used essentially for the Sm-Co magnets. Europium is a primary component of phosphorus and is responsible for white light in compact fluoroscent lamps when used with terbium compounds.

Erbium used as fibre optic and has emerged in the nineties as a remarkable tool for communication technology through which high quality rapid data in tight pulses can be transferred in speed unthinkable in the past.

The main application for neodymium-iron-boron (Nd-Fe-B) magnets are in automobiles for anti-lock brakes, and in computer hard disk drives, videos, CD-ROMs used in many small-size electronic consumer products, such as, digital cameras, where major advantage is their small sizes. Nickel metal hydride (Ni MH) batteries, containing mischmetal, a mixture of rare earth compounds, are used mainly in portable electronic equipment, such as, laptops, camcorders and mobile phones. Though, the market for batteries for portable electronic equipment is growing strongly, the Ni MH batteries are increasingly replaced by lithium-ion batteries.

Monazite contains about 25.28% P_2O_5 which can be recovered as a by-product for manufacture of fertilizers and production of elemental phosphorus or its salts. Beside, rare earths, thorium is also recovered from monazite. It is a source of atomic energy. An important use of thorium is for addition to tungsten in minute quantity (about 0.75%) to increase the ductility of tungsten wire and thus to facilitate its drawing into filaments used in electric lamps. Metallic thorium is also used in photoelectric cells and X-ray tubes and in certain alloys. Thorium is used as catalytic agent for various processes. Amongst thorium salts, thorium nitrate is used largely in the manufacture of incandescent gas mantles. Mesothorium, the chief radioactive element recovered as a by-product in the chemical treatment of monazite, is marketed usually in the form of its bromide and used in self-luminous paints or enamels. Mesothorium is also used in the treatment of certain types of cancer and skin diseases.

The total consumption of rare earths during 2016-17 to 2018-19 is furnished in Table-5. The reported consumption during 2018-19 is not available. Rare Earth Compounds producer was the main consumer accounting for about 99.68% of the total consumption followed by Glassware.

Table – 5 : Consumption of Rare Earths, 2016-17 to 2018-19 (By Industries)

(In tonnes)

Industry	2016-17	2017-18	2018-19
All Industries	**1867.90**	-	-
Rare Earth Compounds Producers	1862.0	-	-
Paints Driers/Pigments	-	-	-
Cinema Arc Carbon	-	-	-
TV Colour picture tube	1.0	-	-
Glass/Optical polishing	1.0	-	-
Glassware decolouring	0.4	-	-
R&D and others	3.0	-	-

Source: *Department of Atomic Energy, Mumbai.*

Industry-wise consumption of minerals in India, IREL.

WORLD REVIEW

The total world reserves are estimated at 120 million tonnes of rare earth oxides equivalent content (REO) of which China alone accounts for 44 million tonnes (37%) followed by Brazil & Vietnam (18% each) and Russia (10%) (Table- 6).

China holds the leading position among producers of rare earth oxides with 140 thousand tonnes. The other major producers are Myanmar, Australia, USA, Russia and Malaysia (Table-7). Concentrates/partially-processed intermediate products are further processed at many locations in Europe, USA, Japan and China.

In China, the principal production centres of rare earths are located at Baotou, Inner Mongolia and in Jiangxi & Sichuan provinces. At Baotou, bastnaesite is recovered as a by-product of iron ore mining while in Sichuan and in Gansu, bastnaesite occurs as primary mineral. In Jiangxi, Guangdong, Hunan and Jiangsu provinces, the ion adsorption clays are the source of the greater proportion of world yttrium production.

The Russian Rare Earths Industry is based on loparite, a titanium-tantalum niobate mined from Lovozero massif in the Murmansk region. Rare earth minerals have been recovered as by-products from titanium-bearing heavy sands, particularly in Australia and from tin dredging in Malaysia.

Table – 6 : World Reserves of Rare Earths (By Principal Countries)

(In '000 tonnes of REO equivalent content)

Country	Reserves
World: Total (rounded off)	**120000**
Australia	3300
Brazil	22000
Myanmar	NA
Burundi	NA
Canada	830
China	44000
Greenland	1500
India	6900
Madagascar	NA
Russia	12000
South Africa	790
Tanzania	890
Thailand	NA
USA	1400
Vietnam	22000
Other countries	310

Source: *USGS, Mineral Commodity Summaries, 2020,*

Table – 7 : World Production of Rare Earth Oxides (By Principal Countries)

(In tonnes)

Country	2016	2017	2018
China(b)*	140000	140000	140000
Myanmar*	4500	20000	23000
Australia(d)	12631	16003	17754
USA	-	-	9000*
Russia	3063	2500	2596
India(a)	2265	2000*	2000*
Malaysia	1221	196	1012
Vietnam*	220	200	400

Source: *BGS, World Mineral Production, 2014-2018,*
a :Year ending 31st March following that stated.
b :Includes production from iron ore extraction, bastnaesite concentrates and ion adsorption clays. ** Estimated*
d :Year ending 30th June following that stated.

FOREIGN TRADE

Exports

Exports of Rare Earth Metals (Scandium & Yttrium) increased to 12.44 tonnes from 1.89 tonnes in the previous year. Bhutan (91%) and UAE (8%) were the main buyers from India (Table-8).

Imports

Imports of Rare Earth Metals (Scandium & Yttrium) in 2018-19 increased to 643.41 tonnes as comapred to 492.41 tonnes in 2017-18. China (97%), USA (2%) were the main suppliers to India (Table-9).

Table-8 : Exports of Rare Earth Metals (Scandium & Yttrium) (By Countries)

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**1.89**	**2176**	**12.44**	**4476**
Australia	-	-	++	24
Bahrain	-	-	0.10	65
Bhutan	1.4	497	11.31	3947
Denmark	-	-	0.02	14
Iran	0.49	1666	-	-
Mauritius	-	-	0.01	5
Morocco	++	1	-	-
Singapore	++	12	++	50
UAE	-	-	1	311
USA	-	-	++	60

Figures rounded off

Table-9 : Imports of Rare Earth Metals (Scandium & Yttrium) (By Countries)

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**492.41**	**170116**	**643.41**	**278993**
Austria	++	8	-	-
Belgium	++	5	-	8
Taiwan	0.5	508	-	-
China	487.01	158885	623.1	256237
Czech Republic	-	-	++	35
France	++	87	-	-
Germany	0.01	225	0.08	387
Hong Kong	-	-	10	4246
UK	0.15	1058	0.03	488
USA	4.74	9340	10.2	17592

Figures rounded off

FUTURE OUTLOOK

IREL is setting up a Rare Earth Permanent Magnet (REPM) plant at Visakhapatnam for production of samarium-cobalt magnets for use by DAE, Defence and Space sector. The plant, based on technology developed by Bhaba Atomic Research Center (BARC) and Defence Research Laboratory (DMRL), Hyderabad, will be set up in BARC campus, Vizag.

The positive impact on the demand especially for Neodymium, Praseodymium, Dysporsium that are used in RE magnets, is likely only when production of Electric Vehicles start in a big way and industries in the intermidiate value chains are established in the country.

The thrust on renewal energy, EV's and other niche sectors, such as, communications, nuclear energy etc. would be good market of end-products of rare earths in times to come. There is trend for production of EV cars by major car producers around the world. The Government of India is also committed to promote EV's. While this would have a positive impact for Rare Earths that are used in RE permanent magnets in the long run.

IREL is setting up a RE & Titanium theme park for the technologies being developed by BARC in the RE value chain. Pilot-scale plants shall be installed in this facility to attract enterpreneurs to upscale the technology to commercial scale.

A carbonatite deposit containing REO has been identified in Gujarat. Action has been initiated to ascertain the economic feasibility and financial viability for harnessing the deposit.

IREL has in operation a Processing Plant in Ganjam district of Odisha, which has installed capacity for producing about 11,000 tpa mixed RE chloride, containing about 5,000 tpa of RE Oxide (REO).

IREL has also facilities in Aluva, Kerala, for processing of about 5,000 tpa of mixed RE chloride for production of about 2,000 tpa equivalent separated High Pure Rare Earths in the form of individual/compounds (Neodymium, Praseodymium, Samarium, Cerium, Lanthanum etc.)

Driven by the global shortage of petro-fuels and the spiralling cost of importing them with costly foreign exchange puts a tremendous indirect pressure on the national policymakers and manufacturers alike to support largely the case for electric vehicles. This brightens the prospects of the REE Sector in India, provided the gap in the scale, experience and resource utilisation is strategically made up by Public and Private endeavours.

In case of rare earth, the prices continued to decline as the demand remained subdued for most of the rare earths. This impacted price realisation of rare earth chloride and high pure rare earths. The US - China trade dispute also engendered the uncertaininty which probably is one of the reasons for the adverse impact.