Draft National Non-Ferrous Metals (Aluminium and Copper) Scrap Recycling Policy

Ministry of Mines is in the process of formulation of a National Non-Ferrous Metals (Aluminium and Copper) Scrap Recycling Policy. Accordingly, a draft of the said policy has been prepared and is being circulated for comments from stakeholders and the public at large. A copy of the same is enclosed. Comments/ suggestions on the draft policy document for pre-legislative consultation are invited from the public at large. It is requested that the comments/ suggestions may be furnished to this Ministry on the email – met4-mines@gov.in, positively by 30th April 2020.

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DRAFT
NATIONAL NON-FERROUS METAL
(Aluminium and Copper)
SCRAP RECYCLING POLICY

Ministry of Mines, Govt. of India
PREAMBLE

Non-ferrous metals, due to their inherent characteristics like excellent thermal and electrical conductivity, high recyclability, high strength-to-weight ratios, form the backbone of a growing economy like that of India. Metals like aluminium, copper, zinc and lead are key inputs to a wide range of critical industries, including infrastructure, power, automobile, defence, transport, telecom and manufacturing in general. However, there are many critical challenges which are affecting robust growth of the sector in India, especially the underdeveloped scrap recycling sector. This policy envisages a framework to address the challenge of underdeveloped scrap recycling in the non-ferrous metal sector in general and Aluminium and Copper in particular.
INTRODUCTION

Key Government reforms like Make in India, focus on urbanization, including initiatives like Smart Cities, place strong emphasis on expansion of our manufacturing sector. Growth of the manufacturing sector will be directly proportional to the growth of the non-ferrous metals industry. Aided by strong demand in sectors like automobile, construction, electrical and consumer durables, the non-ferrous metals industry in India has historically witnessed good progress.

The Non-Ferrous Metals (NFM) industry consists of a host of productive activities along different levels of the value chain which include upstream operations like mining, smelting, recycling, refining and secondary processing and fabrication of intermediaries further downstream.

The non-ferrous metals industry constitutes several sub-sectors –

1) Base metals (aluminium, copper, zinc, lead, nickel, tin)
2) Precious metals (silver, gold, palladium, other platinum group metals)
3) Minor metals including refractory metals (e.g. tungsten, molybdenum, tantalum, niobium, chromium) and
4) Specialty metals (e.g. cobalt, germanium, indium, tellurium, antimony, and gallium).

The non-ferrous metals industry, with its far-reaching linkages across various downstream sectors, is of great economic significance. While the demand for non-ferrous metals in India is expected to rise with the Government’s ‘Make in India’ and ‘Smart City’ initiatives, the industry is also preparing to face challenges to reduce costs and support technological innovation.

One of the key challenges faced by the non-ferrous metals industry is its heavy dependence on scrap metal imports. A major share of metal scrap demand is served by imports owing to the underdeveloped metal scrap collection, segregation and processing infrastructure in the domestic market. Given India’s population and metal consumption, the gap between demand and supply of metal scrap is glaring. However, scrap generation domestically has been rising year after year, thanks to the excess recycling capacity in the country. India also imports scrap from other countries over and above the locally generated.

To tackle the problem of indiscriminate metal scrap imports, India needs to develop and strictly implement quality standards pertaining to the import and use of metal scrap. Furthermore, well-defined end-of-life norms are essential to ensure availability of quality scrap and cut dependency on imports.
OBJECTIVES:

- To take a holistic perspective for RECLCYLING as a systems activity with a view for
  - economic wealth creation and contribution to GDP;
  - sociological transformation and job creation;
  - technological leadership in terms of scientific methodology, process know-how, facilities and best practices for collection, processing and value addition;
  - strategic perspective with respect making available critical raw materials that are not available as primary resource;
  - reduction of import of metals & alloys and promotion export of value-added products made from recycled materials;
  - conservation of energy and resources
  - environmentally friendly operations, lower water stress and lower carbon foot print.

- To aggressively adopt data-based analysis and policy making at all stages of recycling chain to determine and utilize opportunities available not only available inside in India, but also from abroad for enhancing extraction of many metals, improve trade and commerce;

- From analysis of data, identify steps and processes to graduate recycling sector from predominantly un-organized collection aggregator system in to an organized sector;

- Establish necessary comprehensive legislative, regulatory and institutional framework for recycling of all metals and materials;

- Sorted scrap is already a globally traded commodity; Digital marketing has made all scrap commodities accessible across the world and India is a net importer of sorted scrap for many metals. Investment friendly legislations, policies for processing scrap, import-export regimes, designated processing zones and promoting data-based development should be the ultimate goal to enhance trade and use of scrap commodities for Indian economy on product by product and metal by metal basis;

- Sorted and treated scrap will start to supplant ores and concentrates for many metals and in particular for critical raw materials (CRM). India to formulate a policy for critical raw materials availability, stock piling, technologies for recovery from domestic EOL products.

- Review existing laws across multiple ministries to bring in coherent synergy to render Recycling as INDUSTRY which will attract investment, technologies and value addition;
• **Import – Export Policy** to be reviewed vis a vis Recycling requirements from (i) strategic angle, (ii) technology development to reduce CAD by emphasizing export oriented policies and practices in recycling, (iii) mapping with lack of primary resources in the country and (iv) conceive and implement progressive policies for import of scrap with a view to significantly value – add both for domestic demand as well as exports. Banning of export of scrap containing critical raw materials (CRM) and removal of restrictions and facilitating import of crucial scrap and technologies for creation of value-added metals & alloys that are imported is the crying need of the hour. Review of FTAs in particular with ASEAN/ Japan and inverted duty between scrap and metal that is presently encouraging import of refined metals in some cases has hurt jobs as well as has an adverse impact on CAD. For example, in the case of copper instead of importing lower value scrap, cathodes and finished products like tubes and cables are imported while Indian industries are running at 50 – 75% capacity of products.

• Bring in executive orders for making it mandatory for households, offices and entities to deposit in identified collection points or hand over to authorized dealers specific identified products at the end of their life. These products are well known and can be identified. Eventually, municipal garbage collection is to be reduced to just organic waste which should also be converted to fuel and manure.

• Listing of metals and materials in a product by manufacturer to be made mandatory and the metals that are to be recycled compulsorily have to be identified in each product by data analysis.

• Promotion and investment in technology development to extract all metal values from various recycled materials.

• **Design, Develop, Demonstrate and Deploy** well engineered, organized, specialized and regulated URBAN MINES from ground zero. Engineered Urban Mines with investment in technology and processes for extraction and value addition apart from meeting shortfall in domestic demand should become a FE earning sector;

• As Indian economy is targeted for $ 5 Trillion by 2025, there will be significant shift in terms of metal usage paradigm. Advanced economies are characterized not only by increased per capital utilization of base metals (Al, Cu, Zn, Pb & Sn apart from steel), but higher consumption of 20-25 technology metals or critical raw materials; Recycling policy should be carefully formed to take in to account the need to recycle a large number of CRMs from products that are already in use thanks to large imports over the last 2 decades.

• To shift to circular economy in the next 10 years for focussed base metals, critical raw materials (CRM) and other essential materials for India;
1 INTRODUCTION

Aluminium is an ideal material for the circular economy as it can be recycled repeatedly without losing its quality. According to International Aluminium Institute (IAI), 75% of the estimated 900 million tons of aluminium produced worldwide since 1880 is still in productive use. It was quoted that recycling the metal currently stored in various usages such as buildings, automobiles, electrical cables etc. would equal up to 17 years’ worth of current annual primary aluminium production.¹

Virtually all of the aluminium used in cars, buildings, airplanes etc. is recycled. Additionally, consumer products like beverage containers are recycled at far higher rates than competing packages such as glass, plastic bottles, or multi-layer composite containers.

Figure 1 Aluminium stock pie chart

The role of aluminium sector will be critical, as India advances to meet its economic growth targets. With India’s growing economic might, it should be able to produce enough high-quality metal to ensure self-reliance in its defence and critical infrastructure needs in order to avoid global volatility in supply and prices.

Globally, aluminium is produced by two different methods. The primary production process involves the conversion of ores to aluminium and the other is secondary production (recycling) where the aluminium scrap is recycled to produce aluminium products again. Primary or virgin aluminium production takes around 4 tonnes of bauxite to produce 1.93 tonnes of alumina, 13460 kWh of energy, 415 kg of carbon, and 20 kg of fluoride to produce 1 tonne of aluminium through primary production process as shown in Figure 2.

¹ http://recycling.world-aluminium.org/review/global-metal-flow/
The term 'Secondary Aluminium' refers to aluminium that is produced from recycled aluminium originating from various forms of aluminium scrap including new production off-cuts, machining swarf, dross or end-of-life aluminium products. Secondary aluminium production route can be depicted from figure 4.

Aluminium has been recycled since it was first commercially produced and today secondary aluminium accounts for about one-third of world aluminium consumption. The initial reasons for recycling were commercial as well as environmental. Aluminium quality is not impaired by recycling – it can be repeatedly recycled and hence aluminium retains a high scrap value. Almost 100% of the scrap arising from manufacturing of aluminium products is being recycled.

India’s aluminium capacity utilization has gone up substantially from 56% in 2015 to 90% in 2019-20 and the projected increase in capacity utilization by 2025 is upto 98%. As shown in the figure 3 below, the demand for aluminium has been slightly higher than the production in 2019-20, however this gap is going to be done away with the capacity expansions planned in the industry.

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2 http://www.balcoindia.com/operations/pdf/Aluminium-Production-Process.pdf
Figure 3 India’s Aluminium Capacity, Production & Demand (FICCI report)

Figure 4 Secondary aluminium production
1.1 **Benefits from aluminium recycling**

Secondary aluminium has important characteristics related to recycling:

- The inherent quality of aluminium is not affected by recycling irrespective of the number of recycling cycles.
- Energy savings through recycling can amount up to 95%, depending on the type of scrap, recycling technology and fuel sources used.
- There are several environmental benefits from secondary Al production. Figure 6 compares the raw material consumption, air emissions and solid waste generation for ingots produced from primary or secondary aluminium. For example, CO$_2$ equiv. savings of 94% can be made with secondary aluminium compared with primary metal production. Figure 7 gives CO$_2$ emissions in primary aluminium production for various energy sources.
- Recycling of aluminium needs as little as 5% of the energy which is lowest amongst the other recyclable metals (Figure 8).
- Nevertheless, the production of primary or secondary aluminium should not be regarded as competing processes. They are both essential and integral parts of the aluminium material cycle.

*Figure 5 Benefits of aluminium recycling*
**Figure 6** Comparison of bauxite consumption, air emissions and solid waste between primary and secondary aluminium production.

**Figure 7** Comparison of recycled aluminium emissions with primary aluminium production.\(^3\)

**Figure 8** Primary versus secondary (recycling) production energy requirements.

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\(^3\) The Circular Economy by Material Economics
Improved efficiency in the aluminium recycling industry is need of the day⁴

- Recycling improves CO₂ footprint
- The industry is still in a growth phase in US and Europe, with large efficiency improvement potentials.
- The industry is growing very fast in emerging countries, becoming industrialized and applying new technologies.
- The industry competes with other industries, like the steel and copper that are experienced in recycling.
- The aluminium industry must be attractive for the inherent players as well as for the customers.
- Customers (society, consumers) are demanding products with low carbon footprint.
- Secondary aluminium capacity can be created at less than 1/10th the capital cost of primary smelter.
- The price of recycled aluminium is capped by that of primary metal. Recycled aluminium will always be cheaper than primary aluminium. Presently the cost difference is about 10-15%

The Indian Aluminium industry is forging ahead with rapid expansion in both primary metal and downstream sectors. With the continuing trend of economic growth, the demand and consumption of aluminium is expected to increase rapidly. India’s downstream processing industry is likely to witness a phenomenal progress in coming years as growth of aluminium consumption looks imminent through value added products. Aluminium consumption in India is poised to grow from current levels of 3.3 million tons in 2015-16 to 5.3 million tons in 2020-21. Per capita aluminium consumption in India is only 2.5 kg against world average of 11 kg and 24 kg in China (Figure 9).

There is huge potential for increasing the consumption of aluminium due to government initiatives like, Make in India, Smart Cities, Housing for all, rural electrification, freight corridors, bullet trains, power to every household, energy efficient/electric automobile, aluminium wagons and many more. The aluminium industry in India is strategically well-placed and is one of the largest producers in the world with discernible growth plans and prospects for the future. Aluminium is already set to play a key role in the progress of industrial development in India because it serves as a basic input for a number of industries apart from its use as a strategic metal (Figure 10).

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⁴Hydro, Corporate Strategy and Analysis November 18th, 2014
Aluminium recycling has become the need of the hour for sustainability of this metal in country on long term basis. The recycling of aluminium scrap needs to be promoted by all means and measures because:

- Dwindling bauxite resources in terms of quality and quantity both
  - As per the IBM data in spite of having deposits of 3.9 BT only 656 million tons are recoverable (IBM data)
  - Bauxite definition has been modified by IBM due to depletion of bauxite quality
- Ever increasing Environment Pollution due to mining as most of the deposits are in forest areas
- Inconsistent Coal/Power Availability affecting the efficiency of aluminium plants

- Higher input material cost of imported raw materials like caustic soda and aluminium fluoride, highly volatile Al/Al2O3 prices as they are LME dependent.

2 GLOBAL & INDIAN ALUMINIUM INDUSTRY

2.1 Primary aluminium Industry

Globally aluminium industry comprises of two basic segments: upstream, and downstream. The upstream sectors are involved in extraction of aluminium from bauxite and produce primary or “unwrought” aluminium. Primary aluminium is the starting block for aluminium products and is mainly in the form of ingots and billets or slabs (Figure 11).

![Flow chart of primary aluminium production](image1.png)

*Figure 11 Flow chart of primary aluminium production*

![Global primary aluminium production data](image2.png)

*Figure 12 Global primary aluminium production data*

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The processing of aluminium into semi-finished aluminium goods such as rods, bars, rolled products, castings, forgings and extrusions comprises the downstream segment of the industry (Figure 14). These aluminium products can be manufactured using primary or secondary aluminium, or a combination of both depending on the specification of the final product. Aluminium production from recycled scrap is termed as secondary production.

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6 World mineral statistics, British Geological Survey (BGS)
Figure 14 Process flow of primary aluminium\textsuperscript{7}

\textsuperscript{7}http://www.balcoindia.com/operations/pdf/Aluminium-Production-Process.pdf
2.2 Contribution of aluminium towards India’s growth

Railways
- Power Trains.
- Driving Energy and cost efficiency
- Enhancing Safety of passenger cars

Transport
- Stringent CO₂ norms.
- Faster adoption & Manufacturing of Hybrid/ electric vehicles.
- Switch to automotive transmission

Power
- Renewable share to increase up to 40% by 2030
- Solar capacity increased from 3GW to 20GW in last 4 years and increase to 100 GW by 2022

Defense
- 5th largest defense spending ($64 billion, 13% YoY growth)
- Largest importer of defense equipment.
- Indigenization of equipment is being promoted to increase consumption of Aluminium.

Consumer durables/Packaging
- Increase urbanization: Urban population set to cross 50% by 2039.
- Rising per capita consumption.
- Environment and health centric regulations to eliminate plastic usage in packaging- Aluminium green and healthy substitute.

Aerospace and civil aviation
- Increasing of indigenization by ISRO.
- Civil market to be expected to be third largest by 2030.
- Demand boost through offset obligations.
- Boeing, airbus, Dassault expected to spend $14 billion by 2028.
2.3 Secondary aluminium Industry

According to estimates by the International Aluminium Institute (IAI), in 2016 around 17 million tons of aluminium old scrap were accrued worldwide. This number will increase to around 21 million tons in 2020, according to IAI. This corresponds to a share of more than a third of today’s global output of primary aluminium. Today, around 20% of our aluminium demand worldwide is covered by old scrap. Besides old scrap, new scrap is also generated. Some examples are cutting scrap in the production of semi-finished goods, sprues from casting foundries and chips from the mechanical processing of semi-finished goods and products.⁸

![Graph showing primary and secondary aluminium consumption](https://www.spotlightmetal.com/markets-for-steel-and-aluminum-scrap-a-789883/)

**Figure 15 Primary and secondary aluminium consumption - Indian and Global statistics**

Initially, automotive sector has been the most important resource for recycled aluminium from end-of-life products. Scrap from building applications has only become available in 2000s due to their longer lifetimes. Estimated life span of various product categories is presented in Figure 19.

Aluminium recycling industries were mainly two types viz. remelters and refiners. Remelters produce primarily wrought alloys, meaning that careful selection of scrap grades and chemistries is essential. Again, remelters use primarily new scrap, with some added primary metal to dilute impurity content to the needed level and associated with either extrusion/rolling activities. Whereas refiners produce wide range of alloys from processing in-house scrap, primary metal or clean cast/wrought scrap.

From bikes to spaceships, all vehicles contain aluminium in varying amounts. It makes up 75 – 80% of a modern aircraft and key aluminium alloys used in aviation are 2xxx, 3xxx, 5xxx, 6xxx, and 7xxx series. 7075 is the most widely used alloy in the aviation. As the automotive industry begins to pay more attention to fuel efficiency, reducing CO\textsubscript{2} emissions and design, aluminium started playing more important role in modern cars. An all-aluminium body vehicle released in 2014 witnessed much better fuel economy and significantly lower CO\textsubscript{2} emissions.

Automakers has significantly expanded the use of aluminium parts in their models and soon aluminium is going to find its way into body parts and entire car bodies are going to be built from aluminium. High speed trains that are coming to India uses aluminium to reduce the weight and helps it to achieve higher speeds. Hence it is evident that aluminium usage in transport sector is increasing and this result in generation of continuous flow of aluminium scrap for recycling in India and promote some extent of indigenization in aluminium scrap.

Aluminium recycling industry treats all the aluminium scrap collected or imported from end-of-life products and process scrap. Each application sector

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9 aluminium and Life Cycle Thinking Towards Sustainable Cities, IAI 2015
requires its own recycling solutions and the recycling industry need to optimise the recycling rate. Global recycling rates for aluminium used in the transport and building sectors are very high up to 90% and 70% for aluminium used in beverage cans. Globally, transportation is the major field of application worldwide and in India it is next to electric sector. Increasingly, aluminium products are being employed to reduce vehicle weights, without loss of performance, improving safety and reducing greenhouse gas emissions from vehicles’ use-phase. Stringent emission norms, adoption of hybrid/electric vehicles will boost the aluminium demand and can be met only with focus on secondary aluminium production.

Aluminium scrap is collected, sorted and melted everywhere in the world, but recycling plays a particularly leading role in Europe, North America and Japan. United States is the world’s most resource-abundant secondary recovery site because of its long history of aluminium production and consumption. Flow cycle of aluminium is show in Figure 21.

A study on aluminium mass balance for the aluminium recycling industry in the EU-15 was carried out by Delft University of Technology and revealed that real metal losses for all scrap melted in EU-15 are usually less than 2% and for old scrap, it may touch 5%.

The robust increase in the secondary aluminium consumption (Figure 20) has led to the idea of scrapping centres to recover Aluminium.

![Figure 17 Robust growth of secondary Al consumption in India](image)

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10Evolving Role of Scrap in India by Rahul Prithiani, Director – CRISIL Research
From a technical point of view, there is no problem to produce a new aluminium product from the same used product. There are no quality differences between a product entirely made of primary metal and a product made of recycled metal. But, if scrap sorting and processing is not carried out efficiently, there will be unwanted impurities being ended up with secondary aluminium. If these products are not properly regulated, secondary aluminium will get a bad name despite of several advantages in its production and utilisation. However, recycled aluminium is used where it is deemed most efficient in economic and ecological terms. Due to the overall limited availability
of aluminium scrap, any attempt to increase the recycled content in one particular product would just result in decreasing the recycling content accordingly in another. The high market value of aluminium means that, if scrap is available, it will be recycled and not stockpiled or landfilled in India or in world.

The pie chart in Figure 22 shows the share of scrap from various sectors in recycled aluminium production globally. It is evident that transport sector is the major source for aluminium scrap. Despite being the efficient sector for recovery of aluminium at the end-of-life, building sector contributes less due to its long-life time.

![Pie Chart]

*Figure 19 Global share of aluminium scrap from various sectors*

Aluminium scrap has considerable market value because most of the energy required for the production of primary aluminium is embodied in the metal itself and, consequently, in the scrap. Therefore, the energy needed to melt aluminium scrap is only a fraction of that required for primary aluminium production. The aluminium recycling industry has almost quadrupled its output since 1980.

Worldwide, secondary aluminium production is following an increasing trend and is shown in the table below. Secondary aluminium production in India is shown in Figure 23. It can be seen that China is the leading producer of secondary aluminium while it is importing major portion of the scrap from US. Europe is leading in recycling rate of beverage cans, some countries reaching 98%.
Global secondary aluminium production (in '000 tons)

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2.4 Aluminium recycling scenario in India

India has been a country that consumes aluminium in sectors having typically long useful life and lower recoverability rate. Production of secondary aluminium in India is shown in Figure 23. Recycled aluminium contributes to one third of all the aluminium currently produced globally through old, new and traded scrap. This trend is seen in India also. In India, 1.3 million tons of recycled aluminium is produced during 2018.

![Figure 20](image)

*Estimated value based on 1st quarter production which is 3,48,817 tonnes during 2019-20

Secondary Al accounts for ~30% of India’s Overall Al consumption of ~3.7 mil MT. Over the past 6 years, secondary Al demand grew @ 12% from 0.56 to 1.3 mil MT. Growth driven by increased penetration across end-use sectors, especially automotive sector. By 2023, secondary Al demand will be 2 mil MT. Figure 24 shows applications of recycled aluminium in various regions across the country.
Secondary aluminium finds its application majorly in automotive industry and three fourths of the scrap is being imported. Newer and stricter fuel and emission laws and regulations in several international markets have created favourable conditions for downstream aluminium manufacturers. Applications of primary and secondary aluminium products are largely distinct which is evident from the figure 25.

Figure 22 End-use demand breakup for primary and secondary aluminium

Around 67% of the secondary aluminium produced in the country constitutes alloys based on customer requirements. Hence there will be no problem
regarding quality as customer will reject if the product does not meet their requirements. Aluminium as deoxidant for steel industry constitutes approximately 7% of the total secondary aluminium produced. Sheet and wire products were well organized and standardized as the processing routes imposes stringent quality requirements in the aluminium.

Separation of aluminium scrap from end-of-life products is mainly driven by market mechanisms and high value of the scrap. In India, majority of the aluminium scrap comes from building products and overhead cables. Additional efforts are required for collection and separation of aluminium from end-of-life products and make India independent of aluminium scrap imports. This may take a long time due to very low per capita consumption in our country and mostly, aluminium products have long life usage. It is expected that the imports will keep growing before it will reach peak point and will gradually reduce thereafter with increasing domestic scrap supply. Societies, governments and communities need to work alongside the industry to create effective collecting systems to ensure the constant improvement of recycling rates in all applications sectors.

In India more than three fourth of the scrap is being imported and scrap generation is also very limited. Higher share of imported scrap at 85-90% (as compared to domestic scrap) is largely on account of lack of efficient ecosystem in India for scrap collection, segregation, and processing facilities (such as scrap yards). Quantity of aluminium scrap being imported during the past decade is shown in figure 26 (a).
Majority of the primary aluminium goes into electrical sector in India, which has a long end-life. Since the last two years large part of scrap usage is getting diverted in to manufacturing other products which is leading to an increase in imports. Indian aluminium scrap industry is import dependant. We primarily import our aluminium scrap from US, Europe and Middle East (Figure 27). HS code for aluminium scrap in India is 76020010, which covers all grades of ISRI (Institute of Scrap Recycling Industries) scrap namely tablet, taint/tabor, tabloid, taboo, take, zorba, talap etc. ISRI codes doesn't specifically indicate the metal aluminium content, however it gives permissible contaminants or attachments.

Share of domestic aluminium scrap and imported scrap during FY18 is shown in the figure 28. It is evident that the domestic scrap generation is less, and hence secondary aluminium industry is dependent on scrap imports.

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12Export Import Data Bank, Department of Commerce
Aluminium usage per unit of passenger and commercial vehicles stood at around 29 kg during FY18 as opposed to 110 – 140 kg per a passenger vehicle in the countries like North America, Europe and Japan. Aluminium used in other modes of transportation like aircraft, railway coaches, ships, etc. is collected separately during dismantling at the end-of-life. Demand from two wheelers, cars and UVs will support robust growth in secondary aluminium demand, which can be depicted from figure 29.

Being labour intensive, aluminium scrap recycling industry creates numerous jobs. Aluminium scrap sorting is being carried out manually and is aided by beneficiation techniques like eddy current separator, magnetic separator, shaking table, gravity separator, heavy media separation etc. Secondary aluminium production involves major steps like scrap collection, scrap

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13 DGFT Import-export database & CRISIL Research (Domestic scrap figures are estimated)
14 Evolving Role of Scrap in India by Rahul Prithiani, Director – CRISIL Research
processing, melting, alloying and casting. The flow chart presented in Figure 30 lists various steps involved in scrap processing.

There are mainly two types of scrap, namely post-consumer scrap and process scrap. Waste is generated in every aluminium manufacturing facility and this waste material from a manufacturer is known as production or process scrap. Process scrap from rejections, handling damage, edge trim, start-up material, clipping, stampings and various trims in the production generally goes directly to the cast house furnace. Even in NALCO, Hindalco, utilisation of in-house or process scrap is 100%. Post-consumer scrap occurs when an aluminium product reaches its end-of-life. This post-consumer scrap is contaminated with different metals, organic metals and plastic. Hence sorting and cleaning is crucial part of the recycling process.

As the aluminium parts are often too large to be directly melted in the furnace, they must first be reduced to small pieces by processes such as shearing/shredding. Collection rate of aluminium packaging is less compared to transportation and building sectors.

![Scrap processing flow chart](image)

There is an increase in demand for aluminium products with a low environmental footprint during growing conscience about environment globally. Development of sustainability and environmental standards for aluminium production, research funding to boost recycling rates and improvement in sorting of aluminium scrap will help lowering the environmental footprint of aluminium products. Current context of aluminium recycling is shown below (Figure 31).
Around 30% of the remelters produce 70% of the products with stringent quality measures. These remelters were small and medium scale enterprises. Remaining 70% remelters in the country produce 30% secondary aluminium products. Out of this 30%, except utensil manufacturers, other remelters sell their products to small or medium scale enterprises where stringent quality measures were being followed.

Hence only 10% of the market is unorganized which includes utensil manufacturers and some extruders. They sell products directly to consumers who are not well aware of compositional requirements. Making this 10% market standardized, will solve the quality issues with secondary aluminium. Also, small and micro scale industries are well aware of the pollution control systems that are to be installed for complying with pollution norms. A set of guidelines from competitive authorities mentioning right type of equipment for complying with pollution norms. The main drivers and deterrents for aluminium recycling were shown in figure 32, which can be controlled by taking certain measures to enhance secondary aluminium usage. India’s domestic scrap industry is trying hard to modernise, which can be achieved only with regulatory support.

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**Figure 28 Current context of aluminium recycling**

**Figure 29 Aluminium recycling- Drivers and Deterrents**
2.4.1 Employment rate in aluminium recycling industry

It is estimated that presently the secondary aluminum industry employs nearly 3 lakhs people directly and 3-4 lakhs people are employed indirectly. Great value can be created by efficient segregation of scrap by its usage/alloy for which large manpower has to be deployed. India has the unique advantage of availability of large pool of cheap, trained & hard-working manpower. Also, it will help in reducing the problem of unemployment that India is facing presently.

2.4.2 End of life recycling rate in India

According to International Resource Panel, end-of-life – recycling rate (EOL-RR) refers to functional recycling and includes recycling as a pure metal and as an alloy\(^\text{15}\). The end-of-life recycling rate is affected by initial collection activity, which is typically the least efficient link in the recycling chain. EOL-RR is calculated based on the formula given below.

\[
EOL-RR = \frac{Recycled \ EOL \ metal}{EOL \ products \ (metal \ content)}
\]

The EOL-RR estimated in India is approximately 25% and recycling rate over last 3 years is shown in the figure 33.

Figure 30 Calculated end-of-life recycling rate in India during 2017-2019

\textit{\textsuperscript{15}}Recycling Rates of Metals, A Status Report by International Resource Panel
COPPER

1. Introduction:

Metrics of economic evolution of societies and nations have been marked throughout the centuries by metals and materials. Copper and bronze age ruled for five Millennia followed by Iron age till the industrial revolution magnified the iron age into steel age around the mid-19th Century. At the turn of the nineteenth century, aluminium came into game and it could supplant copper for electrical power transmission, brass in fittings, and steel in structural. This was followed in the mid twentieth century by nuclear age and electronics revolution in quick succession, defined by atomic metals (U, Pu) and silicon. At the turn of this millennia, we have energy metals, namely silicon in new avatar for energy production, Rare Earths (samarium & neodymium etc) for energy conversion in motors and wind mills finally, lithium, cobalt and nickel, for energy storage devices.

From the above preamble, it is evident that copper preceded all other metal ages and it is further buttressed by a recent discovery of artefact [1] that has proved that human race has discovered and used copper for nearly 10000 years, which gives pointers to the fact that ancient societies would have known and exploited processes for extraction and recycling of this metal. Scientific reasons for this are not far to seek, as copper along with gold and silver are the only electropositive metals in the electrochemical series and therefore it would have been available in rich ores even as placer and with minimal physical beneficiation, the metal could be separated and used. Another important attribute of copper, namely, it being infinitely recyclable, makes its availability almost perennial in the society along with primary source for ever, since the time it was first put to use. Discovery of zinc and tin and its alloying with copper magnified the application of this metal to articles for construction and household items, worship (idols, lamps, church bells and domes), commerce (coinage) and above all warfare. It is easy to note that during war time emergencies in ancient societies, other articles of copper alloys and particularly scrap would have been re-melted and used to make weapons. Substitution of (a) copper and brass in utensils by cast iron and steel and stainless steel during the industrial revolution and thereafter and (b) copper power cables by aluminium in the twentieth century freed up copper for other uses. Notable high-volume applications are beginning to take over, such as in renewable energy, energy storage devices and electric motors. Consumption of copper will increase by 40-50% by 2035, thanks to these emerging high-volume applications.

2. World Copper Reserves and Annual Production Rate

Copper Development Association has estimated the primary copper resources (2018) at nearly 2.6 trillion tons and till date about 12% of that has been mined out ever since antiquity. It has been estimated that at least 80% of all copper ever mined is still available (having been repeatedly recycled). The US Geological
Survey estimated that 3.5 billion metric tons of undiscovered copper resources worldwide in porphyry and sediment-hosted type deposits and identified deposits of nearly 2.1 billion tons which together make up about 5.6 billion metric tons of resources. As of 2018, nearly 700-800 million tons of copper is slated as mineable (0.3-0.6% content) and Chile alone has the largest mineable/extractable reserve of 170 million tons which is nearly 20% of world’s proven mineable resource and it produces annually 2.5 million metric tons, which at the present rate will last for 65 years.

The current annual production (2018) of copper ore from the top 10 mining countries in the descending order are Chile (28.5%), Peru (11.6%), China (8.5%), US (6.5%), Australia (4.8%), Zambia (4.7%), Congo (4.6%), Indonesia (3.7%), Russia (3.2%) and Canada (2.9%) 20.6 Million tons/copper. Scenario for refined copper (copper metal as anode or cathode or melted bars and ingots) is 24 Million tons in 2018 as produced by the primary metal producers with smelting, hydro-met and electrowinning processes.

Table: 1 Refined Copper & copper Products:

<table>
<thead>
<tr>
<th>Country</th>
<th>Million tons</th>
<th>Percent</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 China</td>
<td>8.7</td>
<td>36%</td>
<td>Imports 60% of concentrate requirement.</td>
</tr>
<tr>
<td>2 Chile</td>
<td>2.5</td>
<td>10.4%</td>
<td>Major mine and metal producer in the world.</td>
</tr>
<tr>
<td>3 Japan</td>
<td>1.6</td>
<td>6.7%</td>
<td>Japan has no mine reserves and it is in the top three with regard to metal production</td>
</tr>
<tr>
<td>4 USA</td>
<td>1.1</td>
<td>4.6%</td>
<td></td>
</tr>
<tr>
<td>5 Congo</td>
<td>1.0</td>
<td>4.2%</td>
<td></td>
</tr>
<tr>
<td>6 Russia</td>
<td>1.0</td>
<td>4.2%</td>
<td></td>
</tr>
<tr>
<td>7 India</td>
<td>0.83</td>
<td>3.9%</td>
<td>India imports concentrate; It is now in the top 6/7 world producers in the world. India is a net exporter of refined copper. India has installed capacity of one million tons.</td>
</tr>
<tr>
<td>7 S. Korea</td>
<td>0.69</td>
<td>2.8%</td>
<td></td>
</tr>
<tr>
<td>8 Germany</td>
<td>0.67</td>
<td>2.8%</td>
<td></td>
</tr>
<tr>
<td>10 Poland</td>
<td>0.5</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>11 Others</td>
<td>5.0</td>
<td>18%</td>
<td>Multiple countries with 0.1 – 0.4-Million-ton production totalling 5 million tons.</td>
</tr>
<tr>
<td>12 Total</td>
<td><strong>24.1</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
<tr>
<td>13 Total ore mine output</td>
<td>20.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Copper)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td>14</td>
<td>Recycled Copper entering Primary stage; (12-13)</td>
<td>3.5</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Copper scrap enters at primary metal production stage itself</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>World Production of Copper Products</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Recycled Copper entering Secondary Melting (15-12)</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>TOTAL Scrap RIR (14 + 16)</td>
<td>7.0</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>7 tons forms Recycled Input for product manufacture of 27 tons &gt;&gt; RIR= 27%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3. India’s Place in Copper World

Of 10 countries endowed with ores, only Chile, China, US, Congo and Russia figure in the next stage of refined metal production, as given in the table above. This shows that half of these countries export the concentrates while countries that have no or poor reserves, but technology to process figure in the top ten refining nations. Notable examples in this category are Japan, S. Korea, Germany, India and Poland. In terms of value addition up to metal, ore to concentrate forms the biggest chunk, while countries like Japan, Germany and India add value from ore / concentrate to refined copper (as cathodes and CCWR).

India’s copper reserve is very small compared to world standards. The total reserve/resource of copper ore is estimated at 1.51 Billion tons as against the world estimated Cu resources at 2.6 trillion tons. Of these, 1.51Bn Tons, 8.28 million tons are above 1.85% grade, 657.92 million tons fall under 1-1.85% grade category and rest being below 1% grade. Cu ore production in 2017-18 is pegged at 3.68 million tons with metal content of 33,360 – 36,800 tons, thus averaging 0.9 – 1.0% tenor from five reporting mines from three different regions, namely Madhya Pradesh, Rajasthan and Jharkhand. Copper concentrate production (2017-18) from 3.68 million tons of ore is at 1,41,863 tons, which translates to 36.8/1.41= 26, in other words, the metal was concentrated from 0.9-1.0% to 23-26% average in mineral beneficiation. Given that 0.1% metal is lost to tailings and likewise in copper slag in smelters, the net production of metal from our own ores and concentrates stood at 35000 tons by Hindustan Copper Limited. However, India’s total production of refined metal (cathode) is at 830, 000, which is the six largest in the world, which points to predominant production being done with imported concentrates and copper scrap.
India has a net installed capacity of 1 million tons of refined copper cathode production. India imports concentrates from major Cu ore countries and the three major companies, Hindalco, Vedanta and Hindustan Copper Ltd produced 830,000 tons of copper metal (2017-18) which is the six largest refined copper production in the world. India is also a net refined copper exporter as illustrated in the table below.

**Imports (including scrap) & Exports by India 2017-18 (in Million Tons)**

<table>
<thead>
<tr>
<th>Domestic Production Concentrate</th>
<th>Import Cu Concentrate</th>
<th>Total Conc (MIC = 27%)</th>
<th>Potential Copper Metal In Conc</th>
<th>Import Cu Scrap + Cu unrefined</th>
<th>Cu Metal possible</th>
<th>Cu production reported 2017-18</th>
<th>Export of Copper Cathodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C = A+B</td>
<td>D = 0.27 x C</td>
<td>E</td>
<td>F = D+E</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>0.142</td>
<td>1.99</td>
<td>2.13</td>
<td>0.52</td>
<td>0.3</td>
<td>0.82</td>
<td>0.83</td>
<td>0.33</td>
</tr>
</tbody>
</table>

India imports Cu concentrate to the tune of 1.99 million tons and together with 0.142 million tons of domestic production should give approximately $2.13 \times 0.27 \times 0.90 = 0.52$ million tons of refined copper, if we are to assume 27% concentrate grade and 90% of it being extracted in converter and electro-refining steps. Nearly 0.3 million tons of copper scrap and unrefined copper has also entered the system at primary production stage thereby totalling a production of $0.52 + 0.3 = 0.82$ million tons, a figure which is close to reported production of 0.830 million tons from primary production itself. This internal consistency shows that concentrate grade should be predominantly around 27-28% in the imported concentrates and furthermore, $(0.3/0.83) \times 100 = 36\%$ of copper is imported as scrap and unrefined blister/anode copper. Germany and US meet nearly 44-50% of their copper requirements from scrap and US is the largest exporter of copper scrap as well. What is also of interest to note is that 0.33 million tons of refined copper as cathodes has been exported by India. In copper world, India has graduated to net value addition in terms of importing concentrates and scrap and exporting refined copper. It is yet to catch up in terms of export of further value-added alloys, products such as tubes and other mill forms. Any disruption in the supply chain of concentrates and scarp will adversely affect the copper scenario in India.

From the above figures, it is evident that nearly 0.5 million tons $(0.83 - 0.33 = 0.5)$ of copper is being consumed domestically from primary production, predominant product being CCWR (continuous cast wire rods) at 0.38 million tons. Therefore, rest of nearly 0.12 million tons of copper cathodes go to other product manufacture. While it is difficult to estimate the secondary melting and product production and consumption, it can be anywhere from 10 – 25%
of the primary production. India’s consumption of copper will increase by 50% in the coming two decades, thanks to major infrastructure projects, renewables, Electric mobility.

4 Global Recycling Input Rate (RIR) for Copper and India’s Position:

As given in the table above, 24 million tons of refined copper production at primary smelters and refineries vis a vis 20.6 million tons/copper metal content from ores points to fact that copper scarp entering the primary metal production cycle itself to the tune of nearly 3.5 million tons. World production of copper and copper alloy semis is nearly 27.5 million tons copper equivalent, thus another 3 – 4 million tons of recycled materials enter the system at this second stage. In particular, brass and bronze production use 75% of input as recycled copper, brass or bronze scrap and only a smaller quantity of primary refined copper is taken in by these producers. Overall, 30-35% copper re-enters the copper life cycle and primary new copper is contributes to 70%. Countries that are not endowed with copper as in Europe has gone in for extensive recycling and operate on imported scrap. 50% of entire European demand for copper is met from recycled materials, also called Secondary Raw Materials (SRM), which is the highest in the world. European commission has put into place an elaborate policy and implementation strategies for not only copper but a host of non-ferrous critical raw materials. Production of copper from both primary and secondary sources has to increase by nearly 50% in the next 15-20 years to meet the demands placed by emerging sectors in renewables and Electric Mobility. The following figure illustrates the primary copper and products manufacture and entry points for copper scrap and creation point for new scrap from both primary refining stages as well as downstream processes. Scrap recycling as processes are given in the last row in green.
Following gives an outline of copper flows together with estimate of copper in circulation in 2017. It is estimated that nearly 433 million tons of copper is in use as stocks. Scrap enters the system in two major points, first in the primary refining stage at nearly 3.37 tons to augment production from 20 million tons to 23.220 million tons and in the semi-finished processing stage into mill forms and cables to take the overall production to 28.35 million tons. Thus overall RIR is estimated at 33%.

Indian domestic copper market is at 0.5 million tons and 0.33 million tons is exported as refined copper and products, taking in nearly 0.3 Million tons of refined scrap import. While analysis given above, assumes that all of imported scrap and unrefined copper has entered the primary copper production from smelters, secondary metal producers consume scrap to a higher degree as RIR. Amount of old scrap and new scrap entering as SRM in brass and downstream copper manufacture is estimated at 100, 000 tons in 2003 by ICSG and with 2.5% CAGR, it is around 160, 000 tons in 2018. Given that overall Indian domestic copper market is 0.5 million tonnes, 160, 000 tons corresponds to 30% RIR, it is likely that scrap to product is linear as source of scrap and
product manufacturer are directly related as in auctioning of railway scrap, ordnance scrap etc.

5. **Sources for Domestic Copper & Alloy Scrap:**

Copper scrap is usually divided into two categories of old scrap coming from used goods and articles and new scrap which are most from in-process. Out of 160,000 tons of annual scrap availability, about 65% is from old scrap with following break-up. Except for ship breaking source, others are well entrenched with either auctions, repair shops which are in the front line of collection from articles. Cables are routine items that come from households, factories and offices thanks to refurbishment and renewals. Older scrap contains more copper in thicker gauge while replacements are either thinner gauge or substituted by aluminium.

<table>
<thead>
<tr>
<th>Old Scrap</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Ship breaking (20%)</td>
</tr>
<tr>
<td>(ii) Spent brass cartridges (15%) from defence unit stores for disposal</td>
</tr>
<tr>
<td>(iii) Winding wires from motors and electrical appliances (10%)</td>
</tr>
<tr>
<td>(iv) Electrical wiring cables (10%)</td>
</tr>
<tr>
<td>(v) Radiators and heat exchangers (5%)</td>
</tr>
<tr>
<td>(vi) Mixed Railway scrap (annual auction) (5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New scrap</th>
</tr>
</thead>
<tbody>
<tr>
<td>(vii) Ends and cut pieces of new but unusable cables and wires (10%)</td>
</tr>
<tr>
<td>(viii) In-process waste in forgings, flats, castings and fabrication works (25%)</td>
</tr>
<tr>
<td>(ix) Copper ash and dross (5%)</td>
</tr>
</tbody>
</table>

A large number of downstream copper and alloy products companies in wire and cable, castings and forgings, semis and flat products rely on copper, brass and bronze scrap input. While wire and cable manufacturing take in primary refined wire rods (8-30mm) produced by primary metal producers, many manufacturers rely on recovery of copper from used cables as supplementary feed to keep the costs down. Industrial products such as alloy castings & forgings, semis (flat products, busbar etc) use higher quantum of recycled copper materials and virgin copper cathode as input is kept to a minimum. The RIR for Copper alloy products in brass, bronze, cupro-nickel, Nickel aluminium bronze can be as high as 50% and brass units taken in as high as 90% RIR, making India one of the most efficient collectors and recycler of copper.

On a cautionary note, due to FTA with ASEAN, there has been sudden spurt in the import of higher value copper products from Malaysia and Thailand as in copper tubes, wires and mill forms to the tune of 50,000 tons while India exports refined copper. This is mainly due to the inverted duty structure which has put zero duty on copper products and 5% duty on concentrates and scrap. It is also suspected that Malaysia and Thailand are being used as conduits for Chinese goods.
6. Copper Recycling: Favourable Factors –

Copper availability has a healthy mix of primary production and efficient reclaim and recycle solutions that has been put into place over millennia. Its unique properties of high electrical and thermal conductivity, excellent corrosion resistance, easy fabrication, high life cycle in many applications, high resale value for metal content (nearly 90% of metal value in some cases for well sorted scrap) had enabled development of well-knit and highly efficient network for copper and copper alloy recycling. Copper articles and products are fairly concentrated in bulk forms, unlike modern technology metals in most of its applications and therefore it is visible and easy to locate for collection. There is high awareness amongst all sections of the society regarding the market value of copper articles from a small length insulated cable to that of large articles such as used propellers of ships. This heightened sense of awareness of high market value commanded for copper in scrap together with easy liquidity of copper articles has been responsible for efficient collection and even theft of this metal. It is estimated that almost all of that copper produced from days of antiquity is still in circulation, which is equalled only by gold and silver and nothing was ever thrown away. No other metal has commanded such a long lineage of almost 10,000 years of extensive use in the society.

India collects, recovers and recycles copper very efficiently. Following are major favourable factors contribute to such efficient recycling:

(i) high level of awareness about the value of copper scrap and articles; copper shines and it is very visible and gives itself away to be collected;

(ii) high market value and high liquidity for copper in any form gives faster velocity for movement of copper scrap up the value chain;

(iii) there is perpetual demand for copper scrap; scrap more often is in short supply and thus favours scrap collection;

(iv) very good net-work between secondary manufacturer of copper products and the scarp aggregator (across the globe) in view of high market value and ready demand of copper scrap which gives automatic incentive for repair shops, dismantlers of white goods (e.g. refrigerator), radiator from vehicles, cables from used motor and other electrical goods to quickly move copper to secondary processing;

(v) large scale scrap auctions are conducted annually by railways (used cables and parts) and defence (Ordnance >> brass cartridge casing) for disposal of copper scrap;

(vi) equipments specific to processing of scrap such as used cables are cost effective and made in India;

(vii) product manufacturers in semis, castings category also have in-house melting facility to take in 100% scrap, remove impurities and re-alloy as per their requirements; low energy consumption and
low capacity induction furnaces are sufficient for handling scarp to alloy conversion;

(viii) impurities in copper scrap can be effectively removed in a single step by electro-refining even by MSMEs and high-quality LME grade cathode can be produced from re-melted scrap.

(ix) Copper recycling can be conducted as a proper business with engineering facilities for sorting, cleaning, shredding, small scale melting, which take inputs from established supply chain networks to service the needs of end customers; alternatively, secondary manufacturers of copper products also set up a back end scrap processing units with inputs from established supply chain net-work.; symbiotic and long term relationships between scrap collectors and aggregators and secondary copper processors are well established.

(x) Copper and copper alloy scrap are well established traded commodities with proper specifications across the globe.

(xi) Energy economics facilitating SMEs and MSMEs to get in to sector

As per the licences granted by Central Pollution Control Board, there were 35 units operating in different states with a combined capacity of 0.24 Million tonnes per annum for handling different types of scrap including copper. In addition, there are 132 units with combined capacity of 0.52 Million tonnes per annum which recover copper along with other metals. As per the estimates made recently published Market Survey on Copper by IBM, production of 0.11 million tonnes per annum of secondary copper was reported, all of which have been in organised sector in the country.

Apart from copper scrap, there are cottage and SME operations which take in slag, furnace dumps, used refractory linings to extract residual copper locked in these wastes. Operations have even been established wherein zinc dross containing copper is extracted with hydrometallurgical processes and electro-refined to obtain cathodes in MSMEs. One of the emerging scrap processing is e-waste and it is still an unorganized / unskilled and un-regulated copper and other metals recovery from e-waste. This recycling sector is to be organized and regulated. Recently, nearly 300 plus e-waste processors have been granted licenses and copper is the principal metal that is recovered along with gold, silver, tin and sometimes even germanium and palladium. This new front is likely to add 3000 to 5000 tons per year of copper metal back in to the system.

7. **Energy Economics and Easy Recyclability of Copper.**

Compared to extraction of many metals, energy required for recycling is small. Energy required to extract copper starting from mining stage is around 90 – 100 Giga Joules/ton of metal produced. Reasons for this are in nature of ores of copper. Globally, about 90% of all copper is produced from sulphide ores, rest 10% from oxidic ores. Sulphur being present in the copper bearing minerals acts as a fuel (exothermic reactions) and combined with carefully
engineered slag, enables separation of copper from other metals resulting in the extraction of copper in a converter. This process step takes in copper scarp up to nearly 20%, and flue gas dust is routinely returned at this stage of the process. Thus, no carbon or any other metallurgical reductant is required. In fact, excess energy is available from the converter to be used elsewhere in the plant. The final step of electro–refining (unlike electro-winning) is done at room temperature with aqueous sulphate bath and low energy input together with advantage of taking impure anodes (from re-melted scrap) to obtain 99.9% copper. Copper production process has three distinct advantages namely (a) no fuel requirement at smelting stage; (b) ability to take in 20% scrap at this primary production step itself; (c) low energy electro–refining step that can take in even re-melted scrap as anode. Recycling of copper takes in only 10-15% energy.

Unlike lead, copper/alloy scarp is not melted in artisan facilities and it moves immediately to aggregators at fast pace. Small induction furnaces of capacity of 100 kg to 1000 kg at well-established downstream companies are sufficient to handle secondary source raw materials such as scrap to produce alloy castings. Capex requirements for operations are modest for efficiently handling copper scrap. 1000–5000TPY operations based on scrap and cathodes are well established across the country for copper sector to produce mill forms. Copper scrap as mentioned in the previous paragraph after re-melting as anodes can be electro-refined to obtain cathode copper.

**IMPLEMENTATION STRATEGY** - Translation of WHATs (objectives) to HOWs:

- **Preamble:**
  In the previous section on objectives, what are to be achieved as goals were enunciated. Given that recycling has to be seen as systems activity spanning multiple stake-holders with significant impact on economic, strategic, energy and environmental sectors, it is imperative and urgent that appropriate implementation strategies are chosen and put in to place. Recycling as a policy is to treated as an opportunity to enhance economic activity with potential for exports as well as meet our strategic requirements with minimal energy inputs and low carbon footprint. When we carefully analyse products, their life span and their recycling potential, we find that India as a large market has opened its doors to import of many products for over a decade and 100s of millions of which are already a repository of metal values that have come from outside and are available in concentrated forms at EOL. Thanks to advances in separation technologies, large data analytics, systems science and AI, time is now ripe for India to make use of these advances to become a key player in recycling sector.

- **Approach Scrap as strategic resource to build technologies, manufacturing businesses and economic wealth.**

In developed economies, particularly Europe and Japan, recycling is carried out with a twin pronged approach as a deliberate strategy. Where the
primary resource is not readily available in open world market or if it is dependent on a single country (China or Congo) which increases risks, there is an aggressive approach to go for recycling technologies thereby promoting deliberate creation of urban mines. Japan being a resource poor country could develop to third largest economy by 1970s, on the basis of technology and large sized plants in 1970 to 1990s in a host of metals starting with steel. Earlier stand was to take in raw materials from mineral rich countries like China, Brazil, Australia, S. Africa and India (iron ore, alumina, Rare earth sands). Augmenting imported raw materials with recycled materials for inputs as a strategic policy has been adopted by Germany and Japan which is technology and data science-based approach. Germany considers Europe as a whole to become self-sufficient for all critical raw materials (CRM) by 2025 and has identified 20 such metals for immediate action plan via aggressive recycling leveraging large product base in the market that will be available in perpetuity if handled carefully. Accordingly, 50% RIR is kept as target with inputs coming from not only domestic scrap, but also from across the world.

- The important message here is that instead of considering scrap as dump, it is now being looked upon as a strategic resource to design and create URBAN MINE. India should follow Germany and Japan’s approach and consider scrap from across the globe as a resource to create our own urban mines to serve our needs in this 21st century as we strive to reach $ 5 trillion economy by 2025.

- A 5 trillion-dollar economy would have nearly 2.0-2.5 times the present quantum of products in the system and at the current rate of innovation and replacements, primary source of raw materials alone cannot meet the demand. It is anticipated that renewables and Electric Mobility alone will push the metals requirement of copper, Li, Co, Ni and Rare Earths (Sm, Nd) to nearly four times the present rate. Concurrently, the used batteries and other articles will bring in significant quantities of these materials in recycling stream and if products are made in India then RIR will increase favourably.

- Data Based Solution Approach:

  Taking large data-based approach as one of the important anchors for implementation of an effective recycling policy, it is required to create central and state level recycling eco-system data centres and effectively link data to individuals and entities on one hand and imports and strategic needs on the other. Further linkages to GST, PCB, EPR etc will also become possible. European Commission has put in to place a data-based analytics system. The approach that is suitable for India is given below: Obtain and analyse

  o data of present status of known metals and materials in terms of point of collection to storage to recycling processes to end – user of recycled materials, from existing disjointed information bases and
regulatory agencies to obtain quantum, market price and velocity of movement of recycled materials into higher value chain; understand gaps and lacunae in the system to obtain pointers for required intervention;

- data in terms of various metal/material content in products and life span of the products; in other words, shift to circular economy requires the data on each product de-convoluted in terms of metals and materials like nutrition value of food items. Presence of very small quantities of speciality metals also to be brought out. For example, metal and material content in EOL refrigerator is potentially large source for copper in view of compressor motor and copper tubing in cooling circuit while a vehicle has metals like Cu, Al, lead, steel, Zinc, Nickel, REEs (dc motors) and other materials like including plastics, rubber tyre; The original BOM of parts of the automobile or refrigerator itself will give the list of metals. This has to be brought out as data for each product; EPR to be suitably amended to include metals / materials content in products.

- data on EOL point of discharge of products to be categorized as known/unknown/to be decided; (e.g. used motor >> motor repair shops); vehicles not yet implemented.

- Obtain and analyze data of strategically important metals and materials that are not available as primary resource but is embedded in the products (e.g. cell phones and laptops>> Li, Co, Ni, Rare Earths, W etc) and how these products are moving after EOL in the present system;

- Obtain and analyze data from landfills to find out if there are products or materials that inadvertently end in landfills (e.g. used Zn-C, Ni and even Li batteries, thin aluminium packaging foil materials); We have an opportunity of recovering large quantities of Nickel, Zinc and some rare earths just from used batteries AA, AAA, button cells etc.

- data in terms of existing dismantling processes of high value original products at the end of life and identify further waste / residue that emanates from recycling processes (e.g. oil/lubricant contaminations, heavy metals inadvertently going in to ground water;

- Obtain and analyze data in terms existing process technologies and those practised in India and abroad and facilities and equipments that are presently made and available in India vis a vis those to be developed or acquired for recovery and reclamation of metals;

- Identify artisans and un-organized “points” of operation and empower and incentivize them as foot-soldiers and frontline self-employed entrepreneurs in recycling eco-system; Link their geographical operational zones with personal identities to obtain cluster maps; incentivize them with welfare schemes that are already available as
well as bring them in to awareness programmes about each product and potential value that is available;

- Collectors and aggregators, the second line of battle – front in recycling eco-system are also predominately free entrepreneurs; these points and their outlets are known to local authorities and regulatory agencies; bring out their existing operations in to formal and digital frame-work with linkages to EOL of products, their recycling processes and their customers (secondary melting / manufacturers);

- **Making Recycling Sector an Industry in its own right:**

Institutionalization of Recycling SOPs, Practices and graduating recycling entities as a formal industry sector in cases where they are not.

Create institutionalized best practices and mechanisms for evaluation for ranking individuals (first line, entities (municipal, aggregators, processors) to encourage moving up the ladder and disincentives for not doing enough.

- Create systems and mechanisms leading to declaring recycling sector as an industry on case by case basis with well-defined metrics to achieve, best practices that are to be adopted and sound business plan with supply – chain, technology, end-user/customer and financing. Already existing and well – established business in recycling sector to be studied and methodology for replication of best practices and successful cases to be institutionalized.

- **Create Urban Mines and Recycling Parks.**

Design, Develop and Create Specific Urban Mines as a special economic zone and co-locate SMEs, MSMEs for different categories of products. Each Urban Mine will be specific to a particular EOL of products. More than one Urban Mine can be created and co-located. Example: E-waste, Vehicle dismantling, white goods dismantling, batteries recycling, tyres and so on. The data base collected and analyzed will show self – organizing sets. Create special recycling zones for Critical Raw Materials; These zones can take in imported scrap as a policy rather than just as a necessity. Creation of Urban Mine is not to be confused with a dump yard, but a location to collect and hold large quantities of similar products (say use batteries or tyres, or hard disks or vehicles). The size of Urban Mine shall vary as per the product. For Ni and Li battery (cylindrical cells alone), two – three football size area would suffice as volume occupied is less. The Urban Mine is a technical area which has its own SOPs for accepting the scarp materials and discharging may be carried out nearby to render it safe and also check for good cells for second life. This triage work will be specific to each mine. Likewise, a computer and accessories Urban Mine can be co-located, with a view of extract stepper motor with RE magnets and PCBs to go to e-waste.

- An important and immediate outcome of designated collection points leading to an Urban Mine is awareness that will be created amongst public,
offices and entities on where to take the used product that appears small and not very impactful at first sight such as AA Ni-MH battery or a tyre. Presently, both of them end in a landfill dump.

- To start with 100 Urban Mines and Special Purpose recycling zones spread across the country are required. Exclusive ones for Batteries are an urgent need. Battery is not e-waste and unfortunately it is coupled with it for wrong reasons. It has to be decoupled and separate policy or sub-policy for batteries as a set is required. Batteries are essentially materials enabling energy storage and therefore it is materials intensive in its construction.

- **Develop / Acquire Process Technologies**

  Given that Urban Mine gets created, next important step is to develop or acquire process technologies to separate metals and materials from complex products. This field is the new sun-rise one which encompasses smart, flexible and digital manufacturing technologies. It is just evolving and India can take a lead in it. Large objects like vehicles need not follow western examples of crushing, but one can establish with OEMs as partners dismantling lines to remove parts. Dismantling lines are data and knowledge based and India can create a large employment in this sector alone. Metal separation is always by mineral beneficiation, pyro, hydromet, chemical or electro-refining routes. Size and density differences are significant in metals that go in to products and mineral beneficiation techniques used in conventional mines are to be tweaked and re-deployed in Urban Mines. These are known process technologies and sizing of the plant can be enlarged as per demand.

- **Promote and Invest in Mission Oriented and Directed R & D for Technology Development.**

  There are two possible routes for implementing it. One is to set up dedicated Technology Centres with 51-49 participation from Industry and government first round facilitation by government. These centres are to be run as autonomous non-governmental and self – financing centres. Each centre will work on a basket of recycling technologies which have been identified for various sectors including strategic sector. The industry body or units have the responsibility to source the scrap or EOL products for technology development. To start with two centres can be created, one for base metals and other for a few CRMs. Second approach would be to create specific missions for recycling with translational technology development as requirement which will be predominantly funded by Industry under their in-house R & D schemes and CSR. Industry – laboratory – academia consortia are to be identified and the later are to be funded by government while the former puts up the pilot facility. These are to be industry driven and lead. Data collection and analysis will throw up many such R & D needs. Present system of S & T schemes are unsuitable for any translational R & D. Second approach. Approach promoted by DoS and DoD are more appropriate. The needs are well identified and EOI is sent to multitude of companies and R
&D institutions. It is not open-ended research, but with a commitment to make products, do elaborate testing and supply for at least next 10 – 15 years for space programme. This approach has developed a hierarchy of entities that can do very demanding product developments. DoS, DoD are ideal partners and facilitators for CRMs.

- **Promote start-ups in Recycling eco-system:**

Fastest and surest way to convert idea and process in to a business is only through start-ups. In Europe, many start-ups have come up based on few product-based recycling businesses. In India, E-Parasara pioneered e-waste recycling nearly 2 decades with technology as base and with good portfolio of in-house developed IPs.

- **Industry and Investor Friendly Approach:**

There have been examples and case studies of state of art waste to metal extraction plants that came up in the last decade have been closed and shifted to Middle East and Africa due to inverted duty structure and inspector – raj syndrome which is overbearing on this sector. Indian recycling industry has been reduced to just collection and export of scrap to Middle east, S.Korea and Japan. Of late, Vietnam and Bangladesh are processing more recycled scrap to value added products.

- **Transformation Example to Demonstrate and Showcasing**

Identify and transform existing cluster of artisan and cottage operations (e.g. Moradabad) with intervention of community involvement, individual training, space and area identification and allocation; process technology, tools, facilities intervention; safety and long-term health care through linkages to existing welfare schemes.

- **Formation of Recycling Mission / Agency that will cover the aforementioned implementation strategy.**

While NMET was conceived to fast forward exploration, the first mining targets based on exploration had failed due to lacunae in mining Policy 2015. However, in this case, an Urban over-ground specific mines and recycling parks are the aim and it would succeed with investor friendly policies and incentives.
ALUMINIUM SCRAP

1 Objectives

Aluminium scrap usage in India is diffused and not regulated through standards or end-use restrictions with heavy reliance on imports. India soon will witness hitting some steady-state value of Aluminium consumption. Scrap that can be recycled again and again will cater to steady state consumption demand. Domestic scrap generation and collection must be our priority and recycling industry has to be promoted.

The main objectives of this policy are:

1. To promote resource efficiency and circular economy in aluminium sector
2. To promote processing and recycling of products in an organized, safe and environment friendly manner.
3. To promote a formal and scientific collection, dismantling and processing activities for end of life products that are sources of recyclable aluminium scrap, which will lead to resource conservation & energy savings and setting up of an environmentally sound management system for secondary aluminium industry.
4. To promote 6Rs principles of Reduce, Reuse, Recycle, Recover, Redesign and Remanufacture through scientific handling, processing and disposal of all types of aluminium scraps, through authorized centres / facility.
5. Create a mechanism for treating waste streams and residues produced from dismantling and shredding facilities in compliance to Hazardous & Other Wastes (Management & Transboundary Movement) Rules, 2016 issued by MoEF&CC
6. To provide guidance to enable India to establish an appropriate legislative, administrative and institutional framework for recycling of aluminium scrap
7. To achieve a target of 50% recycling rate by the year 2025 from the current 25% and enhance job creation opportunities
8. To evolve a responsive ecosystem by involving all stakeholders.
9. To transform the current aluminium scrap recycling industry into an organized sector
10. To increase per capita consumption of aluminium in India to world’s average
11. To produce high quality aluminium scrap for quality secondary aluminium production thus minimizing the dependency on imports.

2 Strategy

Aluminium is a key metal for industrial growth of India. Its unique properties like strength, durability, conductivity, flexibility, impermeability, light-weight, non-corrosiveness, recyclability make it a metal of choice for various industrial
activities. Aluminium is considered a strategic sector by various industrialized economies due to

- high linkage effect
- high market potential
- high technological intensity
- high value addition

Industries with strong linkages based in the hinterlands of the country are also generating peripheral employment and are aiding in the development of the region.

Main challenge lies in collecting end-of-life products for increasing scrap generation in India and also to organize the informal aluminium scrap recycling sector in India. Already two dismantling/vehicle scrapping facilities were proposed to come in India with the support from government. According to an estimate by the Central Pollution Control Board (CPCB), GIZ, a German development agency, and Chintan, an NGO, there were 8.7 million end-of-life vehicles (ELVs), in 2015. Most of them were simply abandoned or not properly being dismantled. A government policy on scrapping commercial vehicles and support in setting up of scrapping centres in various parts of India will create indigenous sources for aluminium scrap in future with increasing usage of aluminium in transport sector.

These vehicle scrapping facilities should be supported by adequate logistics. State scrap metal laws should be formed for an organized scrap collection sector. These laws should regulate the scrap metal yards (or vehicle scrapping) centres on payment related terms, record maintenance and ID information of seller and the vehicle to avoid any misuse.

An energy policy is required for energy intensive sectors to ensure that these industries compete with global players on lowering energy consumption and greenhouse gas emissions. This further will help aluminium recycling industry as recycling of aluminium scrap needs lower energy and emits lower greenhouse gases.

Also, aluminium scrap collection centres should be located near residential areas for effective recovery of scrap from packaging. Also, public should be made aware of the necessity and benefits of scrap recycling both economically and environmentally.

3 Guidelines
3.1 Moving towards resource efficiency in scrap utilization:

1. Based on the assets (which include plant and machinery) the remelters are to be organised into a micro, medium or large-scale industry.

2. As India imports approximately 90% of its Al-scrap requirements, imported scrap must be properly checked for radiation when received in containers and ensure no harmful things to be processed.
3. The secondary aluminium makers are to be fortified with pollution control systems with making usage of finest accessible technology for melting the scrap and shall adhere to the pertinent health and safety legislation/norms/guidelines laid down by the Ministry of Environment and Climate control and BIS etc (Annexure 01).

4. Wastes generated from the aluminium scrap handling/recycling units e.g. plastics, tyres, cable sheathings, coatings etc. must be handled according to the MoEFCC rules/guidelines.

5. End products from secondary aluminium are to be certified with BIS/ JNARDDC.

6. The facility shall be encouraged to use best available technology for processing the end of life goods and other scraps to produce quality recycled metal.

7. The collection /dismantling centre and/or scrap processing centre must issue a Certificate of Destruction (COD)/Proof of scrappage to the owner. Records of the same must be maintained and it should be available for scrutiny by the authority concerned. (Steel Scrap Recycling Policy-2019)

8. The collection /dismantling centre and scrap processing centre to upload the data with regards to the scrapped vehicles, white goods and other scraps on a common digital platform or as per guideline issued by the concerned ministry / department from time to time. (Steel Scrap Recycling Policy-2019)

9. Secondary aluminium industry units to upload the data with regards to the import of scrap, secondary aluminium production on a common digital platform or as per guideline issued by the concerned ministry / department from time to time.

3.2 Scrap traders/Recycling units shall ensure that:

1. The facility should have appropriate equipment and use best available technology progressed with time for the activities defined viz shredding, baling, briquetting, sorting, melting, casting, forming etc. Also mixing of various grades of scrap shall be avoided.

2. The scrap processing centers should be equipped with radioactive detection equipment.

3. The facility shall have equipment and manpower that have the capability to carry out the functions defined as detailed and reviewed time to time by Ministry of Mines or its appointed agency. Furthermore, the industry should have best available technology/disposal plans in place for processing the residue (Annexure 02).
4. The facility should have adequate space for equipment, storage and handling of segregated wastes. Further it should have adequate competent and trained manpower to operationalize and manage such a facility in a safe and eco-friendly manner.

5. Remelting centres may be RIOS (Recycling Industry Operating Standards) certified (established by ISRI, The Institute of Scrap Recycling Industries) to provide a systematic framework to achieve measurable continual improvement in their Quality, Environmental, Health and Safety (QEH&S) performance.

6. To ensure safe operating practices, remelters are expected to follow updated guidelines of BIS standard on occupational health and safety management (Occupational Health & Safety Management System as per IS 18001 & IS ISO 45001) and shall engage competent and trained manpower to process the scraps e.g. ITI or diploma engineers to operate the machinery & equipments.

7. The facility should maintain a common digital platform to have a record of scrap and finished good.

8. Scrap trading and recycling units to upload the data quarterly to Ministry of Mines or common portal.

4 Authorization/De-Authorization Guidelines

1. Additionally, from the above guidelines stated, the scrap traders/recycling units should adhere to following statutes or any other relevant guidelines issued by government from time to time:
   e. Guidelines for environmentally sound management of ELVs, Nov’ 2016 laid down by Central Pollution Control Board (CPCB) - AIS 219.
   f. Waste regulations notified by the Ministry of Environment Forest (MoEF&CC), as applicable for the management and recycling of ELVs.
   g. Atomic energy (radiation protection) Rules, 2004
   h. Solid Wastes Management Rules, 2016
   i. The Ozone Depleting Substances (Regulation and Control) Rules, 2000
   j. The Batteries (Management and Handling) Rules, 2001
   k. The E-waste (Management) Rules 2016
   m. Factory Act 1948 along with amendments 1987 and rules made therein
   n. Any other rules notified by Ministry of Mines or any other Ministry or the State Government from time to time in this regard

Authorizing agency may deauthorize such a centre when found violating any of the above-mentioned norms
2. In case, the remelting centres do not have adequate capability / provisions for recycling of hazardous waste or recycling of material which is outside its scope, then such materials should be sold to authorized recyclers, who have adequate capability.

3. Scrap remelting centres should preferably accredit their centres/ units with the latest version of quality standards viz.
   - ISO 9001 (Quality management system),
   - 14001 (Environmental Management System) and
   - 18001 (Occupational health and safety) besides compliance to other norms/rules as laid down in various statutory rules/regulations.

This is required for establishing “Environmentally Sound Aluminium Recycling Systems” with focus on continuous improvement on technology, safety and environment.

5 **Responsive ecosystem**

Development of an organized scrapping / shredding /trading/recycling industry through a self-regulatory ecosystem based on a **system of shared responsibility (SR)** to be evolved, for collection, dismantling and disposal of ELVs, White Goods and other scraps, involving all the key stakeholders such as aggregators, scrapping centres, manufacturers (OEMs), owners and Government. Such a shared responsibility system would enable the development of appropriate ecosystem in terms of setting up of Collection, Dismantling centres and Scrap processing/remelting centres, either by independent entrepreneurs or through Joint Ventures between Corporate entities and/or PSUs. For, the development of well-ordered channels for the flow of materials, it is critical that the roles and responsibilities of different stakeholders in such a shared responsibility system are defined below:

5.1 **Role of government**

Ministry of Mines will be the focal Ministry to deal with all the issues arising from Secondary Aluminium industry; Ministry of Mines will facilitate the following:

1. Developing standard operating procedures including technical, safety and environmental norms for handling and processing of scraps in association with MoEFCC, SPCB, CPCB, BIS, etc.

2. Creating public awareness about benefits of efficient scrap collection and recycling to environment, energy and resource efficiency.

3. Regular monitoring of scrap processing/remelting facilities to see that there is no deviation from the standard operating procedures.
4. Facilitate competent authorities (MoEFCC& BIS) to develop guidelines for remelters or refiners about right type of equipment to comply with pollution norms. Whereas refiners produce wide range of alloys from processing in-house scrap, primary metal or clean cast/wrought scrap. Remelters are usually associated with rolling/extrusion activities also. Both refiners and remelters uses identical furnaces for melting, but casting equipment to obtain specific product may differ.

5. Promoting research and development activities in consultation/participation with all the stake holders to improve capacity building.

6. Introducing recycling-based tax incentives for both industries and public for effective scrap recovery/collection and remelting in consultation with Ministry of Commerce and Industry.

7. As there is no aluminium scrap standard, BIS & JNARDDC shall develop standards for consumer oriented secondary aluminium products like utensils and extrusions. Quality standards (compositional and mechanical characteristics) should be developed for utensils and extrusions where target customers are public who are unaware of quality issues. Recycled metal or product from recycled aluminium should be certified from the NABL accredited laboratory.

8. CPCB/SPCB to Ensure that any hazardous waste is routed to authorized recyclers only, who are adequately capable of recycling such wastes.

9. Reducing compliance burden to the minimum by avoiding multiple registrations, licencing and reporting requirements and promoting Ease of Doing Business (EoDB) in setting up remelting Centres.

10. Ensure that MoEF&CC streamline and clarify the regulatory requirements eliminating multiple clearances wherever feasible for secondary aluminium industry. MoEF&CC shall prepare a Standard Operating Procedures (SOP) and codify the procedures for setting up of aluminium remelting centres and shall establish a Single Window Clearance System by ensuring expeditious clearances with respect to Environmental and Pollution Regulations. This shall help in smoother and faster setting up of remelting centres.

11. Ensure that through coordination with MoEFCC, effective enforcement of regulations through CPCB, SPCB and State Governments to prevent illegal scrap aggregation, processing and remelting which is an environmental and public health hazard.

12. Ensure that MoEF&CC/CPCB/SPCB may adopt uniform norms for categorization of scrap processing/remelting centres and care shall be taken to give guidelines such that these centres shall not be categorized above ‘Orange’ as per the environmental norms.
13. Encourage development of competitive markets for recycled materials. The recycled / reusable materials to be sold in the market post collection and recycling, may be done through a dedicated ecommerce platform, to bring transparency and provide fair opportunity.

14. To take up with the State Governments the following issues:
   - Scrap recycling segment may be granted Industry Status
   - Incentives may be provided irrespective of investment amount
   - Relief on conversion charges, stamp and registration charges
   - Rationalization of Industrial power tariff - duty support
   - Necessary Logistics Support (connectivity) for the Processing/remelting Centres
   - Recycling zone development by State Government

5.2 Roles of Aggregators

1. Aggregators to associate themselves with the dismantling and/or scrap processing center to strengthen reverse supply chain for collection of scraps through long term suitable mechanisms to facilitate continuous and regular supply of scraps to authorized scrapping centers.
2. May assist in initial segregation and sorting of scraps. The aggregators may work closely with the scrap processing centers for segregation and compliance to BIS guidelines.
3. To setup value yards for systematic and segregated collection and treatment of scraps.
4. Suitable weighing machines/weighbridge to ensure systematic collection and weighment of scraps.
5. Further, aggregators may involve peddlers as partners, for collection of scraps, who belong to the unorganized and informal sector. They shall support and assist them in adopting safe and environmentally sound practice.

5.3 Responsibilities of Dismantling & Scrap Processing Centres (SCs)

In addition to the points in provided in guidelines, the scrap processing centers, should adhere to the following roles in addition to the guidelines issued from time to time by MoM & MoEFCC and other concerned Ministry or Regulatory bodies:

1. The setup of such centers shall be in consonance with the Factory rules and as per the Industrial norms as laid down by the competent authorities in this regard from time to time.

2. To ensure manpower development through continuous training and evaluation to make them competent in handling ELVs, white goods and other scraps and thus minimizing risks.
3. To be in consonance with the technical and statutory norms for handling, processing, melting scraps in line with the guidelines issued MoEFCC /other statutory bodies.

4. The scrapping/trading center may develop facilities, to segregate the processed scrap, based on its composition or chemical analysis, which would facilitate the downstream industries with quality scraps.

5.4 **Responsibility of Manufacturer**

5.4.1 **Role of Automobile OEMs (Original Equipment Manufacturers):**

1. Automobile manufacturers, being an important stakeholder, should design vehicles keeping in mind the recyclability of the vehicle at the end of life. This would mean that the use of hazardous materials and Substances of Concern (SOC) shall be avoided to the extent possible so that risks associated during disposal & recycling are taken care.

2. The Extended Producer Responsibility (EPR) guidelines/draft Regulations of MoEF&CC be strictly adhered to.

3. Manufacturers should undertake responsibility to make adequate provisions relating to the classification, packaging, labeling and color scheme for dangerous substances. They should ensure proper component and material coding standards to facilitate the identification of those components and materials which are suitable for reuse and recovery, and the same should also be communicated to the scrapping centres.

4. The use of lead, mercury, cadmium and hexavalent chromium should be avoided by manufacturers. This will ensure that hazardous materials and components do not become part of shredder residues which may be a source of air and water pollution.

5. Further, the vehicle manufacturers should also shoulder responsibilities to use an increased quantity of recycled material in vehicles and other products, (provided they do not give rise to safety or environmental hazards), thereby creating a market for recycled products, and the percentage use of such recycled materials in vehicles should be periodically audited to ensure compliance.

6. Additionally, the vehicle manufacturers as a practice should provide dismantling information for each type of new vehicle within six months of the launch and should assist / guide the recycling centers to expand the technological knowhow for segregation and recycling.

7. The OEMs and/or its dealers can facilitate the collection of old vehicles/ELVs/ recyclable spare parts of old automobiles either through its take back schemes or through set up of scrapping center of its own or through tie ups with such facilities, thereby acting as an aggregator for the collection of vehicles.
8. To apprise the consumers of environmentally sound management of wastes and inform them about special incentives provided by manufacturers on new products/vehicles upon exchange or scrapping of end of life products/vehicles.

5.4.2 Role of White Goods OEMs:

1. Designing the products to contain safer materials (so they do not need to be managed separately) or designing products that are easier to recycle and reuse in efficient and environmentally sound manner and set a minimum level for generic identification by labelling / marking of plastic products, if used.

2. Promoting the usage of recycled materials in new products and avoid toxic and hazardous substances while packaging, through appropriate change management and adequate measures.

3. Additionally, the white goods OEM as a practice should provide dismantling information for each type of new product within six months of its launch and should assist / guide the recycling centres to expand the technological know how for segregation and recycling.

4. The OEMs and/or its dealers can facilitate the collection of white goods either through its take back schemes or through set up of scrapping centre of its own or through tie ups with such facilities, thereby acting as an aggregator for the collection of white goods.

5. To apprise the consumers of environmentally sound management of wastes and inform them about special incentives provided by manufacturers on new products upon exchange or scrapping of end of life products.

6. Incentives: OEMs may decide to provide incentives to those purchasing a new vehicle in lieu of exchange of White Goods

5.5 Role of Public

5.5.1 Role of ELV owners

1. The owner must hand over for scrapping vehicles that do not meet the fitness criterion for the vehicles.

2. The Owner must ensure that s/he has relevant documents/papers suggesting s/he is the owner of the vehicle being considered as ELV.

3. The owner has the right to authorize some other person, on his behalf, to handover the ELVs for scrapping.

4. The owner, should take the responsibility of handing over the end-of-life vehicles only to authorized collection cum dismantling centres authorized by the authorizing agencies or its appointed agencies.

5. The owner may ensure that the ELV does not contain any waste other than an ELV.
5.5.2 White Goods owners

1. The Owner shall give a self-certified undertaking that he/she is the legitimate owner of the white good and provides his consent for its recycling.

2. The owner has the right to authorize some other person, on his behalf, to handover the white good for scrapping.

3. The owner must handover the white goods to the authorized collection cum dismantling centres or to the manufacturers / dealers / distributors having “take back” facilities.

5.5.3 Other Scraps

1. Public should responsibly dispose metal scrap at designated metal scrap collection centres.

2. The generators of other scrap items, including ferrous, non-ferrous and non-metallic scraps may approach the scrapping centres for their effective and environmentally sound processing.

3. The scrap items should be in the legal possession of its owner, and upon verification of documental evidence by the scrapping centres, the same may be processed by the scrapping centres.

4. Documents similar to COD/proof of scrappage may be issued to the owner after due processing of the scrap

6 Power to amend the Policy

Notwithstanding anything contained in the foregoing paras, the Ministry of Mines, may amend various aspects of this Policy from time to time depending upon the experience gained during implementation, market dynamics, end user interest etc.

7 Conclusion

This policy contemplates the future of aluminium scrap recycling sector to be indigenous through organized and scientific metal scrapping and collection centres across India and make India less dependent on imports for scrap. Also, remelting centres produce quality products for consumers in various sectors. This will promote resource efficiency in aluminium sector.

Ministry of Mines or its appointed agency or other designated statutory bodies shall ensure that the policy is implemented in accordance with the state-of-the-art environmental friendly technologies and in compliance with applicable Acts, rules, and regulations.
8 Definitions/Glossary

Aggregators/ Collection Centres: Aggregators/Collection Centres are entities/ individuals/ importers/ local scrap dealers/distributers facilitating the collection of end of life vehicles, white goods and other scraps.

Authority
A) Advisory Authority: Ministry of Mines or its appointed agency or other designated statutory bodies to be the competent authority to monitor and issue necessary advisory instructions as may be deemed fit to ensure establishment and operation of Aluminum Scrap processing Centre.

B) Authorising Authority: “Authorisation” means permission for, collection, reception, treatment, transport, storage, reuse, recycling, recovery and pre-processing in accordance with different laws as enumerated in this policy. It shall be given by the Authority as defined under the respective Act.

Certificate of destruction (COD): On a product being made inoperable at the collection cum dismantling centre in an environmentally sound manner, the COD / Proof of scrappage certificate shall be issued by the collection cum dismantling centre to the owner, certifying that the product received for dismantling/recycling has been scrapped as per the laid down norms and the guidelines.

Collection Activity: Collection activity is defined as the process of collecting the ELV, white goods and other scraps by the aggregators/ collection centres for the purpose of handover to the scrapping/recycling centres.

Collection cum Dismantling Centres/ Dismantling Centre: Centres, who perform collection, depollution and dismantling activities of products for scrapping (including ELVs, white goods, plant and machineries, structural material etc.) and are duly authorized as per authority.

Dismantling Activity: Dismantling activity is defined as the process of inspection of product for likely radiation, stripping down / dissembling the collected product for scrapping (including ELVs, white goods, plant and machineries, structural material etc.) for removing hazardous and non-hazardous substances, recovering the reusable, recyclable and waste parts and segregating the same for further processing.

End of Life Vehicles (ELVs): ELVs includes the following categories:

- Natural ELVs refer to those vehicles that have come to the end-of-life due to wear and tear.
- Premature ELVs refer to those vehicles that have come to end-of-life due to unnatural reasons such as an accident, fire, and flood or vandalism damage.
- Statutorily declared ELVs.
- Voluntarily declared ELVs.

Other Scraps: Scrap includes the following categories:
- **New scrap**: represents scrap generated in the downstream processing during manufacturing.
- **Old scrap**: represents scrap generated where products have served their useful life. ELVs also falls under this category.

**Owner**

a. The ‘Legitimate owner’ or ‘owner’ of white goods means the person, who provides a self-certification of the ownership.
b. The ‘Legitimate owner’ or ‘owner’ is the person who has the legal possession of the End of Life vehicle.
c. The ‘Legitimate owner’ or ‘owner’ of the miscellaneous products arising out from other sources means the person who has either obtained the material through auctioning or the person having legal rights of ownership.
d. The owner has the right to authorize some other person, on his behalf, to handover the product including end of life vehicles or white goods for scrapping.

**Processing Centres (PCs) / Facility**: Authorized centres or Processing Centres shall have the same meaning as of “Facility” described in the Hazardous & Other Wastes (Management & Trans boundary Movement) Rules, 2016 i.e. who perform scrap processing activities of products (including ELVs, white goods, plant and machineries, structural material etc.).

**Scrap Processing Activity**: Scrap processing activities includes the activities of shredding, sharing, baling, slitting etc. including the activities such as segregation, sorting and bundling and can be independent or common with processing centres. It may also include scrap melting or recycling and product manufacturing.

**Scrap Processing Centres (SCs)**: industry involved in the Scrap Processing Activity.

**White Goods**: Include household appliances and large electrical goods such as refrigerators, washing machines, Ovens, Air Conditioners, stoves, cookers, etc.
### 9 References

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<th>Sl. No.</th>
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<td>1</td>
<td>Environment (Protection) Act 1986 (29 of 1986)</td>
<td>Ministry of Environment Forest and Climate Change</td>
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<td>2</td>
<td>Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016</td>
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<td>3</td>
<td>Guidelines for environmentally sound management of End-of-Life Vehicles (ELVs)</td>
<td>Ministry of Environment Forest and Climate Change</td>
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<td>4</td>
<td>Concept note: Voluntary Vehicle Fleet Modernization Program (VVMP)</td>
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<td>5</td>
<td>Draft Automotive Industry Standard-129/F4</td>
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<td>7</td>
<td>National Steel Policy-2017</td>
<td>Ministry</td>
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Annexure01

Technologies for various activities like shredding, sorting, agglomerating, melting and casting:

- Air classification – zig-zag air classifier, air table
- Magnetic separation – drum separator, overhead belt separator
- Eddy current sorting (ECS) – Linear motor ECS, Conveyor ECS, Induction separator
- Heavy media separation (HMS) – water classifier, drum type HMS
- Laser-induced breakdown spectroscopy (LIBS)
- X-ray based alloy sorting system
- Balers&Briquetting machines – Roller press, Punch & Die
- Hot crush
- Melting – Crucible furnace, reverberatory furnace, rotary kiln furnace, tilt rotary furnace (TRF)
- Casting – Sow casting, Ingot casting, DC Casting, Continuous casting, shaped casting
- Energy efficient furnaces, which maximise the metal yield through better control of the melting conditions
Annexure 02

Technology Support

- Sorting technology
- Melting and alloying (processing of liquid metal)
- Casting/rolling/extrusion technology
- Testing and characterization (Quality assurance)
- Pollution control
- Waste disposal
- Process & energy efficiency